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Fish & Wildlife News

LAST PRINT ISSUE

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SPOTLIGHT

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Departments

Correction: The cork duck and goose decoys shown in the Summer issue's "Ducks in a Row" blurb in Curator's Corner were made and donated by Clarence "Ki" Faulkner.

Features

SPOTLIGHT

ALSO IN THIS ISSUE

ON THE COVER: AMANITA MUSCARIA MUSHROOM. CREDIT: COURTNEY CELLEY/USFWS

Going Paperless, But Far From Going Away

In many ways, it is fitting that this issue of *Fish & Wildlife News* spotlights the challenges posed by our changing climate and how the Service is tackling them. That's because a small part of that response is making this the last issue of our magazine to be printed on paper.

Printing contributes to climate change in multiple ways. Paper, of course, comes from trees, and printing our publications consumes a lot of them.

Carbon dioxide (CO_2) is one of the chief greenhouse gases causing climate change. Trees take in CO_2 and help produce oxygen, making them an essential component of living on our planet.

And it's not just carbon capture and oxygen production. I live outside Washington, DC, an urban heat island. Trees provide shade and don't radiate heat like concrete and asphalt. As a result, temperatures inside DC, and other "heat islands," are higher than the surrounding suburbs.

Then there are the chemicals used to produce the paper and inks, each requiring energy and resulting in waste. And that doesn't even consider the emissions needed to run the presses, as well as bind and distribute thousands of copies across the nation.

Knowing this, and as a conservation-focused organization, we have an ethical obligation to pare our printed products down to the bare essentials.

That doesn't mean, however, that the great stories, incredible photos and other information provided by *Fish & Wildlife News* will disappear. It will simply migrate online—where we hope and expect it will reach an even bigger audience.

Far from shuttering the magazine, we are kicking off a new chapter in communications: one better-suited to engage the growing proportion of Americans, who get their information from social media platforms. By transitioning the magazine to be consumed online, those same stories will be shared easier on mobile devices and online social networks.

We will still provide an electronic copy with its traditionally strong design. But going forward, we will place more emphasis on ways to present our stories online, using interwoven text, graphics, photos and videos to tell stories in more exciting and compelling ways—ways that do justice to the incredible work of our agency and partners.

I am confident that by doing so, we'll be making ourselves fit for the future and able to inform and engage the American public more effectively, even as we reduce our impact on the landscape we're working so hard to sustain. I hope you'll agree. □

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CLIMATE CHANGE

Conserving Monarch Butterflies in a Changing Climate

When factoring in climate change, the monarch butterfly's uncertain future becomes even murkier.

Some monarch traits — a large range, short generation time and high reproductive rate — may allow them to easily adapt to climate change. Other characteristics, however, such as migration timing, reproduction requirements and overwintering habitat, rely heavily on temperature cues and may make them vulnerable.

The increasing frequency of extreme weather events such as severe storms, droughts and temperature fluctuations — one of the symptoms of climate change — are impeding monarch survival. A vast portion of the U.S. monarch population winters in a small area of Mexico, and in 2004, a sudden severe storm killed close to 80 percent of the overwintering monarch population. Drought and excessive heat in the Midwest United States during summer 2012 resulted in low reproduction.

The 2015-2016 population estimates showed an increase of 225 percent in overwintering habitat from the previous year. This is great news, but it is estimated that more than a million monarch butterflies were hit with a deadly freeze in Texas and Mexico just as spring migration was beginning in March.

The Service is working to better understand just how big a threat climate change is to monarchs. A Species Status Assessment for the monarch is in the works, and that will use the best available science to characterize the monarch's ability to sustain populations, taking into consideration threats, stressors and conservation efforts.

Climate change models suggest that monarchs may need to move north from their current range in June and July, which would require a longer migration to Mexico in the fall. Models also predict that in future decades the forest habitat in Mexico may no longer be suitable due to changing climate at the elevation where monarch colonies currently overwinter.

On the plus side, research by Dr. Karen Oberhauser, professor at the University of Minnesota, shows monarchs can withstand temperatures up to 40 degrees Celsius and can even weather summer storms by latching onto plants.

Monarchs' response to climate change may ultimately be driven by how milkweed reacts to the changing climate. Monarch caterpillars depend on milkweed alone as a host plant, and milkweed is declining throughout the monarch's range — usually for reasons unrelated to climate change.

"We have to over-engineer the carrying capacity of the landscape, restoring enough [milkweed and native nectar-producing plants] to ensure that the monarch population can withstand catastrophic weather events that may become more frequent due to climate change," says Ryan Drum, wildlife biologist and the Service's monarch science lead.

That work is already underway.

Starting at Minnesota's shore of Lake Superior, Interstate 35 heads south for more than 1,500 miles through fields of corn and soybeans and the remnants of Midwestern prairie, until it reaches the Texas chaparral country by the Rio Grande. This interstate overlaps perfectly with the central flyway of migrating eastern monarchs. Imagine the potential of transportation corridors and rights-of-way being designated as monarch habitat. Creating a "Monarch Butterfly Highway" would provide not only corridors of suitable monarch and other pollinator habitat but also an opportunity for Americans to learn about and witness the incredible monarch migration each year.

Iowa, Kansas, Minnesota, Missouri, Oklahoma and Texas, along with the Federal Highway Administration, have taken the first step in creating this highway. Using a federal strategy, they will promote the health of monarch butterflies, honey bees and other pollinators by using pollinator-friendly management practices along the Interstate 35 corridor.

By joining together with partners, old and new, the Service is working to ensure a future filled with monarchs in the ever-changing climate. □

MARA KOENIG, External Affairs, Midwest Region

Total area occupied by monarch colonies at overwintering sites in Mexico
1994/1995–2015/2016

TOM KOERNER/USFWS

CHART COURTESY OF MONARCHWATCH.ORG

CLIMATE CHANGE

Rewetting Pocosin Peatlands to Mitigate Climate Change

In its 2015 Global Lands Report, The Nature Conservancy (TNC) notes that at least 20 percent of global emissions of human-caused greenhouse gases (GHG) can be offset through protecting, restoring and enhancing such managed natural landscapes as grasslands, forests and wetlands. With the National Wildlife Refuge System responsible for more than 850 million acres of land and water, the Service's management practices can be a natural climate solution, capable of meeting the Service's wildlife mission while simultaneously achieving climate adaptation and mitigation.

For example, did you know that the Service collaborated with conservation organizations and other private entities on projects that have restored more than 80,000 acres of bottomland hardwood forests and will sequester more than 33 million tons of carbon?

The Service can expand this approach to other priority ecosystems where the restoration need and carbon sequestration capacity are great. Peatlands, such as those at Pocosin Lakes National Wildlife Refuge in North Carolina, are one such ecosystem, and the Service is collaborating with partners to increase resiliency to climate change by restoring the hydrology of these carbon-rich wetlands.

There is a tremendous opportunity to reduce GHG emissions, restore hydrology, reduce fire frequency and intensity, and improve resilience to climate change by rewetting peatlands.

SARA WARD/USFWS

Pocosins are unique peat-based wetlands, also known as southeastern shrub bogs, which occur from southern Virginia to northern Florida along the southeastern Coastal Plain. The typically thick (up to 14 feet) layer of peat soil underlying pocosins has acted as a chemical sponge over geologic time, locking up metals, carbon and nitrogen in vegetation and the deepening soil layer. North Carolina's Albemarle-Pamlico peninsula has the greatest pocosin acreage in the United States, but, like peatlands all over the country, 70 percent of this habitat in Albemarle has been drained and converted to agriculture and forestry since the 1960s.

Drained pocosin peatlands present several problems: They are a source of carbon emissions and are particularly vulnerable to catastrophic wildfires that emit large amounts of carbon and negatively impact wildlife habitat and air quality.

Peatland forests are gaining global recognition for their tremendous carbon sequestration potential. Restoring the wetland hydrology in peatlands stops the loss of carbon via peat oxidation while allowing carbon sequestration via soil and biomass accumulation to resume (halting surface elevation loss and enhancing resiliency in low lying pocosins vulnerable to sea-level rise). Partnerships with TNC, North Carolina and others have already restored 20,000 acres of pocosins at Pocosin Lakes Refuge, which the Service estimates should ultimately sequester more than 21 million tons of carbon dioxide equivalents.

Given the magnitude of the carbon-mitigation benefit and the geographic scope of restoration needed (nearly a half million acres of degraded pocosin wetlands in North Carolina alone), the Service has partnered with TNC, TerraCarbon, East Carolina University and the U.S. Geological Survey to implement a 1,300-acre peatland restoration demonstration project at the refuge to test a first-of-its-kind accounting methodology to quantify the carbon-sequestration benefits gained.

The accounting methodology is undergoing review for adoption as an eligible method to verify carbon offsets.

Approval could provide entities a new way to offset their carbon impact that, because of the amount of carbon retained in restored peatlands, could offer a high return on investment. Additionally, these entities might not otherwise have broad interests in restoration efforts. But the value of peatland restoration could entice nontraditional partners to help meet priority Service restoration, land conservation and monitoring goals in peatland habitats nationwide while meaningfully contributing to achieving GHG emission reduction targets. □

SARA WARD, Raleigh Ecological Services Field Office, Southeast Region

CLIMATE CHANGE

Planning for Future Changes in America's Heartland

In the Southern Great Plains — where farming, ranching, energy development and rapid population growth intersect with native cultures, wildlife, and other cultural and natural resources — climate change brings a new set of challenges to an already challenged landscape.

Grasslands, one of the most threatened ecosystems in North America, continue to face declines in quality and quantity across the Southern Great Plains. For grassland-dependent species, particularly grassland birds, the loss of native prairie has resulted in dramatic population declines.

For resource managers who want to reverse this trend and increase the size and connectivity of grasslands with limited conservation dollars, the question of where to target conservation is critical. Climate change, population growth and changes in land use are all variables to consider while making management decisions. Understanding how, where and to what extent these changes will affect grasslands in the future can help resource managers plan and prioritize, while also ensuring water, food and energy needs are met.

In response to this need for new data, the Great Plains Landscape Conservation Cooperative (LCC) has convened a team to develop models that will describe the relationship between climate change and vegetative cover in the region. These models will help stakeholders and resource managers make better long-term decisions about where to invest in grassland conservation, improving outcomes for this unique ecosystem.

Together with LCC members who have expertise in the region's vegetation and represent likely end-users — managers, planners and researchers — the team has begun to develop climate change impact scenarios for vegetative-cover and land-use change.

"These datatsets will be used as a base layer for conservation decisions for my agency and will inform everything from our Comprehensive Wildlife Conservation Strategy to our Landscape Level Conservation planning," says Allan Janus, research and GIS supervisor at the Oklahoma Department of Wildlife Conservation and Steering Committee member of the Great Plains LCC.

To develop these models, the team is bringing together distinct but related pieces of information developed by partners. These include:

- Detailed maps of the vegetative cover of Oklahoma and Texas;
- Assessments of the populations and locations of many key species and ecosystems in the Southern Great Plains;
- Temperature and climate projections for the South Central United States; and
- Land-use change projections.

"The South Central Climate Science Center is very pleased to be a partner in this effort," says Mike Langston, deputy director at the South Central Climate Science Center. Other partners are the North Central Climate Science Center, Playa Lakes Joint Venture, U.S. Geological Survey (USGS) Earth Resources Observation and Science Center and the USGS Fort Collins Science Center. "We believe this work will take modeling of land-cover and land-use change to a new level of usefulness for the agencies and conservation organizations in states covered," Langston says.

"Cooperative conservation is not about funding scientists to independently produce products we hope managers can use," says Nicole Athearn, coordinator for the Great Plains LCC. "Rather, we bring together managers and scientists to collaborate on all stages of information and model development, so scientists can develop the kinds of products that meet the needs and address the concerns of resource managers."

When completed, probably in 2017, this project will provide a suite of scenarios showing possible future landscape conditions under different climate and land-use projections. Rather than providing climate information alone, these scenarios will also offer information about how species and habitats might be affected by a variable climate. These scenarios can be used by managers and decision-makers to visualize potential changes in the dynamics of the systems they manage and set conservation priorities accordingly.

Because the resource management decisions made today can have effects for decades, responsible stewardship of grasslands requires future thought. By joining forces through LCCs, partners can demonstrate their commitment to working across boundaries to preserve the nation's grasslands for generations to come. □

AISLINN MAESTAS, External Affairs, Southwest Region, and JESSICA BLACKBAND, Great Plains LCC

Prairies such as this one support more than 400 species of birds and other wildlife.

TAMMY JAMES

In 2014, the Desert National Wildlife Refuge Visitor Center in Nevada was awarded LEED Platinum certification by the U.S. Green Building Council.

USFWS

CLIMATE CHANGE

Working Toward Carbon Neutrality

In 2009, the Service committed to becoming carbon neutral in its business practices by the end of fiscal year 2020. Since that time, several Executive Orders have directed all federal agencies to adopt sustainable business practices by first reducing energy use and cost, and then finding renewable or alternative energy solutions. Taking the lead for the Service in the collection, measurement and reporting on greenhouse gas (GHG) emission reductions are the Divisions of Engineering, Contracting and General Services, and Financial Management within the Headquarters Business Management and Operations (BMO).

So how is the Service doing?

The Service's GHG emissions have fallen 29 percent from 161,964 metric tons of carbon dioxide equivalents (MTCO2e) in Fiscal Year (FY) 2008 to 115,321 MTCO2e in FY 15. Scope 1 emissions—direct GHG emissions from sources the Service owns or controls (e.g., building energy use)—and Scope 2 emissions—indirect emissions from purchased electricity, steam, heating and cooling—both declined 30 percent from FY 2008 to FY 2015 (purchased electricity less renewable energy). Scope 3 emissions, which are from sources the Service does not own or directly control (e.g., employee commuting), fell 27 percent over the same period. The biggest sources of emissions for the Service are purchased electricity (34 percent), employee commuting (22 percent) and the use of its motor vehicle fleet (21 percent).

While the Service has yet to achieve its lofty goal of being a carbon-emitting neutral agency, it is leading other federal agencies in reducing its GHG footprint. A 2015 Executive Order required stringent emissions reductions for federal agencies, and the Service is close to achieving Source 1 and 2 reduction goals (36 percent by 2025 for Interior agencies) and has already met reduction goals for Source 3 emissions (23 percent).

Much of the emissions-reduction success is due to plans developed in 2011 with specific steps the Service could take to achieve reduced emission goals. For instance: To reduce electricity consumption, the Service has conducted energy audits for its facilities and has identified cost-effective, energy-efficient upgrades such as lighting replacements, heating, ventilation and air conditioning (HVAC) retrofits, and installation of low-e glass. Additionally, new buildings and major renovations must meet federal standards for high performance and sustainable buildings.

The reduction in the largest source of Scope 3 GHG emissions, employee commuting, has been largely attributed to the expansion and acceptance of teleworking, according to Kim Washington who monitors commuting practices in the Division of Engineering. Washington calculates that since 2012, Headquarters staff has reduced total miles commuting to and from work from 47,706 in 2012 to 26,231 in 2015, nearly a 50 percent reduction in associated GHG emissions.

The Service continues to search for innovative means and methods to further reduce its footprint—it is now developing strategies to incorporate electric, zero emission and plug-in hybrid vehicles into fleet purchases. The reductions show other federal agencies and the public that a fundamental change in business practices to address arguably the greatest conservation threat won't sacrifice the ability of the organization to successfully achieve its mission. □

CLIMATE CHANGE

The Kenai Mountains to Sea Partnership: A Local Effort to Address Climate Change at a Landscape Scale

The 6 million-acre Kenai Peninsula in southcentral Alaska is a spectacular landscape of ice, mountains, forests, fens, tundra, coastal bluffs, rocky shorelines and rivers with lots of salmon. Congress knew the land was special when it conserved three-quarters of the peninsula within Kenai National Wildlife Refuge, Chugach National Forest and Kenai Fjords National Park.

But climate change doesn't respect conservation boundaries. The Kenai is changing quickly, responding to temperatures warming twice as fast as those in the Lower 48. Available water on the western peninsula has declined 60 percent since 1968 as glaciers recede in the Kenai Mountains. Trees and shrubs encroach into warming alpine tundra and drying lowland wetlands. In the aftermath of a 15-year spruce bark beetle outbreak, grassland fires in spring are now common in a boreal ecosystem that has historically only experienced forest fires in summer.

Nonglacial streams on the Kenai Peninsula are already reaching lethal temperatures for salmon during short periods in July, due to warming summers and loss of riparian shade caused by spruce bark beetles and green alder sawflies (an exotic species). Working with private landowners, partners can promote re-vegetation of banks with more resilient species.

Outside the federal conservation estate, the Kenai is being rapidly developed. Connected to mainland Alaska by a 10-mile wide isthmus and the state highway system, the Kenai is a playground for tourists and Anchorage residents. It is also one of the fastest growing regions in Alaska.

This nexus of a rapidly developing landscape in a rapidly warming climate prompted the Kachemak Heritage Land Trust (KHLT) to ask, "How can we be more strategic about prioritizing private land acquisition for conservation of the Kenai?" Out of that simple question evolved a very local, landscape-scale strategy of habitat conservation called Kenai Mountains to Sea.

Kenai Mountains to Sea partners — KHLT, the Service, Audubon Alaska, Kenai Watershed Forum and the Cook Inlet Keeper — envision a landscape of connected private and public lands. They are working with willing landowners, agencies and tribal entities, and strengthening longstanding and effective private-public partnerships dedicated to voluntarily conserving and enhancing fish and wildlife habitats for the continuing economic, recreational and cultural benefits to residents and visitors of the Kenai.

One monitoring metric of sustained ecosystem health will be the sampling of riparian vegetation to confirm that salmon are being dispersed by brown bears and scavengers.

Because Kenai's landscape is changing so dramatically, the partners focused on riparian corridors as enduring features that provide ecological connectivity between freshwater headwaters high in the Kenai Mountains and Caribou Hills and their salty mouths in the Cook Inlet and Gulf of Alaska.

Conserving riparian corridors brings many benefits — they save salmon; transport marine-derived nutrients; maintain hydrology; provide green infrastructure for recreation, access, cultural resource site protection, plant dispersal and wildlife movement; connect existing protected areas; and, in a world of rapidly changing vegetation due to climate change, protecting them makes sense for landscape conservation.

But which riparian corridors? Nearly 400 stream outlets (1,800 miles of anadromous salmon habitat) intersect the Kenai's coastline, so the strategy targets "interjurisdictional" streams, those partly inside and partly outside federal land management. These streams, 20 in total, comprise half of all stream miles for anadromous fish on the peninsula and flow from federal lands through lands of multiple ownerships to the sea. By focusing collective conservation efforts on these interjurisdictional streams, every mile of corridor outside federal boundaries will ultimately leverage three miles of streams on federally managed lands.

After a two-year planning process, the strategic document was formalized in early 2015 along with an interactive, online decision support tool developed by Audubon Alaska. With a $50,000 grant from the Service's Alaska Coastal Program for KHLT to hire a project coordinator, there have been early and promising successes.

The strategy was critical for securing $5 million to initiate the removal of a fish passage barrier on Crooked Creek, a priority corridor. It also prompted discussions with an Alaska Native Corporation about leveraging its own land management planning with Kenai Mountains to Sea. And it helped identify possible acquisition of two parcels that separate the Kenai Refuge from the Kasilof River, another priority corridor.

Another benefit of developing the plan is the increased and shared understanding of the changing landscape among project partners and others in the area such as Kenai Peninsula Borough planning department. Kenai Mountains to Sea is indeed a local effort to address climate change at a landscape scale. □

BERKLEY BEDELL©

DR. JOHN M. MORTON, Kenai National Wildlife Refuge, Alaska Region

DAVID WIGGLESWORTH, Deputy Assistant Regional Director/Fish and Aquatic Conservation, Alaska Region

MANDY BERNARD, Conservation Director, Kachemak Heritage Land Trust

Smelling a Rat Leads to a Bust

Generally, the Service must clear all wildlife (including parts and products) imported into the United States. This prevents the importation of wildlife taken illegally as well as wildlife dangerous to our native ecosystems. The Centers for Disease Control and Prevention (CDC) also looks at the importation of wildlife but focuses on wildlife capable of causing human disease.

The two frequently work together at U.S. ports of entry, and in December 2014, Fernando Gattorno, Special Agent with the Service's Southeast Region, helped intercept about $200,000 worth of dried rats on sticks. They were shipped from Nigeria to South Florida for ceremonial use by people seeking help with spiritual and health problems, but CDC has banned most importations of live or dead African rodents ever since they were connected to an outbreak of monkeypox in the United States in 2003.

Besides CDC, Gattorno worked with the U.S. Department of Agriculture (USDA) and Florida Department of Health for guidance on how to safely handle hundreds of Gambian pouched rats, called oketes, and other items.

The shipment of dead rats on sticks in a cardboard box initially shut down the West Palm Beach post office and attracted a bomb squad and hazardous materials team. A postal worker had noticed a bad smell coming from a leaky package bound for a local artifacts importer's store. This was at the height of the Ebola crisis, so the U.S. Postal Service was taking precautions, wearing face masks and gloves handling the package. Postal Service police alerted USDA, which regulates agricultural items coming into the United States — in this case, the wooden sticks that held the dried rats.

"I called Fernando knowing there were also animals involved," says USDA's Louis Volpe. "Fernando and I are friends. We fish together. I said, 'Hey, we've got something you might be interested in.' "

The oketes, other African rodents and rodent pieces weren't the only problem.

"To add insult to injury, in one of the four boxes, there were a whole bunch of wild bird feathers with blood on their tips, which was a big deal because of the potential for avian flu," Gattorno recalls.

Gattorno called CDC's Miami Quarantine Station for advice on personal protection. Emily Davenport, a quarantine public health officer, took the call. "Because this was during the Ebola crisis and the package was coming from West Africa, people were on edge and being extra vigilant," Davenport says. "We told them to follow their normal personal protective equipment protocol. The way they handled these regulated items was outstanding."

Davenport praises Gattorno for his quick work and calm, cool demeanor, and for calling CDC. "Agent Gattorno and the rest of the Service's team are really great. Their work helps us prevent diseases from entering the country."

USDA

USDA's Louis Volpe holds a dehydrated jungle rat.

Gattorno and his Service colleagues and port partners met with the artifacts importer and his interpreter. They fined the importer and educated him about U.S. laws, explaining why rats, bird feathers and wooden items are regulated, and how to process items to avoid disease and to comply with regulations. Their efforts seem to have worked. "We haven't had a problem since to my knowledge," says Gattorno. □

RONDA ROBINSON, CDC

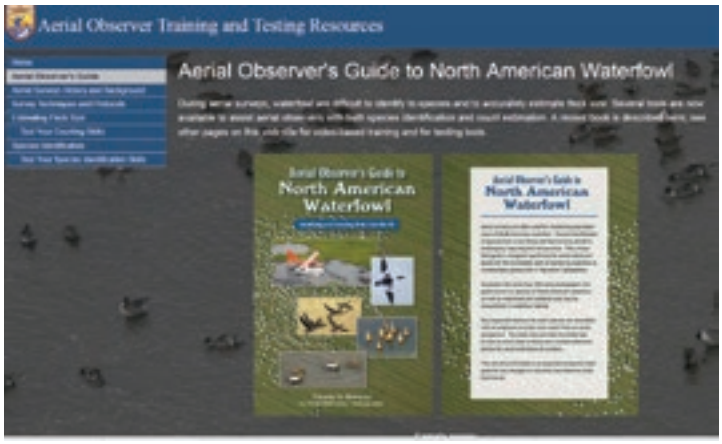
How to Count, ID Waterfowl When You're Flying

Ever try to identify or count ducks when looking down at them while flying in a plane at 100 mph? If you're a biologist who's conducted aerial waterfowl surveys, you know how tough it is. Although wildlife managers routinely conduct aerial waterbird surveys to measure status, no comprehensive training tools have existed to improve species identification and establish quantifiable standards for aerial observers. Until now.

Two products are now available to help in training aerial observers—a field guide, using still photos, and a website that employs high-definition video, still photos and interactive testing features. The field guide, *Aerial Observers Guide to North American Waterfowl*, is intended more for in-flight use to help improve skills in waterfowl identification. It covers all species of North American waterfowl highlighting distinguishing characteristics and flight patterns.

The website, <fws.gov/waterfowlsurveys>, includes tools for species identification and counting that simulate the visual experience of aerial surveys. To obtain the videos for this training, Service biologist Tim Bowman worked with videographers to acquire geographically comprehensive aerial footage of waterfowl species throughout North America. Video footage was obtained using an ultra-stabilized camera system mounted on the nose of a helicopter (the same technology used in the *Planet Earth* TV series).

Taken together, these two components represent a user-friendly program to help standardize training for species identification and flock estimation. It's a creative solution to a decades-old challenge for aerial observers and is intended to promote more reliable and defensible aerial survey data. □



Modeling a Future for Horseshoe Crabs and Red Knots

Horseshoe crabs have been around hundreds of millions of years, and in that time they have attracted a lot of fans, especially around Delaware Bay.

The fishing industry uses them as bait in the conch and American eel fisheries on the Atlantic Coast.

The pharmaceutical and medical industry uses them for their blood to produce a clotting agent that helps detect pathogens that could hurt people.

The red knot, a migratory shorebird, is also a big fan—the bird feeds on horseshoe crab eggs to fuel their 9,000-mile migration from wintering grounds in South America up to breeding grounds in the Arctic. And they migrate at the same time of year every year, landing in the Delaware Bay right when horseshoe crabs are spawning.

So much demand puts tremendous pressure on the horseshoe crab population and red knots.

During the mid-1980s to the late 1990s, there was a huge decline in shorebirds on the Delaware Bay when horseshoe crab harvest rates rose dramatically. The Delaware Bay is home to the largest population of horseshoe crabs in the world and in spring, hosts the second largest population of migrating shorebirds in North America.

GREGORY BREESE/USFWS

The drop in shorebirds led to a series of harvest restrictions as well as intense debates for the next 15 years, and in 2006, New Jersey and Delaware asked for help from the Atlantic States Marine Fisheries Commission in regulating the harvest of horseshoe crabs.

A team of scientists, led by Dr. Conor McGowan from the U.S. Geological Survey (USGS) along with Dr. David Smith (USGS), and Drs. John Sweka and Mike Millard of the Service, came up with a way to make decisions about horseshoe crab harvest, while safeguarding the survival of the red knot.

The solution is an amazing mathematical model of the unique relationship between two species, which also considers the economic value of the horseshoe crab fishery. The scientists

Red knots feed around a horseshoe crab at Mispillion Harbor, Delaware.

weaved together the ecology and biology of the red knot with the ecology and biology of the horseshoe crab to come up with predictions for the survival of red knots based on the abundance of spawning horseshoe crabs. And once the scientists had the basic model, like the lead character in the movie *Martian*, they "sciened the &*%# out of it" to come up with a model that describes important ecological and economic features.

One such feature: Horseshoe crabs need about 10 years to mature. The number of adult spawning crabs harvested in any given year will affect the number of crabs reaching adulthood to spawn a decade or more later. And the number of spawning crabs affects the number of eggs produced, which affects the red knot's primary food source during their migration.

Besides the science, the team worked with stakeholders to make sure that affected parties understood how the model worked and could trust future decisions.

"Over the past 15 years, the single-species approach for managing the horseshoe-crab harvest was frequently mired by conflicting values among the various groups. This collaborative resolution is helping to reduce that conflict," says Millard.

As an adaptive management framework, says ecologist and statistician Smith, "one of the features that makes [the model] so useful is that it allows 'learning'—new information is added into the model, which improves management over time."

Like all global migrants, the red knot population faces many threats outside of Delaware Bay. But the new model will help ensure that its migration super-food remains available. □

CATHERINE GATENBY, Fish and Aquatic Conservation, Northeast Region

New Weekly Online Feature Stories Highlight Conservation and Recreation in Refuge System

A photo story points out lighthouses on refuges. All the features are archived at <fws.gov/refuges/about/FeaturedOnlineStories.html>

They say a picture is worth a thousand words. The lands and waters conserved by the Service within the National Wildlife Refuge System are among the most picturesque natural places on Earth. They are also home to some of the most compelling fish, wildlife and plants on the planet.

So, in late July the Refuge System began publishing weekly online stories that use photos to highlight the conservation accomplishments and recreation at national wildlife refuges, wetland management districts and marine national monuments. These photo-rich stories will engage audiences new to the Service and those who have long visited national wildlife refuges. A new story is posted prominently on the Refuge System homepage each Wednesday.

The first story, "A Beginner's Guide to the National Wildlife Refuge System," gave veteran conservationists and newcomers alike a brief sense of what the Refuge System has become since its founding by President Theodore Roosevelt in 1903. Readers who clicked through the story and its hotlinks saw that, yes, the Refuge System is primarily for fish, wildlife and plants, but it's also for people.

The Refuge System has been using social media extensively to promote the stories. Any Service employee can use the stories and photos in presentations to internal or external audiences. They also can be used on Service regional or individual refuge/program webpages.

The online stories are designed to replace—not replicate—*Refuge Update*, which ended its print run with the May/June 2016 issue after 12 years. >>

But the Refuge System is not totally abandoning the *Refuge Update* brand. Some of the online stories will be highlighted in a quarterly digital newsletter called *Refuge Update*. The digital newsletter will launch in the fall and be delivered electronically to all Service employees who work for the Refuge System as well as those who have already requested it. You can subscribe by sending your e-mail address to <RefugeUpdate@fws.gov>. Ask Friends, volunteers and others in your community to do the same. □

Corpus Christi Municipal Marina: A Showplace for Sport Fish Restoration Grants

A journey of many miles starts with the first step. The renovation of the Corpus Christi Municipal Marina dates back to the year 2000, when the first of what would become seven grants from the Service's Wildlife and Sport Fish Restoration Program (WSFR) helped to modernize the popular boating facility.

Sixteen years later, boaters and anglers from across the United States and around the world come to the Texas Gulf Coast to enjoy a top-notch marina for boats big and little. It's an excellent launch point for near-shore anglers and recreational boaters on long sojourns.

"This marina is hugely important to both boaters and anglers on the Texas Gulf Coast, and exemplifies how the Wildlife and Sport Fish Restoration Program works in partnership with others to improve boating access and infrastructures," says Cliff Schleusner, Chief of WSFR in the Service's Southwest Region. "Boaters and anglers paid for it in excise tax, and now they and others reap the benefits."

The WSFR Program stems from two acts of Congress, laws originally enacted in 1937 and 1950 that laid the path for a "user-pay, user-benefit" system.

Manufacturers and importers of firearms, ammo, archery gear, boats and motors and fuel, and fishing gear pay excise taxes to the federal government. That tax is passed on to consumers at the cash register. That little bit extra is held in trust by the WSFR Program and distributed as grants, such as those received by the Corpus Christi Municipal Marina. The end result is improved hunting and fishing and boating.

Since 2000, the marina has received more than $1.7 million in WSFR grants, specifically targeted at an improved marina infrastructure, access for boaters and improved sanitary facilities to maintain clean water. The grant monies, matched by the City of Corpus Christi and Texas Parks and Wildlife Department, have built modern septic pump-outs, restrooms and showers, a laundry, meeting rooms, a four-lane boat ramp and more than 80 slips for boats greater than 26 feet in length. The upgrade also includes Internet systems needed for navigation. The new infrastructures replace outdated and decayed materials and should better withstand the forces of hurricanes that may hit the coast.

Corpus Christi dedicated the most recent work—35 slips for boats 30 to 45 feet in length—in a ceremony in May.

"Boating and angling are to Corpus Christi and the Texas Gulf Coast what finance is to Wall Street: inseparable," says Schleusner. "The upgrades made to the Corpus Christi Municipal Marina should be a boon to boating and business."

The upgrades also aid conservation. What's good for boaters and anglers is also good for clean water and the species that rely on it. □

CRAIG SPRINGER, External Affairs, Southwest Region

Corpus Christi Municipal Marina has been renewed with WSFR funds.

CITY OF CORPUS CHRISTI

Black-footed Ferrets Return to Ancestors' Stomping Grounds in Wyoming

One of the most meaningful and symbolic reintroduction efforts in the history of endangered species conservation occurred July 26 when the elusive and highly endangered black-footed ferret returned home to Meeteetse, Wyoming, where it was rediscovered 35 years ago.

"Bringing the black-footed ferret home to Meeteetse is an extraordinary achievement. [It is] a source of pride not only for the citizens of Wyoming but for conservationists everywhere," Service Director Dan Ashe said at the release event.

The black-footed ferret was once a familiar sight on the prairies across 12 Western states, as well as Canada and Mexico. By the 1950s however, habitat loss and disease decimated ferret numbers so severely the world assumed the ferret was extinct. In 1964, a small, dwindling population was discovered in Mellette County, South Dakota, and shortly after, the black-footed ferret was designated as endangered under a precursor to the Endangered Species Act in 1967. But it was too late. When the last ferret from the South Dakota population died in captivity in 1979, the world once again thought that the black-footed ferret was extinct.

RYAN MOEHRING/USFWS

A black-footed ferret checks out its surroundings in Meeteetse.

"I remember newspaper headlines announcing, 'Black-footed Ferret Extinct; Gone from the Planet,' and how sad that was," recalls Kimberly Fraser, who has been with the Service's Black-footed Ferret Conservation Center as a volunteer and outreach specialist for the past six years. It seemed as if only a miracle could bring the species back.

In 1981, a story nothing short of miraculous turned the situation around. One summer night at the Hogg family ranch in Meeteetse, Wyoming, Shep, the family dog, scuffled with an unidentified long, slender mammal. The next morning, the Hoggs took the carcass to the town's taxidermist where they discovered that the creature was none other than the supposedly extinct black-footed ferret. The area was sustaining the planet's final, dangerously tiny population of black-footed ferrets.

The world's last 18 black-footed ferrets were caught and placed in a captive-breeding program. Over the course of the next 35 years, federal, state and local partners joined forces to enable the reintroduction of the black-footed ferret throughout the West. There are now hundreds of wild black-footed ferrets at 28 reintroduction sites in eight Western states, Mexico and Canada. And now, one of those reintroduction sites is at the very place where the last known wild ferrets were found and captured.

The Endangered Species Act provides a phenomenal structure for this kind of cooperation, setting high standards for conservation, while simultaneously allowing flexibility to suit the needs of local communities. For instance, the designation of an experimental population, such as the one in Meeteetse, protects landowners from any harm they might accidentally cause to a black-footed ferret. Safe harbor agreements, another example, allow landowners to voluntarily conserve critical habitat with assurance that the government won't further restrict land use in the future, creating a mutually beneficial agreement for both interested landowners and the black-footed ferret. Partnerships with zoos and captive-breeding centers around the nation are expanding research capacity, and the state natural resources departments play a crucial role in reintroduction.

"The Fish and Wildlife Service could not have accomplished this alone. We need all of our partners in the recovery effort," says Fraser.

Indeed, this is a story of a committed team drawn together by a national conservation framework to a common purpose: to reestablish the black-footed ferret as more than a shadow, a ghost on the prairie, but as an essential part of a rich and dynamic prairie ecosystem that both wildlife and humans call home. □

LYNNEA SHUCK, Office of the Director, Headquarters

INSIDE

CLIMATE CHANGE

WILD

WILD P

Rising to the urgent challenge

LIFE & LACES

by LAURA MACLEAN | The unmistakable signs of a rapidly changing climate are everywhere — increased global air temperature; melting glaciers; rising seas; more frequent and intense weather events, droughts and wildfires; flowers blooming earlier and lakes freezing later; migratory birds delaying their flights south; among many, many indicators.

No geographic region is immune to what is, and will continue to be, the transformational conservation challenge of our time.

While numerous fish and wildlife species will still thrive, some populations and species may decline, many will shift their ranges substantially, and others may be lost despite the best efforts to intervene.

It's easy to feel overwhelmed by it all. But as the late Fish and Wildlife Service Director Sam Hamilton said, "We must act now, as if the future of fish and wildlife and people hangs in the balance—for indeed, all indications are that it does."

Rising to the Urgent Challenge: Strategic Plan for Responding to Accelerating Climate Change is the Service's framework to uphold public trust responsibilities and help ensure the sustainability of fish, wildlife, plants and habitats in the face of accelerating climate change.

The plan is threefold:

Adaptation — minimize the impacts of climate change on native fish and wildlife using the best science available to inform decisions and actions;

Mitigation — decrease greenhouse gases in the Earth's atmosphere by reducing the Service's emissions and supporting carbon sequestration; and

Engagement — work with partners to seek solutions.

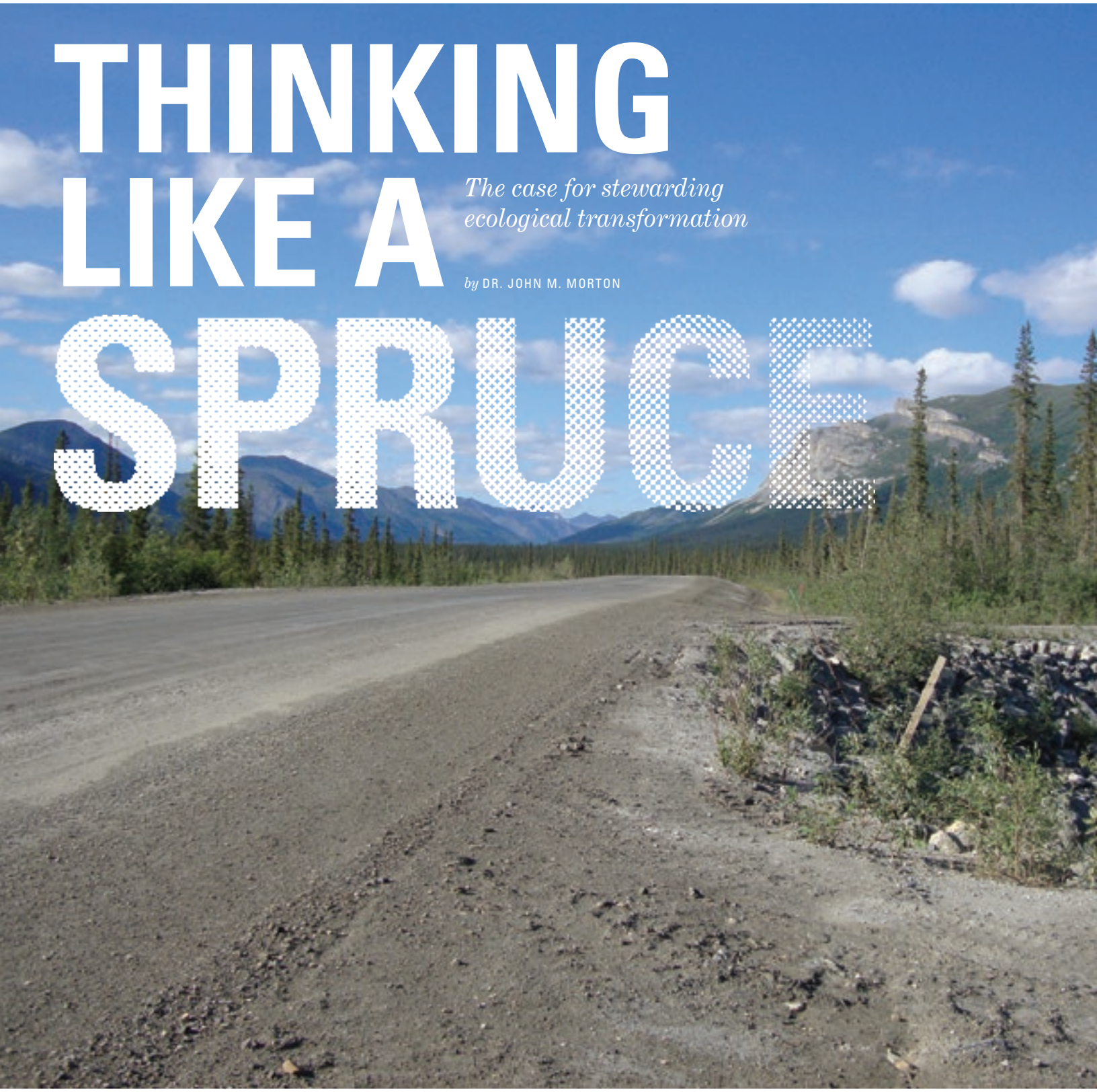
Read on for just a glimpse of the widespread efforts by Service staff with partners to safeguard natural as well as important cultural resources to make the greatest difference in swinging the balance forward. □

LAURA MACLEAN, Science Applications, Headquarters

THINKING LIKE A SPRUCE

The case for stewarding ecological transformation

by DR. JOHN M. MORTON



JOHN M. MORTON/USFWS

White spruce and moose co-exist over most of the North American boreal forest, except northern Alaska. There, long-legged moose have almost finished their colonization of arctic Alaska, following wind-dispersed willows northward as they respond to temperatures warming twice as fast as those in the Lower 48. Invading the treeless tundra just a half century ago, moose are now so common they're recreationally hunted along the Colville River. Balsam cottonwood, another boreal species, spreads through glacial valleys in the Brooks Range, its seeds dispersing in warming winds.

JANET JORGENSON/USFWS

(Left) The white spruce forest thins north of Coldfoot, Alaska, because of the harsh alpine climate. It's quite plausible that a camper or caribou hunter traveling up the Dalton Highway collected firewood near here (as did the author), unintentionally transporting a cone that germinated on the North Slope circa 1999.

(Above) This is the only known white spruce north of the Brooks Range to have not been deliberately planted.

The white spruce is working hard to catch up to its boreal brethren—moose, willow and cottonwood—which have leapt northward in the warming climate. Tree-rings from spruce on the leading edge of the boreal forest in western Alaska show great growth in recent decades, more so than their counterparts in interior Alaska. But spruce expansion northward is checked by the extreme alpine climate in the Brooks Range, the topographic barrier separating the Arctic Coastal Plain from subarctic spruce forests.

Slicing through this barrier, the Dalton Highway (aka "Haul Road") extends due north 414 miles from just outside Fairbanks to Deadhorse. Sometimes paved but mostly gravel, it cuts through spruce-covered hills before crossing the Yukon River—heart of the Far North—with a 2,300-foot wooden-decked bridge. Entering the land of midnight sun as it crosses the Arctic Circle, the Dalton Highway passes through Coldfoot—start of the longest service-less road segment (245 miles) in North America—eventually climbing the 4,800-foot-high Atigun Pass in the Brooks Range before descending to Galbraith Lake. Here, the Dalton Highway stretches 130 miles northward across the Arctic coastal plain to where the Trans-Alaska pipeline originates near the Arctic Ocean. ››

JOHN M. MORTON/USFWS

This 273-year-old white spruce, girdled by a vandal in 2004, once delineated the northernmost extent of the boreal forest along the Dalton Highway.

Along the way, the white spruce forest thins, challenged by a harsher climate as the Dalton Highway traverses northward and upward in elevation. Just north of Coldfoot, as the road ascends the southern flank of the Brooks Range, a wayside sign alerts occasional travelers of the "Farthest North Spruce Tree." This tree, now girdled in a random act of vandalism, no longer holds that crown. Spruce have sprouted further upslope, moving one woody cone at a time, perhaps 200 meters a year, a Herculean effort to reach the other side of the mountains where the climate becomes more boreal with each passing year. Modeling suggests that goal might happen in 1,000 years if left to natural dispersal in a world of anthropogenic climate change.

White spruce can survive on the coastal plain beyond the mountains. Bob Marshall, wilderness advocate, unsuccessfully sowed spruce seeds above the treeline in the Brooks Range back in 1939. They've since been experimentally planted at Toolik Lake, a long-term ecological research site on the coastal plain, where they grow but have yet to produce cones. And in 2008, a single white spruce seedling was found growing along the Dalton Highway near Galbraith Lake, a popular site for caribou hunting on the other side of the mountains. This tree almost certainly sprouted from a cone on a branch that was collected for firewood by hunters or campers as they drove north through spruce forests en route to the North Slope.

A novel boreal ecosystem is indeed fledging on the Arctic Coastal Plain, albeit a depauperate one. Populated by wind-dispersed woody plants such as willow and cottonwood, spruce forests are conspicuously absent as moose work to evade predators and high winds. So why don't we just transplant spruce, accelerating what is just a matter of time?

We 'ologists tend to be cautious, not wanting to display hubris about heady decisions like deliberately manipulating biological communities. So we try to control Old World invasives such as white sweetclover creeping up the Dalton Highway, even as we hesitate to manipulate our native spruce. Our inaction allows the random act of a camper or hunter to move the tree beyond the mountains, a decision that could and should have been thoughtfully weighed. Even after the deed is done, the 'ologists who documented the first spruce to make it to arctic Alaska in the last several thousand years mused about "whether to protect or pull this likely human-introduced seedling or leave its future to chance." So much angst about naturalness in a world in which its very climate is no longer natural.

When Aldo Leopold penned "to keep every cog and wheel is the first precaution of intelligent tinkering," Leopold almost certainly didn't envision the sixth extinction. Perhaps climate change needs more emphatic recognition as the unidirectional driver it is to better understand that we are part of nature—like it or not—and helping spruce over the mountain is the transformational thinking needed now to ameliorate the unfolding Anthropocene. □

DR. JOHN M. MORTON, Kenai National Wildlife Refuge, Alaska Region

Recommendations

In addition to describing the impacts of climate change on U.S. natural systems from forests to grasslands to the Arctic, the adaptation strategy lays out a set of goals, strategies and actions, and describes opportunities for multiple sectors to address these challenges. Key recommendations:

- Conserve habitat to support healthy fish, wildlife and plant populations and ecosystem functions;
- Manage species and habitats to protect ecosystem functions and provide sustainable use;
- Enhance capacity for effective management;
- Support adaptive management through integrated observation and monitoring;
- Increase knowledge and information on impacts and responses of fish, wildlife and plants;
- Increase awareness and motivate action; and
- Reduce non-climate stressors to help fish, wildlife, plants and ecosystems adapt.

The National Fish, Wildlife and Plants Climate Adaptation Strategy can be found on the web at <wildlifeadaptationstrategy.gov>.

Climate Adaptation Strategy

The Service is certainly not alone in working to plan for and respond to a changing climate, and since 2010, it has taken a leadership role in developing and implementing a broad, partner-based framework for helping safeguard our valuable natural resources in a changing climate through the collaboratively developed National Fish, Wildlife and Plants Climate Adaptation Strategy.

Since the strategy's release in March 2013, federal, state and tribal agencies have been working together to support the strategy's recommendations. For example:

- California is working with partners to develop a reintroduction plan for winter-run Chinook salmon that will support a more climate-resilient population.
- An interagency collaboration, led by BLM, is developing a National Seed Strategy to ensure the availability of appropriate seeds in a changing climate.
- The Swinomish Indian Tribal Community is modeling future conditions to estimate the impacts from sea-level rise and storm surge on the near-shore environment of the reservation on Puget Sound in Washington.
- The Service is working to incorporate climate change considerations into land acquisition and financial assistance programs.

In 2016, the partnership sponsored and launched the first national Climate Adaptation Leadership Award for Natural Resources to recognize exemplary efforts by both federal and non-federal entities to help safeguard America's living natural resources from climate change. Efforts in 2017 will include continuing to promote the strategy goals and framework, highlighting examples of climate adaptation at work, and identifying and addressing areas where more work is needed. □

ONE SALT MARSH AT A TIME

Building coastal resiliency after Hurricane Sandy

by ANNE POST

Susan Adamowicz shows interns marsh surface elevations that support healthy vegetation growth at Rachel Carson National Wildlife Refuge.

Dr. Susan Adamowicz is standing on a salt marsh along the shores of the Webhannet River at Rachel Carson National Wildlife Refuge in Maine. This refuge is practically her home, where she has worked for the past 13 years as a land management and research demonstration biologist for the Service.

Coastal marshes are a habitat she has known and loved since she was a child. But today, salt marshes are facing new and unprecedented threats from climate change. We asked her to talk to us about the important role salt marshes play in protecting coastlines and building coastal resiliency.

Q: *What are salt marshes and what makes them important?*

Susan: Salt marshes are exciting places to work! They are dynamic areas.

Salt marshes form where rivers meet the sea and where the velocity of water is slow enough to allow the sediment to deposit and for plants to take root. Over time, as

salt marshes continue to grow, they rise in elevation and expand outward horizontally.

They support a wide variety of wildlife that's specialized to live in this salty, tidal environment, everything from micro biota to birds such as the saltmarsh sparrow to numerous species of mammals and fish. They also provide excellent services, such as storing carbon, filtering water and providing natural defenses against storms by buffering the force of both storm surges and storm waves.

Q: *Let's talk about storms—how did Hurricane Sandy change the way we think about protecting coastal communities?*

Susan: The coast was forever changed as was our perception of what it means to live along the coast. We saw the tremendously destructive force of what nature can do, but we also saw how this force can be lessened by having salt marshes in place to protect our shores.

After Hurricane Sandy, I think many of us woke up to the challenge of having to think about our coastal systems in new ways. How might we redesign our coasts so that in some areas we could restore the natural systems, like salt marshes, that can provide more natural flexibility and protection from storm surge, big storm waves or even additional rainfall?

Q: *How do we prepare for future storms and sea-level rise and stay resilient?*

Susan: Salt marshes play a vital role in the resiliency of coastal systems. Imagine if this salt marsh was not here. There would be no buffer from the turbulence of storms. And because healthy salt marshes can grow higher in elevation, they can provide a continuing protection to human communities if sea levels don't rise too high too quickly. By being able to handle the force of storms and recover quickly, we say that salt marshes are resilient and they pass this protection on to surrounding human communities.

We're also using all kinds of new techniques to restore coastal marshes and improve resiliency. Thin-layer deposition is one example. It uses clean dredge sediments to build up the marsh surface elevation to a height that's optimal for the salt marsh grasses to continue to build the marsh on their own over time. We have several thin-layer deposition projects on national wildlife refuges as a result of Hurricane Sandy funds [for example, at John Chafee National Wildlife Refuge in Rhode Island and Edwin B. Forsythe National Wildlife Refuge in New Jersey].

USFWS

Susan Adamowicz and Toni Mikula read a surface elevation table in a Maine salt marsh.

Q: *You've worked in coastal marshes for a long time—how has your work changed and what do you see for the future?*

Susan: A lot has changed. We no longer talk about restoring a salt marsh to the configuration it had in the 1600s. Now we talk about restoring the trajectories of salt marsh-building forces so that a salt marsh can sustain itself and have a high degree of integrity over time.

With super storms, climate change and their effects, we're seeing unprecedented forces placed on the coast. It's like Godzilla is walking all over our picnic and we are trying to figure out how best to prepare ourselves, how best to respond to this climate change Godzilla. I may be exaggerating a little bit, but maybe only a little bit because it has been such a challenge to us.

Some of the models predict that our coastlines are going to be entirely changed by sea-level rise in the next 100 years and I worry a great deal about the kind of planet that my nieces and nephews and their children will inherit.

I take hope in realizing it is not just me alone, but within the family of the U.S. Fish and Wildlife Service and my family of other professional scientists, there are a lot of us that are concerned about the same thing. We want to pass on a healthy planet to future generations. If we can bring these salt marshes 50-75 years into the future, I think we will have done a service for the next generation of scientists, wildlife lovers and folks that live on the coast, a service that they can then build on. □

ANNE POST, External Affairs, Northeast Region

LAMAR GORE/USFWS

Interns learn how to measure salinity in a salt marsh at Rachel Carson National Wildlife Refuge in Maine.

USFWS

COMMUNICATI

CHALLENGES & OPPORTUNITIES

Moving from the dire to stories of inspiration and optimism

Extensive stand of severely bleached coral at Lisianski Island in the Papahanaumokuakea Marine National Monument in Hawaii.

NOAA

by BRIAN HIRES | For more than two decades scientists have been warning of the devastating impacts climate change will have on the planet's biodiversity and ecosystems. Sharing the meaningful and timely actions the Service is taking with partners to mitigate those impacts is key to smarter, more engaging communications.

As a public affairs officer working on Endangered Species Act and imperiled species issues in the United States, every day I read or hear about species impacted by climate change, including red knots, migratory birds that are losing an important food source in Delaware Bay, Key deer in Florida will likely lose their habitat to flooding, and moose in the Midwest and Northeast that are being devastated by ticks and disease caused by warmer winters.

A Most Difficult Issue to Communicate

You don't need to be a communications expert to see what a tremendous challenge it is to make the climate change discussion engaging, constructive and inspiring.

Just try to put a positive spin on news involving out-of-control greenhouse gas emissions, rising temperatures, melting glaciers and acidifying oceans that spur yet other problems for people, wildlife and ecosystems, all at some uncertain time in the future. These threats include habitat loss, habitat fragmentation, invasive species, disease, and drought and water availability. Climate change is also mired in both political controversy and an ostensible, but really non-existent, debate over its reality. Further, while we all contribute to climate change through our daily activities, there are few clear actions individuals can take to meaningfully affect the direction of global climate policy negotiations. These traits overwhelm and depress people, even those deeply concerned about the issue, and as a result people tune out on climate change.

For climate change to gain traction in the public mind, say leading climate scholars and social scientists, we must find a way to instill a sense of optimism that we as individuals and as a society can take meaningful action. How can this be possible, however, if leading countries and the planet as a whole continue to increase the rate of greenhouse gas emissions and >>

blow past mitigation targets for avoiding the worse consequences?

Service's Communications Opportunity

The Service occupies a unique space in our ability to gather diverse stakeholders to mitigate the harmful impacts of climate change on wildlife and engage the public with real solutions that groups and individuals can take. The Service is well-positioned to engage scientists, communicators, state wildlife agencies, conservation groups, federal agencies and private landowners to clarify the climate impacts to imperiled wildlife and ecosystems across the country and then address them.

The Service has already been actively forging and leveraging diverse partnerships and implementing forward-thinking solutions. Just a few of the many examples include:

■ Across the country, Landscape Conservation Cooperatives (LCC) are fostering unparalleled collaborations between state, federal, local and international agencies; tribes and First Nations; nongovernmental organizations; universities; and interested public and private organizations to discover shared conservation priorities, increase their collective science and management capacity, and address climate resiliency at a level of coordination rarely seen.

■ The Service, U.S. Geological Survey, state wildlife agencies, National Park Service and National Academy of Sciences are developing on "climate vulnerability assessments," a new strategy for evaluating the impacts of climate change on plants, wildlife and entire ecosystems and how well they will adapt to that change. Knowing these factors will allow us to create effective, timely conservation strategies for imperiled species.

■ In Florida, the Service is working with partners to model the state's rapid population growth, sea-level rise, land-use planning and financial resources to conserve wildlife and natural resources in the face of climate change.

The Peninsular Florida LCC and the Southeastern Conservation Adaptation Strategy are critical tools in bringing diverse partners together and developing coordinated, region-wide strategies. "We should not decide what land to conserve in today's world," says Service senior biologist and science coordinator for the Peninsular Florida LCC Steve Traxler. "We need to look 20 and 50 years down the road to see where migratory birds, the Florida panther and other wildlife can survive."

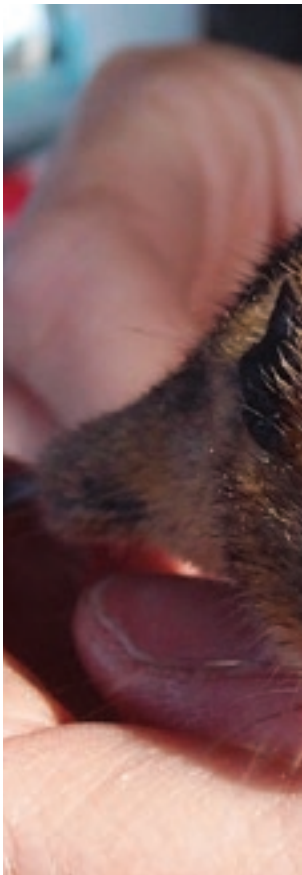
■ In the South Pacific, where the Service manages coral reef habitat in 11 wildlife refuges, scientists are seeking ways to reduce coral vulnerability to bleaching. Since tropical reefs around the world are dying due to acidification as oceans take up more carbon dioxide from the atmosphere, our science and conservation efforts could help reefs not only in the South Pacific but around the world.

■ In the Northeast, the Service and is working with local, state and federal stakeholders is removing high-risk dams and other barriers. Reconnecting waterways makes them more resilient to flooding, extreme weather and sea-level rise. Since 2009 our efforts have restored connectivity on thousands of river miles from West Virginia to Maine, and is resulting in cleaner water for local communities, restored fisheries and increased tourism and recreation.

■ In Hawaii, the Service is working with scientists from other agencies and institutions to measure the impacts climate change will have on bird species there that are already barely holding on in the wild. Higher temperatures will allow malaria-carrying mosquitoes to expand their ranges upslope and threaten imperiled bird species such as the akekee, 'akiapola'au, akikiki, 'akohekohe and others.

■ In northern and central California, the Service and partners are protecting tidal marsh ecosystems in the face of sea-level rise and to recover imperiled species such as the California clapper rail, salt marsh

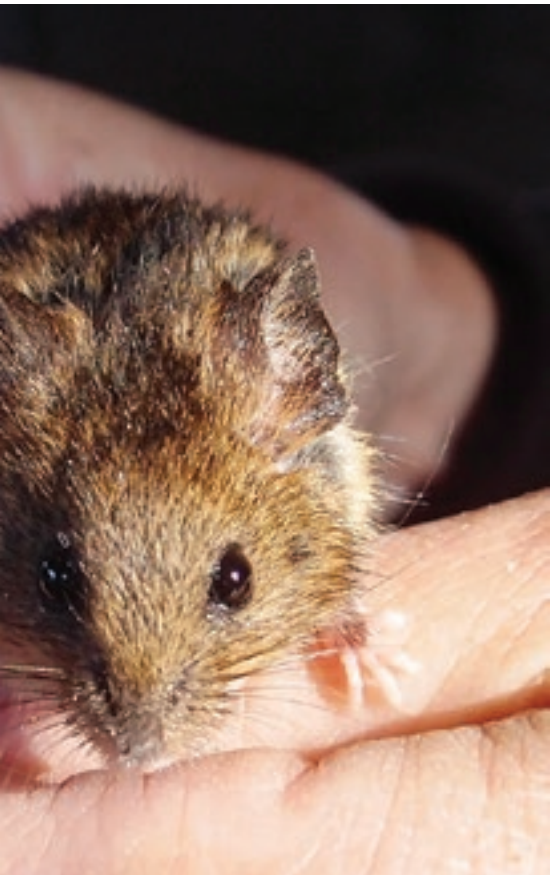
JOHN OBERHEU



STEVE MARTARANO/USFWS

(Above) The Florida Key deer's habitat is threatened by sea-level rise and other impacts of accelerated climate change. (Upper right) Removal of the Westecunk Creek Barrier in Eagleswood, New Jersey, restored fish passage for both migratory and year-round resident fish and increased the resiliency of the ecosystem. (Right) Much of California's tidal marsh is gone, threatening species such as the salt marsh harvest mouse.

REBECCA REEVES/USFWS



harvest mouse, Suisun thistle, soft bird's-beak and California sea-blite.

Public and partner understanding of and support for these efforts, why they are important and what is further needed are critical. As such, the work of Service communicators and public affairs will be equally important. These efforts should get a boost from the National Climate Communications Strategy due later this year. The plan prioritizes improved internal communications and engagement between Service employees and between the Service and our partners. We will also roll out the Climate Portal later this year, a first-of-its-kind tool for Service scientists, leaders, communicators and employees working on climate change to share, collaborate and inspire.

Challenges for Getting There

Given the scale and severity of the threats posed by climate change to America's wildlife, special places and our way of life, few will argue that much more needs to be urgently done. Are we conserving, collaborating and communicating at a scale and in a time frame that meets the challenge? Are we clear what those challenges are and are we communicating them as well as our successes? As the oldest and most accomplished federal conservation agency in the world with a diverse, skilled workforce and the most powerful conservation tools on the planet, we have an opportunity to engage, inspire and leverage local, national and international stakeholders by resoundingly answering these questions. □

BRIAN HIRES, External Affairs, Headquarters

Wood thrush

ON THE WINGS OF CHANGE

Bringing some predictability to the uncertainty surrounding our changing climate

by PATRICIA HEGLUND

When I was a young biologist, more than 30 years ago, I was stationed on Adak Naval Air Station at the Aleutian Islands National Wildlife Refuge. Out in the Aleutians, the weather was always changing. It could be dead calm one minute and gale force winds in another.

Rain squalls would blast from above, pelting your face with millions of icy needles for a few minutes and then the sun would break through. Heavy fog could roll by on 50-knot winds for days on end, and then skies would suddenly clear. The weather was so variable that the Nightly Navy News weather report was called, "Today's Weather Was…" The unpredictability of the Aleutian weather was, well, predictable and thus, something we were well-prepared for.

Today, climate change is throwing an increasing number and magnitude of unexpected extreme weather events at wildlife and land managers. Our uncertainty about the impacts of such change is something managers need to get a hold of so that we can prepare for and respond to such change. In 2011, the Service partnered with NASA's Ecological Forecasting Program and the University of Wisconsin-Madison to look at the potential impacts of climate change and extreme weather on bird populations on national wildlife refuges in the continental United States.

Birds, and all wildlife, are now experiencing a higher frequency of extreme events, such as droughts or heavy rains, in some places where extreme events were once rare. When combined with higher temperatures, an extreme event can affect the availability of critical resources and be more than a species can bear. As a result, wildlife may move to more suitable areas, abandon breeding attempts or even die. In a recent paper, Dr. Sebastian Martinuzzi and others reported that droughts are expected to become more frequent on some wildlife refuges, particularly in the Southwest, where increasing temperature may already be pushing the limits of some species, so we know we will need strong management there.

Even in other areas, drought may have a profound effect on birds. Drs. Brooke Bateman and Andrew Allstadt developed models suggesting that drought and precipitation are particularly important in shaping the suitable climate range for breeding wood thrush. The projected increase in drought conditions in the southern United States may influence the loss of the region's suitability as future breeding habitat for the wood thrush by the end of the century. Suitable climate conditions, however, are projected to expand north and east.

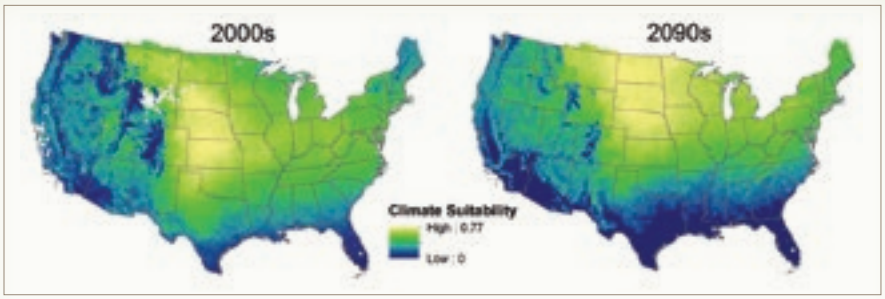
The grasshopper sparrow needs a more even combination of temperature and precipitation conditions, although it appears to favor wetter conditions like those projected for the Midwest in the future. So while its suitable climate range is projected to shrink in the south and west, it is also projected to expand north and east.

Armed with projections like these, we are better able to think about alternative actions the Service can take in response to climate change.

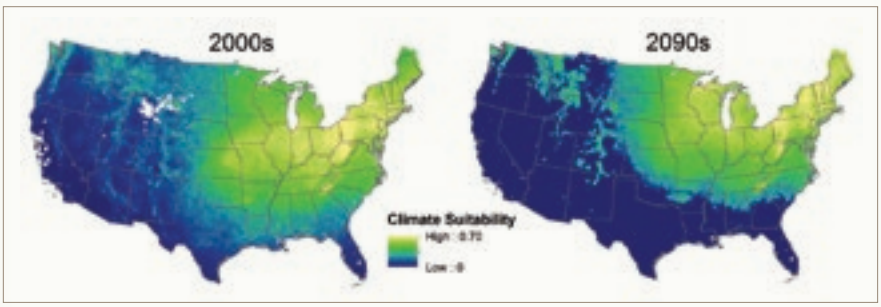
Even in the face of an uncertain climate future, knowing the potential magnitude of change allows the Service to better prepare and act with intention. □

Contributing: Anna Pidgeo, Volker Radleoff, Steve Vavrus, Brooke Bateman, Andy Allstadt and Sebastian Martinuzzi, all from the University of Wisconsin-Madison; Wayne Thogmartin, U.S. Geological Survey; Tom Albright, University of Nevada-Reno; and Resit Akcakaya, Stony Brooke University

PATRICIA HEGLUND, Division of Biological Resources and Regional Refuge Biologist, Midwest Region



Current suitable climate space vs. projected suitable climate space for breeding grasshopper sparrow.



Current suitable climate space vs. projected suitable climate space for breeding wood thrush.

SCOTT WHITTLE

What's Your 'Climate Handprint'?

You've probably heard of the term "carbon footprint," which is a measure of the carbon dioxide and other greenhouse gas emissions you create in your everyday life by commuting to work, powering your home, throwing out the trash, etc.

The footprints we leave behind are important because carbon emissions are linked to climate change, and climate change is impacting wildlife and people. Just by making a few simple changes, you can reduce your footprint:

Increase your handprint as a citizen scientist with an app like eBird Trail Tracker.

Switch to high-efficiency lightbulbs and look for the Energy Star® label the next time you buy an appliance, electronics or new windows (you'll save money, too). Buy locally produced foods to cut transportation emissions and bring your own grocery bags to cut down on plastic waste that ends up in landfills. And don't forget the mighty Rs: reduce, reuse and recycle.

You can also start a wave of climate-minded conservation by lending a hand in your community and inspiring others to do the same. Here are just a few ideas to increase your "climate handprint":

■ Flex your citizen muscle in your hometown by supporting initiatives for a sustainable community. Create a community garden with native plants and shrubs.

■ Incorporate climate good into the recreational teams or clubs that you and family members participate in by carpooling to practices and events, and look for eco-friendly disposable plates and utensils for your next family reunion or neighborhood party.

■ Be a citizen scientist on national projects such as the eBird Trail Tracker, Project BudBurst or the National Phenology Network. Whether you live near a city or in a rural area, you can track and share your observations on what you see happening with native plants and wildlife.

Community gardens have a host of benefits. Bringing people together is only one of them.

■ Be creative! The best way to engage others in climate-friendly conservation is to share a fun and easy experience.

It's easy to feel overwhelmed by climate change; however, you really can make a difference when all of those handprints add up.

For more ideas on how you can make a climate handprint, visit <fws.gov/climate>. □

LAUREL HILL, Midwest Region, and ALEXANDER NICOLAS, Headquarters

Teaching Native American Youth to Use Traditional Knowledge to Adapt Communities to Climate Change

This summer, nearly 100 Native American, Alaska Native and Native Hawaiian students between the ages of 15 and 18 attended the second annual Inter-Tribal Youth Climate Leadership Congress at the Service's National Conservation Training Center (NCTC) in West Virginia to learn about climate change issues in indigenous communities, federal agency efforts on climate change, and most importantly, how the students can help their communities become more resilient in the face of these challenges.

"The U.S. Fish and Wildlife Service is committed to uniting students for the common cause of conserving the American landscape and the wildlife that depend on it. These Native American youth are on the forefront of climate issues," says Georgia Jeppesen, NCTC course leader. "We've already seen several tribes from Alaska being affected by climate change."

During the congress, federal scientists taught the students about climate science, traditional ecological knowledge, and how a changing climate is impacting native environmental health and ways of life across the country. All the speakers told the students that traditional ways of life are not fading away because of climate challenges, but rather are evolving to respond to new ecological and social conditions. The other main messages were the importance of learning from their elders and the imperative that youth apply traditional teachings to current climate change challenges.

After the congress, many of the students said they now felt more confident discussing climate issues with their tribal leaders, peers and communities, and hope to make a difference advancing climate change initiatives back home.

"I didn't know much about climate change before the congress, but I do know that our sacred mountain used to have snow on it all year-round and now snow can only be found on that mountain for five months of the year," says Cody Apachito, a Mescalero Apache and Navajo tribal member and congress attendee from the Mescalero Apache Reservation in New Mexico. "The decrease in the snow melt is directly affecting my community's gardens, fish hatchery and how much fresh water we get in our homes. Seeing that change makes me feel sad, but after the congress I feel like I can have a discussion with my friends and educate my community in making a difference."

This event was made possible by the Service, Bureau of Indian Affairs, Environmental Protection Agency, National Oceanic and Atmospheric Administration, National Park Service, U.S Forest Service and U.S. Geological Survey. □

ALEJANDRO MORALES, External Affairs, Midwest Region

ALAN KOTOK/FLICKR

KEANU JONES/USFWS

Hopi students demonstrate their culture to the congress by doing a traditional corn dance during the cultural gathering night.

BIG THINKING IN TEXAS

Making the Endangered Species Act work for all

by ADAM ZERRENNER | Deep in the heart of central Texas are many of the nation's fastest growing cities and counties. This rapidly growing region is also considered a national biodiversity hotspot. It is home to numerous rare wildlife species found only in Texas, some of which are protected by the Endangered Species Act (ESA).

(Top) The population of Texas wild rice, a local, aquatic grass species limited to only a small segment of the San Marcos River, has doubled since the Edwards Aquifer HCP began in 2013. (Middle) Many species, including the Houston toad, are found nowhere in the world but Texas. (Bottom) Austin is just one of the major cities along I-35 working to conserve monarchs.

This unique natural heritage is associated with the Balcones Escarpment, a rugged landscape that houses one of the most productive artesian aquifers in the world, the Edwards Aquifer. The Balcones Escarpment is where the ocean once met the land and is now where the Texas Hill Country meets the prairies of Central Texas. Interstate Highway 35 (I-35) follows the escarpment and passes through rapidly growing cities including Austin and San Antonio. This region, as with most of Texas, is almost entirely privately owned, and a key issue has been to both protect wildlife and facilitate development.

Landscape-Level Conservation Planning

Texas is a place of innovation, and a model for making the ESA work for people and wildlife. Breaking new ground in 1996, the Service issued its first ESA permit for a landscape-level, regional Habitat Conservation Plan (HCP) in the nation: the Balcones Canyonlands Conservation Plan (BCCP). To offset the development that has taken place throughout the area, the BCCP has guided the strategic acquisition of habitat preserves in and around Austin for the benefit of 46 species, including the golden-cheeked warbler and black-capped vireo, through a collaborative partnership with the City of Austin, Travis County and numerous other key partners.

Following the lead of the BCCP, landscape-level conservation plans in nearly 10 adjacent I-35 corridor cities and counties have taken root over the past 20 years. These plans, managed by local governments, have proved to be an efficient way of administering the ESA, effectively applying the concepts of Strategic Habitat Conservation.

Community-Based Collaboration and Incentives

These landscape-level plans provide locally driven solutions with the Service as a partner. Each of these plans has developed solutions to potential conflicts through community incentives such as regulatory certainty, permit streamlining, species recovery, water quality protection, regional water supply security, property tax benefits for participating landowners and open space preserves, which provide economic benefits to local communities through trails, recreation and youth education.

In Travis and Williamson counties alone, almost 700 projects have taken advantage of HCPs for a streamlined process that affords regulatory certainty, while providing a benefit to rare species covered by the plans.

Additionally, these plans provide landscape-scale conservation benefits that far exceed the time-consuming, project-by-project permitting. Almost 100,000 acres of preserves and open space have been strategically protected through the BCCP, and these acres support conservation preserves established by the Balcones Canyonlands National Wildlife Refuge and City of Austin watershed protection lands. These preserve lands protect the endangered golden cheeked-warbler, black-capped vireo and numerous rare cave-dwelling species, along with the Edwards Aquifer recharge zone, which benefits central Texas's beloved Barton Springs, home of the endangered Barton Springs and Austin blind salamanders. The BCCP's preserve system also plays a critical role in educating future generations about conservation; over the past three years more than 14,000 young people attended 285 individual events hosted by the BCCP.

The Bastrop County HCP has provided many of its participants the ability to utilize Texas's property tax exemption law that allows landowners to realize property tax reductions when they enroll in a Service-permitted plan that benefits a federally protected species. The state tax law and HCP have served as a strong incentive for landowners to enroll in this HCP, seeking the financial incentive associated with conservation actions that benefit the endangered Houston toad.

The Edwards Aquifer HCP is restoring Texas wild rice, a local, aquatic grass species limited to only a small segment of the San Marcos River. Its population has doubled since the HCP began in 2013. The HCP provides water security to the 2 million users of Edwards Aquifer, including the seventh largest city in the United States, San Antonio, through the Edwards Aquifer water market. The water market helps to maintain spring flow at Comal and San Marcos springs, the two largest springs in Texas (and the southwestern United States) through a voluntary irrigated agriculture suspension program. The water not pumped for agriculture is dedicated to spring flow.

What's Next?

One thing is certain, implementing the ESA in Texas requires thinking big and continually identifying new solutions that work for local communities, private landowners and Texas's natural heritage. Leveraging past successes, the I-35 corridor is now quickly becoming a conservation model for the monarch butterfly. Many major metropolitan cities along I-35 have voluntarily agreed to implement a variety of monarch conservation actions.

The Service is also working proactively with its Texas partners to get ahead of potential species listings by using the Species Status Assessment process. This framework allows the Service and partners to use the best available science to get an early look at a species' future viability. The Service and partners then can collaborate on important scientific research and conservation tools for species in need, and leverage strategic resources for high priority species conservation.

Texas is setting the stage for creative ways to approach conservation and these conservation strategies may well become the way of the future for successful ESA implementation across the nation and beyond. □

ADAM ZERRENNER, Austin (Texas) Ecological Services Field Office, Southwest Region

What's an HCP?

A Habitat Conservation Plan (HCP) is one tool the Service uses to protect species and habitat with any nonfederal landowner like a private individual, corporation or a municipality. If worried that its actions might accidentally harm a protected species, an entity (or individual) can apply for an Incidental Take Permit. To get the permit, they have to have an approved HCP. Among other things, the HCP describes potential harm to listed species, how it will be avoided and minimized, how it will be mitigated for, and how the HCP applicant will pay for the conservation. In return, the Service gives the applicant "no surprises" assurances. That means the Service will honor the HCP—and not require more conservation—as long as the applicant does likewise. An HCP is one way the Service conserves the nation's imperiled species in light of developmental interests.

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ADAM ZERRENNER/USFWS

FOLLOWING THE PIPING PLOVER

30 years of conservation pays off; energy to recover species still strong | *by* MEAGAN RACEY

A piping plover with its sand-camouflaged eggs.

January 31, 2015: A major winter storm dropped more than two feet of snow in Boston. But 1,200 miles south, wintering piping plovers—and biologists from the East Coast—were enjoying the relative warmth of the Bahamas' Andros Island.

One male plover was receiving some unique bling from a biologist: a pink leg band marked "26." For the first time ever, a group of these palm-sized and sandy-colored shorebirds would head north adorned with a pink band, the color the Pan American Shorebird Program assigned to the Bahamas/Caribbean.

The Bahamas/Caribbean project, a collaboration among the National Audubon Society, Bahamas National Trust, Virginia Tech Shorebird Program, Conserve Wildlife Foundation of New Jersey, the Service and Environment Canada, is helping track plovers during their annual travels and life cycle.

In the spring of 2015, Pink 26 headed north but apparently never attempted to nest. He stopped at Masonboro Island, North Carolina, Edwin B. Forsythe National Wildlife Refuge in New Jersey, and, on his way south, Carolina's Outer Banks. Surveyors found him wintering in Andros during the February 2016 International Plover Census—a census that, for the second time, put much emphasis on the recently discovered significant numbers of plovers wintering in the Caribbean.

This past summer, Pink 26 checked out Massachusetts, pairing with another plover to breed and incubate a nest on Nantasket Beach. Days later, the pair lost their four eggs, with a crow the prime suspect. The pair tried again, as plovers are known to do, laying in another nest farther south at Third Cliff in Scituate. This time, all four eggs hatched, but one by one by one, three of the chicks disappeared. The last, though, survived to fledge.

Biologist Patricia Levasseur of Massachusetts Audubon cheered once Pink 26, his partner and one surviving chick took to the sky for southern shores. There are many challenges for the birds on Third Cliff, she says, noting that while the sand spit beach is remote, it's busy with beachgoers, boaters and dogs.

Throughout New England, plovers continue to lose their sandy beach habitat to development and shoreline management, and they face artificially high numbers of predators and ongoing disturbances that impact their feeding, resting and nesting.

Thirty years ago, the future looked grim for these little shorebirds. The summer of 1986, just after the piping plover was protected under the Endangered Species Act, just 550 breeding pairs headed to South Carolina and farther north to breed along the U.S. Atlantic Coast. Sound like a lot? Estimates suggest that for each pair of plovers, at least 450 pairs of laughing gulls spread across our shores. The plovers searched for space along increasingly popular beaches to lay their sand-camouflaged eggs and safely raise chicks that look like cotton balls on toothpick legs.

Yet significant progress has been made, with the 2016 plover season marking three decades of dedicated conservation efforts. Federal and state agencies and conservation organizations have stepped up to work with beach owners and managers to develop and make plover-friendly beach management practices the norm. Beach managers, landowners, volunteers, staff and others rope off nests, require leashing of dogs, post warning signs and keep activities outside roped-off areas.

Thanks to those partnerships and plover-friendly beachgoers, the U.S. population has tripled, from 550 to almost 1,700 pairs. In Massachusetts, where numbers have soared from 139 in 1986 to 687 pairs as of 2015, the Service and state announced this summer a Habitat Conservation Plan instituting long-term conservation for the shorebird while carefully easing the challenges of managing recreation on beaches with nesting plovers.

"Beaches are always going to be prime destinations for summer recreation, and they will always be homes for piping plovers and other beach wildlife," says the Service's piping plover recovery coordinator Anne Hecht. "Thirty years of work by federal agencies, states, private landowners and local governments have not only yielded impressive progress toward recovery, but they've resulted in stewardship practices that will help ensure a future where beaches can provide much-needed homes for plovers and the many other wildlife that benefit from these actions."

As summer came to a close, biologists like Hecht and Levasseur began looking toward next year, in hopes that Pink 26 and other plovers make their way north for another successful nesting season. With fewer than 1,700 piping plover pairs, each one—and each act of stewardship—makes a difference. □

MEAGAN RACEY, External Affairs, Northeast Region

SHEILA CONNOR

Pink 26 has been wintering in the Bahamas.

BILL BYRNE

A Voice That Pulls at Your Heart Strings

Recollections of Green Schools Expo invigorate coordinator

story and photos by CAROLYN KOLSTAD

"When a child gets to eat a fresh tomato that they've grown, a kid who's never had a tomato, and they bite into it, and they like it. It just makes your heart pound!" Holding her hands close to her chest, as if to contain her heart, a very emotional teacher, Becky Brunger of the Environmental Charter School, describes what it is like to watch students learn and grow in their school garden.

The Service's Schoolyard Habitat Program was founded in an effort to facilitate such outdoor experiences for students. The building and nurturing of a green schoolyard—whether it is a forest, wetland, meadow or garden—is an interdisciplinary learning opportunity for teachers and students alike. Outdoor habitats open a door of possibility for teachers looking to complement classroom lessons in not just math and science but English, social studies, art and music. These spaces afford students an opportunity to become stewards of the land by using hands-on learning to develop an appreciation for their environment and the role they play in keeping it healthy and sustainable.

This spring in Pittsburgh, Pennsylvania, I saw how green schoolyards are having an impact on teaching and learning in our school's classrooms. As an attendee of the 2016 Green Schools Conference and Expo, I participated in several sessions illustrating the impact that ecological literacy and green schoolyards are having on our students, as well as the powerful role partnerships can play in making green, healthy and sustainable schools a reality.

'We are Guests Here'

My first workshop was a field trip to Pittsburgh's Environmental Charter School at Frick Park (ECS), a K-8 urban charter school that uses ecological literacy as a basis for curriculum and student development. The core of this school is strong, built by individuals who harnessed their love of nature and education, and connected them by creating ECS.

We witnessed the creative teaching and learning in the Learning Lab, where teachers integrated different subjects. This day, students were sharing their knowledge about rocks and minerals, which they captured eloquently with photographs and writing.

One of the best parts of this workshop was being able to engage in an outdoor activity with ECS students. Our group was split up and paired with fourth-graders for a fossil tour through Frick Park. This wasn't just any tour; it was a tour that the students had created, using Google Maps, by uploading photos of fossils and writing the scientifically appropriate descriptions of them. Two students, Clemy (short for Clementine) and Abe, explained how the ocean was in that very spot more than 300 million years ago, and how when we arrive at the ancient lakebed, now a stream, we will see for ourselves the fossils left behind. Notably, Clemy reminded us that "we need to respect the animals' homes and be quiet. We are guests here." We explored the ancient ocean fossils for nearly an hour as the students used toothbrushes to brush away debris so we could see them more clearly embedded in the rocks.

(Top) Students and participants make a fossil discovery during a fossil tour through Pittsburgh's Frick Park. (Middle) A student shows off the tools used to clean the rocks off to see the fossils. (Bottom) Clemy shows the Google Maps project identifying the fossils in the park.

Communities as Outdoor Classrooms

"I see, I think, I wonder." These words on a scratch pad of paper given out during the field trip compelled me to attend a session titled "Outdoor Classroom: Connecting Learners and Community through Environmental Science and Service Learning" presented by science and social studies teachers William Koenig and Edward Loiselle of Shakopee High School in Minnesota. Koenig and Loiselle use a co-teaching model to engage their students in environmental science learning experiences. Following the steps of the scientific method, their students examine environmental and sustainability issues through project-based, service-learning activities. Both teachers guide their students throughout the year along their chosen project paths, serving as the conduit for student engagement within the larger community.

"Let the students be leaders, let the students do the work. Sometimes they fail, but most of the time they blow us away! Giving students the responsibility to go out and experience real life situations can be scary, but most of the time it's the most rewarding thing you can see them do. You see the students just grow right in front of you."

Koenig's and Loiselle's passion for teaching, their willingness to take chances and their faith in students have propelled their program from humble beginnings into a model community program. They demonstrated that by working together and making a concerted effort to involve the community, students are able to create more authentic, influential and meaningful projects. Their presentation reminded me that outdoor classrooms do not have to be limited to the school grounds. Our communities can be classrooms, too.

Partnerships Drive Success

The third presentation I attended was called "A Tale of Three States: Different Approaches to Successful Outcomes." At the outset, the audience was asked to provide examples of when the whole is greater than the sum of its parts. After a few silent moments, the presenter provided some examples: "Peanut butter and jelly, Simon and Garfunkel."

He went on to explain the ins and outs of the multi-state, multi-agency partnership his organization has been involved in to create healthy schools that foster learning and energy efficiency. He concluded that we must look to how others in our regions are succeeding and build from there.

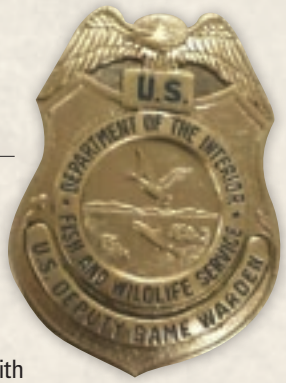
His beginning question about the whole being greater than the sum of its parts came together for me. When we work together, we accomplish more and what we accomplish is better and stronger. How does this relate to green schoolyards? I've always said, "You can't be everything to everyone, but you can be great at what you're good at." The vision of the Service's Schoolyard Habitat Program is that all of the nation's children will have enjoyable and meaningful experiences in the outdoors, that they will understand the value of our fish and wildlife and their habitat, and that they will actively participate in habitat protection, conservation and enhancement. This is our piece of educating the whole child. We teach the voice of stewardship. However, we cannot do our work alone.

Organizations such as the Green Schools National Network help connect us to educators, schools, districts and other outdoor classroom/green schoolyard champions who can benefit from our program, and who have stories and best practices to share and learn from. When our voices join together to become a network of thought leaders, we are providing an example to our students that demonstrates the potential of true, meaningful collaboration. Together, we are empowering students to discover what is important to them and to use their voices to lead the next generation on the journey to transform schools for a sustainable future.

CAROLYN KOLSTAD, Schoolyard Habitat Program Coordinator, Pacific Southwest Region

MUSEUM OBJECTS COME TO LIFE

This is a series of curiosities of the Service's history from the U.S. Fish and Wildlife Service Museum and Archives. As the first and only curator of the museum, Jeanne M. Harold says the history surrounding the objects in the museum gives them life.



Badge Protector

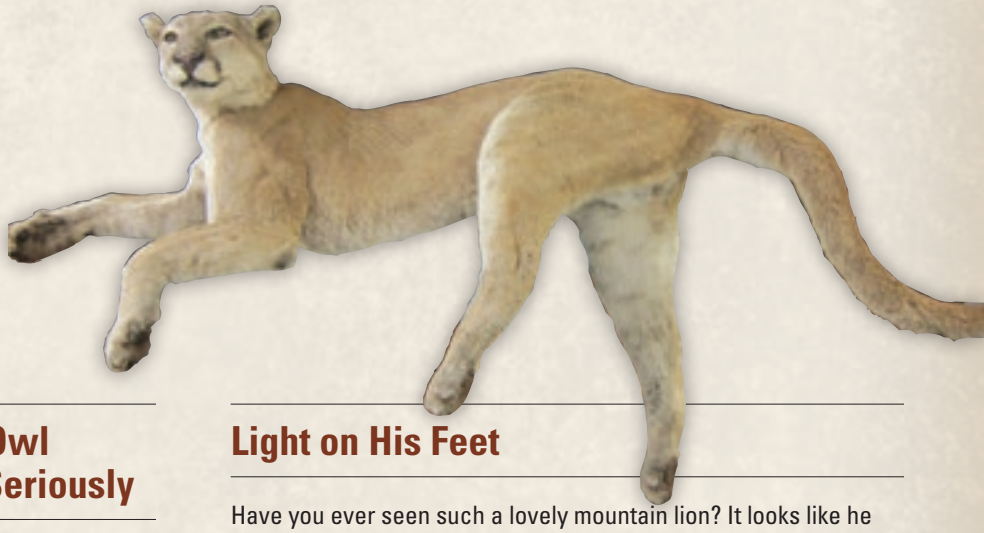
Many years ago I traveled to Miami to speak with Christopher "Kip" Koss, the grandson of the great cartoonist and ex-director of the Service Jay N. "Ding" Darling. Kip generously donated a Deputy Game Warden badge to the museum. Ding had treasured the badge, which was awarded to him by the Service in appreciation of his tenure with us. I was so protective of that badge, that I didn't want it out of my sight for the remainder of the trip. Actually, I couldn't even let it out of my grasp!

Apocalypse Now

We are obsessed with the apocalypse nowadays. All our television shows and movies, it seems, are about zombies, asteroids and invading aliens. I am no exception in my visions and obsession. In our museum, one of our displays about the future of conservation has a population counter. This digital counter goes up by three every second and reflects the current world population, factoring in deaths as well as births. When our electricity goes out, the population counter zeroes out. I have to look up the world population on the Internet and put that current number back in. I am sometimes tempted to just count me, my friends and family and enter that smaller number. Goodbye everyone else—I just officialized the apocalypse!

Spotted Owl Helper! Seriously

We recently received several boxes of books and artifacts from a loyal and thoughtful Service employee that included a box of, can you believe it, Spotted Owl Helper in a macaroni and fleas sauce mix? It turns out that this was a prank perpetrated by folks who were against the decision by the Service to list the owl as a threatened species and save habitat in order to save the species, thus preventing areas from being logged. It states on the box that it was made for laughs, not for consumption. The directions and graphics are quite comical. I wonder if the Hamburger Helper folks ever threatened them with a lawsuit!?



Light on His Feet

Have you ever seen such a lovely mountain lion? It looks like he is floating on air. Well, he is! When an illegally taken animal is confiscated by our law enforcement folks, the mounting that it is perched on does not have to be surrendered. The perpetrator/criminal in this particular case decided to keep the log that this pretty kitty was lying on, just to be mean, our officers said. So I guess people who see him in our storage room might think that he is a new hovercraft species of puma or that he is resting on an invisible branch. In reality, he is just a reflection of resentful law breakers!

transitions

Headquarters

After inauguration next year, Service Director **Dan Ashe** will serve as president and CEO of the Association of Zoos and Aquariums. Ashe was confirmed on June 30, 2011, as the 16th Director of the Service and has been with the Service since 1995. Ashe's father was a career employee with the Service, and much of Ashe's childhood was spent on national wildlife refuges and fish hatcheries in the Southeast, where he learned to band birds, fish, hunt and, most importantly, simply enjoy the outdoors. □

Paul Rauch has been named the Service's new Assistant Director for Wildlife and Sport Fish Restoration (WSFR). Rauch, a career Service employee of more than two decades, has served as WSFR's Acting Assistant Director since April.

In his new capacity, Rauch will oversee grant programs that provide more than $1 billion annually to states, territories and federally recognized Indian tribes to support on-the-ground wildlife and fisheries conservation.

"The Wildlife and Sport Fish Restoration Grant Programs are among our nation's greatest conservation successes, funding thousands of vital wildlife conservation, education and wildlife-associated recreational opportunities for Americans across the nation," said Fish and Wildlife Service Director Dan Ashe in announcing the appointment. "Safeguarding and managing these programs effectively and efficiently is our highest priority, and there is no one more qualified to ensure their continued success than Paul Rauch. Paul has consistently shown the ability to solve complex management challenges and find efficiencies in our business operations, and I'm excited that he's agreed to lead WSFR on a permanent basis."

Rauch replaces Hannibal Bolton, who is now spearheading the agency's diversity recruitment and retention efforts.

He previously served as Assistant Director for Business Management and Operations (BMO) beginning in 2012, and as BMO's Deputy Assistant Director for four years prior to that. In those capacities, he helped the Service significantly improve transparency and accountability of the Service's business operations.

Under his leadership, BMO made great progress in improving and streamlining contracting and acquisition services. He oversaw the successful deployment of the Department's Financial and Business Management System (FBMS), the single largest and most complex Service-wide system deployment ever. FBMS will be a key part of the Service's future business successes.

Rauch also played a pivotal role in the development and implementation of more than 700 American Recovery and Reinvestment Act projects nationwide. This enormously complex initiative was completed on time and on-budget, with unprecedented transparency and financial accountability. Its success is a tribute to Paul and his team across the agency.

Most recently, Paul spearheaded the Service's move to a new Headquarters building in Falls Church, Virginia. The new building has significantly reduced the Service's carbon footprint, fostered greater collaboration among employees and programs, and reduced operating costs – enabling the agency to allocate millions of additional dollars to on-the-ground conservation work.

Before becoming Deputy Assistant Director, Paul served as Chief of the Division of Engineering in Headquarters. He also Served as Regional Engineer and worked in the Water Resources program in the Pacific Northwest Region.

Rauch received a bachelor's degree from Oregon State University and a master's degree from University of Nevada. He and wife Patty reside in Virginia. □

Teresa R. Christopher has been named the Service's Associate Director. She serves as principal adviser to the Director on major policy issues, and represents the Service's priorities within the U.S. Department of the Interior and the broader administration. She will also develop, coordinate and implement a variety of special projects as assigned by the Director.

Christopher came to the Service from the U.S. Department of Commerce, where she has served as Senior Advisor to the Secretary of Commerce for Gulf Restoration since October of 2012. In that role, Christopher spearheaded the establishment of a new federal agency responsible for investment of more than $3 billion in economic and environmental restoration projects. Prior to joining the Commerce Department, Christopher served as Ocean and Coastal Policy Advisor at the White House Council on Environmental Quality (CEQ). At CEQ, she was responsible for advising on U.S. and global ocean and coastal policy and was instrumental in the development of the United States' first National Ocean Policy. Christopher served as Senior Policy Advisor in the Office of the Under Secretary at the National Oceanic and Atmospheric Administration. She has also held positions as a Special Assistant to the Director at the Smithsonian National Museum of Natural History; within NOAA's National Ocean Service managing communication, outreach, and legislative initiatives; and in public diplomacy for the Australian Embassy in Washington, D.C.

Christopher holds a J.D. from the Georgetown University Law Center, and a B.S. in earth and ocean sciences and a B.A. in political science from Duke University. □

Midwest

His smile and signature cowboy hat have greeted countless visitors, volunteers and employees at Midwest hatcheries, but after more than 40 years with the Service, **David Hendrix** is retiring.

A pillar at Neosho National Fish Hatchery in Missouri for the past 26 years of his career, David built and led the Neosho team who to-date are responsible for successfully growing and stocking thousands of pallid sturgeons and Topeka shiners into the waters of the Midwest. Their efforts earned the 2015 Recovery Champions award, one of the Service's highest honors. In addition to his success at rearing iconic fish species, David's warm and welcoming nature gave him the invaluable ability to build and nurture relationships with a wide array of partners both within the Service and externally with state agencies, nongovernmental organizations and academia.

In his career, David worked at nearly all of the Midwest Region's fisheries facilities. He started as a co-op student and worked his way up the ladder, culminating his career as project leader at Neosho National Fish Hatchery. He is known as a champion for the resource and for working tirelessly to educate others about the importance of the work undertaken by the Service in pursuit of our mission.

As a leader, mentor and friend to many, David Hendrix will be missed. Join us in celebrating his career and in wishing him the very best in retirement! □

Pacific

Longtime natural resource professional **Greg Hughes** has been named State Supervisor for the Idaho Fish and Wildlife Office of the Service. Greg succeeds Mike Carrier, who retired from federal service in 2015.

Greg previously was the Regional Chief for Migratory Birds in the Service's Southwest Region. He has been with the Service for 29 years, including positions in Fish and Aquatic Conservation, Ecological Services and within the National Wildlife Refuge System across the country.

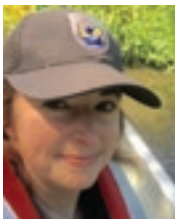
"The Service, our partners and the public will benefit from Greg's proven leadership skills and cooperative approach to conservation," said Robyn Thorson, Pacific Regional Director, in announcing the appointment. "What really stands out about Greg is his experience in partnering and collaboration. He develops partnerships in the early stages of projects."

Based in Boise, his 64-person staff manages complex natural resource issues throughout Idaho. The Idaho Fish and Wildlife Office's core responsibilities include species conservation and recovery, private lands and conservation partnerships, listing and classification of endangered species, federal agency assistance and consultation, and the assessment of contaminants on natural resources.

Greg will provide leadership in all facets of the Service's wildlife conservation responsibilities, including important partnerships with Native American tribes, state agencies, other federal agencies, nongovernmental organizations and landowners.

He received a B.S. in zoology with a minor in fisheries management from Colorado State University. He plans to live in Boise with his wife, Michelle. □

Northeast



After time in Headquarters, where she led the Urban Wildlife Conservation Program with the "Conserving the Future" vision team, **Marcia Pradines** was named project leader at the Chesapeake Marshlands National Wildlife Refuge Complex in Maryland. The refuges that comprise the complex are Blackwater, Eastern Neck, Glenn L. Martin and Susquehanna National Wildlife Refuges.

She previously served in Headquarters' Division of Migratory Bird Management where she oversaw national efforts to partner for bird conservation and was later Deputy Division Chief. She then joined the Refuge System as Division Chief for Visitor Services and Communications. □

Southwest

Dr. Kenneth Ostrand has been selected as the new Director of the San Marcos Aquatic Resources Center in San Marcos, Texas. He brings with him a wealth of knowledge and experience, and he has waded in with both feet in the conservation of imperiled organisms found in Texas that are held at the federal science facility.

Ken is no stranger to the Lone Star State. He grew up in Kingwood, near Houston, where he graduated high school. He earned his academic credentials at three Texas institutions: first, a B.S. in zoology at Texas A&M; an M.A. in biology at Sam Houston State University; and finally a Ph.D. in fisheries science from Texas Technological University where he researched stream-dwelling fishes.

In the 16 years since finishing his doctorate, Ostrand has gained valuable experience in natural resources conservation. He worked five years as a scientist with Illinois Natural History Survey, and followed that with a seven-year stretch

with the Service's Abernathy Fish Technology Center in Washington State where he directed ecological physiology research on trout and salmon. Ken arrived in San Marcos as the Deputy Center Director of the facility in 2011.

"During my 26-year career I have seen a lot of changes in conservation, but no matter what it is called or what method we use, saving species and improving their habitats remain the pinnacle benchmark that defines our success," he says. "I am proud to be a small part of such a hard-working team at San Marcos that is making strides to save so many species from extinction. I am in awe of my team, peers and leadership that continue to fight this tough battle every day."

"It is great to have Ken Ostrand as the Director of the San Marcos Aquatic Resources Center," says Stewart Jacks, the Service's Assistant Regional Director of Fish and Aquatic Conservation in the Southwest Region. "He's a very capable scientist and a proven leader. Ken's skills and talents coupled with his commitment to working with partners, and his vision for conservation will be keys to the continued success of the Service."

The San Marcos Aquatic Resources Center (previously called San Marcos National Fish Hatchery) is one of 70 such facilities found across the United States. San Marcos biologists work with rare and imperiled organisms such as Texas blind salamander, fountain darter, Texas wild-rice and Devils River minnow. The facility was originally established on the grounds of Texas State University in 1897 and opened in its current location in 1974. □

Linda Miller has been named deputy wildlife refuge manager for the Southwest Arizona National Wildlife Refuge Complex, under the direction of Elaine Johnson, the manager of the complex, which includes the Kofa, Imperial, and Cibola National Wildlife Refuges. She will be working closely with refuge staff to administer refuge programs and assist in broad scale conservation efforts.

"This new assignment is a good opportunity for her, our team in Yuma, and for all of us in the Southwest Region as she is a valuable asset," says Dr. Benjamin Tuggle, Southwest Regional Director. "We're very fortunate to have someone of Linda's caliber to fulfill this role. She has been an outstanding conservation leader throughout her career in the Fish and Wildlife Service and I'm confident that she will continue to contribute to our mission."

Linda is a career Service employee who brings a wealth of experience, serving nearly 30 years within the Service's Refuge System. Her areas of expertise include desert ecosystems, conservation issues, planning and policy, threatened and endangered species, land acquisition and easement programs, human dimensions of conservation and stakeholder outreach. She has worked with federal and state agencies and county governments to develop conservation plans for protected wildlife species, issues entailing conservation design and management, and environmental contaminants. □

honors

Service-wide

Deputy Chief of Law Enforcement **Ed Grace** (pictured) and the team of Special Agents behind Operation Crash, an ongoing nationwide criminal investigation led by the Service that focuses on the illegal trade in rhinoceros horn and elephant ivory, have been recognized with the 2016 Service to America People's Choice Award.

The Samuel J. Heyman Service to America Awards recognize exceptional public servants from across the federal government.

Operation Crash—the most successful and meaningful investigation in recent memory—has been a model for cooperative law enforcement, thanks to the relationships the team has developed with the international law enforcement community.

Within the Service, Operation Crash has brought together investigators from multiple regions, as well as the National Forensics Lab in Ashland, Oregon, and Digital Evidence Unit in Jacksonville, Florida. It has involved cooperating law enforcement agencies from 10 separate nations and multiple federal and state agencies here in the United States.

To date, this investigation has led to 41 arrests, 30 convictions, and seizure of rhino horn and elephant ivory with street values exceeding $75 million. In addition to wildlife crimes, the defendants also have been charged with money laundering, tax evasion, falsifying documents, mail fraud and bribery.

These convictions have also drawn international attention to the wildlife trafficking crisis—helping make it a priority for governments across the globe.

Pacific Southwest

On May 12, **Jonathan Snyder** (pictured with IRC's Michael O'Connell), supervisory fish and wildlife biologist at the Carlsbad Fish and Wildlife Office, was recognized by the Irvine Ranch Conservancy (IRC) for his pioneering support and encouragement of the conservancy's approach to landscape-scale mitigation-based habitat restoration.

Jonathan oversees the Service's conservation work in Los Angeles and Orange counties, and Marine Corps Base Camp Pendleton. This area of responsibility includes lands covered by the Orange County Central-Coastal Natural Communities Conservation Plan /Habitat Conservation Plan (NCCP/HCP), one of the first >>

landscape-scale conservation planning efforts in the country.

Approved in 1996, the Central-Coastal NCCP/HCP conserves more than 37,000 acres through a network of protected and managed reserve lands, while providing for economic development in other areas. An additional 13,500 acres of additional wildlands have been donated to the system since 2010 by the Irvine Company.

Among the organizations working to protect and enhance this landscape is the nonprofit IRC. The conservancy was founded in 2005 to encourage shared stewardship of this spectacular landscape and help public landowners with all aspects of land management. The IRC's vision is to achieve long-term sustainability of species and their habitats on these lands by working closely with a wide range of partners and maintaining the highest level of conservation integrity and sound scientific principles.

Working together, Jonathan, the conservancy and other partners including several Orange County public agencies have planned and implemented a restoration initiative based on mitigation funding that includes habitat enhancement to provide for ecologically intact, functioning subwatersheds. Currently, nearly 1,300 acres are in restoration with more planned in the future.

Habitats restored under this initiative include the globally rare coastal sage scrub and California native grasslands, oak woodlands, and riparian corridors that support numerous listed and rare species of wildlife and plants such as the coastal California gnatcatcher, Orange throated whiptail lizard, coastal cactus wren, badger and thread-leaved brodiaea.

"Jonathan exemplifies the spirit and actions of partnership, innovation and excellence that are the hallmark of our work," says Michael O'Connell, executive director of the IRC. "We are thrilled to give him our highest award for partnership."

Mitigation funds from several Orange County public agencies have financed the restoration effort. The restored land will be managed long term by Orange County Parks as part of the NCCP/HCP reserve system.

In 2006, the Department of the Interior designated about 40,000 acres of the reserve lands as a National Natural Landmark, and in 2008 the State of California designated the same lands as the first California Natural Landmark. □

Southeast

Outstanding work by Service biologists **Pete Tuttle** and **Colette Charbonneau**, who lead Deepwater Horizon (DWH) oil spill injury assessment and restoration efforts, was recognized by the Department of the Interior at the 2016 National Office of Restoration and Damage Assessment (ORDA) Conference in May in Phoenix.

The **2016 NRDAR Program Award for Damage Assessment** went to Pete, assistant manager of the DWH Natural Resources Damage Assessment and Restoration (NRDAR) Field Office in Fairhope, Alabama. He began his career with the Service in in Nevada in 1984 as a research biologist, but for the past six years, his work has been dedicated to assessing the injury suffered by fish and wildlife and their habitat caused by the 2010 oil spill.

Pete was recognized for his role in leading the Service's injury assessment and managing a complex and multifaceted plan for analyzing injury to the hundreds of bird species that rely on the Gulf of Mexico ecosystem for all or part of their lives. This work supported the 2016 settlement with BP, which included $501 million in damages for injury to bird species. Pete led development of effective damage assessment protocols and a comprehensive injury assessment strategy that included more than 50 data collection and analysis plans. He also managed the development of several models—exposure models for beach, marsh and open water bird habitat, a model for delayed mortality of birds exposed to oil, and one for the likely survival of oiled and rehabbed birds.

Colette, the Department's DWH NRDAR program manager, took home the **2016 NRDAR Program Award for Restoration.** She started working for the Service as a co-op student while at the University of Missouri. Since 2011, her career has been dedicated to restoring the Gulf of Mexico.

As she was joining the Department's Deepwater Horizon team, BP was making $1 billion available for extensive "early restoration"—restoration that could begin before the injury assessment was completed. The "early restoration" efforts proceeded at an unprecedented rate until the 2016 settlement with BP. During that time, Colette played a pivotal role in development of 65 projects proposals, five restoration plans and all of the required NEPA analysis. She not only represented the Department and the Service in development of the plans but also managed the restoration plan development process for the entire Trustee Council. The projects, with a combined cost of $866 million, will enhance barrier islands, dunes, coastal marshes, sea grass beds and recreational uses of natural resources, and will benefit oysters, sea turtles, birds, fish and other wildlife. □

Northeast

Dr. Richard Bennett, regional scientist for the Northeast Region, has been named the 2016 GreenGov Presidential Awards Climate Champion for his leadership in Hurricane Sandy recovery. Following the devastation left by the storm in 2012, Dr. Bennett led the Department of the Interior response team, overseeing $167 million in funding for Service projects to help revitalize the Northeast and to protect it from future storms and sea-level rise. He worked to launch more than 100 sustainability-focused projects, and led a team that developed performance metrics for climate resilience that are changing the way the federal government prepares for severe weather events.

"This is a prestigious and well-deserved honor, and an illustration of the leadership and science excellence demonstrated by Dr. Bennett," says Service Director Dan Ashe. "Under Dr. Bennett's leadership, we are working with partners in communities all across the Atlantic Coast to create more resilience ecosystems that provide long-term benefits for people and for wildlife. By ensuring the rigorous application of science in our resilience investments, and developing smart metrics for those investments, Dr. Bennett is leaving a legacy that will help future generations deal more effectively with complex natural resource management challenges."

Dr. Bennett began working for the Service as Chief of the contaminants program at the Annapolis, Maryland, field office in 1989. He then worked for the Washington, DC, in fish and wildlife management assistance until he was selected as the Deputy Assistant Regional Director for fisheries in the Northeast Region. He subsequently served as one of two geographic Assistant Regional Directors, working closely with all Service programs in six states, and then as the Assistant Regional Director for migratory birds and state programs. He then was named regional scientist.

As regional scientist, he guides the region's efforts on topics such as Strategic Habitat Conservation, climate change, national efforts on amphibian and reptile conservation, ocean science initiatives, and science coordination across programs and agencies. □

in memoriam

Charles "Chuck" Peck died May 22 in Hot Sulphur Springs, Colorado, at the age of 78. He was born in Lemmon, South Dakota, in March 1938 and spent most of his boyhood in Nebraska. He was a 1956 graduate of Fairfied, Nebraska, High School. He continued his education at the University of Nebraska and the University of Idaho, where he graduated in 1960 with a degree in wildlife biology.

After graduation at Idaho, he served three years in the Army, then took his first job with the Fish and Wildlife Service as a member of a range survey crew working at Malheur National Wildlife Refuge (NWR) in Oregon conducting grazing surveys. His next assignment was at Charles M. Russell NWR in Montana. From Montana he transferred to J. Clark Salyer NWR in Upham North Dakota, where he served as assistant project leader.

In 1974, Chuck took the position as project leader at Des Lacs NWR in Kenmare, North Dakota, where he served for four years. In 1978, the Service consolidated management of refuges, and Chuck was assigned to the newly created Southeast Idaho Complex in Pocatello, which was formed by combining Grays Lake, Minidoka, Camas and Bear Lake Refuges and adding Oxford Slough Waterfowl Production Area. He served as project leader until his retirement in 1994.

Chuck was a much revered and respected supervisor. He was well-known for his quick wit and dry sense of humor as well as his very professional work. He loved the outdoors, especially fishing, hunting and camping. But the real loves of his life were his daughters.

He is survived by three daughters, Wendy Farjami (Mehdi), and Heather and Holly Peck; sister Patricia Agnew; and three nieces. He was preceded in death by wife Mary. □

Chris Lucash, senior biologist with the Red Wolf Recovery Program, died June 4. Just one year earlier, he was diagnosed with Amyotrophic Lateral Sclerosis (ALS; also known as Lou Gehrig's disease). Fifty-four years young, he is gone too soon due to this debilitating disease.

Born in Illinois, Chris was always an avid outdoorsman and grew up with a deep connection with nature. Farmer, gardener, hunter, beekeeper, philosopher, wanderer and earth advocate, he was simultaneously the student and teacher. A constant tinkerer, he would salvage the smallest piece of scrap to create, refurbish or just simply save for some yet-to-be-determined project.

Chris started with the Service nearly 30 years ago first working at Alligator River National Wildlife Refuge in North Carolina and dedicated his career to the conservation and recovery of red wolves. He arrived in sync with the wolves in 1986 and was on the ground when reintroduction efforts began. He then led efforts to establish a second restoration site in the Great Smoky Mountains in the mid-1990s, where he met his wife, Alisa. When the project ended in Tennessee, he returned to North Carolina as a senior biologist with the Red Wolf Recovery Program. >>

KATHERINE TAYLOR/USFWS

Gone Fishing

The Steve Harvey National Mentoring Camp for Young Men brought more than 200 fatherless young men (ages 13 to 17), many from inner-city areas, to Camp Grace in Georgia in early June. The camp helps the teens envision a bright future by introducing them to leaders in various careers and new experiences. The Service and the Georgia Department of Natural Resources (GADNR) introduced many to fishing, archery, aquatic ecology and careers in conservation.

In many ways, Chris was like a red wolf himself—rare, fiercely loyal, inspiring, resilient, wild and completely unique. Deeply dedicated, compassionate, and stubborn as hell, he was their (and our) persistent advocate. Our community has benefited much from his navigation of field techniques, challenges and partnerships. His legacy will continue to impact many through *Staring Down Fate*, a documentary film about his life and battle with ALS being developed by his friend and colleague, Jeff Mittelstadt of WildSides.

We will miss the mischievous sparkle in his eyes, his explosive smile, his wit, his soulful musings, and his endless passion. While his pack and all the wild ones grieve his absence, we are better for bearing witness to his light and are grateful he is now running free. □

BECKY HARRISON, Supervisory Wildlife Biologist, Alligator River & Pea Island National Wildlife Refuges

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Volunteer Bob Ebeling, Bear River Migratory Bird Refuge Healed Together

The long, winding road to Promontory is a linear time machine. A solitary window in the simmering Utah desert into the nation's technological prowess, and hubris, of the last 150 years.

At one end lies the Golden Spike, Abraham Lincoln's daring experiment in transcontinental nation-building. Launched in 1863, amid civil war, it melded two halves of a fractured country together by railroad. The audacious "moon shot" of its era.

At the other looms the futuristic testing site of Morton-Thiokol, a conglomerate that began as a shipper of salt down the Erie Canal and evolved into the building of engines and rocket components that wo1uld one day propel man into space. The real moon shots of today.

This lonely back road is book-ended by a national historic site, a lightly visited and seemingly forlorn collection of rail ties and antique steam engines; on the other by a head-turning missile garden, where visitors wander through an overpowering outdoor forest of rockets and boosters in a surreal vestige of Cold War-era omnipotence.

This same Promontory Road led Bob Ebeling to the doorstep of a national wildlife refuge, in perhaps the Fish and Wildlife Service's least-known, yet most poignant, tale of a wandering soul in the wilderness.

Bob Ebeling is the "second-chance" story of a successful failure—a man who couldn't budge one bureaucracy...but who profoundly moved and altered another.

"I still remember the minute I met him," recalls retired Bear River Migratory Bird Refuge manager Al Trout (possessor of perhaps the Fish and Wildlife Service's most eponymous of last names). It was years after the refuge flood of 1983, when the Great Salt Lake slipped its borders and inundated the region to biblical proportions.

A four-to-five foot wall of water swept away most of the refuge's dikes, roads and boundaries, killing the bulrush with its desert brine.

Trout assumed Bear River's management in 1989 with a borrowed desk, no staff, no telephone, no computer, no money and no windows in a cubbyhole office in a dumpy shopping mall. Some suggested the Fish and Wildlife Service walk away, dropping the sodden and salt-choked refuge on the state.

"A loud knock on the door came as I was commiserating with a county commissioner. 'My name's Bob Ebeling and I want a job!' This guy didn't realize our financial constraints. He was so hyped-up and totally out-to-lunch. Was he on drugs?"

"No, no, I want to volunteer. I want to give you two years of my life!" Ebeling pleaded.

"I couldn't figure out a way to tell him no, and that night my wife, Kathy, asked, 'What have you got to lose?'"

He started that Monday. Ebeling's truck became the refuge truck. Ebeling's tools became the refuge tools. "A complete, over-energetic, hyper guy, short and slightly-built, a firecracker," remembers Trout. "So full of enthusiasm. I realized then that there's a lot more to this guy than I first thought."

An understatement — this initial assessment by Trout — of his new recruit.

For before pounding on Trout's office door, Ebeling had been a high-powered engineer and project manager, first for the California maker of the Atlas rockets used in NASA's Project Mercury, America's first entry into space in the heady days of the New Frontier. In 1962, he joined Morton-Thiokol, maker of engine boosters and components for the future space shuttle, where he developed the new orbiter's sophisticated ignition systems.

It was at Morton-Thiokol where Ebeling confronted a dark and increasingly troubling reality, pegged to a component as basic and uncomplicated as a rubber O-ring: These simple joint-sealing rings didn't always function properly in cold weather, potentially leading to catastrophic failure.

Ebeling and other engineers desperately warned a largely unhearing and increasingly "go-go" corporate and NASA bureaucracy that the upcoming launch of the space shuttle Challenger was threatened and should be scrubbed, to await warmer weather.

On launch day—January 28, 1986—a more and more agitated and distraught Ebeling watched with a daughter as the countdown at the Kennedy Space Center in Florida commenced. "He said, 'The Challenger's going to blow up. Everyone's going to die,' " the daughter told NPR.

That premonition would haunt Bob Ebeling for the rest of his life, consuming him with guilt, and later landing him on the doorstep of a failed and fractured wildlife refuge,

Al Trout and Bob Ebeling repair a water structure.

perhaps in some subliminal effort to create solace in his life.

"He was beating his fist on the dashboard. He was frantic," the day of the disaster, the daughter continued "I could feel [him] trembling. And then he wept — loudly."

For the Challenger did explode—for the very reason Ebeling and his colleagues predicted —claiming the lives of seven astronauts in what was perhaps the greatest body-blow to America's national psyche in the four decades between the assassination of President Kennedy and the conflagration of 9/11.

In a later interview, Ebeling mused that maybe he should have taken a gun to work that morning and held hostages in some crazed attempt to provoke public attention to his warnings.

"I've been under terrible stress since the accident," he once confessed to the *Houston Chronicle*. "I have headaches. I cry. I have bad dreams. I go into a hypnotic trance almost daily."

Bob Ebeling prepares bulrush seeds for reseeding the marsh.

So this, too, was the Bob Ebeling who appeared at Al Trout's office door, having endured the trauma of national calamity and abandoned his career, looking for some renewed purpose on earth.

An avid duck hunter who had tramped the refuge and memorized this saturated and bird-rich corner of Utah, Ebeling threw himself at his new mission. He negotiated grading and dike rebuilding with a local contractor, using money he had wrangled from Ducks Unlimited. He demanded wood —delivered free—from a local lumber company...and got it. He named himself as first member of the "Friends of the Refuge" and progressively recruited 50 volunteers, working two shifts, day and night.

"I'm blown away. It was hard to process so much stuff going on. I was convinced early on that I had a man like no other. I had a racehorse. He'd worked on the military and corporate sides and knew how to get things done.

"This man drank rocket fuel for breakfast. The stars had lined up, telling me that God loves Bear River Refuge."

Ebeling volunteered for 22 years. Together, he and the refuge healed.

In 1990, President George H.W. Bush gave Ebeling the Theodore Roosevelt Conservation Award. In 2013, he was named "national volunteer of the year," the Refuge System's highest civilian honor.

"We owe Bob a debt of gratitude for which we can never repay. The refuge is here for future generations," says Bob Barrett, Bear River's current manager.

Last March, shortly after the occupation of Malheur National Wildlife Refuge in neighboring Oregon had ended, Bob Ebeling died quietly at his home in Brigham City, Utah, at age 89.

His funeral at a local mortuary was a small and modest affair, says Trout, even while his death was being reported by the *New York Times*, the *Washington Post*, national television networks, and media outlets around the world. There's now talk of a simple little overlook on the refuge in his memory.

People show up at the doors of national wildlife refuges for a variety of reasons. Some are restless, armed men who travel down lonely backroads in the dark, intending to steal the public trust.

Others, like Bob Ebeling—equally restless, and tormented by inner demons—travel identically lonely paths, but to different ends, seeking to heal. Their journey, they find, ends in redemption. □

This is the latest in a series of short features about little-known aspects of the U.S. Fish and Wildlife Service by David Klinger, a retired employee living in Boise, Idaho.

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parting shot

Stomp the Garden
Students from Orchard Lake Elementary School in Lakeville, Minnesota, learned about the decline of pollinators and decided to do something about it—plant a pollinator garden with some help from the Service. Here, they use the old-fashioned method of planting—stomping the seeds into the ground.

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