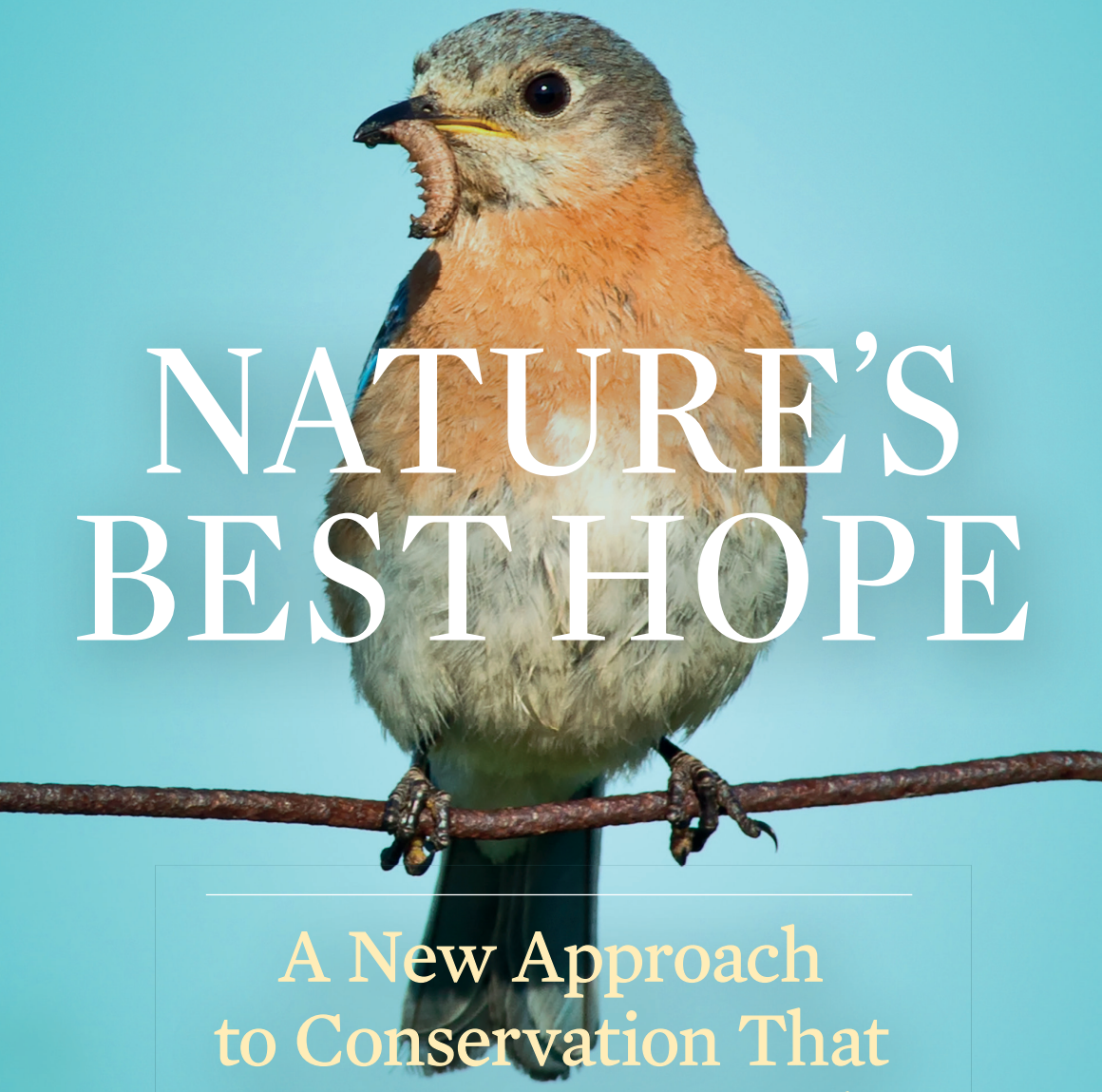
"Tallamy is one of the most original and persuasive present-day authors on conservation."

—EDWARD O. WILSON, University Research Professor Emeritus, Harvard University



NATURE'S BEST HOPE

A New Approach to Conservation That Starts in Your Yard

DOUGLAS W. TALLAMY

bestselling author of *Bringing Nature Home*

CHAPTER ONE

The Dreamers

Conservation biology . . . [is] a discipline with a deadline.

—E. O. WILSON

MANY VISIONARIES have recognized that humans do not have a sustainable relationship with the natural world that supports them, and they have worked or continue to work to improve that relationship. Conservation pioneers who immediately come to mind are George Perkins Marsh, Theodore Roosevelt, and John Muir, who helped create our system of national parks, monuments, and preserves; those who organized the public sector of our national environmental movement, such as Edward Abbey and David Brower; courageous people such as Rachel Carson and James Hansen, who employed modern science to expose environmental threats from big business; science writers such as Bill McKibben and Elizabeth Kolbert, who have dedicated their careers to bringing critical conservation messages to the public; and countless others who have practiced conservation successfully at the state and local levels, but who will never receive the recognition they deserve. Among all of these dedicated people are two of the most respected giants in the world of conservation: Aldo Leopold and

Edward O. Wilson. They stand above the rest, particularly for me, because the many unique insights in their writings stimulated my own ideas and inspired me to write this book.

ALDO LEOPOLD

On 11 January 1887, in Burlington, Iowa, a small town on the banks of the Mississippi River, Rand Aldo Leopold entered the world he would come to love so passionately (Meine 2010). He was born with an innate interest in all things wild. Although he was guided by his parents, he needed little encouragement to become a naturalist, forester, wildlife biologist, professor, restoration ecologist, author, philosopher, and perhaps the most influential conservationist of the twentieth century.

Aldo Leopold was fascinated with the natural world; wherever he traveled, he habitually recorded the seasonal cycles of the plants, birds, and other animals he saw, as well as the climate cycles that influenced them. In fact, what distinguished Leopold from other naturalists of his day was his interest in how members of a community interacted with one another and the physical world they inhabited. Today we would call Leopold a systems biologist; he was well ahead of his time, and he recognized and was intrigued by the complexities of ecosystems decades before the term was even coined.

But like Teddy Roosevelt before him, Aldo Leopold's early relationship with nature was somewhat schizophrenic. In Leopold's day, the most common introduction to wild things came through hunting, and that is how his father first exposed him. Not long before young Aldo took his first foray into the woods, hunting was considered more a necessity than a sport, and the notion that wildlife existed to be hunted was deeply rooted in his culture. The fledgling field of wildlife management consisted of shooting as many wolves, cougars, and bears as possible to encourage growth of populations of the deer, moose, and elk that hunters pursued. After all, predators were thought to compete with the needs of hunters and therefore ought to be eliminated. One of the primary responsibilities in his first job as a forester in the U.S. Southwest was to kill as many predators as he could—and he was good at it. Perhaps the most ironic aspect of Leopold's life was that it was he who shot and killed one of the very last Mexican gray wolves in the United States.

Aldo Leopold is often considered the father of modern conservation.

But it was also Leopold who first recognized the results of such carnage. In what would much later be termed "trophic cascades" (Hairston et al. 1960), Leopold saw that when top predators were eliminated from an ecosystem, the herbivore populations they once kept in check exploded (despite hunting pressure) and the vegetation that supported the entire ecosystem became disastrously overbrowsed. This, in turn, led to starvation and disease for the very species predator removal was supposed to be helping, as well as for myriad other species that depended on healthy plant communities. In a stark departure from accepted wildlife management protocol, Leopold suggested that members of the top trophic level—the predators—were essential to the well-being of the trophic levels beneath them—the smaller predators, herbivores, and

particularly the first trophic level, the plants that fed them all. Removing wolves, cougars, and bears created an imbalance in the energy flow through an ecosystem that cascaded down to the plants, and the ecosystem collapsed to a paltry remnant of its former abundance and diversity.

Some hunters still protest when Leopold's advice is heeded and top predators are protected, but nearly a century of research has proven him correct. From starfish in tidal pools of the Pacific Northwest, to sea otters off the California Coast, to the overabundance of white-tailed deer in the predator-free East, as well as dozens of other examples from around the globe, studies have shown that top predators are not simply desirable members of a community but are essential to the sustainability of their ecosystem.

The far-reaching impacts of removing top predators from an ecosystem came into focus more clearly than ever before when wolves were returned to the Yellowstone ecosystem in 1995, some seventy years after they had been exterminated (Stolzenburg 2008). In just a few years, Yellowstone's wolves reduced the moose and elk populations, eliminating overbrowsing by the herbivores, and caused a truly remarkable recovery of other species, including the bison with which exploding populations of moose and elk had been competing; beavers and all of the species associated with the stream and wetland ecosystems they create; grizzly bears, bald eagles, and ravens that depend on wolf kills for scavenging; six species of song birds that breed in restored streamside vegetation; and, of course, the all-important willow, aspen, and cottonwood populations upon which all of these species depend. Never had Aldo's foresight been so dramatically demonstrated, but it was forty-seven years too late for him to enjoy himself.

Leopold's recognition of the importance of predators and the trophic cascades that result from their removal was only his first contribution toward tempering humanity's relationship with the natural world. In 1924 he was transferred from New Mexico to Madison, Wisconsin, where he soon joined the faculty at the University of Wisconsin, but not before he had written a management plan for New Mexico's Gila National Forest, which that year had become the country's first official wilderness area. He would flourish at Wisconsin, becoming the first chair of a new program in game management, writing the first and arguably most famous textbook on wildlife management, and founding The Wilderness Society. Despite his successes, he was deeply disturbed by what he saw in the environment around him.

In almost every way, people were destroying the natural world and the coevolved associations that glued it together. Society's relationship with what he famously called "the land" was not a relationship at all, but a unidirectional exploitation of resources that returned nothing. Farmers overworked the soil in ways that encouraged catastrophic erosion, grasslands were severely overgrazed nearly everywhere, rivers were treated as sewage receptacles and garbage dumps, marshes and prairie potholes were drained or filled, and what remained of virgin grasslands was plowed under. Repeated clearcutting and burning transformed majestic forests into wastelands, and wildlife was slaughtered so often and in such numbers that many species were extirpated from Wisconsin. The sandhill crane, which Leopold revered as the symbol of the untamed past, was hunted relentlessly, and by the time he moved to Wisconsin, only a few cranes remained in the far north.

But Aldo Leopold had a dream. He dreamt of a time when people humbly accepted their roles as citizens of the natural world rather than its conquerors, a time when the land was not viewed as a commodity to be exploited but as the source of our continued existence. He longed for a time when people appreciated and even respected wilderness, not just as a hunting or recreational playground, but as a truly awesome and unimaginably complex machine that required all of its parts to function well.

These ideas, these hopes, and these dreams didn't come to Leopold overnight; they came from a lifetime of thoughtful observation, reflection, and informal experimentation. In 1935, his family bought a degraded tract of land in the Central Sand Plains of eastern Wisconsin. Once a poorly managed farm, the eighty acres were barren scrub that supported little life when the family bought it. Leopold built a small summer home he fondly called "the shack," and for the next thirteen years the family restored the ecological integrity of their tiny piece of the world. Through trial and error, they learned how to bring life back to their land by rebuilding prairie, savannah, and marshland where it had once been. Leopold painstakingly recorded the rapid return of the wild things he loved and was so encouraged by the success of the restoration that he wrote his masterpiece, *A Sand County Almanac*, with hopes of inspiring a new land ethic that would transform how people viewed and interacted with nature (1949). He viewed conservation as a state of harmony between people and land and foreshadowed the concept of environmental sustainability when he stated, "A thing is right when it tends to preserve the integrity, stability,

and beauty of the biotic community. It is wrong when it tends otherwise." On Easter Sunday 1969, twenty-one years after Leopold died of an untimely heart attack, sandhill cranes returned to the marshes of his property, an event that still brings tears to my eyes each time I think about it.

Remarkably, *A Sand County Almanac* was rejected by several publishers before being accepted for publication by Oxford University Press the week Leopold died. Though it sold slowly at first, it eventually became wildly popular, and today more than two million copies have been printed in fourteen languages. Most people agree with Leopold that we need to adopt a land ethic that respects and protects all members and aspects of nature in harmony with the needs of people. The Aldo Leopold Foundation, founded in 1982 by his wife, Estelle, and their five children, fosters his concept of the land ethic through education and a celebration of the man himself. Yet, as I look around, I wonder where I see this land ethic in practice? Oh yes, there have been great strides in the environmental movement since Leopold died in 1948, and much of the credit for these necessary changes goes to him. Powerful organizations such as The Nature Conservancy, Sierra Club, National Audubon Society, as well as smaller land conservancies around the country, have protected many wild places beyond our national parks and wilderness areas. In the United States, legislation in the 1970s, such as the Clean Air Act and Clean Water Act, have noticeably curbed point source pollution, while the Endangered Species Act created a national recognition that extinction at the hand of humans is not OK.

Nevertheless, we cling to the notion that nature should be saved where nature remains, not where humans work, live, farm, or play. Though persuasive and moving, Aldo's plea for a land ethic has thus far been unable to change the nearly universal belief that people are here and nature is somewhere else. And this is where philosophical musings about conservation have run head-on into the brick wall of the earth's finite size and resources. The ecosphere, the frighteningly thin zone at the earth's surface to which life is constrained, is not getting any bigger. There is no more land today than there was 600,000 years ago when *Homo erectus* first harnessed fire. In fact, the resources that support life on earth are all under pressure from growing human populations and consumption. And yet we continue to grow, continue to build, continue to sprawl. Where is our expression of an ethical relationship with the land and the life it supports when we fragment forests to add another housing development, pave more roads, seed a new sterile lawn, build another shopping mall, or expand

another airport? It is not part of the discussion. After all, we are told that we need development, and that our economy must continue to grow forever, even though such growth is antithetical to the laws of physics. Conservation is fine as long as we do it in ways that do not constrain the human activities we call progress—as long as we do it someplace else. And so, we continue to exile the natural world to increasingly small parcels of land where no people reside. We admire Leopold's concept of a land ethic, but sadly, we have yet to apply it in a meaningful way.

EDWARD O. WILSON

In 1929, while Aldo Leopold was busy expanding the wildlife management program at the University of Wisconsin, Edward Osborne Wilson was born in Birmingham, Alabama. Wilson split his early years between Mobile, Alabama, and Washington, D.C., and, like Leopold, he was irresistibly drawn to the natural world. His route to becoming the world's foremost myrmecologist (ant specialist) was a circuitous one, shaped largely by mishap and serendipity. Like so many boys, E. O., as he would fondly become known decades later, was fascinated by snakes, both poisonous and otherwise. An unfortunate encounter with one of his poisonous friends convinced him to spend more time with less aggressive creatures, so he added fishing to his activities. One day, while fishing alone off Paradise Beach, Florida, one of his favorite haunts, he jerked a hooked fish out of the water so quickly that it hit him in the face, and one of the spines on the fish's dorsal fin pierced his right eye. One can only imagine how painful that must have been, but he was reluctant to give up his afternoon of fishing, so he didn't seek medical treatment at the time. Neither did he do so after he arrived home. After several months, a thick cataract developed, which led to the surgical removal of his lens.

Wilson's fishing accident and blinded right eye was traumatic, to say the least, but it did have a decided bright spot: Wilson had superior 20/10 acuity in his left eye, and he discovered that he could see tiny things exceptionally well. This ability quickly led to a fascination with insects, and though he chased butterflies and dragonflies like all young entomologists, he decided he liked flies best of all. Wilson's passion for flies did not last long, however, because flies needed to be mounted on pins for study, and insect pins were scarce during the lean years of World War II. For some reason, small glass vials

were not, so in a pragmatic decision, Wilson shifted his focus from flies to ants that could be stored by the dozens in vials. With the encouragement of experts at the Smithsonian's National Museum of Natural History in Washington, he began a detailed account of the 136 species of ants of Alabama. At the age of eighteen, Wilson published his survey, which included the first account of a colony of dreaded fire ants in the United States.

Edward O. Wilson is one of the most eminent biologists of our time.

By any measure, Wilson has had an exceptional career; while most scientists are lucky if they make a single seminal contribution to their field, it is difficult to keep track of the many ways and times he has substantially advanced science over the course of his long career. In 1956, he coauthored with William Brown the article "Character Displacement" in the journal *Systematic Biology*, which was to become one of the most frequently cited scientific papers of all time. In the lab, Wilson was the first to demonstrate the all-important roles of pheromones in social insects, a discovery that not only explained how insect societies worked, but one that became the basis of thousands of future research papers by dozens of top scientists. Collaborating with Robert MacArthur, Wilson developed the highly influential equilibrium theory of island biogeography, the stimulus for hundreds more research papers. He also created, defended, and brought to fore the field of sociobiology, which, itself, spawned the new discipline of evolutionary psychology. In his spare time, Wilson has been an uncommonly prolific and accomplished author (to date, he has written twenty-nine books) and is the only scientist to have won the Pulitzer Prize for General Nonfiction twice. I include Wilson here, however, because of his tireless role in promoting the conservation of biodiversity.

First coined in 1968 by Raymond F. Dasmann and introduced to the scientific community by Thomas Lovejoy more than a decade later, the term "biodiversity" (a contraction of biological diversity) means exactly what it implies:

the diversity of life forms on Earth (Lovejoy 1980). Included in the definition is not only the vast number of different species, but also the variation of their genes and the diversity found within populations of those species that is so necessary for their adaptability, ongoing evolution, and thus continued existence in a rapidly changing world. Many scientists have extended the definition to include the diversity of ecosystems and biomes as well.

In 1992, Wilson wrote *The Diversity of Life*, the first book to describe the seemingly infinite diversity of species that reside on Earth today, as well as the many imminent threats to their future. If, as I have claimed for some time, that knowledge generates interest, and interest generates compassion, then Wilson has compassion to spare for life on Earth. And if compassion generates action, Wilson has also been exemplary. His primary tool has been his pen, and he has written time and again about the need to preserve biodiversity. He followed *The Diversity of Life* with seven more books on this theme: *The Biophilia Hypothesis* (1993), *In Search of Nature* (1996), *The Future of Life* (2002), *The Creation: An Appeal to Save Life on Earth* (2006), *A Window on Eternity: A Biologists Walk Through the Gorongosa National Park* (2014), *The Meaning of Human Existence* (2014), and his latest book at this writing, *Half Earth: Our Planet's Fight for Life* (2016).

In *Half Earth*, the normally eloquent Pulitzer Prize winner does not mince words. Time is running short, he says. So is clean water, fresh air, the bounty of the sea, the area of remaining rainforests, and the numbers of plants, reptiles, amphibians, fish, mammals, and birds—all of which are essential to sustaining the living portions of our planet. Wilson claims that emergency measures are required to stabilize the biosphere before the sixth great extinction—the sixth time in world history that a large number of species has disappeared in rapid succession—renders recovery impossible: we must set aside half of planet Earth as a human-free natural reserve to preserve biodiversity.

Say, what? Save half of the earth? Could he be serious? Indeed, he could. Using arguments from species area curves and his own theory of island biogeography, Wilson describes how saving half of the earth could stabilize 80 percent of its species. (Michael Rosenzweig [2003] writes that he is not as optimistic; his own analyses of what generates and sustains biodiversity predict that preserving half of the earth would, in the long term, save only half of its species.) Wilson claims that we cannot select a random half; we have always been generous in setting aside areas such as mountain ridges, the driest deserts, and tundra that are incapable of supporting humans, or most other species. No,

to save a lot of species effectively, we must save areas that best support those species, such as tropical forests (both wet and dry forests), much of the African plains, scrublands of southwest Australia, important parts of all major biomes, and half of the fishable ocean. Echoing Leopold's mantra, Wilson reminds us that "the biosphere does not belong to us; we belong to it" (2017). If we continue to ignore the health of the earth, we are dooming ourselves.

To many, including some of the most zealous conservationists, Wilson's *Half Earth* manifesto seems as preposterous as it is noble. Though he makes an irrefutable case for the need to save viable populations of the earth's biodiversity, how can we possibly put aside half of the earth when nearly eight billion humans already occupy most of it? Protecting our oceans should be relatively easy, and there are still substantial chunks of unprotected tropical forest in the Amazon and Congo River basins that can and must be preserved. But what about the rest of the land? We already intensively farm or graze nearly half of the earth's land surfaces (Owen 2005). The remaining 50 percent is divided between cities, suburbs, vast complexes of infrastructure, the patchwork of fragmented second-growth habitat scattered here and there, uninhabitable areas, and the areas already preserved, which total only 17 percent of the earth's land surface.

Biodiversity is not equally distributed across the earth and, at least in the United States, it is not correlated with the land that is preserved. Most of our nation's biodiversity is found east of the Mississippi River, while most of our protected areas are west of the Mississippi (Jenkins et al. 2015). Protecting what is not needed for agriculture, in the sense that most people interpret Wilson's mandate—that is, creating preserves in the traditional model of our national parks or wilderness areas—seems impossible, because it *is* impossible with the current human population size.

Fortunately, there is an alternative.

DREAMS TO REALITY

Giving up is not an option; our current model of destroying the biosphere to expand the human footprint is not now and never has been sustainable. We need a new conservation plan, one that sustains the living systems we depend on everywhere, where humans dwell as well as where they do not. We must abandon our age-old notion that humans and nature cannot mix, that humans are here and nature is somewhere else. Starting now, we must learn how to

coexist. When Leopold moved east from New Mexico, he recognized that the conservation model he had followed in the West, setting aside large tracts of government land, would not work in Wisconsin, because most land there was in privately owned farms and ranches. His solution was to teach farmers and ranchers techniques to restore and conserve the natural resources on their own lands. With incredible foresight, Leopold suggested "rewarding the private landowner who conserves the public interest."

Today, with more than 83 percent of the United States privately owned and 86 percent east of the Mississippi River in private hands, it is clear that Leopold's approach is an important part of the solution. If conservation is to happen, it must happen largely on private property, but not just on farms and ranches; it must include all types of private property, from the smallest city lot to the largest corporate landscape. This is not to diminish the critical conservation role public preserves now play; they are the repositories of the species we want to save as well as the genetic diversity that will enable us to save them. But public preserves are not enough to sustain biodiversity into the future. The United States could become a model for the rest of the world in this regard. If we can save biodiversity here, where aggressive economic development has been the goal for centuries, where McMansions have replaced modest homes in affluent communities across America, where we have paved over an area larger than the state of Ohio, where we have built airports twice the size of Manhattan, where mega-farming in the absence of hedgerows was invented, and where biological wastelands we call lawns are core symbols of wealth and status and now occupy a space the size of New England, we can save biodiversity everywhere.

Our relationship with the earth is broken. Leopold and Wilson offered ways to fix it, but the conservation approaches developed in the twentieth century are not inclusive enough to realize their dreams. We need a new conservation toolbox, packed with more expansive tools. New knowledge will be our most important tool, followed by a cultural recognition that conservation is everyone's responsibility—not just those few who make it their profession. Every day we are learning more about how to redesign both public and private landscapes in ways that meet the aesthetic, cultural, and practical needs of humans without devastating the resources needed by humans and other species. We are learning how to convert at least half of the area now in lawn to attractive landscapes packed from the ground to the canopy with plants that will sustain

complex food webs, store carbon, manage our watersheds, rebuild our soils, and support a diversity of pollinators and natural enemies. In other words, we are learning how to create landscapes that contribute to rather than degrade local ecosystem function. Finally, we are learning how rapidly the animals return to our yards, parks, open spaces, neighborhoods, and even cities when we landscape sustainably.

These are exciting times. The necessary task of restoring ecological function to the land lies mostly before us. But it is an exhilarating, entertaining, and hugely rewarding task. Leopold once lamented that "the oldest task in human history" is "to live on a piece of land without spoiling it." In the past, we have not known how to do this, but now we do know how. There are few of us who cannot improve our relationship with the land we own. Most of us bought land that was already spoiled, and we must now fix it. Leopold and Wilson are not the only people who have dreamt of preserving the wonders of the natural world. Their dream has been shared by millions of us mere mortals. In this book, I hope to tap the energy of the dreamers among us and show how to make many, if not all, of these dreams come true.