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SPECIAL FOCUS + WATER CONSERVATION

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THE

WILDLIFE

PROFESSIONAL

RUGGED VULNERABILITY

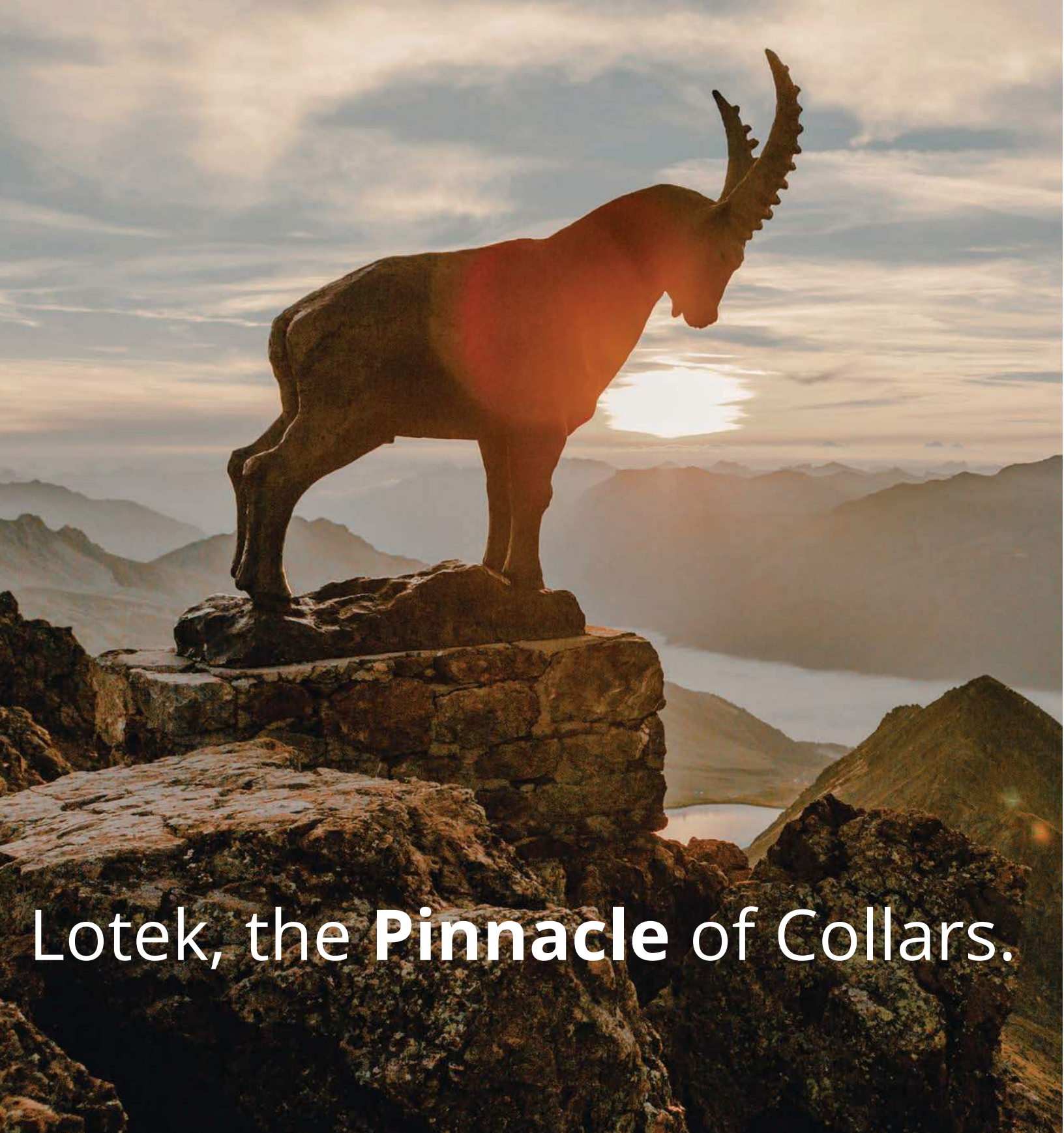
Changes in the desert
challenge hardy species

Inclusion Through Accommodation

Educating Ecotourists




A Striking Career

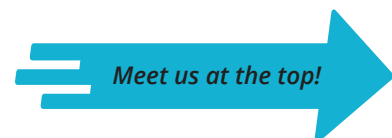




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ABOUT

The Wildlife Society, founded in 1937, is an international nonprofit scientific and educational association dedicated to excellence in wildlife stewardship through science and education. Our mission is to inspire, empower and enable wildlife professionals to sustain wildlife populations and their habitat through science-based management and conservation. We encourage professional growth through certification, peer-reviewed publications, conferences and working groups. For more information, visit us at www.wildlife.org.

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A mule deer among Saguaro cacti in the Mojave Desert.

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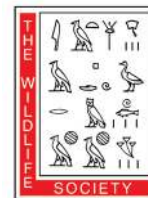
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The Wildlife Society

Headquarters

425 Barlow Place, Suite 200
Bethesda, MD 20814-2144
301.897.9770 phone
tws@wildlife.org
www.wildlife.org

Mailing Address

25 Century Blvd., Suite 505
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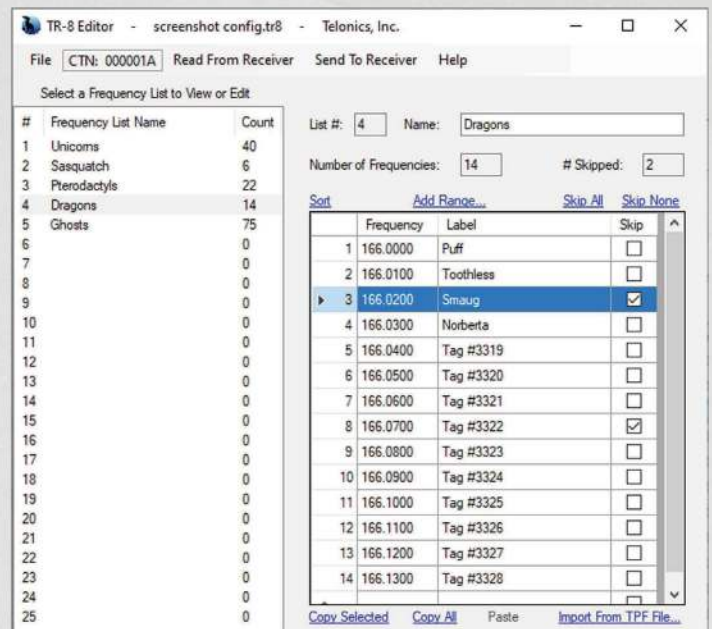
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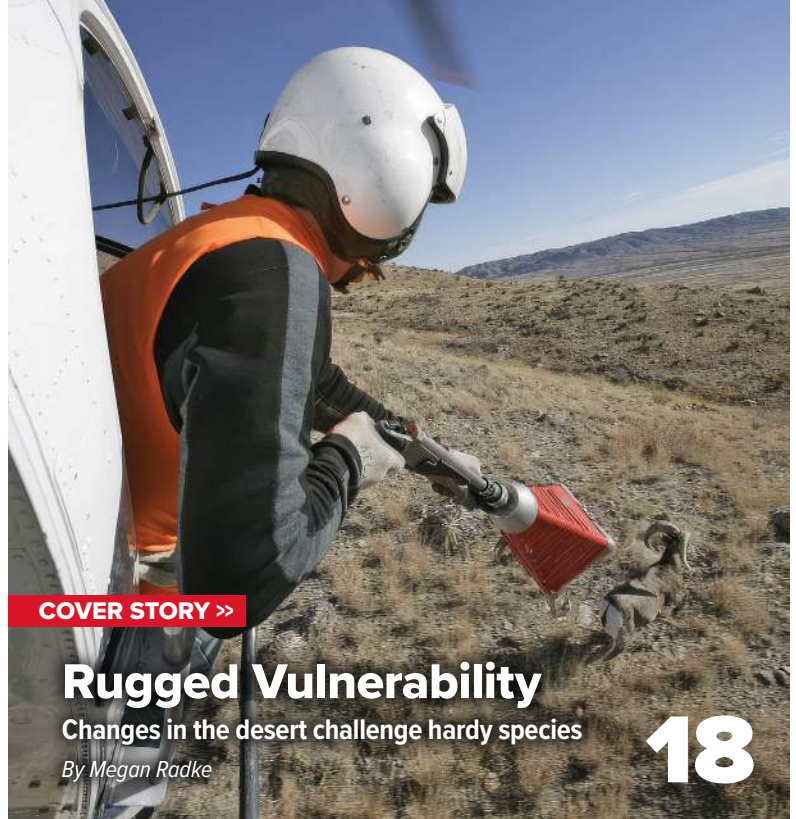
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COVER STORY >>

Rugged Vulnerability

Changes in the desert challenge hardy species

By Megan Radke

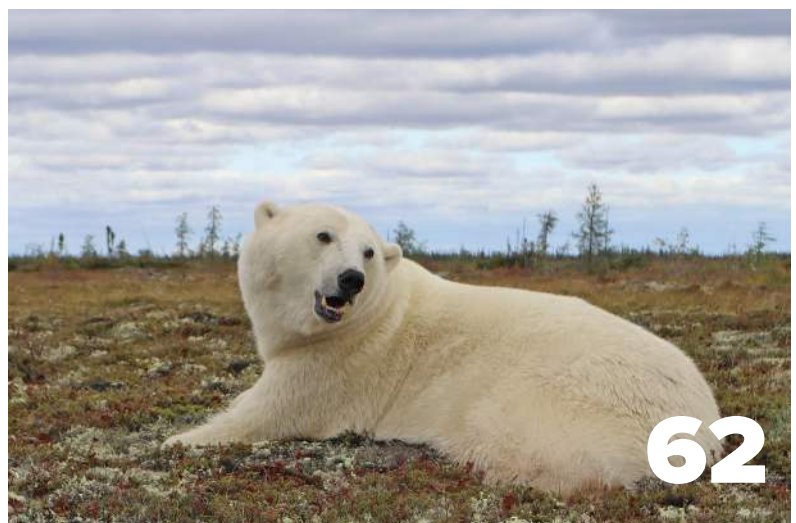
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Credit: Earl Nottingham, Texas Parks and Wildlife Department



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Credit: South Florida Water Management District



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Credit: Tyler Ross

Into the Desert

For our first issue of *The Wildlife Professional* for 2025, I want to bring you deep into the desert. It's not as barren there as you might imagine. I, myself, have ridden camelback through the sands of the Negev—one of the most famous deserts in the world due to its Biblical ties—and couldn't imagine another living thing being anywhere in sight. That is, until I lifted my sleeping bag to straighten it out during one cold night and a scorpion scurried out. That ended up not being the only wildlife close by. Looking up, griffon vultures fly through the sky. In the mountains, Nubian ibex sport their long, curved horns. But while those species are specialized to this area, they're a bit harder to detect.

You may have had similar thoughts about the “desertedness” of deserts closer to home. The Great Basin, Mohave, Chihuahuan and Sonoran deserts are home to a number of species that specialize in these areas. And it's not all barren land, either.

This issue's cover feature takes us through desert ecosystems in the U.S., from the desert mountains where bighorn sheep roam to the Bosque del Apache at the edge of the Chihuahuan Desert, which includes native riparian forests and meadows that host a number of bird species. But while species in these ecosystems are well adapted to the extreme arid and warm climates associated with deserts, climate change exaggerates these extremes even more. This isn't the only challenge. Desert wildlife are also facing urbanization, invasive species and disease.

While water in U.S. western deserts may be hard to come by, there are other areas throughout the country—and in other countries—where water conservation continues to be a challenge. Our special focus for this issue of *The Wildlife Professional* highlights water conservation and conservation of wildlife associated with water. Articles in this section focus on how scientists and partners are putting biodiversity back on the edges of farm fields through water conservation, how to balance the water needs of people and wildlife in the Florida Everglades, how scientists are rehabilitating Swedish rivers and riparian areas toward a more natural state, and more.

I hope this first issue of the year gives you some insight into the inner workings of ecosystems that you may not have known much about before.

As always, your feedback and input on *The Wildlife Professional* are welcome and encouraged. ■



Dana Kobilinsky
She | Her | Hers
Managing Editor
The Wildlife Society
dkobilinsky@wildlife.org

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TWS: The Next Generation

Every morning when I look in the mirror, I face a stark reality—I'm getting old! I hate it, but I am not alone. Baby boomers are moving on, and we all need to think about how to adapt TWS to attract, serve and retain millennials and the next generations (Gens X, Y and Z) in the coming decades. Younger generations bring fresh perspectives and innovative ideas but have distinct values and expectations that TWS must recognize and address.

To attract younger generations, it's essential that The Wildlife Society create a sense of belonging and community. Younger TWS members—and potential TWS members—are likely looking for a place to connect with peers, share experiences, and collaborate on their professional and educational endeavors. TWS is well positioned to facilitate these needs through networking events, conferences, workshops and informal gatherings that encourage relationship building. In addition, by participating in smaller subgroups, such as student chapters and working groups, younger members can develop personalized connections that make it easier to meaningfully engage with one another. But the challenge is ensuring that all TWS subunits welcome and appeal to millennials and the next generations by personally inviting them to get involved.

TWS can also nurture a sense of community through its digital platforms, which not only have the potential to enhance interactions but can also keep members informed about TWS activities and opportunities. TWS must continue to update its website, mobile applications and newsletters to provide user-friendly, easy access to resources, events and networking opportunities. TWS has recently hired a social media director, Katie Perkins, who has used TWS social media channels to foster discussions, share insights and highlight member achievements. These engagement efforts must continue, but there's also room for more. Podcasts and video content that resonate with younger audiences can keep members informed and involved. Scheduling virtual events can broaden participation by allowing members from various geographical areas to engage without the constraints of travel.

A major draw for millennials and the next generations is an emphasis on professional

development. Like boomers, these generations prioritize skill enhancement and continuous learning, so TWS must continue to offer robust programs that can meet their needs. Again, TWS is well positioned to meet these needs through efforts such as our certification program. However, we need to ensure that our certification program aligns with new college curricula and degree requirements. By aligning educational opportunities with the career aspirations of younger members, TWS can demonstrate its commitment to personal and professional growth, making membership more appealing. Workshops, webinars and mentorship programs that focus on emerging trends, leadership skills and industry-specific knowledge can significantly enhance the value of TWS membership for younger members.

Inclusion is also fundamental to attracting and retaining younger generations. Millennials and the next generations prioritize diversity and social responsibility, expecting professional organizations to reflect these values. TWS must continue to actively promote inclusion by creating initiatives and developing programs that support underrepresented groups and diversity within our profession. We need to reach out and look for opportunities to engage in social impact initiatives, such as collaboration on community service projects, that resonate with younger members who value organizations that contribute positively to society as a whole. We must continue to cultivate an environment where all voices are heard.

You may have noticed that these suggestions align with the new TWS strategic plan, especially the themes of building community and supporting professionals. As we implement the plan this year, we need to consider how we will meet the needs of younger generations in TWS. I welcome suggestions from millennials and the next generations on how to do so. At the same time, I encourage millennials and Gens X, Y and Z members to reach out to boomers to learn from their experiences and wisdom before they are gone. This way, we can build on the past, learn from our mistakes and ensure TWS continues to empower future wildlife professionals to advance conservation through science, community and professional excellence. ■



Art Rodgers, PhD, is a research scientist for the Ontario Ministry of Natural Resources, a TWS Fellow and current president of The Wildlife Society. He previously served two terms on Council, as president of the Canadian Section, charter past president of the Ontario Chapter and associate editor of WSB.

Recent papers from wildlife conservation and management journals

Citizen science uncovers healthy ferruginous hawk population

Ferruginous hawk populations in California are healthier than researchers expected.

As grasslands in California's Central Valley are declining due to factors like conversion to vineyards, researchers expected ferruginous hawks (*Buteo regalis*) that depend on the ecosystem to be similarly impacted. But in a [study](#) published in *The Journal of Raptor Research*, the team used 25 years' worth of Audubon's Christmas Bird Count data that proved otherwise.

"Although most grassland birds are in decline, this species seems to be doing well in California," said study co-author Edward Pandolfino.

Their stable population could be related to a preference for larger prey, such as black-tailed jackrabbits (*Lepus californicus*), compared to other raptors in the area. The jackrabbits often live in ecosystems intertwined with agriculture or cattle.

"In California, nearly all ferruginous hawks use active cattle ranches," he said. "If you don't graze these habitats, they become overgrown, leaving some raptors unable to find prey."

▼ **Data show Central California's ferruginous hawk populations are doing well.**



Credit: Ed Harper



Credit: froglover_84

▲ **A cougar spotted in southwestern Saskatchewan.**

Open-source data reveals cougar range in Canada

Citizens science observations have helped researchers uncover cougar distribution in Canada.

Cougars had been extirpated from areas in the eastern part of the country, like Ontario, by the 1940s. "There was definitely a possibility that they could expand eastward back into their historic ranges," said Jennifer Christoff, who was a master's student at the University of Edinburgh at the time she conducted the [study](#), published recently in *Ecology and Evolution*.

Using information gathered by the Global Biodiversity Information Facility, a website that collects species data from citizen science apps such as iNaturalist and eBird, as well as from studies using trail cameras and GPS data, Christoff and her co-author compiled an overall picture of where cougars (*Puma concolor*) have been spotted in the last few decades.

The eastern edge of the species' current range is in Saskatchewan. Citizen scientists reported a few individuals in Manitoba, but Christoff said they are unlikely part of a breeding population. Additional sightings in Ontario—mostly in the 1990s—may have been of animals that escaped from captivity when there were roadside zoos that held species like cougars.

Christoff also estimated suitable habitat in the east to facilitate their recolonization. Protected areas in Manitoba and Ontario are small, but "the possibility is there because cougars are very adaptable," she said.

Iowa harvest data show river otter habitat

Iowa river otter populations are thriving in the state's wetlands, streams and small waterways.

In the [study](#), published in *The Wildlife Society Bulletin*, researchers used data collected from trappers from 2006 to 2016 to determine conditions the state's river otters prefer. They found that the otters mostly used biodiverse wetlands and streams and steered clear of forested areas, large river corridors and waterways with catfish.

North American river otter (*Lontra canadensis*) populations declined in the early 20th century due to overharvesting, water pollution and habitat loss. But following reintroduction efforts by the Iowa Department of Natural Resources in the 1980s, the species now occupies waterways in every county in the state.

"We don't want to get back in a situation where we have a declining population," said Bridget "Bridie" Nixon, a co-author on the study and laboratory assistant at Drake University. "Using this data really showed us how otters in the state might be doing and where they might be thriving."

▼ **North American river otters appear to be thriving in Iowa.**



Credit: Neal Herbert/NPS

Icebreaker ships may disturb narwhals

Icebreaker ships in parts of Nunavut, Canada, are likely getting too close to narwhals.

Underwater noise produced by ships built to break up sea ice interferes with narwhals' echolocation, which they use for foraging, communication and navigation. The breakup of the ice in the fall can also disrupt narwhals, whose winter migration timing depends on the reformation of the sea ice.

"It's a good reminder of how all these vessels together contribute to noise pollution in that small environment that's important to narwhals," said Alexandra Mayette, a research scientist with the Canadian Wildlife Federation.



Credit: Calvin Kigutikakjuk

▲ **Icebreaker ships may disturb narwhals in the Canadian Arctic.**

In a [study](#) published recently in the *Journal of Wildlife Management*, Mayette, contracted by Fisheries and Oceans Canada at the time, and her colleagues examined GPS tag data attached to narwhals (*Monodon monoceros*) in Tasiujaq, formerly known as Eclipse Sound, between Baffin and Bylot Island. They compared narwhal location data with that of icebreaker ships that transited through the area between 2016 and 2018.

The ships often passed close to narwhals, they found, closer than the 50-kilometer buffer zone that researchers have determined is a safe distance.

Some icebreakers took repeated routes back and forth. That's a problem for narwhals, which have site fidelity to this small region for calving or foraging in the summer and may not be able to avoid these constant threats to their habitat.



Credit: Guillermo Carmona Castresana

▲ A juvenile polecat in Valladolid, Spain.

European polecat genes

DNA analysis on roadkill has revealed that a rare mustelid found in Spain could be divided into four distinct groups—one with very low genetic diversity.

“The population with very low genetic diversity must be a priority for conservation,” said Jose Horreo, a geneticist at the Complutense University of Madrid.

Scientists don’t know much about the population status of European polecats (*Mustela putorius*) despite the species being widespread in Europe. But “the number of reports suggesting population declines in several regions—including some Spanish and Portuguese—are speeding up,” Horreo said.

Horreo and his colleagues published a [study](#) recently in the *Journal of Wildlife Management* tapping into a network of more than 80 volunteers that monitored roadkill in Spain.

DNA analysis of samples taken from roadkill revealed that the polecats of Spain could be divided into four distinct genetic groups. They also found a significant amount of inbreeding in the southern and northern populations.

Horreo said this information will be important for considering future conservation actions to protect polecats in Iberia and the rest of Spain.

Snake deterrents ineffective at protecting wood duck eggs

Some commercial snake repellent pellets don’t deter rat snakes from wood duck nest boxes.

In a recent [study](#) published in *The Wildlife Society Bulletin*, researchers found that eastern rat snakes (*Pantherophis alleghaniensis*) and woodpeckers (*Picidae* spp.) were the primary predators of wood duck (*Aix sponsa*) eggs in North and South Carolina.

Even when using snake repellent pellets in nest boxes with predator guards installed underneath, rat snakes still consumed almost 650 eggs during the three-year study.

“The snakes seemed to be pretty localized and wouldn’t travel too far from the boxes, knowing they had a chance to find eggs,” said Emily Miller, study co-author and PhD student at the State University of New York.



Courtesy Emily Miller

▲ Researchers found raptor decoys effectively deterred woodpeckers from wood duck nest boxes.

Researchers also placed plastic raptor decoys atop nest boxes when female wood ducks were incubating eggs, which proved to be an effective woodpecker deterrent.

Miller suggests wildlife managers routinely check nest boxes for any evidence of predation, even if they’re using predator deterrents, to give nesting sites the greatest opportunity for success. ■

Contributed by Dana Kobilinsky,
Joshua Rapp Learn and
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CANADA

Nova Scotia Land Trust protects 317 hectares of coastal habitat

The Nova Scotia Land Trust has purchased an entire island to add to protected land along the adjacent Blanche Peninsula. The Cape Negro Island sits just off the southern end of the province and represents some of the last undeveloped coastline there. “Recognized in the scientific community as one of the most important coastal peninsulas in the province for bird conservation and recovery, it supports crucial stopover sites for migratory birds and habitat for overwintering and nesting birds, including landbirds, shorebirds, waterfowl and raptors, continental migrants and species at risk,” the Land Trust said in a press release. In preliminary research, scientists have identified some 174 species of birds in the area, as well as rare and endangered lichens. Together with previously acquired land, about 717 hectares will now be protected in the Blanche Peninsula area.



Credit: byliner

▲ A burrowing owl (*Athene cunicularia*), rarely found so far north, is among the species that have been seen in the Blanche Peninsula area.



Credit: MacNeil Lyons/NPS

▲ Gray wolves will be sourced from British Columbia for Colorado's reintroduction efforts.

CENTRAL MOUNTAINS & PLAINS

Colorado to source wolves from British Columbia

Colorado Parks and Wildlife will source wolves from British Columbia for a second year of reintroductions. In an agreement with the B.C. Ministry of Water, Lands and Resource Stewardship, managers will capture and translocate gray wolves (*Canis lupus*) from the Canadian province between December 2024 and March 2025. “We learned a great deal from last year’s successful capture and transport efforts and will apply those lessons this year as we work to establish a self-sustaining wolf population in Colorado,” said CPW wolf conservation program manager Eric Odell in a press release. Before reintroduction, CPW biologists will test and treat captured wolves for disease and will also collar them to learn more about their behavior and health following release. As outlined in the Colorado Wolf Restoration and Management Plan, CPW will release 10-15 wolves on the state’s West Slope

for the next three to five years. None of the wolves will come from packs that have been involved in repeated livestock depredations.

WEST

California signs new beaver law

California has enacted a new law to promote beaver restoration in the state. The California State Assembly and Senate



Credit: Eric Sonstroem

▲ A beaver on the Calaveras River in Stockton, California.

voted unanimously to pass the rule, which the governor signed into law in September. Beavers are “one of the most cost-efficient, sustainable solutions for ecological restoration and climate change resilience,” due to their work as ecosystem engineers, the legislation states. “Beaver-created dams, ponds and associated wetlands help mitigate and adapt to the impacts of climate change, drought and wildfire by enhancing carbon sequestration, increasing water storage, maintaining stream flows, providing flood and erosion control, and establishing riparian corridors that serve as critical fire refugia.” In practice, the new law will create a new section in the California Department of Fish and Wildlife to advise on policies, set guidelines, coordinate beaver restoration and develop methods to deal with human-beaver conflict.

NORTHEAST

Maine bans lead fishing gear to help loons

Maine has expanded its ban on lead fishing gear in an effort to help conserve loons in the state. The new rule prohibits



Credit: Paul VanDerWerf

◀ Lead fishing tackle can kill common loons like this one near Georgetown, Maine.

lead sinkers and unpainted jigs less than 2.5 inches long or weighing less than 1 ounce in inland waters. Common loons (*Gavia immer*) sometimes ingest small lead sinkers and jigs. They get stuck in the birds’ gizzards and slowly leech lead into their bodies, eventually killing them. The Maine Department of Inland Fisheries and Wildlife estimates that lead fishing tackle is one of the leading causes of death for loons, responsible for 12.2% of deaths. “Adult loons catch fish with lead sinkers

and jigs attached, or they pick up lead objects while eating gravel that they need to aid in digestion from lake bottoms,” said Laura Williams, a wildlife biologist with Maine Audubon, in a press release. The ban officially takes effect in September 2026, giving people who fish a chance to switch the tackle in their boxes. The agency has partnered with Maine Audubon to help anglers switch to nonlead options. The nonprofit is also working with stores to buy their lead inventory.



Credit: Grayson Smith/USFWS

▲ A proposed rule would establish a trapping season in 40 counties in southern Indiana.

NORTH CENTRAL

Indiana one step closer to bobcat trapping

Following an increase in the bobcat population over the last two decades in Indiana, the state’s natural resources commission is considering allowing regulated trapping of the species. The Indiana Natural Resources Commission took public comments on the proposed change through November and plans to have rules in place by July, 2025. The proposed rule would establish a regulated trapping season in 40 counties in southern Indiana that dictates a bag limit of one bobcat (*Lynx rufus*) per trapper and a season quota of 250 individuals overall. “Our research shows that bobcats are established in the 40 proposed counties

and have access to high-quality habitat to sustain populations in those areas,” said Geriann Albers, Furbearer and Turkey Program Leader for Indiana DNR, in a press release. “DNR is confident that this framework for a regulated harvest will allow for bobcats to continue to thrive.”

SOUTHEAST

Florida launches landowner program to support panthers

A pilot program in Florida will benefit private landowners and the panther population in the state. The Florida Fish and Wildlife Conservation Commission is launching the Payment for Ecosystem Services program, which will pay landowners by the acre for areas that support Florida panther (*Puma concolor coryi*) conservation and landscape connectivity. “This program will also advance the sustainability of ranching’s contribution to Florida panthers and the Florida Wildlife Corridor being created to ensure the long-distance movement and genetic health of panthers, Florida black bears and other fauna and flora,” said Andrew Walker, President and CEO of the Fish and Wildlife Foundation of Florida, in a



Credit: Florida Fish and Wildlife Conservation Commission

◀ A new program will pay landowners to help conserve Florida panthers on their land.

press release. Landowners who participate in the program—which is supported by the National Fish and Wildlife Foundation, the U.S. Fish and Wildlife Service and the Fish and Wildlife Foundation of Florida—will receive annual payments for three years to maintain or improve the quality of panther habitat on their land. The program will be reevaluated after the third year. The Commission accepted applicants for the program between Sept. 19 and Oct. 19.

SOUTHWEST

New ocelot research center breaks ground in Texas

Construction has begun on a new research center focusing on ocelot conservation. The Caesar Kleberg Wildlife Research Unit and partners broke ground on the \$20 million facility that will include 30,000 square feet of space for ocelots (*Leopardus pardalis*). “We’ve been working at this lone project for at least 18 months, but really it’s four decades of work that has gotten us to a point of recognizing the need for this facility,” said David Hewitt, Leroy G. Denman, Jr., Endowed Director of Wildlife Research for the Caesar Kleberg Wildlife Research Institute, in a press release. “There’s a lot of conservation values in this for the ocelots, but we’re excited about the opportunities this is going to bring for graduate student education and undergraduate experience you can’t get anywhere in the country.” There are only about 100 ocelots left in the wild in the U.S., all residing in Texas. Experts from the East Foundation and the Cincinnati Zoo will breed ocelots in the facility and will also provide medical and reproductive care. The facility will provide space for young ocelots to learn hunting skills and other



Credit: Texas A&M University Kingsville

▲ Construction began on an ocelot research center in Texas.

behaviors before their release into the wild. The building construction is set to be completed in December 2025.

NORTHWEST

Rat sighting causes concern in remote Alaska

A reported sighting of a rat is alarming wildlife officials on Alaska's Saint Paul Island. While a rat has yet to be found since the sighting, officials remain vigilant as rats can quickly establish populations, devastating bird populations and biodiversity on the remote island, also known as the "Galápagos of the north." Rats have been known to decimate seabird colonies and other wildlife in Alaska and across the world. In fact, the U.S. Fish and Wildlife Service has opened a public scoping period recently for an environmental impact statement on rat eradication on four uninhabited islands in Alaska. "Rats on islands within

the archipelago are a major threat to seabirds and other birds of all ages," the USFWS said in a press release. "And the negative impact of rats is not limited to seabird mortality—they can change entire island ecosystems." Though the Saint Paul Island community surveils for rats year round, the last time a rat was reported, it took almost a year to find it.

INTERNATIONAL

Rare wombat caught on camera in Australia

A trail camera in a wildlife refuge in southwest Queensland has captured a photo of one of Australia's rarest mammals. The image depicted a young northern hairy-nosed wombat (*Lasiorhinus krefftii*) emerging from an active burrow in Richard Underwood Nature Refuge (RUNR), showing evidence that the species is breeding there. "It's very gratifying to know that one of the world's most critically



Credit: Australia Wildlife Conservancy

▲ A young northern hairy-nosed wombat was caught on a trail camera in Richard Underwood Nature Refuge in Queensland.

endangered animals is doing well and breeding within the safety of the fenced area," said Andy Howe, the senior field ecologist with Australia Wildlife Conservancy (AWC), in a press release. "Although this isn't the first joey born at the refuge, it is the first juvenile spotted for a few years." Only 400 of the wombats remain in the wild, including three populations, all of which are protected by the Queensland government. Data from the trail cameras put up with the help of a government grant will help AWC conserve the species in alignment with the Northern Hairy-nosed Wombat Recovery Plan—including developing a fire management strategy, controlling the spread of weeds, improving food resources and more. "Government funding enables AWC and its partners to improve the trajectory of the species by reducing key threats, commencing a genetic management plan and increasing data knowledge—all of which will support a growing and sustainable population at RUNR and hopefully assist with the establishment of future populations," Howe said. ■



Credit: Bill Briggs

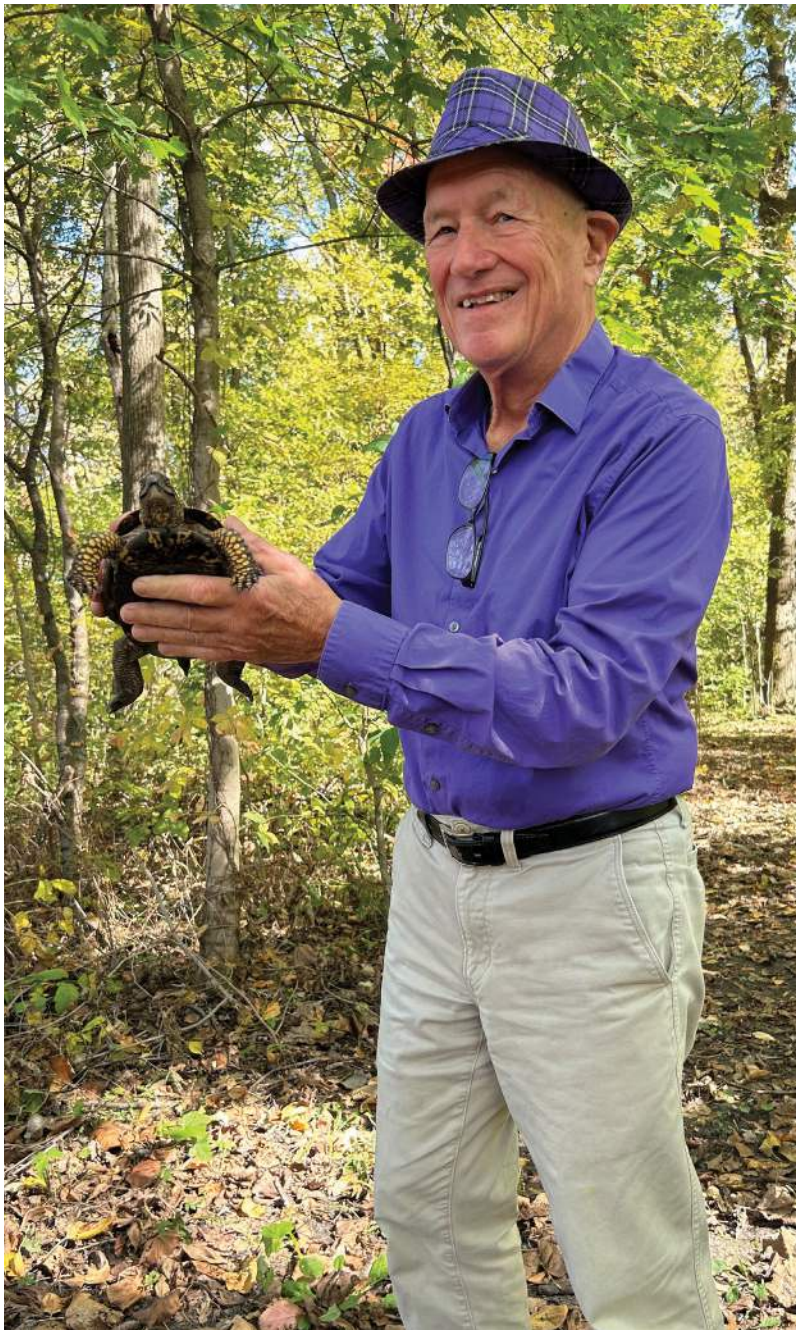
▲ Alaska's Saint Paul Island is known for its biodiversity and seabird colonies.

Contributed by Dana Kobilinsky, Joshua Rapp Learn and Megan Radke

A Striking Career

HOW THE “GODFATHER” OF BIRD CONTROL AT AIRPORTS NAVIGATED SUCCESS IN WILDLIFE MANAGEMENT

By Joshua Rapp Learn



Credit: Mona Rutger

It wasn't long after the terrorist attacks in New York City on 9/11 that experts were picking through the rubble looking for people's remains. Boats transported material to a landfill, where workers carefully sorted it. But soon gulls and other birds began picking through the debris, and authorities became concerned that they might eat some of the victims' last remains. The New York Police Department and the Federal Bureau of Investigation tasked Richard Dolbeer with keeping the scavengers away until authorities could exhume and analyze the remains.

Dolbeer and other experts trapped rats and mice, hazed gulls using paintball guns and lasers, and sometimes killed them. But recent regulations limited the techniques they could use to ones that weren't so loud due to sensitivity after the attacks. "We moved thousands and thousands and thousands of gulls," said TWS member Rich Chipman, now a coordinator with the National Rabies Management Program at the U.S. Animal and Plant Health Inspection Service, who worked with Dolbeer on the project.

Dolbeer was the right person for this kind of job. Throughout his decades-long career, he had already managed birds at airports, snowshoed through mountains and conducted crop control. "He was the calm in the storm—he has always been a guy that puts his head down, rolls up his sleeves and gets to work," Chipman said.

Early spark of wildlife interest

Dolbeer can trace his interest in wildlife back to his childhood. Growing up in Jackson, Tennessee, his house was surrounded by woods and a nearby pond where he and his grandmother would birdwatch. She even taught him how to identify species. Dolbeer also

◀ Dolbeer studied box turtles in Tennessee as part of his master's thesis.

spent parts of five summers in Maine, where his uncle rented cabins on small lakes.

“That’s where nature really had an influence on me,” Dolbeer said. “I became particularly interested in the factors that regulate wildlife populations.”

In high school, Dolbeer loved math and science—biology in particular. His teachers said he should be a physician, so he enrolled in pre-medical courses at Sewanee: The University of the South. “I came within a hair’s breadth of going to medical school,” Dolbeer said.

Dolbeer enjoyed his time at the university—he played football and even fell in love and got married. But he soon realized all his pre-med colleagues were way more into medicine than he was. After graduating, instead of applying to medical school, he enrolled in a research assistantship at the University of Tennessee, Knoxville, to study ecology—much to his mother’s chagrin.

“How are you going to take care of this beautiful young woman you’re going to marry, and what does this word ‘ecology’ even mean?” his mother asked him.

It was the late 1960s, a time when such terms were hardly in the lexicon of the average American. But that was about to change. Rachel Carson’s *A Silent Spring* had made a big impact on Dolbeer. People were growing conscious of the effects pesticides such as DDT had on wildlife populations, many of which were at all-time lows in the country. U.S. lawmakers began taking action as Dolbeer was in graduate school, creating the Environmental Protection Agency and the Endangered Species Act, and banning DDT.

“It was an exciting time to be entering into this world of wildlife management and wildlife science,” he said.

In the cold, wild world

Dolbeer conducted his master’s thesis on eastern box turtles (*Terrapene carolina*), learning how to estimate the levels and age structures of populations. After graduation, he got a research assistantship at Colorado State University studying the population dynamics of snowshoe hares (*Lepus americanus*) in the Rocky Mountains.



Credit: Harvey Donoho

▲ Dolbeer conducted research on snowshoe hares in 1969 in Summit County, Colorado.

“When I first got out there, being from western Tennessee, three inches of snow was the most snow I’d ever seen in my life,” he said. Initially, he struggled to adapt to the 11,000-foot elevation and deep snow. He even contemplated quitting. But his wife wouldn’t have it—not after picking up their lives and moving to Colorado. He was soon snowshoeing through deep powder, pulling a sled full of hare traps.

“It was very exciting, but it was very difficult to do that at first,” he said. Nonetheless, “getting into a different ecosystem was very valuable.”

The Denver Post spotlighted his PhD dissertation, which found the hare populations were healthy, and the Colorado wildlife agency liberalized the hunting season on the species based on his research. “That was a really neat experience to go through—that really made me happy,” he said of impacting regulatory decisions.

After three years of setting traps, Dolbeer’s time in Colorado came to an end. He wanted to stay,

but other opportunities abounded. He ultimately settled on a position at the Ohio Field Station in Sandusky, Ohio, which at the time was affiliated with the Patuxent Research Refuge in Maryland.

The field station was set up to deal with human-wildlife conflicts around the country, which in the beginning mostly revolved around keeping red-winged blackbirds (*Agelaius phoeniceus*) and other migratory birds away from crops.

“We were leery of moving to Ohio—Lake Erie was considered an ecological disaster,” Dolbeer said, recalling that the Cuyahoga River in Cleveland was in the news for catching fire due to such high levels of pollution. “But I took the job because it sounded like a fascinating opportunity to work on applied problems.”

His instinct was right—he still lives there today. But his work has evolved over time. He went from developing hazing tactics, bird repellents and hybrid corn varieties with tougher husks that blackbirds couldn't open as easily to working with airports to keep birds away from aircraft.

Off the runway

When many bird species populations increased in the 1980s following the DDT ban, another problem reared its head. Birds were making their homes at airports, where they could cause potential bird strikes to aircraft. Nowhere was this more pronounced than at John F. Kennedy International Airport in New York City, where a large gull colony took up residence in Jamaica Bay Wildlife Refuge adjacent to the airport. The National Park Service didn't want birds managed on their land.

“It was a classic conflict between aviation safety and wildlife conservation,” Dolbeer said. It was 1989—around the time his research group was transferred from the U.S. Fish and Wildlife Service to the U.S. Department of Agriculture and became Wildlife Services—when Dolbeer's first big task was to tackle this problem. “I jumped on it like a flea on a Tennessee hound dog,” he said.

Embracing the controversial

Since the beginning of aviation, bird strikes have been a problem. But most airports and the Federal Aviation Administration really didn't keep track of them. Fortunately, Sammy Chevalier in airport operations at JFK had maintained a detailed

account in a spiral notebook of all strikes at the airport since 1979.

His records revealed that bird strikes were increasing there, parallel to the gull colony moving in. Dolbeer entered Chevalier's data in a spreadsheet and added to it, creating what would become the Federal Aviation Administration's National Wildlife Strike Database. “If you can't measure something, you can't manage it,” Dolbeer said.

The gulls had to be controlled. But this was around the time when the effects of DDT on birds were becoming widely known, and bird conservation was huge in the popular press. The plan to shoot gulls to control them was controversial.

But Dolbeer didn't shy away from the press. In 1991, Dolbeer's team shot 15,000 gulls flying over JFK Airport, and he had the science to back his results—revealing that their control didn't affect overall gull populations. Their meticulous record-keeping also showed that the tactic worked. “Our program did result in a dramatic drop in the number of strikes,” he said.

“He's like the godfather of the bird strike world,” said TWS member Laura Francoeur, chief wildlife biologist for the Port Authority of New York and New Jersey. “It was the single most important strategy that we've used to reduce strikes at JFK.”

Chipman, who worked with Dolbeer on the JFK Airport gull control issue as well as the work on 9/11, described Dolbeer as the type of person who can balance science, management and public communication. “He was a problem solver—he wasn't worried about entering into the breach of controversial things,” Chipman said.

And he always had the science to back up management actions. A TWS member since 1969, Dolbeer has published more than 230 scientific papers, and at 79 years old, he hasn't stopped. He still works part time with Wildlife Services and manages a 60-acre farm dedicated to environmental education and Alzheimer's awareness in memory of his late wife, Sandra.

“No matter whether it was more complex research or straight-forward research, he was really good at that,” Chipman said. “I appreciate this guy so much.” ■



TWS
MEMBER
**Joshua
Rapp Learn**
is a science writer
for The Wildlife
Society.



Colleen Olfenbuttel, CWB®

Credit: Melissa McGaw/NC Wildlife Resources Commission



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Rugged Vulnerability

CHANGES IN THE DESERT CHALLENGE HARDY SPECIES

By Megan Radke

On a late September morning in 2024, Ellie Sutherland, a graduate research assistant at Sul Ross State University's Borderlands Research Institute, walked into Froylán Hernández's office at the Texas Parks and Wildlife headquarters with some potentially bad news about the desert bighorn sheep she was tracking in the Chihuahuan Desert. An alert coming from its collar suggested it may have died.



“It was out of the blue when we got this notification,” said Hernández, Texas Parks and Wildlife Department’s bighorn sheep program leader, who uses GPS collars to track bighorn sheep movement, health and mortality.

Texas was almost devoid of the native species by the 1960s—they were taken out by unregulated hunting and disease from domestic sheep and goats. Since then, Hernández and his colleagues have worked diligently to restore their populations. But he wasn’t initially concerned about this individual.

“Some of these notifications are false mortalities,” he said. “The animal just lays there so still for so long that the collar thinks it’s dead, but it’s just motionless.”

But the coordinates showed the sheep in the middle of the Rio Grande that borders Black Gap Wildlife

Management Area (WMA)—an unusual place for a sheep to be spending its time. While bighorn may frequent this area for a drink, the water’s flow during this time of year was low, so it was unlikely for the animal to fall or drown in the river. Hernández and Sutherland were compelled to find out what happened. Temperatures would be scorching, but they drove the 86 miles from the office to the WMA to find the animal.

The mountains of southern Brewster County are shaped by a volcanic past, rising over 7,000 feet at their highest points. To the north, grasslands blanket rolling hills. They arrived at Black Gap after a 1.5-hour drive, but their trip wasn’t over yet—finding the sheep would require a three-mile hike along the river.

They decided to brave the 103-degree heat, but at the halfway point of their hike, they began to

▼ A herd of desert bighorn sheep in the Trans-Pecos region of Texas.

Credit: Froylan Hernández



question their decision, fearing heat-related illness. Then suddenly, there it was: a desert bighorn sheep (*Ovis canadensis*) lying dead in a few inches of running water in the middle of the river.

Hernández and his colleagues are still trying to determine what caused the sheep's death, but they suspect it was sick—potentially through contact with nonnative Barbary sheep (*Ammotragus lervia*), which most scientists think can spread disease.

“What we have to do now is look at the weeks and months prior to compare its movements because if it was sick, those movements would have gotten shorter and shorter,” Hernández said.

Disease and competition from nonnative species add to a litany of other problems that bighorn sheep and other species face in arid landscapes. Deserts may seem barren, but they host a whole ecosystem of species that are often highly specialized to their conditions. But these conditions are changing fast. Studies show that average annual temperatures in the desert southwest have increased by over 2 degrees Celsius over the last 50 years. Over the last century, precipitation has decreased by approximately 20% in many areas (Rich et al. 2019). Meanwhile, urbanization in desert cities like Phoenix and Las Vegas is eating up native ecosystems and converting them to well-manicured lawns, either using excesses of precious water or raising already high temperatures.

▼ Biologists take samples from a desert bighorn sheep during a translocation event.



Credit: Texas Parks and Wildlife Department

Every desert is unique, from the “green desert” landscape of the Chihuahuan Desert characterized by the flora biodiversity to Death Valley's otherworldly Badwater Basin, thought to be one of the hottest places on Earth in the summer. Small changes to these landscapes could have outsized impacts on the wildlife that live in these ecosystems. While some species will have the strategies to adapt and thrive through these changes, others may not be so lucky.

“What we're going to lose is some of the more habitat-specialist species,” said Donald Miles, a professor of biological science at Ohio University. “[With] habitat fragmentation combined with warmer environments, we'll see shrinking populations of a number of species. Species that are more heat tolerant will still be there, but even then, they won't be as abundant as they once were.”

Disease in the desert

Desert bighorn sheep, one of several bighorn sheep subspecies, are one of the most iconic desert species in the high desert mountains of the U.S. The animal is well-equipped for quickly climbing the rough desert terrain, has a digestive system capable of extracting nutrients from tough desert plants, and can go long periods without water by extracting moisture from its food.

Estimates put the North American bighorn population between 150,000 and 200,000 before the 1800s. At the turn of the 20th century, the sheep experienced steep declines but through translocations and modern management, bighorn sheep numbers recovered to approximately 80,000 nationwide today.

In recent years, the sheep population in Texas began to recover as well—Hernández's colleagues estimated 1,500 sheep spread across 11 Texas mountain ranges, “so, we were sitting pretty,” he said.

But more trouble came from disease in 2019 when a strain of bacteria called *Mycoplasma ovipneumoniae*, or *M. ovi*, “almost knocked them out,” Hernández said.

The problem snowballed. Scientists reported more bighorn die-offs in the Van Horn Mountains, Black Gap, and other Trans-Pecos ranges where the Texas Parks and Wildlife Department (TPWD) had been working diligently to restore the population through careful management and translocations.



Credit: Cody Stricker, iNaturalist

But even though few domestic sheep and goat operations are currently found near bighorn sheep habitat, a nonnative ungulate had moved in during the mid-20th century.

Aoudad, or Barbary sheep, were brought to the southwestern United States from northern Africa in the 1950s for hunting opportunities. Current estimates suggest that thousands now occupy desert bighorn habitat in the Trans-Pecos. Until now, there hasn't been much research—or concrete evidence—regarding disease transmission between two species. But researchers from the Texas A&M University College of Veterinary Medicine and Biomedical Sciences are getting closer to an understanding.

In a recent [study](#), researchers speculated that aoudad may transmit and contract respiratory bacteria, including *M. ovi* and *Pasteurellaceae*, both of which can cause severe pneumonia in the animals. While both bacterial strains can kill bighorn sheep, these bacteria are less impactful to aoudad.

“We think it is unlikely that *M. ovi* and/or *Pasteurellaceae* infections in aoudad are lethal without other predisposing conditions,” said Logan Thomas, an author of the study and assistant professor in Kansas State University’s Department of Horticulture and Natural Resources. “For bighorn sheep, though, *M. ovi* is—and likely will always be—a consistent mortality threat at both the individual and population level.”

Complicating an already difficult situation, in parts of West Texas where aoudad and desert bighorn populations overlap, some landowners make money by running aoudad hunts on their properties. Because the species isn't native, there are no harvest limits. Consequently, not all landowners want to see the animals removed, regardless of possible impacts to native species.

“I get it,” Hernández said. “I can't ask a landowner who is making a good portion of their income on aoudad to suddenly get rid of them all.”

▲ An aoudad ewe with a lamb in Val Verde County, Texas.

▼ **Water guzzlers** provide water for wildlife in arid regions. In the design pictured here, the black cylinders store water sent out to troughs that wildlife drink from.

But researchers believe that there is reason for hope for the bighorn. The team plans to begin a historic translocation effort in the winter of 2025, moving 80 bighorn from Elephant Mountain WMA near Alpine, Texas—an area without these diseases—to the Franklin Mountains State Park in El Paso. Wildlife managers hope the sheep will be buffered from sickness in this area due to a lack of aoudad.

“When I first started in this role 15 years ago,” Hernández added, “I said that I’d like to see bighorn back in the Guadalupe, the Chisos and the

Franklins, but I never thought I’d actually get to see it happen in my lifetime.”

Dried up

Dealing with disease is only part of the solution for desert bighorn sheep. While this species is adapted to survive without water for weeks or months, these animals—along with many others—still need water from occasional rain or snow, as do the plants they eat. But extreme droughts are increasing, even in deserts. Drought can force bighorn to select locations closer to water sources, where they are more susceptible to predators



Credit: Froylan Hernández

or other herbivore species that compete with them for resources.

That's where water guzzlers come in. These artificial water sources help supplement water for bighorn and any other species that happen upon them.

"Guzzlers have been traditionally placed to benefit game species," said Brett Furnas, a senior environmental scientist supervisor with the California Department of Fish and Wildlife (CDFW), who has studied guzzlers—or artificial water catchments—in parts of the Mojave Desert. "We found that bighorn sheep, Gambel's quail and mourning doves benefited, but we also found benefits to a wider diversity of species, including coyote, bobcat, badger, horned larks and more."

Furnas said that during a year-long [study](#), across 200 sites, seven terrestrial mammals, one bat species and 10 different bird species regularly used water guzzlers.

As California deserts become increasingly arid, Furnas says that the CDFW is working in close collaboration with nongovernmental organizations and other land management agencies to build, monitor and maintain guzzlers throughout the state.

"Average temperatures have already increased over the last 50 years, and precipitation has decreased in our southern deserts due to climate change," Furnas said. "Guzzlers are an important adaptive measure to help mitigate impacts of drought and climate change for a diversity of wildlife, including both game and nongame species."

Other areas in the Southwest have oases in the form of lakes or rivers, lending water to wildlife and contributing to biodiversity. But these ecosystems are still vulnerable. Even in the most protected areas, wildlife managers are dealing with drought.

In the New Mexico high desert, the Rio Grande is partly responsible for the bird biodiversity at Bosque del Apache National Wildlife Refuge. Larger than 57,000 acres, the refuge is either home to or a stopover for over 400 bird species.

"At this refuge in particular, we support a significant amount of native riparian forest as well



Credit: Marvin De Jong, USFWS Volunteer

as moist meadows and other water-dependent habitats, which have been lost or degraded on a large scale elsewhere in the southwest due to water use, drought, invasive vegetation and land development," said Joel Gilb, a Park Ranger at Bosque del Apache.

But Gilb said drought has even hit the Rio Grande.

"A drying river means less surface water to be used for refuge habitat management. At Bosque del Apache, that means we must rely increasing on groundwater, and unfortunately, our local groundwater can be quite saline and thus is not ideal for habitat management or crop irrigation," he said.

Land of extremes

Deserts are characterized by their dry conditions and extreme weather, but climate change is causing these extremes to worsen—perhaps most notably in the form of even higher temperatures. Desert regions are experiencing more frequent and prolonged heatwaves, putting stress on both plant and animal species that have evolved to survive in a narrow range of environmental conditions.

Some species are able to retreat to higher elevations that provide refuge from rising temperatures. Other species—like cactus mice (*Peromyscus eremicus*), kangaroo rats and white-tailed antelope squirrels (*Ammospermophilus leucurus*) in the Mojave Desert—will be able to use burrowing strategies to continue to thrive in hot, dry conditions

▲ Sandhill Cranes at Bosque del Apache National Wildlife Refuge.



Credit: Sean Kreig, iNaturalist

▲ A Morafka's desert tortoise in Maricopa County, Arizona.

(Riddell et al. 2021). Their numbers have remained stable despite a changing climate.

But many desert species, like reptiles and small mammals, rely on specific temperature thresholds to regulate their body temperatures, and these rising temperatures are disrupting their ability to function and survive.

▼ Volunteers pull buffelgrass by hand on Tumamoc Hill in Tucson, Arizona.

Miles, with Ohio University, has been studying reptiles and amphibians in the Southwest since the early 1980s. He said that others won't be so

fortunate, especially as droughts become longer and more extreme.

"I started catching lizards in Arizona in 1987," Miles said. "We had a one-hectare plot, and we could capture about 200 lizards in just a couple of weeks. I've gone to the same plot almost every year, and this last year, I think we caught maybe 30 lizards." Miles attributes this at least in part to a warming climate.

"There's a certain resilience that arid species have," Miles said. "But as it gets hotter, species experience heat stress. Because it's warmer at night and during the day, their metabolic rates are higher, and that makes them go into a negative energy balance."

He said that when there isn't efficient shade from plants or burrows, it often lowers their reproductive success and increases the risk of mortality, and then populations begin to decline. Miles' studies show that some desert species endemic to Arizona, including the barred tiger salamander (*Ambystoma mavortium stebbinsi*), the desert short-horned lizard (*Phrynosoma ornaticornis*), and Morafka's desert tortoise (*Gopherus morafkai*), could face extinction by 2070.



Credit: Julia Rowe, Arizona Sonora Desert Museum

"When we look at issues with water availability, the mega drought in the Southwest has resulted in the death of a lot of vegetation," he said. "In some of the study sites I've been visiting for the past 40 years, I've seen mesquite trees become sparse—and it's hard to kill a mesquite tree. We're not just looking at changes in the landscape, but changes in habitat availability and food availability."

The shifting climate also contributes to the spread of invasive plant species in desert regions. Many nonnative plants, including grass species, are better adapted to warmer temperatures and changing precipitation patterns, allowing them to out-compete native desert vegetation. One such species is buffelgrass.

Carlos Alcalá-Galván, a professor and researcher at the University of Sonora in Hermosillo, Sonora, Mexico, has extensive experience studying the impacts of buffelgrass (*Cenchrus ciliaris*) in the Sonoran Desert. Buffelgrass was introduced to parts of the Sonoran Desert in the U.S. and Mexico in the 1950s to help feed cattle.

While buffelgrass worked almost too well for those purposes—spreading far beyond its initial plantings—these types of invasive plants often alter the fire regimes in deserts, more prone to burning than native species. This increases the frequency and intensity of wildfires, which can devastate native plant communities that are not adapted to frequent fires, further altering the ecosystem balance and reducing biodiversity. Cooperative research between the University of Arizona, Saguaro National Park and the City of Tucson showed that wildfire in an area dominated by buffelgrass spread about 10 times faster than usual desert fuels.

Alcalá-Galván said that despite buffelgrasses' ability to take over parts of the Sonoran Desert, volunteers in parts of the desert—especially in Arizona national parks like Saguaro—are working tirelessly to remove the grass through hand pulling, herbicide and more treatment measures.

“No matter how hard you try to eradicate buffelgrass, there are still seeds in the soil that are viable to germinate under favorable conditions even after 30 years,” said Alcalá-Galván. “The work of removing these plants will be an ongoing activity.”

Urban sprawl

Water scarcity in urban regions can't simply be blamed on climate change. Urbanization in the western United States is having a significant negative impact on desert ecosystems, primarily through habitat fragmentation and the depletion of water resources.

Water overextraction is another critical issue exacerbated by urbanization in desert areas. The growing demand for water in cities—particularly for agriculture, landscaping and drinking—is placing enormous pressure on already scarce water supplies in these arid regions. Many urban areas rely on groundwater, which can take centuries to replenish, leading to the depletion of aquifers. This not only threatens the long-term availability

of water for human use but also impacts desert springs, rivers and riparian habitats that many species depend on for survival.

As cities and towns expand, roads, buildings and other infrastructure are replacing natural desert lands. The Texas horned lizard is particularly affected by urban sprawl. Urbanization has destroyed habitat for Texas horned lizards (*Phrynosoma cornutum*), which used to be found almost everywhere, from backyards to arid natural environments in Texas, Oklahoma, Kansas, New Mexico and northern Mexico.

It's difficult to point to any one cause of their disappearance, but there's no question that the beloved reptiles are getting harder to find.

“They're not a mobile species, and they've just gotten so isolated that their populations declined,” said Nathan Rains, a wildlife diversity biologist with TPWD. “We eradicated their food source, we took away their habitat and they just couldn't adapt.”

According to the nonprofit Texan by Nature, the number of highway miles in Texas has increased

▼ Texas horned lizards blend seamlessly into their surroundings.



Credit: Texas Parks and Wildlife Department



Credit: George Andrejko

▲ **Sunset in the Sonoran Desert of Arizona.**

exponentially from 35,000 miles to over 79,000 miles since 1935.

Although biologists can't stop the expansion of cities and roadways, Rains and agency partners like the Fort Worth Zoo are working to reintroduce Texas horned lizards on managed state lands. At the same time, university collaborators are trying to find ways to specifically bait and kill nonnative red (*Solenopsis invicta*) and black (*Solenopsis richteri*) imported fire ants that outcompete harvester ants, the lizard's main food source.


The problem and the solution

While humans are primarily to blame for many of the challenges facing desert ecosystem species, they're also part of the solution, whether it's the desert bighorn or the Texas horned lizard.

After Hernández and his team collected samples from the deceased bighorn in the river to search for more clues about its death, they devised a cooler plan to get back to their truck. Instead of hiking, they stayed in the river, using their backpacks as floatation devices in deeper water, letting the water carry them back to the trailhead.

Just as Hernández and his team had to think on their feet to return to safety, as extreme drought, urbanization and other conditions continue to present problems for deserts, wildlife—and the managers who conserve them—are going to need novel solutions.

“This is a global problem,” Miles said. “Unless there is effort from people and other entities to make an effort and really think about a more sustainable life on the planet, we won't have a chance to sustain anything.” ■

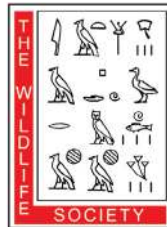


TWS MEMBER Megan Radke is a staff writer for The Wildlife Society.



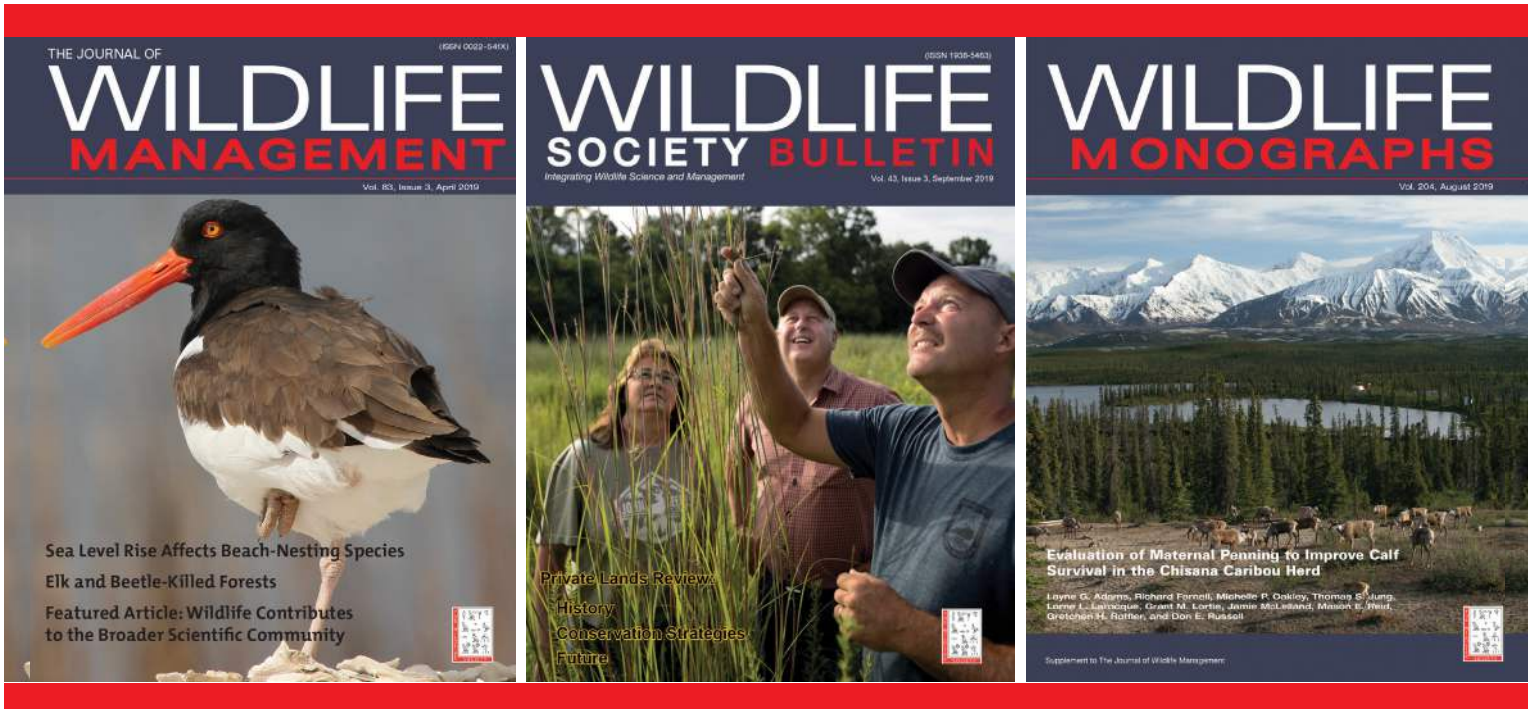
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Back to Byproducts

HOW EDGE-OF-FIELD WATER CONSERVATION PRACTICES COULD BRING BACK FARMLAND WILDLIFE

By Adam Janke and Karen Wilke

Credit: Adam Janke

▲ Upland sandpipers are one of dozens of birds that stand to benefit from water conservation practices in agricultural landscapes.

It's sort of accepted lore here in farm country that certain species of wildlife were once byproducts of agriculture. White-tailed jackrabbits (*Lepus townsendii*), spotted skunks (*Spilogale putorius*), American badgers (*Taxidea taxus*), eastern (*Sturnella magna*) and western (*Sturnella neglecta*) meadowlarks, northern bobwhites (*Colinus virginianus*), and fox snakes (*Pantherophis vulpinus*) all earned the moniker “farmland wildlife” and became intertwined with rural life. They thrived where agricultural land uses created diversity in plant communities and landscape structure—until they didn't.

A mix of factors—some political, some economic and some social—led to the steady erosion of heterogeneity in agricultural landscapes during the second half of the 20th century. With it went the wildlife that once thrived at its margins.

Thankfully, today—all across farm country in the U.S.—innovative wildlife biologists, engineers, agronomists, farmers and policymakers are finding promise in practices that put some diversity back

on the edges of farm fields in the name of water conservation. Most of these practices make space for wildlife, too. With these efforts, it seems within reach that the wildlife that once shared this land could soon return as byproducts of agriculture once more.

Forces of homogeneity

There's evidence for the once mutual prospering of farmland wildlife and farms in some of the earliest literature coming from the modern discipline of wildlife conservation. In the summer of 1928, Aldo Leopold set out on an epic road trip to study farmland wildlife, stating in the resulting “Report on a Game Survey of the North Central States,” “... the crux of the game problem is on the farm.” A couple decades later, a 1947 study on pheasant nesting in Iowa reported only 31% of all nests were in idle areas, with the difference—over two-thirds of nests—spread between hay fields, pastures and small grain fields (Basket 1947). Meadowlarks and other grassland birds in Illinois thrived in grain fields, pastures and hay meadows at the turn of the 20th century (Forbes 1913).



Two major changes in agriculture compelled a shift away from the heterogeneity that helped wildlife. The first was equipment. Once, the horsepower that pulled implements and growers through fields to cultivate crops was literally horses or other grazing animals like oxen or mules. Not only did such “equipment” constrain the pace and scale of agriculture, but it also took its fuel from the land in the form of pasture and grains for feed and hay. But the main fuel farmers used became oil when technology shifted to tractors by the mid-20th century. There was less need for pasture, hay and grains as feed, and tractors made converting those fields to commodity crops easier.

The second shift was in the source of nutrients farmers used for their crops. Until World War II, most nutrients for agriculture were coming from the farm itself—the soil, plants and livestock that made them available. Owing to innovations from the technological revolution of the early 1900s and the boon in industry and inventions associated with World War II in the 1940s, agriculture started a decades-long shift toward reliance on inputs from off the farm, namely synthetic fertilizers, to increase yields to meet increasing global demands.

Agriculture shifted abruptly from labor-intensive to capital-intensive, tightening profit margins and forcing farms to grow to gain wealth. Infamously, “get big or get out” became the de facto policy of the U.S. Department of Agriculture and its extension services at public universities.

Water and wildlife woes

The loss of diversity in agriculture and the shift to high-intensity annual crop production precipitated population declines in once-thriving wildlife populations. The North American Breeding Bird Survey that started around the 1970s documented the change. A recent summary of those data and others revealed widespread declines among birds—grassland birds declined the most at 53%. The eastern meadowlark that once thrived in Illinois and all across farm country declined by 75% (Rosenberg et al. 2019). Data among other taxa are less longitudinal but show similar patterns. White-tailed jackrabbits are functionally extirpated from the eastern portion of their former range, where row crops prevail (Brown et al. 2019). Land use change and contaminants associated with agriculture have been implicated in regional and global declines among amphibians, reptiles and many

invertebrate taxa. Recently, declines in monarch butterfly (*Danaus plexippus*) population arising from agricultural land use change have been well documented (Thogmartin et al. 2017), and so too has the decline in milkweed within farm fields as a contributing factor (Hartzler 2010).

Water has changed, too. Timing and intensity of flow have been altered due to drainage and loss of perennial vegetation. Sediment from erosion of uplands and streambanks has increased. Contaminants from manure and pesticides are more prevalent. And nutrient enrichment related to fertilization and annual cropping systems has thrown off the balance of aquatic ecosystems. These changes have had direct impacts on aquatic life, including—perhaps most notably—freshwater mussels.

Although the impacts on wildlife populations have captured the attention of many in our profession, arguably more of society has taken note of degraded water. Direct contamination of surface water and shallow wells through nutrient enrichment or contamination is widespread throughout farm country. In the Great Lakes, extensive efforts are ongoing among coastal communities to find fresh drinking water sources farther from shore. Large municipalities spend millions to remove nitrate from river water used in major metropolitan areas like Des Moines, Iowa. Altered trophic structure in freshwater and marine environments leads to algal blooms that consume oxygen or produce toxic byproducts that threaten drinking water or fisheries. Recreation in lakes and rivers is halted for floods, bacteria contamination, toxic algae or degraded aesthetics.

There’s an enticing intersection between water conservation and wildlife conservation in the form of the fixes that could solve each. On the edges of farm fields—often where surface waters and agriculture meet—stands an opportunity to target conservation practices that work to improve surface water quality while also creating places for farmland wildlife to thrive.

Edge-of-fields of opportunity

There are dozens of possible interventions available to address water quality challenges. Researchers and policymakers generally divide these options into two categories: in-field and edge-of-field conservation practices (Christianson et al. 2018).



The former includes things like tillage practices, cropping systems, cover crops, agronomic techniques or products such as nitrification inhibitors. These practices are important for water, but they show limited potential to have positive secondary impacts on terrestrial and semiterrestrial wildlife. In contrast, edge-of-field practices that intercept water before it goes downriver show tremendous promise for wildlife and water alike.

Edge-of-field practices take many forms. The most common characteristic is that they slow water down and allow natural processes to remove sediment, nutrients and contaminants. Riparian buffers occurring naturally in the environment intercept surface flow, preventing contaminants from entering streams and stabilizing banks from erosion. When subsurface drainage bypasses buffer vegetation and outlets directly into the stream, installation of saturated riparian buffers allows that drainage water to filter through the buffer vegetation first. Wetlands work to clean up water and slow down floods anywhere they occur in the watershed. Constructed wetlands can be targeted to small watersheds with high nutrient loads.

Disconnected meanders of rivers and streams called oxbows work like wetlands along those water bodies' banks. Two-stage ditches mimic the natural processes of floodplain benches in the highly altered context of a drainage ditch. Strategic integration of perennial vegetation into profit-loss areas like wet spots or field edges improves farm profitability while storing and intercepting water before it leaves the field.

All of these practices are proven to improve water quality on farms while often improving the farmer's bottom line by targeting marginal acres or supplementing income with conservation payments. Promisingly, each can be implemented with diverse native perennial vegetation that increases heterogeneity and diversity in agricultural landscapes and helps wildlife, too.

Oxbows on the edge

In Iowa and neighboring states with intensively farmed landscapes dissected by low gradient prairie streams, we find an exemplary case of collaboration and impact for wildlife and water at fields' edges.



► Sampling in restored oxbow wetlands has documented use by the federally endangered Topeka shiner.

Credit: Casey Struecker



Edge-of-field conservation practices take many forms, and each have potential to have positive impacts on wildlife and water conservation in agricultural landscapes.



Credit: Omar de Kok-Mercado

▲ **Prairie strips**



Credit: Adam Janke

▲ **Constructed wetlands**



Credit: Lynn Betts NRCS/SWCS

▲ **Saturated riparian buffers**



Credit: Adam Janke

▲ **Restored wetlands**



Credit: The Nature Conservancy of Iowa

▲ **Oxbow wetlands**



Credit: Adam Janke

▲ **Strategic perennials**



Credit: Kriss Nelson

▲ Conservation professionals train partners about oxbow restorations in Iowa.

Most water quality issues in these landscapes revolve around a surplus of nitrate-nitrogen. Water soluble nitrate-nitrogen—a nutrient critical for growing crops—leaches from fields during rainstorms, accelerated by the superhighway of underground tile drainage systems found under most modern farms, allowing the nutrient a direct path into streams. High levels of nitrate-nitrogen in streams cause a whole suite of issues for human and wildlife health alike in freshwater and marine systems. Nature’s solution to the nitrate problem is a natural process called denitrification that naturally converts nitrate-nitrogen from the water into harmless nitrogen gas in the atmosphere. But denitrification takes time.

Oxbows are ubiquitous on marginal, flood-prone lands near rivers and stream. They do a good job of filtering out excess nutrients, but they are often degraded through the deposition of sediment or lack of water inflow.

Restoration involves removing that sediment and routing drainage tile from nearby farm fields into the oxbow. The resulting water retention means oxbows can naturally filter out nitrate-nitrogen by an average of 62% (Pierce & Schilling, 2023). The oxbows also reduce flooding and capture sediment. And wildlife benefit, too.

One recent study in Iowa found oxbows supported 71 species of birds, including marsh wrens (*Cistothorus palustris*) and spotted sandpipers (*Actitis macularius*) (Shaver et al. 2022). Another found dozens of fish species using them, including the federally endangered Topeka shiner (*Notropis topeka*). Topeka shiners have returned to areas that they hadn’t been found in for over three decades. Restorations are having such a positive impact on the recovery of the Topeka shiner that regulators may soon downlist it from endangered to threatened. River otters (*Lontra canadensis*), beavers (*Castor canadensis*), mussels and other wildlife enjoy the restored habitat as well.

The power in the promise of edge-of-field practices like oxbows comes from partnerships. In Iowa, the list of partners engaged in oxbow restoration is almost as long as the wildlife species benefiting. Traditional conservation nonprofits like the Nature Conservancy partner with commodity groups like the Iowa Soybean Association. Traditional conservation agencies like the USFWS partner with the state department of agriculture. When diverse partners come together to pool expertise and funding, conservation outcomes reach unprecedented levels. Conservation professionals provide guidance (e.g., Wilke et al. 2024) while partners pool funding sources and recruit candidate sites from



their diverse networks. Diverse partners attract diverse audiences, which leads to more conservation on more acres.

A win-win-win for water, wildlife and farmers

Oxbows and other edge-of-field conservation practices fit well within the farm, since they are typically targeting marginal land prone to erosion or floods. Oftentimes, farmers continue to farm the same number of acres after practices are installed. Sometimes, they reduce total acres but increase per-acre profits on the remaining ground. Edge-of-field practices can improve timing and trafficability of field access, and—in the case of oxbows that remove fertile black soil from the basin and put it back on the fields—they can even improve soil health.

The practices are good for the neighborhood, too. Recreation and aesthetic values of properties can increase with the diversification wetlands, buffers and oxbows bring. Friends and family enjoy improved fishing, wildlife viewing and hunting.

The solution is simple: restore natural functions that allow nature to do the work, and reap the rewards for the people and wildlife that thrive there. We've seen system-wide change in agriculture before. Perhaps the next chapter of that change could be a collaborative one where water winds up clean and wildlife are byproducts of profitable farms once more. ■



Adam Janke, CWB®, is an associate professor and wildlife extension specialist in the Department of Natural Resource Ecology and Management at Iowa State University. He is a co-organizer of the Wildlife Society's Out in the Field Initiative and a member of this magazine's editorial advisory board.



Karen Wilke is the associate director of Freshwater at The Nature Conservancy in Iowa.

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Getting the Water Right

IN CONSERVATION RELATIONSHIPS, WORDS MATTER

By Laura A. Brandt

I got into biology to work with nature, for nature and in nature. As a biologist, I was trained to study the natural world to better understand why plants and animals live where they do and what drives their populations. I have always wanted that information to help improve habitat conditions and ensure that our native species thrive. But over the years, I have learned that if I want what I do to make an impact, I have to effectively work with people. That requires good communication skills. Conservation is all about relationships, whether that's between healthy habitat and ecological stressors, species of conservation concern and restoration efforts, people and nature, or scientists and non-scientists. Not only have I learned throughout my career that relationships matter, but where people are involved, words also matter.

the quality, quantity, timing and distribution of water by changing the configuration and operation of water management infrastructure in an 18,000-square-mile ecosystem. This is a challenge, as the Everglades is a complex system, both ecologically and socially. Over 9 million people live adjacent to the 1.5 million acres of natural systems that make up the Greater Everglades Ecosystem that support species like alligators, crocodiles, wading birds and snail kites. This ecosystem spans from the Everglades Headwaters National Wildlife Refuge just south of Orlando through the Florida Keys. Water is the lifeblood of the Everglades. It is critical for sustaining fish, wildlife and plants as well as people through drinking water, irrigation, flood protection, land- and water-based recreation and tourism, and the conservation of agricultural lands. But defining what “get the water right” means for each of those needs—and balancing those needs to follow a multiple-use management framework—can be challenging and requires clear understanding and communication.

▼ Sometimes hands-on experiences with the resource, such as catching alligators as part of monitoring for Everglades restoration, are the best ways to build relationships and develop mutual understanding.

When it comes to Everglades restoration, the South Florida Ecosystem Restoration Task Force chose the words “get the water right” to describe one of their primary goals. That phrase means restoring

Developing mutual understandings

When I started as the senior biologist at the Arthur R. Marshall Loxahatchee National Wildlife Refuge in 1999, there was tension between the refuge and water managers. Much of that tension stemmed from a 10-year-old lawsuit, where the federal government had sued the state of Florida and the South Florida Water Management District (SFWMD), arguing that the state was threatening the water quality in Everglades National Park and the Arthur R. Marshall Loxahatchee National Wildlife Refuge due to the state's failure to enforce water quality laws. The lawsuit is still active and is the longest running environmental lawsuit in the country. Additional tension came from the perceived tradeoffs between water levels within the refuge for wildlife and water levels for external water supply and flood protection needs.

Most of the refuge is an overlay of Water Conservation Area 1, one of the five Water Conservation Areas (WCAs) established in the 1940s and '50s in



Credit: U.S. Fish and Wildlife Service



Palm Beach, Broward and Miami-Dade counties. The original design of the WCAs was to maintain water supply, provide flood protection, and enhance fish and wildlife habitat. These multiple uses cause potential for conflicts.

The U.S. Army Corps of Engineers (USACE) in coordination with partners—in this case SFWMD and Lake Worth Drainage District (LWDD)—uses water regulation schedules to manage water levels in impounded areas. Those schedules describe the bounds of water levels to maintain throughout the year and provide guidance on how to operate under varying seasonal requirements. To the extent possible, conditions are managed “between the lines” with consideration of any specific conditions that require inflows or outflows to the area. Sounds easy, right? In years of average conditions, maybe. In years of extreme high or low rainfall, not so much. These are the conditions under which communication and collaboration are key.

Refuge staff, myself included, identified alligators, apple snails, tree islands and wading birds as key indicators to guide water management actions within the context of the water regulation schedule. These indicators were identified using a set of criteria that included relationship to the refuge purpose, ecosystem, and threatened and endangered species. We developed a document titled, “Key features used to evaluate appropriateness of water levels in the A.R.M. Loxahatchee NWR,” that identified some “whys” and needs for the environment: why that indicator was important, critical times of year and undesired conditions. It started out as an internal document to help us think about how we would interact with water managers and later proved useful when we started having quarterly water coordination meetings with USACE, SFWMD and LWDD.

Initially, the conversations were terse as water managers viewed the refuge as somewhat of an impediment. However, over the course of a year, these meetings allowed us and the water managers to share our “whys.” As we developed relationships and a mutual understanding, the conversations became more solution-focused, where we could jointly come up with the “third alternative.” These relationships did not just develop during our quarterly meetings. There was a deliberate effort by the refuge manager on building trust with both the water managers and local landowners by getting to know them, follow-

ing through on actions and showing interest in their perspectives. Some of this happened during one-on-one meetings and some happened in less formal situations where water managers and landowners were invited to refuge functions. Laying this groundwork of trust was critical for being able to navigate challenging situations.

As we went into a very dry year, we were in a much better position to figure out mutually acceptable solutions to a situation that was challenging for everyone. A key indicator of the progress we made was when a representative from LWDD asked during a meeting what the consequences of a water management action would be on apple snails. Building these relationships and creating mutual trust and understanding led to a more collaborative approach to water management in the refuge that continues today.

Selecting your words

One of the ways we were able to strengthen relationships and gain mutual understanding and trust was by taking water managers into the field and letting them see firsthand the resources they were helping to manage. One spring, I took our water manager contact from USACE on an alligator survey. This gave us an opportunity to chat informally about alligators, water management and anything else that came up. While we were waiting for it to get dark, I told her about the relationship between alligators and water levels in the context of water conditions that year. It had been relatively wet leading into spring, and the usual dry-down that promotes concentration of aquatic prey had been slow. In other words, it was harder for alligators to forage, which can result in poorer body condition.

I commented that water levels are too high in the refuge. I was trying to convey that water depths needed for successful alligator foraging were higher than optimal. It had been a rainy spring, and I was not attributing the high depths to water management, as we had been coordinating on inflows and outflows. In my head, I was just stating a fact. But I could see her body stiffen as if I had said something offensive. She commented that everything had been done that could be done to coordinate inflows and outflows. “What do you mean water levels are too high?” she asked. I could tell by her tone that I had hit a nerve.

At that moment, something clicked. What she had heard me say was: “Water management actions are



► **Black-necked stilts and their young use levees in Storm Water Treatment Areas (STA) creating potential conflicts with STA operations and maintenance.**



Credit: South Florida Water Management

creating adverse conditions in the refuge despite our efforts to coordinate.” I apologized for my wording that implied that I was being critical of the water management actions that had been taken. I clarified that alligators don’t care if it is rainfall or water management that creates depths that are too high to forage—they have to expend more energy to forage either way. I was referring to the actual state in the refuge and not being critical of the water management. As I explained this to her, I could see her body relax and we had a good laugh about the cross talk. This conversation strengthened our relationship and ability to work together. This was an “Aha!” moment for me and a reminder to pause and make sure disagreements or tension is not caused by a difference in interpretation of words.

I was reminded of this need to pause and communicate when subsequently talking with a colleague who worked on fish. I had just finished an analysis of alligator surveys in areas that I had classified as either long or short hydroperiod—the number of days during the year water is at the marsh surface—and wanted to get his take on how fish respond in those areas. I neglected to clarify my definitions of long and short hydroperiods at the beginning of the conversation. We kept coming back to disagreement revolving around those words. Finally, I paused and

asked for his definition of short, which was not even close to mine. As in the previous example—because we had a relationship built on mutual respect—we were able to navigate through this conflict that centered around words and continue to have productive interactions.

Stilts and stormwater

There are other examples in the Everglades where communication and collaboration have been key. Remember the water quality lawsuit I mentioned earlier? One of the outcomes of that lawsuit was the recognition that there was too much phosphorus flowing into Everglades wetlands from upstream runoff. Part of the solution has been the construction of over 62,000 acres of Stormwater Treatment Areas (STAs), primarily by the SFWMD, for water quality improvement. These STAs are large, constructed wetlands with emergent and aquatic plants designed to remove and store nutrients such as phosphorus from stormwater runoff before it enters the Everglades.

STAs also benefit migratory birds compared to the previous agricultural land use. But use by migratory birds—and other protected wildlife—sets up potential conflicts between construction, operations and maintenance of the STAs, and federal and state



wildlife laws. One species—the black-necked stilt (*Himantopus mexicanus*)—provides particular challenges for STA construction, operations and maintenance.

Black-necked stilts nest in wetlands on emergent vegetation, mud flats, levees or islands and have a strong tendency to nest in manmade impoundments. While most nesting is initiated in March and April, opportunistic nesting can occur in response to favorable water levels and vegetation cover through August. Ordinary water depth in STAs provides conditions that preclude nesting except along levees above the waterline. However, during times of drought—or during operations or maintenance where bottom sediments are exposed—potential breeding habitat can also be exposed. The problem is that these areas are prone to rapid rises in water levels from storms or when maintenance is completed and STA operations return to normal. If birds do end up settling here, it could result in flooding of nests, eggs or young birds.

In the early days of construction in 2004, the SFWMD consulted with the U.S. Fish and Wildlife Service and the Florida Fish and Wildlife Conservation Commission on a case-by-case basis when stilts were observed in the STAs. Because over 62,000 acres of STAs were planned, there was a need for a more comprehensive way to provide guidelines that would maximize flexibility in construction and operations while minimizing risks to protected wildlife. An innovative approach for constructed wetlands—an Avian Protection Plan (APP)—was taken. The concept of APPs was initially developed jointly by the Service and electrical utilities to minimize adverse impacts to bird populations caused by high-voltage power transmission lines while allowing utilities to meet public needs for a safe and affordable source of electricity. The 2008 APP for the STAs was a novel use of that concept for constructed wetlands. Development of the plan, which was based on a risk assessment framework, required extensive collaboration to understand and articulate the needs of wildlife and the needs for successful STA construction, operations, and maintenance.

Key components of the plan are guidelines for changing water levels that minimize impacts, surveys to understand where there might be conflicts like the presence of nesting or young stilts,

modifying STA operations and maintenance and communication to water managers, contractors and partner agencies. It is not only a matter of the nests being vulnerable, but also a temporal concern as chicks don't fly very well for over three weeks. Before the chicks can fly long distances, they and adults spend a lot of time on the levees, which are also the roads used by contractors working in the STAs. Posted signs alert workers of the presence of stilts coupled with email reminders including pictures. According to the lead biologist for the APP, inclusion of pictures seems to increase likelihood that people will both read the email and look out for the birds and—if necessary and feasible—change maintenance activities. In a sense, posted signs and pictures provide more of a relationship with the birds. That same biologist described the need for continued communication as both frustrating, as the same messages had to be delivered continually year after year, and rewarding when actions were taken by contractors and operators to avoid impacting stilts. Navigating through the challenges of managing an STA while looking out for wildlife relies on a willingness to work together to find innovative solutions through continual communication and understanding.

In all of these examples, positive outcomes resulted from communication, collaboration and trust. There are plenty of examples of not-so-positive outcomes that, in my opinion, are the result of the opposite—people didn't recognize that words mattered. Developing mutual understanding takes time, persistence, a willingness to truly listen and not just hear, paying attention to nonverbal cues, and—as famous author and speaker, Stephen Covey, would say—“seeking first to understand.”

Thinking back on my education, I would have benefited from more formal training in communication, collaboration, and group decision making. The value of those skills and the importance of words is apparent every day as we work to “get the water right.” ■



Laura A. Brandt, PhD, CWB®, is a wildlife biologist with U.S. Fish and Wildlife Service based in South Florida.



Predicting Population Status of Imperiled Turtles

POPULATION MODELING INFORMS CLASSIFICATION UNDER THE U.S. ENDANGERED SPECIES ACT

By Kaili M. Gregory, Catherine Darst, Samantha M. Lantz, Katherine Powelson, Conor P. McGowan

Every morning when we wake up, we make decisions quickly and informally. What are we going to wear? Should we scramble up some eggs for breakfast or reach for the cereal bowl? We often predict—sometimes consciously and sometimes subconsciously—what results our decisions might have. If we wear a pair of sandals on a cold, rainy day of field work, we can expect to have frozen, wet feet. Dressing for the weather, on the other hand, will make us more comfortable and successful in completing our work. The goal of our predictions is to improve the outcome of our decisions.

In conservation, assessments of potential outcomes are often more formal due to higher stakes. Anticipating how our actions affect wildlife and their habitats guides the decisions we make. For instance, if we aim to recover a species, we might compare conservation strategies based on effectiveness, cost and sustainability. We predict the consequences of each strategy, weigh the tradeoffs of our options, and then choose the best course of action. Predicting consequences can sometimes be straightforward, like the anticipated cost of a habitat structure or efficacy of a well-researched

▼ Two southwestern pond turtles bask on a log.



Credit: U.S. Fish and Wildlife Service Pacific Southwest Region.



predator exclusion device. Other predictions, like the fate of a species, are much more complex. This is where modeling and forecasting come in.

Our group of scientists, some from the University of Florida and the U.S. Fish and Wildlife Services (USFWS), tapped into these prediction tools to help support the listing decision of two turtle species—the northwestern and southwestern pond turtle—under the Endangered Species Act. These two at-risk species, which spend most of their lives in or around the water, face the threat of drought, among other factors.

Evidence-based decisions

The Endangered Species Act (ESA), a key piece of environmental legislation in the United States, aims to conserve and protect the country’s most at-risk species and their habitats. It provides protections to species classified as endangered or threatened, the definitions of which are based on the apparent risk of extinction.

In recent years, the decision-making process for listing species under the ESA has become more formalized and evidence based through the Species Status Assessment (SSA) framework. The framework provides comprehensive, best available information on a species, its status and relevant uncertainties. The SSA is presented to decision makers at the time of classification as a support science document, independent of policy or conservation action. SSAs include projections of species status, often in the form of probability of extinction, or inversely, probability of persistence. Scientists have increasingly used population viability analyses in SSAs, as they are flexible tools that can incorporate a variety of information and uncertainty.

From 2021 to 2023, we worked iteratively with a group of species experts from universities, state and federal agencies and others, to develop population viability models for the northwestern and southwestern pond turtle, to inform their [joint SSA](#).

Two species, many threats

The northwestern (*Actinemys marmorata*) and southwestern pond turtle (*Actinemys pallida*) are semi-aquatic freshwater turtles native to the western United States. The northwestern species is found in Washington, Oregon, Nevada and Northern California, while the southwestern species is



Credit: U.S. Fish and Wildlife Service Pacific Southwest Region.

found in central and southern California and Baja, México. Once considered a single species—the western pond turtle (*Actinemys marmorata*)—the two species were formally split in 2015 following a comprehensive genetic analysis.

▲ A researcher holds a juvenile southwestern pond turtle during a survey. Handled with all proper permits.

Whether one or two species, these turtles have been of conservation concern for decades. In 1992, the USFWS was petitioned to consider the then western pond turtle for listing under the ESA. Although the USFWS determined listing was not warranted, concern for the status of the species remained. In

▼ Just-emerged hatchling pond turtles.



Credit: U.S. Fish and Wildlife Service Pacific Southwest Region



Credit: Jeff Lovich, U.S. Geological Survey

▲ Remains of a southwestern pond turtle following a large fire and years of drought in Elizabeth Lake, California.

1996, the International Union for Conservation of Nature classified the species as “vulnerable”—a title that indicates a level of concern but does not afford any legal protections. Washington state has designated northwestern pond turtles as endangered since the late 1990s, when populations nearly went extinct due to a respiratory disease, among other factors such as habitat loss. Today, those Washington populations are largely reliant on head-starting and other conservation measures. Since previous assessments, threats to both species throughout their ranges have persisted and, in some cases, worsened, leading to a 2012 petition for USFWS to again consider the species for ESA protections.

Despite being different species, the life histories of northwestern and southwestern pond turtles are similar. The turtles thrive in slow-moving or still freshwater habitats, such as ponds, marshes, rivers and canals. With dark, mottled shells, they camou-

flage well in their aquatic environments. They rely on external temperatures to regulate their body heat and, as a result, are often found basking on sunny days. While the turtles spend most of their lives in and around water, females also use upland habitats to nest and lay their eggs. After hatching, young turtles find their way to nearby freshwater habitats, facing numerous threats such as predation from both native and nonnative species until they reach adulthood. Adult turtles have notably higher survival rates than hatchlings and juveniles, with lifespans up to 50-plus years in the wild. Despite the high survival of adults, threats such as habitat loss, road mortality, drought, wildfire, invasive species and disease, among others, increasingly pose a risk to the persistence of these species.

Predicting extinction risk

To predict the future status of these turtles, we constructed a population model tailored to the species’ life history. We built a stage-structured, female-only population viability analysis to project the abundance of three life stages—hatchlings, juveniles and adults—and the probability of extinction to the end of the century. We used various modeling techniques to account for multiple types of uncertainty. Because the range of both species is so large, we broke down each species’ range into smaller spatial analysis units. The boundaries of each unit, determined by USFWS and species experts, were based on a combination of genetic, management and ecological information. The model predicted abundance and probability of extinction for each spatial unit and for the entire species’ ranges.

Since a myriad of factors threaten the survival of these turtles, choosing which threats to include in the model required careful consideration. The selection of these factors was based on two main criteria: availability of information and severity of the threat. More impactful threats with lots of information, for example, were favored over those with less information and smaller effects. [Previous research](#) listed the ranked threats to both species based on appearance in peer-reviewed, gray and unpublished literature. The authors of the paper scored each threat by the number of mentions and descriptions of gravity of the threat. We compared the top-ranked threats with literature and information provided to the USFWS to determine which threats had information compatible with a predictive population model. With the support of species experts,



three threats seemed most appropriate to include in the model: drought, invasive species—specifically, the American bullfrog (*Lithobates catesbeianus*)—and habitat loss.

Climate change has, and will continue to alter the timing, duration and intensity of droughts in the western United States. Species that rely on freshwater—like the northwestern and southwestern pond turtles—are particularly vulnerable to droughts. Simply put, no freshwater equals no freshwater species. Both the intensity and duration of droughts negatively affect the survival and reproduction of the northwestern and southwestern pond turtles. We cross-referenced studies on the effects of drought on the turtles with publicly available data from the U.S. Drought Monitor and found that moderate and extreme-severity droughts have negative effects on the species. During moderate droughts, the species are somewhat resilient, not experiencing a reduction in survival until the fourth year of a continuous moderate drought. Extreme droughts, however, begin to impact the species as soon as the first year, getting worse each year the drought continues.

After incorporating the status and effects of drought, invasive species and habitat loss, the model predicted the probability of extinction and abundance for both species to the years 2050, 2075 and 2100. Despite variation in starting population sizes, all analysis units for both species are predicted to precipitously decline. By 2100, there's a predicted 50% chance for the northwestern pond turtle to become extinct. In other words, a coin flip if the species will be around in the year 2100. The future status of the southwestern species is predicted to be even more dire, with an extinction probability of 75% by 2100.

Sensitivity analyses determined which life history stage is most influential over population growth and which threat poses the greatest risk to species' persistence. Adult turtles were most important for population growth rate, meaning conservation efforts focusing on adults would be most fruitful for populations. The feasibility of efforts for protecting adult turtles, however, is tenuous, as the turtles often live longer than the lifespan of a research or conservation program. In terms of threats, we found that invasive bullfrogs and drought pose the greatest risk to northwestern and southwestern species, respectively.

Modeling for conservation

After nearly two years of work, the turtle models and results were incorporated into the SSA for the northwestern and southwestern pond turtles. The SSA served as the primary support science documentation for the classification decision for these two species. In October 2023, the USFWS published a proposed rule to list both species as “threatened” under the ESA. The USFWS is currently working to address public comments on the proposed rule. When the final rule is published and if the species are officially listed, they will receive significant federal protections under the ESA. The USFWS will then develop a recovery plan, identifying actions to improve the status of the species and benchmarks for recovery.

Ultimately, our work to assess the extinction risk of these freshwater turtles played a role in the broader conservation of the species, a task that will no doubt take an immense collective effort. The SSA for these turtles, including a detailed description of our model, associated [journal articles](#) and [model code](#) are all publicly available. Broadly, we hope that this work will help provide guidance on how to forecast extinction risk for at-risk species facing multiple threats, accounting for many sources of uncertainty. ■



Kaili M. Gregory is a PhD student at the University of Georgia studying decision analysis and population modeling. She completed this work as part of her master's thesis at the University of Florida. She is a member of TWS' Biometrics Working Group.

Catherine Darst leads the U.S. Fish and Wildlife Service program for determining species status under the Endangered Species Act for California and Nevada. She completed her bachelor's degree at University of California at Davis and PhD at University of Texas at Austin.

Samantha M. Lantz is an assistant field supervisor in the Ventura field office of the U.S. Fish and Wildlife Service. She completed her undergraduate work at Willamette University and PhD at Tulane University.

Katherine Powelson is a partnership coordinator with the U.S. Forest Service, stationed at Tahoe National Forest. She contributed to this work during her previous position with the U.S. Fish and Wildlife Service's Science Applications program.



Conor P. McGowan is an assistant unit leader for the Florida Cooperative Fish and Wildlife Research Unit with the U.S. Geological Survey. He is a member of TWS' Biometrics working group.

Restoring Rivers and Riparian Areas in Sweden

A SHIFT TOWARD SUSTAINABLE INTEGRATION OF THE TWO IN CONSERVATION

By Samuel J. Shry, Jeffery D. Marker, Jacqueline H.T. Hoppenreijts

The Vindel River Valley in northern Sweden is known for its meandering rivers, a rich tapestry of wildlife and some of the European Union’s last remaining old-growth forests. The poster children of wildlife conservation and habitat protection efforts in this area are not the usual large

and iconic mammals, but specific species of plants, invertebrates and fish. These include the macrophyte *Persicaria foliosa*, invertebrates such as the Great Raft Spider (*Dolomedes plantarius*) and the freshwater pearl mussel (*Margaritifera margaritifera*), as well as predators such as the Atlantic salmon (*Salmo salar*) and European bullhead (*Cottus gobio*). These diverse groups of organisms structurally and functionally support freshwater ecosystems, as they are inextricably linked across the freshwater-riparian boundary (Hoppenreijts et al. 2023). Freshwater water bodies and riparian zones provide each other with nutrients and habitat—and ultimately create a resilient system that is able to adapt and absorb environmental changes and disturbances.



Credit: photo from Järnvägs museet, ID JvmKCAC13723



Credit: Jacqueline Hoppenreijts

The Vindel River Valley is a designated Natura 2000 site, where Sweden is dedicated to preserving its unique biodiversity. Roughly 15% of the country’s land is protected through national parks, nature reserves and as part of the EU’s Natura 2000 program—an EU-wide network of protected areas established to conserve Europe’s most threatened habitats and species.

With around 100,000 lakes and 500,000 kilometers of rivers and streams, Sweden has an abundance of freshwater wildlife and an enormous potential to preserve freshwater biodiversity. Next to the above-mentioned species—as not all of those spend parts of their lives in the riparian zone—

◀ Two major types of freshwater and riparian disruption in Västernorrboten, Sweden. Top: timber floating in Liden in 1941. Bottom: impoundment of the Grundfors power station, built in the 1950s.



species such as the Green club-tailed dragonfly (*Ophiogomphus cecilia*) and the Eurasian otter (*Lutra lutra*) are typical examples of species that spend large parts of their lives in-stream, but also use riparian zones to fulfill their life cycle. However, as in other parts of the world, industrialization effects via timber floating and rapid expansion of hydropower have created unique pressures on streams, rivers and riparian systems over the past 100 years. Today, dams fragment many Swedish rivers, leading to lower biodiversity in-stream and on land. Simultaneously, peat and timber production have led to drainage of wetlands and the development of an extensive ditch network, causing stream channelization and rerouting of natural flows.

However, the tides are turning. Policy shifts, such as the aforementioned Natura 2000 areas, the EU's Water Framework Directive and Sweden's national plan for hydropower relicensing, have begun rehabilitating Swedish rivers and riparian areas toward a more natural state. Fish-passage solutions, stream and flow restoration and even dam removals are becoming increasingly common as Sweden tries to balance sustainable development and environmental integrity.

Looking into the Swedish riparian system

Riparian vegetation looks different throughout Sweden's climatic zones. In the temperate south, lush deciduous shrubs and trees scatter throughout the landscape, while in the boreal north, Scotch pine and Norway spruce—don't let yourself be fooled by their names; these species are native to Sweden or have been around for centuries—prevail below the tree line. A large variety of sedges and rushes grow closest to the water, stretching into the forests as far as the peaks of the flow regime allow. Especially in the north, riparian vegetation is one of the most species-rich components of the ecosystem. Narrow or wide, along a small first-order stream or along the majestic Vindel River, it determines the functioning of the riparian zone. That means that



Credit: Jacqueline Hoppenreijts



Credit: Jacqueline Hoppenreijts

riparian vegetation controls the quality of habitat for other organisms as well as chemical and physical buffering of water flows. While regulation for hydropower production and timber floating has degraded many riparian zones, parts of the Vindel River Valley area underwent process-based restoration. While these restoration efforts were targeting in-stream organisms, riparian vegetation was also certainly affected.

Moving up a level on the ecological pyramid, there's a highly diverse invertebrate species pool in the riparian zone, perhaps more diverse than one would expect in the cold Swedish climate. There is no better illustration of this than the data researchers collected from the Swedish Malaise Trap Project,

▲ Two streams in the Vindel River catchment. Top: Bjurbäcken, channelized. Bottom: Mösupäcken, previously channelized and now restored in the Vindel River LIFE project.



Photos provided by Ebbe Berglund

▲ Left: Marieberg hydropower station before removal. Right: Mörumsån River after removal of the power station.

a long-term project intended to support a country-wide invertebrate taxonomy initiative (Karlsson et al. 2020). So far, this project has collected over 20 million insects and has identified over 4,000 unique species. Over 75% of the specimens collected in this project are represented by the flies, and the dominant family identified within this group includes an extremely important, often overlooked, fundamental piece of freshwater ecosystems: the nonbiting midges. These tiny creatures serve as indicators of ecosystem health, reflecting the overall condition of freshwater habitats, and they play a vital role in nutrient cycling, water filtration and food webs. They also make up a huge proportion of prey for a wide range of Swedish freshwater and riparian wildlife, symbolizing the many interactions between freshwater and riparian communities.

Continuing up the chain, fish enjoy the benefits from riparian vegetation cooling down stream water and from invertebrate prey foraging on riverbanks and hatching in the water. Fish and water conservation are basically inseparable. Fish survival, breeding and migration are intricately linked to aquatic conditions affected by connectivity, pollution and urbanization. Riparian zones provide habitat and prey inputs and can improve water quality, creating a valuable environment for fish. In Sweden, river restoration efforts have historically been—and to some degree still are—centered around economically valuable fish species, primarily Atlantic salmon. Because of their economic and cultural value, most of the habitat restoration, fish

passage solutions and fishing regulations have been enacted to preserve this species. Salmon act as indicator species for restoration efforts in that once salmon return to a stretch of river, the ecosystem is often considered functioning once again. This ultra-simplistic view is often the basis of river restoration efforts in Sweden and should be improved to encompass ecosystem function across a broader range of species. Only recently, in the late 1990's, have fish passage solutions for nonsalmonids been incorporated at barriers (e.g., nature-like fishways instead of fish ladders). Restoration goals should encompass not only economically important species, but creation of a functional and sustainable river system to improve connectivity and habitat for all native fish species, as well as other species groups. Restoration of freshwater ecosystems and their riparian zones is ongoing, and today, managers are beginning to restore these environments to improve ecosystem functioning rather than focus on single-species solutions.

Undoing channelization in northern Sweden

Before semi-trucks and large cargo trains entered the scene, rivers such as the Vindel River facilitated large-scale timber transport in Sweden. Stone piers and booms guided timber harvested at the foot of the Scandes Mountains through the straightened streams and to the Gulf of Bothnia as fast as possible. The fast flow and physical changes in the streams significantly altered the aquatic life they supported. Riparian zones decreased or were



completely replaced by piles of stones, and populations of the freshwater pearl mussel and fish such as brown trout (*Salmo trutta*), Atlantic salmon and European grayling (*Thymallus thymallus*) declined due to a lack of spawning habitat and shelter.

The EU-funded Vindel River LIFE project aimed to restore the conditions for these species by increasing in-stream physical complexity. Not only did the project focus on removing piers and booms, but it also included the addition of large boulders, spawning gravel and dead wood to the streams. This didn't happen throughout the entire Vindel catchment, but in a significant enough number of streams for follow-up studies to be possible. While it's visible from photos that the streams' natural state and riparian width have increased, the effects across different species groups and especially riparian vegetation were not as clear (Nilsson et al. 2015). This is partly due to a lack of early and consistent monitoring of vegetation at these sites. However, the widening of these riparian zones usually leads to them harboring more species—and, interestingly, the different sites have developed their vegetation in quite different ways, thereby increasing diversity on the landscape scale. In-stream, process-based restoration for one group of species may lead to positive and occasionally unexpected results for other groups, which suggests that there is a lot of low-hanging fruit in terms of maximizing effect while making only minimal extra effort.

Dam removal restoration

In order for rivers to function properly, they must be unobstructed, allowing for natural variation in flow, water levels and temperature throughout the seasons. Dams do not only block flow but stagnate this natural variation and impede river connectivity for migratory aquatic species. The environmental costs of hydropower have been well documented; and today, many countries around the world are removing unnecessary dams to restore river connectivity and function.

The Marieberg hydropower station, located in a Natura 2000 area in southern Sweden, is one instance where this restoration measure has been implemented. In 2020, this dam was removed in order to improve the surrounding riverine habitat for both aquatic and terrestrial flora and fauna. Many valuable plant, mussel, fish, bird and mammal

species rely on this river for habitat and sustenance, and conservation action was deemed necessary to sustain these species. Just a year after removal, benefits of this restoration action were already noticeable in the salmon smolt migration to sea (Shry et al. 2024). Everything from Atlantic salmon to freshwater pearl mussels to European otters (*Lutra lutra*) can now inhabit a more natural river ecosystem due to this restoration effort. This includes riparian species, such as Hairlike claw moss (*Dichelyma capillaceum*), that profit from large but infrequent flooding rather than the frequent disturbances that flow regulation causes.

Becoming wilder

Moving to this new and integrated view on ecosystem restoration creates opportunities to support the return of threatened species as well as restoring the web of interactions that they are a part of. Moreover, this type of restoration often relies on the environment to rewild itself over time. This is often not only more effective but is usually more sustainable than focusing on one species or one problem in an ecosystem. The interactions between riparian and freshwater aspects of an ecosystem need to be integrated in conservation and restoration to further increase success. The two examples indicate that, indeed, more than one species profits from conservation and restoration and that our rivers become wilder with each passing season. ■



Sam Shry is a PhD student at Karlstad University, Sweden. His research focuses on management of diadromous fish, specifically impacts of hydropower on riverine migration and how fish passage solutions and river restoration can be implemented to mitigate these impacts.



Jeffery Marker is a food web, community and spider ecologist focusing on the effects of forestry on riparian ecosystems. He received his PhD degree in December of 2023 from Karlstad University in Sweden.



Jacqueline Hoppenreijns is a community and landscape ecologist with experience from a range of taxa and ecosystems. She received her PhD degree in September 2024 from Karlstad University, Sweden, and currently works on the effects of hydrology and flow regulation on riparian vegetation.



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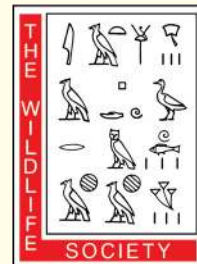
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Edmonton, or as it is known in my nation's language (Cree/Nehiyaw) **amiskwaciwâskahikan**, means **Beaver hills house**. To honour the name we use for Edmonton, I choose the animal representation to be our cousin Beaver, and within its body is our written language also known as spirit markers (syllabics)—we are taught that our people and our language originate in the stars and that we are ever-connected to the celestial realm through our spirits and our ancestors. Our four direction colors are red, yellow, blue and white. The text color choices reflect our four direction colors and the arch of the text represents the “hills house.” The syllabics listed in the writing are for the word amiskwaciwâskahikan.



A River Used to Run Through It

WATER AND WETLAND CONSERVATION IN THE INTERMOUNTAIN WEST

By Casey M. Setash and James R. Lovvorn

Credit: Jim Lovvorn

After a cinnamon teal (*Spatula cyanoptera*) duckling hatches in a nest along an irrigation ditch in western Montana, it could spend its entire first year of life in the wetlands of the Intermountain West. It may fledge with surviving members of its clutch in a stock pond rimmed with bulrush. It might then migrate south to Bosque Del Apache National Wildlife Refuge in New Mexico, stopping to fuel up along the way in a beaver pond in Yellowstone, and later a flooded impoundment in the San Luis Valley of Colorado surrounded by sand-hill cranes (*Antigone canadensis*). Although these wetlands differ greatly when it comes to hydrology, they share many common conservation challenges and immeasurable importance—especially for wildlife—in the increasingly arid landscape of North America’s Intermountain West.

As urbanization abounds, people are siphoning water for their own usage, which inadvertently affects waterbirds. At the same time, climate change is creating dry conditions in the Intermountain West. Wildlife biologists recognize these

challenges and are working to maintain wetland habitats in creative ways. Researchers studying waterbirds in flood-irrigated agricultural lands are starting to understand where, when and for how long land managers should flood to benefit wetland-dependent species. They are also starting to highlight the crucial role landowners—and their water rights—play in waterbird conservation. Using the results of on-the-ground research, conservationists are working with landowners to maintain irrigation infrastructure that holds and moves water on the landscape to benefit both birds and humans.

Shifting waters

Wetlands are a pivotal component of wildlife habitat in the Intermountain region during each period in the annual cycle of a waterbird—like the cinnamon teal. From the breeding season through southbound migration, wintering and returning north, every waterbird needs wetlands every day.

Historically, the spring brought snowmelt from the mountains via rivers and their tributaries to

▲ An impounded wetland with emergent stands surrounded by flood-irrigated fields in the Green River Basin, Wyoming.



Credit: Jim Lovvorn

▲ A flooded basin with emergent vegetation, perhaps partly impounded, within an arid shrub-steppe environment in the Wind River Basin, Wyoming. This photo highlights how different each basin throughout the Intermountain West can be in its hydrology and why it is therefore difficult to generalize best wetland/wildlife management practices across basins.

flood oxbow lakes, wet meadows and small basin wetlands. These floods inundated land where seed-producing plants had grown the previous year, making those seeds available to foraging waterbirds fueling up on their northbound migrations. The floods would have initiated reproduction in aquatic invertebrates that supplied valuable protein to their many consumers. Often bordering upland sagebrush steppe, the wet meadows grew dense grasses and forbs that provided nesting habitat for waterfowl and shorebirds as well as foraging habitat for broods of greater sage-grouse (*Centrocercus urophasianus*) hatching throughout the summer. Mudflats scoured by spring floods and exposed by receding water later in summer provided seeds and invertebrates once again to newly-fledged shorebirds on their first migration south.

This cycle looks somewhat different in the Anthropocene, with most components altered in some way to benefit humans. People quickly siphon spring runoff into irrigation canals to flood hay and rice meadows for agriculture rather than native grasses and forbs. In some places—like the many national wildlife refuges across the West—managers flood human-made impoundments or basin wetlands annually to benefit wildlife, again via irrigation canals. But in others, water is drawn into reservoirs and piped to cities to assuage the thirst of growing human populations.

Waterbirds have responded to these changes. These days, northern pintails (*Anas acuta*) move from the flooded rice fields of California's Central Valley through the irrigated pastures of southern Oregon on their way north. In North Park, Colorado, local residents call Arapaho National Wildlife Refuge "The Duck Factory," as ducks seem to prefer its artificially-flooded ponds to the surrounding meadows of Timothy hay. In Idaho, white-faced ibises (*Plegadis chihi*) nest in tall emergent vegetation around the perimeter of managed lakes, but commonly feed in temporarily flooded agricultural fields in the surrounding area.

Human-made havens?

As climatic drying reduces the overall footprint of semi-permanent wetlands that wildlife need across the landscape, irrigation-associated wetlands provide some of the most extensive remaining habitat to those wetland-dependent species (Donnelly et al. 2022). For example, Wilson's phalaropes (*Phalaropus tricolor*) are declining steeply across the Great Salt Lake region, but are locally abundant in the flood-irrigated basins of Colorado associated with hay. In the early 2000s, researchers from the University of Wyoming found that a whopping 65% of wetland inflows in the Laramie Basin stemmed from irrigation, both as surface flow from ditches and by percolation from so-called "inefficient" (or unlined) ditches that allow water to seep out through permeable soil (Peck and Lovvorn 2001). Unlined ditches sometimes get a bad rap among water conservationists worried about the massive proportion of water going to the inundation of agricultural lands, but indirect benefits such as wetland recharge are often overlooked (Knight 2024)

But are agriculture-driven or otherwise anthropogenic wetland types always beneficial to waterbirds? Casey Setash led a group of researchers from Colorado State University and Colorado Parks and Wildlife to determine whether cost-sharing programs—like those Ducks Unlimited, Inc. (DU)



initiated to refurbish or install flood irrigation infrastructure—benefited ducks. The results contradicted the narrative that flooded hay meadows were equally as valuable as more natural wetland types to breeding (versus migrating) ducks. In flooded hay meadows, ducks had less food available to them (Setash et al. 2024) and selected nest sites far less than other habitats (Setash et al. *in press*). The vegetation community in hay meadows was also less diverse than that of wet meadows, often comprised of fewer sedges, rushes, forbs and litter. Unharvested wet meadows, on the other hand, were more reminiscent of historical flooded meadows. But the researchers found that human-made wetlands did provide a unique benefit to the ducks. Irrigation ditches acted as superhighways for hens with ducklings. They used them to move between wetlands during the especially vulnerable first days of life and congregated in safer, more stable waters like those of small reservoirs. In general, these findings have redirected the main focus of upcoming DU projects away from flooded hay meadows and toward small basin wetlands or impoundments.

The reasons for this focus shift are complex and nuanced, but come down to the fact that the ways flood-irrigated hay meadows function as wetlands are simply not the same as other types of wetlands. Hayfields are typically inundated with snowmelt runoff in May and June and drained and harvested in July. This practice has long provided habitat for birds migrating northward through the arid West. But elimination of flooding and nesting cover by harvest in mid-summer curtails breeding in many waterbirds. Temporary flooding (*i.e.*, from May to early July) generally does not promote tall emergent vegetation that overwater nesters need or the dense cover in an otherwise shortgrass steppe landscape that upland nesters seek. Species of ibises, herons, egrets, bitterns, rails, grebes, coots and diving ducks—some designated as species of greatest conservation need in Colorado and Wyoming—nest in this type of vegetation (Colorado Parks and Wildlife 2015; Wyoming Game and Fish Department 2017). Several of these species, as well as trumpeter swans (*Cygnus buccinator*), feed on submersed vegetation which also requires prolonged flooding.

The habitats these species need are most often found in impoundments on state or federal wildlife areas or in small reservoirs where irrigators store



Credit: Derek Christians (Campus Waterfowl)

water through summer to hedge against drought within or between years. As climate warming decreases snowpack runoff in many areas and greatly increases evapotranspiration, irrigators and municipalities alike have often called for increased water storage at a local scale. These appeals are generally not driven by concerns for wetland wildlife, but may present important win-win opportunities for maintaining or expanding habitat.

▲ Casey Setash searches for duck nests in the wet meadows of Arapaho National Wildlife Refuge in North Park, Colorado.



Credit: Jim Lovorn

▲ Flood-irrigated fields in the Laramie Basin, Wyoming, early in the spring at the start of the hay growing season. Ranchers typically graze hayfields after harvesting them in mid-summer, so this image shows what hayfields in this area typically look like both before and after a season of growth and harvesting (*i.e.*, there is often little to no residual cover for either early or late nesting).



Credit: Charlee Manguso

▲ Cinnamon teal drake in a basin wetland on Arapaho National Wildlife Refuge in North Park, Colorado.

‘Buy and dry’

In the past, win-wins between wetland wildlife and people may have been hard to come by in the arid West, where water rights have long been sacrosanct. But now, severe water shortages are creating pressure on states to decrease water use for irrigation to meet legally mandated deliveries to other states.

In the Colorado River Basin, an ongoing experiment funded by the 2021 Infrastructure Investment Jobs Act pays landowners on a year-by-year basis to forego irrigating their fields to allow more water to flow downstream to drought-stressed users ([System Conservation Pilot Program, or SCPP](#)) One rancher in the upper Green River Basin of Wyoming, a tributary basin of the Colorado River, reported that she made 13 times the profit from such payments than if she had grown hay by flood irrigation ([Hager and Sackett 2024](#)). But these reductions in irrigated areas will likely come at the expense of wetlands dependent on local irrigation.

It’s unclear whether Congress will reauthorize the SCPP payments. And what’s more, in many western areas the extent of flood-irrigated hayfields is declining. Profit from growing hay can be marginal, the average age of ranchers is increasing, their descendants or other family owners often do not want to maintain the ranches, and the economic incentive to sell land to housing developers is great and growing. At the same time, many western cities are seeking to purchase properties for the water rights. As an alternative, directly paying landowners not to irrigate may become an option that circumvents the owners’ reluctance or legal barriers to selling land ([Dilling et al. 2019, Varzi and Grigg 2019](#)).

State regulators are increasingly resisting this so-called “buy and dry” process because of the adverse impacts on local economies, rural communities and the environment. However, the forces behind it are powerful and mounting in the long term. Strategies to help landowners continue irrigation, perhaps by locally storing water to get through more frequent droughts, are necessary to maintain wetland habitats both during migration and through the breeding season. Western water law generally does not allow annual storage of water that exceeds the amount of “consumptive use” of evapotranspiration by crops. That’s because return flows—water that is applied but drains back into ditches—are obligated to users downstream.

As about 80% of water use in the West is devoted to irrigated agriculture, there are growing calls for changes to water laws that would facilitate the transfer of water from irrigation to other uses (*e.g.*, [Dilling et al. 2019, Varzi and Grigg 2019](#)). However, water rights are the domain of state—not federal—laws, and openness to such changes varies greatly among states ([Richter et al. 2017](#)). In many cases, proposals to amend water laws would encounter heavy resistance.

Wildlife advocates have strongly promoted the notable benefits of “inefficient” flood irrigation, which creates important habitat during spring migration ([Donnelly et al. 2024](#)). Moving forward, the need of many species for summer-long flooding and related vegetation, the ever-growing water shortages, and resulting economic pressures will demand similar recognition and management solutions during the breeding season. Establishing more steady water supplies with small storage reservoirs that also function as wetlands may be a strategy that can attract support from multiple users.

Win-wins

In this period of rapid change in climate and human populations, attention to water, wetland and water-bird conservation in the West is critical. Research measuring how and whether specific water conservation strategies are beneficial to wildlife will be especially important in the near term, so that such programs can be incorporated into evolving plans to manage water.

So far, researchers have mainly studied the trade-offs of allocating water to various wetland types in terms of ducks. Few data are available on the nesting



habitat and diets of other waterbirds. We know that high evaporation rates, variable flooding regimes and resulting salinities are key drivers of plant and invertebrate foods as well as vegetation for nesting (Lovvorn 2023). But work is needed to evaluate how flooding schedules and intermittent droughts affect seed germination and survival of tall emergent vegetation, and the persistence and recolonization of invertebrates. The few existing studies indicate that because of highly unstable water levels, waterbirds in this region are often nomadic in searching for suitable habitat in a given year. As a result, in addition to developing methods to produce complexes of different wetland types locally, consideration of wetland availability at the landscape level over time is also needed.

Finally, it is important to note that often something is better than nothing in these arid systems. Without the historical presence of cattle ranches and flood-irrigated hay meadows, what would replace them? Low-density ranchettes that bring along invasive species, thirsty humans and fragmenting roads?

In a time of polarizing black-and-white viewpoints, cinnamon teal and other wetland wildlife live and

die in the colorful, nuanced in-between of wetland management. Climate change and the resulting altered wetland dynamics are not going to be all good or all bad. There is a wide spectrum of how bad it might get, which gives natural resource managers the flexibility to focus on solutions—no matter how small—to provide win-wins for humans and wildlife, and to exercise our skills to manage finite resources in science-driven, effective ways. ■



Casey M. Setash, PhD, is an avian researcher for Colorado Parks and Wildlife in Fort Collins, Colorado.



James R. Lovvorn, PhD, is an emeritus professor in ecology at the University of Wyoming.

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Educating Ecotourists

CAN ZONOTIC DISEASE KNOWLEDGE MAKE FOR BETTER ECOTOURISTS?

By Eileen Keating

Ecotourism, in its simplest form, is an activity that connects humans with nature while educating people on conservation needs and about the local community. As individuals who partake in this activity, we need to ask ourselves: Am I a good ecotourist or a bad ecotourist? If ecotourism at its core is meant to decrease the negative impacts on the environment while increasing people's bond with nature, to be a good ecotourist, you would need to aim to limit your impact while enjoying your activity.

Achieving this connection while avoiding negative impacts on animal welfare can be challenging, as

can enforcing the regulations put in place to keep tourists and nature safe. I recently experienced this firsthand while traveling in Costa Rica for a graduate course to learn about ecotourism from local community partners paving the way in the field. My very first field journal entry reflects on how I feel ecotourism is a force in the future of conservation. "Ecotourism has the ability to make a direct connection between the tourist and a conservation effort, raising both awareness and much needed funding," I wrote. Travel can benefit communities and the environment while deepening one's understanding of what nature needs. However, throughout my next several journal entries, my heartbreak becomes



► The turtle conservation center in Costa Rica, in the early morning hours after an all-night patrol.

Credit: Eileen Keating



evident. “I have heard for years that Costa Rica is paving the path for ecotourism and I could not wait to visit and see this in action,” I wrote. “If this is the top tier of ecotourism, what is the future for the animals we are trying to protect?”

In the face of increasing zoonotic diseases—diseases transmitted from animals to humans—it’s more important now than ever to enforce ecotourism regulations. Coming into too close contact with a wildlife species can be the start of a health crisis, as we’ve seen in the case of the recent COVID-19 pandemic. But there can be ways to reap the benefits of ecotourism while being safe.

Turtle tourist disturbance

At a turtle conservation center in a remote area of Costa Rica, tourists from all over the world learn from the local community that runs the rustic accommodations and educates tourists on the importance of sea turtle conservation. Each tourist becomes an environmental steward by joining evening patrols to watch the awe-inspiring site of a massive leatherback sea turtle (*Dermochelys coriacea*) emerge from the ocean to lay its eggs. Meanwhile, scientists collect, log and protect the eggs of this vulnerable species. Prior to the patrol, local guides educate ecotourists about the sea turtle’s sensitivities to sounds, vibrations and lights and how this can negatively impact their ability and willingness to lay their eggs. Then, the guides lead the groups and enforce rules, including prohibiting people from touching the wildlife or taking photographs and requiring tourists to remain quiet and still.

During the two times that my fellow graduate classmates and an additional group of middle school students joined the overnight beach patrols, I watched how the excitement from the emergence of a sea turtle overrode the enforced rules and violated the sea turtle’s peace. The middle school children and parents swarmed the turtle, disregarding all instructions by talking loudly, touching the turtle and disrupting egg-laying. Unfortunately, the conservation graduate students behaved in much the same way. The guide seemed enervated but also seemed resigned to what seemed a regular—and expected—occurrence.

The sight of watching a sea turtle move its body out of the water and onto the beach with great



Credit: Eileen Keating

effort, hearing it slap its fins on the sand and the huffs of its breaths as it digs a hole for its eggs before returning to the ocean inspires awe. It is understandable that my fellow citizen scientists had difficulty containing their excitement on patrol. But if ecotourists cannot be trusted to protect the animals they came to see, what does that say about ecotourism?

Preventing disease

I have reflected on my experiences in Costa Rica and how ecotourists might be able to improve their behavior and ethics to help minimize the negative impacts on animal welfare. After reviewing the websites of ecotourist attractions I visited in Costa Rica and talking to local tour guides, I found that neither mentioned zoonotic disease prevention and safety. Shedding light on the influence humans have on zoonotic spillover risk may help create a healthy boundary between humans and animals. Conservationists can use tailored zoonotic disease education to help decrease the risks tourists cause to wild animals.

After the global pandemic of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), healthcare professionals, conservationists and the public are more acutely aware of the catastrophic abilities of zoonotic disease. Up to 75% of all human infectious disease pathogens are zoonotic in origin, including Ebola, salmonella, rabies and certain influenza strains (Ellwanger 2021; Esposito 2023).

▲ A group of graduate students on a midnight patrol for sea turtle conservation guided by the light of a full moon.



Zoonotic diseases are also transmissible from human to animal, commonly called reverse zoonosis (Ellwanger 2021).

The Center for Disease Control (CDC) website provides information about disease risk and transmission for travelers. The website also has a [generalized section](#) labeled “Avoid Animals,” which gives a broad overview of what animals in various countries could carry, with additional information on each disease—including details on transmission, symptoms and what to avoid, along with vaccines and preventative measures. One common theme on traveler preparation websites is the advice to not touch or interact with wildlife. Many travelers, even eco-conscious travelers, neglect to educate themselves prior to travel or

ignore guidelines and restrictions regarding wildlife. Do you know which diseases you are at risk of spreading? Or the precautions that could be taken prior to and during your travel?

In a study from 2022, researchers found that tourists often accept more risks while traveling, including interacting with wildlife, than they would at home. The authors surveyed tourists to gauge their level of knowledge of these risks and understanding of the implications of their actions. Tourists with a pro-environmental mindset took measures to prevent human to wildlife disease transmission; 87.28% of those surveyed had knowledge of zoonotic and reverse zoonotic diseases. However, most did not seek advice on health-related risks prior to traveling, and 13% of the surveyed individuals had infectious disease symptoms during travel. Of the 13%, over 50% had direct contact with a nonhuman primate, which is often more susceptible to disease transfer from or to humans. Lastly, 76% of all polled wanted to touch primates, and 43% wanted one as a pet (Muehlenbein 2022), showing that education and a pro-environment mindset are not enough for disease prevention.

In a time increasingly dominated by social media, tourists are willing to break rules and safety precautions to obtain the perfect social media post. This includes crossing barriers, feeding wildlife and coming into direct contact with animals (Esposito 2023). The World Animal Protection Organization (WAPO) conducted a survey of over 34 billion images on Instagram and found tens of thousands of wildlife selfies (Esposito 2023). To help tourists and wildlife stay safe, the Jackson Hole Travel and Tourism Board has launched a [selfie control](#) filter that notifies people when they are at an unsafe distance from wildlife and has made the coding for the app available for others to create a similar feature. Instagram has also added pop-up features to educate about wildlife trafficking, and many organizations like WAPO have pushed education against this kind of animal exploitation. However, rules are often broken despite signage, potential fines, known risks and regulations (Esposito 2023).

Effective messaging

Messaging has proved to be a cost-effective way to increase tourist compliance with safety measures. One study looked at messaging and how that helped impact tourist compliance in regard to gorilla

▼ Prints in the sand left by a female sea turtle looking for the right spot to dig her hole prior to laying her eggs.



Credit: Eileen Keating



conservation at a tourist destination in Uganda. This ecotourist attraction is a major source of revenue for the community and government and is essential to gorilla conservation in this area. Gorillas are susceptible to zoonotic respiratory diseases from humans, so guidelines were put in place to help decrease the risk, including a set distance to be maintained between gorillas and humans (Gessa 2021).

To determine the most effective messaging, the researchers separated participants into two groups. One group received positive messaging about steps to help protect the gorillas. The other received negative messaging about the consequences and impact to the gorillas if regulations were not followed. The group that received the negative messaging had a much higher rate of compliance, showing that negative messaging, when done correctly, can be a good educational tool that is influential to tourists. This could be partly because the negative messaging generated fear in tourists that they would be responsible for the demise of an endangered animal (Gessa 2021). The tourist receiving this message and maintaining a safe distance, contributed to conservation efforts (Gessa 2021).

Gorillas aren't the exception. Other wildlife like sea turtles are also susceptible to zoonosis, whether it's chlamydia, salmonella, mycobacterium or several parasitic infections (Warwick 2013). How could ecotourism interaction at the sea turtle patrol in Costa Rica benefit from zoonotic disease education? The initial talk from the guides on rules and regulations could include information on the possibility of disease transfer through touch and close proximity to help enforce a respectful distance from the turtles. I can attest that even at a respectable distance, without touching or following, that leatherback made a lasting impression on me. This safe distance allows for that same connection with nature while decreasing the risks of exploitation and decreasing the risks of disease spillover. This change would be a win for ecotourism and conservation. ■



Eileen Keating is a veterinary technician and services manager working in elephant conservation. She is a graduate student at Miami University, studying conservation and ecotourism, with a focus on zoonotic disease education and prevention.



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Inclusion Through Accommodation

STUDENT AND FACULTY PERCEPTIONS OF ACCESSIBILITY IN A CONSERVATION DEPARTMENT

By Nia Morales and Maiya Lester

When Maiya Lester headed out into the Florida Everglades to study invasive Burmese pythons (*Python bivittatus*) as part of a Doris Duke Conservation Scholars Program—a program designed to provide undergraduate research and field experience—she had to carry a number of extra supplies with her. In addition to the radio telemetry tools and GPSs field techs had to carry, as a type 1 diabetic, she also had to take with her a lancet, insulin pump site replacement, blood glucose meter, test strips, insulin and an insulin pump controller. Most of these supplies—especially her insulin—are sensitive to temperature, which can be a challenge in climates with extreme temperatures like that of the Everglades. Since anything can happen while out in the field, Lester always brought extra supplies and carried her phone with an app that has the capability to monitor her blood sugar. With the help of her mentor, everything went smoothly, but others might not be as lucky to receive such an understanding supervisor. Without the proper accommodations, she probably wouldn't have made it through the summer field season.

▼ **Diabetic supplies.** Starting from the top left counterclockwise: lancet, Omnipod replacement, insulin pump PDM, insulin vial, test strips, blood glucose meter.



Credit: Maiya Lester

Most wildlifera wouldn't think twice about the demands of field work, whether that's working long hours, traveling extensively, hiking or camping—they're things that are expected of them that they can easily handle. But for wildlifera with physical disabilities, these requirements are tough—and sometimes impossible—to meet. Some of these individuals may need access to refrigerated medications, have difficulty hiking long distances, or can't carry heavy items.

People with disabilities face barriers even when it comes to just enjoying activities associated with the outdoors like hunting, fishing and hiking. And within undergraduate wildlife and conservation programs whose aims are to train the next generation of professionals, courses with field components often pose challenges to disabled students. Though field work usually involves some aspect of physical labor, that does not mean it must be exclusionary. Disabled individuals have been—and always will be—present within wildlife spaces.

Recently, wildlifera have put forth a significant effort to increase diversity, equity and inclusion (DEI) within the wildlife ecology and conservation fields, both in recruiting and retaining traditionally underrepresented groups—typically focusing on factors such as race, ethnicity, gender and sexual orientation, and in addressing DEI concerns in the education of future wildlife professionals (Morales et al. 2020, Morales et al. 2024). While progress has been made for some underrepresented groups, issues related to disability and accessibility within STEM are still often overlooked (Lee 2022).

Recreation hurdles

As of July 2022, 12.7% of the United States population, or around 40.8 million, identified as disabled, according to the U.S. Census Bureau (U.S. Census Bureau 2023).

It was only within the past few decades that the United States government created protective laws



for disabled people. In 1990, Congress passed the Americans with Disabilities Act, which “prohibit[ed] discrimination against people with disabilities in several areas, including employment, transportation, public accommodations, communications, and access to state and local government programs and services” (U.S. Department of Labor 2023). In the 21st century, individuals and organizations have made more of an effort to prevent the continuation of past mistakes, with the voices of disabled people being more amplified than ever through the rise of the internet and social media.

However, there is still work to be done. Discussion regarding disability throughout the United States’ history may seem disconnected from conservation, but these topics are deeply intertwined and have been for many years.

Over the decades, programs have aimed to increase accessibility and participation of disabled people in recreation. The Illinois Handicapped Deer Hunter Program, for example, started in 1989, creating a space for disabled individuals within the hunting community (Manfredo et. al 1989). In a survey of members of the program, most reported that, in general, finding accessible places to hunt was their main constraint. Despite many obstacles in their way, these hunters also reported a high sense of “togetherness, positive self-image, relationships with nature and friendship.” Many disabled individuals are also paying more than the average person for medications, medical bills and medical devices, and cannot afford to pay hundreds more for hiking, hunting or camping gear. Disabled individuals may also lack the previous experience and social belonging in the outdoors.

Disability in undergraduate programs

It is estimated that 19% of undergraduate students in the U.S. have disabilities (ADA 2023). While there is little specific information about the number of disabled students in wildlife and conservation programs, it is clear there is a growing community of disabled ecologists, highlighting the urgent need for proper representation and accessibility within the field.

There are a number of challenges that disabled students face in these programs. Many programs in wildlife and conservation require field courses, as these typically expose students to concepts that can’t be recreated in a lab setting (Chiarella 2019). However, these courses may pose obstacles due



Credit: Bureau of Land Management

to physical barriers such as rugged terrain, challenging environments or lack of facilities—but also issues that exacerbate mental, cognitive or learning disabilities, such as lack of accessible course materials, social isolation, and a lack of empathy or understanding on the part of course facilitators (Feig 2019). Traditional and stereotypical views about field work—such as the emphasis on “grit” and “endurance” despite accessibility challenges, coupled with the assumption of able-bodiedness and invisibility of disabled individuals—also pose a challenge (Chiarella 2019, Morales and Reano 2023). Undergraduate wildlife programs are designed to expose students to skills and experiences that will translate into wildlife jobs. As such, many of these same barriers students face during their undergraduate program may be experienced as they enter the career field.

A look inward

Because there is limited data about the challenges and opportunities to accessibility in undergraduate wildlife and conservation programs, we decided to take a close look at our own wildlife ecology program at the University of Florida. Our program, housed in the College of Agricultural and Life Sciences, offers undergraduate and graduate degrees in wildlife ecology and conservation with focus areas in a variety of disciplines, including management, TWS certification and human dimensions. We conducted a study to understand how students and faculty define accessibility and disability, student and faculty perceptions of accessibility in our department, and any differences in perceptions of accessibility between students who identify as disabled and those who don’t.

We distributed an online survey to all department faculty (excluding courtesy or affiliate faculty) and

▲ A recent study showed students generally had a positive outlook on accessibility in their department.



Frequency of responses related to support of students with disabilities at the University of Florida.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
It is a high priority for this department/unit administration to make our program accessible and inclusive to disabled students	0	2	4	5	2
This department/unit knows how to support disabled people with multiple marginalized identities (such as disabled students of color)	0	3	4	6	1
Department/unit faculty are willing to work with students to best accommodate their needs in courses	0	0	2	5	2

the entire undergraduate student population. This project was approved as exempt by our Institutional Review Board (Protocol # ET00020481). Out of 213 undergraduates emailed, we received 40 completed surveys. Of those, 12 respondents identified as having a disability. Of 34 faculty emailed, we received 13 completed surveys, 11 of which were teaching faculty.

A positive outlook

The results of our surveys showed that students generally had a positive outlook on accessibility in the department. Most disabled and able-bodied students felt welcomed by their peers, instructors, staff and administrators, and reported that

information about accommodations is fairly easy to access. For example, course syllabi are required to have links to the Disability Resource Center (DRC).

We specifically asked students who reported having a disability additional questions about their perceptions of accessibility in the department. First, we asked them the extent to which they felt their disability would limit them in their pursuit of their degree. Six

students responded that their disability “moderately” limited them, and four indicated their disability “slightly” limited them.

Second, we asked students about the perceptions of the extent to which the department prioritizes accessibility for students with disabilities, the extent to which the department knows how to support disabled people with multiple marginalized identities, and the extent to which faculty are willing to work to accommodate disabled students’ needs in their courses (Table 1).

An open-ended question at the end of the survey asked students to provide recommendations to improve the department’s support for students with disabilities and overall accessibility. The top mentioned recommendations included finding alternatives to physical components of field courses, making accommodations for mental health issues, and finding ways to mitigate feelings of judgment and alienation that accompany disability issues (Table 2). In addition to the more visible types of disability, interestingly, we found mental health issues to be of increasing concern. Most of the students who reported having a disability reported a chronic illness, learning disability, and/or mental health issue.

Faculty responses were also generally positive with many willing to make accommodations for students. Most respondents agreed that instructors are willing to work with students to best accommodate their needs, and they strongly disagreed with the statement “accommodations are burdensome for my ability to run my course(s).” Further, most faculty somewhat or strongly agreed with the statement, “I make reasonable efforts to accommodate students.” Many professors commented that they were willing and able to work with students but were not aware of where they could find proper information and resources to do so.

Finally, faculty were asked to make recommendations for the department. These recommendations included providing more information and guidance on how faculty can address disability issues, better physical access to facilities and more alternatives for physical field courses.

Student recommendations for improving the department’s support for students with disabilities at the University of Florida.

Recommendation	Number of mentions
Alternatives for physical field courses	8
Accommodations for mental health	5
Mitigating feelings of alienation and judgment	4
Reassurance from professors so students feel more comfortable asking for accommodations	3
Informal accommodations/flexibility	3
Physical access	3



While we acknowledge the limitations of this study—namely, our small sample size and the possibility that this program may differ from other ecology or wildlife programs—we believe the concerns raised are shared across conservation and natural resource programs. But how exactly are these recommendations to improve accessibility turned into actions?

Creating more accessible and inclusive undergraduate programs

Although disabled students must advocate for themselves in some capacity, it is also the responsibility of the faculty to foster an inclusive and nonjudgmental space for these individuals. When students feel their concerns are valid, they are more likely to communicate their needs and speak about issues that may arise (Anadu et al. 2020). While there are somewhat limited data on disability in conservation, researchers and practitioners have compiled suggestions for improving accessibility and inclusion.

A number of studies have offered suggestions for making field courses more accessible. Devitz (2023) advocates for creating equipment repositories for accessibility (*i.e.* purchasing mobility equipment and assistive technologies) to address systemic barriers to participation. Chiarella (2019) suggests providing alternatives such as tactile maps, audio field guides and sign language interpreters. Healy et. al (2002) encourage instructors to be thoughtful about course planning and provide alternatives, such as written descriptions of features, or using taps or thumps to indicate rhythms of animal calls for hearing impaired, providing videos of field sites or techniques that may be difficult to access, and investigating alternative venues that would provide opportunities for better participation without compromising learning outcomes.

Thoughtful planning of field courses is important not just to address physical limitations, but also to encourage a social learning component, where students can learn from each other through observation and modeling behaviors. Disabled students are more likely to feel isolated than their able-bodied peers (Feig 2019, Devitz 2023). Atchison et al. (2019) suggest that thoughtful selection of field sites and course components can create an environment where students can develop through shared experiences. In situations where a location is partially or fully inaccessible, synchronous or asynchronous technology (video streaming, VOIP communication, photos, or shared videos and other

files) can encourage inclusion. The researchers also note that these technologies or practices are not a panacea but should be tools within a larger framework aimed at inclusive education.

Feig and colleagues' (2019) study of a geoscience field trip found that faculty often are given little guidance or support for understanding disabilities and how to effectively accommodate students with disabilities while accomplishing their course goals. They further suggest that disability service providers on campus have little understanding of the challenges associated with field-based learning. Training for faculty and administrators should be made available to ensure that both administrators and instructors are aware of the challenges and are met with adequate resources to effectively address accommodations.

Further, “invisible” disabilities, like those related to mental health, are even more overlooked than those that are more visibly obvious and represent unique challenges (Devitz 2023). Lacking definitive or formal diagnoses for mental health challenges also limits access to accommodations, and the nature of these challenges may lead to others perceiving them as “faking it” or not actually requiring accommodation. There is a clear need for more and better training for faculty to better understand and address these issues.

Through increased recognition of the challenges faced by students with disabilities and a desire among programs to foster inclusive learning communities, we can take steps to address the needs of all of our students and aid them in their journey to becoming productive professionals. ■



Nia Morales is an assistant professor in the Wildlife Ecology and Conservation Department at the University of Florida. Her area of expertise is in human dimensions and her courses and research seek to better understand human behavior and interactions with nature and wildlife. She is also interested in creating a more inclusive conservation career field and has published a number of papers in this area.



Maiya Lester graduated from the University of Florida majoring in wildlife ecology and conservation. She was a previous member of the Doris Duke Conservation Scholars Collaborative Program and has special interests in environmental justice, conservation science and geographic information systems.

Merging Science, Policy and Culture

TWS' 31ST ANNUAL CONFERENCE HIGHLIGHTS POLICY ENGAGEMENT OPPORTUNITIES FOR WILDLIFE PROFESSIONALS

By Kelly O'Connor

Wildlife professionals from across North America and beyond recently gathered in Baltimore for The Wildlife Society's 31st Annual Conference to learn about new wildlife science, expand their professional networks and advance policies impacting wildlife conservation. TWS' government affairs staff continues to offer opportunities for members at the annual conference to improve their policy engagement skills and guide our Society's work in the greater conservation advocacy arena. This year's annual conference included several new policy-focused opportunities to align with the theme of our plenary and amplify the [TWS Conservation Affairs Network's](#) work.

Using your voice

Over 50 attendees joined TWS staff and wildlife professionals working in congressional offices for a workshop on policy engagement through a wildlifer's lens. Participants covered everything from how the U.S. Congress enacts laws to how to use TWS policy resources and how to communicate with lawmakers who may have little to no background in wildlife science. We discussed ways to leverage partnerships, practiced identifying our members of Congress and concluded with an exercise tackling how to strategically engage with legislation impacting wildlife and wildlife professionals. We worked on developing talking points, identifying possible op-

ponents—and how to find common ground with those opponents—and leveraging resources like fact sheets and policy briefs to make policy engagement more effective.

Participants also discussed their prior experiences with conservation policy, barriers

around policy engagement for wildlifers at different stages of their career and how to tackle those barriers using TWS' [Policy Toolkit](#) and the support of the Conservation Affairs Network. Based on feedback that staff gathered during the workshop,

we look forward to expanding this annual opportunity to include understanding regulatory processes and how to engage meaningfully with rulemaking at state, provincial and national levels. As we look toward the 2025 annual TWS conference in Alberta, there will be ample opportunities to feature Canadian policy engagement and the efforts of TWS' Canadian Section and provincial chapters in our next workshop.

Policy priorities for The Wildlife Society

For the first time, the TWS Annual Conference included a facilitated discussion for Conservation Affairs Network participants and other members to identify priority issues impacting wildlife that we should consider during our process of developing TWS policy priorities. We heard from members tackling issues like anticoagulant rodenticides, injurious wildlife policy and renewable energy siting. Participants also learned more about the process of developing more inclusive and transparent policy priorities to further TWS' new strategic plan. We discussed how to better leverage the expertise of our members in Canada and Mexico to tackle big-picture issues like climate change and grasslands conservation. As you're reading this, we're likely in the implementation phase of a new set of policy priorities for TWS, many of which these preliminary discussions will probably have informed. I hope you'll consider ways that you, as a TWS member and wildlife professional, can help advance those priorities to benefit wildlife and our profession.

The Conservation Affairs Network goes to Washington

On the final morning of the conference, a small group of TWS staff, members and leaders in the Conservation Affairs Network boarded the train near Camden Yards, the Oriole's baseball stadium, and traveled to Washington, D.C., for a day of meetings with officials from the Department of the Interior and staff from the U.S. Congress. This was a first for everyone involved; all of our participants were new to meetings on the Hill, and staff have never organized this type of opportunity for the CAN before. A fellow wildlife professional and congressional staffer, Mariah Lancaster, helped us kick off our day with a tour of the Capitol. Then, we met

Wildlife professionals can support their policy engagement efforts using TWS policy resources at wildlife.org/policy.

with the U.S. Geological Survey and the U.S. Fish and Wildlife Service. Participants practiced their elevator pitches and highlighted the mission of The Wildlife Society and the work of the Conservation Affairs Network. Our group agreed that TWS and the CAN have more work to do to support these agencies, whose capacity to innovate and implement wildlife conservation is limited by a lack of funding from Congress. Staff are already thinking of ways to act on some of these discussions during our future engagement with the congressional appropriations process.

We trekked up the National Mall for an afternoon of meetings with staff from the Senate Committee on Environment and Public Works and House Committee on Science, Space, and Technology. We had an especially productive meeting with House staff, connecting our conference plenary presentation on NASA Earth Science (NASA falls within the Committee’s jurisdiction) to issues affecting wildlife, like drought and wildfire.

The idea of walking into offices on the Hill was quite daunting for many participants. But they also shared how gratifying it was to discuss the work of TWS during our meetings. I’m thrilled we were able to provide our participants with this experience and hope we can find more opportunities for CAN fly-ins (or train-ins) in the future. If the plenary at this year’s conference inspired you to want to help shape science-based policy, consider joining other members of the Conservation Affairs Network or reaching out to TWS staff for more resources to support your engagement. ■



Kelly O’Connor, MS, is the conservation policy manager for The Wildlife Society.

In Memory

The Wildlife Society pays tribute

■ Claude Victor VanSant, III



Contributed photo

Longtime TWS member Claude Victor VanSant III died Sept. 9 at 73 years old.

VanSant grew up in Douglasville, Georgia. He received a Bachelor of Science degree in forestry and a master’s degree in wildlife management, both from the University of Georgia.

A member of The Wildlife Society for more than four decades, VanSant worked

as wildlife biologist for the Georgia Department of Natural Resources for 30 years until 2021. Then, he served as a regional supervisor for the DNR in over 33 counties in middle Georgia.

VanSant is survived by his wife, two children and four grandchildren. ■

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Field Notes

Tools and techniques for today's wildlife professional

Fur combs track polar bears

By Joshua Rapp Learn

The best way for scientists to check out polar bear movements may be to use a good comb—but it has nothing to do with style.

Biologists are combing GPS devices through polar bear hair to track the large carnivores.

Polar bears (*Ursus maritimus*) are so large and move such great distances across remote parts of sea ice and land in the North that they're hard to track. Plane surveys are costly, and sea ice inhibits boats from accessing many areas for much of the year.

Typical tracking devices don't always work well. Ear tags are more or less permanent because, unlike collars, they don't

have a drop-off mechanism that allows them to fall off after a predefined period of time. Collars often used on other large mammals are fine for females, but they don't suit all bears. For adult males, "the circumference of their neck is wider than their heads," said Tyler Ross, a PhD candidate at York University in Toronto.

As a result, the nonprofit Polar Bears International challenged 3M, a global science and manufacturing company responsible for creating things like Post-It Notes and asthma inhalers, to devise a new way to fix tracking devices on the marine mammals.

As detailed in a [study](#) published recently in *Animal Biotelemetry*, scientists came up with "Burr on Fur" devices that latched onto polar bear hair.



Credit: Tyler Ross

- ▲ Polar bear males have large necks, making traditional GPS tracking collars impractical.
- ▼ Researchers tested three different designs to track polar bears.



Credit: Tyler Ross/York University/Polar Bears International

The researchers attached three differently designed tags to 16 bears in Hudson Bay, Canada, during the summer and early fall of 2021 and 2022. Six bears received the Pentagon Tag, a five-sided device with holes to pull tufts of hair through, and a tracking device; six bears got the SeaTrkr Tag, an oval-shaped tag with 10 holes and a GPS device; and four bears got the Tribursh Tag, a triangular device with a tracker and pipe brushes that latched to hair along the sides.

The SeaTrkr Tag lasted the longest on average, at 58 days, followed by the Tribursh Tag at 47 days and the Pentagon Tag at 22 days. "The SeaTrkr was the standout in terms of data quality and average length," Ross said. The longest individual tag was a Tribursh that stayed on for 114 days and included two-part epoxy glue as a secondary adhesive.

On average, none of these devices lasted as long as conventional ear tags or collars. But these tags offer promise, Ross said. And scientists can still improve the designs, perhaps by using the two-part epoxy from the most successful Tribursh Tag on the SeaTrkr.

The devices revealed what other researchers have found—the bears spent roughly 70% of their time resting and the other 30% swimming, walking and foraging. ■



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Photo by Jenna Palmasino

Gotcha!

Wildlife photographer Jenna Palmasino captured this photo of a dusky pygmy rattlesnake (*Sistrurus miliarius barbouri*) in ambush during early February 2024 in Florida. She was on a field expedition, conducting visual surveys of the species for her dissertation on snake fungal disease and an invasive lung parasite impacting the populations throughout the state. It was a cooler day, but most of the snakes were actively in ambush in dappled sunlight like this male, ready for meals of small lizards or frogs.

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