TESTIMONY OF MARVIN MORIARTY, REGIONAL DIRECTOR, NORTHEAST REGION, U.S. FISH AND WILDLIFE SERVICE, DEPARTMENT OF THE INTERIOR
BEFORE THE
HOUSE SUBCOMMITTEES ON INSULAR AFFAIRS, OCEANS AND WILDLIFE; AND NATIONAL PARKS, FOREST AND PUBLIC LANDS
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Chairman Grijalva, Chairwoman Bordallo, and Members of the Subcommittees, I am Marvin Moriarty, Regional Director for the U.S. Fish and Wildlife Service's Northeast Region. I am currently acting as the bureau's Deputy Director. Thank you for the opportunity to testify on behalf of the Department of the Interior about the impacts of climate change on the Chesapeake Bay.

After a brief introduction, my statement will focus on the impacts of climate change on the Chesapeake Bay watershed that are being observed by the Department's bureaus working on Chesapeake Bay restoration, and what we are doing to anticipate and respond to these impacts. I also offer a brief discussion of Executive Order 13508, issued by President Obama on May 12, 2009, that calls for leadership and action by federal agencies to protect and restore the Chesapeake Bay.

I am joined here today by representatives from the National Park Service and the U.S. Geological Survey who are here to answer any questions you might have with respect to their activities here in the Chesapeake Bay.

Introduction

The Chesapeake Bay is the largest estuary in the United States and, due to the Bay's geography, water characteristics and hydrology, is one of the most biologically productive estuaries in the world. The 64,000 square mile watershed that supports the Chesapeake Bay is home to a myriad of native species whose abundance, in the early 17th Century, awed Captain John Smith and fellow explorers and settlers through the 18th and early 19th Century. The Bay is a national treasure enjoyed by millions of visitors each year.

The U.S. Fish and Wildlife Service (Service) and the National Park Service (NPS) within the Department manage nationally significant federal lands, parks, wildlife refuges, monuments and museums in the Chesapeake Bay and its watershed. The U.S. Geological Survey (USGS) provides scientific information to the Department, other agencies, and the public to describe, monitor and understand the Earth's response to climate change over time. The USGS supports the mission of the Service and NPS by delivering accurate, impartial, and timely scientific information and geospatial data and assisting in biological, water and other natural resource management

The scientific community studying the impacts of climate change on natural systems, like the Chesapeake Bay, has increasingly verified impacts on these treasured landscapes, including alteration of precipitation patterns that are affecting water supplies and impacts to wildlife and habitat through temperature changes.

The Chesapeake Bay, along with its immense watershed, thousands of miles of tributaries, and multitude of living and nonliving resources, is acutely vulnerable to the impacts of climate change. A recent report (Pyke and others, 2008) by the Chesapeake Bay Program Scientific and Technical Advisory Committee stated that significant warming and sea-level rise trends during the 20th century have been detected in the Chesapeake Bay. The report suggests the Bay region is likely to experience significant changes throughout the 21st century, including increased carbon dioxide concentrations in its waters; relative sea-level rising; increasing water temperatures; and changes in precipitation patterns.

The Chesapeake Bay ecosystem has already been severely degraded due to human population increases, resulting in poor water quality, loss of habitat, and declines in populations of biological communities (Phillips, et al., 2007). The additional impacts of climate change could have additional, profound derivative effects on water quantity, water quality, and the sustainability of numerous aquatic freshwater, and marine and terrestrial living resources, as well as on the quality of life and economic well-being of visitors to and residents of this iconic watershed. For example, changes in precipitation patterns and intensity will induce changes in streamflow and water temperature. This will drive changes in nutrient and sediment loads to the Bay. All of these changes will impact aquatic habitats in the Bay and its watershed.

Threats to Fish and Wildlife

The Chesapeake Bay is a flooded river delta, fed by the freshwater of the Susquehanna River to the north and major rivers on the Eastern Shore and Western Shore of the Bay, which is mixed with ocean water drawn from the Atlantic. The waters range from fresh to brackish to ocean water, increasing opportunity for a diversity of aquatic species. A shallow basin, the Bay retains warmth from the sun, which has historically maximized its ability to support plants, fish, and shellfish. It supports extensive salt marshes, as well as emergent freshwater wetlands and over 16 species of submerged aquatic grasses, which provide food for waterfowl, shelter for young fish and shellfish, dissolved oxygen, and water clarity. Without these grasses, the Bay's ecosystem would be extinguished. It is believed that the Bay once supported over 600,000 acres of these grasses, but in 2006, only 23,941 acres were accounted for in the annual Bay survey of submerged aquatic vegetation. (Virginia Institute of Marine Science).

About 350 fish species live in the fresh and brackish waters in the watershed, including commercially important oysters, blue crabs, and clams (Jung and Houde, Science Direct 2002). The Bay, along with Delaware Bay, also supports the largest concentrations of migrating shorebirds in the western hemisphere, as well as one of the most important resting and wintering areas for other migratory birds. Millions of waterfowl come to the Bay each year, along with song birds and other species which feed on the rich abundance of aquatic, plant, and other food sources in the watershed. The plants and animals in the Chesapeake Bay watershed have evolved to depend on one another. The complex interaction between the characteristics of the water as it cycles through the Bay and the Bay's native species are delicate and key considerations to effective Bay restoration efforts.

Climate change will bring added stress to this system, which is already experiencing significant threats from human activities. For example, an influx of nitrogen and phosphorus coming from agriculture and other land uses is a significant threat to this delicate balance. The Bay's food web has changed

from an ecosystem dominated by zooplankton to one that is increasingly populated by phytoplankton, because of these excess nutrients. Increased presence of phytoplankton increases the prevalence of algal blooms. Algae covers the leaves of submerged aquatic grasses, cutting out the sunlight they need to grow.

The Smithsonian Environmental Research Center has identified over 200 nonnative, invasive species in the watershed. In 2001, 46 of these were identified as "nuisance" species and six (the mute swan, nutria, phragmites, purple loosestrife, water chestnut, and zebra mussel) were identified by the EPA Chesapeake Bay Program as posing the greatest threat to the Bay. The increase in disease affecting native aquatic species, such as oysters, clams, and blue crabs, are due in part to decreasing water quality and the introduction of exotic species, and is adding to what may ultimately be an irreversible change in the Chesapeake Bay's biological community.

These impacts alone have driven the population of some species into steep decline, prompting petitions for their listing under the Endangered Species Act. These include the Virginia oyster, which is said by some fisheries biologists to be "commercially extinct" at about one percent of its historic density. Petitions have also been filed with the Fish and Wildlife Service for the American eel, and with the Service and NOAA fisheries for the Atlantic sturgeon.

Climate change threatens to increase the significance of existing challenges to restoration of the Chesapeake Bay and its fish and wildlife populations. The warming of the Chesapeake Bay -- about 2 degrees since the 1960s -- and its tributaries is contributing to the decline of eel grass, an important source of food for waterfowl and shelter for fish and shellfish. Warmer waters also support fish and shellfish diseases, such as Dermo and other diseases and parasites of shellfish, affecting migratory waterfowl which rely on these sources of food. In the last century, Bay water levels have risen by about a foot, eroding or destroying wetlands and many of the Bay's islands. The erosion of these islands and shorelines has removed important nesting habitat for colonial nesting waterbirds, like black skimmers, least terns, and royal terns in the Bay.

The open, loblolly pine forests found along the marshes of the lower Eastern Shore of the Delmarva Peninsula are important habitat for the endangered Delmarva fox squirrel, and this and other forest communities unique to this part of the East Coast are threatened by sea-level rise. If plant hardiness zones, established by the U.S. Department of Agriculture, are moving north, some bird species may also move north, away from the Chesapeake Bay. The Baltimore oriole, for instance, is observed nesting further north and may in time leave Maryland altogether. At the rate of current warming, the red spruce forests of the Shenandoah National Park could be replaced by southern pines and oaks in the next 30 to 80 years, greatly affecting the species living there (EPA, Climate Change and Virginia, 1998).

Impacts on National Wildlife Refuges

Climate change also threatens to increase challenges faced by National Wildlife Refuges in the Chesapeake Bay watershed. Among the many threats to fish and wildlife, the most profound in coastal habitats is sea level rise. At the Blackwater National Wildlife Refuge, which is part of the Chesapeake Marshlands National Wildlife Refuge Complex, thousands of acres of shoreline marshes have eroded away, subsided or been overcome by sea level rise, including about 8,000 acres of

wetlands at the Blackwater National Wildlife Refuge (Chesapeake Marshlands NWR CCP, 2006). Invasive species, such as nutria, have also severely damaged these wetlands. Sea level rise related to climate change may inundate these wetlands; a recent USGS study that modeled sea level rise at Blackwater forecasts that most of the refuge will be in open water in approximately 50 years. These marshes are used by millions of waterfowl, shorebirds, bald eagles, and other bird species, and refuge managers are working to restore them where practicable and feasible while securing habitats further upland to plan for future marsh habitat needs.

The other refuges in the Chesapeake Marshlands National Wildlife Refuge Complex are Eastern Neck National Wildlife Refuge, Martin National Wildlife Refuge, and Susquehanna National Wildlife Refuge. These and the other refuges in the Chesapeake Bay watershed, including Eastern Virginia Rivers National Wildlife Refuge Complex, Patuxent National Research Refuge, and Potomac River National Wildlife Refuge Complex and all of these protected areas are facing climate change related challenges.

Impacts on National Park Units

Climate change is a far-reaching and consequential challenge to the National Park Service (NPS) mission and its ability to leave America's natural and cultural heritage unimpaired for future generations.

Rising water levels and associated storm-surge tides in the Chesapeake Bay watershed pose significant potential risk to the associated historic and cultural landscape. Bank erosion results in the loss of land and the associated cultural properties, and also indirectly impacts the natural resources of the area. For example, at Fort McHenry National Monument and Historic Shrine, foundations of historic structures at risk include the 1814 and 1912 Water Battery fortifications and the Married Soldiers' Quarters and Gunshed. The 2,900 linear feet of seawall, constructed in 1816-1897, and 2,000 linear feet of adjacent seawall trail (also a contributing feature and high-priority asset) are especially vulnerable. The bank erosion and rising water levels at George Washington's Birthplace National Historic Site have meant the loss of native sea grass beds, the nurseries for many of the fish, crabs, and especially oysters that are critical to the health of the bay, in addition to being the prey base for breeding birds such as bald eagles and osprey.

Historic structures and landscapes are affected by static water inundation, higher ground water tables, saturated soils, and damage from tidal water surges resulting from major storm events. The proposed Harriet Tubman National Historical Park and the surrounding nationally significant landscape, located in Caroline, Dorchester and Talbot Counties, Maryland, is vulnerable to these threats, and could result in the loss of historic sites.

Unlike plants and animals that are capable of adapting to new circumstances through migration, cultural resources are typically fixed in place on the landscape. Most cannot be moved without considerable cost and with the threat of incurring severe damage and loss of integrity. In addition, cultural resources are unique; they do not reproduce when conditions improve and once they are lost, they are lost forever. The combination of being geographically fixed and unique limits the range of appropriate responses in dealing with the effects of climate change on cultural resources.

Rising waters in the Chesapeake Bay watershed, which, it is noted below, is predicted to increase during the next century in the Bay region, will likely have significant consequences for units of the National Trail System and NPS partners in the region due to their geographic location – many NPS and partner resources in the watershed are located along or near the shoreline of the Chesapeake Bay or its tributaries – and low elevations, which increases their susceptibility to inundation due to relative sea level rise and storm surge. Increasing sea levels will threaten the landscapes, archeological sites, places important to Native American communities, and other resources significant to the Captain John Smith Chesapeake National Historic Trail. From the north of the trail at Garrett Island to the south at Historic Jamestowne, trail resources and public access sites will be impacted, as will the Star-Spangled Banner National Historic Trail and the NPS partners that make up the Chesapeake Bay Gateways and Watertrails Network.

Among the greatest areas of uncertainty for future scenarios of the natural environment of Assateague Island National Seashore is frequency and intensity of storm surges and the rate at which sea level rise is occurring. Whether storms become more frequent is less well understood. Should storms become more frequent , it is expected that erosional processes associated with storm events would challenge the system's ability to "keep pace" and it may not recover as well as the current dynamics allow. Hence, the dune system may become less stable under climate change projections that project more storms. Driven by increasing rates of sea level rise, more intense and possibly more frequent storms, the island is subject to an increased likelihood for erosion, overwash, inlet breaching, shoreline retreat, and island narrowing. This could in turn impact the spawning habitat for blue crabs and migratory overwintering sites for shorebirds and marine mammals such as right whales. Should the highest rates of projected sea level rise occur, the island may exceed stability thresholds, resulting in rapid migration landward, segmentation, and possibly disintegration.

Significant loss of salt marsh will decrease primary productivity and reduce habitat availability for both terrestrial and aquatic species; some of which are important to regional commercial fisheries. Habitat diversity is expected to decrease with a trend towards plant species and communities able to tolerate greater and more frequent disturbances from stressors such as sediment movement and saltwater inundation. Those community types requiring more stable conditions, such as the island's maritime forests, are likely to decline.

The effects of climate change could threaten to challenge the ability of the NPS to provide recreational access and opportunities for Assateague's visitors in traditional ways, too. Rapid rates of shore retreat and storm driven overwash will make fixed location infrastructure such as roads, parking lots and visitor-use facilities increasingly more difficult and costly to maintain. Some adaptive measures currently being demonstrated at Assateague include low-impact road and parking lot construction techniques and mobile visitor-use facilities that can be easily removed from harm's way prior to storms.

Colonial National Historical Park includes two of the nation's most significant historic sites, Historic Jamestowne and Yorktown Battlefield, as well as the Colonial Parkway. They are located on the James and York Rivers, tributaries of the Chesapeake Bay. Over the years, damage from rising sea levels, erosion, and an increase in violent storms have done extensive damage to buildings such as the park's visitor center, bridges on the tour roads, roadways and archeological sites along the routes, campsites and historic buildings (Moore House). For example, the storm surge associated with

Hurricane Isabel caused extensive damage to the collection at the visitor center, requiring $3.5 million to recover, stabilize and preserve the artifacts. Wind-driven wave forces also cause moderate to severe shoreline erosion, as does boat traffic and rising sea levels.

As discussed above, parks are already experiencing some dramatic impacts that may be the result of a changing climate. While some impacts are already measurable, the long-range effects of climate disruption on park natural and cultural resources, infrastructure, and visitor experience are just beginning to be understood.

Executive Order: Chesapeake Bay Protection and Restoration and Departmental Initiatives

On May 12, 2009, President Barack Obama signed Executive Order 13508, launching a "new era" of shared federal leadership and action to protect and restore the Chesapeake Bay. The order pronounces that the Bay is a "national treasure" and calls for the development of a Federal Leadership Committee, made up of relevant agencies including the Department of the Interior and led by the U.S. Environmental Protection Agency. The Committee is to manage the development of a new strategy to restore the Bay, assigning specific tasks to each of the major federal agencies involved and to coordinate restoration activities, including data management and reporting. The Executive Order specifically calls on the Committee to "assess the impacts of a changing climate on the Chesapeake Bay and develop a strategy for adapting natural resource programs and public infrastructure to the impacts of a changing climate on water quality and living resources of the Chesapeake Bay watershed." The Department of the Interior and the Department of Commerce share the lead on this task and will provide a report and recommendations to the President addressing it by the end of the summer.

The Department of the Interior, through its bureaus, is a national leader in climate science and in developing a framework for effectively addressing the impacts of climate change on all of our trust resources, including those in the Chesapeake Bay watershed. The U.S. Geological Survey has expertise in geological, hydrological, and biological science that is needed to better understand the impacts related to climate change. Relying on data and information from the U.S. Geological Survey and their own research and monitoring data, the U.S. Fish and Wildlife Service and the National Park Service can identify and test potential adaptation and management strategies for managing our natural resources and vital ecosystems in the face of these changes. Research and monitoring in all three bureaus provides data and information that guides the Department's land management decisions and local and regional adaption strategies to address climate impacts in the Chesapeake Bay watershed.

To effectively respond to the Executive Order, the Department is:

- Continuing research on relative sea-level rise, long-term changes in climate, and near-term changes in land use on the Bay estuary and National Wildlife Refuges and other DOI land and water resources.
- Beginning study of the impacts of climate change on streamflow in the Bay watershed and potential changes in nutrient and sediment loads to the Bay.
- Identifying additional opportunities to address the impacts of climate change on fish and wildlife populations and their habitats, and establishing associated monitoring programs,

through the National Climate Change and Wildlife Science Center and through implementation of the USGS Climate Effects Network.
- Conducting research with U.S. Forest Service and other partners on the potential changes in forest conditions and their ability to provide water quality and habitat benefits.
- Conducting these activities based on the strong foundation of existing USGS research and monitoring in the Bay and its watershed.
- Continuing to work closely with the U.S. Environmental Protection Agency through the Chesapeake Bay Program.

The USGS has provided critical projections of the impacts of sea-level rise on vital marshes in the Blackwater National Wildlife Refuge (BNWR). The rate of sea-level rise is predicted to increase two- to four-fold during the next century in the Bay region. To determine what impact this sea-level change would have on wetland resources, and to improve land-use planning within the immediate vicinity of the BNWR for the next century, USGS scientists developed a digital elevation model (DEM) showing BNWR land surfaces data collected in March 2002 (Larsen et. al., 2004). DEM simulations using current sea-level rise rates reveal that high marsh will convert to low marsh and low marsh will continue to convert to open water for the next century, assuming 2002 surface elevations remain unchanged. Marsh loss rates will be higher, and the area impacted greater, for predicted future rates of sea-level rise. The Service has used these results to plan wetland mitigation projects.

The USGS has demonstrated that rapid climatic and sea-level change influences water quality, temperature, and biota in the Chesapeake Bay. Research by USGS scientists and colleagues has focused on reconstruction of dissolved oxygen trends in the Chesapeake Bay during the past 2,500 years (Cronin and Vann, 2003; Willard and others, 2003). Data gathered from this study, together with earlier research, clearly indicate much more severe and extensive zones of oxygen depletion in the Chesapeake Bay and its tributaries during the past four decades than at any time in the past 500–2,500 years. The findings were used to help set new dissolved oxygen standards for the Chesapeake Bay.

The Fish and Wildlife Service has a long and distinguished history of supporting Service trust species and their habitats in the Chesapeake Bay. These trust species include threatened and endangered species, interjurisdictional fish, and migratory birds. In fiscal year 2007, 27 Service offices spent over $11 million contributing to the conservation and management of these trust species and their habitats. Service offices have worked collectively to: (1) Identify 11 priority fish and wildlife species, ranging from oysters and blue crabs to striped bass, black ducks, bog turtles and Delmarva fox squirrel; (2) identify priority habitats; and (3) in cases where the science is available, set species population goals necessary to achieve sustainable biological outcomes. The Service is now well positioned, through improved governance, shared performance measures for priority species, and shared performance measures for habitat conservation on and off Service lands, to contribute effectively to the goals and objectives of the Executive Order.

Because sea level rise is an immediate threat to our coastal resources, including the fish and wildlife in the Chesapeake Bay, the U.S. Fish and Wildlife Service is applying a model to help us plan for the future and communicate directly with the public about the impacts of sea level rise. The Sea Level Affecting Marshes Model (SLAMM)-View is a web-based application that displays map pairs of an area, each depicting different sea levels. The strength of this tool is its ability to visually show the

modeling of sea level rise predictions, allowing people to see the impacts in a more intuitive way. SLAMM is guiding long-range habitat management planning in the Chesapeake Marshlands National Wildlife Refuge Complex. The model helps managers determine where to protect uplands and to restore wetlands for the fish and wildlife protected on these coastal areas.

The Service's approach to addressing climate change focuses on monitoring, modeling, and addressing habitat and species populations changes at the landscape level, with conservation and management strategies that take into account inputs from landscapes that support native species. Considered as a whole, these actions – under the broad categories of adaptation, mitigation, and education and communication – will allow the Service to address the most pressing near-term climate change challenges to fish and wildlife. At the same time, these steps will help us lay a strong foundation for the Service's long-term response to climate change. These actions include: (1) increasing regional climate science and monitoring expertise, (2) acquiring biological planning and conservation design expertise, (3) conducting species and habitat vulnerability assessments, and (4) incorporating consideration of climate change and its impacts into all Service activities and decisions.

The Service is also working closely with a range of partners, including NOAA, the U.S. Forest Service and other federal agencies, state fish and wildlife agencies, local governments, academia, nonprofit conservation groups and other private stakeholders to help biologists and managers understand, model, and effectively address both the short and long-term impacts of climate change on fish and wildlife resources. The Service is developing Landscape Conservation Cooperatives, for instance, which will serve as regional hubs for collecting and disseminating relevant information to support responsive conservation and identifying priority research within the region. The Service's landscape conservation approach to anticipating and addressing the impacts of climate change on fish and wildlife will be applied to the Chesapeake Bay region and will be integrated into the agency's planning, programs and activities toward Chesapeake Bay restoration.

Addressing climate change and its impacts on fish and wildlife is a priority for the Service. Consequently, the Service plans to deploy its resources, creativity, and energy in a long-term campaign to reduce the bureau's emissions of greenhouse gases and safeguard the fish and wildlife, and their habitats, over which it has management responsibility.

The NPS has hired a full-time climate change coordinator, established a service-wide steering committee, and is developing a comprehensive framework for a strategic response to global climate change. The response includes the development of a service-wide climate change response office, implementation of additional climate change monitoring, and development and implementation of bio-regional adaptation units and strategies. Vulnerability studies related to sea level rise and scenario planning are underway in pilot parks across the country and adaptation projects are being formulated to build resilience in park ecosystems. In addition, the NPS has begun a strategic communication effort to make park staff and the public aware of the possible impacts to park resources by climate change.

As a major element of NPS response, scenario planning is currently being developed for use as a long-range planning tool for incorporating climate change into a range of park management processes and documents, including General Management Plans, Adaptation Plans, and Resource Stewardship Strategies. Scenario planning offers a tool for developing a science-based decision-making framework in the face of an uncertain future. Climate change scenario planning involves exploring qualitative as

well as quantitative models in order to envision future outcomes under a variety of different decisions, policies, or societal pathways. In this way, park managers are able to evaluate potential management actions and implement those actions that will be most effective in protecting cultural resources and facilities and enhancing ecosystem resilience into the future.

Conclusion

There is a growing consensus that changes in the natural and human systems related to the effects of climate change must be better understood, monitored, and forecast so that all of the nation's resources can be effectively managed and protected. The Department is in an important position to evaluate and develop proactive strategies for the impacts that we are observing and cataloging on the natural, historical, and cultural resources in the Chesapeake Bay and its watershed. We look forward to working with you to better understand and mitigate these impacts.

Thank you for the opportunity to testify before you today. I would be happy to answer any questions that you or the committee members might have.

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