Vol. 16 No. 1
January/February 2022

THE WILDLIFE PROFESSIONAL

PEOPLE-POWERED SCIENCE

Citizen science expands our ability to study and manage wildlife

2021 Aldo Leopold Memorial Award Presentation

Starkey Project – A legacy of science and partnerships

Cooperation in conservation law enforcement

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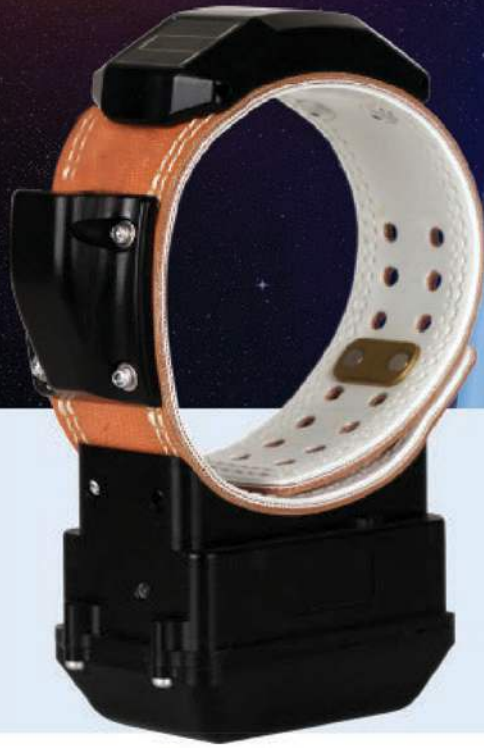

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THE WILDLIFE PROFESSIONAL

January/February 2022 Vol. 16 No. 1

The Wildlife Professional is the flagship publication of The Wildlife Society and a benefit of membership. The magazine —published six times annually—presents timely research, news and analysis of trends in the wildlife profession.

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.

BECOME A MEMBER

Membership is open to wildlife professionals, students and anyone who is interested in wildlife science, management and conservation. To learn about the benefits of TWS membership or to join, go to www.wildlife.org/join.

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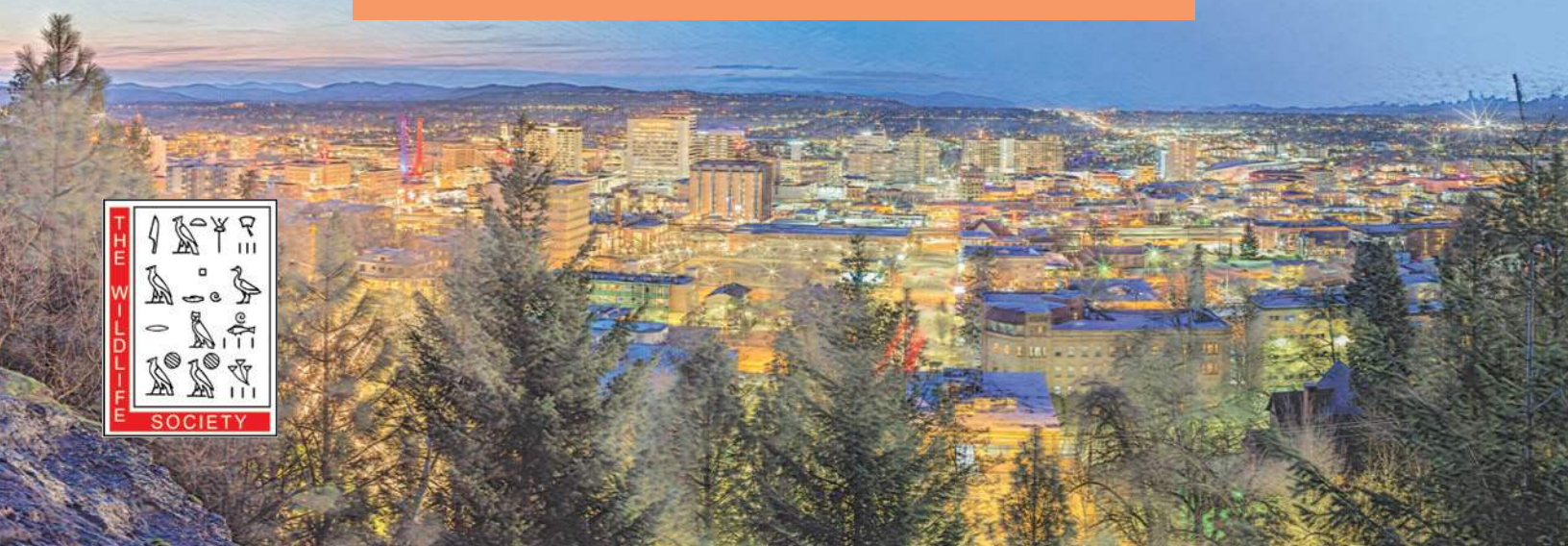

THE WILDLIFE SOCIETY

THE WILDLIFE PROFESSIONAL

COVER STORY »

People-Powered Science

Citizen science expands our ability to study and manage wildlife

By Dana Kobilinsky

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Credit: Kyle Christensen/Wildlands Conservancy

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Credit: New Mexico Department of Game and Fish

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Expertise and capacity

Successful wildlife management requires professional capacity. The North American Model of Wildlife Conservation asserts that "science is the proper tool to discharge wildlife policy," and The Wildlife Society has a standing position specifically emphasizing the use of science in policy and management decisions. Our profession was built recognizing this capacity requirement and the understanding that scientific knowledge, exploration and expertise are necessary to sustain wildlife populations and their habitats as they face increasingly complex challenges.

But what are the limitations of our profession's capacity? Our cover feature in this issue highlights the increasing roles that "citizen scientists" play in helping our profession advance wildlife conservation and management.

Our article explores the many ways that non-wildlifers around the world are contributing to our work. Our profession reaps great benefits from their engagement. They contribute huge quantities of data, provide countless hours of volunteer effort and help professionals spot patterns or trends we might miss.

These contributions are guided by our profession's expertise. People-powered science has its challenges and limitations, but professional wildlifers can help shape the questions, guide the data collection and properly apply the information to ensure its usefulness. By pairing our professional expertise with the added capacity of non-wildlifers, we can greatly enhance our chances of being successful.

Engaging "citizen scientists" in our work is also a key way to connect the public with science and with the wildlife resources around them. Enabling the public to contribute garners their buy-in and allows them to recognize their ownership of wildlife resources and their responsibility for sustaining them. It also likely increases the trust they have in wildlife professionals. Citizen science opportunities engage people, and they increase the relevancy of wildlife and our profession—which will help ensure our future and that of wildlife.

As we start the new year, the membership of our magazine's Editorial Advisory Board transitioned. Composed of your fellow TWS members and representing many facets of the wildlife profession, this board plays a critical role in the success of this magazine. From providing suggestions for magazine content and conveying member input, to lending expertise on key subjects and reviewing contributed articles, to supporting and encouraging the efforts of TWS staff writers, each EAB volunteer helps ensure this magazine continues to be a relevant, engaging and useful service for TWS members and the wildlife profession. I want to thank all of them for their service.

Working with the EAB, we have put together a great lineup of cover features and special focus sections for you in Volume 16 that explore a variety of challenges and opportunities facing our profession. You can look forward to receiving them throughout the year!

I hope the articles contributed by your fellow wildlife professionals and TWS staff in this issue make you feel inspired, empowered and enabled to continue your important work of wildlife conservation and management. As always, your feedback and input on *The Wildlife Professional* are welcome and encouraged.

Keith Norris, AWB® (he/him)
Director of Wildlife Policy & Communications
keith.norris@wildlife.org

The Wildlife Society thanks the following organizations for their financial support of *The Wildlife Professional.*

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U.S. DEPARTMENT OF AGRICULTURE

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

By Gordon R. Batcheller

On commitment

When we join The Wildlife Society, we pledge, via our Code of Ethics, to contribute "to an understanding of human society's proper relationship with natural resources and, in particular, for determining the role of wildlife in satisfying human needs and addressing the management of wildlife-related impacts." In short, we make a commitment.

Commitment was a hallmark of Dr. Ronald Labisky's career in the wildlife profession, and he recently provided another key example of his dedication to our vocation. Dr. Labisky worked with The Wildlife Society to create the Ronald F. Labisky Graduate Fellowship in Wildlife Policy. This new TWS Fellowship has been made possible by his commitment to the advancement of the wildlife profession and, specifically, to the development of sound policy to promote important conservation issues.

A Certified Wildlife Biologist® and a TWS Fellow, Dr. Labisky received The Wildlife Society's Aldo Leopold Memorial Award in 2009, an indication of his role as a leader of groundbreaking wildlife science. He earned degrees from South Dakota State University and the University of Wisconsin, and under his name are scores of published articles and technical papers on a wide variety of species and topics. Thanks to his finely honed administrative skills, he was instrumental in establishing the Florida Cooperative Fish and Wildlife Research Unit, and he laid the groundwork for the University of Florida's Department of Wildlife Ecology and Conservation, where he was named professor emeritus.

Dr. Labisky's most recent commitment to the profession recognizes that policy is a key component of wildlife conservation. TWS bylaws recognize, of course, that sound science must underpin wildlife conservation. As an "educational and scientific society," they note, TWS was established to, among other things, "gather and disseminate scientific ... information about wildlife." However, those bylaws also underscore the importance of making science available to "public policy makers."

Dr. Labisky's generous donation is aligned squarely with this purpose and this critical contemporary need for the profession. The fellowship in his name will "...encourage early career wildlife scholars to understand, formulate and recommend wildlife policy on critical conservation issues and to further encourage these wildlife scholars to pursue careers advancing wildlife policy issues." As a highly trained wildlife researcher and manager, Dr. Labisky demonstrated throughout his career an understanding of the importance of applying research to management and the importance of applying science to policy. This requires training and advanced study. The new fellowship will meet a vital and contemporary need for our Society and profession.

The Wildlife Society will inaugurate this fellowship in 2022. A selection committee chaired by Past-President and former TWS Policy Director Tom Franklin will oversee the review of applications from eligible candidates in Canada, the United States and Mexico. I look forward to celebrating the inaugural award with all our members at our 2022 conference in Spokane, and I thank Dr. Labisky for his lifelong dedication to the wildlife profession. May his example of dedication, generosity and commitment throughout his distinguished career be an example for all of us. ■

Gordon R. Batcheller, CWB®, was chief wildlife biologist in New York before retiring in 2015, and he now serves as executive secretary for the Northeast Association of Fish and Wildlife Agencies. He is a TWS Fellow and president of The Wildlife Society.

The Ronald F. Labisky Graduate Fellowship in Wildlife Policy will encourage early career wildlife scholars to understand, formulate and recommend wildlife policy and pursue careers advancing wildlife policy issues.

◀ **Dr. Ronald F. Labisky**

Recent papers from wildlife conservation and management journals

Beaufort Sea polar bear numbers have stabilized

Polar bear numbers on Alaska's Beaufort Sea have stabilized after plummeting due to ecological stress.

"To the best of our knowledge, it's a climate change situation," said TWS member Jeffrey Bromaghin, a research statistician at the U.S. Geological Survey's Alaska Science Center.

In a study published in *Ecology and Evolution*, Bromaghin's team examined polar bear (*Ursus maritimus*) data in the American portion of the region. Researchers confirmed low survival from 2004 to 2006, when biologists documented famished polar bears preying on one another and trying to reach seals through thick sea ice. The population climbed and stabilized, except for a brief dip in 2012, when sea ice hit a record low and some bears developed alopecia, a form of baldness.

The analysis suggests the bears go through periods where their numbers drop, then stabilize at new lower levels, Bromaghin said. The population remains low relative to historical records, with an estimated average of 560 bears.

▼ **Researchers Anthony Pagano and Todd Atwood weigh a polar bear. The bears' health and population numbers have been affected by climate change.**

Credit: Tyrone Donnelly

Credit: Hunter Bodenchuk/USDA Wildlife Services

▲ **Texas's wild pigs show two distinct genetic patterns, offering clues about how best to manage them.**

Rooting out genetics to manage wild pigs

Managers have struggled to manage wild pigs in Texas, where they can devastate agriculture and ecosystems. Taking a population genetics approach, researchers found some may be easier to control than others.

"Texas has about 40% of the U.S. population of invasive wild pigs," said Anna Mangan, a wildlife biologist at the National Wildlife Research Center and lead author of the study published in the *Journal of Wildlife Management*. "They're just spread everywhere. Not surprisingly, they create a ton of management challenges."

Wild pigs (*Sus scrofa*), also called feral pigs or hogs, are descended from domesticated pigs that fed early explorers and from European wild boars introduced for hunting. Although some populations have been on the continent for over 500 years, they largely remained restricted until the 1980s, when their populations and ranges expanded dramatically and the amount of damage they caused exploded.

Using a molecular approach to assess the pigs' genetic structure throughout the state, Mangan's team found two distinct patterns. In most areas, wild pigs didn't fit well into population clusters—animals moved in and out of the populations—and clusters could stretch hundreds of miles. In a few places, however, the pigs were genetically similar, more isolated and occurred in smaller clusters.

If managers want to eliminate pig populations, those smaller clusters would be better to target, Mangan said. In broader, weakly resolved clusters, they may be better off focusing on reducing damage. "A one-size-fits-all approach isn't going to work when you're dealing with wild pigs," she said.

Drone with thermal cameras can detect bird nests

Drones are being used in a variety of wildlife applications, from counting populations to tracking individuals. In a study published in the *Wildlife Society Bulletin*, researchers found they could mount thermal cameras on drones to detect hard-to-reach bird nests.

"More people are using drones in wildlife settings, and there's more support and automated software out there for analysis of thermal signatures," said co-author David Walker, a professor in the Department of Environment and Geography at the University of Manitoba.

Researchers flew drones over a variety of landscapes in the Dakotas, North Carolina and Alberta in search of nests from both game and nongame species. Using the GPS coordinates to verify the nests were really there, they found the drones were able to detect 78-100% of nests present at a site, although objects like warm rocks—even cow hoofprints—could throw them off.

"It has huge potential," Walker said.

▼ **Drones with thermal cameras helped detect bird nests.**

Credit: Roald Stander

Long-term inbreeding benefits massasauga rattlesnakes

Inbreeding is usually a problem for wildlife. It limits genetic diversity and sometimes results in harmful traits in offspring. But for massasauga rattlesnakes, researchers found, genetic bottlenecks lasting millennia may eliminate bad genetic mutations.

"Inbreeding may not be as bad as we think it is," said Lisle Gibbs, a professor of evolution, ecology and organismal biology at The Ohio State University.

Credit: James E. Chiucchi

▲ **Genetic diversity may not be as important as previously thought for managing threatened eastern massasauga rattlesnakes.**

Found throughout the Great Lakes region in the U.S. and Canada, eastern massasaugas (*Sistrurus catenatus*) are considered threatened by the U.S. Fish and Wildlife Service, and their isolated populations have raised concerns about inbreeding. Habitat fragmentation has contributed to their isolation, Gibbs said, but in many areas, eastern massasaugas have always been sparse.

In a study published in *Molecular Ecology*, he and his co-authors examined the snake's genetics to look for the effects of long-term genetic bottlenecks and compare the snakes' genomes to those of western massasaugas (*S. tergeminus*), which have larger, less fragmented populations.

Surprisingly, they found eastern massasaugas had fewer bad genetic copies than western massasaugas. Snakes with poor genetics probably didn't survive and disappeared from the gene pool over time, Gibbs said.

"History matters," he said. "These populations have probably been small for a long, long time, and this purging has likely occurred fairly frequently. This means that these genetic costs may not be as important as we thought they were."

That's good news for wildlife managers, Gibbs said. They may not need to be as concerned with matching genetic diversity when translocating massasaugas to boost populations.

Credit: Jenny Jones

▲ **An elk herd gathers in Montana's Madison Valley, where researchers studied the effectiveness of hunting and hazing to keep the elk away from livestock.**

To hunt or to haze?

When elk descend from the high country, Montana Fish, Wildlife and Parks uses a mix of hunting and hazing to keep them away from livestock and reduce the spread of brucellosis. Elk (*Cervus canadensis*) are hard to control, though, and officials wondered how successful those efforts were.

"One of our mandates is to make our management actions more effective," said Jenny Jones, a conservation technician with the agency. In a study published in the *Journal of Wildlife Management*, her team evaluated the effectiveness of hunting and hazing—at both the population and individual levels—at two locations.

The results were mixed. Hunting was slightly more effective at the population level, but frequent hazing was better at discouraging individuals from returning. Managers may want to use both, researchers concluded, but neither approach worked for long.

"It's very hard to get elk to stay off of places they want to be," Jones said.

For baitfish farmers, scaup trouble may fall when the temperatures rise

Scaup often take advantage of baitfish farms in Arkansas, leading to conflicts with farmers. The diving ducks can take a bite out of profits, prompting farmers to haze them to keep the scaup away. But researchers found conflicts seem limited to colder winters when the birds—which usually eat invertebrates—change their feeding behaviors.

Stephen Clements, a TWS member and PhD student in wildlife biology at Mississippi State University, led a study published in the *Wildlife Society Bulletin* estimating fish consumption by lesser scaup (*Aythya affinis*) and greater scaup (*A. marila*). Observing 15 baitfish farms over two consecutive winters, the researchers didn't see many scaup the first year. Warmer weather likely allowed the migratory birds to winter farther north. The scaup that did show up were diving for invertebrates, not preying on baitfish. The second winter was colder, and their behavior changed during the coldest periods. More scaup appeared, and many had different feeding strategies. Instead of dispersing across ponds and diving into deeper water, the ducks remained near the baitfish ponds' shores. Likely due to the colder water, baitfish were observed in dense groups near the edges of ponds, too, possibly making them easier prey.

Credit: Lanna Durst/NWRC

▲ **Researchers found that scaup conflicts with baitfish farmers increased in colder weather.**

Clements suggests farmers prioritize hazing techniques and lethal take using depredation permits during colder weather. Aside from saving time and money for farmers, who often hire hazers, strategic nonlethal harassment could increase the effectiveness at times when scaup are suspected to be problematic.

"Birds can get conditioned pretty quickly to nonlethal harassment techniques," Clements said. ■

Contributed by David Frey, Dana Kobilinsky and Joshua Rapp Learn

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SOUTHWEST

Southwestern snake gains critical habitat designations

The U.S. Fish and Wildlife Service has designated critical habitat to protect the narrow-headed gartersnake (*Thamnophis rufipunctatus*) in New Mexico and Arizona. Listed as federally threatened since 2014, the snake inhabits rocky stretches of perennial streams and pools. In a final rule published in the Federal Register in October, the Service designated 23,785 acres of critical habitat for the snake in five Arizona counties and three New Mexico counties, mostly on federal land. Biologists say the snake population has declined significantly over the last 50 years as the fish species it preys on decreased and nonnative aquatic predators became more common. "This decline appeared to accelerate during the two decades immediately before listing occurred," the Service concluded. The critical habitat designation includes 447 stream miles within the Gila River, San Francisco River, Salt River and Verde River watersheds.

Credit: Chris Harrison

▲ **The narrow-headed gartersnake's population has declined in the Southwest.**

WEST

California governor signs desert conservation bill

California Gov. Gavin Newsom recently signed a bill to create a program to acquire and enhance desert habitats in the state. The California Wildlife Conservation Board would administer the California Desert Conservation Program, which will incorporate funding from private, federal and other sources. The new program is intended to address climate change; protect and restore desert habitats and indigenous lands; and reduce the threats of wildfires, drought, flooding and other events. "Our desert region is a precious but fragile asset and is home to the largest still-intact ecosystem in the Lower 48 states," said state Assembly member James Ramos, who helped champion the legislation, in a press release. "These lands perform critical environmental roles, including capturing and storing carbon to help us fight the climate change crisis." Congress designated the California Desert Conservation Area in 1976 as part of the Federal Land Policy Management Act, including parts of the Mojave and Colorado deserts. "Establishment of the California Desert Conservation Program will provide direct, well-deserved investment to protect and restore important natural lands and to help preserve our invaluable cultural resources," said Mojave Desert Land Trust Executive Director Geary Hund, in a press release. "This is a great day for the desert and its diverse array of plants and animals, dark night skies, spectacular open spaces and desert lovers in California and worldwide."

Credit: Floyd

▲ **A new bill in California would help fund desert conservation in California.**

NORTH CENTRAL

Study suggests people are spreading coronavirus to deer

Researchers believe people are spreading the novel coronavirus to deer in Iowa. In a study in preprint, researchers led by Penn State University biologists found that a third of white-tailed deer (*Odocoileus virginianus*) in Iowa tested positive for SARS-CoV-2, the virus that causes COVID-19 in humans. This is the first study to show active infection among wild deer, although a previous study found signs of exposure among white-tailed deer in four

Credit: Daniel Johnston

▲ **A third of white-tailed deer in Iowa tested positive for the novel coronavirus.**

other states. Based on the geography of clusters of deer and human occurrences of the virus, the latest study suggests the virus is spreading through "multiple human-to-deer spillover events and deer-to-deer transmission." That raises concerns about "the potential for spillover to other animals and spillback into humans," the authors wrote.

Kirtland's warbler continues to thrive

Once at risk of extinction, Kirtland's warblers are flourishing in Michigan, where nearly all of the population nests. A census of the birds conducted by the Michigan Department of Natural Resources, U.S. Fish and Wildlife Service, U.S. Forest Service and volunteers found that the population has remained fairly stable since the bird was removed from the endangered species list in 2019. The June

Credit: Michigan Department of Natural Resources

▲ **After being delisted, Kirtland's warbler numbers remain strong.**

2021 survey found 2,245 Kirtland's warbler (*Setophaga kirtlandii*) pairs. It's the first full count since 2015, when 2,365 pairs were counted. The bird's recovery remains dependent on conservation actions. Kirtland's warblers nest in young, dense stands of jack pine (*Pinus banksiana*)—a landscape historically created by large wildfires. "We must continue to invest in creating habitat for this disturbance-dependent species to thrive," said TWS member Brian Bogaczyk, a threatened and endangered species biologist with the U.S. Forest Service, in a press release.

Credit: Craig Stihler

▲ **A little brown bat shows signs of white-nose syndrome, which led to steep declines in the species in West Virginia.**

NORTHEAST

WNS has devastated some West Virginia bat species

Populations of three bat species in West Virginia have declined significantly in the past decade as the deadly white-nose syndrome has spread throughout the state. In a study published recently in *Ecology and Evolution*, researchers surveyed and compared bat populations in the Mountain State from 2003 to 2008, before the fungal disease first appeared in bats there, and again from 2011 to 2019, after it had taken hold. Their analysis showed that state populations of little brown bats (*Myotis lucifugus*), northern long-eared bats (*M. septentrionalis*) and tricolored bats (*Perimyotis subflavus*) "declined significantly and rapidly," said Catherine Johnson, who then worked as the wildlife program manager for the Monongahela National Forest. Big brown bat (*Eptesicus fuscus*) and eastern red bat (*Lasiurus borealis*) populations actually increased, however, possibly taking advantage of habitat features that were freed up as the other species declined. "There were increases in some other species that are not impacted by white-nose syndrome in the same way," said Johnson, who now works as a coastal ecologist with the National Park Service.

NORTHWEST

Washington state begins CWD surveillance

Washington state is conducting surveillance for chronic wasting disease as it appears in surrounding states. The disease, which is deadly to cervids, has not been reported in Washington, but it has been discovered in Idaho and western Montana. "As we know, it doesn't take much for this disease to cross borders," said TWS member Melia DeVivo, an ungulate research scientist with the Washington Department of Fish and Wildlife. "We really saw the writing on the wall and were even more concerned." The state conducted surveillance for CWD in the early 2000s, but federal funding dried up. After securing funding from the state legislature, the agency implemented a plan for two years of surveillance. The program includes check stations where WDFW staff can collect tissue samples from animals harvested by hunters. So far, all the tests have come back negative. "We're hoping to continue to be funded, and we're looking to do this every year moving forward," DeVivo said.

Credit: Washington Department of Fish and Wildlife

▲ **A student volunteer from Washington State University and Melia DeVivo with the Washington Department of Fish and Wildlife sample a harvested white-tailed deer (*Odocoileus virginianus*) to test for chronic wasting disease.**

CENTRAL MOUNTAINS & PLAINS

Black-footed ferrets find new home in Wyoming

As part of ongoing efforts to bolster the numbers of federally endangered ferrets, wildlife managers have released 20 captive-bred animals to a recovery area in Wyoming where the species historically had been found. The Wyoming Game and Fish Department worked with the U.S. Fish and Wildlife Service to release 10 male and 10 female black-footed ferrets (*Mustela nigripes*) into the Meeteetse recovery site, which is made up of private land. "We have phenomenal partnerships with the Lazy BV and Pitchfork ranches who are dedicated to black-footed ferrets and their success," said Zack Walker, WGFD nongame supervisor, in a press release. The Wyoming agency tries to maintain at least 35 ferrets at the Meeteetse recovery site, where ferret numbers declined due to plague. Many captive black-footed ferrets were vaccinated for SARS-CoV-19, the virus that causes COVID-19 in humans, but vaccinated ferrets were not among those released in this batch, a USFWS spokesperson said.

Credit: Ryan Moehring/U.S. Fish and Wildlife Service

▲ **Captive-born black-footed ferrets were recently released on two ranches in Wyoming to help bolster their endangered populations.**

Credit: Jason Clay/Colorado Parks and Wildlife

▲ **A black bear makes use of an underpass beneath Interstate 25 between Denver and Colorado Springs.**

Wildlife takes to Colorado highway crossing structures

With construction still underway, wildlife has begun using a new system of crossing structures along a busy stretch of interstate between Denver and Colorado Springs. Officials with the Colorado Department of Transportation and Colorado Parks and Wildlife have documented black bears (*Ursus americanus*), elk (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*) and smaller mammals using crossing structures on the Interstate 25 Gap Project. Its wildlife mitigation system includes four new underpasses, one refurbished underpass and 28 miles of deer fencing, deer guards and other structures. The highway is bordered by a large tract of contiguous open space frequented by wildlife, which has resulted in frequent collisions with vehicles. "In the I-25 South Gap, it is estimated that one animal-vehicle crash occurs per day," said CDOT Executive Director Shoshana Lew, in a press release. "Our wildlife mitigation system aims to reduce these crashes by 90%." Crews are installing 59 cameras throughout the system to measure its success.

SOUTHEAST

Seabirds return to restored Louisiana island

Seabird nests on a restored island off the Louisiana coast far exceeded expectations in the first nesting season. The Louisiana Coastal Protection and Restoration Authority restored the 102-acre Rabbit Island using dredged sediment plantings of grasses and shrubs to enhance nesting habitat for

Credit: Louisiana Department of Fish and Wildlife

▲ **Rabbit Island hosts southwest Louisiana's only brown pelican nesting colony.**

brown pelicans (*Pelecanus occidentalis*) and other colonial nesting water birds. Located in Calcasieu Lake, the island is southwest Louisiana's only brown pelican nesting colony, but the birds had lost about half their nests due to destructive tides and storm surges. Biologists observed about 6,100 nests on the island in 2021, as restoration work neared completion. That was far more than the 370 nests expected. Researchers counted 1,150 brown pelican nests and noted nests of other birds designated in Louisiana as species of greatest conservation need. The $16.4 million project was funded with settlement money from the 2010 Deepwater Horizon oil spill.

CANADA

Wild pigs enter national park for first time in Canada

Managers have confirmed a sounder of wild pigs has entered Elk Island National Park in Alberta—the first time the invasive species has been documented in a Canadian national park. "Parks Canada is always on the lookout for invasive pests in efforts to protect conservation areas," said Dustin Guedo, the acting resource conservation manager with Parks Canada. "Wild boars in Alberta are at the forefront." For the last few years, the destructive species has been documented throughout the county surrounding the fenced-in park. Last fall, public sightings and videos from landowners allowed Parks Canada to confirm at least one sounder—a sow and piglets—periodically enters into the park. Park staff members have been working with the province of Alberta to monitor and manage for the animals, using dogs to sniff out areas where the wild pigs (*Sus scrofa*) are, and working with landowners outside the park to set up traps to remove them from the area. Elk Island is home to large conservation herds of plains bison (*Bison bison bison*), wood bison (*Bison bison athabascae*), elk (*Cervus canadensis*), moose (*Alces alces*) and deer, raising fears that the feral pigs could spread diseases to other species. "We're concerned with the potential for all interactions and the problems wild boar represent," he said. "They're known to degrade wetland habitat that nesting birds use in these areas."

Credit: Richard Bukowski

▲ **Elk Island National Park in Alberta is fenced, but wild pigs have entered it.**

Credit: Richard Crossley

▲ **Bermuda petrels, listed as endangered by the IUCN, are among the species that will benefit from the new marine protected area.**

INTERNATIONAL

European countries designate new protected area for seabirds

Fifteen European countries joined together to create a new 230,000-square-mile protected area in the North Atlantic to benefit seabirds. The countries signed onto the Convention for the Protection of the Marine Environment of the North-East Atlantic (known as the OSPAR Convention) to form The North Atlantic Current and Evlanov Sea Basin Marine Protected Area, which sits south of Greenland. The area is an important feeding and foraging area for seabirds breeding along the Northeast Atlantic, and by birds migrating and nesting in other parts of the world. "The NACES Marine Protected Area protects one of the most important concentrations of migratory seabirds in the Atlantic," said Tammy Davies, marine science coordinator with BirdLife International. Species that will benefit from this protected area include some listed as endangered by the International Union for Conservation of Nature, like the Bermuda petrel (*Pterodroma cahow*) and Zino's petrel (*Pterodroma madeira*), and some listed as vulnerable, like the Atlantic puffin (*Fratercula arctica*). "The [marine protected area] currently has a low level of human activity," Davies said. "By protecting it now we have a better chance to safeguard it from increasing emerging threats." OSPAR has a two-year plan to form the protected area.

Contributed by David Frey, Dana Kobilinsky and Joshua Rapp Learn

Developing a place for wildlife

BRIAN KIRKPATRICK CREATES HABITATS FOR WILDLIFE IN URBAN SPACES

By Dana Kobilinsky

Courtesy Brian Kirkpatrick

▲ **As an environmental consultant, Brian Kirkpatrick helps development projects that accommodate wildlife.**

As Brian Kirkpatrick was showing a Reuters reporter around a New Jersey solar facility, about 10 pairs of small brown-and-gray birds started swooping over their heads. Construction on the Toms River Merchant Solar Site hadn't even finished yet when the grasshopper sparrows came seeking the native grasses and forbs planted for them. That was exactly the response Kirkpatrick hoped to see.

"Finding uses and bringing what we call brownfields back to productive life, either for human use or wildlife use, has been one of the things that I've been interested in since the beginning," Kirkpatrick said.

This particular "brownfield to brightfield" redevelopment project was converting an old dye-making factory, which shut down in 1996 after contaminating the soil and groundwater, into a 120-acre solar array able to generate 29 megawatts of power. Kirkpatrick, a senior project manager with GZA GeoEnvironmental, wanted to make sure the Superfund site could support wildlife, like northern pine snakes (*Pituophis melanoleucus melanoleucus*) and the grasshopper sparrows (*Ammodramus savannarum*) flying overhead, both of which are state-listed as threatened.

"We were starting to see birds nesting in some of those areas just as Brian predicted," said Scott Hesser, the real estate and development counsel at EDF Renewables, the company that started the solar project.

Becoming a consultant

Colleagues say Kirkpatrick can spot the tiny birds a mile away. He has an eye for nature that's not exactly typical in urban New Jersey.

"You might think I grew up on a farm," Kirkpatrick said. Instead, he grew up on a narrow lot in the South Jersey suburbs—just a couple of miles from another property that, like the Toms River area, was designated a Superfund site because of the long-term response required to clean up contamination.

One of his first jobs was maintaining the buildings and grounds at a New Jersey factory. Seeing the inner workings of industrial sites motivated Kirkpatrick to keep habitats on these lands safe for wildlife. It made him want to "do something good with dirty sites," he said.

Even as a child, though, he hunted, fished and always had a garden in his suburban home. At his first opportunity as an adult, he bought property in central New Jersey and managed it for bees and firewood. On a small farm he owns in Vermont, he manages the landscape for early successional

Courtesy Brian Kirkpatrick

◀ **Brian Kirkpatrick evaluates habitat for threatened and endangered species in a proposed renewable energy site in western Pennsylvania.**

vegetation that has attracted upland birds. His passion for wildlife pushed him to become a leader with The Wildlife Society. He currently serves as the president of the New Jersey Chapter.

After earning a bachelor's degree in wildlife resources at West Virginia University in 1986, Kirkpatrick soon began consulting work focusing on wetlands. Wetlands conservation was just in its infancy, and his career evolved along with it, from determining wetlands boundaries to designing wetlands restoration projects.

Since then, his career has taken him down highway medians and golf fairways in an effort to bring nature to developed areas. "I'm finding ways to squeeze in a little bit more wildlife habitat value in places you really wouldn't expect it," he said.

Cleaning up dirty sites

A Certified Wildlife Biologist®, Kirkpatrick has worked at multi-discipline engineering firms in New Jersey for about 28 years. Now at GZA GeoEnvironmental, he continues to make these differences for wildlife and humans—including at the Toms River site.

"It's that balance between providing the infrastructure we need as humans to make life work and creating, maintaining and managing wildlife habitat," he said.

Understanding that balance is what makes Kirkpatrick stand out, Hesser said.

"Most biologists that we work with absolutely have a solid understanding of their area of expertise," he said. "And that's helpful, but only to a certain extent. What really distinguishes a good biologist that's working as a consultant is how they're going to not just represent the information in their field of expertise. What comes with that is the capability of being able to learn quickly what's critical for the client."

Kirkpatrick first got involved at Toms River when the chemical manufacturer BASF bought the land and wanted to redevelop the 1,200-acre site, taking a largely undeveloped property and turning it into an urbanized development. Kirkpatrick gave them the news most developers don't want to hear. The presence of two state-listed endangered species on the site would make it virtually undevelopable. Northern pine snakes occupied primarily the forested areas on the site. Grasshopper sparrows occupied the former plant site, and they needed constant vegetation management to maintain an early successional landscape.

Courtesy Brian Kirkpatrick

▲ **Brian Kirkpatrick works at places like the Toms River Merchant Solar Site to ensure that native vegetation sustains wildlife, including the state-endangered grasshopper sparrow.**

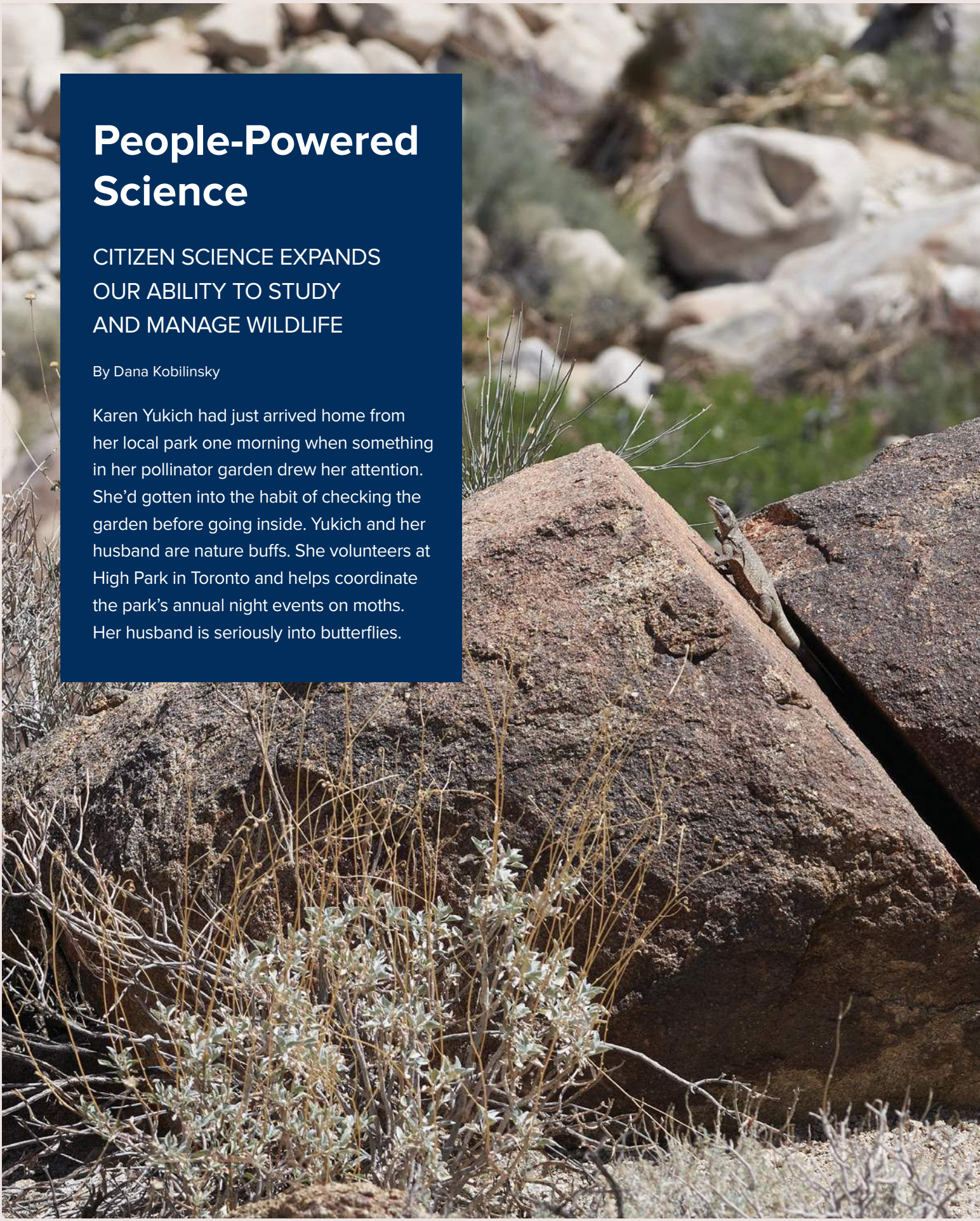
BASF contacted the renewable energy company EDF about creating a solar array on a portion of the site. With Kirkpatrick's help, the companies got permission to move forward. While research on the impacts of solar panels on these species was limited, Kirkpatrick worked to make sure the project aligned with the species' needs.

That wasn't always easy. To generate power, the solar panels needed to be free of shade, but mowing could alter the vegetation the birds relied on. Kirkpatrick sought out mixes of grasses and forbs that would benefit the birds and not block the sun from the panels. One year after the panels were put in place, he said, "I've got to say we were very, very pleased."

Working together

Urban areas can be a challenge for wildlife, Kirkpatrick said, but they're not incompatible. Often, they include greenways that have lots of resources for wildlife and plenty of opportunities for wildlife education. It's that combination that inspires him, he said, "meeting human needs in a compact footprint as well as improving wildlife habitat." ■

Dana Kobilinsky is the associate editor for The Wildlife Society.



People-Powered Science

CITIZEN SCIENCE EXPANDS OUR ABILITY TO STUDY AND MANAGE WILDLIFE

By Dana Kobilinsky

Karen Yukich had just arrived home from her local park one morning when something in her pollinator garden drew her attention. She'd gotten into the habit of checking the garden before going inside. Yukich and her husband are nature buffs. She volunteers at High Park in Toronto and helps coordinate the park's annual night events on moths. Her husband is seriously into butterflies.

▲ An iNaturalist user takes a photo of a lizard in San Bernardino County, California. Mobile applications like this allow non-scientists to provide photos and data to researchers.
Credit: Tony Iwane

"I walk by carefully to see if there are skippers in there or something, so I don't just plow through," she said.

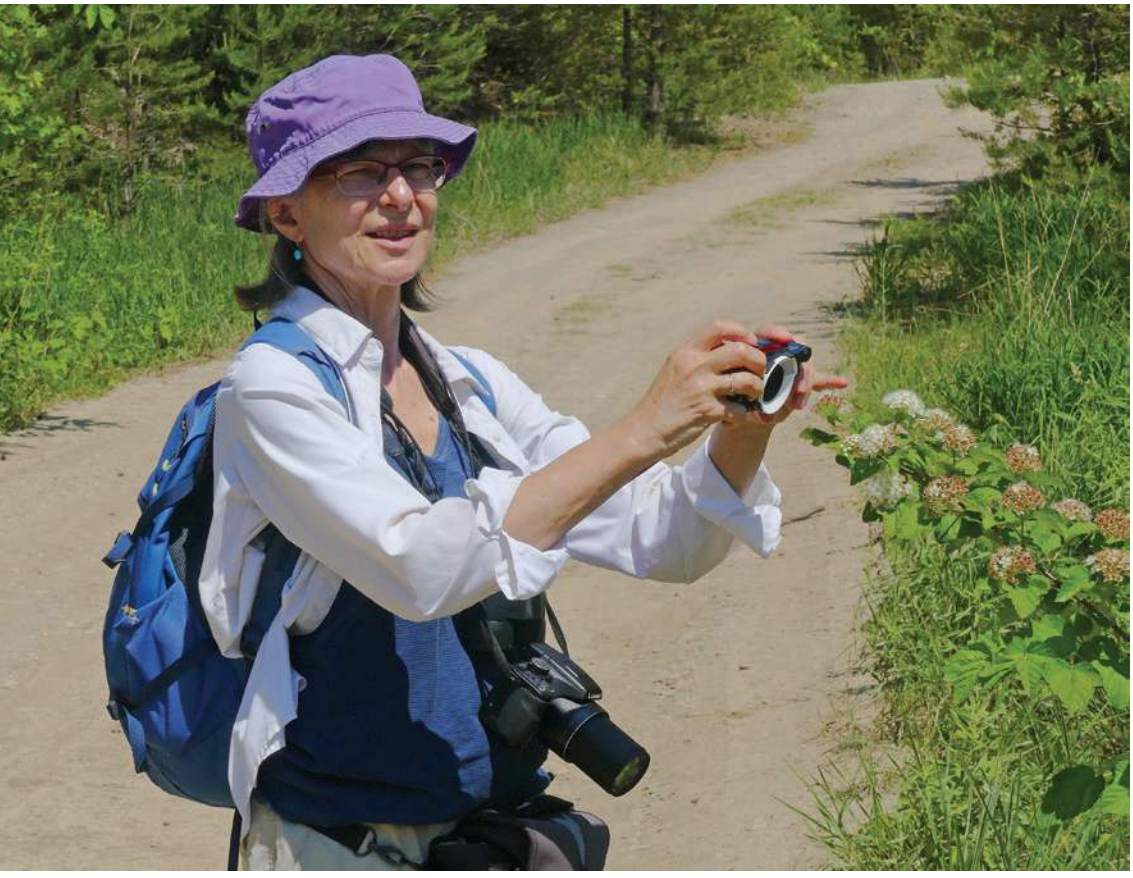
Slowly and carefully as to not scare anything away, Yukich peeked amid the flowers where a shimmering moth caught her eye. She thought it was a melonworm (*Diaphania hyalinata*) fluttering among the Indian hemp (*Apocynum cannabinum*), but she had only seen them in south Texas, and this moth lacked the bushy-tipped abdomen that melonworms sport.

Sneaking past the moth, she entered her house, grabbed her camera and snapped a few photos as the moth fluttered to her neighbor's ornamental shrubs and disappeared into a boxwood hedge. She uploaded one of the images to iNaturalist, a mobile app where members of the public can post photos of wildlife and plants that other users of the app help identify. When people viewed the photo Karen uploaded, they suggested it was a box tree moth (*Cydalima perspectalis*)—a moth native to Asia known to decimate ornamental hedges in Europe. Could the invasive moth have reached Toronto, too?

Crowd science applications like iNaturalist—and other projects that encourage members of the public to contribute or analyze data—have become prevalent in recent years with the growth in popularity of smart phones and mobile apps. Laypeople have helped researchers keep an eye on wildlife as the world transforms, whether through climate change, habitat alteration or a global pandemic. This approach to science comes with challenges. Volunteers may be limited in their knowledge and scientific training. Recruiting them can be hard. And areas that lack people or technology can leave gaps in the data. But by using these tools strategically, scientists have been able to unearth findings that never would have turned up without the public's help.

Coming up with a term for this kind of science has been difficult. Most people know it as "citizen science." The term was coined in the 1990s to describe projects guided by scientists that invited the public to contribute scientific data, even if participants didn't have a scientific background. That could include cataloging species they find in their backyards, helping determine what animals show up in camera trap photos or other pursuits.

But more recently, many people in the field felt the term was a poor choice. You don't have to be a citizen to be a citizen scientist. In search of a more inclusive name, some, including the Cornell Lab of Ornithology and the National Audubon Society, have started to use the term "community science." They want their projects to be "welcoming to any birder or person who wants to learn more about bird watching regardless of their citizen status," said Lynn Fuller, spokesperson for eBird Northwest, a regional portal for eBird—one of the world's largest collections of biodiversity data, managed by the Cornell Lab of Ornithology.



Credit: Bob Yukich

▼ **Karen Yukich is an avid iNaturalist user. One of the photos she added to the app became the first-ever identification of a species of invasive moth in Toronto.**

Audubon, which pioneered the first Christmas Bird Count, where everyday people help collect bird data throughout the winter, has also pushed for the use of the term "community science."

But, using the term "community science" proved to be problematic as well. Researchers were already using the term to describe groups of people who come up with their own research question to solve an issue within their community (Cooper et al. 2021).

For the purposes of this article, we're going to call it "citizen science," while recognizing the merits of the ongoing discussion to determine the most appropriate, inclusive term that recognizes this approach to scientific inquiry and contributions of the public to wildlife conservation.

Gathering the data

The idea of relying on laypeople to help gather data has been around before smart phones were even a thought. One of the most popular citizen science programs goes back to the 1970s when Erica Dunn, a researcher at the Long Point Bird Observatory in Ontario—now part of Birds Canada—needed more data for a paper she was publishing on birds in the province. With all the people feeding birds in their backyard, she figured, why not ask them what species they were seeing?

She called it Project FeederWatch, and it's still around today, now as an online platform that makes it easier for participants to share their findings and for researchers to tap into them. About 30,000 people in Canada and the United States watch their feeders during certain months, record the birds they see and send their observations to Birds Canada and the Cornell Lab of Ornithology.

Staff provide instructions to volunteers about how to count birds to ensure that all of the data is collected the same way. "We are taking an existing hobby and overlaying that with a bit of scientific method and standardized data collection," said Emma Greig, the project leader of Project FeederWatch at the Cornell Lab.

Volunteers also get a poster of "likely suspects" they will come across during specific times at specific locations. "Anyone can learn those birds," Greig said. "We have just amassed this enormous, fantastic dataset of birds at known locations over time."

Credit: Bob Vuxinic

▲ **A red-headed woodpecker (*Melanerpes erythrocephalus*) makes an appearance at a birdfeeder in Crossville, Tennessee. The photo was sent to Project FeederWatch, where laypeople contribute data on birds visiting their feeders.**

So far, Project FeederWatch has contributed to a number of research projects, from papers looking at how light and noise influence bird abundance to a recent study on eye disease in birds. One project found that hawks are attracted to birdfeeders in Chicago because of the prey they find there. "It's astonishing the different types of questions you can answer just from bird counts," she said.

Another project is taking a similar approach with mammals. Through North Carolina Candid Critters, researchers trained 580 volunteers—including middle school students and hikers—to check out trail cameras from local libraries just like they would check out a library book, set up the cameras outdoors and see what they find. Over the past three years, volunteers have collected 2.2 million wildlife photos, increasing the number of mammal sighting records previously available in the state by a factor of five (Lasky et al. 2021).

On the phone

For some projects, though, training isn't necessary. People can use equipment that's already in their hands every day—smart phones.

Credit: North Carolina Candid Critter Project

▲ **A camera trap captures an image of a coyote as part of the North Carolina Candid Critters Project. As part of the project, volunteers check out trail cameras from local libraries and set them up to help researchers understand mammal appearances in the state.**

"Technology has been driving the rapid, exponential increase in engagement and excitement over citizen science," said Greg Newman, the director of CitSci, an online citizen science platform that provides tools for anyone, anywhere to create and build new projects.

Applications like iNaturalist require only a photo—or sometimes just a sound or other proof of observation—as well as geographical location data and date and time of the observation. App users then suggest species, aided by AI algorithms, and the data is crowdsourced to resolve a final identification. The result is a treasure trove of data never before available—and data that couldn't reasonably be collected in any other way. Currently, iNaturalist has around 4 million verifiable, research grade observations of 100,000 species. "Of over 60,000 biodiversity datasets tracked by the Global Biodiversity Information Facility, the iNaturalist dataset is the most cited, with over 1,800 citations," said Scott Loarie, a co-director of iNaturalist. "It's the kind of dataset you couldn't collect individually or independently. I love the idea that we have an eye on things that are changing."

The advent of iNaturalist has led to BioBlitzes—events where groups of people use the app to identify as many species in an area as they can. With the COVID-19 pandemic, iNaturalist saw its biggest bump in participation last May, when it broke 3 million verifiable observations since it was founded in 2008. "That's more active than we have ever been," Loarie said.

The app has allowed researchers to answer questions they might never have anticipated asking. Tapping into iNaturalist photos, Michael Moore, a postdoctoral fellow at the Living Earth Collaborative at Washington University in St. Louis, concluded that warmer climates have changed the colors that male dragonflies use to attract mates (Moore et al. 2021). Because dark colors draw in more heat, the insects have evolved lighter pigmentation, he found, raising questions about how climate change might affect mating and populations in the future.

That kind of study wouldn't have been possible without iNaturalist, Moore said. The database not only gave his team images of dragonflies. It also recorded where and when the photos were taken. "Images get stored with the latitude-longitude and timestamp, and researchers like me can take those observations and use them for scientific research," he said.

From the stars to the Serengeti

Collecting data isn't the only way citizen scientists can be involved in wildlife biology. They can also help analyze the data scientists gather.

About 15 years ago, astronomer Chris Lintott was having trouble going through photographs of galaxies. He asked a student look at 50,000 of them. To save his student some time—and eye strain—he reached out to NASA to put the images online with the hope that others could help him identify stars in the galaxy. "Then, an unexpected thing happened," Lintott said. "Hundreds of thousands of people were motivated to help."

Before he knew it, Lintott was flooded with calls and emails from researchers wanting similar platforms to help count penguins or identify species in the Serengeti. That led him to create Zooniverse, an online platform where researchers can post projects, and volunteers can choose what they'd like to help with. Although it started with astronomy, Zooniverse has drawn tons of wildlife projects, from individuals documenting whooping crane (*Grus americana*) nests in photos to classifying the sounds of seabirds.

Credit: Snapshot Serengeti

▲ **Zooniverse hosts a project called Snapshot Serengeti, enlisting citizen scientists to help identify species in the area.**

The platform has allowed researchers to increase the scale of their studies and organize vast datasets in just a few days. In some cases, Lintott said, citizen scientists outperform artificial intelligence by recognizing when something unusual appears in the data. And by their sheer numbers, volunteers can outperform experts. "They're collectively better than just a few PhD students," he said.

Credit: Andrew Hara/National Geographic Your Shot

▼ **Students collect data at a BioBlitz in Hawaii Volcanoes National Park. During BioBlitzes, iNaturalist app users add as many photos as they can of different species in a particular area.**

Stumbling on a Discovery

Sometimes it takes citizen scientists to make discoveries researchers may never otherwise find.

When a junior naturalist club in New Zealand went fossil hunting on the beach in Kawhia Harbor, the students noticed something a bit different.

"They were clearly seeing bones of a vertebrate," said Dan Ksepka, curator of science at the Bruce Museum in Connecticut. "That was rare in itself. But basically, the bones were still in life posture—the knee bone connected to the thigh bone, and those kinds of things."

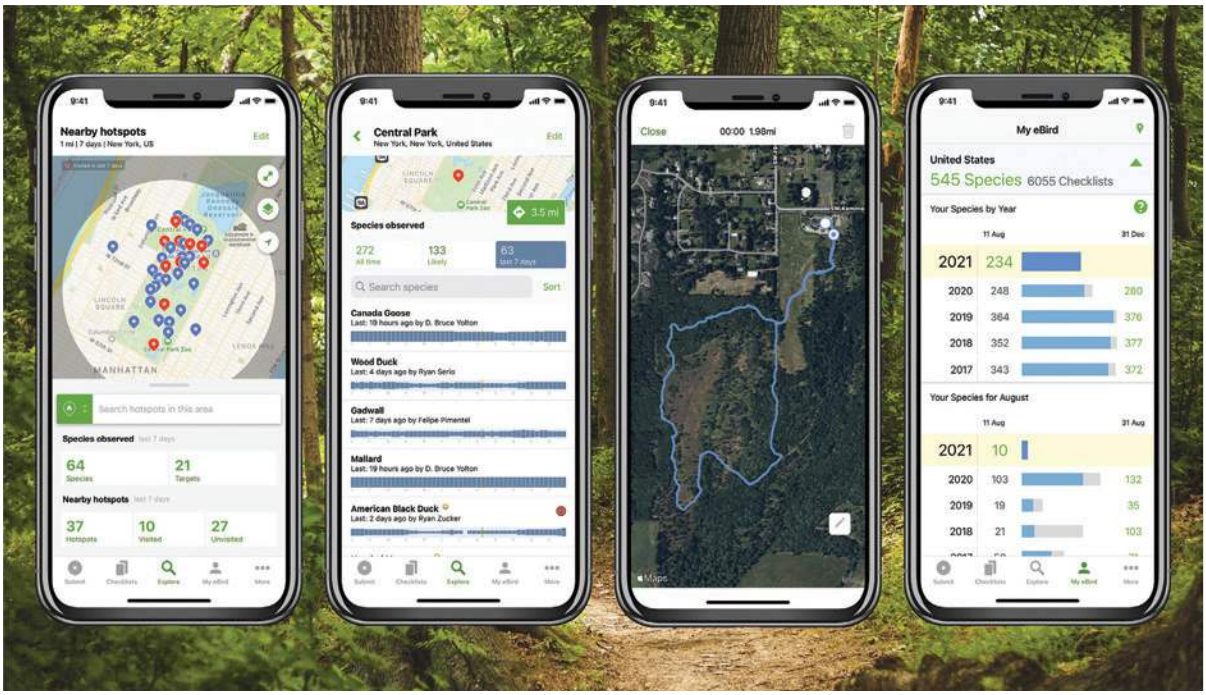
After turning in the specimens to the nearby Waikato Museum, the students learned they had discovered an ancient giant penguin species that had never been identified.

"If they hadn't found it, it would have been eroded away by the waves," said Ksepka, who co-authored a paper on the finding in the *Journal of Vertebrate Paleontology*. "It would have been destroyed."

This isn't the only time laypeople have presented museum collections with new or rare species, Ksepka said. "I think it's tremendously important and a little bit underappreciated that amateur collectors really do a lot of heavy lifting in the field," he said.

▼ **When junior naturalists stumbled upon a penguin fossil, it ended up being a newly discovered species, the Kawhia giant penguin (*Kairuku waewaeroa*).**

Credit: Hamilton Junior Naturalists Club



Credit: eBird

Scientists created eBird in 2002 as a way to get birders to submit their findings. Its mobile app is growing in observations about 20% every year.

Battling bias

Citizen science can provide many services to wildlife conservation, but it can also have its limits. While their consensus is often accurate, individuals lack the knowledge that professionals have.

For a study published in the *Wildlife Society Bulletin*, Gabriel Gadsden and his colleagues turned to the public to help sort through thousands of camera trap photos (Gadsden et al. 2021). "Growing up, I didn't have opportunities to be a part of science," Gadsden said. "We can have the opportunity to give students and people who are not scientists a chance to meet us where they are and intrinsically be involved in the work to help us answer questions."

He and his team developed an online platform called Michigan ZoomIN, where students from elementary schools to colleges identified species in camera trap images. In comparison to experts, they were about 97% accurate in their identifications. Some species were tricky, though. Volunteers often confused species like gray wolves (*Canis lupus*) and coyotes (*Canis latrans*) and other species that can look similar.

For apps relying on laypeople to report species, the unusual and the eye-catching can outweigh common species. Researchers have found informal bird enthusiasts are great at detecting new species' arrivals, but they aren't as good at providing accurate population counts once a species has become established (Smith et al. 2019).

At eBird, *birder* behavior can play as much a role as *bird* behavior in the data that comes from it.

"Birding culture is so different around the world," said Jenna Curtis, the eBird project leader at the Cornell Lab of Ornithology. "What motivates some people in North America may be a rare bird. In India and Asia, a lot of what makes birding popular is photography driven."

Some scientists are using these biases to their advantage. One team tested if iNaturalist data was as accurate as telemetry data at determining the distribution of coyotes and red foxes (*Vulpes vulpes*). When reviewing the data, the researchers noticed a discrepancy—iNaturalist data showed more coyotes in developed areas than the telemetry data (Mueller et al. 2019). That made sense because that's where people spend their time, so it's also where they make their observations.

While the mobile app users didn't accurately show the distribution of the urban canids, their data still told an important story. "This can be very helpful

Credit: Lauren Bucholz

▲ **A Colorado Pika Project volunteer helps conduct a pika occupancy study.**

Credit: Mike Malloy

▶ **One citizen science project that has garnered a lot of public involvement is the Colorado Pika Project, which is on the CitSci platform. As part of the project, volunteers hike to 289 different sites in the state to help researchers determine how climate change is affecting the species.**

with management," said Max Allen, an assistant research professor at the University of Illinois and the senior author on the study. "It's exactly what managers would want to know about where the urban canids are interacting with people and can be used to manage potential conflicts."

Inclusivity is another challenge for these platforms. "There's plenty of evidence that citizen science tends to trend toward white retirees," said Sarah Newman, director of operations for CitSci.org, and wife of Greg Newman, who is also a director of the platform.

To actively engage marginalized communities, researchers need to understand and address barriers for participation. This can improve the data, particularly in regions of the world that are underrepresented. A recent study comparing population trends estimated using eBird with trends from BirdLife International, a global partnership that conducts bird

surveys around the world, found the two projects didn't always produce the same trends (Neate-Clegg et al. 2020). Results from eBird were biased toward North America and had less global geographical coverage than BirdLife's data. This suggests eBird may not be the best tool to look at bird totals geographically. But it can be useful in other ways as long as researchers using the data recognize its limitations and primary application to North America.

All hands on deck

"Citizen science is amazing in that it could be extremely rewarding," said Sarah Newman. "It can pay back dividends far beyond what you expect, but you have to put your effort into communicating with volunteers and giving them feedback. You can't just collect data and walk away. That leaves a bad taste."

For one project on the CitSci platform, people are lining up to be involved. The Colorado Pika Project—a collaboration of Colorado Parks and Wildlife, Rocky Mountain Wild, the Denver Zoological Foundation and a researcher at the University of Colorado—tasked volunteers to look for American pikas (*Ochotona princeps*) at 289 sites in the state to see how climate change has impacted the species—a mountain-dwelling mammal related to rabbits. Even 10-mile hikes to get to the species' high-elevation

Standout Science

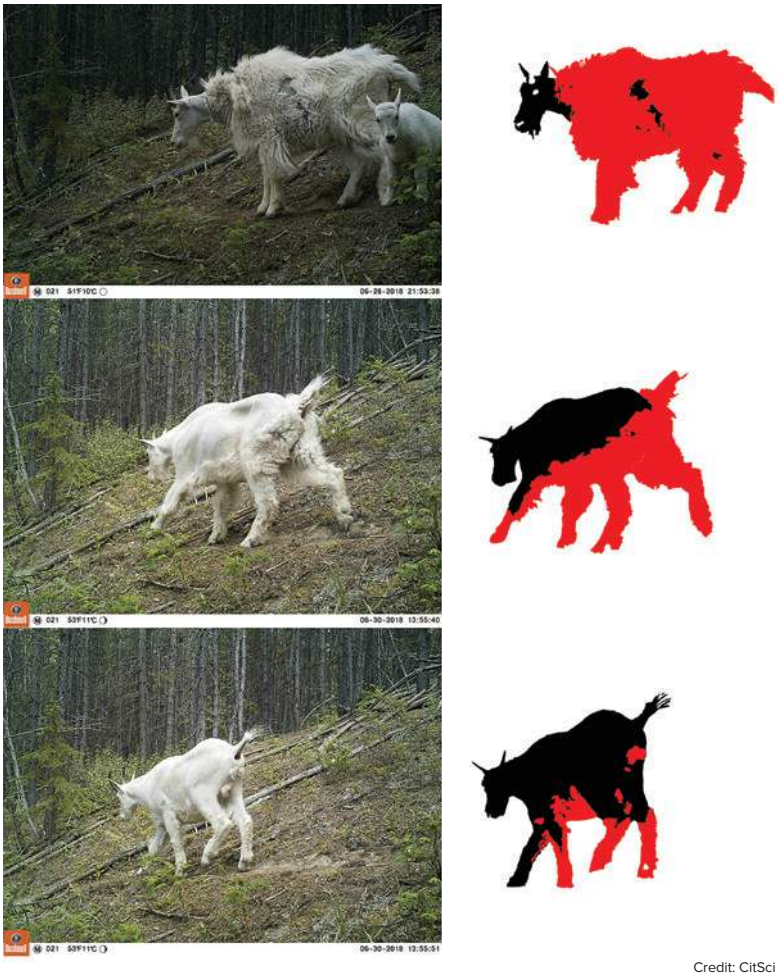
Here are some of the projects where citizen scientists are helping researchers gather and manage data.

Mountain Goat Molt Project: Community photography from CitSci and iNaturalist as well as forums and listserves of wildlife agencies and professional societies helped researchers find out the timing and rate of mountain goats shedding their fur. Researchers doing work like this can now benefit from a new integration between CitSci and the Zooniverse for near real-time photo analysis.

The Serengeti Lion Project: The University of Minnesota Lion Project has turned to camera traps and radio tracking to learn more about 24 lion prides in Serengeti National Park, Tanzania. Citizen scientists are helping researchers plow through camera trap photos to find out about carnivore coexistence, herbivore coexistence, predator-prey relationships and more.

Wild Spotter: Citizen scientists can download the Wild Spotter Mobile App to help the U.S. Forest Service track invasive species.

Monarch Monitoring: Volunteers can help collect long-term data on larval monarchs and milkweed habitat across the U.S. and Canada during breeding season.



Volunteers are helping scientists learn more about mountain goat molting in the Yukon Wildlife Preserve. They found that while all of the goats fully shed by mid-August, ones that birthed twins shed much more slowly than those without kids.

Credit: CitSci

Credit: Karen Yukich

▲ **When Karen Yukich captured this image, she didn't know she was documenting the first known Toronto appearance of the invasive box tree moth, a species that has devastated ornamental plants in Europe.**

habitats didn't discourage them. "It generated enough interest in the public for conservation of these critters that they actually have a waiting list to visit these sites," said Greg Newman.

Sometimes getting people interested means targeting people who already have a wildlife watching hobby. That was eBird's approach when it started in 2002 as an online platform. Now, it attracts participants of all skill levels, and with the addition of a mobile app, it's growing about 20% every year, with a total of about 1 billion bird observations. "One of the best parts of my job is following along with research that comes out of eBird," Curtis said.

The platform has allowed researchers to collect data they never thought they would need. When the COVID-19 pandemic hit, researchers had data to determine how lockdowns were impacting birds. Many species, they found, benefited by having less risk from traffic (Schrimpf et al. 2021). And while the lockdowns meant fewer cars on the road, it brought out more birders logging their observations and using the apps to find new places to explore. "So many people have chosen to make contributions at the same time as enjoying nature," said Nicola Koper, the study's senior author. "That allows for some of these unexpected questions to be answered."

"The benefit to the public is huge," said TWS member Lauren Pharr, a PhD student in the Caren Cooper Citizen Science Lab at North Carolina State University. "As researchers, a big part of our job is to report our findings to the public. This is one of the reasons why we publish."

The opportunity to engage in science has allowed participants to become more exposed to the issues at hand and to learn more about the scientific process. Having individuals participate will assist in working toward improving openness and reliability, as well as improving scientific literacy and knowledge about science, Pharr said. One survey found that those involved in citizen science are more likely to support wildlife conservation and advocacy.

Yukich's moth finding certainly made a difference. Her friend David Beadle, co-author of the *Peterson Field Guide to Moths of Northeastern North America*, confirmed she had spotted an invasive box tree moth. A few days later, he detected the same species in his own backyard moth trap in Toronto. Soon, the Canadian Food Inspection Agency confirmed its presence.

With help from iNaturalist, Yukich's was the first recorded sighting in Toronto—and in North America—of a moth that had already ravaged landscaping in Europe. Efforts were put in place to stop the movement of infested boxwood material in Canada and to treat infestations with a biological pesticide.

"At the end of the day, we need a global conservation system to help us save the planet," iNaturalist co-founder Scott Loarie said. "Building a constituency of people who care, we have a stronger chance of success." ■

Dana Kobilinsky is the associate editor for The Wildlife Society.

Credit: Melissa McGaw/NC Wildlife Resources Commission

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A Hill to Climb

ONE OF WILDLIFERS' GREATEST CHALLENGES MAY BE FIGHTING PUBLIC APATHY

By John Organ

Credit: U.S. Geological Survey

▲ For some researchers, like these U.S. Geological Survey scientists studying climate change on ecosystems in Glacier National Park, climbing mountains is a part of the job. John Organ, recipient of the 2020 Aldo Leopold Memorial Award, says wildlife biologists also have another hill to climb in overcoming public apathy.

"Sportsmen and zoophiles have a common enemy of vastly greater importance to both than any real conflict of interest.... That enemy is public indifference." – Aldo Leopold, 1935

I am fortunate. I grew up in a place and time where connection to nature was an everyday activity. From an early age, I came to sense wild animals with awe. They were not lesser beings on some Aristotelian chain. They were fellow creatures whose wildness and reclusiveness, avoidance and aggressiveness, commanded respect. They are the ultimate source for lifelong learning within an infinite realm. They can thrill you and they can kill you, and for the last 150,000 years or so, we have been obsessed with them, because it was they who made us human.

I am a wildlife nerd: a hunter, a birder, a watcher, a trapper, a tracker, a photographer, a chef, a dreamer. Wildlife for me, like so many of you, is my central life interest. As Gordon Batcheller and I wrote (Organ and Batcheller 2010), though, we are a minority, and therein lies a clue to what I believe is one of our greatest challenges—the hill we must climb—for conservation of wildlife and biodiversity.

People and wildlife

"Conservation is our attempt to put human ecology on a permanent footing." – Aldo Leopold, 1942

Aldo Leopold stated that one of the greatest accomplishments of the 20th century would be the fusion of studying the biological and human realms (Organ et al. 2006). Leopold did not live to see the human dimensions discipline emerge (Decker et al. 2012), nor has his vision of a fusion been truly achieved (Morales et al. 2021), but since the 1970s we have increasingly considered the human aspects of wildlife conservation. Riley et al. (2002) redefined wildlife management in terms that focus on human desires, within limits prescribed under public trust laws (Geist and Organ 2004; Organ and Batcheller 2009). Over the last 50 years there have been many studies

directed at unlocking people's attitudes and beliefs about wildlife (e.g., Kellert and Berry 1980, Duda et al. 1998, Kellert et al. 2017, Manfredo et al. 2018).

Manfredo et al. (2018) placed people in four categories based on survey responses. They infer that Americans, due to modernization (urbanization, education, income) are becoming increasingly "mutualistic," defined as being most extreme in seeing wildlife as part of their extended social network, more likely to exhibit anthropomorphism and less "traditionalist," defined as utilitarian. "Pluralism"—scoring high on both traditionalist and mutualist scales, is highest among Native Americans.

Kellert et al. (2017) explored a theoretical framework originating in the biophilia concept (Kellert and Wilson 1993)—people possess an inherent inclination, based on evolutionary history, to affiliate with nature. They identified eight ways people attach meaning and derive benefit from nature. Their results indicate solid support for land protection, funding and other elements conducive to wildlife conservation. Despite widespread positive feelings towards nature, though, many adults expressed fear and avoidance of aspects of nature and wildlife.

I infer from this that most people are happy to support increased wildlife funding as long as it does not come at extra cost to them personally. This suggests a lack of public vested interest in wildlife conservation. Most telling are data related to people's willingness to pay for wildlife. Strong support is shown for using fines levied on polluters and hunting and fishing license fees. The lowest support and strongest opposition is for a small extra charge in state sales tax on merchandise—the key to the universally envied funding model for the Missouri Department of Conservation.

What about wildlife professionals? Menale (2021) recently surveyed value orientations and attitudes of TWS members as a follow-up to an earlier study (Muth et al. 1998). The inferences I draw from her work are, in relation to categories used by Manfredo et al. (2018), younger TWS members tend to be more mutualistic, but members with more years of experience tend to be more pluralistic. This raises many questions and concerns in my mind. Do these data suggest plasticity where attitude and value orientations shift as wildlife professionals gain knowledge and experience? Do those who initially have either traditionalist or mutualist orientations move towards pluralism as an endpoint as their careers mature? Recall that Manfredo et al. (2018) identified Native Americans, whose traditions and lifestyles may be more directly connected to nature, as having the highest percentage of pluralists.

Now, concerns. Placing humans in categories based on survey data is convenient for organizing and analyzing data, but I fear these categories are taken too literally. People do not exist in silos created by researchers. Categories are purely a means to help us understand what we are observing. The literal interpretation has led some to suggest that since society is moving towards mutualism, we need to hire wildlifers who are mutualistic to better represent society. Mutualism, characterized by Manfredo et al. (2018) as a product of urbanization, income and education, may at heart reflect the detached ethos of the urban educated mind, where our best act may be avoidance, our deepest obligation protection from a distance, with a finality of disconnection (Shepard 1996). Pluralism, on the other hand, may reflect connection, respect, reverence and life-long learning.

Wildlife literacy

"There must be born in the public mind a certain fundamental respect for living things and the epic grandeur of the processes which created them." –Leopold 1933

What I see as a place where the discussion can be strengthened is an evaluation of wildlife literacy.

Courtesy John Organ

▼ John Organ, left, joins Mark Sayre and Wendell Dodge, leader of the Massachusetts Cooperative Wildlife Research Unit, in immobilizing a black bear in its winter den in the 1980s. "Wildlife for me, like so many of you, is my central life interest," Organ says.

Credit: Forest History Society

▲ **Aldo Leopold, left, standing here with colleagues at the Royal Saxon Academy of Forestry in Germany, never saw the human dimensions discipline develop, but he imagined a fusion of studying the biological and human realms.**

Kellert (1980, 1981) in his early work evaluated wildlife literacy and found in general that Americans had a very low level of knowledge related to animals. However, he found especially high knowledge scores among bird watchers, hunters who hunted to be close to nature, scientific hobbyists and fur trappers. If we assume that TWS members have higher wildlife literacy than the general public, would we therefore desire to see the public's literacy increase for the sake of better-informed wildlife policy?

We have recently acknowledged our deficiency in recognizing and incorporating traditional ecological knowledge in wildlife education, research and policy. We have much work to do to fill this void and increase our own literacy, let alone that of the public. Are we popularizing our science and working to use it to increase wildlife literacy? The English ecologist Frank Fraser Darling cautioned that if we accept the philosophy of respect for life and that we are fellow members with wildlife in the world community, we must be constantly guided by the discipline of ecological observation (literacy). Otherwise, we are in danger of being rather silly.

Courtesy John Organ

▼ **John Organ, second from left, stands alongside *trocheros*, or trailblazers, in the Peruvian Amazon, where he trained biologists in habitat sampling techniques.**

Developing a workforce that mirrors the ethnic diversity of society could reap multiple benefits. For example, census data indicate Hispanics are among the most rapidly growing segments of American society, and data from Kellert et al. (2017) show Hispanics having the highest support for wildlife funding.

Wildlife and political realities

"Our political parties espouse 'conservation' in general terms, but they carefully avoid commitment on its internal contradictions. Hence, when occasion arises to split a wilderness with a road or sacrifice a salmon stream to power dams, they may do so without embarrassment." –Leopold 1936

The United Nations report on the extinction crisis lists five direct drivers of change in nature with the largest global impacts to date: changes in land and sea use, direct unsustainable exploitation, climate change, pollution and invasive alien species. To these I will add a sixth: political apathy.

Kellert et al. (2017) cite overwhelming evidence showing that the physical, psychological and social wellbeing of humans depends on contact with nature. Yet, in my lifetime, I do not recall wildlife conservation featured prominently in major political party platforms.

An analysis of the 2016 and 2020 platforms for the Democratic and Republican parties in the U.S. indicates wildlife is an afterthought at best. The only mentions are in the 2016 Democratic platform, opposing efforts to undermine the Endangered Species Act, and in the 2020 platform, related to the promising and refreshing 30 by 30 initiative. The Republican platforms were identical in 2016 and

Credit: Public domain

▲ **Incorporating traditional ecological knowledge into science, education and policy can enhance the learning of wildlife professionals and aid in efforts to increase public wildlife literacy.**

2020, with the only reference related explicitly to wildlife expressing a need for limits on the ESA.

Political platforms reflect party ideology, but they also reflect what is perceived to be important to voters. It is not surprising that jobs, the economy, health and security are the primary issues. If wildlife is so inherently important to humans, why is it virtually absent in political priorities?

Marketing wildlife

"My own gropings come to a dead end when I try to appraise the profit motive. For a full generation the American conservation movement has been substituting the profit motive for the fear motive, yet it has failed to motivate." –Leopold 1938

Advertisers ubiquitously know that wildlife resonates with people and is successful in selling products. A glance at Jumbotrons in major cities around the world reveals wildlife iconography is used overwhelmingly in advertising. Television advertisements during the NFL's Super Bowl are legendary for their cost and sophistication. In 2015, 35% of Super Bowl ads featured live animals as a significant part of their message (Braunwart 2015). What do the advertisers know that we don't, and how have they co-opted our *raison d'etre*?

There is an entire discipline devoted to conservation psychology and marketing, with abundant peer-reviewed literature. Phillips (1996) explored the cultural meaning of animals and its application to advertising. She posited that animals transfer cultural meanings to products and identified themes associated with different animals, such as personality and place. The website Justcreative.com provides guidance to advertisers for animal symbolism in designing logos, emphasizing that animal symbolism evokes emotional responses. Social spatial analyst Maarten Jacobs (2009) suggests human emotional connection to animals develops through phylogenesis, sociogenesis and ontogenesis. He reviews the concept of the unconscious human mind and how certain reactions are based on evolutionary history and survival adaptations.

This survival mechanism operates subconsciously and we relate to different animals in different ways without consciously knowing it. Braunwart (2015)

reviews Jacobs's work and relates his findings to Kellert and Wilson's biophilia hypothesis (1993) that, in part, relates the role of animal presence to maintaining human health. Stone (2014) reviewed the neurological evidence for subconscious human reaction to animals. Electroencephalograph data revealed insights into amygdala and frontal responses to different animal stimuli and how these can be used to provoke action, such as purchasing a product or contributing to a cause.

Marketers and advertisers explored and exploited human subconscious affiliation to wildlife, understanding there exists a deep connection and importance that most people don't even realize. Is there a benefit to human health, wellbeing and quality of life from the existence of wildlife beyond direct benefits derived from nonconsumptive and consumptive uses? How can we determine this with rigor? And if so, how do we increase public consciousness, awareness and concern so wildlife conservation becomes a political priority?

Why is wildlife important to people?

"A pair of wood thrushes is more valuable to a village than a Saturday evening concert and costs less." –Leopold 1933

Louv (2005) popularized the concept of "nature-deficit disorder." He heightened awareness of the importance of contact with nature to child development. Two decades earlier, Shepard (1982) took an even deeper dive into the role of nature and wildlife in human psychological health.

Shepard integrated evolutionary biology and psychology to demonstrate the adaptive and survival benefits of psychogenesis based on direct contact with nature. He emphasized the importance of nature-based external models of order to the development of self-identity and maturity. He defines full maturity, in part, as understanding and affirming limitations and achieving an ever-deepening fullness of self and world in ever-widening spheres of meaning and participation through contact with nature, as opposed to nature being merely an escape or abstraction.

Such development, of course, is best achieved in aboriginal or rural societies. With the United States population over 80% urban (DeStefano et al. 2005), such direct contact with nature through developmental years is challenging. Indeed, Shepard (1996) acknowledged that the modern marginality of wildlife is associated with wildlife's physical absence and our shifted attention. He also posited that *Silent Spring* (Carson 1962) was not simply a warning against pesticide use but against the deafening self, against emptiness.

Anthropologist Robert Ardrey (1972) argued that humans in all ways of life read animals as a special body of signs that is a result of a human ecology that emerged with cognition itself, with hunting being the prototypical form where the sacred significance of animals became part of the human condition. Modernization, though, may have spawned a culture-wide fear of being a participant in a world where life lives on death, and detachment from nature and aversion to this reality lead to indifference (Shepard 1996, Vialles 1994).

▼ **Despite research indicating the importance of nature to our well-being, major political party platforms have been mostly mute on wildlife conservation.**

Credit: Walt Disney Television

A need for broader science

"There must be born in the public mind a certain fundamental respect for living things, and the epic grandeur of the processes which created them." –Leopold 1933

"Services [of the wildlife profession] are vital to those atavistic few for whom a world without wild things would be no world at all." –Leopold 1936

"The thing for us to do now is what science always does....start over and dig deeper." –Leopold 1948

The evidence seems clear that wild animals were essential to human evolution. I suspect, though, that even humans disposed to embrace evolution will not be compelled to carry banners advocating for wildlife at rallies or open their pocketbooks purely based on this knowledge. The question is the relevancy of wildlife to our health and well-being in a postmodern society. I don't believe this is really known, but I suspect it is real.

The wildlife profession is not poised for the kind of inquiry required to answer the question of why wildlife enhances human health itself. This will require true transdisciplinarity, engaging with scientists with whom we have had little or no interaction and increasing social science capacity within the profession (Morales et al. 2021). Developing the science and revealing answers will not be enough, though. It will be crucial to increase public awareness and literacy through communication and messaging to foster a vested interest in wildlife conservation that elevates it in the political arena.

It is critically important for The Wildlife Society to be a leader in this effort. Our policy program, our working groups, our annual conference and chapter and section meetings can become forums for identifying and engaging with researchers from disciplines that can aid and lead this effort.

TWS has recently become a member of the International Union for Conservation of Nature, which has a Sustainable Use and Livelihoods Specialist Group that includes an active North American branch. When practiced sustainably, the livelihoods of people connected to wildlife—and to the land that supports it—foster conservation, not threaten it. These examples can improve public wildlife literacy.

Our hill to climb

"We shall achieve conservation when and only when the destructive use of land becomes unethical—punishable by social ostracism." –Leopold 1943

By Leopold's metric we have not yet achieved conservation—we have a long way to go. Until wildlife becomes greatly elevated in human priority, the erosion of wildlife diversity will continue.

I have no doubt that many of you believe I'm in a pipe dream to think we can actually get to the root of the questions I pose, let alone change public consciousness. Possibly, but I draw inspiration from a past president of The Wildlife Society, Olaus Murie. He wrote, "We may be content to expertly tinker with the wildlife machine to keep it alive somehow; or *we can give our profession the dignity and importance it deserves* and help the public interpret the facts so as to contribute in [people's] struggle to find [themselves]" (Murie 1954).

Courtesy John Organ

John Organ weighs a Canada lynx (*Lynx canadensis*) kitten.

I also draw inspiration from Amanda Gorman's inaugural poem, "The Hill We Climb." To paraphrase her, the hill we climb, if only we dare, to help people realize they need wildlife, means we must keep climbing. We will not march back to what was but move to what shall be. Our inaction and inertia will be the inheritance of the next generation. Our blunders become their burdens, so let us leave behind a conservation ethic in our society better than the one we inherited.

To Olaus Murie I will say, I am not content. To you I say, let's climb the hill together. ■

John Organ, PhD, CWB®, is a past president of The Wildlife Society and the recipient of the 2020 Aldo Leopold Memorial Award. A TWS honorary member and TWS Fellow, he received the 2014 George Bird Grinnell Award from the Wildlife Management Institute and the Interior Department's Meritorious Service Award.

A Legacy of Science and Partnerships

FOR OVER 35 YEARS, THE STARKEY PROJECT HAS CONDUCTED POLICY-SHAPING RESEARCH ON DEER AND ELK

By Mary M. Rowland, Michael J. Wisdom, Darren A. Clark and Bruce K. Johnson

The 1980s were the era of the "elk wars." Tensions ran high as cattle (*Bos taurus*) producers in eastern Oregon pointed fingers at elk (*Cervus canadensis*) herds decimating crops and haystacks on private lands and competing for limited summer forage on public grazing allotments. Meanwhile, wildlife enthusiasts and game managers decried the cattle taking grasses that could have fed elk. Soon the wars dissolved into occasional skirmishes. A big part of the solution was the birth in 1985 of a long-term research program designed to inform integrated management of deer (*Odocoileus* spp.), elk and cattle—the Starkey Project (Wisdom 2005).

As scientists fortunate enough to work in this unique setting, we have helped guide the evolution of the project's focus. We have tried to keep true to its original mission of understanding how common land management activities affect ungulates. But we have also allowed it to expand to encompass emerging topics, from how grazing by cattle versus deer and elk affects native pollinators (DeBano et al. 2017) to disentangling the complex interactions of Starkey's carnivore community (Ruprecht et al. 2021, Ruprecht et al. 2021).

In 1940, long before the Starkey Project launched, the demand for research on overgrazing by domestic

Credit: Mary Rowland

Extensive outreach and technology transfer are hallmarks of the Starkey Project and are critical to buy-in of research findings. Since the project's inception, Starkey staff members have led hundreds of field tours, workshops and public meetings. Here, tour participants learn about a riparian restoration project implemented to benefit salmon species in Starkey.

stock and elk in the mountain ranges of eastern Oregon had spawned the creation of the Starkey Experimental Forest and Range (Starkey; Skovlin 1991; Rowland et al. 1997). The site is one of 84 long-term experimental areas managed by the U.S. Forest Service. Studies on the 27,000-acre research site initially targeted livestock forage production and grazing techniques (Skovlin 1991). Wildlife research began in the 1970s, exploring how forest management affects pileated woodpeckers (*Dryocopus pileatus*; Bull and Meslow 1988) and other wildlife, as well as interactions of cattle grazing with deer and elk distributions and diets—a precursor to one of the Starkey Project's first studies.

From the start, Starkey Project research relied on a novel combination of technologies, allowing scientists to answer otherwise intractable research questions. These technologies facilitate long-term, manipulative experiments to address management issues at landscape scales that are operationally relevant to land use and wildlife planning. Arguably the most notable feature of Starkey is the fence, erected in 1987 to create a 25,000-acre ungulate enclosure that remains foundational to the research. With the fence, and additional interior fencing to produce separate research enclosures, we can manipulate ungulate densities to meet study objectives across this broad expanse of forested rangelands. Yet we can also allow free-ranging ungulates the same habitat choices from spring through fall as those available to animals outside the fence. Moreover, access and activities of humans can be controlled, which has enabled us to use people as research "treatments," as in our studies of nonmotorized recreation and hunting (Wisdom et al. 2018; Rowland et al. 2021).

Partnerships are key

With its game-proof fence and controlled access, Starkey is truly a one-of-a-kind research facility. Throw in automated traffic counters, a herd of tractable elk that helped break new ground in elk nutrition research, decades of telemetry data to facilitate long-term habitat use and competition studies and animal handling facilities and you have a world-class resource. A broad spectrum of federal, state, private, Tribal and university partners have collaborated to make it all happen, leading to widespread acceptance and use of project results to tackle national issues in resource management. But key to its success is the 30-plus year collaboration and co-leadership between the USFS Pacific Northwest Research Station and the Oregon Department of Fish and Wildlife.

Credit: Mary Rowland

▲ **The New Zealand woven wire fence that encloses Starkey was originally intended to last 20 years, but with minimal reinforcement, it continues to serve as a nearly impermeable barrier to deer, elk and cattle movements while allowing predators like cougars and black bears to move freely across the fence.**

From the get-go, both agencies worked together to develop the facility, its technologies and its research agenda, while leveraging funding and equipment. Both PNW and ODFW support a full-time Starkey Project leader, with scant turnover through the years. Jack Ward Thomas, the Starkey Project leader for the Pacific Northwest Research Station in the 1980s and early '90s, who later became chief of the Forest Service, was instrumental in getting the fencing and supporting technologies established, working closely with Donavin Leckenby, ODFW's project leader. Moreover, project staff members have always been co-located to ensure the work remains tightly integrated. This long collaboration has been one of the closest and most successful research partnerships that we know of between federal land management and state wildlife agencies.

Other partnerships have also been crucial to Starkey's productivity and relevance. The U.S. Forest Service's National Forest System—a primary stakeholder—supported Starkey research from the beginning at scales ranging from national and regional to local. The NFS funded most of the initial fence construction. In close cooperation with scientists, the Wallowa-Whitman National Forest has implemented contemporary management actions at Starkey, such as prescribed fire and riparian restoration as research treatments. This coordination helps ensure that results are highly relevant to management and society.

Contributions by additional partners also have been indispensable to Starkey's success. Scientists John Cook and Rachel Cook with the National Council for Air and Stream Improvement, for example, provided unique expertise in ungulate nutritional ecology in hand-raising a herd of tractable elk at Starkey. The elk were used in pioneering diet studies at Starkey and across the Pacific Northwest, with results incorporated in ecoregional nutrition and habitat-use models of direct utility to management (e.g., Rowland et al. 2018). Oregon State University and its Eastern Oregon Agricultural Research Center have contributed years of expertise in the management and ecology of livestock, vegetation, riparian restoration, invertebrates and carnivores, resulting in dozens of publications and many graduate student projects. The Rocky Mountain Elk Foundation has been a staunch supporter throughout the project's history.

The early years

The Starkey Project was designed to evaluate mule deer and elk responses to some of the most common—but contentious—management activities on national forests in the western U.S. in the 1980s. Debate centered on four issues: road and traffic management, intensive timber production and thermal cover for elk, competition between wild ungulates and cattle, and declining productivity in elk herds—topics that remain vexing challenges, in varying degrees, for managers today. All the studies relied on the unique combination of Starkey technologies, such as the fence, telemetry system and traffic counters.

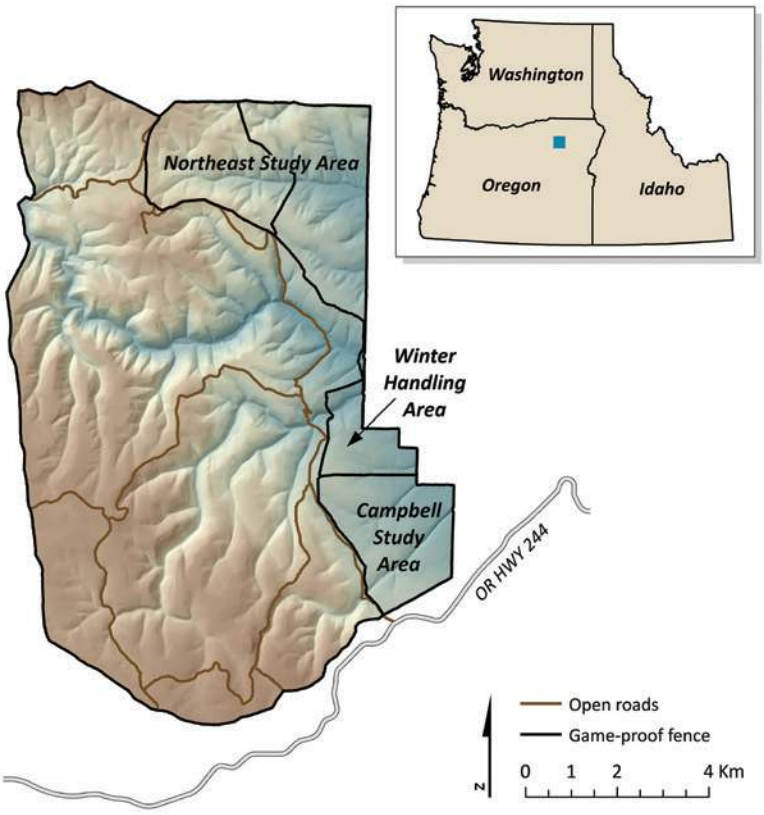
Through analyses of road type and traffic rate, we found that elk strongly avoided areas adjacent to open roads in summer, even out to a mile, but that deer selected areas close to roads (Wisdom et al. 2004). Moreover, we found that distance to open roads was a much more robust metric for evaluating road effects than road density (Rowland et al. 2004). Elk avoidance of roads open to motorized use has been consistently documented in all Starkey research as well as other studies throughout western North America.

The initial timber studies of the 1990s (Wisdom et al. 2004), which coincided with dramatic spruce budworm (*Choristoneura occidentalis*) outbreaks at Starkey and beyond, provided the setting to evaluate how ungulates respond to long-term changes in habitat (e.g., Spitz et al. 2018). Although elk distributions shifted slightly in response to timber removal, the most pronounced effect was the increase in elk vulnerability to harvest, with hunter success increasing substantially after the removal of security cover (Wisdom et al. 2004). In related research that relied on tractable elk raised at Starkey, scientists from NCASI could show no thermal benefit to elk of dense forest cover (Cook et al. 1998).

Forage competition studies revealed spatial separation of deer, elk and cattle across landscapes and seasons (Ager et al. 2004, Findholt et al. 2004, Stewart et al. 2002). By August, when spatial overlap was greatest, diets overlapped, but competition for forage was greater among animals within species than between species (Coe et al. 2004).

Research on elk recruitment, now widely used in elk hunting regulations, demonstrated that conception dates became earlier and more synchronous as the ages of the oldest cohort of bulls increased from yearlings to five-year-olds (Noyes et al. 1996, 2002). However, pregnancy rates were unaffected by bull age, indicating other possible mechanisms were at play. This finding precipitated further research to examine how the timing of birth and different levels of summer nutrition might explain variation in elk recruitment.

▼ **The Starkey Experimental Forest and Range spans about 25,000 acres of mixed conifer and grasslands in northeastern Oregon. Entry is through a single gate in the southeast corner, allowing for control of human access and maintaining closed populations of deer, elk and cattle. Separately fenced study areas allow for concurrent experiments, with varying densities of deer, elk and cattle.**



Courtesy USFS Starkey Project

These studies clearly showed that summer nutrition was a much better predictor of calf growth and subsequent pregnancy rates of lactating females (Cook et al. 2004), but that even the largest calves would not survive severe, prolonged winter conditions.

Staying relevant

Over time, the needs—and questions—of natural resource managers, policymakers and the public have changed. The research has adapted accordingly in the breadth of topics undertaken, their geographic scope and the technologies and analysis approaches used to produce new science. For example, although elk studies dominated early research, the primary focus now is documenting causes for ongoing declines in mule deer populations at Starkey and elsewhere in the species' range. Taking advantage of Starkey's experimental setting, we have reduced the elk population at Starkey by about 85% to determine if and how mule deer habitat use, nutrition and population dynamics may change in response to reduced competition with elk, well documented in prior Starkey studies.

Tightly coupled with this research is an intensive study of the role of predation on mule deer populations, specifically by cougars (*Puma concolor*), black bears (*Ursus americanus*), coyotes (*Canis latrans*) and bobcats (*Felis rufus*). An added benefit of studying carnivores is the opportunity to compare different sampling techniques used to estimate carnivore populations and thereby obtain a better understanding of behavioral interactions among

Credit: Oregon Department of Fish and Wildlife

▲ **New research on carnivores, like the black bear captured here, is advancing knowledge about how and when Starkey predators prey on deer and elk, but also documenting complex interactions among the carnivores themselves.**

Policy-shaping research

Dozens of Starkey studies have been completed, with results widely adopted for managing forests and rangelands of the western U.S and Canada.

- Elk nutrition and habitat-use models have guided forest and road management strategies in Oregon and Washington, with approaches adopted in other regions.
- The Forest Service used findings from motorized traffic and off-road recreation research to develop national roadless and off-highway vehicle policy and travel management plans.
- Studies of elk-deer-cattle grazing resulted in improved methods of allotment management planning for livestock grazing on federally managed rangelands.
- Research on interactions of fuels reduction with ungulate herbivory provided key information about management designs to benefit ungulate habitat use and performance while reducing fire risk in forest ecosystems.
- Timber harvest and thermal cover studies addressed national controversies, resolving litigation and ultimately saving the Forest Service millions of dollars in land use planning.
- Hunting research on game animals and hunters has dramatically improved harvest designs by state and provincial wildlife agencies, enhanced hunting opportunities and offered insights into hunter behavior and factors that influence their success.
- Grazing-riparian restoration studies evaluate effects of cattle, deer and elk on salmonids and other resources, with results used to identify best management practices for riparian restoration.
- Factors limiting mule deer population growth are being evaluated in relation to elk and carnivores, with implications for declining deer populations.
- Carnivore studies are providing new knowledge of their roles in regulating ungulate populations, inter-specific interactions and options for predator-ungulate management.

Credit: Maura Olivos

▲ **Rachel Cook, a senior research scientist with NCASI, records each bite, by species and plant part, of forages consumed by tractable elk during one of thousands of feeding trials conducted across the Pacific Northwest.**

Harnessing technology

A unique set of technologies and infrastructure has been foundational for Starkey research, including:

- **One of the largest ungulate research enclosures** ever established (25,000 acres), enabling cause-effect landscape studies with control of animal densities and human access to address a diversity of management-relevant topics.
- **Telemetry systems** that have generated millions of locations of deer, elk, cattle and recreationists since 1989, and of cougars, black bears, bobcats and coyotes since 2016.
- **An automated system of traffic counters** on roads and trails to document impacts of traffic and other human activities on wildlife.
- **Camera trap arrays across upland and riparian areas** to estimate ungulate and predator populations and record their interactions and habitat use.
- **A deer and elk winter feeding and animal handling facility** for monitoring disease and health, deploying telemetry collars and collecting data on pregnancy status, body fat, body condition, age and weight to support multiple research projects.
- **Tractable ("tame") elk, mule deer and cattle** have been used in nutrition and grazing studies to address critical management questions.

medium- and large-sized carnivores (Ruprecht et al. 2021, Ruprecht et al. 2021). In addition to global positioning collars on each of the four carnivore species, we have established an array of trail cameras not only across Starkey but also continuing outside the fence, which are used to estimate carnivore abundance annually.

Starkey research has also expanded to include interactions between another predator—humans—and ungulates. In studying the behavioral responses of both targeted (male elk) and non-targeted (female deer and elk) animals to human hunting pressure, we found that regardless of sex, elk during the hunts strongly avoided roads, with potentially forgone foraging opportunities, but male responses were more pronounced (Smith et al. 2021). During rifle hunts for male deer, female deer moved more quickly within their home ranges, but overall showed little response to hunters (Brown et al. 2020). Different factors also influenced how successful hunters used landscapes compared to unsuccessful hunters, and these varied by hunting method (archers versus rifle hunters) and species (deer versus elk; Rowland et al. 2021). Together, these studies helped identify landscape features that can affect harvest by, and the degree of refuge from, human hunters.

Another topic of keen interest to public lands managers is how cattle grazing affects riparian condition, especially along streams supporting coldwater fish listed under the Endangered Species Act. With support from the Wallowa-Whitman National Forest and Bonneville Power Administration in implementing a riparian restoration project, we initiated a long-term study with OSU to evaluate how not only cattle, but also deer and elk, affect a host of riparian metrics, many used by regulatory agencies to manage livestock. With a design that allowed us to evaluate grazing by deer and elk in the absence of cattle, we found that wild herbivores can substantially reduce the survival and growth of shrubs planted for riparian restoration to benefit fish (Averett et al. 2017). In a companion study, these shrubs were shown to be an important early foraging resource for native bees, a finding not previously documented that can help guide restoration efforts (Mitchell et al. 2021).

The longevity of the Starkey Project's data, especially ungulate locations, allows inference at time scales rarely observed in field studies. For example, one project investigated how elk respond to forested stands following fuels reduction treatments,

showing that elk selected these stands for 15 years post-treatment before returning to baseline use. Elk also responded at daily and seasonal scales, increasing their use of treated stands at night, and with use peaking in late summer (Spitz et al. 2018). Our findings highlight the importance of a mosaic of forest conditions to provide options for habitat selection by large herbivores daily, seasonally and annually to meet their life history requirements (Long et al. 2010).

Starkey's future

Searing temperatures and the lowest stream levels in memory in 2021 point to the urgent need to better understand how a changing climate will affect not only ungulates but also entire ecosystems of the western U.S. Fortunately, we have invaluable long-term datasets that we can leverage to help managers prepare for the future, including hard-to-get data on deer and elk pregnancy rates and body fat. Data on plant phenology, collected at Starkey in the early 1990s and again from 2015-2019, reveal dramatic changes already, with the active growing season now two to three weeks shorter and senescence of many species occurring up to three weeks earlier. Such changes will undoubtedly impact many wildlife species, including deer and elk. Discussions are also underway to initiate new research exploring how thinning in upland forests may alter hydrologic systems, with the objective to retain snowpack longer and boost soil moisture. Whatever the direction, we are confident that we will continue to design and carry out research that directly serves management of wildlife and its habitats, with support from our longstanding partners. ■

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Darren Clark, PhD, is a research wildlife biologist for Oregon Department of Fish and Wildlife and Starkey Project Team Leader for ODFW.

Bruce Johnson, PhD, is a former Starkey Project Leader for ODFW (now retired).

The U.S. Forest Service is a Premier Partner of The Wildlife Society

No Justification Needed

ALLEVIATING CONFLICT SHOULD BE A BONUS OF PREDATOR HUNTING, NOT A REQUIREMENT

By Chris Comer

Credit: Steve Hillebrand/U.S. Fish and Wildlife Service

▲ **Black bears are widespread and relatively abundant across much of North America, but they have been the subject of numerous ballot initiatives and state referenda to restrict hunting.**

Numerous proposals have targeted carnivore hunting in the United States and Canada in recent months. The Great Lakes region has seen a constant stream of news and opinion about delisting gray wolves (*Canis lupus*) and allowing a regulated harvest there. In California, the since-withdrawn bill SB252 would have banned black bear (*Ursus americanus*) harvests. The spring bear hunt in Washington was recently suspended in response to public pressure, and a petition in Nevada to ban the use of dogs for bear hunting was defeated last spring. Recent years have seen a number of attempts to limit or end the hunting of cougars (*Puma concolor*), bobcats (*Lynx rufus*), grizzly bears (*Ursus arctos horribilis*) and wolves.

This is, perhaps, not surprising. Large predators elicit strong emotional responses for a variety of reasons. Some people may perceive them as rare, even when they aren't. Sometimes, the animals remind people of pets. Yet data from numerous studies have shown that regulated harvest is sustainable.

When trying to make a case for predator hunting, state agencies and hunting advocates almost always discuss the value of hunting as a tool to reduce human-wildlife conflicts. This argument holds a lot of merit, and it can be a convincing one. Years of surveys have shown that the public supports regulated hunting as a management practice. Reducing conflict is not the only reason for predator hunting, however, and it shouldn't be necessary for policymakers to use it to justify the activity.

Even engaging in these discussions can detract from consideration of important issues related to predator hunting. Oftentimes, hunting critics use "value claims" (e.g., hunting black bears is bad for society) rather than evidence claims (e.g., hunting black bears reduces conflict with people). Separating these types of claims is important when considering issues such as the social licenses to hunt (Darimont et al. 2020). When justifying hunting or making the decision to have a harvest for a species, it's important to consider all values and evidence.

Dynamic wildlife responses

In questioning agency management plans, anti-hunting groups often grasp onto the fact that hunting is not universally associated with reduced human-predator conflict. In fact, the literature does show different species react differently to hunters and human presence.

This issue came to my attention a few months ago when I came across an excellent scientific paper about black bear management in Minnesota (Garshelis et al. 2020). The authors described a relatively straightforward study of human-bear conflicts over four decades and their relationship to bear abundance. The researchers found that bear-related complaints declined following a dramatic reduction in population density due primarily to hunter harvest over several years. Other factors such as food availability and presence of

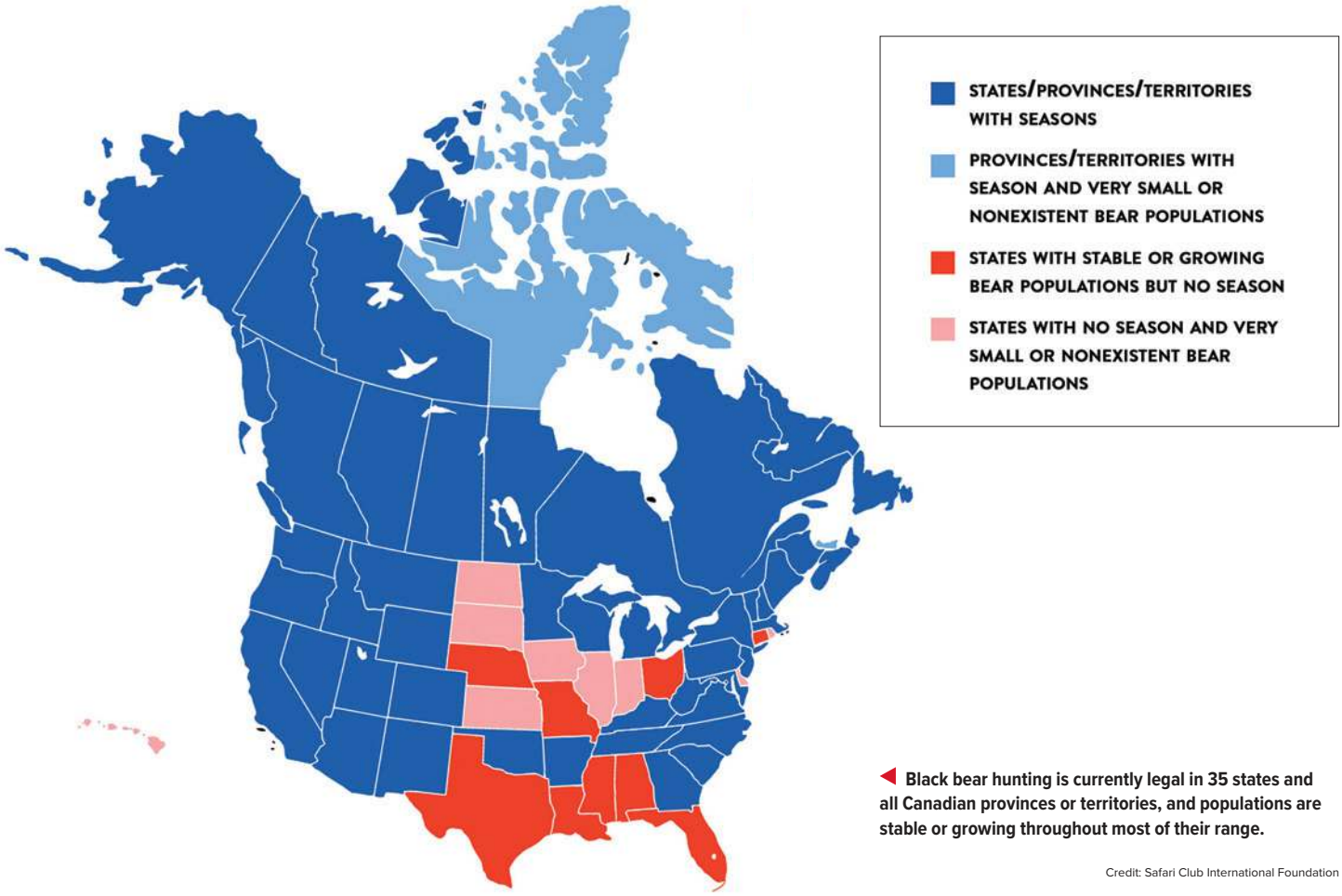
attractants also affected the incidence of complaints, but bear population density was the most important one.

Of course, the finding that fewer bears produce fewer negative interactions makes intuitive sense. Similar results have been found in other species and other locations (e.g., Raithel et al. 2017). The relationship between population density and human conflict should be relatively uncontroversial.

The relationship between hunting and animal behavior isn't as straightforward, though. Some authors have suggested that increased hunting mortality is associated with increased human-cougar conflict in western North America (Teichman et al. 2016), although further research will be needed to verify this effect. Others have found that hunting pressure can reduce human-wildlife conflict due to the animals' increased fear of humans (e.g., Cromsigt et al. 2013).

The idea that hunting increases social tolerance for predators also has some merit in the scientific literature (Heberlein and Ericsson 2008). Populations of larger predators—including bears, cougars and wolves—have been generally expanding across North America in recent decades, and social tolerance will be key to the future management of these species. The evidence of hunting's impacts on predators' behavior and social tolerance is mixed, though, and it varies depending on species, location and other factors. For such a complex issue, this should not be surprising. However, anti-use groups often seize upon the fact that hunting is not universally associated with reduced conflict to question agency management plans.

Defining the impacts of hunting and other management techniques on predator populations and wildlife conflict is an active area of research (e.g., Treves et al. 2019). However, resolving the scientific debate about the impacts of hunting on human-wildlife conflicts is largely unnecessary to make



Black bear hunting is currently legal in 35 states and all Canadian provinces or territories, and populations are stable or growing throughout most of their range.

Credit: Safari Club International Foundation

decisions about hunting predators or other species. Wildlife management entities have narrowed their options and done themselves a disservice by engaging with these issues when considering the merits of sustainably using their wildlife resources.

Keeping conflict out of the decision

Under the North American Model of Wildlife Management, government entities manage wildlife in trust for the people and to maximize public benefit. High demand for hunting opportunities and, in some cases, high willingness to pay for those opportunities shows that there are irrefutable benefits to the public from sustainably using species such as bears and cougars. In many states, the demand for bear or cougar permits exceeds the number that can be sustainably harvested, and tags must be allocated by lottery or similar means.

Basic economic theory tells us that society clearly benefits from having regulated and sustainable harvest of wildlife, including predators. Hunting provides both monetary and nonmonetary benefits. Hunters receive recreational benefits. Rural and Indigenous communities often reap monetary gains from permit sales and hunters' expenditures.

Further, sustainable hunting does not preclude other public benefits from that resource by those that choose not to hunt and engage instead in wildlife viewing or photographic tourism. Given these societal benefits, sustainable harvest of wildlife should be allowed unless that harvest inflicts quantifiable costs that outweigh those benefits. The real issue is not whether hunting reduces wildlife conflict. It is how society weighs the costs and benefits of these activities among various stakeholders and users.

A push for sustainable hunting

The first and most obvious reason to halt or change harvest of a species is if that harvest is unsustainable. In North America, the unregulated and unrestrained market hunting of wildlife in the late 19th century provides a cautionary example. However, our understanding of wildlife ecology and wildlife management has grown immeasurably since market hunting threatened many species in North America. Indeed, the past hundred years or so have seen numerous examples of species being brought back to healthy populations through effective regulation and management led and funded largely by hunters. Well-publicized examples include wild turkeys (*Meleagris gallopavo*), wood ducks (*Aix sponsa*), elk (*Cervus canadensis*) and white-tailed deer (*Odocoileus virginianus*). Outside North America, examples include white rhinoceros (*Ceratotherium simum*) in Africa and markhor (*Capra falconeri*) in central Asia.

Today, black bear populations continue to grow and expand across North America, despite hunting seasons in over 35 states and 12 Canadian provinces. They now occupy their greatest range since a low point in the first half of the 20th century. Regulated hunting clearly can occur in a manner that provides for stable or growing black bear populations throughout their range. According to some researchers, hunting has even contributed to the growth of bear populations.

Evidence from all over the world shows that regulated hunting can take place in a way that does not negatively affect wildlife populations and in many cases provides tangible benefits in the form of habitat or population management. The value of sustainable use of wildlife for humans and for wildlife conservation is recognized by a variety of entities, including The Wildlife Society and the International Union for Conservation of Nature.

Arguments against sustainable use of wildlife rely on value claims rather than evidence claims. In general, these take the form of arguments asserting that hunting wildlife is cruel or questioning the moral impact of harvesting animals for pleasure. The full argument in this case must be that the moral impacts on society of allowing hunting offset the clear and quantifiable benefits of that use.

These arguments seem dubious at best. Although harvest with a modern rifle or bow clearly is not painless, it is difficult to argue that a hunted animal suffers any excess pain or distress compared to others in the population that die by "natural" means such as starvation, disease, predation or conflict with other wildlife. In the absence of regulated hunting, mortality may increase from non-hunting human factors, including vehicle strikes or euthanization after being involved in conflicts with humans, or from symptoms of overpopulation, such as malnutrition or disease. The public may come to view wildlife as a pest rather than a resource, and issues such as illegal or retaliatory killing may increase (DeStefano and Deblinger 2005).

In these cases, the animal is seldom used by people, and it is difficult to manage impacts on the

population. If there is no excess pain or distress for a hunted animal compared to other mortality and the animal is less likely to be wasted, then it is difficult to argue that hunting represents a moral blemish on society.

The cost of hunting bans

Elimination of hunting imposes real and quantifiable costs in the form of lost opportunity to participate (including for the 30,000 black bear hunters in California that would have been affected by SB 252) and lost income for state agencies, rural communities and outfitters (Southwick Associates 2018). In 2018, hunting guides and outfitters in British Columbia filed a lawsuit to recover damages to their business due to a ban on grizzly bear hunting in that province. Would black bear hunters in California or houndsmen in Nevada have cause for a similar action?

The case for sustainably hunting predators such as bears can—and should—stand purely on the benefits to those members of society that engage in the activities. Hunting may provide further benefits in the form of reduced human-wildlife conflict or direct income to operators. However, proving those benefits should not be necessary to implement or maintain sustainable wildlife use. As a society rooted in individual liberty, citizens should be allowed to engage in activities according to their individual will and ethics unless such activities impose negative impacts on society. The burden of proof should be on opponents to show quantifiable costs to society if we are to deny the benefits of a regulated harvest to those who engage in it. Management agencies have a responsibility to ensure harvest is sustainable, and hunters themselves are responsible for maintaining ethical standards.

The North American Model clearly states this principle, but it applies anywhere in the world where sustainable use of wildlife resources can benefit society. ■

Chris Comer, PhD, is the director of conservation for the Safari Club International Foundation in Washington, D.C.

Cooperation in Conservation Law Enforcement

OVER THREE DECADES, THE INTERSTATE WILDLIFE VIOLATOR COMPACT HAS HELPED STATES ENFORCE WILDLIFE LAWS

By Bruce Thompson, Douglas Messerly, Travis Franklin, Mike Fowlks and Pat Fitts

Credit: Florida Fish and Wildlife Conservation Commission

▲ **A wildlife enforcement officer contacts legal hunters in the field to verify compliance with regulatory obligations.**

Wildlife provides substantial value to humans, both in terms of subsistence and enjoyment, but its stewards have long recognized that to ensure these benefits, they needed to control human pursuits. Recent decades have shown us that habitat and wildlife protections are not enough to manage and conserve wildlife. We need regulations in a variety of forms—hunting, fishing and trapping regulations; animal trafficking controls; recreationist dispersal—intertwined in natural resources policy and law (Leopold et al. 2018).

Agencies are limited in their enforcement capabilities, though, making it an ongoing challenge to regulate consumptive wildlife users equitably. As a result, an innovative approach arose over 30 years ago to aid state wildlife agencies in the United States—an interstate compact to share information about fishing, hunting and trapping violations. The Interstate Wildlife Violator Compact has seen many successes over those decades, and it continues to develop.

Hunters, anglers and trappers have long traveled widely in pursuit of wildlife across North America, but it wasn't until the 20th century that improved transportation and technology allowed those pursuits to expand substantially. Increasingly, individuals began traveling to other states in search of fish and game species they couldn't find close to home. With this increase came problems. Over time, out-of-state residents increasingly violated wildlife laws and regulations. Since enforcement ended at the state line and extradition was unlikely, violators only faced penalties in the state where the violation occurred. If they failed to appear in court and went back home, the state had no recourse.

Throughout the 1980s, members of the Western Association of Fish and Wildlife Agencies identified the problem and began developing a solution. Law enforcement personnel were seeking ways to devote realistic time to processing nonresidents' violations. Given that most wildlife- and fish-related violations are misdemeanors with relatively minor punishment options, states were seeking ways to make it faster and easier to handle them, treat nonresidents and residents similarly and provide reciprocal recognition of suspensions among states. For violators, having their license privileges suspended or revoked for failing to appear in court or having to pay fines could prove a strong motivation to resolve their cases rather than return home and ignore the violation.

WAFWA proposed a new agreement between states to recognize wildlife crimes that occurred in each other's jursidictions. A law enforcement agreement like this wasn't a novel idea. It emulated existing driver license agreements between states and the model replicated in other interstate compacts addressing natural resources, energy, education, medicine and agriculture. In 1989, Colorado, Nevada and Oregon all passed legislation formally establishing procedures to suspend and revoke hunting and fishing licenses, issue notices

for out-of-state violators to appear in court and impose bond on them. Their work served as model legislation for future member states to adopt this new agreement—the Interstate Wildlife Violator Compact (IWVC).

The compact evolves

Throughout the 1990s and 2000s, the program spread across the U.S. as states saw the benefits of joining. The IWVC extended recognition of suspended hunting, fishing and trapping license and permit privileges across state lines, diminishing illegal activities over a larger area. The IWVC requires members to alert compact members about wildlife violation convictions that invoke suspensions. It also gives members discretion to honor each other's suspensions and provides a means to exchange violator data among members. These constraints can affect activities related to a broad array of vertebrate and invertebrate wildlife, depending on the statutory authority of member states. Compact provisions apply to illegal pursuit, taking and possession of wildlife as well as failure to comply with terms of a ticket or summons.

To join the compact, a state first must enact legislation (National Center for Interstate Compacts 2020). A state's wildlife agency then must adopt regulations to implement IWVC membership. There is no additional funding or staffing requirement, but each state must pay a $500 annual database access fee. Entering violator information into a database is typically the responsibility of existing state wildlife agency staff, but it doesn't take much time. As of July, every state but Hawaii and Massachusetts were members of the IWVC. Since the legal structure of an interstate agreement doesn't allow for nonstate partners, federal agencies, Canadian provinces and Indigenous groups do not participate.

The IWVC creates reciprocity among member states for suspending hunting, fishing and trapping license privileges. In most instances, when a resident of a compact state commits a violation in another member state, enforcement staff can treat nonresident violators as though they were a resident by issuing a citation and releasing them on personal recognizance. If violators don't comply with the citation, their home state can be requested to suspend license privileges until they meet their obligations. Any member state may accept or reject the conviction for license suspension purposes. Through this ratification process, a member state can recognize a suspension from an entering state and suspend pertinent licenses. Some states only recognize suspensions for violations that would result in suspension in their state.

The IWVC provides general procedures for enforcement agencies and courts. A state can develop compact-specific procedures to meet legal and administrative requirements as long as they comply with the intent of the compact. The IWVC does not affect the right of any participating state to apply any of its laws relating to license privileges. When there is a conflict with a state's laws, the IWVC remains in full force and effect for the state aside from the conflicting provision. A board of compact administrators made up of one person from each member state oversees IWVC operations and serves as a governing body for resolving all related matters. Board action may only be taken at a meeting (which can be virtual) at which a majority of the participating states are represented.

Beginning in the late 1980s, violator suspension information was recorded in an interstate database. That database is now maintained by Systems Consultants, Inc.-Nevada, a private firm that helps states process special draws for licensing opportunities. That system remains in use

▼ **This is the sort of egregious wildlife violation that the Interstate Wildlife Violator Compact strives to reduce.**

Credit: New Mexico Department of Game and Fish

Credit: Florida Fish and Wildlife Conservation Commission

▲ **A Florida Fish and Wildlife Commission officer checks with a hunter.**

to support selection of special hunt participants, but it also advises aspects of IWVC information sharing. The combined use ensures that violators whose privileges have been suspended cannot draw special privileges for which they don't qualify. Because of legal variability among states, the IWVC doesn't track whether a crime is a misdemeanor or a felony.

Experiences and outcomes

State wildlife resource agencies are partners in developing and implementing the IWVC. They recognize that the inherent time savings, similar treatment of individuals across jurisdictions and prospective deterrence behavior all serve their constituency interests.

Four regional state fish and wildlife agencies (Midwest, Northeast, Southeastern, Western) cooperate to advance interests of their state agency partners. Further, the Association of Fish and Wildlife Agencies works nationally to advance the interests and functionality of the state partners, in part through committees that address member needs. Law enforcement committees in each organization aid the implementation, coordination and interstate review of IWVC operations as a service for state wildlife agency members. The IWVC board of compact administrators is a subcommittee of the AFWA Law Enforcement Committee, which meets annually. State legislatures also are key cooperators, enacting legislation to enable state fish and wildlife agencies to participate.

"The Interstate Wildlife Violator Compact represents a broadly successful collaborative effort among wildlife law enforcement professionals nationwide to conserve wildlife resources while being sensitive to interests of the people involved in all facets of adjudicating violations," wrote David Croonquist in an email. As assistant law enforcement chief with the Colorado Division of Wildlife at the time the IWVC was created, Croonquist was part of the original team that developed its principles.

From the compact's inception to late 2020, at least 87,576 suspensions nationally for resident and nonresident violations were entered into the IWVC database. Florida provides an illustrative example for using this information. Among all suspensions in the database, Florida ratified 66,990. Of that total, 654 suspensions related to Florida violations. Those Florida suspensions primarily involved cases of big game violations (74.2%), fishing-related violations (5.5%), trespassing (4.1%) and failure to appear situations (3.2%) outside Florida. Sixteen other categories each were 2% or less of all suspensions.

Generally, there has been increased communication among states while implementing the IWVC and courts have upheld the compact against legal challenges (Musgrave 2009). Assessing equitable applicability is difficult, though. Data were insufficient to assess the ethnicity or gender of individuals subject to suspensions compared to licensees overall. Clearly, there are many nuances of such statistics among 48 states with staggered entry into IWVC use. Nonetheless, this is a process and dataset with many options to assess enforcement effects on conservation interests.

The prospect of not being able to hunt, fish or trap in many states arguably deters would-be violators. The compact streamlines processes for adjudicating nonresident violators, conserving staff resources, enhancing process efficiency and deescalating difficult field encounters. Because nonresident violators can be cited and released, fewer arrests take place, reducing demand on jails and courts.

Dissuading people from violating laws and regulations is seen as a positive. The goal is to maintain stronger wildlife populations and resource use opportunities by reducing violations and making it harder for habitual or egregious violators to cross state lines posing as licensed users. Having their

privileges suspended makes it more difficult for a habitual violator to pretend to be a legal hunter elsewhere. Anecdotal accounts from conservation officers across the country suggest that the IWVC has been successful.

Looking to the Future

As the IWVC has expanded, differences have arisen among states. States have discretion regarding what privilege suspensions they recognize and where. Ultimately, each state wildlife agency applies a review and ratification process to determine what suspensions to accept under state-specific due process and statutory requirements. A recent review among administrators indicates that about 30% of states don't broadly apply interstate suspensions. About 25% apply an extensive review of individual cases to ratify what is accepted. Nearly 50% have a mix of processes. Model IWVC statutory language remains the guide for overall standardization among member states.

Since hunters, anglers and trappers may represent different demographics and ethnicities (U.S. Census Bureau 2018), it's important to assess if the IWVC's processes are implemented equitably. With 48 states implementing the compact in concert with their own procedures, imbalances or differentials can arise. For example, differing procedures from state to state may mean individuals are contacted, notified and adjudicated differently. The board of administrators is responsible for periodically monitoring these aspects, aided by AFWA and regional associations. Given current social justice concerns in law enforcement, a social justice review across participating states is well worth considering and would fit within previously reviewed conservation law enforcement research needs (Haines et al. 2016).

To the degree that the IWVC makes hunters, anglers and trappers more aware of regulations against the inappropriate taking of wildlife, it can play a positive role in helping wildlife populations. If it cracks down on egregious violators' interstate activities, it likely benefits wildlife populations through reduced waste and disruptive activities during sensitive times of year.

It is unclear to what degree the compact may affect chronic poachers, flagrant violators and people involved in the illegal wildlife trade who are unconcerned with regulations and licensing. If it even marginally diminishes the taking of wildlife to a degree that is not sustainable or counter to providing quality hunts or other special opportunities, however, it benefits public interests. Also, discouraging illegal activities in areas with special access provisions is beneficial to ethical licensees. Anecdotal law enforcement observations indicate that the IWVC continues to help deter egregious violations. This is difficult to evaluate, though, and no systematic review has taken place.

The IWVC is still developing. Some states have been involved for fewer than 10 years. Yet its potential benefits extend beyond enforcing wildlife laws out of state. IWVC data could serve as an intelligence gathering tool to help states recognize patterns of criminal behavior in other states. It would be wise, however, to examine its intended effects and the nature of people affected in coming years. Perhaps targeted aspects could be featured to gain added benefits to wildlife and conservation enforcement. One example could be compliance with regulations on handling animal parts to diminish the spread of communicable wildlife diseases. Many states have prohibitions on the movement of live cervids or carcass parts from outside the state or from geographic areas where chronic wasting disease has been detected. IWVC processes could aid in such regulatory efforts.

Over the decades, however, the IWVC has been an important tool for fish and wildlife law enforcement, and its potential continues to grow. ■

Bruce Thompson, PhD, CWB®, is a TWS Fellow and past president. He is a WAFWA honorary lifetime member and a former director of the New Mexico Department of Game and Fish.

Douglas Messerly is a retired law enforcement investigator for the Utah Division of Wildlife Resources.

Travis Franklin is wildlife law administrator for the Florida Fish and Wildlife Conservation Commission Division of Law Enforcement. He is the IWVC Florida compact administrator.

Mike Fowlks is a retired director of the Utah Division of Wildlife Resources and past chair of the WAFWA Law Enforcement Committee.

Pat Fitts is a retired director of the Arkansas Game and Fish Commission and past chair of the AFWA Law Enforcement Committee.

‘A Huge Opportunity’

TWS’ NEW CEO, ED ARNETT, SAYS IT IS A ‘CRITICAL TIME IN WILDLIFE CONSERVATION HISTORY’

By David Frey

The white SUV left a wake of dust as it cut across the Nevada desert. Around it, the rangelands had been denuded by wild horses and burros whose populations had risen out of control. The vehicle came to a halt at a spring, and the two men stepped out as video cameras captured the scene.

The driver was Alan Jenne, habitat division chief for the Nevada Department of Wildlife. He wanted to show his passenger, Ed Arnett, a place where the vegetation was growing tall, thanks to a fence that kept out the feral equids. In the distance, a hillside looked stripped bare. “Our public lands deserve better,” Jenne said.

Arnett nodded. “When you’re in a high, cold desert situation like this and [water] is your lifeblood, you’re right, we can do better,” he said.

The scene was part of an episode of “This American Land,” a public television show Arnett has hosted since 2015 that shines a spotlight on conservation issues in the United States. Television host is just one of the many roles Arnett has played as a wildlifer.

Credit: Sara Way

▼ **Ed Arnett looks out over a herd of elk (*Cervus canadensis*) in Rocky Mountain National Park.**

His latest is as CEO of The Wildlife Society, a position he started Nov. 1. The timing let him play an active role in the virtual TWS Annual Conference before setting off on an annual hunting excursion in the mountains of Colorado. A Certified Wildlife Biologist®, Arnett lives with his wife, Glenda, and their dogs in Loveland, Colorado, and he will work from there as CEO.

“This is a huge opportunity to maximize my impact in this last part of my career,” Arnett said of taking the position as CEO. “I’m humbled and deeply honored to be joining the TWS team and help our staff, Council and members lead TWS into the future at a critical time in wildlife conservation history.”

Originally from a small farming community in south-central Illinois, Arnett grew up in the outdoors hunting and fishing with his grandfather. “My mother and grandparents deserve a ton of credit for my career in wildlife,” he said. “Grandpa introduced me to nature, and my entire family always supported my pursuits to become a biologist. And I can certainly attribute my work ethic, value and integrity to my hometown community of family and friends.”

Since joining TWS in 1984 as an undergraduate in fisheries and wildlife management at Montana State University, Arnett has worked across a broad range of wildlife positions. He received his master’s degree in zoology and physiology in 1990 from the University of Wyoming and a PhD in forest science in 2007 from Oregon State University, where he studied bats in managed forest landscapes. His career has taken him from working as a biological technician at Grand Teton National Park, to serving as a wildlife biologist for the U.S. Forest Service and U.S. Fish and Wildlife Service, to working as a wildlife research biologist for the Weyerhaeuser Company.

He worked at Bat Conservation International as director of conservation programs and director of science and policy, and he led pioneering research efforts on bat mortality at wind energy facilities.

Credit: Bat Conservation International

▲ **Ed Arnett catches an eastern red bat (*Lasiurus borealis*) in a mist net.**

Courtesy Ed Arnett

▲ **Ed Arnett's dogs join him as he fishes along the Little Snake River, which cuts across Wyoming and Colorado.**

The last nine years he spent with the Theodore Roosevelt Conservation Partnership, first as director of its energy and wildlife policy program and for the last 6 ½ years as chief scientist. He also is an adjunct professor in the Fisheries, Wildlife and Conservation Biology Department at Colorado State University, and on "This American Land," he has been a voice for conservation.

That kind of public interface is important, Arnett said.

"Communicating our science and conservation efforts to the public is critical to maintain their understanding and support, and TWS has a role to play in helping our professionals achieve this. If we don't have a public supporting wildlife, we're not going to have wildlife," he said, "or we're going to have wildlife managed in a manner that may be detrimental to many species and unsustainable over the long term."

His diverse background made Arnett stand out amid a talented pool of applicants, said TWS Past President Carol Chambers, who led the search committee that recommended hiring Arnett. "Ed just has this broad background and a very deep dedication to working with wildlife and the wildlife profession," she said. "He has a passion for wildlife, a knowledge of a variety of taxa and experience working with a number of different types of organizations, agencies and groups."

Arnett said his priorities include keeping TWS financially strong despite a pandemic that has left many organizations struggling. He hopes to expand TWS' international presence; implement diversity, equity and inclusion initiatives; and ensure that members are equipped to deal with challenges facing wildlife and the profession, from climate change to the public's shifting wildlife values.

"We need to be able to address all threats to wildlife—old and new—as a profession," Arnett said, "and ensure that the public is still on the side of wildlife conservation. Part of that comes down to ensuring that our profession has the training, the programs, the policies, the initiatives and partnerships necessary to be as effective as we can possibly be as things continue changing now and in the future."

Arnett also stressed the need for greater unity in the profession, paraphrasing Ben Franklin to make his point: "indeed we must all hang together or, most assuredly, we shall all hang alone."

"There are too many challenges facing wildlife and the profession for us to bicker, quibble or be divided," he said. "We can debate ideas, approaches and the science all we want, but at the end of the day, everyone in our profession needs to work together toward the common goal of sustaining wildlife populations—game, non-game and threatened and endangered species—as well as and functioning ecosystems."

"I also want to make sure the breadth and diversity of our wildlife professionals—all of them—believe they are truly welcome and being represented by their professional society," Arnett said. "This is very important to me. No matter who you work for or what you do, there should be something TWS has to offer for everyone." ■

David Frey is the managing editor for The Wildlife Society.

So You Want to Work for a Conservation Organization?

HERE ARE 12 RECOMMENDATIONS FOR HIRING SUCCESS

By Lee Foote, Todd Zimmerling, Matt Besko and Naomi Krogman

Credit: James Potter

For any student entering the workforce, applying for a job can be daunting. Students seeking employment in environmental sciences, wildlife biology, conservation science or applied ecology have to compete for a handful of available jobs. Knowing employers' expectations could help them put their best foot forward.

Here we provide our perspectives. One of us is CEO of an environmental nongovernmental organization supervising 80 wildlife biologists. Another is a senior government manager supervising 32 wildlife biologists. The third is a professor emeritus who trained hundreds of conservation scientists. The fourth is dean of the faculty of environment at a Canadian university. We each saw employee preparation somewhat differently. The employers among us tended to view the first day on the job as the start of training. The educators saw graduation as both an endpoint and launching pad. As a group, we recognize that post-secondary degrees tend to lead to a different, likely higher-income path (Ma et al. 2016, Walker and Zhu 2020), but for the field of conservation, we argue, like Orr (1999), that there are other experiences that can significantly enhance a graduate's likelihood of satisfying employment and success in the conservation field. We set out to provide multiple perspectives on early-career expectations.

Several authors have described beneficial professional attributes of wildlifers, many of which are related not to technical wildlife knowledge but to personal characteristics (Blickley et al. 2013, Decker et al. 2020, Muir and Schwartz 2009). Muir and Schwartz found students in the conservation workplace to be lacking in decision-making and policy implementation skills and that employers were

Biologists conduct an aerial survey to estimate moose (*Alces alces*) winter tick infestation rates.

seeking better project management, interpersonal, networking and written communication skills. A 2020 review of 29,767 conservation jobs from over 100 countries by Conservation Careers found the top skills employers sought were communication, fundraising and project management—skills often overlooked by university wildlife curricula.

"One of the major shortcomings of conservation biology today is its domination by academic scientists who have little experience outside the university," wrote conservation biologist Reed Noss (1997). Thus, time in university may simultaneously bring long-term advantages and short-term liabilities.

Four years of university provide different skills than four years of employment. In the workforce, on-the-job learning entails accommodating co-workers, demonstrating adaptability and resourcefulness and knowing how to make pragmatic tradeoffs. Many workplaces emphasize authority hierarchies, structure and direct consequences for non-performance. New wildlifers may find that a typical six-month probation period for developing essential workplace skills is less straightforward than university coursework. New hires might consider re-framing their university education as valuable but insufficient and seek co-op or temporary work experience to prepare them to thrive in conservation positions. The workplace and universities are simultaneously updating and evolving for equity, inclusion and diversity, albeit at different rates and with different pressures. Orr (1999) discriminates between higher education and training. Arriving with internship experience means new graduates would have developed skills useful to a specific conservation organization in a specific place.

Universities teach students that contemplation and considering issues from broader social viewpoints is important work. At its core, the conservation movement is embedded in temporal, spatial and cultural contexts. Thus, university training benefits wildlife and conservation students by introducing critical thinking, philosophy, multiculturalism and divergent value and belief systems. Both governmental and nongovernmental workplaces need employees who can frame "why" questions in terms of values, cultural norms, politics and available evidence to discriminate between false and real news, recognize how social perceptions influence organizational mission and success and to recognize that conservation occurs in a political world. Universities teach probabilistic thinking skills. These skills are essential for addressing not only the uncertainties of policy and practice but also the uncertainty of any organizational action in a world of multiple social influences. We believe this nuanced thinking will allow new graduates to stay the course in their conservation careers, seeing their work as part of a larger system of dynamic change.

To help prospective wildlifers prepare, we provide some insights into what many conservation

Credit: Stephen Hamilton

▲ **Biologists participate in a study of piping plover (*Charadrius melodus*) nesting conditions.**

Credit: Kris Kendell

▼ **Red-sided garter snakes (*Thamnophis sirtalis*) mass near a hibernaculum.**

A biologist conducts a multi-species riparian health assessment.

Credit: Kris Kendell

organizations and government wildlife divisions seek in applicants.

1. Build competency for interviews. To succeed in a job you must first be hired into the job. In an analysis of 16 in-depth conservation employer interviews, Blickley et al. (2013) identified the interview and applicant work record as the strongest competency signals from a prospective hire. Books are available to help applicants guide their preparation and manage nervousness (Foote 2016). Your awareness of the organization's history, vision, budget, priorities, awards, organizational structure and leaders' names can impress employers. Might they ask you for a writing sample? Require a real-time data analysis? Pose hypothetical questions? Inquire about your expectations and life goals? The answer is "yes" to all of these, so be nimble, adaptable and ready.

2. Blended experience and education. Employers often seek a mixture of experience and education, realizing tradeoffs come with each component. Having higher education and work experience in summer jobs, co-ops or internships is the best of both worlds. Exposure to the same organization for which prospective applicants want to work is particularly helpful for learning about the workplace culture. Volunteering, co-ops and apprenticeships allow conversations with agency and environmental NGO employees. Understanding workplace requirements can help guide coursework selection, too. Maybe coursework in survey development, financial planning or photography would round out wildlife science training. Some conservation students have expressed a desire for more social science training (Fisher et al. 2009).

3. Excellent communication skills. In their day-to-day conversations, interviews, written reports and public presentations, employees need clarity and engagement to be successful communicators. Training in advanced communication skills such as mediation, dispute resolution and intercultural dialogue brings skills valued in most conservation and wildlife workplaces. The power of communicating with sincerity, credibility and honesty is tremendously important, and it can be learned. If jobs involve written communiques such as government briefs, policy backgrounders or environmental assessments, employees must compose scientifically defensible, succinct and language-sensitive works. Government and environmental NGO employers both value professional speaking and writing skills.

4. Understanding advocacy in relation to government and NGOs. Advocating for an honorable, informed and evidence-supported initiative is essential for garnering public support. Advocacy is an optimization process incorporating a clear recognition of values, evidence and tradeoffs. It is not

ideological propaganda. Avoiding scientific advocacy is common in academic settings, yet responsibly advocating for and promoting activities that benefit conservation and wildlife is the norm in conservation organizations (Foote et al. 2006).

5. An ability to work well with others of differing perspectives. Advancing ideas compatibly is a learned art where one's willingness to compromise, adapt and incorporate is essential. Conflicts arise from working with people. Thus, it is an asset to be able to recognize multiple perspectives and be cognizant of Indigenous issues and deliberations across institutions about equity, diversity and inclusivity. A realistic and circumspect approach to co-workers' differing views may not come naturally, but it too can be learned. University education has much to offer employees in these regards.

6. Humility and realistic expectations. Both the government and CEO co-authors complained that too often university applicants arrive at job interviews embracing some form of entitlement, academic ego and affected contrarianism. This may stem in part from professors inadvertently cultivating an oppositional re-framing of ideas as "free-thinking" or critical thought. While fresh viewpoints are vital to organizations, employees who are too quick to oppose or dominate discussions may appear to lack teamwork skills. Employers initially expect new, inexperienced employees to be information sponges, not information faucets. Navigating the interpersonal spaces of an organization is complex and does not always distill well from coursework. This calls for realism in expectations regarding authority, decision making, salary and promotion. Seniority is valuable for advancement but unfortunately, many small wildlife or conservation departments have limited room for upward mobility.

7. Understanding the core tenets of human dignity. This means being both fair-minded and optimistic about incorporating the values and needs of others (Clark et al. 2011b). Being fair-minded in the workplace means employees know how to share resources, compromise to assist and extend credit to others. President Harry S. Truman offered, "It is amazing what you can accomplish if you don't care who gets the credit." Workplace morale suffers at the hands of narrow and inflexible personalities. Interviewees or new employees whose prejudice, ego or self-serving ambition disadvantages others will not likely thrive in a conservation organization. Organizations dictate workplace conditions and culture, sometimes unfairly so, and university behavioral norms and expectations often differ. Gauge carefully any overly familiar interactions, humor subjects, reference to stereotypes or teasing. Co-workers' responses cannot be assumed given their multicultural backgrounds. This calls for discretion, awareness and curiosity about differing worldviews and life backgrounds. Cultivate emotional intelligence.

8. Creativity and problem solving. In our experience, employees with "good antennae" for problem identification, fixes or creative workarounds are rare and appreciated. We seek workers who remain aware of arising needs, risks or opportunities that others might miss. Recognizing problems is the first step to solving them

▼ **Teams build field skills while handling wildlife and sharing experiences.**

Credit: Stephen Hamilton

Credit: Mike Jokinen

▲ **Biologists can gain independent skills, such as radio-tracking in the solitude of winter.**

cooperatively. Invitations to discuss how a problem is first defined and inviting teamwork into solutions is generally more effective than solo suggestions or pushing a quick fix that requires others to mobilize. "Hey, what do you all think about XYZ?" will be better received than, "I think we should do XYZ." Also, employers appreciate prospective employees acting to address gaps in employee knowledge or skill sets (e.g. proposal writing), and employers may support continuing education. We suggest you demonstrate that you are looking after the whole organization, not just your career.

9. Long-term view. Conservation time frames—evolution, extinction rates, forest succession—often occur at rates poorly understood by those untrained in long-term thinking. The best university courses invite students to grapple with such non-intuitive concepts as nature's time frames for soil development, fire return intervals and population dynamics that may exceed an employee's career length. It can be difficult to grasp problems whose resolution time exceeds human lifetimes. Ecosystem repair rarely has a silver bullet because restoration might span generations of human coordination. Although habitats can be destroyed quickly, the wildlifer's instant gratification of repair is often elusive. Job satisfaction may depend on intermediate goals or progress toward a goal rather than complete achievement.

10. Business sense. Political ideology may affect conservation work, but the most common constraints are limitations of money, time and social license. Because there is never enough money to do everything, the working world requires pragmatic decisions. Tradeoffs are inevitable. Employees who grasp the necessity of fundraising or government budget allocation show a clearer understanding that mission rests on finances. Managing the relationship between broad organizational goals and specific actions such as hiring, budget allocations and prioritization is at the heart of government and not-for-profit operations. Conservation benefits from pragmatism as well as ideals-driven passion. Getting caught in "either/or thinking"—notions like business versus conservation or profit versus environmental protection—is not useful when models are evolving to meet both conservation and business goals.

11. Building collegial networks. Conservation professionals interact with people more than they interact with plants, wildlife or nature. Much of the workplace is like a good stew into which everyone adds ingredients for a communal meal. When the organization advances based on your work, your value goes up and appreciation likely flows back, often in salary, advancement, mentorship and respect. Peers can help support careers through advice, evaluation and assignments, possibly even more so than your supervisors. Success rarely comes through rugged individualism. Instead, it is found in a habit of working well with others. Some wildlifers identify with "social escapism," contending they prefer solitude and relating to wild things rather than mixing with the messy world of human failings and negotiation. Unless one's goal is to be a technician, this is false logic given the social drivers of environmental degradation. Comfort with relationship-building and accountability to those relationships can boost your early career (Grant 2014).

12. Learning how to fail gracefully. Know you will have failures, own them and learn from them. We all make mistakes, but some people cannot accept fault or offer a heartfelt "I am sorry, I will never do that again. When next faced with this situation, I will do XYZ." Realistic employers and managers usually understand humans are not perfect and they know that making mistakes is part of learning. Identify the risks, if possible. Then, if things don't turn out as wished, share with your team how those lessons learned can inform the next steps. There is ample literature to affirm that failures are part of success. It is all in how you use failure to expand your understanding of what to do next, especially if it is tied to intrinsic reasons for your persistence (Gladwell 2011, Pink 2009).

Work expectations vary greatly between and within organizations, and each one may approach conservation priorities and the use of science, policy or advocacy differently. Exclusive exposure to just one of these environments provides incomplete views and expectations of conservation needs. Choosing programs for post-secondary education, additional credentials or certifications that address the complex influences on conservation can help applicants prepare for conservation careers.

Conservation work is an honorable undertaking that brings great satisfaction. We recommend it as a fulfilling profession and hope these insights help students secure jobs and thrive in long careers as they make contributions throughout their professional and personal lives. ■

Lee Foote, PhD, is a wetland scientist and a professor of conservation biology at the University of Alberta.

Todd Zimmerling, PhD, is a consulting wildlife biologist and now serves as president and CEO of the Alberta Conservation Association.

Matt Besko is a wildlife policy specialist and manager with the wildlife division of Alberta Environment and Parks.

Naomi Krogman, PhD, is an environmental sociologist and dean of the faculty of environment at Simon Fraser University.

The Wildlife Society's 2021 Photo Contest Winners

BEST IN SHOW

Evening Stare

Mammals

A red fox (*Vulpes vulpes*) looks on outside of Grand Teton National Park in Wyoming. This photo was taken in very low-light conditions and edited to enhance highlights and shadows.

Credit: Jeffrey Wagner

Reflections on Balls Lake

Mobile Phone

A bald eagle (*Haliaeetus leucocephalus*) soars above smooth, reflecting waters on Prince of Wales Island in Alaska.

Credit: Kristina Harkins

Reflections

Amphibians, Reptiles and Fish

▲ An American bullfrog (*Rana catesbeiana*) sits in shallow, still waters.

Credit: Dennis Quinn

Roughhousing red fox kits

Creative/Comedic

◀ Red fox (*Vulpes vulpes*) kits playing.

Credit: Jay VonBank

Summer Beauty

Birds

▶ An American golden plover (*Pluvialis dominica*) on its tundra breeding grounds in North Slope, Alaska. This photo was edited for clarity and highlighting.

Credit: Andrew Fisher

Standoff

Game Cam

▶ A white-tailed deer (*Odocoileus virginianus*) stares down a raccoon (*Procyon lotor*) over a bait pile in Florida.

Credit: Jeff Bewsher

Crossing

Human Dimensions

▼ This wood frog (*Rana sylvatica*) was photographed crossing a road on a wet night.

Credit: Dennis Quinn

Weaver

Invertebrates

▼ *Oecophylla longinoda* is a species of arboreal ant found in tropical Africa.

Credit: Dennis Quinn

Ebb and Flow

Landscapes & Still Life

◀ The smooth sandstone of Antelope Canyon in Arizona.

Credit: Mackenzie Taylor

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The Wildlife Society

Conservation Affairs Network gets a boost with a new fellow

By Kelly O'Connor

In the summer of 2021, The Wildlife Society's governing council identified the need to further support the Conservation Affairs Network—the communication and collaboration structure for TWS units to engage on policy issues—through the establishment of a Conservation Affairs Network fellowship. I began working in this new role in October with the goal of supporting TWS policy engagement and providing capacity to help grow the network's reach among TWS members and decision-makers.

It's an honor to have the opportunity to join TWS' team and support the work of our dedicated members. Here's a look at some of what's to come for the Conservation Affairs Network.

Resources to support policy actions

The Wildlife Society has a wealth of policy resources available to members looking to engage with policy and legislation impacting wildlife and wildlife professionals. Updates to our Conservation Affairs Network Policy Toolkit, which has been available to support our members' policy advocacy since the network's creation in 2015, are a priority as I evaluate ways to support our sections and chapters engaged with the network. TWS staff will be working with our Canadian section and chapter members, many of whom were involved in the formation of the network, to incorporate information on Canadian legislative and federal budgeting processes into the next edition of the toolkit. I also plan to develop additional toolkit content on engaging at the state and provincial level with agency comment periods and rulemaking, techniques for engaging broader chapter and section membership on CAN activities and more ways to take action on TWS priority policies.

TWS unit Conservation Affairs Committee members are helping identify updates needed for their frequently used policy resources. Looking beyond national priority policies and legislation, some of our existing resources—like policy briefs and fact sheets—provide a jumping-off point for units as they consider creating similar resources that target policy at the local or regional level. I look forward to offering additional capacity to develop these resources and exploring ways to support our members' efforts to engage with local policymaking.

Member engagement with the CAN

I hope to identify additional opportunities for TWS members to engage with the Conservation Affairs Network in the year ahead. I'm also excited to find ways for the CAN to support policy engagement among student members. Some student chapters are already involved with wildlife policy, from hosting letter-writing campaigns asking members of Congress to support the Recovering America's Wildlife Act, to commenting on campus light reduction policies. Their hard work shows that you don't need to be a seasoned professional in the field to advocate for the importance of science in the policymaking process. I'm looking forward to working with student chapter leaders and TWS' Student Development Working Group to incorporate student chapters into our CAN framework and provide new resources to help guide policy engagement for student wildlifers.

We're continuing to keep the network informed about unit activities and TWS' work with federal policies through our monthly CAN newsletter and bimonthly conference calls. TWS staff will be working with members to make sure these communications are meeting their needs and to explore additional means of quickly communicating emerging needs for action across the network.

The Wildlife Society's Policy Library, available in your membership portal, tracks actions taken on policy by TWS staff and our organization units. I encourage all members to learn more about the many ways chapter and section CACs in your area are engaging with wildlife policy by exploring the communications in the Policy Library. Using letters, comments, testimony and other communications submitted by TWS unit CAC leaders, I hope to quantify the network's impacts in advancing priority policies.

Kelly O'Connor, MS, is the Conservation Affairs Network Fellow for The Wildlife Society.

My primary goal as the Conservation Affairs Network Fellow is to ensure our units and members continue to feel empowered to engage with issues impacting their work as wildlife professionals. As a newcomer to TWS' staff and to the network, I'm inspired by the work that our members are doing to ensure the expertise of wildlife professionals is included in the public policy process. If you're interested in learning more about ways to take action on TWS' policy priorities and participate in the Conservation Affairs Network, visit wildlife.org/conservation-affairs-network.

Wolf urine scares coyotes away from sea turtle nests

Wildlife managers in South Carolina were having trouble keeping coyotes away from loggerhead sea turtle nests. No matter how often managers patrolled beaches during nesting seasons, the crafty canids would just wait until people were gone to raid the nests. Building cages around the nests didn't even work. The coyotes would show up before the cage installers arrived, often getting at the eggs the same night they were laid.

Coyotes (*Canis latrans*) consumed some 3,800 federally endangered loggerhead (*Caretta caretta*) eggs every year at the Tom Yawkey Wildlife Center on South Island—an average of 69 eggs from nests that usually have about 120 eggs.

"We think that one coyote pack patrols the length of the beach," said Michael Wauson, who was working as a turtle technician with the South Carolina Department of Natural Resources while he completed his master's degree at Winthrop University in South Carolina.

But Wauson had heard talk of people who urinated around their campsite to keep coyotes from raiding their food. He began to wonder if there was anything to it. Research showed that coyotes were wary, but not necessarily afraid, of humans. But wolves (*Canis lupus*) were another matter. In places like Yellowstone National Park, research has shown coyotes often steer clear of the larger canids.

Wauson ordered wolf urine from a company that sells vials online as a coyote deterrent. To see if it might protect the turtles, he and his co-author placed wolf urine on some sections of beach with turtle nests and left others alone. They published their results in the *Journal for Nature Conservation*.

"We found that as long as there was [wolf] urine present, it would deter coyotes," said Wauson, now a PhD student at Stony Brook University.

In only one instance, a coyote dug under the protective cage to eat turtle eggs treated with wolf urine, and that nest was visible from the edge of the wolf urine area. "They won't usually penetrate deep into a territory," Wauson said.

The experiment was so successful that the department used this technique the following year before Wauson even finished his data analysis. "It's a relatively inexpensive way to protect a lot of cages," he said. "In an indirect way, wolves were able to help protect loggerhead sea turtle nests, and possible other species of sea turtles that are under depredation pressures from coyotes."

—Contributed by Joshua Rapp Learn

Credit: South Carolina Department of Natural Resources

▲ **Coyotes pose a threat to loggerhead sea turtle nests on South Carolina's South Island.**

Credit: Michael Wauson and William Rogers

▲ **Broken shells indicate depredation of a loggerhead sea turtle nest.**

Credit: Sarah Dawsey/U.S. Fish and Wildlife Service

▲ **A nesting loggerhead sea turtle.**

Contributed photo

Vincent Crichton

Longtime TWS member Vince Crichton died Dec. 3, 2020, at the age of 78.

Known to friends and colleagues as "Doc Moose," Crichton was born in Chapleau, Ontario, where he developed a love of the outdoors with his father, who was the area's fish and wildlife supervisor. He earned his bachelor's and master's degrees at the University of Manitoba and his doctorate at the University of Guelph in the field of wildlife diseases.

A Certified Wildlife Biologist®, Crichton joined TWS in 1978 and served on the Retired Wildlife Professionals Committee. He worked for 40 years for the province of Manitoba, starting as a regional wildlife biologist and retiring as the manager for game, fur and problem wildlife. Much of his career focused on moose biology and management, and he spoke internationally on moose conservation and management. His contributions were recognized in Manitoba's Legislative Assembly and its Department of Agriculture and Resource Development, and in a CBC documentary, *Giants of the Boreal Forest*, which highlighted his work.

Members who wish to submit a tribute should send an email to editor@wildlife.org.

Gotcha!

A female western screech-owl (*Megascops kennicottii*) sits above a fledgling in a cedar tree in Boise, Idaho, in the spring of 2020. The nesting box used by this female in TWS member Terrell Rich's yard contained a video camera, providing his family a much-needed diversion during the early days of the COVID-19 pandemic restrictions. He and his wife were able to record observations on the eggs and nestlings, including vocalization and diet. These small owls have a wide-ranging diet and can be found in a variety of landscapes from southern Alaska to central Mexico.

Photo by
Terrell D. Rich

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