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COVER: Photographer Michael Durham caught the plunge of a northern red-legged frog into an aquarium. In a population survey, Oregon researchers collected, then released, the protected frog.

BACK COVER: Photographer Steve Hinch heard that a bobcat was visiting a barn in Paradise Valley, Montana. When he made this image, the cat was "watching various birds" in nearby pines.

EDITOR'S NOTE

LISA MOORE
Editorial Director

Pick a Flower, Disturb a Star?




JULIANNE SMITH (NWF)

The late English theoretical physicist Paul Dirac is credited with the quote: "Pick a flower on Earth and you move the farthest star." This lovely and oddly unsettling image suggests that actions have consequences, often unintended.

That's particularly true in the context of biodiversity, as this issue of the magazine shows. In our cover story (page 22), we examine some key North American species that are in serious decline—from birds and butterflies to salamanders and frogs—mainly because of human impacts on ecosystems. The teeming waters of south Florida—source of America's "River of Grass" and world-class fishing (page 32)—are suffering from algal blooms, dead zones and other ills tied to human land use. And in one notable study of ripple effects, science shows that the noise of natural-gas wells in New Mexico can cause seed-dispersing jays to flee, leaving pinyon pine habitat and the species that depend on it at risk (page 40).

But if human hands cause such problems, they also hold the key to solutions. That's what inspires the National Wildlife Federation to work with members, affiliates, legislators, sportsmen, businesses and others to bring species back from the brink and restore healthy ecosystems.

Does it matter if one tiny flower species disappears, or fish or frog or bee? Why risk the answer when we can ensure that future generations inherit a healthy planet? 

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COLLIN O'MARA

President & Chief Executive Officer

Ranger Rick Helps Teach a Love of Nature

When I speak at schools, one of the first questions I get from students is, "How did you become a conservationist?" And I proudly reply, "I was a *Ranger Rick*® kid growing up." It's heartening that in every corner of the country, students usually clap—a sure sign that many of them also grew up reading *Ranger Rick*, the National Wildlife Federation's flagship magazine for kids.

For me, sharing *Ranger Rick* with my mom and dad was a truly formative experience. Beyond learning from the articles and world-class pictures, we completed the activities together outdoors. We built backyard habitat, helped pollinators and learned about the wildlife all around us. Exploring the wonders of nature at a young age instilled a conservation ethic that still defines me today.

The power of inspiring children

At NWF, we've always known that when we share our love of wildlife with kids, we can spark a lifelong passion to learn about, explore and protect the natural world. And today—when about a third of America's species are at risk of extinction in the coming decades (see page 22)—inspiring children to care about wildlife has never been more important.

There's a lot that we can do right now to save species. All of us can urge the U.S. Congress to pass the recently introduced "Recovering America's Wildlife Act," which will provide necessary funding for state wildlife conservation. But much of that work will span decades, so we need to inspire and empower the next generation of wildlife conservationists *now* by introducing tens of millions more kids to nature and expanding environmental education programs such as those that NWF and




KRISTEN FERRIERE (NWF)

NWF President Collin O'Mara and his 4-year-old daughter, Riley, enjoy sharing *Ranger Rick Jr.*™, one of three children's magazines the Federation publishes to help kids learn about and love wildlife.

its state and territorial affiliates already have in more than 11,000 schools across the nation.

One of my favorite quotes is from Baba Dioum, a Senegalese forest engineer, who famously said, "In the end we will conserve only what we love, we will love only what we understand and we will understand only what we are taught." Clearly, children need mentors to help them discover the great outdoors and connect with wildlife so they develop a lifelong love of nature. My wife, Krishanti, and I are introducing my daughter, Riley, to nature through birding, hiking, camping and fishing—with *Ranger Rick* as our trusted guide.

In this new year, as *Ranger Rick* magazine turns 50, I hope that you'll help us reach millions of young Americans by introducing them to nature through this beloved guardian of the wild. The more *Ranger Rick* kids there are, the better it will be for the future of conservation. 

 **SHARE YOUR VIEWS.** Follow Collin O'Mara on Twitter at twitter.com/Collin_OMara. To share your thoughts and opinions, email president@nwf.org.

King Solomon's Secret Treasure: FOUND

Ancient beauty trapped in mines for centuries is finally released and available to the public!

King Solomon was one of the wealthiest rulers of the ancient world. His vast empire included hoards of gold, priceless gemstones and rare works of art. For centuries, fortune hunters and historians dedicated their lives to the search for his fabled mines and lost treasure. But as it turns out, those mines hid a prize more beautiful and exotic than any precious metal: chrysocolla.

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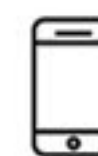
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NEWS OF THE WILD



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True north?

■ Researchers have long known that several animals, including pigeons and bats, have internal compasses that use Earth's magnetic field to guide their movements. Now scientists have discovered the first evidence that two types of swine—boars and warthogs (right)—also possess such compasses.

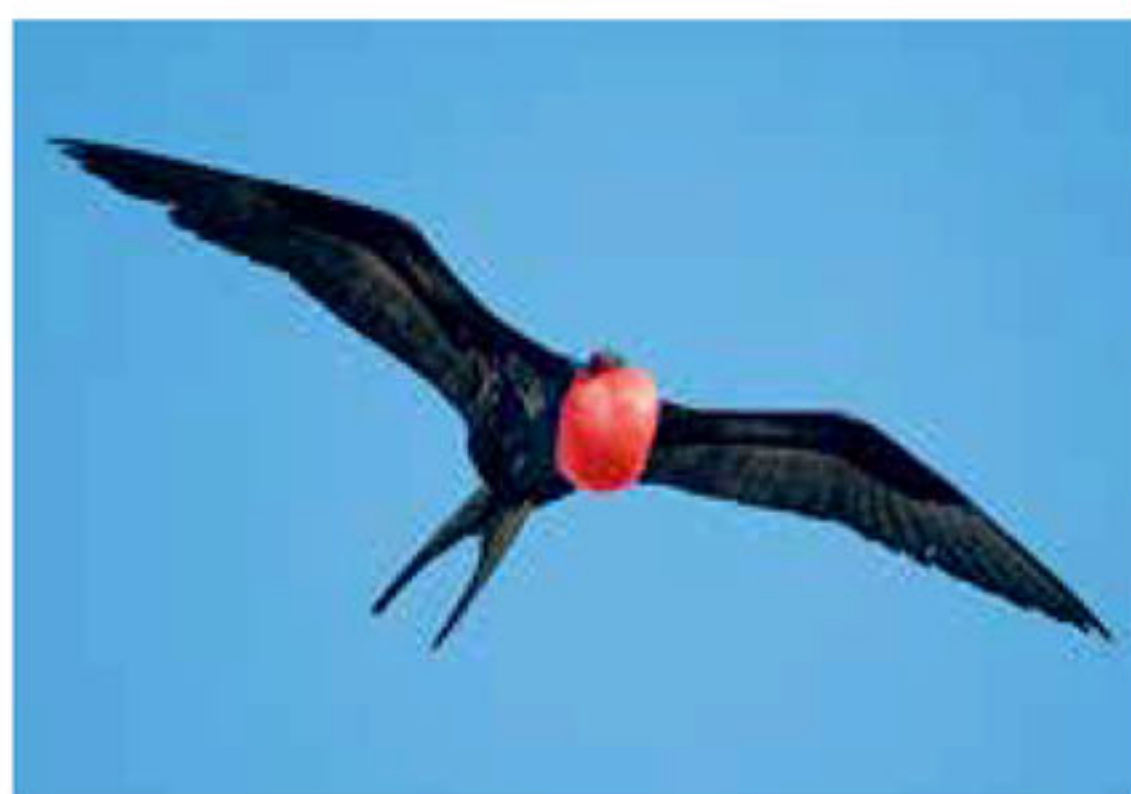
In a lengthy study in which they observed nearly 3,000 of the animals in the wild in the Czech Republic and six African countries, a group of European investigators found that the creatures display a “highly significant north-south preference in their body alignment” while foraging and resting, regardless of season, weather



ANN & STEVE TOON (NPL/MINDEN PICTURES)

or time of day. “Magnetic navigation represents an ideal strategy for species that need to react to environmental changes quickly,” the biologists report in *Mammal Review*. After

considering other possibilities, they conclude that the swines’ proclivity to follow Earth’s north-south axis—or “magnetic alignment”—can be attributed only to internal compasses.



TUI DE ROY (MINDEN PICTURES)

Sleeping on the wing

■ For the first time, scientists have confirmed the ability of some birds to sleep while in flight. In a study of great frigatebirds, a species that can stay aloft for up to two months at a time, ornithologists at the Max Planck Institute in Germany used specially designed monitors to measure the animals’ brain activities.

Unlike other seabirds, frigates do not have waterproof plumage and avoid sitting on the ocean to feed. Instead, they rest by sleeping on the wing an average of 41 minutes per day in bursts of 12 seconds each.

Writing in *Nature Communications*, the researchers explain that frigates nap while circling at high altitudes in rising air currents where they don’t have to flap their wings. Other species, such as mallards, will sleep on the ground using one hemisphere of their brains while the other hemisphere remains awake to watch for predators. Frigatebirds, lead author Niels Rattenborg says, can sleep in the air using either one or both brain hemispheres simultaneously, “and they just continue soaring.”

WHAT IS THIS? Hint: The deceptive guise of this royal creature frequently keeps potential predators at bay. Visit *National Wildlife* online at www.nwf.org/animals for the answer. Last issue’s “What Is This?” pictured a sap-sucking pentatomid bug, one of thousands of species of stink bugs. It was photographed in Thailand by Darlyne Murawski (National Geographic Creative).



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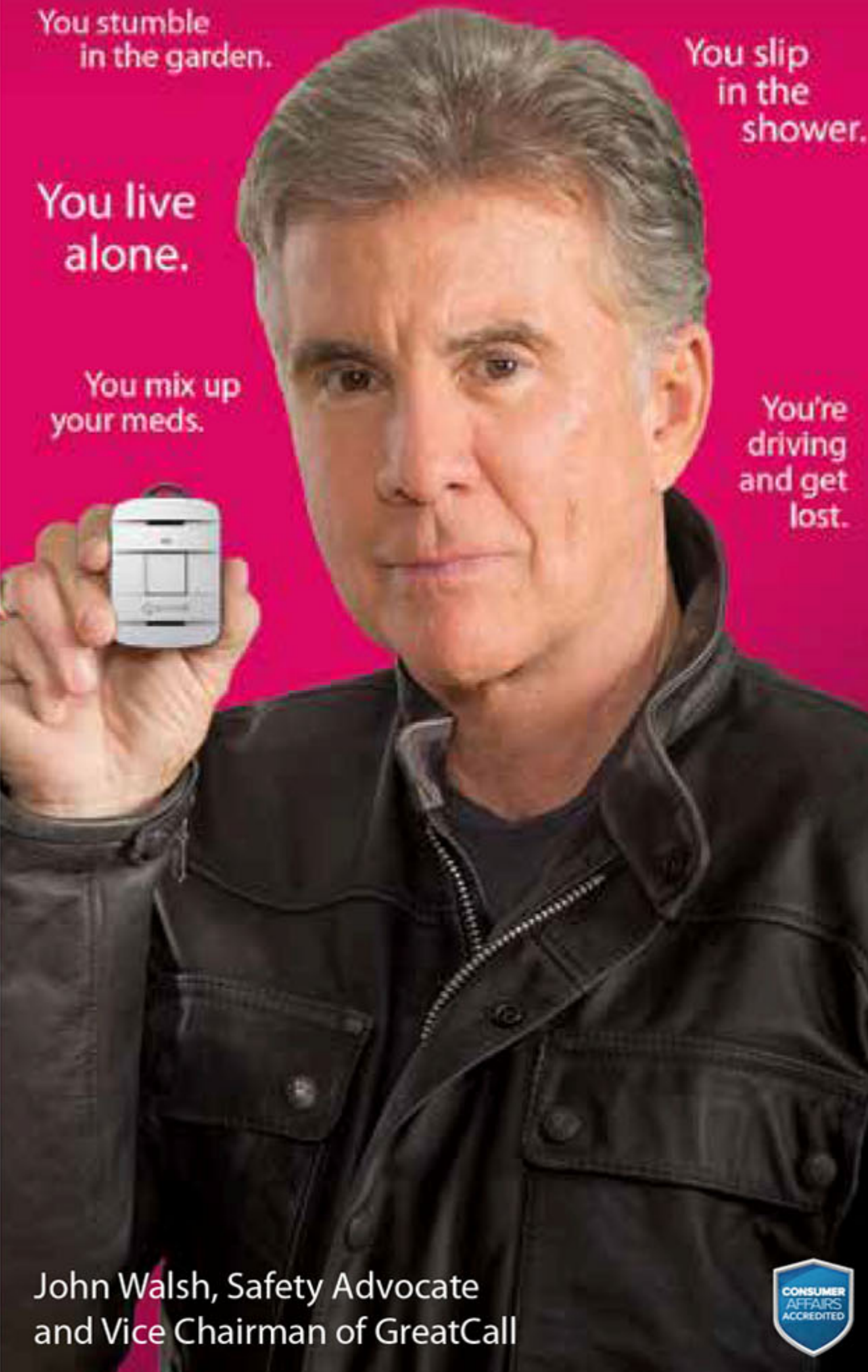
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Creating a Haven for Beneficial Bugs

How to attract insects that will prey on the plant-eating pests in your garden

By Janet Marinelli

Assassin bugs, robber flies and twice-stabbed lady beetles sound like great characters for a blockbuster TV crime series. But they're actually among a wildlife gardener's best friends.

Insects such as these kill plant pests, from aphids and mealybugs to slugs and spider mites. They also form an essential component of backyard biodiversity, says Thelma Heidel-Baker, the Xerces Society for Invertebrate Conservation's specialist on "conservation biocontrol," a growing field that aims to improve habitat for enemies of pests that ravage both crops and prized garden plants.

Some of these beneficial insects are predators. Convergent lady beetles, for example, can gobble down an aphid infestation for breakfast, while ground beetles can devour a juicy slug for dinner. Others are parasitoids that have immature life stages, usually larvae, that develop on or inside a victim and ultimately kill it. These insects include some wasps and tachinid flies, whose tiny maggots feed internally on and destroy a variety of pests, including leafrollers, fall armyworms and sunflower moths.

Attracting good bugs

To attract and keep predators and parasitoids on patrol in your yard, "one of the first things you want to do," Heidel-Baker says, "is have a constant supply of blooms all season long" to provide a steady supply of nectar, which most beneficial insects



MARK MOFFETT (MINDEN PICTURES)

A spotted lady beetle feasts on eggs of the Colorado potato beetle, a major crop pest. Predators such as lady beetles can be effective alternatives to harmful insecticides.

also eat. Unlike butterflies, which have long "tongues" and sip nectar from deep-throated blossoms, many predatory insects require blooms with short nectar tubes. Daisy-shaped native wildflowers such as asters, sunflowers and coneflowers, which have tiny floral tubes, are champions at attracting the insects.

"Culinary herbs can be great resources for these insects, too," Heidel-Baker says, especially species such as dill, parsley and chervil, called "umbelliferous" in botanical lingo because they have flowers that resemble upside-down umbrellas.

Make sure to provide protected places where your pest control accomplices can safely rest, lay eggs and overwinter, advises National Wildlife Federation Naturalist David

Mizejewski. Supply plants of various types and heights, from ground-hugging grasses to shrubs and tall trees. In addition, "tree snags and brush piles are havens for overwintering predators and parasitoids as well as for pollinators such as bees," he says.

"The last, really critical piece of creating habitat for predatory insects is it has to be protected from pesticides," Heidel-Baker adds. Many chemical pesticides are as deadly to beneficial insects as they are to pests. Instead of dousing your plants with dangerous poisons, let backyard biodiversity naturally nip potential pest problems in the bud. [W](#)

Janet Marinelli wrote about overwintering monarch butterflies in the December-January 2017 issue.

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Ensuring a Moveable Feast

Starving wildlife prompts protections of small marine fish that play a big role

By Ken Olsen

A problem long brewing in the ocean has become painfully obvious on land. Wildlife rehabilitators have found thousands of dying sea lion pups in central and southern California. The state's brown pelicans have had difficulty breeding, and scientists have counted hundreds of dead or dying tufted puffins on the Pribilof Islands off the coast of Alaska. While these events may seem unrelated, all have the same culprit: starvation on an unprecedented scale because of declines in forage fish.

Once-plentiful schools of sardines, herring, anchovies and other small fish—which feed sea lions, birds and a host of other animals—have declined severely off the West Coast. Scientists estimate that during the past decade sardine numbers have plummeted more than 90 percent and the anchovy population has dropped from more than 1 million tons to as low as 22,000 tons.

Small fish are a key part of “the foundation that supports the marine food web,” says Jen Zamon, a research fisheries biologist with the National Oceanic and Atmospheric Administration. “If you pull out a piece of that foundation, it can have serious consequences, just as if you pulled out a piece of the foundation of your house.”

While no one cause of their decline has been identified, a contributing factor may have been a hotter ocean. The so-called “Blob,” a large



BRANDON COLE

Sardines form a “bait ball” to hamper efforts of predators such as California sea lions to catch individuals. The decline of such forage fish caused thousands of sea lion pups to starve, including one that collapsed in San Francisco last February (below).

expanse of warm seawater off the Pacific Coast, was first noted in 2014. During the latest El Niño from 2015 to 2016, ocean temperatures in this region increased as much as 9 degrees F above normal. Such events could have chased fish to cooler waters.

In addition, because forage fish often swim in shimmering “bait balls” that ripple through the ocean, they can be easily overfished as fishermen’s nets can engulf entire schools. This can be devastating to a population already under stress. “We end up in cases where fishermen are catching 60 to 80 percent of the population at a time when the



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population is collapsing,” says Tim Essington, a University of Washington marine ecologist. “In times of scarcity, every forage fish really matters to predators.”

In 2015, alarmed by grim stock numbers and starving wildlife, federal fish managers banned commercial fishing of Pacific sardines, sand lance and silversides and are now considering reductions in anchovies. States are also getting on board. Oregon imposed limits on harvesting certain forage fish in October, and similar restrictions are pending in California.

The Association of Northwest Steelheaders, National Wildlife Federation’s Oregon affiliate, worked for four years to obtain such protections. “Forage fish are important food for larger species,” says Norm Ritchie, a Steelheaders and NWF board member. “This means as much for salmon, whales and seabirds as it does for sardines.”

Small fish, big impacts

Forage fish—which are typically less than a foot long—eat microscopic marine plants and animals drifting close to the ocean’s surface and then convert this food into protein. Many marine animals in turn depend on forage fish for food. The small fish can comprise as much as 70 percent of the diet of Chinook salmon and 90 percent of the food for brown pelicans. In the Atlantic, menhaden is the most important forage fish, feeding everything from striped bass and humpback whales to ospreys and eagles.

Forage fish also account for a third of the seafood harvested each year, with commercial fishing fleets scooping up an estimated \$5.6 billion worth worldwide. Sardines and anchovies caught off the West Coast are shipped to Australia to fatten farm-raised bluefin tuna, while menhaden harvested from off the East Coast and the Gulf of Mexico are used in livestock feed, pet food, fertilizer and



BRANDON COLE

Frigatebirds and sailfish vie for sardines in the Gulf of Mexico. A host of seabirds and marine species rely on forage fish—a vital part of the intricate ocean food web.

nutritional supplements. Leaving forage fish in the ocean, however—where they feed larger, commercially important species such as salmon and cod—could be worth more than \$11 billion, report scientists of the Lenfest Forage Fish Task Force.

Taking the larger view

Working with the Pew Charitable Trusts and state affiliates, NWF is promoting an ecosystem-based approach to managing forage fish, one that takes into account how these fish fit into the marine food web rather than managing them individually. “This is a positive decision for everyone who has a stake in a healthy ocean,” says Paul Shively, Pacific Ocean project director for the Pew Charitable Trusts.

This past fall, NWF joined its affiliates the Delaware Nature Society, Florida Wildlife Federation (FWF) and North Carolina Wildlife Federation (NCWF) in supporting the Atlantic States Marine Fisheries

Commission (ASMFC) amendment that would take an ecosystem-based approach to managing menhaden. “It’s a very simple principle: You have to have forage fish if you are going to have game fish species and commercial fish species,” says Tim Gestwicki, NCWF chief executive officer.

In the Southeast, FWF also is working to persuade state wildlife agencies to take a proactive ecosystem-based approach to managing southern Atlantic and Gulf Coast forage fish. “We want to be prepared for potential increases in pressures on forage fish as has occurred elsewhere,” says FWF President Manley Fuller.

Indeed, forage fish are connected to so many other living creatures that their true importance has yet to be fathomed. One thing is certain: These moveable feasts help complete the marine circle of life—a circle that is very hard to repair once broken. **W**

Environmental writer Ken Olsen is based in Portland, Oregon.



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Unexpected Bounties

Extraordinary NWF certified gardens are providing harmony and healing as well as habitat

By Anne Bolen

The National Wildlife Federation certified its 200,000th wildlife habitat this past June at the Denver Zoo. This is just one of the more than 14,000 NWF Certified Wildlife Habitats that have sprung up at zoos, aquariums, arboretums, museums, parks and schools as well as at some more unusual locations that are providing a bounty of unexpected benefits. These swaths of native habitat offer their visitors and caretakers “a way to connect to nature and each other,” says Mary Phillips, director of the National Wildlife Federation’s Garden for Wildlife™ program.

Peaceful sanctuaries

In response to the Obama White House’s strategy to expand pollinator habitat, U.S. Department of

State Division Chief for Biodiversity Barbara De Rosa-Joynt has helped certify more than a dozen embassies, consulates and ambassadors’ residences around the world. For example, monarchs now feed on native milkweed at a consulate in Mexico, Girl Scouts give garden tours at the U.S. ambassador’s residence in Ethiopia and U.S. Ambassador to Canada Bruce Heyman uses his native blooms to educate visitors about declining bee populations. “It is nice to see our embassy and consulate colleagues engage with their communities and local ecosystems in new ways,” says De Rosa-Joynt.


Healing habitats

St. Joseph Mercy Hospital Ann Arbor in Michigan uses nature for treatment and preventive medicine. Strolling its 364 certified acres, visi-

tors might glimpse a fox in its woods or silvery checkerspot butterflies in its prairie or pollinator garden. Patients can work in the “hoop house,” a wheel-chair-accessible greenhouse, as therapy. The hospital cafeteria often serves vegetables from the site’s 25-acre farm. Staff can even tend their own garden plots. Vascular surgeon Brian Halloran says sharing the victories and setbacks of caring for his plot “helps me connect with patients, not just on a doctor-patient level but on a human level.”

Sacred grounds

Restoring the environment is innate to the Adat Shalom Reconstructionist Congregation in Bethesda, Maryland. In 2015, families installed native plants such as Joe Pye weed, blueberries and 50 trees on its 5 acres.

This synagogue participates in Sacred Grounds, a program Adat Shalom Rabbi Fred Scherlinder Dobb cofounded in 2012 with NWF and the nonprofit Interfaith Power and Light to help places of worship create native habitat. “If you are a bird or a butterfly, you can have Jewish breakfast, Muslim lunch, Hindu snack and Christian dinner,” says Dobb. Yet “the greatest multiplier effect is the hundreds of members and visitors who see this habitat, are touched by it and bring that consciousness of nature back to their homes, schools, businesses and communities.” In this way, NWF certified habitats are seeds that never cease yielding. 



SAINT JOSEPH MERCY HEALTH SYSTEM

St. Joseph Mercy Hospital Ann Arbor farm manager Amanda Sweetman says this land cultivates more than vegetables and herbs: “We want to grow a healthier community.”

Anne Bolen is managing editor.

Doctor *Designed.* Audiologist *Tested.* FDA *Registered.*

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“Like many people, it took me a LONG time to admit I had some hearing loss. All signs were there: I'd accuse my husband of “mumbling,” I'd constantly turn up the TV volume, I'd sit silently with friends because I couldn't fully understand what they were saying.

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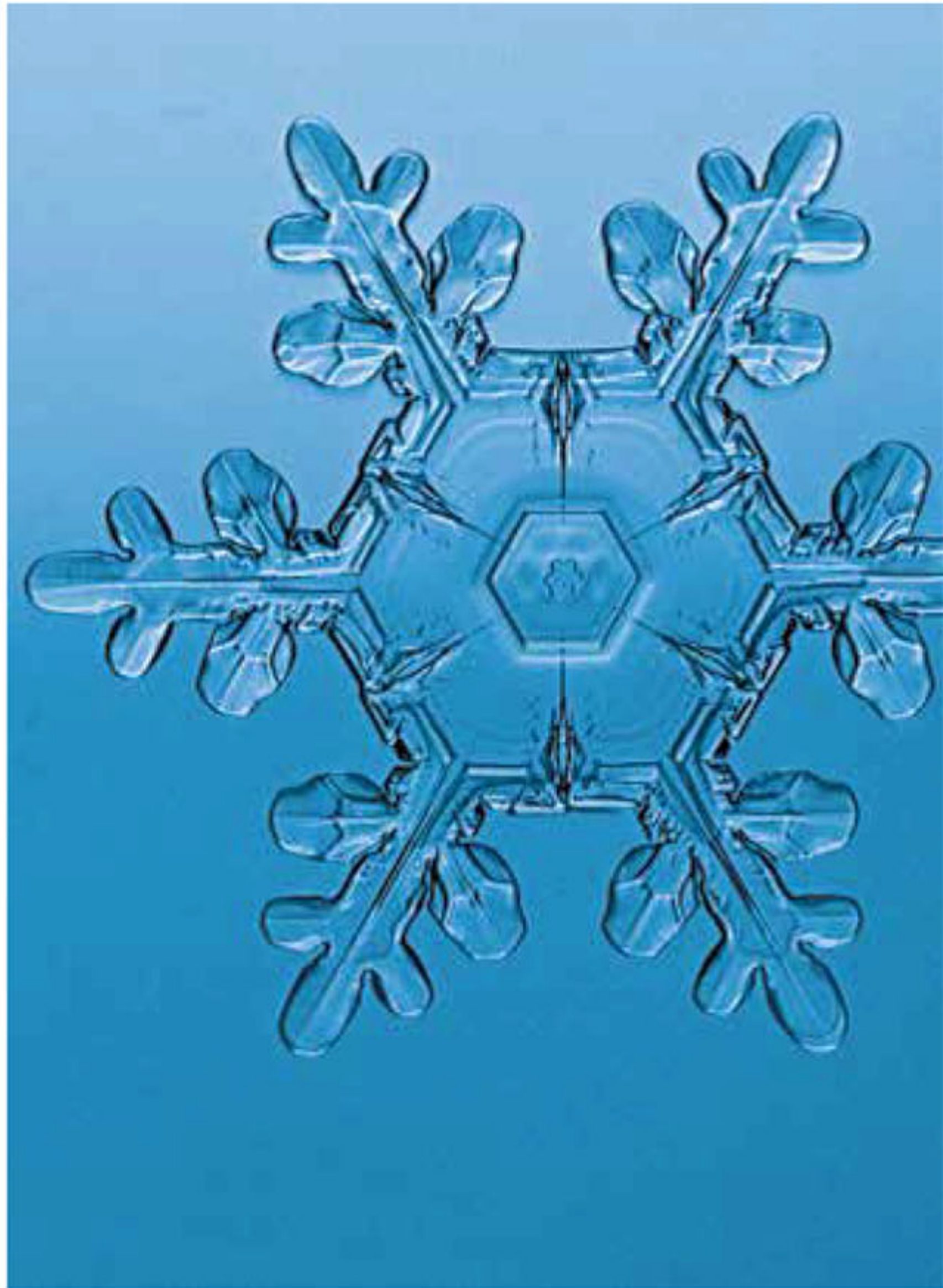
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Infinite in variety and ephemeral in nature, snowflakes captivate photographer Steve Gettle, who has mastered the

art—and science—of photographing some of nature's tiniest treasures.

Working outside in the cold of a Michigan winter, Gettle catches flakes on black velvet. Then he uses two hairs in an artist's paintbrush to transfer a flake to a slide, which he mounts beneath a microscope attached to his camera. "Lighting is the trickiest part," he says, because the ice crystals would melt instantly if exposed to heat. To prevent that, Gettle uses four, fiber-optic light tubes attached to his setup to illuminate the flakes and bring out detail.

"I've looked at thousands of crystals and have never seen two alike," he says. "I love the symmetry, the intricate detail, the beauty." That beauty is fleeting. After about three minutes, the flakes melt away. Yet these lasting portraits attest to the magic that a droplet of water can create as it tumbles through frigid air.

📷 To submit images for consideration, write to nationalwildlifephotography@gmail.com with "Nature's Witness" in the subject line.

Going ... Going ...?

*A surprising number and variety of North American wildlife
species are quietly disappearing*

**An eastern towhee faces the wind in a Delaware snowstorm.
Since 1966, their numbers have dropped nearly 50 percent.**



As a child in the 1960s, ornithologist Geoff LeBaron watched common nighthawks swoop above New Hampshire's Squam Lake, where his family owned a summer cabin. After completing graduate school two decades later, he continued seeing "waves and waves" of these acrobatic insectivores snatching bugs mid-air over a pond in Rhode Island's Burlingame State Park, where he worked as a naturalist.

"That just doesn't happen anymore," says LeBaron, now the Christmas Bird Count director for the National Audubon Society. Hampered by habitat loss, pesticides and vehicle collisions, nighthawk populations have plunged in

"most at risk of extinction without significant action." The list comprises such widespread and familiar birds as the eastern meadowlark, chimney swift and common grackle as well as more than a quarter of the continent's 45 grassland species, including the chestnut-collared longspur, grasshopper sparrow and bobolink.

The problem goes beyond birds. Based on analyses of the nation's best-studied groups of plants and animals—including birds, mammals, fish, reptiles, amphibians and vascular plants—scientists at NatureServe estimate that about a third of all U.S. species are at risk of extinction. That percentage translates to "more than 8,500 of our best-known plant and animal species," says Bruce Stein, the National Wildlife Federation's associate vice president of conservation science and author of *Precious Heritage: The Status of Biodiversity in the United States*. Only about 20 percent of the country's more than 200,000 identified species have been evaluated for extinction risk, he adds, "so the true total of imperiled plants and animals is most likely much higher."

In addition to the aesthetic and moral implications of species declines, "we as human beings depend on natural ecosystems for food, clean water and even safety, such as the coastal habitats that protect us from storms and floods," Stein says. "These ecosystems are made up of individual species. When they disappear, the systems that support us can unravel."

Global biodiversity crisis

In the mid-1980s, the planet's "biodiversity crisis" burst forth as a critical conservation issue at the National Forum on Biodiversity, organized in Washington, D.C., by the National Research Council and spearheaded by Harvard University biologist Edward O. Wilson. According to Wilson and other forum participants, global species losses were accelerating at such a rapid pace that Earth was entering its sixth mass extinction event—the fifth having taken place some 65 million years earlier when the dinosaurs and countless other creatures disappeared forever.

From the beginning, concerns about species loss focused primarily on distant tropical habitats like Australia's Great Barrier Reef and



JAN WEGENER (BIA/MINDEN PICTURES)

A common nighthawk soars during a display flight in Texas. Nationwide, these birds are in sharp decline.

recent decades. According to the North American Breeding Bird survey, the birds declined 61 percent nationwide between 1966 and 2014.

Nighthawks are hardly alone. The species is one of hundreds of once-common U.S. birds that have decreased dramatically in recent years. According to the North American Bird Conservation Initiative, more than a third of the continent's 1,154 avian species are in trouble. The initiative's recent report, *The State of North America's Birds 2016*, features a Watch List of 432 species

SPOTTED SALAMANDER

U.S. amphibian populations are declining nearly 4 percent a year.



CLAY BOLT

GREAT SPANGLED FRITILLARY

Since 1950, at least five butterfly species have gone extinct in the United States.



TWAN LEENDERS

EASTERN MEADOWLARK

More than a third of North American bird species need urgent conservation action.



ROBERT CAMERON



TODD AMACKER

DEERTOES MUSSEL

At least 26 U.S. freshwater mussel species have gone extinct, and 87 are listed as threatened or endangered.



PETE OXFORD (MINDEN PICTURES)

In Tennessee's Hiwassee River, an eastern hellbender cruises along moss-covered rocks hunting for fish and crayfish. The continent's largest salamanders, hellbenders are declining throughout their eastern U.S. range.

Amazonia's rain forest. Today, NWF and its partners want to focus more attention on the biodiversity crisis taking place in our own backyards.

Not all species are in trouble, of course, and some are doing better than at any time in recent history. Conservationists have done a good job restoring large charismatic animals that were once imperiled, including bald eagles, gray wolves and grizzly bears. The same is true for game animals such as elk, white-tailed deer and wild turkeys. But many other species have been overlooked. "While most of us have felt satisfied with what we've accomplished, the truth is we're not winning the war to save biodiversity overall," says Kevin Coyle, NWF's vice president of education and training and coauthor of the Federation's new strategic vision seeking to reverse U.S. species declines (see page 30).

Barrage of threats

Many factors are to blame for biodiversity loss, including wetlands destruction, damming and disruption of waterways, invasive species,

exotic wildlife diseases and climate change. We also continue to develop more and more of our nation's terrestrial habitats. Together, habitat loss and degradation are the leading causes of U.S. species declines, Stein says.

Weak laws, lackluster enforcement and inadequate funding exacerbate the problems. According to a study published in *Biological Conservation*, it takes an average of 12 years—and as long as 40 years—for proposed species to be listed as endangered or threatened under the U.S. Endangered Species Act (ESA). In addition, only 5 percent of plants and animals ultimately listed receive adequate conservation funding, concludes a recent *Issues in Ecology* report, with the lion's share of effort going to a handful of high-profile species.

Meanwhile, the primary agency responsible for ESA listings, the U.S. Fish and Wildlife Service (FWS), is chronically underfunded and under attack from some members of Congress, who in recent years have ramped up efforts to limit listings. And although game species of fish



JOEL SARTORE

Seven-year-old pallid sturgeon crowd a tank at a South Dakota fish hatchery. When the animals sexually mature at about age 20, their progeny will help replenish wild populations of this endangered species.

and wildlife receive reliable and significant conservation funding through the sales of fishing and hunting licenses and gear, no similar big pots of money exist to protect “nongame” animals.

These animals include the hundreds of bird species in decline as well as creatures as diverse as mussels, salamanders, frogs, butterflies and bumble bees. On the following pages, we provide a rundown of several groups of imperiled wildlife, along with what’s at risk if North American species fade away.

Freshwater fish. An ancient species that has survived since the days of dinosaurs, the pallid sturgeon can grow up to 6 feet long, take 20 years to sexually mature and live 70 years or longer. These rarely seen and poorly understood fish once thrived from the headwaters of the Missouri River in Montana downstream to the lower Mississippi River. Today, only a few hundred wild sturgeon remain, all of them hemmed in by dams and other river developments that make it difficult for the animals to spawn and find food.

Unique in many ways, the pallid sturgeon is all too typical in others. According to the Endangered Species Committee of the American Fisheries Society (AFS), 40 percent of North America’s freshwater fish species are imperiled or already extinct. Of 28 native species and subspecies of U.S. trout, three are extinct and 13 of the others occupy less than a quarter of their historic habitat, reports Trout Unlimited. AFS calls these declines “a major tragedy” because “the loss of aquatic organisms is occurring without any knowledge of effects on the dynamics of the ecosystems they inhabit.”

Causes of freshwater fish declines include sediment runoff, water pollution, introduced species, stream fragmentation, dams, dredging and river channelization. “As a whole, our freshwater biota is in much worse shape than our terrestrial biota,” Stein says, “but it does not get much attention because it’s largely out of sight.”

Freshwater mussels. With an estimated population of about 100 individuals, the golden



CLAY BOLT

A male rusty patched bumble bee rests on Joe Pye weed in Wisconsin, a state where the bees have steeply declined.

riffleshell mussel is one of the planet's rarest creatures, found only in a single creek in Virginia. Like the riffleshell, freshwater mussels as a group are among the nation's most endangered categories of animal. Most U.S. mussels live in the Southeast, a region that has the world's highest diversity of these mollusks: 302 known species. At least 26 of these species already have gone extinct, and another 87 are federally listed as endangered or threatened.

Once numbering in the hundreds of millions—perhaps billions—of individuals, mussels are ecologically important filter feeders that

act as giant water sieves. “Historically you could see 20 feet into the Tennessee River, and many of our rivers ran clear,” says Paul Johnson, program supervisor for the Alabama Aquatic Biodiversity Center.

Water pollution, sedimentation, dams and other river and stream alterations all contribute to mussel losses. The animals also have suffered from declines in the host fish they need to reproduce. Different mussel species rely on different host fish—including darters, minnows, bass and catfish—to disperse juvenile mussels. Female golden riffleshells, for example, open their shells in spring, exposing fleshy lures that, to darters, resemble food. When a fish comes in to feed, the mussel clamps shut, trapping the fish. The riffleshells then expel their larvae, which attach to released fish and fall off weeks later to colonize new habitat.

“The life cycles of freshwater mussels are incredibly interesting,” says Jess Jones, an FWS biologist stationed at Virginia Tech University's Freshwater Mollusk Conservation Center. “If more people knew the amazing things they do, we might have a greater interest in saving them.”

Bumble bees. Ranging from Minnesota to Maine, the rusty patched bumble bee was once among the most common and widespread bumble bees in the East as well as an important pollinator of plants ranging from native wildflowers to crops such as cranberries, blueberries, apples and alfalfa.

Today, the bee has vanished from nearly 90 percent of its range.

By far the best-studied of the continent's more than 4,000 native bee species, bumble bees as a whole are in trouble. In addition to the rusty patched, many other once-common species—including the southern plains, crotch, suckley cuckoo and variable cuckoo bumble bees—have disappeared from large portions of their ranges. A recently published analysis by the Xerces Society for Invertebrate Conservation and the Bumblebee Specialist Group of the International Union

for Conservation of Nature concludes that more than a quarter of North America's 47 bumble bee species "face some level of extinction risk."

The threats to bumble bees include habitat loss and fragmentation, climate change and pesticides, particularly a newer and widely used class of insecticides called neonicotinoids. Systemic compounds that remain in plant tissues long after treatment, neonicotinoids are ingested by bees when they feed on nectar and pollen. Scientists have found that even sublethal doses of the pesticides may alter the foraging behavior of bumble bees.

For some vanishing bumble bees, "the evidence points to disease as the primary culprit," says Robbin Thorp, a retired University of California–Davis entomologist who has studied the insects' decline for two decades. One disease, a fungus called *Nosema bombi*, was probably transported around the country with bumble bees reared in captivity to pollinate commercial crops. "We need to be more careful about moving species, and we need to get a handle on what diseases are being potentially moved," Thorp says. One likely *N. bombi* victim is the Franklin's bumble bee. Historically found from southern Oregon to northern California, the species has not been spotted by scientists since 2006, and most of them consider it to be extinct.

Butterflies. The tiny and delicate Karner blue butterfly lives only in pine barrens, oak savannas and a handful of other habitats from the upper Midwest to the Northeast. Just as monarch caterpillars depend on milkweeds as a sole source of food, Karner blue larvae eat only the leaves of wild lupine plants, further restricting the species' range. Within that range, the butterflies once were abundant, but habitat loss wiped them out everywhere except a small number of habitat pockets, and in 1992, the Karner blue was listed as endangered under the ESA.

In one of the butterfly's last strongholds, Indiana Dunes National Lakeshore, biologists fear it is now locally extinct. While surveys during the 1990s turned up more than 1,000 Karner blues each year, scientists in 2015 and 2016 found none.

Researchers suspect that—in addition to habitat loss and other culprits—warmer temperatures caused by climate change are forcing butterfly eggs to hatch too early, before lupine leaves are available to eat.

Several other butterflies are suffering range-wide declines. Since 1950, at least five species have gone extinct in the United States, and approximately 40 more moths or butterflies are listed under the ESA. "For many butterflies, we are seeing declines among broadly distributed habitat generalists, species that we would expect



JOHN ESFORD

A tiny Karner blue butterfly alights in New York's Wilton Wildlife Preserve, among a handful of habitats where the species survives.

to be resilient," says Sarina Jepsen, director of endangered species and aquatic programs for the Xerces Society. One example is the regal fritillary, which historically inhabited 32 states but has disappeared from 14 of them and is classified as imperiled or vulnerable in 15 others.

University of California–Davis researcher Arthur Shapiro has conducted what is believed to be the country's longest-running butterfly study, surveying 10 sites in California from sea level to the High Sierra for more than 40 years. His results reveal declines at every elevation except the very highest. "We are seeing an

accelerating movement of mid-elevation species upslope,” Shapiro says. Unfortunately, the host plants many of these butterflies depend on do not exist at higher elevations, making their upslope resettlement futile.

Amphibians. Growing up to 2 feet in length, hellbender salamanders are among the world’s largest amphibians. The animals prey on fish and crayfish and can live 25 years or longer. Once thriving in rivers and streams from Missouri to New York to Georgia, hellbenders are declining dramatically across most of their range. Degraded water quality, sedimentation, collection for the pet trade and infection by a nonnative fungal disease have all likely contributed to the declines. “It’s a bit of a mystery ... something seems to be going on with habitat quality or water chemistry, which may be associated with forest loss around streams,” says William Hopkins, a hellbender researcher and professor of wildlife conservation at Virginia Tech University who calls the animals “a regional treasure and a symbol of the wildness of Appalachia.”

Poor water quality combined with other threats—including wetlands loss, introduced disease and nonnative species—are hitting many North American amphibians hard from coast to coast. According to a 2016 study by the U.S. Geological Survey, the nation’s amphibian populations as a whole are decreasing by nearly 4 percent annually.

Salamanders are losing ground especially in the Southeast, which has the world’s greatest diversity of these amphibians. For frogs, the declines are sharpest in the Rocky Mountains and elsewhere in the West. Boreal toads, for example, have decreased 80 percent in the southern Rockies. Northern leopard frogs have disappeared from or become rare across much of their western range. And in California, the California red-legged frog, found only within that state, has declined by about 70 percent. Such losses can pose problems for entire ecosystems, notes Hopkins. “As both predators and prey, amphibians play critical roles in many food webs, including the control of harmful insects such as mosquitoes.”

New Vision for Wildlife

Last June, the National Wildlife Federation’s state and territorial affiliates unanimously adopted a new vision to increase North America’s wildlife populations and enhance native species’ capacity to thrive in a rapidly changing world. Now the Federation is developing a strategy to make that vision a reality.

Because habitat loss and degradation are the main causes of species declines, the strategy emphasizes protecting, restoring and connecting core wildlife habitats across America, with a focus on protected natural areas, waters, working lands and communities.

Communities can be made more wildlife-friendly by protecting stream buffers and



restoring tree canopies. On working lands, “there are ways to farm and ranch that share land with wildlife,” says Bruce Stein, NWF’s associate vice president for conservation science, who adds that even protected areas can be better managed to make them more resilient to climate change.

NWF President Collin O’Mara notes that broad-based collaboration will be the key to success. “Across our nation, many great conservation initiatives are underway, but they are not yet at a scale needed to overcome the magnitude of the challenges facing wildlife,” he says. To meet those challenges, “we will mobilize a conservation army of tens of millions of Americans, unlike anything this country has ever seen.”



DEVIN EDMONDS (USGS)

A Sierra Nevada yellow-legged frog surveys its domain in Yosemite National Park, where populations of this endangered amphibian have increased sevenfold in recent years thanks to aggressive conservation action.

But not all news about imperiled amphibians is bad, and in California, some populations of the endangered Sierra Nevada yellow-legged frog are prime examples. Found only at high elevations within the central and northern portion of the Sierra—rarely more than 3 feet from water—the species has declined rangewide by 93 percent. The frogs fell victim to habitat loss and fragmentation, introductions of nonnative fish that devour their offspring and an epidemic of the invasive chytrid fungus that is wiping out frogs and other amphibians in many parts of the world.

Story of hope

In Yosemite National Park, however, the species has bounced back, its numbers actually *increasing* sevenfold between 1996 and 2005. The frog's return is attributed to two factors. First, in 1991, the California Department of Fish and Wildlife stopped releasing into the park's waters predatory nonnative trout that had been stocked for decades for visiting anglers. In 2007, park employees also began to net and remove trout, a program that continues today. Second, some of

the park's frogs seem to have evolved resistance to the chytrid fungus, which during the 1990s killed virtually all the animals it infected.

Without trout, the handful of frogs that survived and developed resistance to the fungus were able to prosper, says San Francisco State University biologist Vance Vredenburg, who has studied the Sierra Nevada yellow-legged frog since the mid-1990s. "These animals are survivors," he says. "The lesson is that if you give them room without introduced fish and allow for time, with a little bit of luck and good management, they will evolve and survive."

Stein and other biologists hold out hope that many more disappearing species will be able to recover—with a little help from the conservation community. "In the face of rapid change, we can't put things back the way they used to be, but we can reverse wildlife declines," he says. "It's a big task but it's doable, and it is our most important conservation challenge." ^W

Paul Tolmé wrote about Malheur National Wildlife Refuge in the December–January 2017 issue.

Paradise Unwound

Famed as the fishing capital of the world, Florida is reeling as water crises threaten fish populations and local livelihoods



In the crystal-clear flats of Biscayne Bay, fishing guide Bob Branham watches a client cast for bonefish. These popular sport fish are “nowhere near as plentiful as they were in the 1980s,” says Branham. “Being a fishing guide gets harder every year.”



For most of the summer and early fall of 2016, Florida's St. Lucie River was in the national news—for all the wrong reasons. Long prized as a legendary fishery and biologically rich estuary that flows into the Indian River Lagoon along the Atlantic coast, the St. Lucie was making headlines for being clogged with putrid, toxic algae so thick it resembled guacamole. And the St. Lucie wasn't alone.

To the west, parts of the Caloosahatchee River also flowed green, sickened with algae. Its waters feed into Pine Island Sound, Florida's sec-

ond largest estuary and home to the J.N. "Ding" Darling National Wildlife Refuge as well as some of the nation's best sport fisheries for species such as tarpon, spotted seatrout and red drum.

The nucleus of the crisis lay inland, in Lake Okeechobee, the vast liquid heart of the Greater Everglades Ecosystem. Excessive El Niño rains last summer had flushed untold tons of phosphorus and nitrogen from agricultural fields into the lake, along with septic-tank pollutants and tainted urban runoff. The intense rains and the summer's excessive heat—worsened by climate

change—led to the growth of cyanobacteria (often called blue-green algae), organisms that reproduce explosively when fed by heat and nutrient pollution. The resulting bacterial bloom grew to more than 230 square miles, a blotch so massive it was visible from space.

Green tide's grim toll

Bloated with water, Lake Okeechobee threatened to burst through the aging, earthen dike surrounding it, an event that would have caused catastrophic flooding. To prevent that, the U.S. Army Corps of Engineers and South Florida Water Management District released billions of gallons a day of fouled lake water into the St. Lucie and Caloosahatchee rivers.

As lake water mixed with the saltier river estuaries, the cyanobacteria ramped up toxin production as a form of self-defense. Eventually, the bacteria began to die and decay, releasing toxins into the water and air. As other bacteria began to consume the resulting slime, they sucked oxygen from the water column, leading to aquatic dead zones.

The crisis took a stark toll. East to west across southern Florida, green tides slopped ashore. People fell ill, beaches closed, seagrass beds suffocated, unknown numbers of



MAP ART BY LASZLO KUBINYI

Much of South Florida lies within the Greater Everglades Ecosystem, which relies on freshwater flow to remain healthy. Demands from agriculture and urban sprawl—along with human mismanagement and warming temperatures—put the region at risk.



RICHARD GRAULICH (PALM BEACH POST)

A toxic tide chokes the St. Lucie River. Across southern Florida last summer, the crisis closed beaches, sickened people and led to fish die-offs. Many years earlier, a similar crisis killed fish in Lake Trafford (below).

fish died, tourism suffered and protests erupted. So widespread was the algal invasion that Governor Rick Scott declared a state of emergency in several Florida counties.

The sportfishing community was especially hard-hit. Valued at more than \$7.5 billion a year, Florida's fishing industry—and the state's reputation as the fishing capital of the world—stood in jeopardy. "I'm down \$160,000 in gross business this year," said Bruce Hrobak, owner of two bait-and-tackle stores in Port St. Lucie, "and that's just because of the green water."

A personal heartbreak

This crisis also hit me hard. I grew up hunting and fishing in the Everglades and have made a career there as a charter-fishing operator, environmental educator and writer. Last summer, I was with my wife and infant son at our home near Indian River Lagoon, not far from the toxic mess. Because of warnings about cyanobacteria's

threat to infants, we evacuated to my mother's cabin near Cody, Wyoming, to ride out the crisis. We felt like environmental refugees and questioned whether our son may ever know the joys of fishing in relatively healthy Florida waters.

I worry about that answer. The 2016 bacterial bloom was only the latest in a string of water crises that have plagued southern Florida for years. Discharges from Lake Okeechobee have periodically degraded the northern estuaries since the

1930s. As far back as the 1970s, dairy-farm pollution and other nutrients prompted fish kills in tributaries of the lake, one of America's most celebrated largemouth bass fisheries. In 2015, drought, record heat and insufficient freshwater flows into Florida Bay killed off 80,000 acres of seagrass beds. When I fished there last May, the water was putrid with foggy algae and suspended sediments, and flats that usually teem with baitfish, sharks and stingrays were as still as death.



STEVEN DAVID MILLER (NPL/MINDEN PICTURES)



ANDY REID (SUN SENTINEL)

Released last fall to ease strain on the aging dike around Lake Okeechobee, tainted waters race through the St. Lucie Lock and Dam near Stuart, Florida. Such releases carry algae and pollutants that harm local fisheries.

To understand how southern Florida came to this tipping point, it's important to understand the history of water management in the state. That history explains the chief cause of the problem—and holds the key to solutions.

A problem of plumbing

The Everglades once comprised a massive, rain-fed series of wetlands, lakes and rivers that flowed in a slow-moving sheet from just below Orlando south into Florida Bay as well as east and west toward the coasts. These waters support

the only living coral barrier reef in the continental United States—a 360-mile tract running from west of the Florida Keys to the St. Lucie Inlet. They also replenish biologically rich estuaries with vital seagrass, bivalve and mangrove communities that provide essential nurseries for myriad marine species, some of which spend most of their lives offshore, including many species of snapper and grouper.

Nature originally engineered this system to distribute Florida's water where it was ecologically needed most. Man had other ideas.

Beginning in the 1880s, real-estate and agricultural interests launched plans to drain the Everglades for crops and development. Sugar and citrus plantations, housing complexes and tourist attractions took root. Hurricanes that led to massive flooding around Lake Okeechobee prompted the U.S. Army Corps of Engineers to build a dike around the lake in the 1930s. But more storms and flooding in the face of growing demand for land pushed the U.S. Congress in 1948 to approve the Central and Southern Florida Project for Flood Control and Other Purposes (C&SF). This launched an unparalleled era of human engineering to rein in Florida's waters.

NWF PRIORITY

Everglades call to action

Last July, the National Wildlife Federation, its Vanishing Paradise program—devoted to restoring wetlands along the Gulf of Mexico—and NWF affiliate the Florida Wildlife Federation signed a letter to the U.S. Congress along with more than 160 other conservation, sporting and business groups to urge funding of the Comprehensive Everglades Restoration Plan. "Delay is no longer an option," they wrote. "Our paradise is vanishing today." To learn more, go to www.nwf.org/evergladesanglers.

Between the 1930s and 1960s, state and federal engineers cut canals, installed pumps, straightened rivers, built levees and otherwise directed water where they wanted it to go. The C&SF designated some 700,000 acres south of Lake Okeechobee as the Everglades Agricultural Area (EAA), where sugar cane and winter vegetables depend on Everglades waters for irrigation.

Bordering the EAA, planners carved out three Water Conservation Areas to serve as water holding pens, where levees and pumping stations either release or hold water depending on how flood or drought may affect water demand in agricultural and urban areas. In addition, to relieve strain on Lake Okeechobee's dike during times of high water, engineers cut canals to shoot lake water east to the Atlantic and west to the Gulf—forcing too much water through the St. Lucie and Caloosahatchee rivers, respectively, and leaving too little to trickle down to Florida Bay through Everglades National Park.

“It’s a disaster for seagrasses and the delicate balance of salt and fresh water so vital to estuarine life,” says David Muth, director of the National Wildlife Federation’s Gulf Restoration Program. “And it’s a disaster for those who make their living relying on the health of these ecosystems.”

A crown jewel in peril

One of the casualties of Florida’s water crises is Everglades National Park. The Greater Everglades Ecosystem once covered about 11,000 square miles. Today, it’s less than half that size, and the park protects only about 20 percent of what’s left. Dedicated in 1947, the park is now designated as a World Heritage Site, International Biosphere Reserve and Wetland of International Importance. It supports hundreds of species of birds, reptiles and fish and is home to about three dozen endangered or protected species, including the Florida panther, West Indian manatee and American crocodile.

Equally important, the park filters water into the Biscayne Aquifer, the primary source of fresh water for four densely populated South Florida counties. Yet because water management and climate extremes prevent enough water from reaching the park, it is increasingly parched, putting the ecosystem at risk.

Ironically, Florida has already shown that it can effectively reengineer itself back to ecological balance. Case in point: the Kissimmee River.



JOE CAVARETTA (SUN SENTINEL/MCT VIA GETTY IMAGES)



RICHARD KERN



J. PAT CARTER (AP PHOTO)

Rampant development along Florida waterways (top) contributes to water problems such as the bacterial bloom last summer that left fishing boats in Stuart mired in muck (center). Protesters of a similar crisis in 2013 begged the state to save the St. Lucie River.



TIM FITZHARRIS (MINDEN PICTURES)



MAC STONE



MAC STONE

American alligators, roseate spoonbills and West Indian manatees (top to bottom) are among the myriad native Florida species that need clean, abundant waters to survive and thrive.

Once a meandering, 103-mile-long ribbon running south of Orlando from Lake Kissimmee to Lake Okeechobee, the river and its floodplain supported everything from waterfowl and largemouth bass to eagles and alligators. In the 1960s, the river was straightjacketed into a 56-mile-long canal, a flood-control project that, by some estimates, reduced waterfowl populations by 90 percent and crippled the bass fishery.

Beginning in the 1990s, the Corps of Engineers and South Florida Water Management District funded a project to restore the middle third of the river, whose revived marshes, curves and oxbows will slow runoff coming from the Orlando area and allow plants to filter out some nutrients entering Okeechobee. When complete in 2020, almost 20,000 acres of wetlands and 44 miles of the historic channel will be revived—the largest river restoration effort in human history.

Where work has already been completed, the benefits are clear. “Bass, panfish and ducks have rebounded,” says Manley Fuller, president of the Florida Wildlife Federation, an NWF affiliate and a driving force behind the restoration. “Native plants and animals that had disappeared have returned and are thriving.”

Blueprint for a brighter future

Similar successes are possible across southern Florida, and there’s already a detailed plan in place to make them happen—if stakeholders and politicians unite behind the cause.

In 2000, Congress approved the Comprehensive Everglades Restoration Plan (CERP), with more than 60 projects designed to restore water flow to the Everglades while providing flood control and adequate water to urban and agricultural areas. The plan, estimated to cost \$10.5 billion over 30 years, includes building wetlands to hold and filter contaminated water and destroying canals that divert water away from the Everglades. Though funding remains scarce and controversy abounds, there’s plenty of progress worth noting:

Tamiami Trail. This route (U.S. Highway 41) has long acted as a dam preventing water from flowing south from Water Conservation Area 3 into Everglades National Park. One mile of the route has now been bridged, allowing water to flow more freely into the park and Florida Bay. Another 2.6 miles are under construction to allow even more flow. That fresh water provides cooling and mixing that’s essential for an estuary to



PAUL MARCELLINI

In Everglades National Park, mangrove swamps serve as nurseries for abundant aquatic life. The entire Everglades ecosystem depends on a steady flow of clean water—in short supply unless humans act fast.


function, particularly during times of high heat and prolonged drought, as Florida saw in 2015.

Stormwater Treatment. Some 57,000 acres of stormwater treatment areas have been built south and east of Lake Okeechobee to remove nutrients from water coming off agricultural fields before release into the Everglades.

Picayune Strand. Nearly complete, this 60,000-acre hydrological-habitat restoration project will revive fisheries in the Ten Thousand Islands National Wildlife Refuge in southwest Florida and restore wildlife corridors for species such as the Florida panther and black bear.

Despite progress, recovery in the Everglades will take time. Stephen Davis, a wetland ecologist with the Everglades Foundation, laments that “it may take 20 years for the seagrass communities in Florida Bay to grow back.” And that’s only if Congress and Florida approve the necessary funding. On the federal level, Congress does seem poised to approve the Central Everglades Plan, a package of CERP projects that would provide vital replumbing and some new flow from Lake Okeechobee. Last March, Flor-

ida legislators approved a bill requiring the state to set aside up to \$200 million each year for Everglades restoration under CERP projects. Also last year, Florida’s new Senate President Joe Negrón began gaining support for a controversial plan to purchase some 60,000 acres in the EAA, removing them from growers to build a reservoir that would store and treat tainted water from Lake Okeechobee. If that happens, it could significantly reduce discharges along coastal estuaries and provide cleaner water to the south—yet battles over the plan make its future murky.

At the peak of the toxic blue-green algae crisis last summer, NWF President Collin O’Mara called it an “utterly preventable disaster.” That’s true, and it’s tragic. The waters of the Everglades should be a source of national pride, not shame, anger and worry that we’re running out of time to restore a national treasure. I just hope that my son will one day know the joy of casting a line into clean, home waters teeming with fish. 

Florida-based writer, conservationist and sportsman Terry Gibson writes for many outdoor magazines.

Coping with Chronic Clamor

A growing body of research reveals how noise pollution alters bird behavior

By Mark Wexler

Despite its diminutive size, the northern saw-whet owl is a big-time hunter. Armed with an exceptional sense of hearing, it can detect rodents buried beneath deep snow and hidden under forest debris. In quiet areas, the raptor can hear sounds as low as negative 20 decibels, “far below levels we humans can hear,” says Boise State University ecologist Jesse Barber. But as energy development has expanded into once-quiet regions, he adds, “the noise that comes with it can degrade habitat for acoustically specialized species like the saw-whet.”

To test that assertion, Barber and his colleagues exposed 31 owls (wild birds held temporarily in captivity) to recordings of a natural-gas compressor station similar to those found in the birds’ Idaho range. Each time they increased the

sound by a decibel, the researchers found the owls’ hunting success declined by 8 percent. By the time the scientists turned up the volume to 60 decibels—the equivalent of people talking in a busy restaurant—the raptors failed to capture any prey at all. “We expected noise to affect the owls,” Barber says, “but not to this extent.”

Completed last year, the saw-whet project provides additional support for a growing body of evidence that chronic clamor from roads, traffic, construction and other anthropogenic sources is changing bird behavior. Compared to many other environmental issues, “noise pollution hasn’t been considered a serious problem in the natural world,” says California Polytechnic State University scientist Clinton Francis. Recent evidence, he argues, suggests otherwise. “We’re now seeing that noise may actually pose a big threat to biodiversity.”



JON MULLEN (ISTOCK/GETTY IMAGES)

Scientists have found that the noise generated by natural-gas compressor stations (above) can decrease hunting success of the northern saw-whet owl (right), which relies on its acute hearing to detect hidden prey.

Eavesdropping on birds

Much of that evidence comes from innovative studies conducted during the past decade. In the Netherlands, for example, Dutch researchers discovered that male great tits near communities have changed their mating calls to a higher pitch that is audible above the low-frequency sounds of roadway traffic. The scientists also observed, however, that female great tits prefer lower-frequency calls when selecting a mate. The result: a Catch-22 situation that could affect the birds’ ability to breed successfully in urban areas.

In North America, biologists are finding that another widespread bird, the white-crowned sparrow, not only





SEBASTIAN KENNERKNECHT (MINDEN PICTURES)



TERRY ANDREWATHA (FLPA/MINDEN PICTURES)

Biologist David Luther (left) employs a decoy bird and recorded calls to study the responses of white-crowned sparrows (right) in San Francisco to different call dialects, which are decreasing in number as noise increases.

is singing louder than in the past but also is changing its repertoire of songs. Much the way residents of New England sound different from people in the Deep South, “many songbirds sing in different dialects depending on where they range,” says George Mason University biologist David Luther, who studies the dialects of white crowns that live year-round in the San Francisco Bay Area.

According to recordings made in the late 1960s by ornithologist Luis Baptista, sparrows inhabiting different parts of San Francisco once sang in three distinct dialects and in as many as 10 dialects in adjacent communities. But as noise levels have increased exponentially since then, white crowns have been altering the pitch and length of their calls. Today, Luther and his colleagues report, the birds all sing in a single dialect. “They clearly have shifted their song to one that can be heard above the urban din,” he says.

How much does roadway traffic alone contribute to changes in avian behavior? A few years ago, Barber and a team of Boise State graduate students initiated a study to find out. Along a remote ridge in a southern Idaho forest where food is plentiful, they created a “phantom road” by attaching several sets of large speakers to trees. “We knew that the study area was an important stopover site where migratory songbirds could rest for a few days and bulk up before continuing on their long journeys south,” Barber says.

At regular intervals throughout fall, when more than 100 bird species flock to the ridge to feed during migration, the team blasted recordings of cars driving in a national park, then documented the animals’ reactions. The racket, they found, drove more than a third of the birds away from the ridge, causing them to lose a critical opportunity to refuel. Migrants that didn’t leave also suffered. “They didn’t lose weight,” Barber says, “but they failed to gain the weight needed to maintain their ability to migrate.” He theorizes that because traffic noise drowned out the sounds of potential threats, the birds were too distracted looking for predators to stop and eat.

The project left a lasting impression on many acoustic ecologists who had focused their work on the effects of noise on breeding and communication. “It provided us with strong evidence that noise impacts other aspects of birds’ lives such as migration and feeding,” says Francis.

Altered avian habitats

In his own research, Francis recently discovered that human clamor can even have ripple effects on plants, potentially impacting an area long after the source of the noise disappears. He conducted experiments during a three-year period on federal lands in northwestern New Mexico, where hundreds of natural-gas wells run nonstop 24 hours a day. The area traditionally has been dominated by pinyon pines, which provide habitat and food for dozens of wildlife species.

One of those species, the Woodhouse's scrub-jay, plays a key role perpetuating the pines by collecting hundreds of fallen seeds and burying them to eat during winter. Many seeds the birds fail to find germinate and produce seedlings. At the study site, however, the noisy compressors appeared to interfere with the jays' ability to communicate. Large numbers of the birds eventually fled to a nearby quiet area.

Without jays to spread seeds, Francis and his associates discovered, pines in the study site are disappearing while they are flourishing in the quiet zone. And because pinyon pines take decades to grow from seedlings to mature trees, "the consequences of noise could have long-term effects on this ecosystem's diversity and structure," Francis says



ROLF NUSSBAUMER (NPL/MINDEN PICTURES)

In New Mexican pinyon pine forests, the noise of natural-gas wells drives away Woodhouse's scrub-jays, harming pines whose seeds the birds disperse.

Francis, like thousands of other scientists and birders across the country, relies heavily on avian calls and songs to identify birds and count their numbers in the field. Such counts are crucial to decisions about the status and conservation of species. But background noise may affect the scientists' observations. "If we see declines in some breeding birds, how much of it is due

to low detections because of background noise and how much is due to actual species declines?" asks Theodore Simons, a North Carolina State University ecologist who has been investigating the question.

For three years, Simons participated in the annual North American Breeding Bird Survey (BBS), which since 1966 has been a major source of population and range data for more than 400 species. Working with other scientists, he set up a series of tests using equipment that played the sounds of singing birds against varying levels of background noise. He then asked experienced birders—including experts from the U.S. Geological Survey who help organize the BBS—to identify what they heard.

The tests showed that even small amounts of background noise led to a 40 percent decrease in observers' ability to detect singing birds. Since then, the study has helped researchers design new data-collection methods and statistical models that account for background noise in estimating populations, including more repeated sampling over a number of days at a specific site. "It allows us to get a truer picture of species numbers and identifications," Simons says.

Seeking solutions

Other researchers are pursuing solutions that could lessen the effects of human clamor on bird behavior. In Wyoming's Grand Teton National Park, Barber and Francis are testing how lowering speed limits by 20 miles per hour can benefit birds. "This is one of the most effective ways to cut noise in protected areas," Barber says. When people drive slower, he notes, the footprint—or distance sound travels—is drastically reduced. Elsewhere, highway engineers are experimenting with several noise-reduction techniques, such as replacing traditional road surfaces with so-called "quiet pavement" made of rubberized asphalt that decreases the sound of traffic by several decibels.

"With so many species decreasing in numbers," Francis says, "we can no longer afford to ignore how the acoustic environment is contributing to avian declines." Identifying and understanding the different ways birds respond to noise is a crucial step toward reducing that contribution. **W**

Mark Wexler is editor-at-large.

WORKING FOR WILDLIFE

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TRIBAL LANDS

Bison welcomed home on Wind River Reservation



ALAN ROGERS (CASPER STAR-TRIBUNE)

■ On November 3, cheers and the beating of drums welcomed 10 bison as they thundered onto the Eastern Shoshone and Northern Arapaho Tribes' Wind River Indian Reservation in Wyoming. The return of

genetically pure bison—absent for 131 years—is the culmination of decades of collaboration among the National Wildlife Federation, the Eastern Shoshone Tribe and the U.S. Fish and Wildlife Service to bring

back an animal inherent to the tribes' culture and Great Plains ecosystem.

The event fulfilled the tribes' goal to restore populations of all the ungulates native to their 2.4-million-square-mile reservation: moose, elk, pronghorn, bighorn sheep, white-tailed deer, mule deer and, finally, bison. These grazers help grasslands thrive by reducing harmful plant overgrowth while stirring and fertilizing soil. "The circle is now complete," says Garrit Voggesser, NWF director of tribal partnerships.

During the past five years, NWF helped bring some 200 bison to Montana's Fort Peck Reservation and is working to restore others to tribal lands. ➔ Visit: www.nwf.org/tribalbison

EDUCATION

20 million sustainability leaders by 2025

■ NWF has joined Second Nature, the U.S. Green Building Council and the Association for the Advancement of Sustainability in Higher Education (AASHE) to create a legion of 20 million "global sustainability citizens" by 2025. To reach this goal, colleges and universities will use AASHE's Sustainability Tracking, Assessment and Rating System (STARS) to calculate how many of their students are learning sustainability skills, whether through their courses or by participating in one of the other organization's programs.

As part of this effort, NWF's EcoLeaders program will host its first virtual EcoCareer Conference February 22 and 23 to show how sustainability skills can be applied. For example, former NWF fellow Kāwika Winter (right), now director of Hawai'i's Limahuli Garden and Preserve, teaches policymakers and residents that biodiversity is vital to the environment and culture. "Every time we lose another tree or bird," says Winter, "that's also a word in our native language that goes extinct, and a story along with it." ➔ Visit: www.nwf.org/ecoleaders



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AFFILIATE SPOTLIGHT

Keeping Illinois waters clean

■ In 1967, four volunteers successfully united community members to defeat a dam planned for Illinois' Sangamon River that would have flooded a woodland. Fifty years later, the group has grown into the Prairie Rivers Network (PRN), an NWF affiliate dedicated to restoring wildlife habitat and keeping Illinois waterways flowing and clean. "This is what happens when you get together and protect a place," says Carol Hays, PRN executive director. "It changes the trajectory of that place and your life."

Illinois has some 50 watersheds flowing into the Mississippi River. One way PRN helps protect these waters is by striving to reduce runoff from streets and agricultural land. It does so partly by teaching farmers how to "farm with wildlife in mind," explains Hays, including using cover crops to minimize soil loss, reducing pesticide use and planting wheat and corn varieties that are "good for the soil and the farmer's bottom line."



ROBERT ESBENSEN

PRN also encourages farmers and others to conserve wildlife habitat, from ponds for wood ducks (above) to native plants for pollinators. And because Illinois is within the monarch butterfly's central flyway, PRN recently convened a diverse group to create a statewide conservation plan for the declining species. ➔ Visit: prairierivers.org

VERMONT

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■ The Staying Connected Initiative (SCI), a coalition of 30 U.S. and Canadian agencies and organizations that includes NWF, its affiliate Vermont Natural Resources Council and The Nature Conservancy (TNC), is preserving forest habitat across the Northern Appalachian–Acadian region to reduce wildlife-vehicle collisions and allow animals mobility within a changing environment. SCI is partnering with the Vermont Agency of Transportation to determine how underpasses could be adjusted or built to encourage wildlife to use them.

Since 2014, SCI has examined some 418,000 images from 84 cameras posted near Vermont bridges and culverts and found while small animals ranging from river otters to bobcats (right) used the underpasses, large animals such as

moose and bears tended not to do so. Also, most animals traveling through fragmented landscape were drawn to crossings with abutting forest cover. "Without that habitat connectivity on either side, there's just not a lot of incentive for them to go that way," says NWF Wildlife Adaptation Coordinator Melissa Gaydos.

This spring, NWF is launching an SCI project for which citizens will monitor camera traps along Vermont's Otter Creek River, a vital wildlife corridor that also provides flood protection to 30 communities. "To really adapt to all the unknowns of a changing climate," says TNC ecologist Paul Marangelo, "we are going to be much better off creating landscapes where animals can easily move between habitats."



VERMONT AGENCY OF TRANSPORTATION

➔ Visit: stayingconnectedinitiative.org

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A federation for conservation

Affiliates of the National Wildlife Federation are autonomous, nonprofit organizations that take the lead in state and local conservation efforts and partner with NWF on national issues. The Federation has 50 affiliates, including in Puerto Rico, the U.S. Virgin Islands and Washington, D.C.

ALABAMA

Alabama Wildlife Federation
www.alabamawildlife.org

ARIZONA

Arizona Wildlife Federation
www.azwildlife.org

ARKANSAS

Arkansas Wildlife Federation
www.arwild.org

CALIFORNIA

Planning and Conservation League
www.pcl.org

COLORADO

Colorado Wildlife Federation
www.coloradowildlife.org

CONNECTICUT

Connecticut Forest & Park
Association
www.ctwoodlands.org

DELAWARE

Delaware Nature Society
www.delawarenaturesociety.org

FLORIDA

Florida Wildlife Federation
www.fwfonline.org

GEORGIA

Georgia Wildlife Federation
www.gwf.org

HAWAII

Conservation Council for Hawai'i
www.conservehi.org

IDAHO

Idaho Wildlife Federation
www.idahowildlife.org

ILLINOIS

Prairie Rivers Network
www.prairierivers.org

INDIANA

Indiana Wildlife Federation
www.indianawildlife.org

IOWA

Iowa Wildlife Federation
www.iawildlife.org

KANSAS

Kansas Wildlife Federation
www.kswildlife.org

KENTUCKY

Kentucky Waterways Alliance
www.kwalliance.org

LOUISIANA

Louisiana Wildlife Federation
www.lawildlifefed.org

MAINE

Natural Resources Council
of Maine
www.nrcm.org

MARYLAND

National Aquarium
www.aqua.org

MASSACHUSETTS

Environmental League
of Massachusetts
www.environmentalleague.org

MICHIGAN

Michigan United Conservation
Clubs
www.mucc.org

MINNESOTA

Minnesota Conservation
Federation
www.mncf.org

MISSISSIPPI

Mississippi Wildlife Federation
www.mswildlife.org

MISSOURI

Conservation Federation
of Missouri
www.confedmo.org

MONTANA

Montana Wildlife Federation
www.montanawildlife.org

NEBRASKA

Nebraska Wildlife Federation
www.nebraskawildlife.org

NEVADA

Nevada Wildlife Federation
www.nvwf.org

NEW HAMPSHIRE

New Hampshire Audubon
www.nhaudubon.org

NEW JERSEY

New Jersey Audubon
www.njaudubon.org

NEW MEXICO

New Mexico Wildlife Federation
www.nmwildlife.org

NEW YORK

Environmental Advocates
of New York
www.eany.org

NORTH CAROLINA

North Carolina Wildlife
Federation
www.ncwf.org

NORTH DAKOTA

North Dakota Wildlife
Federation
www.northdakotawildlifefederation.org

OKLAHOMA

Conservation Coalition of
Oklahoma
www.oklahomaconservation.org

OREGON

Association of Northwest
Steelheaders
www.nwsteelheaders.org

PENNSYLVANIA

Citizens for Pennsylvania's
Future
www.pennfuture.org

PUERTO RICO

Sociedad Ornitológica
Puertorriqueña, Inc.
www.sopipr.org

RHODE ISLAND

Environment Council of
Rhode Island
www.environmentcouncilri.org

SOUTH CAROLINA

South Carolina Wildlife
Federation
www.scwf.org

SOUTH DAKOTA

South Dakota Wildlife
Federation
www.sdwf.org

TENNESSEE

Tennessee Wildlife Federation
www.tnwf.org

TEXAS

Texas Conservation Alliance
www.tcatexas.org

U.S. VIRGIN ISLANDS

Virgin Islands Conservation
Society
www.viconservationsociety.org

VERMONT

Vermont Natural Resources
Council
www.vnrc.org

VIRGINIA

Virginia Conservation Network
www.vcnva.org

WASHINGTON

Conservation Northwest
www.conservationnw.org

WASHINGTON, D.C.

Earth Conservation Corps
www.earthconservationcorps.net

WEST VIRGINIA

West Virginia Rivers Coalition
www.wvrivers.org

WISCONSIN

Wisconsin Wildlife Federation
www.wiwf.org

WYOMING

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www.wyomingwildlife.org

Urgent: Special Driving Notice

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Drivers' Alert: Driving in fall and winter can expose you to the most dangerous glare... do you know how to protect yourself?

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from the harmful effects of solar radiation light. This superior lens technology was first discovered when NASA scientists looked to nature for a means to superior eye protection—specifically, by studying the eyes of eagles, known for their extreme visual acuity. This discovery resulted in what is now known as Eagle Eyes®.

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Aerial Picnic

PHOTOGRAPH BY GEORGE SANKER

Determined to defy gravity, a least chipmunk ignores the snow—and nearby photographer George Sanker—to leap for spotted knapweed seeds on a cold October morning in Grand Teton National Park. Sanker had been tracking a large buck when he noticed two chipmunks scampering up these fragile stems to feast on the invasive weeds. “They did this continuously for about an hour,” says Sanker, who started shooting from a distance and slowly moved closer. “They didn’t care about me,” he says. “They were hungry.”

📷 To submit images for consideration, write to nationalwildlifephoto@gmail.com with “Shared Moment” in the subject line.

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