WHY BIRDS MATTER
Economics

FOLLOW THE MONEY

Some might not realize the tangible value of birds, but it would be foolish to underestimate how tough life would be without them.

By Barry Yeoman
Illustrations by David Plunkert

Odds are, if you're reading this magazine, you feel a moral and aesthetic imperative to support bird conservation. With an estimated 1,200 species facing extinction over the next century, and many more suffering from severe habitat loss, the impulse to protect birds must be universal. Right?

Well, if you happen to be a birder or a biologist, then "of course, birds have an intrinsic value, and we have an ethical obligation to conserve them," says University of Utah ornithologist Cagan Sekercioglu. But bird enthusiasts don't add up to a social consensus. "A lot of people want something more utilitarian," he points out. Elected officials face competing constituent pressures; corporate executives must answer to shareholders; working folks have more immediate economic concerns. If we want policy makers and the public to take conservation seriously, then perhaps we must offer credible research showing that healthy bird populations are essential to human welfare.

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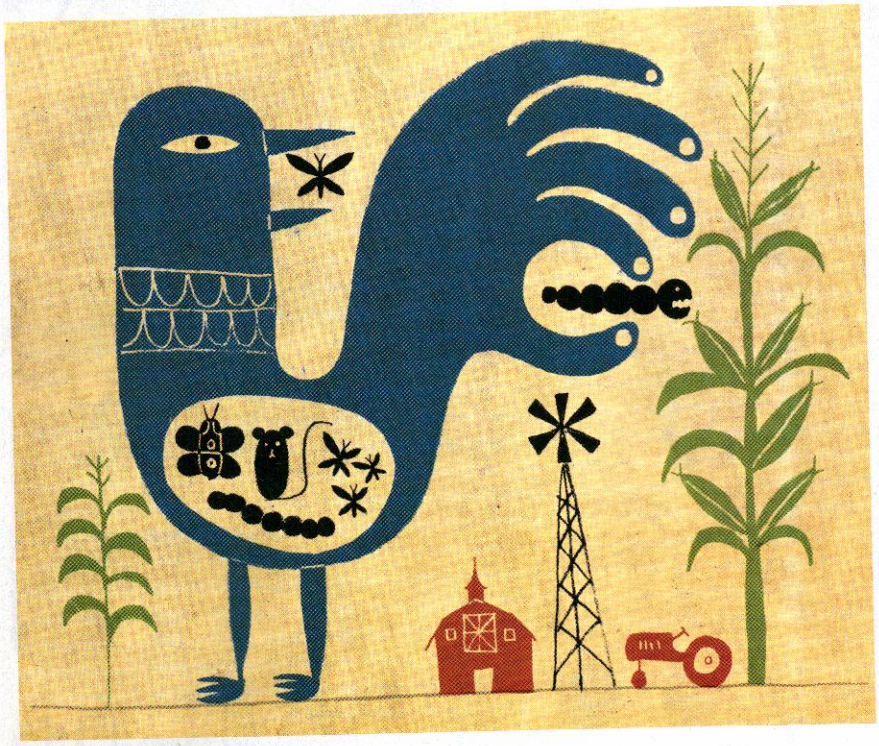
Fortunately, there's plenty of proof. Birds keep farmers in business. They protect our drinking water by preventing erosion. They slow the spread of disease. They keep the furniture industry supplied with timber. They provide critical environmental data. The list continues ad infinitum. The collective term for the many ways birds (and other animals, plants, and landscapes) support and improve human life is "ecosystem services." Understanding these services, and quantifying their dollar value, has been a growing priority for scientists worried about the unprecedented loss of biodiversity we're now seeing—by one popular estimate, some 27,000 plant and animal species each year, many of them driven extinct by human activity.



"Until the next asteroid slams into the planet, it's people that will dictate the future course of all known life in the universe," says Gretchen Daily, director of Stanford University's Center for Conservation Biology. "On our own watch—this 100-year span—we're projecting that half of all plants and animals that were on the planet before humanity became a big force will go extinct. Whatever survives really is a function of our activities. I just find it stunning to think about how dramatic the changes are that we're bringing about."

The past decade has seen an explosion of sophisticated research—and the result is a strong body of evidence debunking the myth that bird protection is an unaffordable luxury. "For better or worse, economic arguments tend to get more attention in political debates," says Geoffrey Heal, a microeconomist at Columbia University Business School. The new research, he says, strengthens the case that "most environmental conservation, if well structured, actually does pay off directly."

PEST CONTROL

When the Mormons settled Utah in the 19th century, their first two crop seasons were destroyed by western crickets. "Promising fields of wheat were cut down to the ground in a single day," naturalist Edward Howe Forbush wrote in 1922. "The people were in despair. Then sea gulls came by the hundreds and thousands, and, before the grain could be entirely destroyed, devoured the insects, so that the fields were freed from them. The settlers regarded this as a heaven-sent miracle."

> "In an age when we experience so much of our world through glass—screens, windows, windshields—birds are a vital connection to the wild. They reach across any barrier, flitting, surprising, and dazzling, always there to refresh my sense of wonder."
>
> —Thor Hanson
> Author, *Feathers: The Evolution of a Natural Miracle*

Modern history is filled with anecdotal examples of birds saving potato fields, fruit orchards, and cranberry bogs from insect devastation. Now researchers are studying the phenomenon more formally, trying to quantify birds' value as living pest controllers. They're starting with a much-loathed insect called the coffee berry borer.

Borers are the bane of coffee farmers, many of whom are small landholders in developing countries. The tiny insects take over individual berries and spend almost their entire life cycles inside, rendering those beans unsellable. There are no safe pesticides that kill the insects, and attempts to control them with parasitic wasps show, at best, limited success. "You work all year to protect your crop the best you can," says Peter Williams, who co-owns Kew Park Estate, a 44-acre shade-grown-coffee farm in western Jamaica. "If you're dealing with infestation rates of anything like 20 percent—which some years we do—then you're talking about a very significant economic effect."

What helps save Jamaican farmers from ruin are neotropical migrants like the black-throated blue warbler, whose slate-blue males and olive-green females hop and fly through vegetation foraging for insects, and the American redstart, known locally as the butterfly bird for its flitting motion and black-and-orange male plumage. These and other birds feast on the borers while the insects are first drilling through the berries' epidermis.

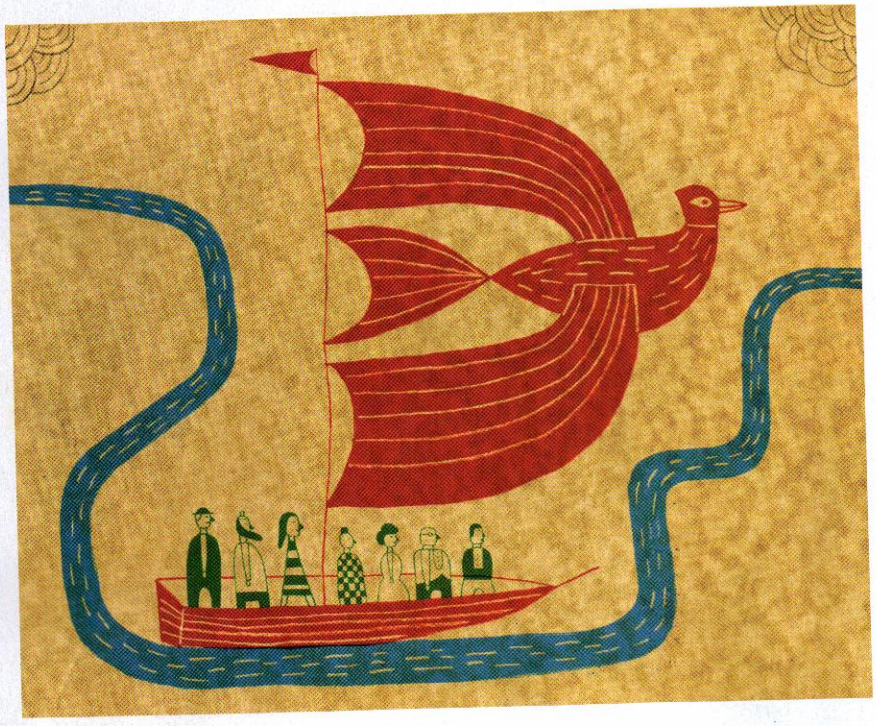
Matt Johnson, a professor of wildlife habitat ecology at California's Humboldt State University, has studied the birds in Jamaica's Blue Mountains—a steep and meandering landscape that produces some of the world's priciest coffee—and in the more rolling terrain where Kew Park is located. Johnson and his team set up nylon nets to keep the birds off individual plants (or small clusters). They then compared those plants to the ones birds could reach. Sure enough, the netted-off plants had measurably lower crop yields. At Kew Park, where the impact was most dramatic, Johnson calculated the birds' pest-control value at $125 per acre, or about one-eighth of the total crop value of $1,044 per acre.

"It may not sound like huge numbers," Johnson says. But personal incomes are so meager in Jamaica that without sufficient bird populations "it might

render the coffee enterprise not viable for a small farmer." At the time of the study, the average per-capita gross national income in Jamaica was $3,400, which made the $1,500 in services that birds delivered to a 12-acre farm substantial. Kew Park now works with Jamaican forestry officials to plant indigenous shade trees like mahogany and almond, which provide warbler habitat. During early mornings, says co-owner Gina Green, the woods come alive with song. "You know you have a healthy system," she says, "when you have not just one species but 20 different species of birds."

Insect-eating birds protect apple orchards in the Netherlands and safeguard Missouri Ozarks white oaks, whose lumber is highly sought by furniture makers. And they reduce pest levels at organic wineries. Ornithologist Julie Jedlicka, a post-doctoral fellow at the University of California-Berkeley, put up nest boxes at two Northern California vineyards. With the approval of the U.S. Department of Agriculture, she simulated a pest outbreak by pinning insect larvae to pieces of cardboard and placing them between rows of grapes. The boxes attracted insect-eating birds, which in turn devoured 3.5 times more larvae than in control plots with larvae but no boxes. Leading the influx were western bluebirds, which have suffered terrible habitat loss in California's wine country because of agricultural and urban development. The bluebirds appear to consume blue-green sharpshooters, insects with piercing, sucking mouthparts that easily spread bacteria among plants. One of those bacteria causes a deadly grape blight called Pierce's disease.

The idea of using bluebirds to kill insects proved inspirational for Napa Valley's Spring Mountain Vineyard. Ron Rosenbrand, the vineyard manager, has installed 1,000 bluebird nest boxes since 2006—and watched the farm's once-rampant Pierce's disease disappear. "It's such a plus to find something in Mother Nature that is a total asset," he says. "I look at them and go, 'Thank you for working for us.'"



TOURIST TRAPS

Birds stimulate economies just by being beautiful. Take a look at Magee Marsh, a 2,000-acre wildlife refuge on the Ohio shore of Lake Erie. A stopover for neotropical migrants, which rest and refuel before crossing the lake, the marsh attracts more than 100,000 birders each year. They walk along a boardwalk, through a wooded beach ridge, in hopes of glimpsing Blackburnian, prothonotary, and Kirtland's warblers and many other species.

> "Birds connect me to the rhythm of the natural world. Flocks of cedar waxwings announce winter in a way no calendar can. The meteorologist declares autumn's arrival, but I wait for goldfinches and juncos to confirm it. Purple martin scouts arrive, chirping from the telephone wire, their oily feathers shining in the sun—spring is here again."
>
> —Ben Jones, Director, Trinity River Audubon Center

Along with their field glasses, these visitors bring their credit cards. Philip Xie, a professor and tourism researcher at Bowling Green State University, looked at Magee Marsh and five other Lake Erie birdwatching areas in Ohio. He calculated that the sites generated $26 million and created 283 jobs in 2011. Because birders arrive before the lake's summer tourists, local restaurants and hotels have bulked up their springtime payrolls. A ferry service now offers migration cruises. "We've effectively created a tourism season in what was the shoulder season," says Kimberly Kaufman, executive director of the Black Swamp Bird Observatory in Magee Marsh Wildlife Area. (She is married to *Audubon* field editor Kenn Kaufman.)

That $26 million doesn't just come from hotel, restaurant, and ferry receipts. It also includes the fees an innkeeper pays her accountant; the vegetables a restaurant buys from local farmers; the movie tickets a park ranger buys on his day off. "I call it tentacles," says Melinda Huntley, executive director of the Ohio Travel Association.

Yet the local impact of birders can't be fully measured in dollars. By preserving wildlife habitat and focusing on hospitality, many towns along Lake Erie have developed distinct personalities. "These communities have a story to tell," Huntley says—a story that shows up in numerous ways, from a bird exhibit at an art museum to the bird sightings listed on blackboards at local eateries.

In an economic analysis released in 2009, the U.S. Fish and Wildlife Service calculated that, based on a 2006 survey, birders spend $12 billion annually on travel, plus an additional $24 billion on equipment like binoculars, camping gear, and nest boxes. That money ripples through the economy and generates $82 billion in output, employs 671,000 people, and enriches state and federal governments by $10 billion.

Sekercioglu, the Utah ornithologist, emphasizes the importance of birding in developing countries, where other tourism jobs tend to be menial and low paying. By contrast, he says, indigenous people with a grasp of natural history can make decent money as birdwatching guides, even with only rudimentary English skills.

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Measuring the global impact of birding is hardly a new phenomenon. In the 1990s a New York Zoological Society biologist computed that in the jungles of Peru "a single free-flying large macaw might generate $22,500 to $165,000 of tourist receipts in its lifetime." Around the same time, researchers estimated the annual value of flamingo viewing in Kenya's Lake Nakuru National Park at $2.5 million to $5 million. More recently, on Scotland's Isle of Mull, the 600,000 visitors who came to see 28 white-tailed eagles in 2010 spent between $8 million and $13 million and created 110 jobs, says the Royal Society for the Protection of Birds.

Of course, none of these studies measures the personal benefits that watching a warbler can bring. Studies have shown that spending time in nature improves both cognition and mental health. "Birding is such a gateway to nature," says Ohio's Kimberly Kaufman. "It gets people outside—away from the computer, away from the television." It exposes them to fresh air and lifts their spirits. "We've been using the phrase *ecotherapy*," she says. "Let's face it: We can all use more joy in our lives."

CLEANUP CREW

Perhaps the least sexy service birds provide is eating dead bodies. "We've got an enormous amount of roadkill produced on our highways in the United States," says Travis DeVault, a research wildlife biologist with the U.S. Department of Agriculture. "I don't think anyone knows what that would look like if vultures weren't around to clean up a big portion." Though scientists have long valued scavenging birds for their sanitation services, he says, "it's pretty recently that we've begun to discover how that translates into human health."

Some of that discovery has come the hard way—from a natural experiment playing out today in South Asia. Vultures are particularly valuable in India because Hinduism prohibits the slaughter and consumption of cows. The livestock, therefore, die naturally, in the open. "We don't have an organized carcass-disposal system," says Vibhu Prakash, principal scientist at the Bombay Natural History Society. "After skinning, vultures would come, and within half an hour they would finish everything that is perishable from a carcass. Then we have people who col-

lect the bones, so there will be no mess around and no stench."

Starting in the 1990s the populations of oriental white-backed, long-billed, and slender-billed vultures began to crash. Researchers noticed the birds' necks drooping in the wild, a sign of debilitating weakness. Within a month, they would be dead. Today their numbers have been reduced by 99 percent—99.9 percent for oriental white-backed vultures. Scientists traced the cause to an anti-inflammatory medicine called diclofenac, which is used as a painkiller for aging cows but also triggers fatal kidney disease in old-world vultures.

In 2006, after a bird-friendly alternative drug was identified, India banned the veterinary use of diclofenac. While some pharmaceutical companies have cooperated, others continue to sell the human formulation in multiple-use vials large enough to medicate a cow. They have refused pleas by conservationists to sell the drug only in small vials appropriate for human doses. "For the drug companies, profit is the main consideration," says Prakash. "They will not stop manufacturing multi-dose vials voluntarily."

Without vultures around, feral dogs have taken over carcass disposal. Massive packs roam India's trash dumps, looking for piles of dead cattle to eat. With this growing canine population comes more fatal dog attacks, as well as rabies from bites. (India has the world's highest human rabies rate.) Economist Anil Markandya has estimated almost 40 million additional dog bites in India between 1992 and 2006, resulting in about 48,000 extra deaths. He calculates that the vulture-dog connection alone produced human health costs totaling $34 billion over 14 years.

South Asia's vulture story offers the most dramatic example of how birds keep us healthy. But non-scavenging species contribute, too. While ducks have been implicated in the spread of influenza, in 1914 Pennsylvania's health commissioner, Samuel Dixon, declared that "the duck is one of the greatest known enemies of the mosquito, and therefore of yellow fever and malaria." Dixon ran an experiment involving two ponds—one stocked with mallards and the other with goldfish—and discovered that the ducks ate mosquito larvae far more "ravenously" than the fish did.

> "Birds remind us that there are angels."
>
> —Jane Alexander, Actress

FREE SHIPPING

In the high mountains of the American West, there's a tree called the whitebark pine that both humans and other animals have come to rely on. Its large seeds feed grizzlies and black bears. Whitebark pine communities provide habitat for deer, elk, and raptors. And because the pines grow all the way up to the treeline, they are effective at protecting drinking-water supplies. "The mountains are the water towers," says Diana Tomback, a professor of integrative biology at the University of Colorado-Denver. The trees' roots hold the soil in place, preventing erosion. Their presence reduces the danger of avalanche. And their canopy shades the snowpack, ensuring a protracted melt rather than a sudden springtime flush.

The tree's seeds are dispersed by just one bird: the Clark's nutcracker, a black-and-white-winged cousin to the crow. The nutcracker's long, sturdy bill

opens the pinecones to pluck out the seeds, which it eats or stores inside its throat. It then buries the uneaten seeds at the depth and location that the trees often need to reproduce. "What would happen if we didn't have the Clark's nutcracker?" Tomback asks. "In the case of whitebark pine, it is unlikely that it could sustain itself."

The value of the nutcracker is coming into sharper focus now that the tree is in danger. A fungal disease called blister rust and the growing menace posed by the mountain pine beetle (in part because of global warming) have delivered what Tomback calls a "one-two punch." In some areas, she says, "whitebark pine ecosystems are verging on nonfunctional."

In response, the U.S. Forest Service has been growing rust-resistant whitebark pine seedlings to plant by hand. This is labor-intensive work: Specially trained climbers must ascend into the canopy twice, first to place animal-proof cages around the cones (which need water and nutrients from their parent trees) and later to harvest the cones. In nature the seeds would germinate over two years, but the forest service speeds the process by specially treating the seeds before they are sown for germination. Figuring out the cost of this process has allowed Tomback to calculate the value of the nutcrackers' dispersal services: between about $800 and $1,000 per acre, based on what it would cost to do the hand planting. Multiply that by about 14.3 million acres of whitebark pine forest, and that's more than $11 billion in the United States alone.

Throughout the world, birds are essential seed dispersers for plants that provide us with food, medicine, timber, and recreation. Among their qualifications: They travel long distances. They assist germination when they eat fruit by removing the pulp and scratching the seed coat. Sometimes their interests coincide perfectly with a tree's.

That's the case in Costa Rica, where male three-wattled bellbirds show off to females from song perches at the edges of canopy gaps. "They're trying to be conspicuous," says Dan Wenny, an ornithologist at Iowa's Loras College. "So they often pick areas that are more open." The bellbirds consume fruit from trees in the avocado family, which are highly prized for their timber. The birds frequently deposit those seeds in the sunny areas below

their perches. "It turns out that being dispersed into a gap is an advantage," says Wenny. "There's a lower probability of getting infected by fungal pathogens."

WINGED SENTINELS

Many of us have read Rachel Carson's 1962 book *Silent Spring*, which chronicled the lethal effects of the insecticide DDT. While Carson, a biologist, documented the havoc wreaked throughout the food chain, her book is best remembered for its account of how the fight against Dutch elm disease poisoned entire populations of robins as well as 90 other bird species. Carson's robins—along with the thinning egg shells of American bald eagles exposed to pesticides—signaled to many Americans that birds could serve as "winged sentinels" of environmental degradation.

More than 50 years later, scientists routinely use birds to gauge the health of ecosystems—and not just for purely biological reasons. Birds often meet the technical criteria, such as sensitivity to environmental changes. "But there's also this practical reason that if we're going to translate science into public action, it needs to be something we care about," says biologist John McCarty from the University of Nebraska-Omaha. Another practicality: Humans have recorded bird populations for generations. "Because people care about birds, we have a lot of data out there"—the North American Breeding Bird Survey and National Audubon's Christmas Bird Count are among the best known—"that we can use to try to evaluate ongoing changes without having to start a whole new program," McCarty says.

McCarty is among the researchers who have used tree swallows to study the impact of a wide range of toxins: PCBs in the Great Lakes and Hudson River, pulp-mill effluent in Western Canada, petroleum in Wyoming's North Platte River, metals in New Jersey. Their work has shown that contaminants that land in aquatic sediment don't remain there; they work their way up the terrestrial chain.

> "Birds matter because I have a grandson. I want him to see his first rose-breasted grosbeak with me just like his dad did."
>
> —Joe Francis, Former director, Wachiska Audubon Society

Likewise, scientists have been monitoring the health of common loons in New York's Adirondack Park to understand the impact of atmospheric mercury from coal-burning power plants and incinerators. A 2012 report by the Maine-based Biodiversity Research Institute (BRI) calls the birds "excellent sentinels of threats impacting aquatic ecosystems. They live more than 20 years, are at the top of the food web, and are very territorial." By measuring the loons' breeding success and correlating it to mercury contamination, the BRI has been able to provide "evidence for the need to stringently regulate mercury and acidic emissions on national and global scales."

Scientists use bird abundance to measure everything from wetlands health to radioactive contamination. Some of the most innovative work uses birds to study climate change. On the Crozet Archipelago in the southern Indian Ocean, zoologist Lewis Halsey has placed heart monitors on king penguins to measure how much energy they expend while foraging for fish. Halsey, who now lectures at London's University of Roehampton, says energy levels might have to increase if climate change or

overfishing makes food more scarce.

And at Oregon State University, researchers use microphones to mechanically monitor bird songs in the western Cascade Mountains during (and before) the breeding season. "The minute the bird arrives from its wintering grounds, you know when it showed up," says Matt Betts, an associate professor of landscape ecology. "Then, if you start comparing those data across years, you can get some idea of how arrival times shifted. As the climate starts warming, are we seeing birds arriving earlier? This is being reported in some studies, but our effort would be to do this in an automated way," and thus collect more data than manual counts possibly could. Betts is now working with computer scientists on his campus to create a program that identifies species by call, even in noisy forests.

Betts says the program is too new to offer up much data. And he's quick to stress that birds alone can't tell scientists everything they need to know about ecosystem health. "There haven't been very many rigorous tests—we still need more information on whether birds are going to well represent other components of biodiversity," he says. "But that said, if there are major problems, we're going to pick it up with birds."

ADDED ADVANTAGE

Pest control, public health, seed dispersal, ecotourism, environmental monitoring—these are some of the ways birds benefit humans. There are many others:

- **After every harvest,** California's rice farmers must get rid of a waste product called rice straw. Burning it is cheap, but it also pollutes and is therefore illegal. An alternative, tilling the straw into the soil, can be very expensive.

Fortunately, farmers can enlist help from wintering waterfowl that travel along the Pacific Flyway. By foraging for grain, weeds, and bugs in flooded rice fields, birds like mallards help decompose the straw. This could reduce the need for tillage, providing considerable savings to growers, concluded a 2000 study from the University of California-Davis. Farmers would be well advised, the report noted, to flood their fields and create wetlands for these avian wayfarers.

- **Pollination is often** the realm of bees, bugs, and butterflies. But more than 900 bird species worldwide pollinate,

too, and their sophisticated sense of geography suits them well to the task. The durian munjit, a wild fruit that is collected and eaten in northern Borneo, relies exclusively on spiderhunters, members of the sunbird family. A passerine called the Canarian chiffchaff pollinates the Canary bell-flower, an ornamental plant with edible fruit that grows on Spain's Canary Islands. (It was cultivated in the royal garden of England's Hampton Court Palace as early as 1696.) And when the cold weather keeps insects away, China's winter-flowering loquat tree reproduces with the help of two passerines, the light-vented bulbul and the Japanese white-eye. The loquat's fruit is eaten in many forms and used medicinally.

Tinkering with the environment disrupts these relationships. Researchers have chronicled how the introduction of the Polynesian rat to Easter Island might have wiped out a parrot species that pollinated a palm. With the parrots extinct (and rats consuming the palm seeds), the most common trees in the island's subtropical forest died out around the 15th century. One hypothesis suggests that without palm wood to build fishing canoes, a culture advanced enough to carve the island's iconic stone statues fell into steep decline.

• **Seabird guano**—rich in nitrogen, phosphorus, and other nutrients—"provides an important source of fertilizer and income to many people living near seabird colonies," according to Utah's Sekercioglu. This has been true for centuries: Guano was considered essential to the Incas' agriculture, "upon which their civilization was based," wrote Edward Howe Forbush in 1922. Two years earlier ornithologist Robert Cushman Murphy declared that the best Peruvian guano was 33 times as effective as barnyard manure based on its nitrogen content.

"Unfortunately," Sekercioglu writes, guano production "is one of the most threatened of avian ecosystem services, due to the rapid decline of seabirds worldwide." Among the culprits are fishing longlines, which entrap birds such as black-browed albatrosses.

• **Birds possess skills** that historically made them useful to militaries. During World War I, pheasants detected oncoming hostile aircraft at long distances and "gave the alarm by their insistent cries," says one account; canaries, of course, sensed poison gas; gulls followed submarines in search of garbage. Carrier pigeons successfully navigated through shellfire (and past bullets aimed at them). They transported messages that helped the Allies capture German submarines, and that saved the crews of downed seaplanes and a sunken minesweeper. It turns out birds aren't just useful. They're bona fide heroes. ■

> "Since the beginning birds have lifted our eyes to the skies. They've shown us we're not gravity's slave, that flight is possible and limitless. It can hover and soar, dive and display, and take us from one end of the planet to the other in a single, impossible burst of energy and purpose. Inspiration is the gift birds have given us from the start."
>
> —Wes Craven, Hollywood director

Barry Yeoman *last wrote "Facing the Future," about the racial divide in the environmental movement, in the September-October 2011 issue.*