



National Wildlife Refuges And Sea-Level Rise

LESSONS FROM THE FRONTLINES





DEFENDERS OF WILDLIFE

Defenders of Wildlife is a national, nonprofit membership organization dedicated to the protection of all native wild animals and plants in their natural communities.

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ABOUT THIS REPORT

From July 11 to 14, 2011, more than a thousand people convened in Madison, Wisconsin, for *Conserving the Future: Wildlife Refuges and the Next Generation*, a conference called to discuss what lies ahead for the National Wildlife Refuge System—the network of public lands and waters set aside to protect America’s fish, wildlife and plants. The conference, the largest gathering on refuges and conservation in more than a decade, drew members of the U.S. Fish and Wildlife Service, the agency responsible for the refuge system, other federal agency employees, representatives of state wildlife agencies that assist with refuge planning and management, staffers from nonprofit conservation and outdoor recreation groups and interested citizens and journalists. Among the featured presentations was “Refuges, Neighbors and Sea-level Rise,” a workshop organized and led by Noah Matson of Defenders of Wildlife and Mike Bryant and Lou Hinds of the U.S. Fish and Wildlife Service. This report is based on the presentations and discussions of that workshop. (The agenda, vision statement, archives, supporting documents and other materials from the conference are available at: <http://americaswildlife.org>.)

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Introduction

Among the many challenges facing conservationists, none is more complex and profound than climate change. Climate change is by definition global in nature; the emission and accumulation of greenhouse gases in the atmosphere is causing substantial shifts in weather patterns, average temperatures and precipitation amounts around the planet, and contributing to a rise in the incidence of extreme weather events.

In 2011, we saw ample evidence of the type of extreme weather that's more likely to occur as the planet warms. The United States experienced record-breaking floods, with six states setting precipitation records in April alone. In the same period, the Southeast suffered through a severe drought, and Texas had its driest six-month period on record. April was the most active wildfire month on record in the United States, with major fires in Arizona, New Mexico and Texas. April also set a record for the number of tornados. Although these floods, droughts, wildfires and tornados can't be directly attributed to global warming, they are the kind of extreme weather events scientists say are likely to occur more frequently in a warmer world.

We're just beginning to feel these and other impacts of climate change, and even if we were to implement the most rigorous emission-reduction strategies today, substantial shifts in climate patterns will continue for centuries to come. Since both species and ecosystems evolved under specific temperature and precipitation regimes, these climate shifts are already imposing major stresses on plants, animals and habitats. Climate change is affecting the timing of biological processes, breaking up ecological communities, hastening species invasions and contributing to the loss of habitat.

These changes pose a major challenge to wildlife conservationists everywhere and to National Wildlife Refuge System managers in particular. With 555 units covering more than 150 million acres across the United States and its territories, the National Wildlife Refuge System is the largest network of public conservation lands in the world. As guardian of these places, the refuge system has an obligation to help species and habitats adapt to and survive the shifts imposed by climate change.

This obligation is especially pressing at the nation's 167 coastal wildlife refuges, where rising sea levels driven by climate change threaten to undo decades of conservation work on 20 million coastal acres. The experiences of three of those refuges are shared in this report to provide information and inspiration not only for refuge system employees and other federal, state and local government staffers coping with similar issues, but also for conservationists, legislators, journalists and citizens concerned about rising sea levels and climate change.



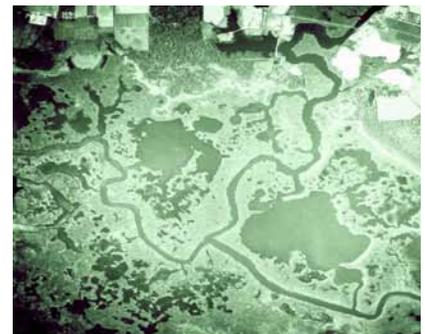
AMERICAN BALD
EAGLE IN A TREE AT
BLACKWATER NATIONAL
WILDLIFE REFUGE, MD.
COURTESY U.S. FISH
AND WILDLIFE SERVICE

Underscoring the Need for a New and Broader Perspective

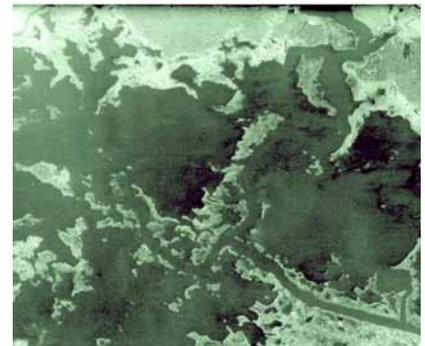
“Science predicts that, with all the greenhouse gasses already pumped into the atmosphere, the climate is going to be changing for millennia. That fact has profound impacts on wildlife, habitat and the whole profession of conservation. The Fish and Wildlife Service must rise to this challenge if it is to achieve its wildlife conservation mission.”

—Noah Matson, Vice President, *Climate Change and Natural Resources Adaptation*, *Defenders of Wildlife*

LEFT AND BELOW: COURTESY U.S. FISH AND WILDLIFE SERVICE



1938



1978



1989

Blackwater National Wildlife Refuge on Maryland’s Eastern Shore illustrates the many challenges sea-level rise poses to the U.S. Fish and Wildlife Service (FWS) and its coastal refuge managers. Covering more than 27,000 acres of tidal marshes and woodlands along the Chesapeake Bay, Blackwater is one of the largest protected areas in the state. The refuge is famous for its large concentrations of migratory waterfowl and shorebirds and its breeding population of bald eagles—one of the largest on the East Coast. But this important refuge is literally washing away. To date, Blackwater has cumulatively lost one-third of its original marshlands; more than 300 acres a year are currently converting to

open water. Invasive nutria (a prolific non-native rodent that feeds on marsh plants), land subsidence and sea-level rise have all contributed to the loss.

In recent years, the refuge staff has done an excellent job of eradicating nutria from Blackwater, so this threat to the marshland has been mostly eliminated. Refuge managers have also embarked on an ambitious marshland restoration project, spraying dredged mud over open-water areas to raise the level of the marsh, and then bringing in hundreds of volunteers to help plant stabilizing grasses. Although expensive and time-consuming, this project has been very successful.

The success of the marsh restoration project led refuge managers to think

The invasive, habitat-destroying nutria is under control at Blackwater, but sea-level rise continues to claim precious marshlands. As the sequence of aerial photographs above shows, the conversion of marsh to open water at the refuge has been dramatic. One-third of Blackwater’s original marshlands are now inundated.

about scaling up the effort to cover much larger areas. They are particularly interested in using the dredge material generated by the U.S. Army Corps of Engineers in maintaining the Baltimore harbor approach channel through the Chesapeake Bay. Operations to keep that channel open for ship traffic produce significant amounts of mud and soil. Blackwater managers proposed using it to restore thousands of acres of marshland at the refuge. With a projected cost of more than \$1 billion, however, it's not likely to happen anytime soon.

Looking at the Bigger Picture

The issues facing Blackwater National Wildlife Refuge raise important questions: Should FWS do anything to resist the changes occurring there? Does it matter if the refuge actually goes under water? These questions can't be answered solely from the perspective of one refuge—they require a broader, landscape-scale perspective provided by looking at the entire Chesapeake Bay region. In the region as a whole, there may be other places with equally good migratory bird habitat that is more resilient to the kind of changes occurring at Blackwater. Or the changes might create new marshes elsewhere in the Chesapeake Bay area. Or there might be places closer to Army Corps dredging operations where, minus the expense of hauling fill long-distance, marshes can be restored more cheaply. FWS should be focusing not on particular plots of land, but on conservation targets—priority species and ecosystems—and how those change over space and time.

The problems posed by the current narrow perspective are exacerbated by the fact that there isn't much communication or support for individual refuges making decisions about managing in the context of this type of change. This trend holds true not just at Blackwater, but at more than 160 coastal refuges across the country. Virtually all of these refuges are making decisions without coordination or the benefit of a network of shared experience and knowledge.



A hydraulic dredge sprays a thin layer of dredged material to restore a wetland at Blackwater. Using dredged sediment from U.S. Army Corps of Engineers channel maintenance operations in Chesapeake Bay to rebuild marshes is promising, but hauling it to the refuge is expensive.

Going forward, FWS must prioritize its conservation efforts at the landscape scale and make sure no refuge is left alone in its work. Managers should be provided with the tools (adaptable to the local conditions at each refuge) and the guidance they need to make decisions. The good news is that organized efforts to help with climate-change planning are in the works.

Federal, state and tribal partners and a diversity of conservation groups from across the nation are working together to develop the National Fish, Wildlife and Plants Climate Adaptation Strategy. The Interior Department's Landscape Conservation Cooperatives, public-private partnerships that transcend political and jurisdictional boundaries, are also fostering a more networked approach to conservation. These efforts, however, have a long way to go in rising to the challenges of helping conservation managers understand the landscape context of their work and providing a network of shared knowledge.

'The Era of Stationary Is Dead'

FWS must figure out how to manage the refuge system and wildlife in general in an era of constant change. "Science predicts that, with all the greenhouse gases already

pumped into the atmosphere, the climate is going to be changing for millennia," says Noah Matson, vice president in charge of climate change and natural resources adaptation at Defenders of Wildlife. "That fact has profound impacts on wildlife, habitat and the whole profession of conservation. The Fish and Wildlife Service must rise to this challenge if it is to achieve its wildlife conservation mission. The era of stationary is dead."

Climate change isn't just affecting wildlife and habitat, but people, too. Citizens who own beachfront property near refuges and elsewhere are going to want to protect it. The public—especially those who live in coastal areas—will call for beach-saving measures such as armoring or nourishment. Refuge managers shouldn't be expected to deal with these issues alone, on a case-by-case basis, without guidance or support.

Climate change is a systemic problem affecting habitats and species everywhere, including those managed by the National Wildlife Refuge System. A challenge of this scale requires a systemic solution. FWS must prioritize its efforts at Blackwater and other coastal refuges and decide where it is going to focus its resources. FWS must prepare for change.

Addressing Climate Change Impacts on the Ground

“There’s no certainty about sea-level rise, but I am certain that migratory birds are going to come every fall looking for the habitat that we manage—so I’m going to manage it to the best of my ability for their return each fall. And for every other species that utilizes that landscape I’m going to try to sustain it for as long as I can—because that’s the patch of ground I was given stewardship of, and I’m going to take care of it.”

—Mike Bryant, Project Leader, North Carolina Coastal Plain Refuges Complex, U.S. Fish and Wildlife Service



LEFT ©AARON MCCALL; BELOW ©BRIAN BOUTIN (2)



Alligator River National Wildlife Refuge sits on a peninsula between the Albemarle and Pimlico sounds in eastern North Carolina—the third-most vulnerable region to sea-level rise in North America. The refuge is one of six in the Coastal Plain Refuge Complex. Its extremely low-lying landscape of tidal marshes, bogs and wooded swamps makes it highly sensitive to sea-level rise, but also provides important habitat for a wide variety of migratory birds, fish and other wildlife. The refuge is in an area with one of the highest densities of black bears in North America and is home to the world’s only wild population of red wolves. And over

the next 150 years, the Alligator River refuge is expected to lose 80 percent of its land from inundation alone.

Tropical storms, hurricanes and northeasters regularly strike the Albemarle-Pimlico region. These storms can change the landscape overnight and cause extensive coastal erosion. They also exacerbate the impacts of rising sea level already evident on the refuge: shoreline erosion, saltwater intrusion, invasive species incursion, rapid transition of plant communities from forest to marsh and more frequent catastrophic wildfires. (The major wildfires that used to occur every 20 to 25 years are now happening at intervals of less than 10 years.)

Left: Workers plant salt- and flood-tolerant trees to provide forested areas as sea level rises. Right: Materials stand ready for another project—installing culverts under a refuge road to keep freshwater marshland connected and flowing.

Partnering Up

To address climate change impacts at Alligator River National Wildlife Refuge, the Nature Conservancy and FWS formally launched a joint project in 2009. The \$1.5 million project, funded in large part by a grant from Duke Energy Business Services, LLC, has several components:

- managing the habitat transition taking place at the refuge by planting

salt-tolerant, vegetation such as bald cypress to maintain and enhance marsh buffers;

- removing invasive species such as *Phragmites australis* (common reed) when possible;
- restoring hydrological function with projects designed to return the area to a “sheet-flow system” and prevent saltwater from intruding into interior wetlands and drastically altering vegetation communities and degrading organic soils; and
- building near-shore oyster reefs to combat wave energy and storm surge along the refuge’s shorelines.

The first phase of experimental work at the refuge involved planting plots of native salt-tolerant trees, such as bald cypress and black gum, alongside a predominant pine species like pond pine. The project partners are hoping to learn which planted tree species are most tolerant in this changing environment where pocosins—endemic evergreen-shrub-bog communities with organic or peat soils—are transitioning to marsh. Results to date show excellent survival rates for bald cypress and black gum and lower survival and some mortality of pond pine. The partners plan to continue monitoring the growth and survival of these trees.

The project partners are also trying to determine if they can—or should—do anything about invasive species. Traditionally, refuge managers have tried to eradicate invasive species such as *Phragmites*, but the partners are taking a fresh look at that approach. The Nature Conservancy has applied herbicide on 11.5 acres of *Phragmites* in the demonstration area and evaluated the biological and cost effectiveness of this treatment. Preliminary results indicate that targeted backpack application of herbicide is costly (\$2,600/acre) and is generally inefficient unless diligently applied every year. However, once *Phragmites* is under control, native marsh vegetation appears to colonize areas quickly, helping to minimize

erosion concerns. The partners are currently discussing the relative benefits of controlling this species or leaving it in certain places.

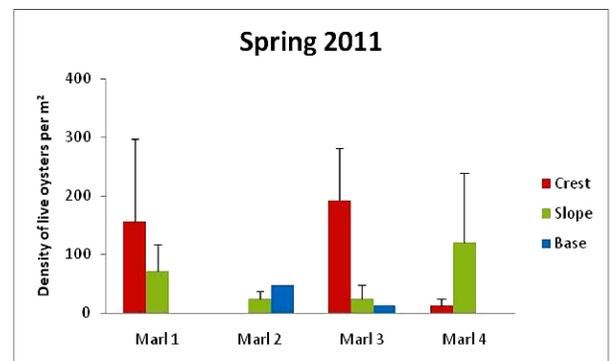
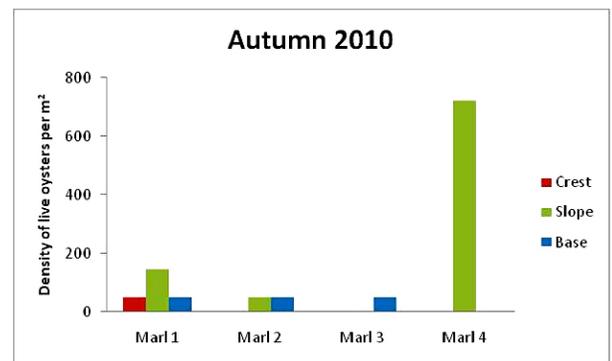
Hydrological work included the installation of a check-valve structure in a canal that runs east-west next to a road through the refuge to stop salt water from Pamlico Sound from intruding up the canal system and pushing out onto the land, where it breaks down the soil, kills plants and increases the rate of soil erosion. The new check-valve structure allows fresh water to drain off the land and down the canal, but keeps salt water from coming onto the land. The project partners also placed three culverts under the road to help reconnect the wetlands and minimize the dyking effect of the road alongside the canal.

On the other side of the east-west road, the partners installed a ditch plug in a shallow secondary drainage ditch, one of several dug before FWS took ownership of the land. Plugging ditches forces the water to move across the land slowly rather than quickly draining out or jetting in.

The results from the hydrological manipulations are promising. Before, when the water was coming off the land through the canal system unimpeded, downstream water salinities in the oyster reefs just off the refuge shoreline were highly variable. This fresh water coming through the canals was black, tannin-stained and hypoxic (low in dissolved oxygen). Now, there are fewer spikes in the salinities in and



NEARSHORE OYSTER REEFS



Heavy equipment does the job of laying the foundation for an artificial reef to attract oysters and shield the nearby shoreline from strong waves. Data from one of two reefs now in place show that oysters are building up the reef structure.

around the oyster reefs and upstream of the new check-valve structure.

The final component of experimental work at Alligator River is the creation of near-shore oyster reefs to help reduce shoreline erosion. The partners constructed two 400-foot-long reefs about 30 yards offshore, one with limestone marl and one with oyster shell bags (mesh bags full

of oyster shells that requires intense labor to make). The results show early strike of oyster spat on the reefs, and increased numbers of fish around them. There is also some decrease in erosion on the shoreline, even though the overall wave energy was higher after reef construction than before.

Lessons Learned

There are several barriers to implementing or expanding an adaptation project like the one at Alligator River. The first is funding. FWS contributed assistance and labor, but very little money; The Nature Conservancy, Duke Energy and other partners have provided nearly all the financial support. Another obstacle is the amount of labor involved. Some

of the adaptation strategies are very labor-intensive and may be difficult to scale up. Other barriers include lack of public knowledge and vandalism.

By identifying specific opportunities to affect the rate of climate-mediated change and seeking help from outside partners, Alligator River was able to move from merely discussing the impacts of climate change to taking action on the ground to address them.

Planning for the Future

The work underway at Alligator River shows great promise for the short term and is being expanded to nine other wildlife refuges in the region. In the long term, however, with the refuge expected

to lose 80 percent of its land in the next 150 years, the Alligator River project is not protecting habitat forever—it's just buying time.

FWS is taking several steps to deal with the long-term challenges. Chief among them is forming a consortium of all the entities that own conservation land in the area and encouraging dialog about the next best places for wildlife to go up-gradient from the areas that become inundated. The goals are to develop a plan that maximizes the benefits to wildlife on existing lands and allows species and habitat to go through an orderly transition as time passes and to acquire (through ownership or easement) new lands for wildlife to move into as needed.

Why Bother with Interim Adaptation Projects?

If the Albemarle-Pimlico region is so extremely vulnerable to climate change in the short- and long-term, why invest in an adaptation project there?

One reason is to protect the region's abundant natural resources and the significant investment the conservation community has already made in the area. These investments include the FWS-led captive breeding and reintroduction program that re-established red wolves in the area, as well as more than 500,000 acres of land managed by federal, state and private agencies in the area.

Another reason to invest in adaptation efforts is to retain the economic benefits natural resources bring to the area. Most of this region is rural, and its economy depends on functioning natural systems—directly and indirectly. Among the direct benefits of intact natural systems here are tourism, commercial and recreational fishing, hunting and other traditional rural land uses. The indirect benefits include ecosystem services such as protection from storm surges and maintenance and improvement of water quality.

Unless an effort is made to maintain or enhance the resilience of this landscape, the changes caused by rising sea level could happen so rapidly the unique ecosystems of the peninsula

will be lost. They will be reduced to unproductive habitat lacking in biodiversity and unable to provide many of the ecological services on which the local community depends. If we do what we can to adapt the landscape, the assemblage of plant and animal life may change, but we can potentially preserve abundant wildlife and biodiversity in the long term.

"It disappoints me to hear people say, 'just walk away if you don't think it's going to be there in 100 years,'" says

Mike Bryant, a project leader for FWS's North Carolina Coastal Plain Refuges Complex. "I know the models predict that 80 percent of Alligator River National Wildlife Refuge could be gone in 150 years, but I'm going to manage that refuge in my short tenure to the maximum benefit of wildlife while it's there. There's no certainty about sea-level rise, but I am certain that migratory birds are going to come every fall looking for the habitat that we manage—so I'm going to manage it to the best of my ability for their return each fall," says Bryant. "And for every other species that utilizes that landscape I'm going to try to sustain it for as long as I can—because that's the patch of ground I was given stewardship of, and I'm going to take care of it."



RED WOLF IN ALLIGATOR RIVER NATIONAL WILDLIFE REFUGE/COURTESY U.S. FISH AND WILDLIFE SERVICE

Communicating with Refuge Neighbors and the Public

“I guarantee you will all have to engage your communities in some sort of a discussion of sea-level rise in the future—if you haven’t already.”

—Lou Hinds, Refuge Manager, Chincoteague National Wildlife Refuge Complex, U.S. Fish and Wildlife Service



LEFT AND BELOW: COURTESY U.S. FISH AND WILDLIFE SERVICE

A refuge and its conservation partners can’t tackle climate change impacts alone. Public support in general and the engagement of communities bordering the refuge in particular are vital. With 167 coastal refuges encompassing 20 million acres and 30,000 miles of coastline from Alaska to the Marianas and Maine to Puerto Rico and touching many different communities and cultures, FWS faces a major communications and outreach challenge.

Not only must refuge managers convince an increasingly skeptical public that climate change is occurring, they must also persuade people that it is necessary to take immediate steps to adapt coastal refuges and to make long-range plans to cope with climate change-associated sea-level rise.

The Communications Challenge

“I guarantee you will have to engage your communities in some sort of a discussion of sea-level rise in the future—if you haven’t already,” says

Lou Hinds, manager of Chincoteague National Wildlife Refuge Complex. Hinds and his staff at the 14,000-acre refuge on the southern tip of Assateague Island off Virginia’s Atlantic coast have succeeded in engaging the locals and have extensive experience in dealing with the communications challenges sea-level rise presents.

Chincoteague’s beaches, maritime forests and marshes host a broad array of plants, migratory birds and other animals, including the world-famous Chincoteague ponies. Its recreational beach logs 1.4 million visits each year, making it one of the most popular refuges in the country and the economic driver of the local community. Area business owners make almost all their money for the year in the three summer months.

With their livelihoods depending on the status quo, the local community did not want to hear it when refuge staff initially presented them with a hard truth: From about 1938 through 2000, Chincoteague experienced between one foot and one-and-a-half feet of sea-level rise.

More than a million visitors a year come to Chincoteague for its barrier beach, wild ponies and other natural attractions. Because tourism drives the local economy, refuge managers have made informing and involving the locals a priority in their efforts to address sea-level rise.

The community also has certain expectations that pose an additional challenge for refuge staff. Storms regularly alter the recreational beach and destroy the parking lots used by visitors. Restoring and maintaining these parking spaces is an expensive operation. For example, in November 2009, a northeaster tore through the refuge, wiping out all the beach parking lots and rolling the entire beach back by about 20 yards or more. Every time the National Park Service (which co-manages the island) restored the parking lots, another storm would wipe them out. It cost between \$400,000 and \$500,000 to finally restore these parking lots, which hold approximately 961 cars. The community expects the refuge to maintain that parking capacity into the future in addition to renourishing the beach, putting

in jetties and doing whatever else is humanly possible, at any expense, to fight the impacts of rising sea levels and keep the beach intact.

Despite a lack of guidance from FWS, the Chincoteague refuge staff is attempting to educate the community about the futility of these actions and trying to implement more adaptive solutions. As manager Lou Hinds puts it, "I'm a land manager, and I'll do whatever I can to help wildlife and to create wildlife habitat. But I'm not ready to make the same commitment to a parking lot." What the refuge has done provides valuable lessons for other refuges dealing with sea-level rise and associated climate change impacts.

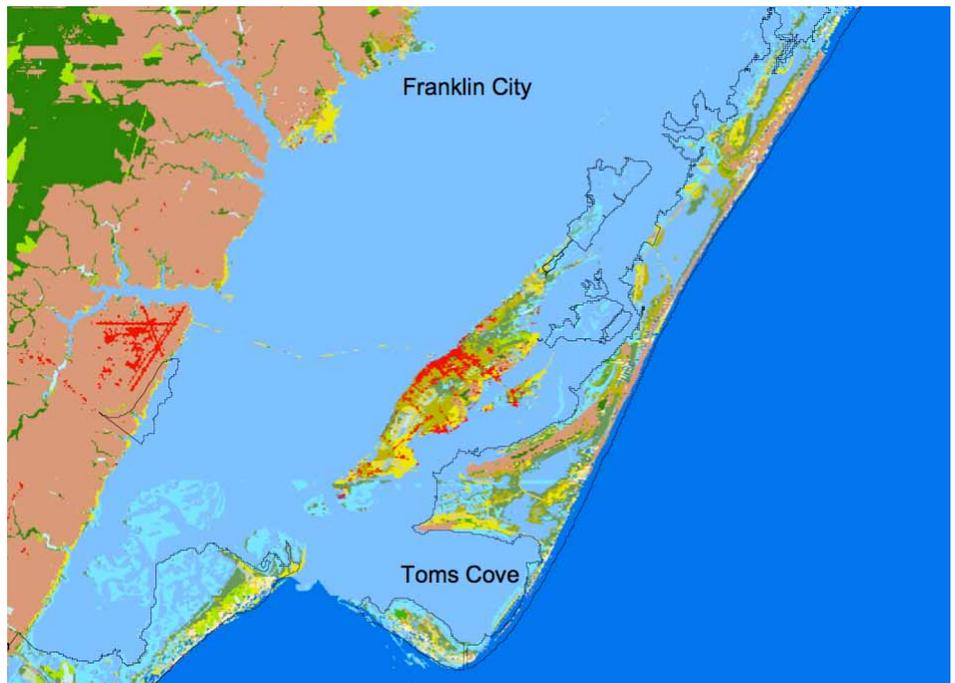
Lessons Learned

1. Know your audience and give them current, concrete local examples to which they can relate.

Specific examples that concretely connect cause and effect for the public make sea-level rise tangible and easy to understand. The Chincoteague staff found one such example in a photograph of the refuge manager standing in the surf, holding a U.S. Geological Survey marker discovered after the November 2009 northeaster. When the survey marker was originally installed in 1962, it was 100 yards from the water's edge in the dunes behind the recreational beach. Now, after nearly 50 years of rising sea levels, it is literally out to sea and underwater. A concrete, irrefutable example like this helps convey to the community the ecological changes that take place slowly and might otherwise be easy to ignore or deny.

2. Use computer modeling to visualize the future of the refuge under various sea-level rise scenarios.

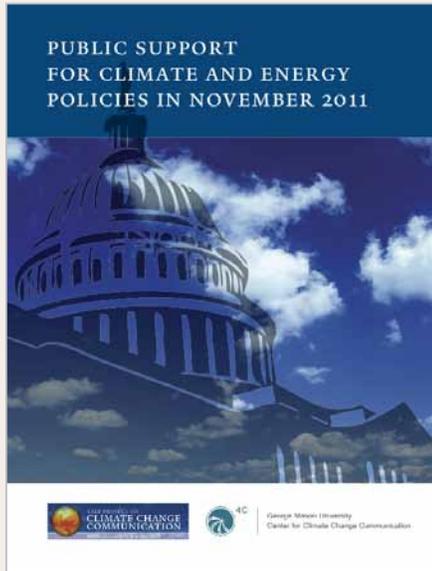
To help visualize the future, Chincoteague managers also commissioned a Sea Level Affecting Marshes Model (SLAMM), an advanced computer analysis featur-



Computer modeling brings us SLAMM View, a vision of things to come. The views above show present conditions on Chincoteague (top) and what the barrier island will look like in 2100 with a projected one-meter rise in sea level (bottom). Actually seeing how much marshland, pony grazing ground, beachfront and personal property will be lost makes a lasting impression on people.

ing SLAMM View. SLAMM View is a web-browser-based application that allows people to visualize the impacts of sea-level rise on coastal areas by using their own computers to compare current and future conditions out to the year 2100 under different sea-level-

rise scenarios such as 0.4 meter vs. 1 meter. To date, SLAMM View provides access to SLAMM simulation results for the entire coastlines of five states, and partial coverage of an additional four states. (For additional information, see www.slammview.org.)



Shifting Attitudes About Climate Change

Are there commonalities in Americans' views about climate change and are they shifting as more information becomes available?

To find out, researchers at George Mason University's Center for Climate Change Communication interviewed 981 American adults in three different years, 2008, 2010 and 2011.

Their findings, highlighted in a recent report, showed that the percentage of people who are either alarmed or concerned about climate change, i.e., believed most strongly that it's occurring, has declined significantly—from 51 percent in 2008 to 39 percent in 2011.

During that same time period, Americans who were doubtful or dismissive of climate change, i.e., were either unconcerned or completely rejected it, increased from 18 percent to 25 percent.

The takeaway message? Garnering public support for efforts to address climate change is becoming all the more challenging. (Read the full report, *Public Support for Climate and Energy Policy*, at www.climatechangecommunication.org.)

Refuge staff at Chincoteague use SLAMM view in a slide show that gives the public dramatic demonstrations of what will happen to well-known refuge landmarks over the next century under a one-meter sea-level-rise scenario. First they show a photo of the famous Chincoteague ponies at Horse Marsh, the area they cross to make their annual July swim to Chincoteague Island—an event that draws thousands of tourists. Then comes an “initial conditions” slide from the SLAMM analysis, an aerial view of the refuge at present sea levels. Refuge staff points out where the photo of the ponies was taken at Horse Marsh and the location of the recreational beach and the road that brings cars from the mainland over to Chincoteague Island.

Next, the public sees a slide of what the SLAMM analysis predicts for the year 2050. Refuge staff notes that the

majority of the marshlands protecting the roadway has been converted to either open water or tidal flats. They also draw the audience's attention to what used to be pasture for the ponies at Horse Marsh and is now mostly mudflats, and to the recreational beach, which has migrated back toward the mainland.

The next slide features the model's predictions for the year 2100. The areas around the roadway have all turned to open water. All the refuge lands to the north of Chincoteague Island are underwater, and the island has rolled back on itself. Horse Marsh is underwater. In addition to seeing the likely fate of well-known landmarks, local residents can also clearly see what the model projects will happen to their homes and businesses during the next century. Although the model cannot make exact predictions, the trends are clear—more change is coming to this refuge.

3. Open a dialog with neighboring communities.

Talking points that include personal, tangible examples of the impacts of sea-level rise—things that are easily visible and will resonate with the audience—are crucial to opening a dialog. To make sure the dialog isn't just in one direc-

tion, refuge managers need to listen and respond to the concerns of their local communities.

At Chincoteague, this has involved going through a careful planning process with ample input from locals to determine how to maintain the recreational beach in coming decades. Based on an exhaustive examination of wildlife-use data and SLAMM models, refuge staff have developed draft recommendations to move the recreational beach north from its existing location.

The new recreational beach area is more stable—a parking lot and other infrastructure can be developed there to last for 50 years or more. Not only will this reduce the costs of maintaining and repairing this infrastructure as the sea level rises, but it will also better protect wildlife by allowing the existing recreational beach and parking lot—some of the best habitat at the refuge—to be utilized exclusively by the wildlife that calls the refuge home. At the same time, it will help to meet the local community's need for beach access and parking facilities that will continue to attract recreationists and their business for decades to come. Moreover, it will allow Chincoteague National Wildlife Refuge to continue to demonstrate its willingness to engage in a constructive dialog with its neighbors.

Watch This

For a good example of making the issue of sea-level rise personal, watch the PBS program “Climate Change at the Doorstep: Sea Level Rise in Norfolk, Virginia,” available online at <http://video.pbs.org/video/2024047890>.

Conclusions and Recommendations

Climate change is the single most profound challenge to wildlife conservation and to the National Wildlife Refuge System. To respond to it effectively, refuge managers must:

- Take a landscape-scale approach to conservation throughout the refuge system.
- Share information throughout the refuge system to avoid ‘re-inventing the wheel’ in responding to climate change.
- Receive policy guidance and support from FWS for coordinated climate change responses throughout the refuge system.



BLACKWATER
NATIONAL WILDLIFE
REFUGE
COURTESY U.S. FISH
AND WILDLIFE SERVICE

With sufficient financial support and manpower, coastal refuges can take steps to help mitigate the impacts of sea-level rise and buy time for species and habitats to adapt to the impacts of climate change. Steps that show promise include:

- Plant salt-tolerant species to minimize the impacts of salt-water intrusion.
- Restore altered hydrology to reduce salt-water intrusion and to regain natural marsh-building processes.
- Restore shoreline reefs to minimize climate-change-mediated coastal erosion.
- Work with partners and the public to develop long-term conservation plans for the next century and beyond.

A large and growing percentage of the American public is skeptical or confused about climate change. To build understanding and support for climate-change-related work at refuges, managers and staff must engage and convince the people who live near refuges. To do this, refuge managers need support and guidance from FWS to:

- Find and present tangible examples the local community can relate to of sea-level-rise impacts that have already occurred.
 - Use modeling tools such as SLAMM to provide dramatic, easy-to-grasp visuals of what the landscape will look like in the future.
- Engage in an open community dialog to find out what’s important to locals and to explore alternatives for reaching their goals.

Only by taking a broad, new perspective to finding creative solutions for addressing climate-change-related problems and to educating and involving local communities and partners can FWS meet its conservation mission and preserve our refuges, the network of special places where the needs of wildlife come first.