America's Wildlife: The Challenge Ahead

International Association of Fish & Wildlife Agencies

Foreword

State fish and wildlife agencies are on the front lines of conservation as stewards of our nation's wildlife. The International Association of Fish and Wildlife Agencies (IAFWA), founded in 1902 by wildlife managers from just six states, now represents all 50 state fish and wildlife agencies, as well as the provincial and federal governments in Canada and Mexico. IAFWA acts as a collective voice for the agencies charged with managing and protecting wildlife.

The Wildlife Diversity Committee of IAFWA requested this report to assist state wildlife agencies, as well as other wildlife stewards and decision makers, to better understand how wildlife is faring across the United States. This document provides a "view from the hilltop" to help us see where we have done well and where we need to redouble our efforts to perpetuate our wildlife legacy. We also wanted to make this record known to others. We believe you will be proud and encouraged by our nation's past commitment to wildlife conservation. But it is also strikingly clear that if we do not renew this commitment, we will lose this hard-won investment in our nation's wildlife.

Although most wildlife in the U.S. is protected under a variety of laws, the realization of these protections—the ongoing stewardship—comes in on-the-ground actions to ensure the survival and prosperity of wildlife populations. State fish and wildlife agencies take these actions on a daily basis. These agencies are the focal point for stewardship in each state. Yet the job is certainly too big for one entity. Thankfully, we have many partners to help undertake the mission to conserve wildlife, including the U.S. Fish and Wildlife Service, other federal, state and local land management agencies, a diverse spectrum of national and local conservation organizations, and conservation-minded private landowners and citizens. These groups and individuals help us forge powerful partnerships to get the job done, and such cooperation must be continuously nurtured and supported.

This summary report is a starting point to help us envision a responsible and sensible approach to conserve our nation's wildlife. It documents some of the lessons we have learned from a century of conservation as well as the trends of rapid wildlife and habitat loss we face today. How we use this knowledge and act on behalf of wildlife conservation for the future is the challenge that lies ahead. The need for action has never been more urgent—we may never be given another opportunity.

Andrew T. Manus, Chair, IAFWA Wildlife Diversity Committee
Director, Delaware Division of Fish and Wildlife

Paid for in part by a grant from the Federal Aid in Sportfish and Wildlife Restoration Programs.

On March 1, 2000, Challenger, a trained 12-year old bald eagle, made history at the US Capitol as he spread his wings over a crowd of 1,000 rallying for permanent wildlife and parks funding. Challenger is a non-releasable educational bird cared for by the non-profit American Eagle Foundation (www.eagles.org) headquartered at Dollywood in Pigeon Forge, Tennessee. Photo on page 1.

Snowy egrets squabble over fishing rights in a springtime flood at Quivira NWR, Kansas. Cover Photo by Mike Blair Kansas Department of Wildlife & Parks.

Executive Summary

The American people have been long committed to protecting, restoring, and responsibly managing our wildlife heritage. Yet we are now faced with greater and more complex challenges as burgeoning demands on land and resources threaten to edge out America's wildlife and wild places. This report provides an overview of the current state of America's wildlife—where we can celebrate conservation successes and where we need to redouble our commitment to sustaining our natural legacy.

- Over the past century, the efforts of sportsmen and women, wildlife professionals, political leaders and other conservationists created a new era of wildlife conservation that helped restore many diminished species. Where we have invested our attention, such as with waterfowl, deer, elk, gray whales, and bald eagles, we have helped populations rebound from critically low numbers.
- Today, however, an alarming number of diverse species across the spectrum of America's natural habitats are jeopardized. In the U.S., 1232 animals and plants are listed as federally threatened or endangered, 93 species are proposed and 254 species are candidates for listing.
- Declining and vulnerable species include many that have received little notice until recently, such as songbirds, small mammals, reptiles, amphibians, crayfish, freshwater mussels, fish, and many insects. Aquatic species are particularly vulnerable.
- The primary causes of species' declines are habitat loss, degradation, and fragmentation, and the invasion of alien species. Pollution and overexploitation also threaten certain species. Freshwater streams, wetlands, estuaries, native prairies, riparian woodlands and ancient forests are some of the most threatened habitats.
- Some species that thrive in human-altered landscapes, such as white-tailed deer, snow geese, and brown-headed cowbirds, are becoming superabundant and creating serious management problems.
- Over 85% of our nation's wildlife receives inadequate funding for management and conservation.
- Better monitoring and research are needed to understand population changes, threats to species, and species' natural history so we can improve our management tools and approaches.
- Today's conservation challenges can only be surmounted by expanding our focus to encompass the health of whole ecosystems for the entire diversity of species—an approach that will help avoid expensive last-ditch efforts to save species at the brink of extinction.
- Wildlife management tools for today and the future include broad coalitions and partnerships among stakeholders, planning across watersheds and ecosystems, and creative approaches to sustain ecological processes and interrelationships to benefit human and natural communities.

We are at a turning point for the future of wildlife—a pivotal moment where we must broaden our vision and deepen our commitment so we can leave a thriving wildlife legacy for coming generations.

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"Challenger the Eagle"
American Eagle Foundation
DAVID BONNARDEAUX©

Acknowledgments

Credit for the conception and realization of this document is due Naomi Edelson, who oversaw the project's progress from beginning to end. We would like to express our deep appreciation to the many wildlife experts throughout the country who so willingly shared their information and expertise. This document could not have been possible without their generous insights and dedication to a future for wildlife. For invaluable review, corrections, and discussions on various drafts we owe a special debt to: Richard Aikens, Ed Bangs, Steve Berkeley, Clait E. Braun, Carol Davit, C. Kenneth Dodd, Tom Franklin, Whit Gibbons, Duncan Gilchrist, Brian Harrington, Scott Hatch, Jane Hendron, Jackie Hiltz, Mary E. Jennings, Terry Johnson, Tobin M. Kelley, Roland A. Knapp, Stephen Kress, Peter Landres, Michael Lannoo, Don MacLauchlan, Andrew Manus, Sara Marinello, Robert McDowell, L. David Mech, Bob Miles, Jody Millar, Richard J. Neves, Mary Jeanne Packer, Laury Parramore, David Parsons, David Pashley, Bruce Peterjohn, Donna Shaver, Kevin Smith, Claude Stephens, Richard Thom, Jack Ward Thomas, Dale E. Toweill, John L. Weaver, and Scott Yaich.

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Our Wildlife Heritage

"Like wind and sunsets, wild things were taken for granted until progress began to do away with them."

—Aldo Leopold

We are the beneficiaries of a century of wildlife conservation and management that has sustained a legacy of wild animals, fish, birds and natural areas throughout our nation—a natural bounty that contributes immeasurably to the wealth of our country and the pleasure and well-being of its citizens. For this inheritance, we can thank the deep-seated value Americans place on their natural heritage and the tenacious efforts toward protecting this legacy by innumerable conservationists, including sportsmen, naturalists, wildlife professionals, and political leaders.

Yet as we step into the 21st century, we confront greater conservation challenges than ever before as growing demands on land and resources threaten to edge out America's wildlife and wild places. Just as we are cheering our success in securing a place for many game animals and bringing some endangered species back from the brink of extinction, we are now encountering new losses among songbirds, amphibians, reptiles, insects, fish, shellfish and other "nongame" species that drew little notice or concern until recently. Wildlife programs have traditionally focused on game animals and species in immediate peril of extinction and have lacked the funding to address other species. Less than 10% of state fish and wildlife funding is devoted to the conservation of 86% of our nation's wildlife species, and the need is ten times greater than current funding levels.[1] We must now broaden our vision and our investments to mitigate the accumulating losses among lesser-known species and their habitats. We must deepen our commitment to wildlife stewardship so we can sustain healthy natural communities for all species and prevent problems before they occur.

No single document can give a complete vision of the state of our wildlife resources. This report provides a snapshot of where wildlife conservation has been, where we can celebrate successes, and where we need to focus renewed attention. It provides a picture of the mushrooming interest in outdoor recreation and nature education and a general overview, from bears to butterflies, of the condition of our nation's wildlife. It highlights species that are on the rebound because of people dedicated to ensuring that nature's chorus loses no more voices, and it presents stories of some of the many species that now need our help to prevent their demise.

A History of Loss and Recovery

Few Americans have any idea of the wildlife heritage that was lost in North America in past centuries. The continent's abundance of wild game helped fuel the engine of European-American exploration and settlement, providing food and income to frontiersmen and settlers, and stirred a belief that such multitudes of animals were inexhaustible. In the 19th century, spreading settlement transformed forests, grasslands, rivers, and wetlands, pushing many species into remnant patches of habitat and remote wilds. Demand for wild meat, plumes, and pelts escalated in the burgeoning cities, stimulating an unprecedented and uncontrolled harvest of wild animals for market. A fear of wild nature and a belief in Manifest Destiny also encouraged the elimination of predators and the domestication of natural landscapes into farmland and cities, and wildlife habitat was lost to clearing for timber and agriculture.

By the first decades of the 20th century, America's once teeming numbers of game birds and mammals were largely depleted. The great herds of bison were decimated, and the passenger pigeon, once

ART WOLFE©

billions strong, became extinct. Additionally, geese, ducks, egrets, deer, elk, beaver, marten, wild cats, wolves, seals whales— any species that was considered vermin or hunted for subsistence, trade, or sport—had been reduced to remnant numbers. Gone forever were the eastern elk and the bright flocks of Carolina parakeets. White-tailed deer and pronghorn antelope were reduced to one or two percent of their original populations. The wild turkey, once so numerous woodsmen encountered flocks of hundreds at a time, became a rare sight, and populations of canvasbacks, redheads, scaup and other waterfowl had plummeted.

This sad chapter of loss is the backdrop to one of America's great untold stories—100 years of wildlife conservation and recovery. At the outset of the 20th century, sportsmen began to fear a total loss of the nation's wildlife and moved to turn the tide against formidable odds. As animal numbers dwindled, concern for the survival of America's wildlife gave birth to a new movement for wildlife conservation, a new hunting ethic, and the science of wildlife management.

Game and fish populations began to rebound as hunting and fishing harvests were better regulated, refuges were created, habitat actively managed, and wildlife populations were augmented or restored with transplanted animals. Much of this effort was first funded by sportsmen through hunting and fishing licenses and later by excise taxes placed on hunting and fishing equipment under the 1937 Wildlife Restoration Act and 1950 Sport Fish Restoration Act. Bit by bit, other national and state legislation aimed at conserving wildlife and environmental quality further relieved the pressures on wildlife and allowed many populations to rally.[2]

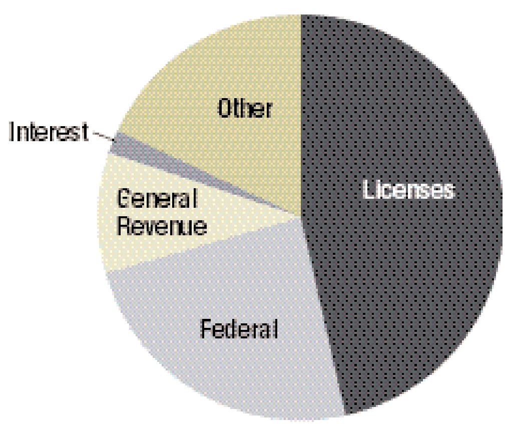
Given the opportunity, nature is resilient. White-tailed deer, moose, American alligators, and wild turkey have now recovered to thriving numbers. Wetland protection, habitat improvement projects, and scientific management have ensured a place for ducks, geese, herons and shorebirds. Protection allowed the return of sea otters, gray whales, and egrets. Captive propagation and reintroductions have re-established greenback cutthroat trout, peregrine falcons, and black-footed ferrets in their former haunts, and translocations have augmented

A Tradition of Fish and Wildlife Investment

In the early decades of the 20th century, the future of game species looked bleak, and funding for wildlife protection and regulation was scarce. The wildlife conservation movement and professional wildlife management began to gather steam, fueled by the concerns of sportsmen, naturalists, and game wardens. In the 1930s, these conservationists were instrumental in spawning a flurry of state and federal legislative acts and programs to reverse wildlife declines. Realizing the need to make a long-term investment in wildlife, sportsmen and the sporting arms industry joined forces with state wildlife agencies and pressed Congress to pass the 1937 Wildlife Restoration Act (also known as the Pittman-Robertson Act after the bill's sponsors) which imposed a 10% manufacturers tax on hunting ammunition and firearms. The proceeds of this tax are distributed to the state fish and wildlife agencies and earmarked for wildlife research, purchase and improvement of wildlife habitat, and wildlife recovery. States invest 25% of project costs, pay for projects up front, and are reimbursed 75% of project costs from Federal Aid funds.[4]

The success of the Wildlife Restoration Act inspired the Sport Fish Restoration Act (also called the Dingell-Johnson Act), signed into law in 1950. A later expansion to the Act included bowhunting supplies and equipment. The Sport Fish Restoration Act placed a 10% excise tax on fishing rods, reels, lures, and flies to raise revenue for fish restoration. In 1984, the Wallop-Breaux Amendment to the Sport Fish Restoration Act expanded the Act to include other boating and angling gear, and support recreation access and education programs.[5]

Main sources of state fish and wildlife agency funding



Source: 1996 Survey of State Wildlife Agency Revenue, The Wildlife Conservation Fund of America. Data for 1995.

Federal Aid apportionments have grown substantially, with a total of more than 6 billion dollars devoted to fish and wildlife restoration over the past six decades. This model partnership between sportsmen, the sporting industry, state wildlife agencies, and the federal government has done what many thought impossible by restoring fish and game species that were nearly lost forever.[6] Without doubt, we owe much of today's wildlife wealth to the vision and dedication of those original conservationists.

Other funding sources to support fish and wildlife management and recovery vary greatly for each state. Projects may be funded through hunting and fishing licenses, income tax check-offs, general funds, state lotteries, sales taxes, vehicle license plates, trust funds, or matching grants from federal programs, foundations, non-profit organizations, and corporations. *However, few states have either stable or adequate sources of funding for fish and wildlife and funding shortages are an ongoing problem.*

A Century of Conservation Legislation

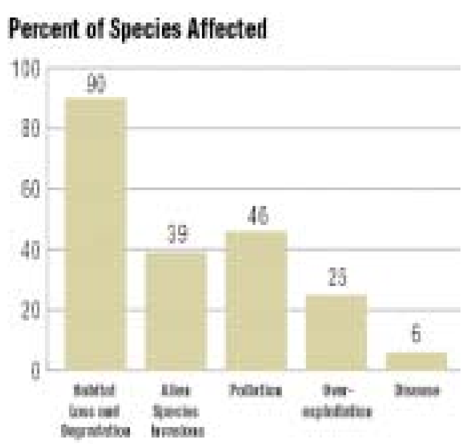
- **1900** Lacey Act
- **1916** National Parks Act
- **1918** Migratory Bird Treaty Act
- **1934** Taylor Grazing Act
- **1937** Wildlife Restoration Act
- **1950** Sport Fish Restoration Act
- **1964** Wilderness Act
- **1965** Anadromous Fish Conservation Act
- **1966** Clean Water Restoration Act
- **1966** Endangered Species Preservation Act
- **1968** Wild and Scenic Rivers Act
- **1969** National Environmental Policy Act
- **1972** Marine Mammal Protection Act
- **1973** Endangered Species Act
- **1973** Convention on International Trade in Endangered Species
- **1976** National Forest Management Act
- **1980** Fish and Wildlife Conservation Act
- **1984** Wallop-Breaux Amendment to the Sport Fish Restoration Act
- **1985** Food Security Act (Farm Bill–Conservation Reserve Program and Wetlands Reserve Program)
- **1989** North American Wetlands Conservation Act
- **1990** Food, Agriculture, Conservation and Trade Act (Farm Bill)
- **1997** National Wildlife Refuge System Improvement Act

and scientific management have ensured a place for ducks, geese, herons and shorebirds. Protection allowed the return of sea otters, gray whales, and egrets. Captive propagation and reintroductions have re-established greenback cutthroat trout, peregrine falcons, and black-footed ferrets in their former haunts, and translocations have augmented bighorn sheep and mountain goat populations. Our management actions have not only helped pronghorn, grizzly bears, striped bass and other highly-valued species, but also Karner blue butterflies, spiny riversnails, and big-eared bats. The 20th century era of conservation not only returned many game species to healthy numbers but has so far helped prevent many critically imperiled species from becoming extinct.[3]

In America, wildlife is considered a public trust, held by the state for the common good—a notion that developed after the American Revolution and establishment of American democratic ideals. As wildlife management evolved, the management of wildlife populations and the setting of harvest limits and regulations became the province of state fish and wildlife agencies. States also manage public state lands for wildlife conservation. In general, the federal government is responsible for habitat management on federal lands, determination of the status of threatened and endangered species, management of ocean fisheries and marine mammals, and administering national and international wildlife law. Today, wildlife management needs often overlap, and state and federal agencies of necessity work in concert with one another.

Wildlife Foes

Habitat loss and degradation is the primary threat to 825 imperiled animals in the U.S. Many species are jeopardized by more than one threat. This chart includes species listed as threatened or endangered by the U.S. Fish and Wildlife Service and those classified as imperiled by the Natural Heritage Network.



Source: Wilcove,D.S., D. Rothstein, J. Dubow, A. Philips, and E. Losos. 1998. Quantifying Threats to Imperiled Species in the United States. BioScience 48:607-615."

Our Challenges Today

We now face ever more complex challenges to sustain our wildlife and natural communities. Where we have devoted our attention, ingenuity, and resources, many species are once again prospering. Yet the vast majority of our wildlife species have not received sufficient management attention, and more than 2,000 species of fish and wildlife are falling through the cracks. We now face widespread population declines and losses across all types of species and ecosystems. To prevent more species from becoming threatened or endangered, we need to broaden our attention to the great diversity of wildlife and natural communities as a whole.

Accelerating Losses

Biologists have sounded the alarm that species extinctions are accelerating the world over. Globally, 465 animal extinctions have been recorded since 1600, and half of those have occurred in the 20th century.[7] In the three hundred years between 1600 and 1900, 75 species of birds and mammals became extinct, and 75 more were lost forever between 1900 and 1980. As of April, 2000, 493 animals and 736 plants, 1232 species total, are now federally listed as threatened or endangered in the U.S. An additional 93 species are proposed and 254 species are candidates for listing[8]. Others are listed as threatened, endangered, or sensitive by individual states, and many more species are showing cause for concern. For example, The Nature Conservancy classifies 1,357 vertebrate and invertebrate animals and 5,103 vascular plants as imperiled or vulnerable in the U.S. By the Conservancy's estimate, 30% of our native animals and plants for which we know status are imperiled or vulnerable.[9] Even some common and relatively abundant species are showing sustained population decreases. Yet the condition of the most of our wildlife species is poorly known or completely unknown.

Declining Habitat

Why are wildlife populations declining? Little more than a hundred years ago, American cities, towns, and farms dotted a continent that was still dominated by extensive forests, wetlands, and prairie, and laced with free-flowing rivers and streams. Today, we live in a land fully embroidered with the riches of American society—productive agriculture, growing cities and suburbs, extensive transportation networks, and blossoming industries—but our natural landscapes are now broken into small remnants of their original expanse, embedded in a human-built mosaic. Many of our most successful wildlife species, such as white-tailed deer, American robins, raccoons, and coyotes, are “habitat generalists” that can thrive in landscapes of croplands, small woodlots, and suburban communities. But the pervasive loss of natural habitats jeopardizes the future of an alarming number of other species, from butterflies, birds, and bears to mollusks, frogs, and fish. The decline of these species is inextricably linked to the alteration, fragmentation, and loss of the natural communities on which they depend. The fabric of life that supports both wild creatures and our own health and prosperity is undeniably fraying.

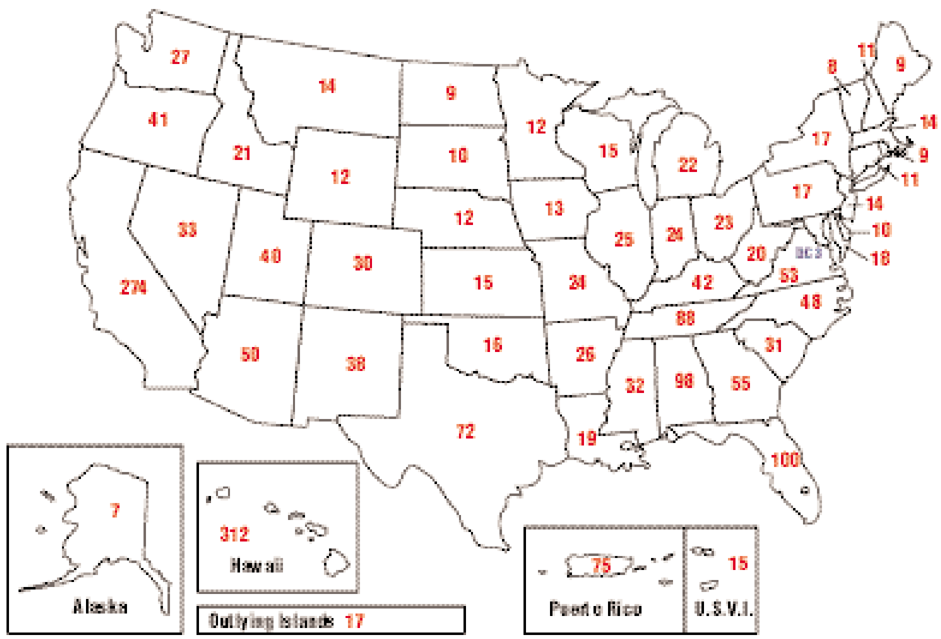
Across the spectrum of species in trouble, the number one cause of decline and imperilment is habitat loss, degradation, and fragmentation. Isolation into habitat remnants erodes animals’ ability to survive environmental stresses and puts populations at high risk of being eliminated by catastrophic events, such as drought or disease. The introduction and invasion of non-native animals and plants that compete with native species is the second greatest menace, followed by environmental pollution and careless exploitation.[10] Most difficult to predict, however, is the potential chain-reaction of losses as natural communities unravel like the stitches of a tattered sweater.

The big picture of habitat decline is sobering, and some ecosystems are themselves endangered. Across the lower 48 states, free-flowing streams and rivers, wetlands, riparian areas, native prairies, and old-growth forests have all suffered greater than 50% declines. Ninety-eight percent of our tallgrass prairies and 75% of our bottomland hardwood forests have been converted to other land uses.[11] As remaining natural landscapes become fragmented or shrink to isolated remnants, no area is immune from the effects of human civilization. For example, in the largest National Parks and Wilderness Areas in the lower 48 states, few spots are more than 20 miles from a road—a distance that can be traversed by a human or a bear in a day. Even the most remote regions are not immune from air-borne contaminants or the spread of alien animals and plants.

Urgent wildlife issues confront every state in the nation, but regions of high human growth will face special challenges. In the U.S., human populations are growing fastest in the South, West, and Hawaii, increasing the pressure on open space and resources in the very regions where we still retain extensive wild habitats in natural areas, public lands, and rural landscapes.[12] Moreover, California, Hawaii, and the Southeast are not only centers of great wildlife diversity, but also home to the greatest numbers of threatened and endangered animals.[13]

TO PREVENT MORE SPECIES FROM BECOMING THREATENED OR ENDANGERED, WE NEED TO BROADEN OUR ATTENTION TO THE GREAT DIVERSITY OF WILDLIFE AND NATURAL COMMUNITIES AS A WHOLE.

Listed Species by State/Territory as of May 28, 2000



Notes: Total U.S. Species–1,231 (including 8 whale species) Numbers not additive. A species often occurs in more than one state. The species counted include listed pinnipeds (seals, etc.) and anadromous fishes under National Marine Fisheries Services jurisdiction that use land or fresh waters within the States and Territories of the United States. The FWS State Lists do not include these species. Omits “similarity of appearance” and some extirpated species. No longer maps whale and non-nesting sea turtle species in State coastal waters.

Source: U.S. Fish and Wildlife Service–Division of Endangered Species

Data Gaps

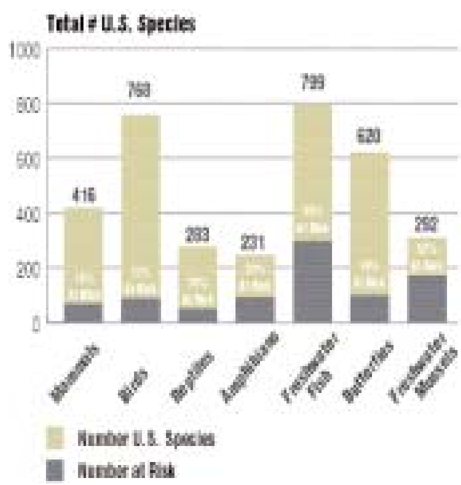
Good management requires solid knowledge of a species' natural history, behavior, population dynamics, and the condition of its habitat. Yet wildlife managers are up against large gaps in knowledge. Wildlife professionals rarely have the funds or personnel to engage in extensive research or monitoring, and there is very little historic baseline data to which we can compare the trends we see today. Even for those species we study and manage closely, such as deer or waterfowl, it is difficult and expensive to pull together a comprehensive picture of population status. For the great majority of lesser-studied wildlife, biologists often lack even basic understanding of species' natural history.

The Good News

Conservation and professional wildlife management have helped maintain our nation's wildlife legacy. Of the animal and plant species for which we know the status in the U.S., about two thirds are apparently secure, presenting us with the opportunity to secure their future.[14] Further, the public lands we manage as state and national forests, grasslands, parks, refuges, wildlife management areas, seashores, marine reserves, and recreation areas are the nation's savings account for wildlife and ecosystems, sustaining our natural legacy. Private lands, farms and ranches also provide important wildlife habitats while serving the needs of human communities. Even the smallest habitat remnants are sanctuaries for smaller species, stopover habitats for birds in migration, or connections between larger habitat areas. Whether a hedgerow or meadow, a copse of woods, a city park, or a neighborhood streamside or marsh, these places not only help sustain animals such as frogs, birds, and butterflies but also enrich people's enjoyment of their own communities. We have many opportunities to restore species and ecosystems. The challenge we face is to balance our stewardship of wildlife and their ecosystems with the other needs of our society.

Wildlife at Risk

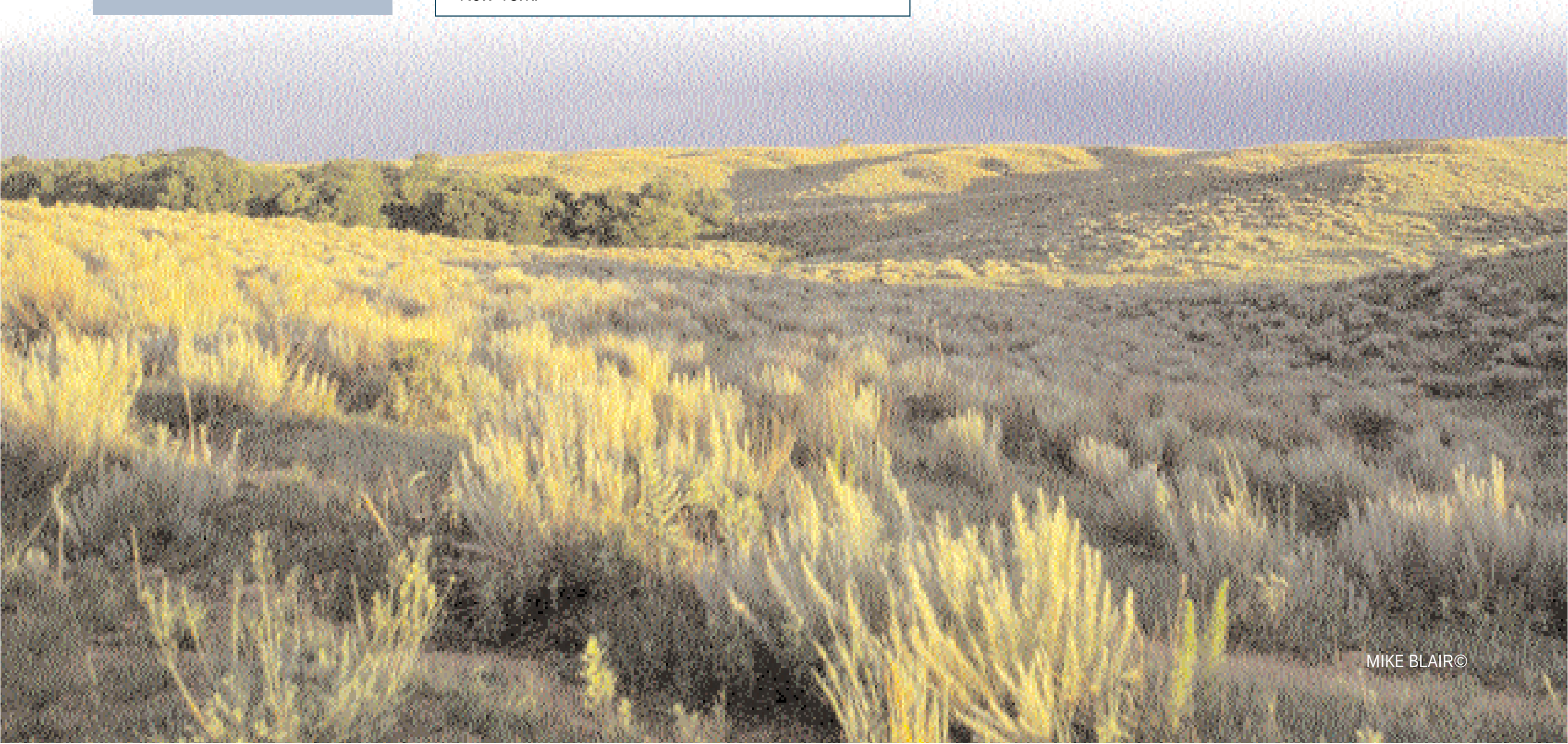
These numbers include native and regularly occurring U.S. species and the number classified as imperiled or vulnerable by the Natural Heritage Network. Little is known about most invertebrate species—only butterflies and freshwater mussels are included here.



Source: Stein, B.A., L.S. Kutner, and J.S. Adams, editors. 2000. Precious Heritage. Oxford University Press, New York.

Wildlife Management for the Future

The best approach to protecting wildlife is to conserve the ecosystems on which they depend. Thus the current trend in wildlife management is toward understanding the dynamic interrelationships of whole ecosystems and managing habitat to keep natural communities functioning and healthy. By sustaining natural communities, the great majority of species can be protected without having to individually manage each species—an efficient strategy that helps avoid expensive last-ditch efforts to save species at the brink of collapse. By working to maintain nature's economy, we help wildlife flourish, just as sustaining a healthy business economy helps us avoid bail-outs and market crashes. This approach is not only preventive medicine that provides for the greatest number of species, but offers the longest-term benefits to the greatest number of people.



MIKE BLAIR©

Pursuing a Passion for Nature

Nature, wildlife, and wild places are a large part of our identity as Americans and our sense of the landscapes in which we live. In ever-greater numbers we seek out opportunities to experience nature, to hunt and fish, run rivers, climb mountains, or simply to walk along woodland trails, prairies, and shores to glimpse wild animals and plants in their natural settings. We turn to nature to rejuvenate our spirits, to nourish our sense of wonder, and renew a sense of our own humanity. It is often the proximity of natural open spaces and wildlife that attracts people to visit or move to certain communities. We pursue a passion for nature because it is clearly a part of our identity as a people and the quality of our lives.

Into the Great Outdoors

As our lives become dominated by urban settings and images on television and computer screens, more people are seeking to connect with wild nature, perhaps recapturing a relationship that human cultures once took for granted. Growing numbers of people are turning to nature and outdoor settings to relax, exercise, pursue pastimes with friends and family, and enjoy nature's beauty and wildlife. Americans also see outdoor pursuits as a positive way to nurture appreciation for the environment and teach positive values to children.[15] These activities directly and indirectly generate billions of dollars in business and tax revenues and support millions of jobs, resulting in economic benefits on local, regional, and national levels.

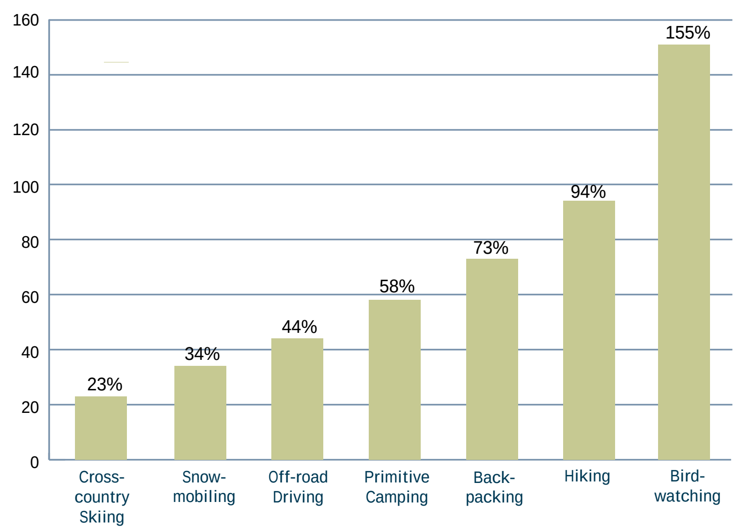
Nearly 95% of Americans claim to be involved in some sort of outdoor recreation. Walking is by far the most popular activity, with about 134 million participants. Visitor attendance at parks and natural areas is climbing nationwide. For example, state park attendance increased 30% over 15 years, drawing 752 million visitors in 1994.[16] Our National Park system hosted over 286 million recreation visits in 1998, up 30% from 1980.[17] Recently, the popularity of strenuous outdoor adventure activities in particular has been growing rapidly. Adventure recreation, such as hiking, backpacking, biking, rock climbing, or mountain-climbing attracts 74 million Americans. In 1996, participants in human-powered outdoor recreation spent an estimated $16 billion in retail sales alone.[18]

On a national survey, recreationists cited natural landscapes and seeing wild animals in their natural settings as important components of their outdoor-related activities, contributing to their sense of fulfillment and enjoyment. In Maryland, for example, 82% to 94% of campers, hikers, backpackers, canoeists, bicyclists and motor-boaters expressed interest in viewing wildlife. Of Idaho residents, 94% say that viewing wildlife in their natural habitats enhances their enjoyment of outdoor activities, and between 70% and 80% of Floridians say they enjoy watching wildlife while pursuing other outdoor activities, such as camping, hiking and boating. One survey respondent echoed the sentiments of many Americans who head to the outdoors, saying, "Getting away is important, but it wouldn't be the same if the wildlife weren't there."[19]

For many people, experiencing wild nature and wild animals is a *primary* reason for travel and outdoor recreation. Nature-related viewing activities attract 153 million Americans,[20] and these general activities often include the opportunities and rewards of viewing wildlife. Sixty-three million Americans participate in wildlife viewing specifically, 55 million in water-based nature study, 54 million in

The Lure of the Outdoors

Percentage increase between 1983 and 1994 in the number of people pursuing the following outdoor sports:



Source: Cordell, H.K., B.L. McDonald, R.J. Teasley and J. Bergstrom. 1995. NSRE: National Survey on Recreation and the Environment. Sporting Goods Manufacturers Association, North Palm Beach , FL and USDA Forest Service, Washington, D.C.

Bird-watching is the fastest growing outdoor pastime.

Nature as Big Business

- Americans spent $101 billion in 1996 on wildlife-related recreation, a 59% increase from 1991, much of it benefiting rural communities.[23]
- Hunters and anglers spend $72 billion annually on equipment and trips in the U.S.
- In 1996, people participating in wildlife watching spent $26 billion on equipment, trips and wildlife-related expenditures, a 21% jump from 1991.[24]
- Bird-watching generates $5.2 billion in goods and services, and 60 birding festivals across the nation now draw thousands of participants each year.[25]
- Internationally, over 200 million tourists undertook wildlife-related trips, generating an estimated $166 billion in direct economic impact to communities.[26]

PEOPLE AS WELL AS WILDLIFE NEED OPEN SPACES AND WILD AREAS.

bird-watching, and 27 million in fish viewing. Birds, land mammals and animals such as turtles and butterflies attract the most attention.[21] Bird-watching is the fastest growing outdoor pastime. Between 1982 and 1994, the number of bird-watchers increased 155%—outdistancing golf and tennis together in number of participants.[22]

LARRY AUMILLER©

A casual glance through the advertisements of regional, travel and nature-related magazines illustrates the mushrooming interest in nature-based tourism worldwide. Although tourism overall has been growing about 4% annually, nature tourism is climbing by 10% to 30% a year.[27] In 1994, over 528 million tourists were involved in nature travel globally, a 35% increase from 1988. For experienced nature travelers, wildlife viewing and wilderness settings are top priorities, as well as hiking or trekking, and visiting parks and protected areas.[28] These travelers are generally willing to spend more and seek out environmentally responsible services than the general tourist, but the interest in nature-based tourism is now expanding into more mainstream markets.[29]

Roughly 40 million Americans hunt or fish, and though these numbers have stabilized somewhat in recent years, the money sportsmen spend on their pursuits continues to climb. In 1996, hunters and anglers spent $72 billion on equipment and trips nationally. Most sportsmen fish or hunt within their state, returning their investment in their sport to local and state economies.[30] Hunters and anglers also participate to a high degree in other wildlife-related activities, such as visiting nature centers and wildlife viewing, and play a significant role in passing on their knowledge of nature and their conservation ethic to successive generations.[31]

Nature Education

Interest in nature study, environmental education, and outdoor programs also continues to grow. The number of natural history and nature-related books has exploded in recent decades, as has the number of outdoor education schools and camps for children, and nature study classes for adults and families through nature centers, natural history museums, and groups such as the Audubon Society. Millions enjoy informal nature education through interpretive sites, nature trails and museums. For instance, 93 million Americans report they visit nature centers and 69 million stop at visitors centers.[32] Americans also strongly believe environmental education is an important part of school curricula—95% of American adults, and 96% of parents support children being taught environmental education in public schools.[33]

Feeling the Squeeze

First-hand experiences are clearly an essential part of understanding the diversity and complexity of nature, nurturing an appreciation for the natural interrelationships that underpin all life, and fostering a desire to conserve wildlife and nature. In turning to nature for recreation and enjoyment, we are often rewarded with new discoveries and an expanded sense of ourselves. Yet as our population grows, development spreads, and more and more people take to the woods, beaches, deserts, and mountains, room for wildlife and for our own explorations is being squeezed.

The demand for scenic areas, wild lands, and opportunities to experience nature and pursue outdoor recreation are expected to keep growing over the next 50 years, while the quality and availability of open spaces and natural resources for outdoor recreation and nature-related activities will continue to shrink. Predictably, the projected gaps between supply and demand for outdoor activities are expected to be greatest for pursuits that require a good deal of elbow room, such as wildlife observation, nature study, dayhiking, backpacking, cross-country skiing, and primitive camping.[34] People as well as wildlife need open spaces and wild areas.

Hooves, Curls, and Tines

Our 13 species of wild ungulates, including deer, elk, wild sheep, and bison, embody Americans' love for the North American wilds. The agility, endurance, and quicksilver speed of these hooved beasts capture our imaginations. No glade, peak, or prairie seems complete without the sight of watchful herds grazing on summer grasses or browsing among willows. Yet few people are aware that many of our native ungulates barely survived into the 20th century. The numbers we see today are but a fraction of the populations existing when European settlers first arrived in North America. Biologists estimate that:

- The continent was home to some 25 to 50 million white-tailed deer—so many that in the 1780s Kentuckian Daniel Boone could claim, "You would have not walked out in any direction for more than a mile without shooting a buck."[35]
- Ten million elk graced woodlands and prairies from the East Coast to the West. In Pennsylvania, elk were once so abundant they trampled paths as wide as wagon roads.[36]
- Buffalo roamed eastern woodlands and swept the Great Plains like prairie fire—approximately 30 million bison inhabited North America at the time of European settlement.[37]
- Rivaling the number of bison, approximately 35 million pronghorn dappled the western plains.[38]

As settlement transformed the landscape and unrestrained market hunting took its toll, these numbers quickly dwindled. By the turn of the 20th century, deer were reduced to one to two percent of their original teeming numbers, pronghorn numbered only 20,000 animals, and in just three decades, elk had been extirpated from much of their range.[39] Bison slaughter had reached its zenith in the mid-1870s and by 1903 only 1,644 bison existed, mostly in zoos and on private ranches. Yellowstone National Park became refuge to the last 23 wild and free-roaming plains bison.[40]

As conservation efforts gained momentum and wildlife managers applied new understandings of population and habitat management, ungulate populations began a remarkable turnaround. Today, because of the management efforts of state wildlife agencies and the investment of sportsmen's groups, most ungulate species have recovered.[41] Nationally, most of our ungulate species are stable or increasing and these animals are now the heart of our modern hunting tradition.

There are still areas of concern for elk, deer, and other ungulates as wildlife managers strive to sustain populations in the face of increasingly complex land use issues. The woodland caribou, Columbia white-tailed deer, and Florida Key deer, Sierra Nevada bighorn and Peninsular bighorn are endangered, and recent declines in mule deer are commanding attention. Wildlife managers contend with providing adequate winter and summer range for many ungulate populations as open lands become developed and fragmented. In contrast, the adaptable white-tailed deer has become so abundant it is a pest in many suburban and agricultural areas, creating a different set of challenges for managers.

Elk Resurgence

By 1920, elk had been extirpated from the East and Great Plains, and only one percent of the original North American population survived. But with careful management, regulated hunting, and habitat conservation, elk populations are on the rise in their western range. By taking transplants from the Rocky Mountains, wildlife managers are restoring small populations to historic elk ranges in the East, Midwest, and Southwest. U.S. elk populations nearly doubled from 500,000 in 1970 to 900,000 animals in 1995—ten times the remnant population that survived in the early 1900s.[42]

These regal animals provide one of the country's most prized hunting experiences to 900,000 hunters each year. Elk bring in significant income to state wildlife agencies from hunting licenses. They also draw thousands of wildlife watchers to parks and refuges such as Colorado's Rocky Mountain National Park and the National Elk Refuge in Wyoming.

Wildlife managers still face many challenges to sustain healthy herds. Elk habitat is often a checkerboard of public and private lands, and management for elk requires partnerships and cooperation across boundaries to provide adequate habitat throughout the seasons. Most native elk habitat in the West has now been restocked, so biologists expect the recent period of steep population growth to taper off and numbers to stabilize at about current levels.[43]

GARY WILL©

Bighorn Sheep: Scattered Sentinels

Guardians of rocky precipices, bighorn sheep are adapted to a wide array of open, craggy landscapes, from mountain promontories and cliffy river canyons to barren desert peaks. In the short period between 1870 and 1900, wild sheep in the

Hooves, Curls and Tines

United States were nearly extirpated by unregulated market hunting, competition with livestock on winter ranges, and the devastating impact of parasites and diseases spread from domestic sheep. In a few short decades, North American bighorn herds were reduced from a population of one to two million down to remnant bands clinging to survival in remote terrain.[44]

Fifty years of management and restoration by state and federal wildlife agencies and conservation groups helped bring bighorn back from the edge. The Taylor Grazing Act reduced historic overgrazing on rangelands, and regulation allowed herds to recover from uncontrolled hunting. With habitat management and sheep reintroductions, wildlife agencies boosted populations and reestablished sheep in historic ranges. Today, nearly 48,500 bighorn inhabit the U.S. The California bighorn has increased from 50 individuals to 7,000 with restocking from founder animals in British Columbia. The Rocky Mountain bighorn has rebounded to 23,500 animals, and in the Southwest, the desert bighorn has been restored to a population of 18,000 animals.[45]

ALAN HUTCHINSON©

Many populations remain vulnerable, however, and need careful management. Nearly 65% of bighorn populations in the West harbor fewer than 100 animals.[46] Habitat fragmentation isolates bighorn herds in small bands, scattered like tiny islands in what once was a vast range, and placing these herds at risk of succumbing to disease, inbreeding, or lack of adequate food or water. For instance, the last of the native California bighorns in the Sierra Nevada have declined drastically since the 1980s and were recently listed as endangered, victims of isolation and predation by mountain lions and coyotes. Wildlife managers must now find ways to help these small, disconnected herds survive.

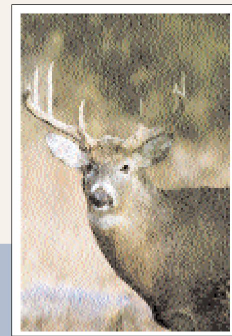
Where wild sheep populations are stable or increasing, managers have reinstated regulated hunts. The bighorn ram is now one of the most prized (and given the terrain, one of the most difficult) trophies for the sport hunter. Bighorn restoration efforts by state wildlife agencies are made possible by funds from hunting permits, sportsman's organizations, and excise taxes through the Pittman-Robertson Act. Although 99% of sheep hunting permits are offered through a lottery-based system, many states also offer sportsmen a single special bighorn hunting permit through bid at auction. Evidence of the esteem hunters hold for the bighorn, these permits routinely bring in $25,000 to $100,000 each, and sometimes as high as $400,000—revenue that goes directly back into the wild sheep restoration and management programs operated by state wildlife agencies.[47]

White-tailed Deer: Backyard Wildlife

The white-tailed deer's grace and beauty, its shining eye, alert stance, and flashing plume of tail, give this animal a special place in American's hearts. Hunters appreciate the whitetail's acute hearing, smell, and sight, its ability to slip like mist through the trees, and sprint from danger at speeds up to 40 miles per hour. The whitetail is now so much a part of our rural landscape, it is difficult to imagine that in the early decades of this century this deer was only a memory to many rural Americans. Settlement and clearing of the eastern forests and unrestrained hunting by both settlers and market hunters reduced whitetail numbers 98% from roughly 25 million deer to only 500,000 animals. By 1900, whitetails hung on only in remote and sparsely settled swamps and woodlands.[48]

With conservation and management, whitetail populations rebounded to an estimated 15 to 25 million deer (roughly the presettlement population estimated by biologists) and deer management problems now revolve around too many deer. The whitetail owes its comeback not only to regulated hunting, restocking programs, and modern wildlife management, but to its adaptability to human-altered landscapes, the reduction of large predators throughout much of the deer's range, and the deer's astounding capacity to multiply. Studies show that in especially rich habitats whitetails can double their numbers every two years.[49]

Whitetails are superbly adaptable animals. A habitat patchwork of woodlands, streamsides, and fields that offer lush browse and hiding cover is supreme whitetail country. In Wisconsin, where rolling landscapes are blanketed by a mosaic of woods and fields, deer densities can reach 70 to 80 animals in a square mile. Whitetail populations are densest in the upper Midwest, New York, Pennsylvania, the eastern seaboard, Georgia, Alabama, and Texas.[50] Because whitetails have a special fondness for farm crops (in some areas crops make up 40% to 50% of their diet), these burgeoning populations create serious problems for farmers. Whitetail management today focuses largely on stabilizing numbers, sustaining quality hunting, and reducing damage to farmlands, urban gardens, forest regeneration, and threats to traffic safety.[51]



MIKE BLAIR©

NATIVE UNGULATE STATUS

Barren Ground Caribou: Stable

Highly migratory, caribou populations undergo large natural fluctuations. Still abundant, roughly 650,000 to 900,000 caribou exist in Alaska, and they are still a major food source for native Alaskans.[52]

Woodland Caribou: Endangered

Dependent on old-growth forests in northern Idaho; sensitive to habitat fragmentation and loss.[53]

Muskox: Stable

Nearly extinct in Alaska by 1900; returned with translocation efforts and regulated hunting. By 1990, about 2,200 animals reinhabited historic range.[54]

Moose: Increasing

Nationwide have increased to roughly 225,000 animals, although there are some local declines. Habitat change and conflicts with people pose management challenges.[55]

Pronghorn: Stable to Increasing

By 1993, pronghorn increased to some 600,000 animals in 11 states, regaining former range. They are expected to stabilize at about this level.[56]

Bison: Increasing

Reduced to fewer than 1,700 animals by 1903, today bison number in the tens of thousands, reestablished in parks, refuges, tribal lands, and private ranches.

Elk: Increasing

Reduced to <1% of presettlement populations by 1900. By 1995, populations rebounded to 900,000 animals.

White-tailed Deer: Increasing

Once reduced to roughly 2% of presettlement populations; now 15 to 25 million strong.

Columbian White-tailed Deer: Endangered

Habitat loss in Oregon and Washington reduced Columbian white-tails to two disjunct populations. The lower Columbia River population numbers roughly 800 animals. A separate population of 6,000 exists near Roseburg, Oregon and is proposed for delisting.[57]

Florida Key Deer: Endangered

Found only in the Lower Florida Keys. Roughly 250 to 300 key deer remain. In the 1990s, the deer has lost habitat and range to urban development, and mortality due to vehicle collisions has increased.[58]

Mule Deer: Declining

Declines across the West are concerning wildlife managers. Habitat competition and condition, drought, fire regimes, land management practices, predation, disease, and hunting may all be factors.[59]

Rocky Mountain Bighorn: Stable to Increasing

Biologists estimate populations at more than 23,000 individuals.[60]

California Bighorn: Increasing

Reintroductions from British Columbia increased numbers from 50 to 7,000. The Sierra Nevada subspecies, the only remnant native herd in California, has been drastically reduced by predation and recently listed as endangered.[61]

Desert Bighorn: Stable to Increasing

Most available habitat has been restocked and pace of increase is slowing. Competition with domestic and feral livestock, degradation of watering sites, and habitat degradation and fragmentation pose problems for sustaining herds. The Peninsular subspecies is listed as endangered.[62]

Dall Sheep: Stable

Alaska's population approximately 60,000 strong, although there have been recent natural declines. People's increasing use of alpine areas may cause future problems.[63]

Mountain Goat: Unknown

Declined precipitously from the 1960s to early 1980s as roads and logging made their habitats more accessible to hunters. More conservative hunting quotas and goat transplants helped stabilize some populations. Remain vulnerable to increasing human pressures in alpine areas.[64]

Javelina: Stable

Abundant in Arizona and southern Texas, and uncommon but increasing in New Mexico.[65]

The Wild Hunters

The U.S. is home to 35 species of terrestrial carnivores. The black bear and grizzly, coyote, red fox, bobcat, and mountain lion may be most familiar to Americans. The lesser known marten, fisher, wolverine, and lynx haunt northern or high-elevation forests; swift and kit fox make their homes in our open prairies and deserts. Three wild cats of Central America—jaguar, ocelot, and jaguarundi, although exceedingly rare, are still occasionally sighted in southwestern borderlands. The smaller carnivores such as badger, least weasel, longtail weasel, shorttail weasel, mink, black-footed ferret, and river otter, as well as the omnivorous skunks, raccoon, ringtail, and coati, are all important predators of smaller animals.

Long considered vermin, predators large and small suffered centuries of persecution. In the early decades of wildlife management, managers advocated eradicating bears, wolves, lions, and other predator species as threats to livestock and more desirable wildlife. In addition, the decline of deer, elk, and bison in the 19th century also took their toll as large predators lost their prey base, and forest clearing and settlement forced many remaining populations into remote areas. However, a few species that were able to adapt to life in the habitats humans created—such as the coyote, red fox, and raccoon—persisted and even thrived. Today we understand that predators play an integral role in their environment, caught in an intimate dance with their prey species—a relationship that has repercussions throughout the wildlife community. Although local conditions may sometimes require predator control, broad-scale eradication efforts are a thing of the past. Public attitudes are also changing, and to many Americans the presence of these animals invests a landscape with the essence of the wild.

KEN WHITTEN©

PREDATORS PLAY AN INTEGRAL ROLE IN THEIR ENVIRONMENT.

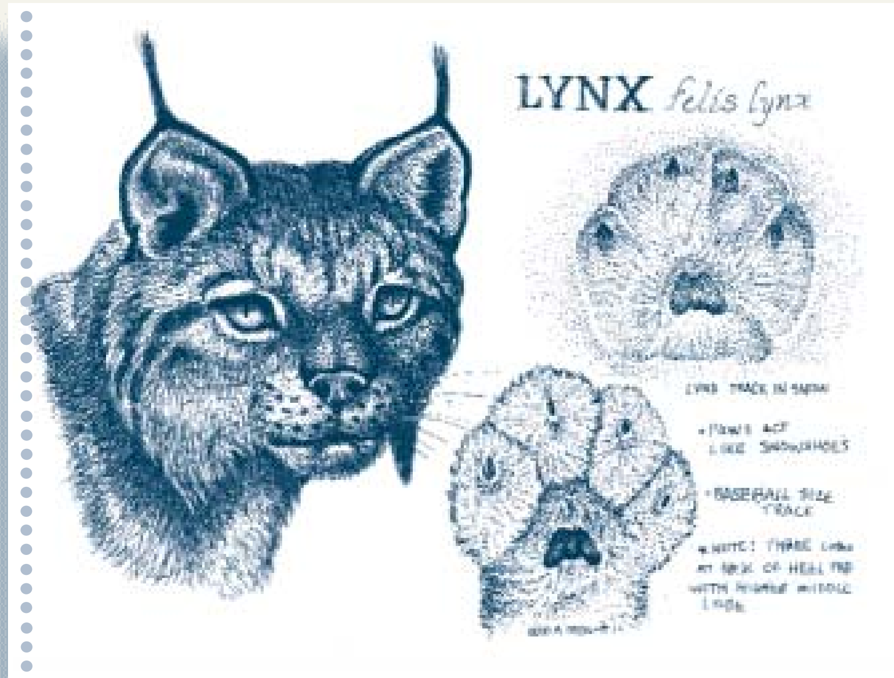
Unfortunately, we know relatively little about the habits and population status of many of our predator species with the exception of those that receive special management focus. Eleven species and subspecies of carnivores are listed as threatened or endangered in the U.S. in all or parts of their range. These include the black-footed ferret, red wolf, gray wolf, San Joaquin kit fox, Louisiana black bear, grizzly, eastern cougar, Florida panther, jaguar, jaguarundi, and ocelot. Other species are still widely distributed, but deserve attention due to steady population declines or local losses. For example, carnivores of the forests, such as marten and fisher, are currently under study because of concerns over habitat degradation in some areas.

Where wild habitats are rapidly shrinking, populations of wide-ranging animals such as bears and mountain lions find less and less room to disperse without coming into conflict with people. Few people are neutral about predators, and wildlife managers face complex challenges in trying to restore and sustain predator populations against this backdrop of widely divergent and impassioned public views.

Canada Lynx: Rare and Declining

The Canada lynx, a small wild cat of high-elevation and boreal forests, was once found at least occasionally in 24 northern states.[66] Although its primary range lies in Canada and Alaska, the lynx is slipping like a ghost from its former peripheral haunts in the contiguous U.S. and was recently listed as a threatened species. Unfortunately, surveying for lynx is like trying to find a needle in a haystack, and estimates of how many cats remain are rough at best. In the contiguous U. S., lynx naturally occur at low population densities. Currently, small resident populations still exist in Maine, Montana, and Washington. Lynx have also been seen in Wyoming and Oregon, but there is too little information to determine if these and other states still support breeding populations.[67]

Lynx populations are cyclic, waxing and waning with the abundance of prey. Even in the best of times the cat has probably never been abundant in the peripheries of its range in the contiguous U.S. However, a triple punch of habitat loss, overharvesting, and competition with other predators has driven numbers of this solitary cat to dangerously low levels. Today, both state and federal agencies are rigorously enforcing protection measures. Lynx are closely tied to the status of their principal prey, the snowshoe hare. Fire suppression and timber harvesting have changed and fragmented the forest landscapes the snowshoe hare and lynx depend upon, and some habitat has been lost altogether to agriculture, settlement, or recreational development. Prior to present restrictions, lynx populations also suffered from heavy trapping when pelt prices were high in the 1970s and 1980s. In addition, lynx have declined from competition with bobcats and coyotes, predators that can survive in today's more fragmented landscapes.[68]



Black Bear: Forest Survivor

American black bears receded as forests throughout the East were cleared for settlement. Ingenious at raiding farmer's stored foods, the bear was little loved in early days, and bounties drastically reduced their numbers. But in the early decades of the 20th century, public attitudes began changing and many states extended protection to the black bear. As the eastern forests matured, restoring bear habitat, the bear began to return. Following World War II, black bears were designated as a game species in most eastern states and harvest quotas were established, yet little was known about the animal's biology. In the last 25 years, state and federal biologists have gained a better understanding of the black bear through research and monitoring to help recover populations.[69]

Between 650,000 and 700,000 black bears now inhabit the relatively undisturbed forested regions of the lower 48 states and the boreal forests of Alaska and Canada. Classified as game in 32 states, most black bear populations are currently stable or increasing. However, there is special concern for bears in the southeastern U.S. where they exist in small, isolated populations, which may compromise their long-term viability. The Louisiana black bear is federally listed as threatened. Florida, Mississippi, South Dakota, Texas classify their populations as threatened or endangered.[70]

LARRY AUMILLER©

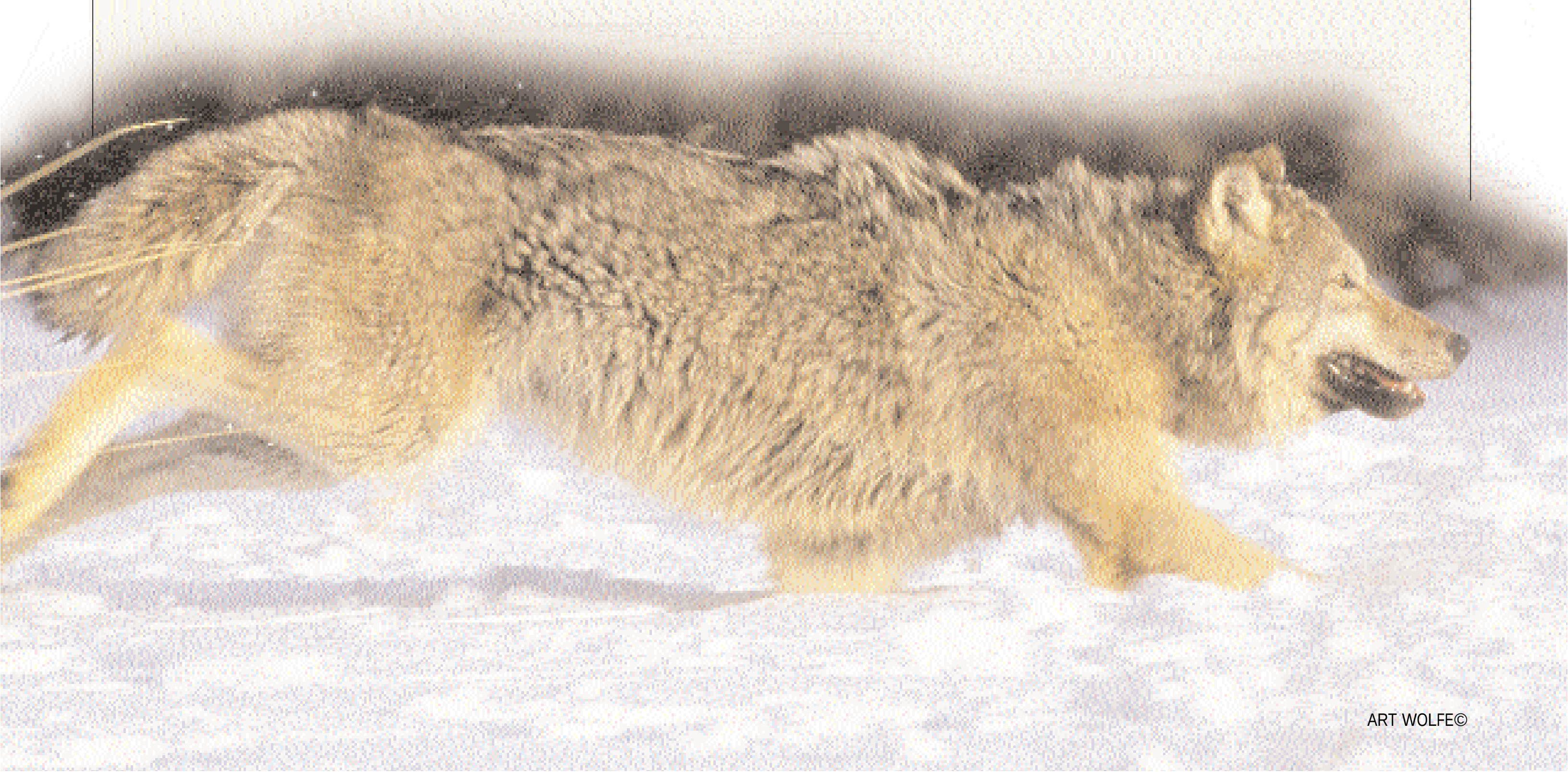
Gray Wolf: Returning to the Wild Side

After a 60-year absence, gray wolves are returning to western wildlands. The wolf is listed as endangered outside of Alaska and Minnesota, and in the late 1970s efforts began to reestablish wolves in certain regions of the West. In the early 1980s, wolves recolonized northwestern Montana on their own, dispersing south from Canada and gradually growing to seven packs ranging throughout Montana's northwest corner by 1999.

However, the return of wolves sparked controversy and concern over livestock depredation and possible impacts to local land uses. Recovery teams worked with landowners, ranchers, state wildlife agencies, tribes, and nonprofit groups to develop management strategies that would not impact traditional ways of life for local communities.

In 1995 and 1996, reintroduction efforts moved forward with the release of 61 gray wolves to Yellowstone National Park and central Idaho wilderness areas. With plenty of elbow room and a strong prey base, the Yellowstone and Idaho populations grew to more than 300 animals in four years. Recovery goals have nearly been met for the region, and if the current population is maintained, by 2002 these wolves will no longer need ESA protection.[72] Now a similar recovery effort for Mexican gray wolves is underway in Arizona and New Mexico. By 1998, the entire Mexican wolf population, fewer than 200 animals, survived only in zoos. That year, the first Mexican wolves set paw to wild soil in Arizona and were soon hunting on their own, bringing down elk, and learning to be wild wolves. As of July 1999, 22 Mexican wolves in five family groups were free-ranging in the Apache National Forest, and three pairs produced pups in the wild. Despite troubles with illegal shootings, some livestock depredation, and the need to recapture some wolves, recovery progresses. Over the next five years, 10 to 15 captive bred Mexican wolves will be released each year into the Apache and Gila National Forests, an area spanning 7,000 square miles, twice the size of Yellowstone.[73]

Returning wolves to these landscapes is a complex job of balancing Americans' hopes for wildlife recovery with the needs of local communities. Public interest in the wolves is intense and thousands of people participated in the recovery planning process, their comments reflecting the divided emotions Americans have about this wild canine. However, the growth of public desire to see wolves in the wild has been astounding, and tourism to view wolves is rapidly growing. More than 30,000 park visitors have spent time watching the Yellowstone wolves.[74] Government biologists are working with ranchers to manage depredations, moving or killing wolves that turn to preying on livestock. In addition, a compensation fund set up by Defenders of Wildlife, a private nonprofit group, reimburses livestock producers at market value for losses to wolves. In the ongoing story of wolf recovery, Americans are demonstrating that with cooperation and compromise we can



ART WOLFE©

Our Small Mammals

The roughly 265 species of small mammals in the U.S.—shrews, moles, bats, mice, woodrats, marmots, ground squirrels, tree squirrels, chipmunks, pocket gophers, lemmings, rabbits and hares, to name a few—are generally out of sight and out of mind unless they become a pesky problem for homeowners or farmers. Most of these small creatures are active at night and hide themselves by day in burrows, crevices, or tree cavities, so we tend to overlook their presence, great diversity, and importance in natural communities.

ART WOLFE©

We have no general assessments of the status of small mammals. The exceptions are for a few rare species and studies of the population dynamics of some species, such as voles, that are important as prey for larger mammals and birds. Like larger mammals, the changes brought to landscapes by human activities have taken their toll on small mammals as well. Habitat loss and fragmentation, isolation of populations, the growing abundance of small predators such as raccoons, competition with nonnative animals, and diseases have all had impacts. Thirty-seven of our native small mammals (14%) are now federally listed as threatened or endangered. These comprise 60% of our mammals listed as threatened or endangered.[75]

Lacking the appeal of eagles or whales, small mammals receive scant public attention or conservation resources, but they play critical roles in their natural communities. Many are important grazers and seed dispersers, influencing the patterns and productivity of plant populations. Species such as voles, mice, squirrels, and rabbits are staples in the diets of larger animals, from foxes to hawks. Shrews and many bats are voracious insect predators, and some nectar-feeding bats are critical to the pollination of night-blooming plants, such as the giant cacti of the southwest deserts. Prairie dogs are keystone species in prairie ecosystems where burrowing owls, black-footed ferrets, mountain plovers and as many as 170 other species of prairie wildlife rely on prairie dog activity for their survival.[76]

As a group, bats may be the best-studied of all the small mammals thanks to the efforts of many amateur and professional bat enthusiasts. Bats suffer from human misunderstanding, fear, and persecution that have lead to widespread destruction of roosting bat communities. Of 39 bats native to the U.S., 9 (23%) are now listed as endangered.[77] Conservation efforts by state wildlife agencies, groups such as Bat Conservation International, and local communities focus on promoting public education about the harmlessness and ecological benefit of bats and protecting wild and urban roosting habitats such as caves and bridges.

Basic surveys are needed for many of our small mammals to better understand their status and management needs. Some imperiled species need protection of threatened habitats. Fortunately, the life strategy of many of these species is to reproduce prolifically in order to offset the pressures of natural predation, which gives them an advantage in sustaining and recovering populations. Given secure habitat and attention to sustainable land management practices, many of our small mammal species will thrive.

Preble's Jumping Mouse: A Signal Flare

In 1998, Preble's meadow jumping mouse was listed as threatened under the Endangered Species Act after surveys found that it had disappeared from much of its historic range in southeastern Wyoming and eastern Colorado. An inhabitant of lush streamside habitats, Preble's mouse has come head to head with land use practices in Wyoming and with spreading urban development along Colorado's Front Range of the Rocky Mountains, home to 80% of Colorado's human population.

Why the fuss over a mouse? Preble's mouse is a riparian obligate, that is, it lives only where dense grasses and shrubs grow along stream corridors within open prairies.[78] It has always been relatively rare, but its recent decline is a warning flare that riparian habitats, on which so many other species also depend, are damaged and rapidly vanishing. In the arid West, riparian habitats harbor the richest variety of wildlife species—the majority of birds, mammals and amphibians depend on or use riparian areas at some stage in their lives for breeding, feeding, or migration, and riparian vegetation is essential to the health of the streams themselves. Human activities have altered, degraded or destroyed an estimated 95% of riparian areas in the West,[79] which are disappearing at a rate of roughly 250,000 acres each year.[80] In the case of Preble's mouse, heavy cattle grazing has reduced or eliminated the streamside grasses and shrubs on which it depends. Urban development has destroyed riparian habitats, turned it into open parks without dense streamside vegetation, or fragmented riparian stringers, leaving animal populations stranded from one another. Unlike most

Small Mammals at Risk

Thirty-seven small mammals are federally listed as threatened or endangered, comprising 60% of our listed mammals.*

Endangered

Gray bat
Hawaiian hoary bat
Indiana bat
Lesser long-nosed bat
Little Mariana fruit bat
Mariana fruit bat
Lesser Mexican long-nosed bat
Ozark big-eared bat
Virginia big-eared bat
Fresno kangaroo rat
Giant kangaroo rat
Morro Bay kangaroo rat
Stephen's kangaroo rat
Tipton kangaroo rat
Merriam's kangaroo rat
Point Arena mountain beaver
Alabama beach mouse
Anastasia Island beach mouse
Choctawhatchee beach mouse
Key Largo cotton mouse
Perdido Key beach mouse
Salt marsh harvest mouse
St. Andrew beach mouse
Lower keys rabbit
Silver rice rat
Carolina northern flying squirrel
Delmarva Peninsula fox squirrel
Mount Graham red squirrel
Virginia northern flying squirrel
Amargosa vole
Florida salt marsh vole
Hualapai Mexican vole
Key Largo woodrat

Threatened

Preble's meadow jumping mouse
Southeastern beach mouse
Utah prairie dog
Dismal Swamp southeastern shrew

* Source: USFWS. 1999. Listed species. Online: www/fws/gov/r9endspp/ U.S. Fish and Wildlife Service Division of Endangered Species, Washington, D.C.

other rodents, Preble's mouse reproduces slowly and lives in low densities, which exacerbates the impacts of habitat loss.[81]

The greatest need for Preble's mouse and other riparian wildlife is quality habitat. In Colorado and Wyoming, state and federal wildlife agencies, private landowners, and conservation groups have begun to work on cooperative approaches to Preble's mouse conservation that will designate protected areas but also accommodate local needs and allow continued grazing, development, and other land uses on private lands.[82] With good management, riparian habitats are resilient and can recover from damage. There may be opportunities to restore these dwindling habitats and eventually relocate Preble's mouse into unoccupied areas to help its recovery.

Beaver on the Rebound

By 1900, three hundred years of exploitation had eliminated the beaver from much of its range. An estimated 60 million beavers throughout North America before European-American settlement were reduced to roughly 100,000. In the early 1900s, state fish and wildlife agencies began reintroduction efforts, and once Federal Aid funds became available through the Pittman-Robertson Act, beaver restoration made real progress through restocking programs and restricted harvests. By the 1950s populations were making a dramatic recovery. Today, beaver have re-inhabited favorable watersheds throughout their former range.[83]

The beaver is considered a keystone species that brings about far-reaching changes to stream communities. By constructing dams and ponds, beaver create a complex mosaic of habitats that benefit waterfowl, muskrats, mink, raccoons, white-tailed deer, woodcocks, turkey, ruffed grouse, brook trout, amphibians, insects and a host of other animals. Beaver ponds increase total water area, stabilize stream flow, serve as catchments for runoff and eroding soils, and enhance water quality. On intermittent streams in the West, beaver activity has restored year-round flow. Beaver chewing on cottonwoods can prompt the trees to resprout, helping sustain stands that would otherwise decline when beaver ponds reduce the flooding that cottonwood seeds need to germinate.[84]

Yet beaver also have detrimental impacts. Beaver can kill trees and inhibit regrowth, alter plant succession, decrease dissolved oxygen, interfere with trout migration and flood spawning gravels.[85] Beaver can flood roads, forests and croplands, damage irrigation ditches and fish ponds, and block culverts, at a significant economic impact. Complaints about nuisance beavers increased as populations rebounded, prompting a need to manage populations through more liberal harvest regulations and relocation efforts. Biologists in many states expect beaver populations to continue to increase in the next 10 years.[86] Wildlife managers and landowners need to balance beaver control with the long-term benefits of beaver colonies in the landscape. But certainly, with the help of our investment in restoration, beavers have returned to stay.

Warm-blooded Swimmers

Whales, dolphins, seals, and other marine mammals often inspire our wonder for an undersea world that still lies largely unexplored. Some 60 marine mammal species are found in U.S. waters: 35 species range along the Atlantic coast and Gulf of Mexico, and at least 50 occur in U.S. Pacific waters. Historically, these warm-blooded swimmers suffered enormous losses to commercial whaling and fishing. In international seas, they fell victim to the "tragedy of the commons." Without international cooperation and regulation, no country had incentive to curb its own harvest, and each seized as large a share as possible until harvests collapsed. Some populations were reduced 90% to 99%.

As marine mammal numbers dwindled, a suite of state and federal laws and international treaties opened the way toward recovery. Today, species protection, marine sanctuaries, and international cooperation are beginning to pay off:

- The gray whale's eastern Pacific population was recently removed from the endangered species list; it numbers more than 20,000 and is growing.
- West Coast harbor seals and California sea lions are increasing.
- Sea otters in California rebounded from a remnant 50 otters to nearly 2,500.
- Northern elephant seals have recovered from 60 to more than 50,000 breeding in California, and a total population of more than 180,000.
- Bowhead whales in the western Arctic have increased from fewer than 1,000 animals to 7,700.
- The bycatch of eastern tropical Pacific dolphins in tuna purse seines dropped from tens of thousands annually to 3,000 dolphins in 1997.

For most marine mammals, however, information is far too limited to evaluate abundance and trends. Twelve species are listed as threatened or endangered, and four are classified as depleted under the federal Marine Mammal Protection Act. The National Marine Fisheries Service also designates stocks of twelve additional species as "strategic" for management attention because of concerns over high mortality rates or unknown status.

As human pressures on the world's oceans increase, the future for many ocean mammals is not secure. Net entanglements, bycatch from commercial fishing, ship strikes, illegal killings, strandings, disease, changes or decline in food sources, exposure to marine pollution and contaminants, coastal development, and disturbance in feeding and breeding grounds remain challenges to the health and recovery of populations.[87] International cooperation, and partnerships among commercial fisheries, industry, and the many state and federal agencies involved in the study and regulation of our ocean resources are needed to provide a future for marine mammals.

Gray Whale: Return of a Leviathan

The gray whale has become a symbol of hope for whale recovery. By the 1930s only a few hundred

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Warm-blooded Swimmers

BOB GARRISON
CALIFORNIA DEPT. OF FISH AND GAME

to a few thousand remained, and in 1970 the species was listed as endangered. With protection, the population has now grown to more than 21,000, roughly equal to its numbers before whaling, and in 1994 the gray whale was removed from the endangered species list.[88]

Perhaps the most easily observed of all the large whales, gray whales are the focus of growing whale-watching tourism along the West Coast as they make their seasonal migrations between shallow calving waters in Baja California, Mexico and their rich feeding grounds in the Bering and Chukchi seas of the northern Pacific.

Despite growing human populations in coastal communities, the gray whale population continues to increase. A few gray whales are harvested each year under quotas set by the International Whaling Commission (IWC) for subsistence take. Securing this leviathan's future will depend on partnerships and cooperation across international boundaries to wisely manage the whale's numbers and marine habitats.

Sea Otter Recovery

With the benefit of state and federal protection, habitat conservation, and reintroductions, the sea otter has made a comeback. By the 1910s, unregulated hunting had reduced populations to roughly 2,000 otters along the west coast of North America, and a remnant 50 otters in California. By 1994, sea otters in Alaska had rebounded to between 100,000 and 150,000 animals, and in 1998, 2,114 sea otters were counted in California. However, populations have declined roughly 20% from 1996 to 1998 due to a large decrease in number of pups, and this has spurred new concerns.[90]

Marine Mammals at Risk in the U.S.*

Species listed as threatened or endangered under the Endangered Species Act, or as depleted under the Marine Mammal Protection Act.

Threatened

Southern sea otter–Increasing in California.

Guadalupe fur seal–Population about 3,000 and increasing.

Endangered

Steller sea lion–Declined >80% in western Pacific; eastern Pacific stock listed as threatened.

Hawaiian monk seal–Population about 1,400; declined 50% between 1957 and 1982.

Caribbean monk seal–Probably extinct–last sighted in 1952.

Blue whale–Severely depleted; trend unknown; about 1,400 in California population.

Fin whale –Severely depleted; trend unknown.

Bowhead whale–Increasing; population about 7,700 in western Arctic.

Humpback whale–Population about 7,000 in U. S. waters; possibly increasing.

Northern right whale–Nearly extinct in Pacific: only 5 to 7 sightings in last 25 years; <300 in western Atlantic.

Sei whale–Severely depleted; population and trend unknown.

Sperm whale–Relatively abundant in north Pacific; about 2,000 in Atlantic and Gulf of Mexico.

Depleted

Northern fur seal–Declined >60% between 1955 and 1980; currently stable.

Atlantic coastal bottlenose dolphin–An epidemic caused a massive die-off of >50% of the mid-Atlantic stock in 1987-88. Western North Atlantic coastal stock is about 2,400.

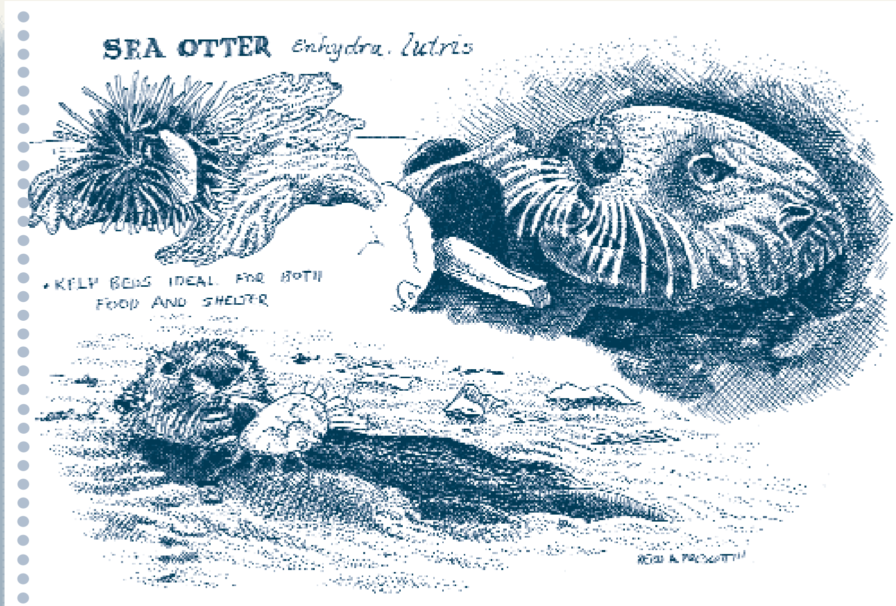
Eastern spinner dolphin–Declined by >50% since 1950's, current trend is stable.

Northeastern Offshore Spotted Dolphin–Population is declining.

*Sources: Kinsinger, A. 1995. Marine mammals. Pp. 94-96 in E.T. LaRoe, G.S. Farris, C.E. Puckett, P.D. Doran, and M.J. Mac, editors. Our Living Resources. USDI National Biological Service, Washington, D.C.

National Marine Fisheries Service. 1998. Marine Mammals Protection Act of 1972 Annual Report. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources. Silver Spring, MD.

Recent events in western Alaska illustrate how otter recovery depends on the larger health of the seas. Between 1993 and 1997, research biologists observed a sudden and steep decline of otter populations throughout the Aleutian Islands, an estimated loss of 40,000 otters and nearly 80% of the region's population. Research revealed a cascade of changes throughout the marine food chain. Killer whales had turned to hunting otters, probably because of a recent collapse of Steller sea lion and harbor seal populations, the killer whale's principal prey. As the otters disappeared, sea urchins, the otter's principal food, flourished. Then, as burgeoning urchin populations grazed away the kelp, the kelp forest communities collapsed. The ultimate cause of this chain of events is uncertain, but the drop in sea lions and harbor seals is thought to be due to declines and changes in availability of fish prey species, linked to some combination of increased commercial fish harvests and changes in climate and sea temperatures since the 1970s.[91]



In addition to the ripple of effects through marine systems, threats to otter survival include chemical pollutants, entanglement in fishing nets, illegal shooting, oil spills and pollution. Sea otter monitoring and research allows state wildlife managers to track populations and respond to problems that are revealed. Clearly, sustaining sea otter populations will depend not only on how we care for our coastal environments, but also on how well we manage our offshore marine communities.[92]

Hawaiian Monk Seal: Unique and Dwindling

Found only in the Hawaiian Islands, the Hawaiian monk seal is now seriously threatened. Between the late 1950s and 1982, seal numbers dropped 50%, and the species was listed as endangered in 1976. Populations continued to decline into the 1990s at nearly 5% per year. In 1997, the total count was estimated at 1,300 to 1,400 seals distributed across the islands in several breeding populations. Overall counts have been stable recently, but the largest breeding population at French Frigate Shoals is still decreasing.

The seals face a suite of problems that are limiting their survival. The seals are sensitive to human disturbance on haul-out beaches and pupping areas, and have benefited from management efforts to reduce disturbance. Managers also regularly clean beaches and reefs of debris to reduce deaths from entanglements. High juvenile mortality is also affecting recovery. Researchers attribute the large loss of young seals to starvation and have begun studies of the seals' feeding ecology to better understand where food resources are limited, research made possible only recently by the use of underwater video cams and satellite links. Problems with recovery are also attributed to skewed sex ratios in some breeding subpopulations. Where male seals outnumber females, males will mob females in an attempt to mate, frequently resulting in the death or injury of the females. In 1994, managers relocated males from one breeding site to another island and observed a subsequent decline in mobbing rates.

Populations on the northernmost islands of Hawaii show hope for the monk seal's future. On Kure Atoll, a program to reduce disturbance and protect female pups from shark attacks and mobbing have pushed the population into an upswing. The population on Pearl and Hermes Reef has been growing steadily without intensive management, demonstrating that seals can rebound under natural conditions where they face few threats.[93]

As human pressures on the world's oceans increase, the future for many ocean mammals is not secure.

Flashing Talons

At the top of the food chain, the raptors or birds of prey—eagles, hawks, falcons, kites, and owls—are often key to understanding and conserving healthy ecosystems. Only a few decades ago, the future of many of these magnificent birds looked terribly bleak. Populations of bald eagles, peregrine falcons, and osprey plummeted from the toxic effects of DDT pesticides. Others, such as the golden eagle, suffered from widespread persecution. But with greater protection, the ban on DDT, and focused recovery efforts, some of our most vulnerable birds of prey have made remarkable comebacks.

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On the whole, our understanding of raptor population status and trends is spotty. Counts conducted during raptor migrations that are carried out by trained volunteers return some of the best information we have for population trends over many years, but these do not cover all species. Of America's 60 species and subspecies of birds of prey:

- 9 (15%) are threatened or endangered.
- There is recent concern for an additional 9 species and subspecies (15%), including two that are steeply declining, the burrowing owl and the southeastern American kestrel.
- 6 species (10%) show increasing numbers or range expansion: osprey, Mississippi kite, white-tailed kite, bald eagle, peregrine falcon, and Cooper's hawk.
- 32 (53%) are thought to be stable, although for many of these there are local concerns or information is very limited.
- Surveys are so scarce or difficult to conduct for 14 species (23%) that their status is currently unknown.[94]

Raptors that are closely tied to declining habitats, such as the southeastern American kestrel, northern goshawk in western forests, spotted owl, and burrowing owl, have lost considerable ground and face a less certain future if habitat loss continues. Some pesticides can also reduce raptors' prey, while environmental toxins can have indirect effects on birds' health. Organophosphate pesticides still used in some regions of Latin America can be directly lethal to birds where they spend half the year. Hope for sustaining our birds of prey lies in forging partnerships among management agencies and across borders to invest in, manage, and conserve the quality of these species' habitats.

SOME OF OUR MOST VULNERABLE BIRDS OF PREY HAVE MADE REMARKABLE COMEBACKS.

Return of the Eagle

The bald eagle, symbol of the United States, nests along rivers, lakes, and coastlines, sweeping up fish with a flash of hook-like talons. As for many other raptors, bald eagle populations were once devastated by the effects of organochlorine pesticides, especially DDT, sprayed over croplands and forests. As these chemicals washed into watersheds and aquatic communities, the birds accumulated the toxins in their tissues and laid eggs with shells so thin the eggs crushed beneath the weight of the incubating parents. Eagle populations plummeted. With the 1972 nationwide ban on DDT, bald eagles and other affected species began to recover. Protection and management actions initiated under the Endangered Species Act, including restoration projects and conservation of shoreline and nesting habitats, have also been critical to the birds' return.

Today eagles are on the upswing. In the U.S. outside of Alaska, bald eagles have steadily increased from 1,300 pairs in 1982 to just under 6,000 pairs in 1998. In 1995, the bald eagle was upgraded from endangered in the lower 48 states to threatened, and in 1999 was proposed for delisting.[95] The abundant Alaska eagle populations now number 20,000 to 25,000 pairs.[96] Wildlife managers are still concerned over low eagle reproductive rates in the Northeast and Great Lakes, and with sustaining the quality of fisheries and shoreline habitats, but the future looks much brighter for these spectacular birds.

DAVID CLENDENEN
US FISH AND WILDLIFE SERVICE

Condors Soar Again

The largest flying bird in North America is again gracing the skies over southern California and northern Arizona due to a remarkable recovery effort. Early explorers once reported seeing California condors from British Columbia, Canada, south into Baja California, Mexico. But this king of the North American vultures gradually declined as it was shot, poisoned, and suffered from

Flashing Talons

the effects of egg collecting. With settlement and development, the condor's food base of carrion of large native animals declined and habitat was lost. By 1982, twenty-four condors remained in the wild and three in captivity, a population of only twenty-seven individuals remaining in the world.

As the birds faced extinction, a captive breeding program was begun with the cooperation of facilities at several zoos. The first captive-bred condor chick hatched in 1988, and the first two condors were released back to the wild in 1992. Three breeding centers now help raise nearly 20 chicks each year. Condors have been returned to the skies at three release sites in southern California and, after a 72-year absence, at two sites in Arizona. At the end of 1998, 43 birds were living in the wild and 149 in captivity.

The current outlook is hopeful though guarded. The birds face numerous obstacles to survival and some released birds have died. The condors have not yet reproduced in the wild, the litmus test for success and real recovery. Yet as the first wild birds reach maturity they are showing signs of courtship behavior, and the recovery team is hopeful the birds will eventually nest and raise a new generation of wild condors.

The progress made by the condor recovery program is due to partnerships between California, Arizona, and Utah state wildlife agencies, federal wildlife and land management agencies, two tribes, two zoos, and raptor conservation groups. Biologists and volunteers have logged hundreds of hours following the condors, helping steward their return. Many once-ambivalent citizens have become condor-supporters, dude ranches and guides are advertising condor-watching opportunities, and bird-lovers are now coming from around the globe to glimpse this great vulture in its native home.[97]

Owl of the Underground

The burrowing owl is a denizen of prairies and grasslands, but unlike most other birds, it nests in underground burrows dug by prairie dogs or ground squirrels and thrives where these colonial mammals are abundant. But widespread control and elimination of burrowing mammal colonies throughout the Great Plains and western states, plus conversion of many grasslands and farmlands to intensive development throughout the bird's range, have hit the owl hard, resulting in steep population declines.[98]

There is hope, however, for there are still population strongholds in Florida, Texas, southern California, and on the National Grasslands in the Great Plains, as well as smaller populations scattered across many states. The burrowing owl is also remarkably adaptable to human landscapes so long as it can find open areas with nest burrows and foraging habitat. Because much of the remaining burrowing owl habitat is on private land, successful management and recovery efforts require creative partnerships and incentives for private landowners to help the owl thrive.

DAVID CLENDENEN
US FISH AND WILDLIFE SERVICE

Bright Wings in the Blue

America is home to a total of 776 native bird species, of which 80 (10%) are now listed as threatened or endangered.[99] Traditionally, managers have only had funds to invest in those birds that are hunted (waterfowl and upland game birds) or are specifically endangered (for example, peregrine falcons and bald eagles). But there is growing concern for other species as well. It has become clear that many smaller birds, including warblers, vireos, flycatchers, thrushes, thrashers, sparrows, woodpeckers, and hummingbirds, are declining at distressing rates. Even some common songbirds are losing ground.

Because birds are visible, ubiquitous, and highly mobile, it is easy to assume their populations are abundant and healthy. Compared to other wildlife, birds are relatively well-surveyed. Research studies and the observations of birdwatchers uncovered the first evidence that many bird species were disappearing from familiar haunts. Subsequent analysis of long-term population surveys, such as migration counts, the North American Breeding Bird Survey, and Christmas Bird Count, have revealed losses of birds in every part of the continent.

If we look at population trends at the grossest level, it is tempting to conclude that there is little problem for birds as a group. Although some species are declining, some are increasing, and the majority show no clear trend. Yet if we examine which species are in decline and where, the picture is troublesome. For example:

TEXAS PARKS & WILDLIFE

- Forest songbirds that depend on large areas of intact woodland, such as the wood thrush and cerulean warbler, are steeply declining across their ranges. In the Adirondacks and Great Smoky Mountains many or most forest songbirds are in decline.
- Grassland birds show more species in decline than any other habitat group. This group includes the bobolink, eastern meadowlark, Sprague's pipit, and many sparrows.
- Many shrubland birds, such as eastern towhee and prairie warbler, and sagebrush steppe birds, such as the Brewer's sparrow, are significantly declining in many parts of their range.
- Crows, cowbirds and some other species that thrive in human-altered environments have become superabundant, creating problems for other birds and for humans as well.

LONG-TERM POPULATION SURVEYS HAVE REVEALED LOSSES OF BIRDS IN EVERY PART OF THE CONTINENT.

Overall, more specific monitoring is needed for a large number of species to make reliable conclusions on status or trends.[100]

Birds have many natural foes, but human-caused changes to our landscapes are tipping the balance. Wild habitats have been lost, degraded and fragmented, not only on breeding grounds in North America, but also on the non-breeding grounds of migratory species in Mexico, the Caribbean, Central America and South America. Predators that thrive in human environments, such as crows, raccoons, squirrels, and our own beloved cats, take a heavy toll by preying on eggs, nestlings, or adult birds. The brown-headed cowbird, which lays its eggs in other birds' nests, expanded its range in the wake of forest clearing and the spread of livestock and is having a dramatic impact on the productivity of many woodland songbirds. Chemical pesticides and herbicides, some banned in the U.S. but still used in Mexico, Central America or South America where birds winter, also impact bird survival and fertility. Biologists also estimate that anywhere from 4 to 11 million migrating birds are killed each year by collisions with the windows of tall buildings and communications towers, disoriented by reflections and lights.[101]

The good news is that wild birds have an increasing constituency of some 54 million bird lovers in America, and a far-reaching network of citizen and professional bird enthusiasts has come together to tackle the problem of bird declines through several conservation initiatives. Partners in Flight, for example, an international coalition with hundreds of corporate, non-profit, and government partners, serves as a catalyst and funding source for many of these initiatives. Partners in Flight is working to set conservation priorities on a regional basis, and has undertaken landscape-level, habitat-based conservation planning for bird communities on state and regional scales. On a grassroots level, wildlife agencies and their partners are working to boost monitoring efforts, build partnerships between public and private landowners, incorporate the needs of birds into land management practices, and conserve bird habitats.

Birds play important roles in every environment, consuming insects, dispersing of seeds, and pollinating plants. The composition and productivity of bird communities are visible indicators of the health of natural environments. We are building a good base of biological knowledge, monitoring programs, and conservation strategies that can serve as a foundation for bird management. The future of our bird life depends on better understanding population declines, conserving habitat, improving land stewardship, and reducing the threats to their survival. We still have much to learn about species' needs and far to go in planning and implementing conservation for birds.

> **How steep are bird declines?**
>
> **Does an average loss of 1% per year sound like much? At that rate, a population would drop by about 25% in thirty years. Steady, incremental declines over many years take their toll, and some losses are staggering. Breeding Bird Survey data suggest that, in the geographic areas covered by the survey, there are almost 50% fewer American bitterns, 60% fewer black terns, and 65% fewer loggerhead shrikes than only 30 years ago. The rufous hummingbird has declined by 55%, the olive-sided flycatcher by nearly 70%, and the cerulean warbler by 75% since the mid-1960s.[102]**

Birds of Meadows and Prairies

In America's grassland habitats, a greater proportion of bird species are declining than in any other habitat type across the country. Meadows and prairies have undergone extensive change, and native grasslands are now perhaps the most limited of bird habitats. For example, 90% to 99% of the Midwestern tallgrass prairie is gone, Florida's dry prairies have been converted to agriculture and pasture, most of Louisiana's coastal prairies are lost, much of our coastal dune grasslands are degraded or gone, and California has lost 99% of its native grasslands. [103] Bird population trends, taken on average across species' ranges, appear to be reflecting these changes. Of twenty-eight species that inhabit grasslands:

- 13 (46%) have significantly decreased across their ranges over the last 30 years
- 7 species (25%) are probably declining
- only 3 species (10%) have significantly increased.

The eastern meadowlark, short-eared owl, mountain plover, Sprague's pipit, dickcissel, and bobolink have all suffered long-term decreases. Many of the sparrows, those "little brown birds" that specialize on grassland habitats, also show significantly declining trends in many parts of their ranges. These include Henslow's sparrow, grasshopper sparrow, Cassin's sparrow, vesper sparrow, savannah sparrow, and Baird's sparrow.[104]

Buntings and Goldfinches: Fewer Birds in the Bush

The American goldfinch readily captures bird-lover's hearts, flashing black wings against canary yellow plumage as it bobs about on thistle heads and feeds in weedy fields. The painted bunting, a brilliantly-colored and shy inhabitant of dense thickets and woodland edges of the South, is also a splashy favorite of bird-watchers. There are signs of trouble for both of these colorful birds, along with many other species that inhabit brushy habitats. Between 1966 and 1996, American goldfinch populations on average slid 20%, and painted bunting numbers plummeted more than 60%. Of eighty-six species that breed in shrublands, thickets, willow bottoms or brush:

- 29 species (34%) show significant long-term losses across their ranges
- 21 (25%) show possible declines
- 16 (19%) have significantly increased.

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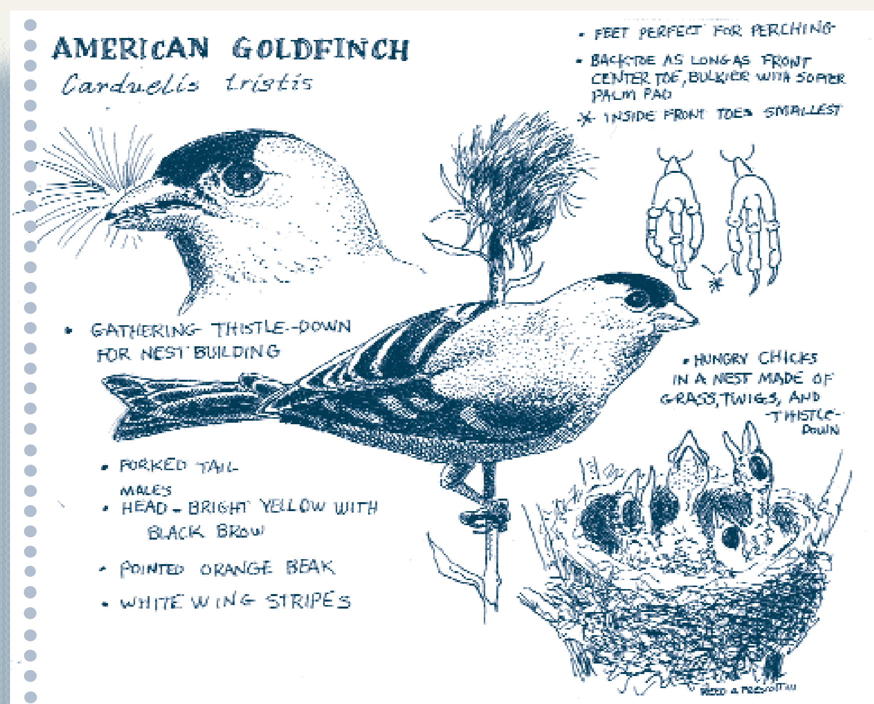

Declining shrubland species include the prairie warbler, indigo bunting, curve-billed thrasher, California thrasher, Bell's vireo, verdin, eastern towhee, canyon towhee, willow flycatcher, Brewer's sparrow, white-crowned sparrow, and song sparrow. [105]

Birds of Forests and Woodlands

As once-extensive forests have been divided into smaller and smaller remnants by agricultural clearing, suburban development, and timber harvest, those bird species that depend on forest interior habitats, such as the wood thrush and cerulean warbler, have been losing ground. Birds breeding in small forest fragments are more vulnerable to brood parasitism by cowbirds and to nest predators that thrive in these patchwork environments. Biologists are finding that predation and parasitism rates can be so high in small woodland fragments that many species are not producing enough young birds to sustain local populations.[106]

Riparian forests, the woodlands that grow along streamsides and river courses, are some of the most important habitats to songbirds. In the arid western U.S., nearly 80% of landbirds use these ribbons of lush green at some point during the breeding, migration or wintering seasons. Yet riparian habitats have suffered heavy losses. At the extreme, California has lost nearly 90% of its riparian forests statewide, and perhaps 90% of the original presettlement riparian habitats in elevations below 4500 feet in Arizona and New Mexico are gone.[107] Control of river flows, development, and overgrazing have altered and degraded these habitats, and many remaining riparian woodlands lack the understory of shrubs and young trees needed by birds. This loss may be reflected in the long-term declines of the yellow-billed cuckoo and willow flycatcher, species that nest only in riparian habitats.

50% OF OUR THREATENED OR ENDANGERED BIRDS IN THE U.S. OCCUR ON ISLANDS.

Endangered Island Birds

Island species are more susceptible to loss simply because their populations are usually small and isolated from continental populations. Through time and separation, island species may gradually become distinct from related species elsewhere, and so islands show high rates of endemism (species that occur there and nowhere else). Because island wildlife is so vulnerable, it is not surprising that 50% of our threatened or endangered birds in the U.S. occur on islands, specifically Puerto Rico, the Hawaiian Islands, Guam and the Northern Mariana Islands.

Puerto Rico is home to three endangered endemic species, the Puerto Rican parrot, Puerto Rican nightjar, yellow-shouldered blackbird; and three endangered subspecies, the Puerto Rican plain pigeon, Puerto Rican broad-winged hawk, and Puerto Rican sharp-shinned hawk. Habitat loss and degradation are the principal threats to these species, but avian disease, parasites, and predation are also problems for dwindling populations.

One of the world's most isolated ocean archipelagos, the Hawaiian Islands harbor a unique array of endemic birds. Human colonization had an enormous impact on bird life throughout Polynesia, and scientists estimate that early Polynesians may have eliminated more than 2,000 species of birds from Pacific islands. Of 76 species of endemic songbirds, 45 were known since European discovery of the Hawaiian islands in 1778; 31 are known only as fossils. Of the 45 known historically, 19 are now extinct, and 9 are possibly extinct with no sightings in the last ten to thirty years. Only 8 species are not listed as threatened or endangered. The remaining endemics are seriously endangered or declining, a result not only of habitat loss, but also introduced avian pox virus and malaria; introduced predators such as cats, rats, dogs, and mongooses; competition for resources with introduced wasps and ants; and feral pigs that degrade rain forest habitats.[108]

Birds of the Sea and Wetlands

More than 150 species of seabirds, shorebirds, and wading birds breed in North America. This group of birds include the cormorants, pelicans, herons, egrets, ibises, puffins, murres, sandpipers, curlews, plovers, gulls, and terns. At the turn of the century, plume-hunting, gunning for market hunting and sport, and destruction of nesting colonies drove dozens of these species close to extirpation. But public concern over the precipitous loss of these birds gave birth to some of our country's earliest conservation laws and our first National Wildlife Refuge. Fortunately, protection of the birds and their nesting habitat has allowed many species to recover from early losses.

Today, information on current population trends for many of these birds is sketchy, although programs such as the International Shorebird Survey, Delaware Bay survey, Breeding Bird Survey, Christmas Bird Count, Colonial Waterbird Inventory and Monitoring Program, and the Pacific Seabird Monitoring Database are building a foundation of baseline data.

Many herons and egrets, the graceful wading birds of our marshes, are the beneficiaries of our country's system of wetland refuges and sanctuaries. Their populations appear to be stable or increasing. For instance, the great blue heron, snowy egret, and black-crowned night heron have all significantly increased in recent decades. However, there are a few exceptions. The American bittern and green heron have shown serious declines in the last 30 years. Local declines have been observed for the reddish egret, which is considered a species of concern on the Partners in Flight Watch List. The whooping crane, Mississippi sandhill crane, wood stork, and three subspecies of clapper rail are federally listed as threatened or endangered.

We know very little about the status of most shorebirds—the sandpipers, curlews, and plovers that inhabit beaches and rocky coasts. Shorebird populations can fluctuate greatly with changes in climate and food abundance, but evidence of declines for 19 species (about 30% of North American shorebird species, and 76% of the species evaluated for trends) is reason for attention. Recent evaluations of shorebird trends show either decreasing populations or no change and only one species, the upland sandpiper, that has increased. Thirteen shorebirds are considered species of concern on the Partners in Flight Watch List. Although many shorebirds nest in the Arctic where breeding habitats are largely intact, they also depend on specific wetlands, bays, and estuaries (such as the Great Salt Lake, Utah; Gray's Harbor, Washington; and Delaware Bay, between Delaware and New Jersey) as staging areas on their long migrations south. Here millions congregate for a brief but crucial period each spring and fall to refuel on seasonal blooms of aquatic invertebrates, where these concentrations of birds are particularly vulnerable to pollution or the loss of these stopover sites. Many shorebirds also concentrate in relatively small wintering areas and migration staging sites in Mexico, Central and South America.

Most seabirds (gulls, terns, murres, puffins, auklets, and petrels) nest in large colonies on rocky islands and sea cliffs, spending the rest of the year dispersed over the oceans. Some nest on beaches where they are vulnerable to destruction and disturbance, and the marbled murrelet nests in dwindling coastal forests. The roseate tern, two subspecies of least tern, and marbled murrelet are on

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Shorebirds and Seabirds at Risk:

Endangered/Trend

Brown pelican
Increasing, now common

Wood stork
Declining

Piping plover
Declining

Eskimo curlew
<50; possibly extinct

Roseate tern
Declining

California least tern
Possibly increasing

Interior least tern
Local increases

Threatened/Trend

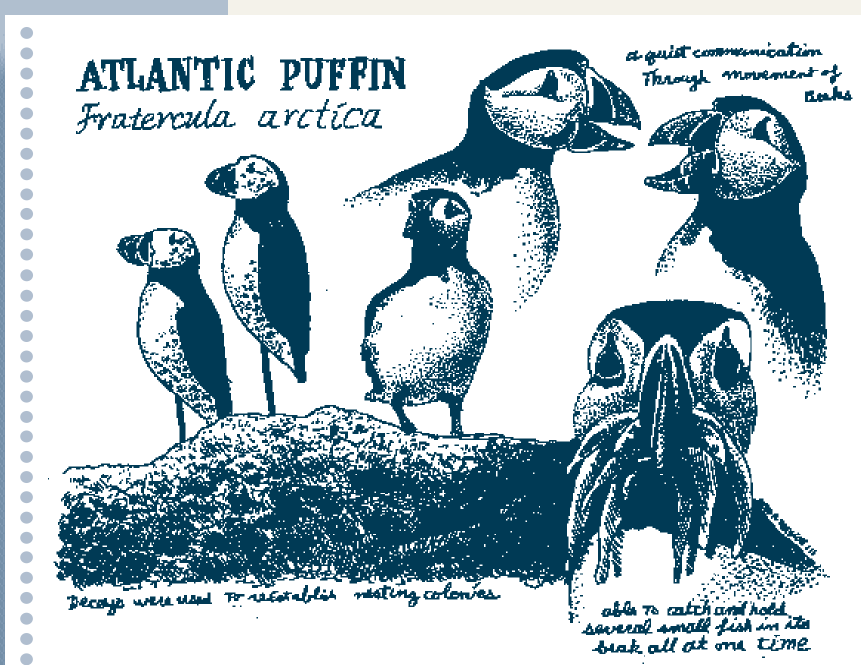
Marbled murrelet
Declining

Western snowy plover
Declining

Source: USFWS. 1999. Listed species. Online: www/fws/gov/r9endspp/ U.S. Fish and Wildlife Service Division of Endangered Species, Washington, D.C.

the threatened and endangered species list; the black tern has suffered serious declines. Researchers have correlated dramatic drops in productivity and populations of murres and kittiwakes in the Pribilof Islands, Alaska, with changes in availability of forage fishes in the Bering Sea. Many gull populations have increased substantially in the last few decades, particularly because of their predilection for eating garbage. But abundant populations of some gull species pose a problem for other seabirds, as the aggressive gulls outcompete them for nest sites and prey on eggs and nestlings.

The future for wading birds and shorebirds depends on how we protect and manage wetlands and strategic stopover sites. Development of national conservation plans for shorebirds and colonial waterbirds, patterned after the North American Waterfowl Management Plan, is now underway. We also need to continue to build international cooperation to monitor populations and manage breeding and non-breeding habitats. The Western Hemisphere Shorebird Reserve Network is a voluntary effort tackling the challenge of cooperative conservation across international borders. One of the greatest threats to nesting seabirds has been the introduction and increase in small mammalian predators (rats, foxes, feral cats, and feral dogs) in many nesting areas. Other problems include oil spills, nesting habitat loss, disturbance of nests on beaches, and entanglement in gillnets and longlines at sea. In a recent step forward, 80 nations agreed to a global accord to reduce incidental killings of seabirds in longline fisheries through cost-effective modifications to fishing practices.[109]



Atlantic Puffin Regaining a Foothold in Maine

Black and white with a bright parrot-like bill, the Atlantic puffin is the clown-faced darling of the seabirds. Today the puffin is making a remarkable comeback, thanks to a 25-year effort by the National Audubon Society's "Project Puffin." By the early 1900s, the puffin was nearly wiped out by hunters for feathers and food in Maine, the only place the Atlantic puffin breeds in the U.S. By mid-century, modest population gains were thwarted by competition for nest sites with great black-backed gulls and herring gulls, birds that thrive on human's garbage. The puffins lost all but one known nesting site to the aggressive gulls.

Between 1973 and 1986, with the cooperation of the Marine Department of Inland Fisheries and Wildlife, the U.S. Fish and Wildlife Service, Canadian Wildlife Service, and dozens of volunteers, Project Puffin brought in 954 puffin chicks from Newfoundland to Eastern Egg Rock, Maine. Volunteers raised the chicks in artificial burrows, fed them fish, and removed gull nests. Puffin decoys were erected to entice the birds to return, creating the illusion of an established puffin colony. In 1981, four pairs nested on Egg Rock. By 1998, a colony of twenty-five pairs was established. Project Puffin also re-established a breeding colony at Seal Island National Wildlife Refuge. In 1992, puffins nested on the island once again, the reward of eight years of re-introduction work, and 105 years after the last puffin had been destroyed on Seal Island. The breeding population has since soared and 78 pairs made Seal Island home in 1998.

Wildlife stars of the North Atlantic, the puffins attract a huge public following. In summer, three tour boats a day, crowded with tourists eager for a glimpse of the dapper birds, ply the waters around Eastern Egg Rock. Through the efforts of Project Puffin, Eastern Egg Rock now also hosts all eight seabird species once known to breed in the area: common terns, laughing gulls, black guillemots, roseate terns (an endangered species), Leach's storm petrel, Arctic tern, common eider, as well as the puffin. The island is again alive with over 5000 raucous, wheeling birds—a vision of what once was, and what can be again.

Whistling Wings

Few of us are left unmoved by the sight of geese and ducks flying across the sky on a spring day, their wings beating a path north to wetlands, prairie potholes, or tundra, carrying the seasonal promise of another cycle of birth and renewal. About 45 species of native waterfowl occur in the continental U.S. These include geese, swans, whistling and perching ducks, stiff-tail ducks, dabbling ducks, diving ducks, sea ducks, and mergansers.

Waterfowl populations were once severely depleted by overharvesting and wetland loss, but with population management and habitat protection ducks and geese have rebounded from severely low numbers. The North American Waterfowl Management Plan (NAWMP) is a model of conservation based on partnerships, a biological framework, and a landscape perspective. Hunting regulation, seasonal population monitoring, joint ventures for habitat restoration and protection, wetland management, international cooperation, and the investments of state and federal wildlife agencies, sportsmen, and conservation groups all contributed to the turnaround for most waterfowl species.

Of 18 species of ducks, geese, and swans that are regularly monitored on the North American Waterfowl Breeding Population Survey, 16 have been stable or increasing since the 1980s. With a boost of productivity from several wet years, most of these ducks and geese are now at a 25-year high.[110] This recovery is a boon to bird hunters, who contribute significantly to state and local economies. For example, in 1996 3.1 million migratory bird hunters (including both waterfowl and upland birds) spent $1.3 billion on hunting trips and equipment.[111]

In contrast, no reliable long-term population data exists for the 15 species of North American sea ducks, which include the eiders, scoters, goldeneyes, bufflehead, and mergansers. However, recent surveys and research suggest that many of these species are steeply declining. Oldsquaw and scoters appear to be suffering long-term declines. The spectacled eider and Steller's eider are federally listed as threatened. Numbers of harlequin ducks are low and the eastern population is listed as endangered in Canada. Sea ducks depend on marine environments and a variety of inland habitats in different seasons and their breeding success is affected by climatic fluctuations, making them vulnerable to habitat degradation and climactic change. Sea ducks reproduce more slowly than other ducks, so it can be difficult to enhance productivity and populations may take longer to recover from declines.[112]

Our success in boosting many waterfowl populations is tempered by the knowledge that their numbers can swing widely in response to environmental conditions, and by our data gaps for many species. Our knowledge of the range-wide status of some species is meager, and consistent monitoring and research is needed for their management and conservation. Growing human population and development are putting increasing pressure on wetland and coastal habitats. Although wetland conservation has made great strides in recent years, losses still exceed gains, now mostly due to urban development rather than to agriculture.[113] Extended drought, pollution, avian diseases, and increasing numbers of small predators (such as foxes, coyotes, skunks, and raccoons) also pose problems for sustaining waterfowl numbers. At the same time, species such as the Canada goose and snow goose have made such an enormous comeback that their overabundance has become a serious management problem.

Wildlife managers face ongoing challenges to manage and sustain waterfowl numbers, and further understanding of species that are declining is urgently needed to manage their recovery. We also need to ensure that there is an extensive safety net of habitat so that populations can recover from natural declines due to climatic cycles. There remain many opportunities for partnerships and incentives to weave waterfowl conservation into private and public land management.

GROWING HUMAN POPULATION AND DEVELOPMENT ARE PUTTING INCREASING PRESSURE ON WETLAND AND COASTAL HABITATS.

PAUL MOURE
OUTDOOR OKLAHOMA

Whistling Wings

Waterfowl Population Trends: 1990-1999

Overall status of species surveyed by the North American Waterfowl Breeding Population Survey.

Increasing

Tundra swan
Greater white-fronted goose
Greater snow goose
Lesser snow goose
Ross's goose
Canada goose
Green-winged teal
Blue-winged teal
Mallard
Northern shoveler
Gadwall
American wigeon
Canvasback
Redhead
Ring-necked duck

Stable

Emperor goose
Brant

Currently stable; numbers depressed

American Black Duck
Northern pintail

Declining

Greater scaup
Lesser scaup

Source: U.S. Fish and Wildlife Service. 1999. Waterfowl population status, 1999. U.S. Fish and Wildlife Service, Office of Migratory Bird Management, Arlington, VA. Online.

Snow Goose: Tundra Trouble

Too many geese can be a headache for wildlife managers. Skyrocketing numbers of lesser snow geese and Ross's geese are causing an ecological crisis in the fragile tundra breeding habitats of the eastern Arctic and sub-arctic. Snow goose populations have tripled since the mid-1970s to over 5 million birds, far exceeding any historical population records. As a result, the expanding flocks are eating themselves out of their breeding grounds. As the enormous flocks grub for roots and tubers, they destroy large areas of slow-growing Arctic plants and the thin remaining soil quickly erodes. The damage ripples through the tundra community, reducing breeding habitat and food sources for many other wildlife species.

Why so many geese? An abundance of cereal crops in agricultural fields where geese migrate and winter has dramatically boosted goose survival and lifespan, meaning each female will produce more goslings in her lifetime. Additionally, a warming climate has increased reproduction and snow goose harvest rates have declined as goose numbers expanded beyond the point where current harvests could impact the population.

Managers are now proposing to use regulated hunting to reduce adult snow goose populations to a sustainable level.[114]

Northern Pintail: Long-term Decline

The northern pintail, one of our most handsome dabbling ducks, has suffered a steady population decline since the mid-1950s. It is one of the few species whose numbers have stayed depressed since the early 1980s despite habitat conservation and restoration efforts.[115] Decreases are most evident in the prairie regions of the U.S. and Canada. Northern populations from Alaska to northern Manitoba have remained more stable. Unable to link this decline to changes in pintail survival or lack of habitat, researchers suggest that agricultural run-off is affecting the shallow-water pothole habitats pintails need to breed, particularly in Canada's western prairies.[116]

Ruffs, Bustles and Drums

America's upland game birds—grouse, turkey, quail, ptarmigan, and doves—have benefited from the devotion of hunters who help support game bird management and habitat conservation through hunting fees and licenses, and from the conservation efforts of game bird foundations. Grouse and quail not only provide exciting hunting and bird-watching opportunities but are critical links in the food chain, furnishing meals to hawks, eagles, foxes, bobcats, and a host of other predators in prairie, forest, and tundra communities. In addition, gray partridge, chukar, and ring-necked pheasant were introduced from Europe and Asia to provide more bird hunting opportunities. These three species are now well-established across broad regions of the U.S.

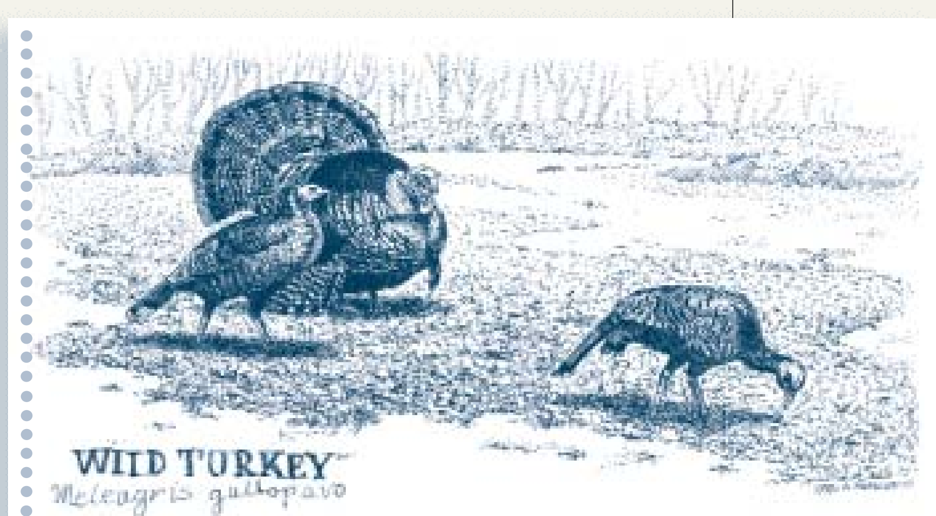
State wildlife agencies oversee game bird monitoring and management, but there is no single survey that provides an overview of all populations across their ranges. Add to this the tendency of many of these species' populations to seesaw in response to environmental conditions, and it can be difficult to get a clear view of population trends or status. We do know, however, that many game birds are struggling against habitat loss and change, particularly farmland and prairie species. For instance, the northern bobwhite, widely regarded as "king" of the upland game birds, once thrived in the thickets, mature woodlots, and rough pastures of the East. But with the advent of intensive, mechanized farming, loss of borders and hedgerows, conversion of native grasslands to introduced grasses, broad-scale use of pesticides, and conversion of mature woodlands to pine plantations, northern bobwhite populations have declined for the past fifty years.[117] Likewise, the greater and lesser prairie-chickens historically numbered in the millions, but were severely reduced with the loss of native grasslands and prairies throughout the Midwest states. Sage grouse, once the most common grouse throughout the sagebrush steppe of the western states, have declined precipitously and been lost altogether from five states. The band-tailed pigeon, once a popular quarry on the West Coast, has declined precipitously over the last 30 years.[118] Counts of mourning doves, one of our more abundant and important game birds, also declined across the U.S. from 1966 to 1999.[119]

State wildlife agencies have helped build our knowledge of these birds, and monitor and maintain many populations. Now the future for these species depends on how well we manage and conserve their habitats to recover declining populations. Partnerships with private landowners, such as the Conservation Reserve Program (CRP) or other financial incentives, may be one of the most effective means to sustain these birds throughout our rural landscapes. For example, sharp-tailed grouse have increased in agricultural regions where CRP plantings provide cover for rearing broods, particularly where native grasses are used. Conservation and sustainable management of woodlots, hedgerows, grasslands, and shrub-steppe habitats will not only help maintain game bird populations but will protect habitat for other wildlife throughout the rural American landscape.

The Wild Turkey's Return

Before European settlement, perhaps 7 to 10 million wild turkeys inhabited what is now the United States, providing a major source of food, ornamentation, and clothing for Native Americans. In the 1800s, settlers' accounts reported such abundant numbers that raising domestic turkeys was needless, and wild turkeys became a significant source of food and income by way of game markets. With unrestrained hunting and the disappearance of mature eastern woodlands, the turkey faded from the landscape. By 1920, turkeys were extirpated from 18 of the 39 states covering their native range, surviving only in small, remote populations.

Wildlife biologists and the hunting community worked together to make wild turkey recovery one of wildlife management's success stories. State wildlife agencies restored and reintroduced wild turkeys into forests and woodlands throughout the U.S. with aid from sportsmen's dollars through the



Wildlife Restoration Act and the efforts of game bird conservation groups. Early attempts to rear turkeys in captivity for reintroduction were frustrating. The captive-reared birds did not have the needed imprinting on wild hens or the experience to survive in the wild. Subsequently, the development of a "cannon-net" to capture wild birds provided a break-through that allowed managers to relocate wild birds into unoccupied areas. Better forest practices that improved habitat conditions, law enforcement that reduced poaching, a ground swell of public support, and the turkey's own adaptability to a variety of woodland habitats also helped the bird rebound. Populations climbed from a few tens of thousands to half a million by 1959, and to nearly 4 million by 1990. Today, hikers in spring woodlands can once again catch a glint of iridescent plumage and a rush of heavy wings, and millions of turkey hunters enjoy the pursuit of this wariest of quarry.[120]

America's Upland Game Birds Status

Mourning Dove

Abundant but counts show 34-year declines across the species' range.

Band-tailed Pigeon

Locally abundant but steeply declining in far western states.

American woodcock

Overall long-term declines indicated over the past 20 years.

Spruce grouse

Numerous in Arctic but scarcer in coniferous forests further south. Insufficient data for an overall trend.

Blue grouse

Numerous in western coniferous forests, but declining in the southern part of its range; data are insufficient for an overall trend.

Willow ptarmigan

An Arctic species, populations are abundant but highly variable.

Rock ptarmigan

Abundant in the Arctic but populations are variable.

White-tailed ptarmigan

A bird of the alpine; numerous in Alaska. Some populations probably cyclic; data insufficient for an overall trend.

Ruffed grouse

Populations are cyclical, but long-term trends appear stable.

Sage grouse

Once common, now scarce and sharply declining due to loss and degradation of sagebrush habitats.

Greater prairie-chicken

Greatly reduced from loss of tall-grass prairie, but some populations common enough to support hunting.

Attwater's greater prairie-chicken

A critically endangered subspecies found only in Gulf Coast prairie.

Lesser prairie-chicken

Populations declined due to loss of native prairie and now survive in small isolated groups.

Sharp-tailed grouse

Numerous in northern regions; local declines and extinctions recorded at range peripheries.

Wild Turkey

Broadly increasing with help from reintroduction and management.

Northern bobwhite

Seriously declining throughout East due to habitat degradation.

Masked bobwhite

An endangered Arizona subspecies; currently being reintroduced from Mexico.

Montezuma quail

An inhabitant of southwest pine-oak hillsides; data are insufficient for population trends.

Gambel's quail

A common bird of desert scrub; populations are stable.

California quail

Numerous in the West, populations are recovering from earlier declines.

Mountain quail

Numerous in mountain slopes of the Far West, populations stable to decreasing.

Scaled quail

A bird of arid scrublands, still numerous but declining.

Gray partridge

Introduced from Europe and established in the northern prairies; populations declining.

Chukar

Brought from Europe, locally numerous in arid mountains, but population declining overall.

Ring-necked pheasant

Native to Asia and established throughout American farmlands and grasslands; declining in the East.

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Creatures of Two Worlds

Until very recently, few people except children and professional herpetologists gave much notice to the world of amphibians—our frogs, toads, newts, and salamanders. In the last decade, however, biologists sounded an alarm that many amphibian populations are rapidly declining and disappearing in the U.S. and worldwide. Field research has documented dramatic and widespread declines that many researchers believe are not part of normal population cycles. Amphibians are not only being lost from altered or degraded habitats but also from protected areas such as Yosemite National Park and the Caribbean National Forest, presenting a paradox for investigators.

In very close contact with their surroundings, amphibians may respond to environmental changes that are imperceptible to humans. They play important roles in ecosystems as both predators and prey, and their permeable skin and lack of a protective shell for their eggs make them sensitive to the chemistry of both air and water. Most species are dependent on both terrestrial and aquatic environments during different phases of their life cycle. For these reasons, many biologists assert that amphibians can be sensitive biological indicators of the health of the environment.

Approximately 230 amphibian species are found in the continental U.S., and another 25 in Puerto Rico and the U.S. Virgin Islands. Sixteen species (6%) are federally listed as threatened or endangered, and eight species or subspecies are under consideration for listing. Most of the federally listed species occur in very restricted areas and are threatened by habitat destruction. But isolated, endemic species are not the only ones at risk. Since 1980, as more declines and disappearances have been documented, the number of species with widespread ranges that are in trouble increased from 5 to 33 in the continental U.S.[121] For example, the once common Blanchard's cricket frog has severely declined throughout the Upper Midwest. The Natural Heritage Network now classifies a total of 82 species (35% of our amphibian species) as imperiled or vulnerable.[122]

DAVID SCOTT©

The western states and Puerto Rico appear to be hotspots for amphibian declines. Twenty percent of the native species are at risk in Washington, Oregon, Nevada, Arizona and Texas.[123] In California, about 30% of native amphibians are in decline, and in particular the eight species of native ranid or "true" frogs are fast disappearing.[124] In Puerto Rico, two-thirds of the native species are declining, and three species of coqui frogs are now extinct.[125]

Despite widespread reports of species losses and declines, research over the past decade indicates that there is probably no single overriding cause. Habitat loss, alteration, fragmentation and pollution have taken the largest and most pervasive toll on amphibians nationwide. Roads and development fragment populations so that natural recolonization is impossible if a population dies, while draining wetlands or converting them to aquaculture farms eliminates habitat. Synthetic chemicals, metallic contaminants, pesticides, acid rain, diseases, chytrid fungus, increased ultraviolet radiation from ozone depletion, fluctuations in drought patterns and humidity from climate change, and collection for biological supply have also been implicated in declines of certain species. Many amphibians, including some living in protected parks and refuges, have suffered from the introduction of non-native fish, crayfish, and bullfrogs that prey on or compete with eggs, tadpoles, or adults.

Some of these many factors probably interact. For instance, general stresses from environmental degradation may increase amphibians' susceptibility to disease or parasites. Researchers in Oregon's Cascade Mountains suggest that increases in ultraviolet radiation from ozone depletion damage the eggs of Cascades frogs and western toads, making them more vulnerable to infection by a fungus that is carried by hatchery-raised fish.[126]

Since the mid-1990s there have also been increasing reports of frogs and salamanders with physical deformities (such as missing, extra, or malformed limbs) that have caught the attention of the public and media. Although occasional physical deformities are normal (there are similar reports dating back into the 18th century) investigators are concerned that in some recent cases the percentage of abnormalities is higher than it should be in a healthy population, and abnormalities are showing up in a wide variety of species, including northern leopard frogs, spring peepers, tree frogs and tiger salamanders.[127] Deformities can be caused by parasites, increased ultraviolet radiation, and chemicals introduced to the environment, such as pesticides and fertilizers. Lately,

In intimate contact with their surroundings, amphibians may respond to environmental changes that are imperceptible to humans.

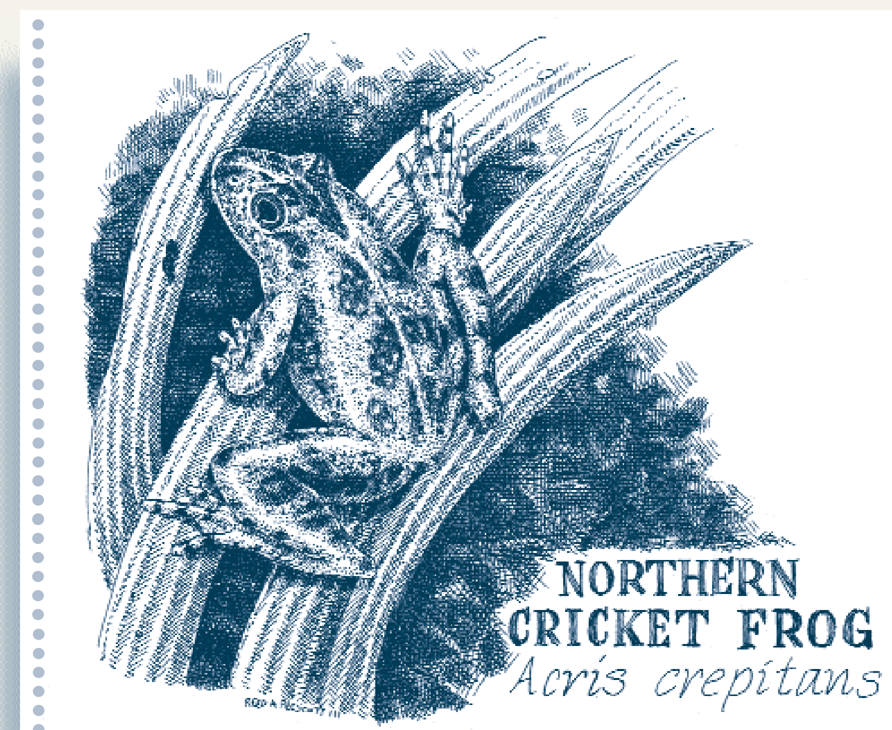
researchers have particularly focused on the impact of retinoids, the active ingredients in many insecticides, which could also have repercussions for human health.[128]

Without long-term survey data it is difficult to distinguish human-related impacts on amphibians from natural patterns, but in the last decade an international network of biologists has begun to address the mysteries of population declines and physical abnormalities. Several cooperative programs (e.g., the Declining Amphibian Populations Task Force, Partners in Amphibian and Reptile Conservation, North American Amphibian Monitoring Program, Task Force on Amphibian Declines and Deformities, and the North American Reporting Center for Amphibian Malformations) were recently established to help investigators coordinate their efforts. Surveys and monitoring projects are underway with the help of volunteers and amateur naturalists. Several state fish and wildlife agencies are compiling geographical atlases of amphibian and reptile locations to create a baseline for mapping populations. At this point, however, facts are still scarce, and much research needs to be done to better understand the loss of our amphibians.

The Sierra's Vanishing Frogs

The high mountain lakes and streams of Yosemite National Park and the Sierra Nevada Mountains of California are as remote and undisturbed a place for amphibians as one might expect to find in the lower 48 states, but several native frogs and toads have disappeared from these mountains. Biologists recently revisited areas first surveyed for frogs and toads over 80 years ago. Between 1916 and 1918, zoologists recorded seven different species of frogs and toads at 70 locations across 90 miles of the Yosemite region. Revisiting the same study sites in 1992 and 1993, biologists found only four species remained, scattered among 26 locations. The Great Basin spadefoot, red-legged frog, and foothill yellow-legged frog have disappeared altogether. Numbers of western toad and Yosemite toad have plummeted, and the toads have vanished altogether from many sites. The mountain yellow-legged frog, once the most abundant frog in the region, hangs on in only a few isolated populations. The Pacific treefrog declined at many sites and could no longer be found east of the Sierra Nevada crest.[129]

How could frogs disappear from protected and remote areas? The researchers suggest that several factors have combined to modify the habitat and overwhelm Yosemite's frog populations, including drought cycles, trout introduced to once fishless mountain lakes and streams, and broad-scale drift of pesticides from intensive agriculture in the San Joaquin Valley to the west.[130] Others are finding similar losses throughout the Sierra Nevada. A recent survey of more than 2,000 water bodies in the John Muir Wilderness and Kings Canyon National Park south of Yosemite found that trout were introduced into the majority of historically fishless lakes and subsequently caused serious declines of the mountain yellow-legged frog.[131]



Wyoming Toad: Struggling Back

Unique to the high, windswept prairie of Wyoming's Laramie Basin, the Wyoming toad must squeeze its year into the brief summer months between May and September. In this short season, it mates, lays eggs, and the new generation develops from tadpole to toad in time to hibernate through the long Wyoming winter. Once quite common in the basin, in the 1980s toad populations began to drop drastically, causing the species to be listed as endangered in 1984. The reasons for decline remain a mystery, although disease, habitat change, pesticide use, man-made hazards, loss of genetic variation, predation or an accumulation of causes are possibilities.[132] Reduced to half a dozen individuals by the early 1990s, the Wyoming toad is now beginning the long road back from the edge of extinction with help from many friends.

In 1992, the U.S. Fish and Wildlife Service purchased the toad's primary habitat at Mortenson Lake from The Nature Conservancy to protect as a National Wildlife Refuge. By 1994, only six adult toads remained—a population perilously close to extinction and with a genetic diversity equivalent to only 2.7 individuals.[133] Wyoming Game and Fish Department brought these last survivors into captivity to begin a captive breeding program with the aid of eight zoos and the Saratoga National Fish Hatchery. Young captive-reared toads have been released at Mortenson Lake each year since 1995 to re-establish a breeding population.[134]

The rate of mortality of tadpoles and young toads is extremely high both in captivity and in the wild. Few young toads make it through their first year. Redleg disease and *Basidiobolus* fungus have been problems for captive and re-introduced populations, seriously reducing survival, but research has helped reduce mortality in captive populations. To increase the toads' survival at Mortenson Lake, toadlets are placed in a "head-start tank," a modified child's wading pool, to protect them while they acclimate to the area. The Wyoming Department of Transportation has also erected barrier fences along certain stretches of roadway and culverts were modified to help funnel toads through the culverts and away from roads.[135] The University of Wyoming is carrying out habitat and survival research, while refuge managers are evaluating the significance of predation on toad mortality. The dedication of the many conservation partners is beginning to pay off. In 1998, surveyors estimated the wild population at 90 adults and subadults, and at least 300 young of the year that survived up to hibernation. Most significantly, in the summer of 1998 wild egg masses were found for the first time since 1991, a hopeful sign that the reintroduced toads are beginning to reproduce again in the wild.[136]

Imperiled Amphibians

Species listed as federally threatened or endangered. Eight additional species and subspecies are under consideration for listing.

Endangered

Barton Springs salamander

Desert slender salamander

Santa Cruz long-toed salamander

Shenandoah salamander

Sonoran tiger salamander

Blind Texas salamander

Arroyo toad

Houston toad

Wyoming toad

Threatened

Flatwoods salamander

Red Hills salamander

San Marcos salamander

California red-legged frog

Guaj n

Cheat Mountain salamander

Puerto Rican crested toad

Source: USFWS. 1999. Listed species. Online: www/fws/gov/r9endspp/ U.S. Fish and Wildlife Service Division of Endangered Species, Washington, D.C.

DAN BROTHERS, OUTDOOR ALABAMA MAGAZINE

Scaled Survivors of the Eons

Throughout human history, reptiles have inspired both our fascination and aversion. They have been objects of worship, prized pets, and important sources of food, leather, and medicine. They have also been victims of our misunderstanding and persecution. Important as major predators and prey in their natural communities, reptiles are of great interest to scientists. Yet as a group they have received little attention for monitoring or management and as a result we know little about the status of most species. Today, however, some biologists fear that reptiles may be undergoing the worst losses since the age of the dinosaurs.

Our native reptiles—snakes, crocodilians, lizards, turtles and tortoises—include 278 species in the continental U.S., and an additional 104 species found in Hawaii, U.S. Territories in the Pacific, Puerto Rico, and the U.S. Virgin Islands. Of the continental species, 36 (13%) are listed as federally threatened or endangered,[137] and the Natural Heritage Network characterizes 51 (18%) as imperiled or vulnerable.[138] Five species and subspecies are under consideration for federal protection, while a number of additional species are protected in individual states, such as the eastern diamondback rattlesnake and timber rattlesnake. Geographically, most threatened species occur in southern California, Florida, the Gulf Coast and the Eastern Seaboard—generally areas of saturated land development.[139]

Of all our reptiles, sea turtles and crocodilians have probably received the most management attention. All six sea turtle species found in U.S. waters are protected under the Endangered Species Act and several international treaties. Management efforts in the United States focus on protecting nesting beaches, reducing mortality to eggs and hatchlings, and preventing incidental catch in fishing gear. Freshwater and terrestrial turtles, many becoming vulnerable from habitat loss and collecting, are receiving more attention for assessments. The American alligator has fully recovered from seriously depleted numbers in the 1960s to a population that now supports regulated harvest. The status of most snakes, lizards, and freshwater turtles, however, remains unassessed.

GEORGE ANDREJKO
ARIZONA GAME AND FISH

A study examining the threats to wildlife in the U.S. found that for the reptiles classified as imperiled or vulnerable, habitat loss and degradation threatens 97%; commercial harvesting and collecting threatens 66%; pollution 53%; and the introduction of non-native animals that outcompete native species or spread disease threatens 37%.[140] Once depleted, populations can be seriously in peril and recovery can be extremely slow because many reptile species have very low reproductive rates and mature slowly, taking 10 to 30 years to reach reproductive age.

Relished as food, valued for turtle shell and medicine, and desired as pets, an expanding national and international market exists for reptiles collected from the wild. Even incidental collection of wild reptiles for pets can seriously deplete local populations.[141] Alarmingly, this country is now responsible for more than 80% of the world exports and imports in CITES-listed live reptiles, yet there are few assessments of the ability of populations to sustain collecting. The U.S. is home to 20% of the world's turtle species and a multimillion dollar international trade in freshwater and terrestrial turtles for food and pets and is seriously depleting populations of some species. Seven million turtles are exported for the food trade. Numbers of exported map turtles for pets jumped from fewer than 10,000 in 1990 to 80,000 in 1996. Most of the eight million red-eared slider turtles exported as pets each year are reared on turtle farms, yet many of these operations replenish their breeding stock from the wild. In addition, a lucrative and mushrooming international black market is increasing the pressure on CITES-listed species, such as box turtles, wood turtles, and bog turtles. Today, 45% of our turtle species are in trouble and need conservation attention.[142]

Conserving habitat is the first step to maintaining our reptile fauna. Broad-scale and standardized population monitoring efforts are also needed to establish baseline inventories and detect losses and declines. Better understanding, regulation and enforcement of the reptile trade can also help stop the erosion of wild populations.

Saving an Ancient Desert Denizen

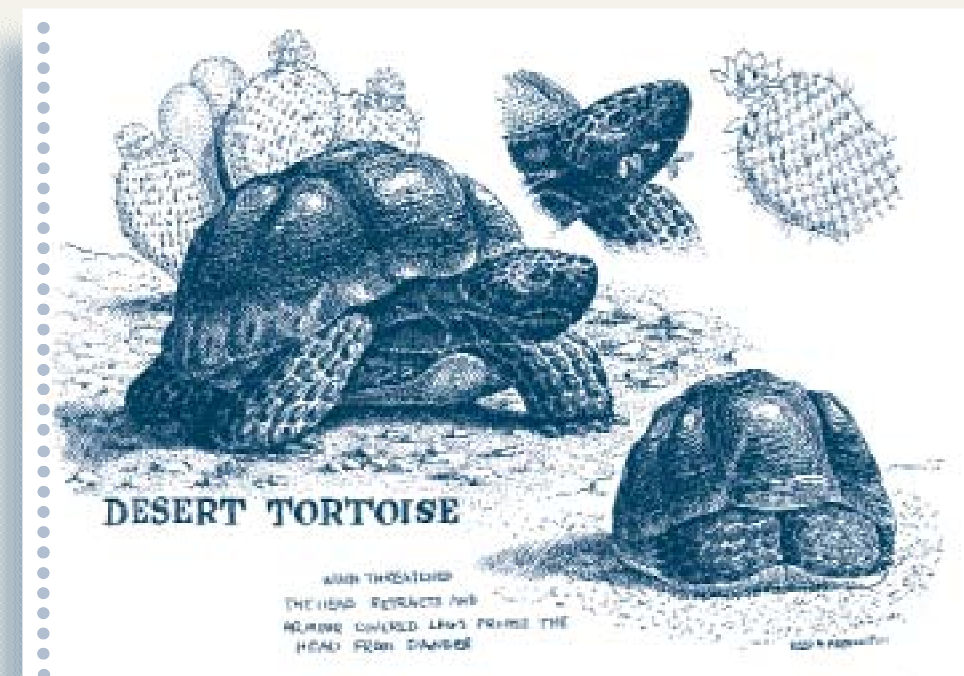
The desert tortoise is federally listed as a threatened species in the Mojave and Colorado desert portions of its distribution, north and west of the Colorado River in California, Nevada, Arizona, and Utah. An inhabitant of low-elevation desert valleys and washes, the tortoise needs terrain and soils suitable for digging the burrows that are essential for escape from summer heat and winter cold.

Tortoise populations have suffered from habitat loss, mortality from off-road vehicles, competition with domestic livestock for herbaceous plants, invasion of non-native plants, predation on juvenile tortoises, mortality on highways, and illegal collecting. Upper respiratory tract disease (URTD), thought to have been introduced from captive tortoises released into the wild, has recently taken an enormous toll on tortoise numbers throughout the Mojave Desert. These factors combined, some populations have plunged by as much as 90%.[143] The long-lived tortoise's slow reproductive rate poses problems for population recovery. Females do not breed until 15 or 20 years old, while juvenile mortality can be as high as 98%.[144]

There are some hopeful signs for the desert tortoise, however. In Las Vegas, Nevada, one of the fastest-growing metropolitan areas in the West, expanding development collided with tortoise protection because much of the best tortoise habitat is found in the area's valley bottoms. Seeking solutions, a steering committee composed of the Southern Nevada Homebuilders Association, Nevada Division of Wildlife, local city and county governments, federal agencies, user groups, tortoise biologists, and conservation groups negotiated a habitat conservation plan that provides a working compromise. The plan allows for incidental taking of tortoises and alteration of tortoise habitat in association with development on non-federal property, while enhancing tortoise survival and recovery on federal lands. Biologists still have concerns over the impacts of recreation, population fragmentation and URTD in tortoise conservation areas, but by working cooperatively, the Las Vegas community hopes to ensure a place for the tortoise.[145]

Kemp's Ridley Sea Turtle: Most Endangered

The Kemp's ridley has the dubious distinction of being the world's most endangered sea turtle. Throughout the year, it ranges through the coastal waters and bays of the Gulf of Mexico and the Atlantic Ocean, feeding chiefly on crabs. Then, between April and mid-August, females come ashore to lay their eggs, most of the population in northeastern Mexico, and a few individuals on the south Texas coast. Only fifty years ago, females nested in stunningly large groups called "arribadas" (Spanish for "arrival"). On a single day in 1947, an estimated 42,000 Kemp's ridley turtles came ashore on the species' primary nesting beach in Mexico.[146] By 1968, the number of nesting females was down to 5,000, and by 1985 numbers had dropped to 300, due largely to egg collecting and high rates of incidental capture and drowning in shrimp trawls as the shrimp fishery boomed. The species was listed as endangered in 1970, and



Reptiles may be undergoing the worst losses since the age of the dinosaurs.

Imperiled Reptiles

Species listed as federally threatened or endangered. Six additional species are under consideration for listing.

Endangered

American crocodile
Monito gecko
Blunt-nosed leopard lizard
St. Croix ground lizard
Culebra Island giant anole
Alabama redbelly turtle
Plymouth redbelly turtle
Green sea turtle
Hawksbill sea turtle
Kemp's ridley sea turtle
Leatherback sea turtle
Puerto Rican boa
Virgin Islands tree boa
San Francisco garter snake

Threatened

Coachella Valley fringed-toed lizard
Island night lizard
Mona ground iguana
Desert tortoise
Gopher tortoise
Bog turtle
Flattened musk turtle
Ringed map turtle
Yellow-blotched map turtle
Loggerhead sea turtle
Olive ridley sea turtle
Bluetail mole skink
Sand skink
Mona boa
New Mexican ridge-nosed rattlesnake
Atlantic salt marsh snake
Concho water snake
Copperbelly water snake
Eastern indigo snake
Giant garter snake
Alameda Whipsnake

Protected due to similarity to crocodile

American alligator

Source: USFWS. 1999. Listed species. Online: www/fws/gov/r9endspp/ U.S. Fish and Wildlife Service Division of Endangered Species, Washington, D.C.

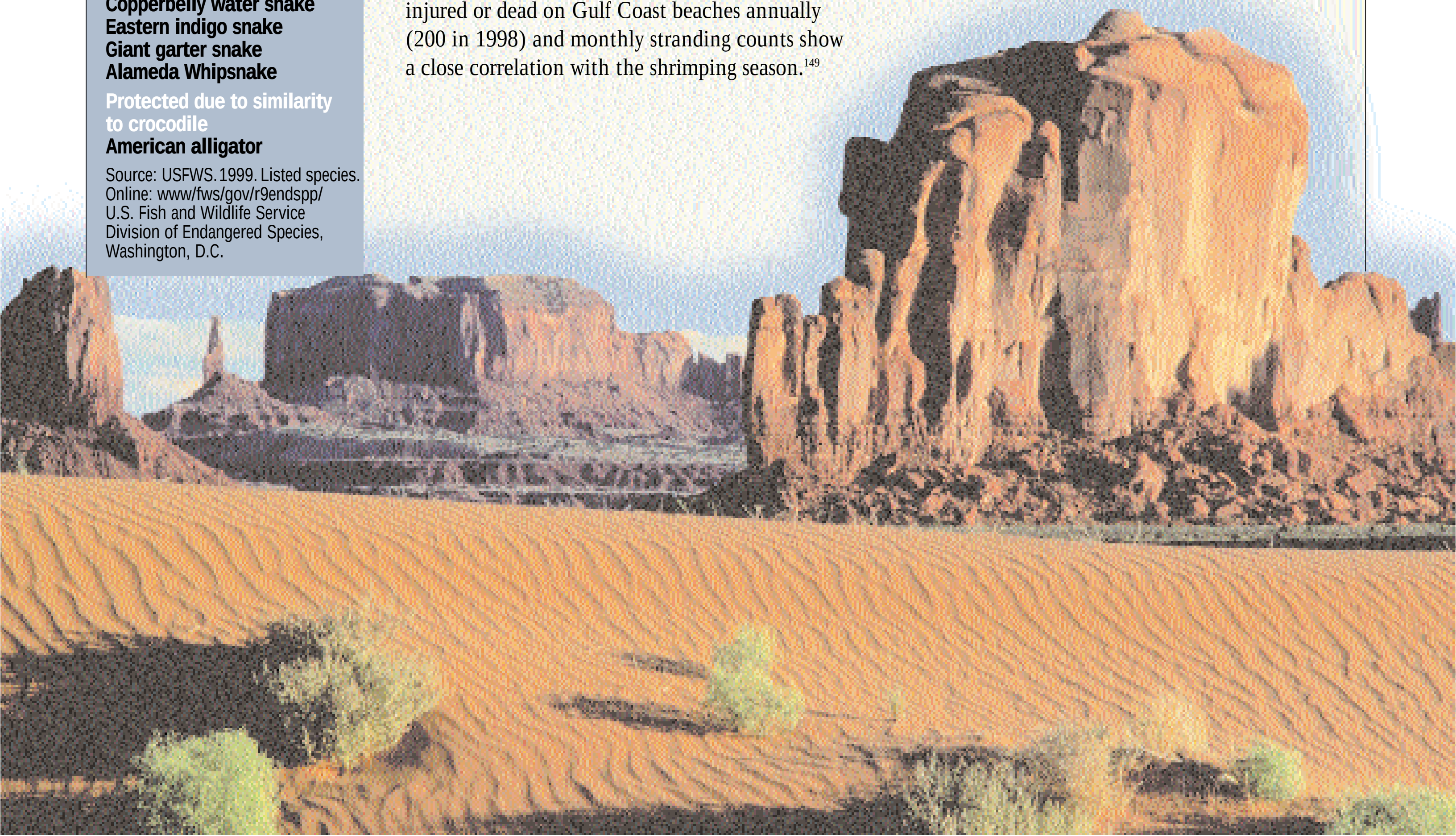
with the benefit of protection, populations have begun an upturn. Approximately 1500 female Kemp's ridleys nested in 1998.[147]

The government of Mexico, through the Instituto de la Pesca, has invested in Kemp's ridley sea turtle research and conservation since the 1960s, and in 1977 declared the nesting beach at Rancho Nuevo in Tamaulipas a protected area. The U.S. Fish and Wildlife Service subsequently joined Mexico's effort to conserve the turtle's Mexican nesting beaches. In the U.S., Texas Parks and Wildlife, the USGS Biological Resources Division, National Marine Fisheries Service, and National Park Service, have carried out ecological research, restoration, and monitoring efforts.

In 1989, Congress required shrimp fishermen to use turtle excluder devices (TEDs), a trap door that allows turtles and other large animals to escape from the shrimp trawls. Prior to the use of TEDs, shrimp trawls killed an estimated 500 to 5000 Kemp's ridleys each year, but National Marine Fisheries Service data indicates that TEDs can be effective at excluding 97% of adult turtles without significantly reducing the shrimp catch.[148] Observers cite high compliance with TED regulations, and Mexico has developed a similar TED program. Incidental capture remains a serious problem for the depleted turtle population. The National Marine Fisheries Service reports that a disturbing number of Kemp's ridleys still wash up injured or dead on Gulf Coast beaches annually (200 in 1998) and monthly stranding counts show a close correlation with the shrimping season.[149]

Concerns also remain over repeated captures in nets that may stress turtles beyond recovery, the impact of incidental capture in other types of fishing gear, and turtles strangling or ingesting marine garbage such as plastic bags.

Yet there is reason for optimism for the Kemp's ridley. The number of nests recorded in Texas and in Mexico has been increasing steadily in recent years.[150] Education efforts have generated enormous public support for turtle conservation. Several organizations are now proposing a Marine Reserve (no commercial fishing zone) for the nearshore waters off Padre Island, as exists off Rancho Nuevo. Such a reserve would not only help protect Kemp's ridleys but also other sea turtles and marine life.[151]



The immense variety of arthropods, which include insects (ants, beetles, flies, butterflies, moths, grasshoppers, and the like) and arachnids (spiders, scorpions and their relatives), represents a largely unexplored biological frontier. No other group of animals is as diverse, abundant, ubiquitous, or unknown. Biologists have so far described some 875,000 arthropod species in the world, including 750,000 insect species and 74,000 arachnids. Yet this far underestimates the total: there may be five to thirty million species in all.[152] In North America north of Mexico, more than 90,000 insect species have been described, and there may be roughly 72,000 species yet unknown to science.[153] New species are as likely to be discovered in our backyards and local parks as in remote tropical forests.

We tend to think of these creatures only as pests and parasites, vectors of disease, and plagues on gardens and crops. Yet they are the lifeblood of ecosystems, critical to the health and functioning of natural communities. "So important are insects and other land-dwelling arthropods," writes ecologist E.O. Wilson, "that if all were to disappear, humanity could probably not last a few months."[154] Arthropods graze, build, gather and collect, transforming the ecological web. They are predators of other organisms, playing an important role in biological pest control. They are sustenance for a host of other wildlife species and major protein sources for birds and bats, lizards and grizzly bears. Arthropods turn the soil and decompose dead plant and animal matter, replenishing soil nutrients. Vast numbers of insects are intricately interdependent with flowering plants, providing the critical service of pollination.

Arthropods have been around for millennia. Many groups survived through the great extinction at the end of the Cretaceous Period that brought an end to the dinosaurs. Yet when confronted by extensive habitat loss and degradation brought about by the very recent activities of humans, populations suffer and species have been lost, eroding the diversity of life. The widespread use of pesticides, dispersion of environmental toxins, siltation of stream courses, acidification or eutrophication of lakes, conversion of landscapes to extensive monocultures or urban development, habitat fragmentation, deforestation, and introduction of alien species are just a few of the modern hazards to insects and arachnids. Habitat changes have also brought about unnatural increases and range expansions in some species, some to pest levels.

Currently, 37 insect and five arachnid species are federally listed as threatened or endangered, although this number does not accurately reflect the problem. Most of these listed species have received attention because they are very limited in distribution or dwell in fragile ecosystems such as caves and springs. The Natural Heritage Network has also made assessments of species status for three insect groups, and classifies 16% (98 of 597) of butterfly and skipper species, 18% (81 of 448) of dragonfly and damselfly species, and 20% (22 of 110) of tiger beetles species as imperiled or vulnerable.

One problem in assessing insect and arachnid fauna is the great need for basic taxonomic research and well-maintained museum collections to identify and classify species. State Natural Heritage Programs track rare and endemic species and several states, such as California, Virginia, Illinois, and New York, have programs underway to document and inventory certain groups of insect fauna. Butterflies are probably the best surveyed group of insects, benefiting from an enthusiastic following of professional and amateur lepidopterists. Lepidoptera species lists have been begun or completed in 28 states.[155] The North American Butterfly Count, an informal survey established in 1975, gathers information that has been used to examine status and trends of some species, such as the migrant monarch butterfly.[156]

Given the ecological importance of the invertebrate world and the possibility that many species could serve as indicators of the larger health of natural communities, we need a better understanding of our impacts on these species and repercussions in the environment. Land management that favors native plant communities, maintains ecological processes and natural disturbances, and minimizes environmental toxins will help maintain our rich diversity of our native arthropods.

The Quiet Loss of Wild Pollinators

Thousands of species of bees, wasps, flies, moths, and other insects make a time-honored trade with flowering plants, dining on nectar or pollen in turn for carrying pollen grains from plant to plant and allowing cross-fertilization. Pollinators are essential to natural communities and to our agriculture. Insects pollinate nearly 70% of the world's flowering plants,[157] and roughly 75% of our staple crops (such as alfalfa, soybeans, sunflowers, almonds, apples, peaches, cherries, squashes, cranberries, and blueberries) depend on wild insects and domestic honey bees to produce healthy fruit and fertile seeds. We take the service of these pollinators for granted. Yet both domestic bees and wild insect pollinators face unprecedented threats.[158]

Little Things that Run the World

No other group of animals is as diverse, abundant, ubiquitous, or unknown.

Little Things that Run the World

Since the 1940s, the number of commercial honey bee colonies in the U.S. has dropped by half. Nearly 25% of all managed colonies were lost in the 1990s, largely due to the spread of disease and parasitic mites, exposure to pesticides, invasion of Africanized bees, and removal of government subsidies for beekeepers.[159] As important as managed bees are to agriculture, wild pollinators also contribute an estimated $4 billion a year to the U.S. economy.[160] These species are rapidly losing ground as habitats and open space are lost and fragmented; remnant habitats may be too small to maintain pollinator populations. The disappearance of specific pollinators is implicated in the decline of many rare and endangered plants. But even losing small patches of native vegetation, such as hedgerows, meadows and woodlots, reduces populations of wild pollinators available to adjacent croplands and gardens.

Environmental toxins, particularly pesticides, are another pervasive threat to pollinating insects. One billion pounds of pesticides are applied in the U.S. each year; they do not discriminate between agricultural pests and beneficial insects.[161] Pesticides, herbicides, and other biocides can be directly lethal to pollinators, impair behavior and reproduction, or eliminate plants needed for food and nesting. Pollinators remaining in small habitat fragments are particularly vulnerable to the drift of pesticides sprayed on nearby croplands.

Wild pollinators need our investment into research, protection of natural habitats, and methods to reduce pesticide applications and other threats. We need to include wild pollinators in land management decisions and the larger equation of environmental health to stem what the U.S. Department of Agriculture calls an "impending pollination crisis."[162]

Recovery of the Karner Blue Butterfly

Sandy oak savannas and pine barrens, periodically renewed by wildfires, were once relatively common habitats in the Northeast and upper Midwest. In these opens, across a narrow band from New Hampshire to eastern Minnesota, the diminutive Karner blue butterfly coursed amidst open-canopied fields brushed purple by wild lupine. The wild lupine is critical to the Karner blue, as the only known host plant for the butterfly's caterpillar stage. Most suitable savannas and barrens have been lost throughout the butterfly's range due to urban development, fire suppression, and the shrinking size and fragmentation of remaining habitat. Karner blue populations have plummeted by 99% in some portions of the butterfly's range, with the steepest losses occurring in the last 15 years.[163] Today Karner blues persist in only a few remnant habitats, their greatest numbers in Wisconsin and Michigan.[164]

Conservation efforts for the Karner blue have focused on restoring and managing oak savanna and pine barrens ecosystems. These vanishing habitats also support several other rare or declining species, such as the Persius duskywing and frosted elfin butterflies, phlox moth, loggerhead shrike, massasauga rattlesnake, Blanding's turtle, and prairie flame flower. Wisconsin has developed a habitat conservation plan with the help of state agencies, conservation groups, utility companies, and private landowners. In Michigan, Indiana, Minnesota, and New Hampshire, state and federal agencies and private groups are undertaking habitat restoration and enhancement work.With | continued investments in habitat management, the Karner blue may continue its annual summer flights through the wild lupines. [165]

THOMAS A. MEYER©

Catspaws and Pigtoes: Freshwater Mussels

Pocketbook, pigtoe, monkeyface, catspaw, heelsplitter—freshwater mussels (known collectively as unionids) surely sport the most imaginative names in all of zoology. The U.S. is home to nearly 300 freshwater mussel species, a diversity unmatched anywhere in the world. This variety is richest in the rivers of the Southeast and Midwest, and particularly the Tennessee River watershed which drains parts of seven states. Generally out of sight, out of mind, and far from glamorous, mussels gather little notice or public concern, yet they are the most imperiled family of animals nationwide. Of 292 native species, 37 (13%) are extinct or possibly extinct and 165 (57%) are imperiled or vulnerable.[166] Sixty-nine species (23%) are federally listed as endangered or threatened.[167] Many others are declining in distribution and abundance.

In addition to filtering water and significantly contributing to water quality, mussels are an important food source for otters, muskrats, mink, fish, birds and other wildlife. Freshwater mussels are also a significant resource for people. Some species are used in cancer research as investigators search for clues to why mussel tissues resist cancer growth. Until recent market downturns, 5,000 to 6,000 tons of mussel shells were exported to Asia annually to provide the bead implants or "nuclei" used to produce cultured pearls. Between 1990 and 1992, for example, the harvest in Tennessee, a major shell exporter, was valued at $8.8 to $9.5 million and nearly 5,000 commercial licenses were sold.[168]

Habitat loss, pollution, soil erosion, and the invasion of non-native mussels such as the Asian clam and zebra mussel are the primary causes of declines and species loss. Mussels depend on clean, free-flowing waters to feed and reproduce. Impoundments, dredging, and channelization radically alter mussel habitats, and dams alone have caused 30% to 60% of freshwater mussel extinctions. Soil runoff from urban and industrial development and poor forestry and agricultural practices can bury mussel beds in silt. Contaminants such as heavy metals, pesticides, and runoff from mines and industry settle at the bottom of rivers and overwhelm the mussels' ability to filter these toxins. Other threats are the poaching of mussels for commercial trade and introduction of fish that may carry non-native mussel larvae. Zebra mussels, inadvertently introduced into the Great Lakes by shipping traffic in 1988, colonize native mussels, inhibiting their movement and competing for food. In a ten-year span, zebra mussels invaded most of the eastern and midwestern states, and are now found throughout the Mississippi watershed. Biologists expect zebra mussels to spread throughout the continent in the next 10 to 20 years.[169]

In addition to these difficulties, one of the problems inhibiting recovery is the mussel's own natural history. To reproduce, mussels depend on fish. During a brief parasitic phase, the mussel larvae attach themselves to the gills of particular fish species to complete their development. After a few weeks, the tiny but fully formed young mussels drop off, the fish none the worse for wear. In many

DAN BROTHERS, OUTDOOR ALABAMA MAGAZINE

THE U.S. IS HOME TO NEARLY 300 FRESHWATER MUSSEL SPECIES, A DIVERSITY UNMATCHED ANYWHERE IN THE WORLD.

river systems, host fish species have also suffered from dams and pollution. Many may no longer be abundant enough for the mussels to reproduce. Our knowledge of these interdependencies is limited. Biologists have identified the host species for only one third of all native mussels, and 25% of endangered mussels.[170]

We may lose a significant portion of our freshwater mussel species unless we can bring the plight of mussels and the health of our rivers into the public eye. Taxonomic work, surveys, and monitoring are needed to establish the abundance and reproductive status of many species. Conservation programs are investing in research needed to identify host fish species and in mussel propagation and reintroduction as key components of recovery. Because of the far-reaching interconnections of river systems, however, mussel conservation must also address ecosystem and watershed levels to best manage habitat and limit the spread of non-native species.[171]

Watershed Recovery on the Clinch River

The upper Clinch and Powell rivers of southwestern Virginia and northeastern Tennessee are the only undammed headwaters of the Tennessee River system. Here in the undulating hills of the southern Appalachian Mountains, the region's rivers and streams shelter a remarkable diversity of aquatic wildlife. However, land use practices in the Clinch watershed, particularly agriculture and historical coal mining and timber harvest, have degraded water quality. Where the region once supported 60 species of freshwater mussels, 45 now remain. Yet the Clinch is still a sanctuary for many species, including the dromedary pearlymussel, shiny pigtoe, birdwing pearlymussel, Cumberland monkeyface, and Cumberland bean mussel. The endangered tan riffleshell, one of 28 federally listed wildlife species found in the area, has reproducing populations only in the Clinch River.[172]

Researchers at Virginia Polytechnic Institute and State University are propagating mussels from the Clinch River watershed and releasing them back to their native habitat to restore threatened species. In 1999, they released 115,000 juveniles of six endangered species. Local communities are also seeking avenues to conserve the region's wildlife diversity and water quality through environmentally sound land management practices. Community groups and counties are planning for sustainable development and undertaking projects to protect and improve water quality, such as fencing streambanks, establishing streamside buffers, and selecting areas to concentrate stream uses. For example, the Clinch River Community Project in Tennessee has arranged for technical assistance for landowners from agency soil and water experts, and has installed watering sites and fences to exclude livestock from streams.[173] Partnerships between community groups, state and federal agencies, and conservation groups are key to their progress.[174]

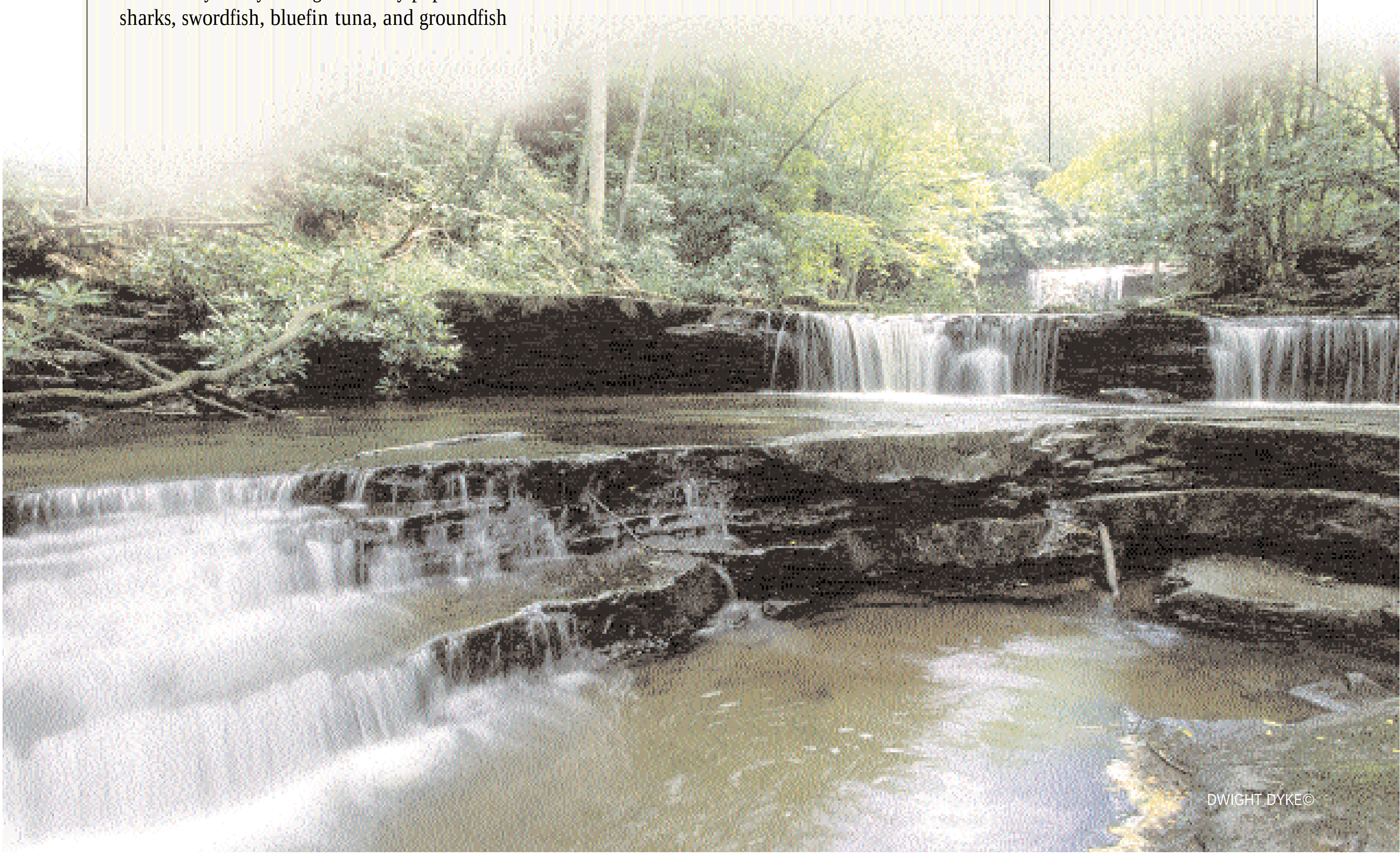
Fins and Gills

In the waters of our rivers, lakes, estuaries and oceans, a largely unseen but far-reaching crisis is underway as declines of many freshwater, anadromous, and marine fish populations accelerate. The quality and health of our aquatic ecosystems are under assault and without quick intervention these losses will prove difficult to reverse.

Currently, 112 freshwater and anadromous fish species are federally listed as endangered or threatened, more than any other group of vertebrate animals.[175] Of the 799 known freshwater fish species native to U.S. rivers and lakes, 18 (2%) are extinct or possibly extinct, and 283 (35%) species are considered imperiled or vulnerable.[176] Of roughly 485 species in the southeastern states, which harbor the greatest diversity of freshwater fish in the U.S., 93 species (19%) are imperiled.[177] In the arid southwestern states, where fish are far less diverse, more than 30% of native species are at risk.[178] In New England, four stocks of Atlantic salmon are imperiled, and in California, Oregon, Idaho and Washington, 214 stocks of seven salmon and steelhead species are at risk of extinction.[179]

The outlook for coastal and marine fisheries, which are managed both by federal agencies and by the coastal states, is also sobering. Commercial catches in all regions of the Atlantic and Pacific have declined since peak harvests between seven and twenty-five years ago.[180] Many populations of sharks, swordfish, bluefin tuna, and groundfish (such as Greenland turbot, Atlantic cod, haddock, pollack and yellowtail flounder) have been seriously overexploited. Of the 275 nationally significant fisheries stocks, status is known for roughly 180 stocks (66%). Only 9% are above population levels that would sustain a long-term yield, 27% are near that level, and 30% have dropped below the abundances that would produce sustainable yields.[181]

As a society, we impose heavy demands on our waterways for drinking water, irrigation, human and industrial waste treatment, transportation corridors, commercial fishing, and recreation. As our demands on aquatic systems have grown, our lakes and rivers have been subjected to unprecedented stresses that have taken their toll on aquatic organisms. On inland waterways, we have engineered a network of dams and diversion systems for water storage, flood control, and municipal, agricultural and industrial uses. Habitat loss and degradation, the primary threat to aquatic organisms, have been implicated in the declines of 93% of the imperiled freshwater and anadromous fish species in the U.S. Dams and other barriers to fish movement threaten 64% of this group, and pollutants threaten 66%.[182] We have impounded, diverted, and channelized waterways to the point that an estimated 85% of our inland waters are now controlled.[183] Of 3.2 million miles of rivers and streams in the contiguous 48 states, only 2%



DWIGHT DYKE©

112 FRESHWATER AND ANADROMOUS FISH SPECIES ARE FEDERALLY LISTED AS ENDANGERED OR THREATENED, MORE THAN ANY OTHER GROUP OF VERTEBRATE ANIMALS.

flow free and undeveloped for enough miles and retain high enough qualities to qualify for federal designation as wild or scenic.[184] Rivers and lakes are depositories of pesticides, herbicides, fertilizers, heavy metals, municipal wastes, and a host of other contaminants and excess organics that degrade water quality and harm aquatic life. Soil erosion and sedimentation, loss of shoreline and streamside vegetation, and changes to water flow and temperature pose further threats to fish and other aquatic species.[185]

The introduction of exotic species is the second greatest threat to freshwater fish and a factor in the decline of 69% of imperiled fish species.[186] In the absence of their natural predators, parasites or diseases, non-native nuisance species have spread throughout watersheds via shipping traffic and through intentional and inadvertent introductions. Once established, these species compete with, prey on, and displace native fish and other aquatic organisms. They are expensive to control and nearly impossible to eliminate. Some species introduced outside their native range for sport fisheries, either by hatchery programs or well-intentioned "bait-bucket" dumping into a favorite fishing site, also pose problems by outcompeting or preying on native fish and amphibians, or hybridizing with closely related species. As of 1991, 44 species listed as threatened or endangered were threatened by introductions of game or bait fish.[187]

Marine fisheries are threatened by overexploitation, changes in harvest technology that have increased catches and incidental bycatch, siltation of coastal waters and other pollution, and destruction and alteration of estuaries, mangroves, and coastal zones. Even natural processes, such as ocean warming, rising sea level and coastal subsidence which alter the rich communities of near-shore waters, are likely being accelerated by human activities.[188] However, it is clear that overfishing is the cause of drastic declines and collapse of valuable commercial fisheries. In 1995, the National Academy of Sciences ranked overexploitation as the most serious threat to the oceans.[189]

STEVE ELLE©

There are some positive trends. Our national commitment to clean water and investment in pollution control have produced significant turnarounds for the health of many waterways. State fish and wildlife agencies and the U.S. Fish and Wildlife Service also have a long history of protection and recovery of native fish and their habitats and enhancing sport fish populations. With the aid of contributions from anglers through the Dingell-Johnson and Wallop-Breaux Acts and an extensive network of fish hatcheries, many sport fish populations are thriving, providing recreation for 50 million anglers and generating nearly $70 billion in local economies each year.[190] Stocking and habitat protection programs are also helping to restore imperiled native species. For instance, greenback cutthroat trout have been restored to more than 40 lakes and streams in Colorado, while lake trout are being stocked in five of the Great Lakes. Lake trout reproduction was recently documented in Lake Huron and Lake Ontario, a milestone toward re-establishing self-sustaining populations.[191] Fisheries managers are returning Atlantic salmon to New England rivers, and after a long absence spawning runs are now partially restored in the Penobscot, Connecticut and Merrimack rivers.[192]

Aquatic systems are resilient when harvests are well-regulated and the assaults of pollutants, sediments, and alien species can be reduced or reversed. Fisheries managers face no more daunting challenge than to reverse the rapid decline of native fish populations and aquatic communities. Yet we still have many opportunities to protect and restore the integrity of freshwater and marine environments. Native fish cannot be maintained by single-species management alone. Protecting and sustaining the health of freshwater and marine communities is essential. In the long run, investing in healthy watershed and ocean ecosystems will return the greatest range of benefits with the least cost.

Vanishing Bull Trout

In the U.S., bull trout, members of the family Salmonidae, historically inhabited rivers and streams throughout the Pacific Northwest. Today bull trout are extirpated in California and have been eliminated from the main stems of most large rivers throughout the rest of their historic range. They hang on primarily in wild upper tributary streams.[193] Three of five distinct population segments in the U.S. (Klamath River population in Oregon, Jarbidge River population in Nevada, and the Columbia River population spanning

Washington, Oregon, Idaho and western Montana) are listed under the Endangered Species Act. The Coastal/Puget Sound population was proposed for listing in 1998.[194]

Bull trout depend on cold, clear streams with a jumble of hiding places, including logs, other woody debris, undercut banks, large boulders, and deep pools. They often spawn in the coldest streams in a watershed or where there are cold-water seeps and springs. The bull trout is mainly an inland species, either resident in streams or migratory within river and lake systems. However, the Puget Sound population is anadromous, migrating between freshwater and saltwater.

The bull trout populations that remain today are chiefly resident and highly fragmented, cut off from migration by dams, impoundments, and habitat degradation. This trout's need for cold, clean waters has made it especially susceptible to habitat damage. Forestry practices, road building, overgrazing, agriculture and development have increased soil erosion and siltation, decreased woody debris in streams, reduced streamside vegetation and increased water temperatures throughout much of the Northwest's river systems.[195] Additionally, for most of this century bull trout were considered an unwanted predator of more desirable brook trout and other non-native sport fish, and state wildlife agencies carried out bounty campaigns and poisoning programs. [196] Introduced brook trout also hybridize with bull trout, producing viable offspring.[197]

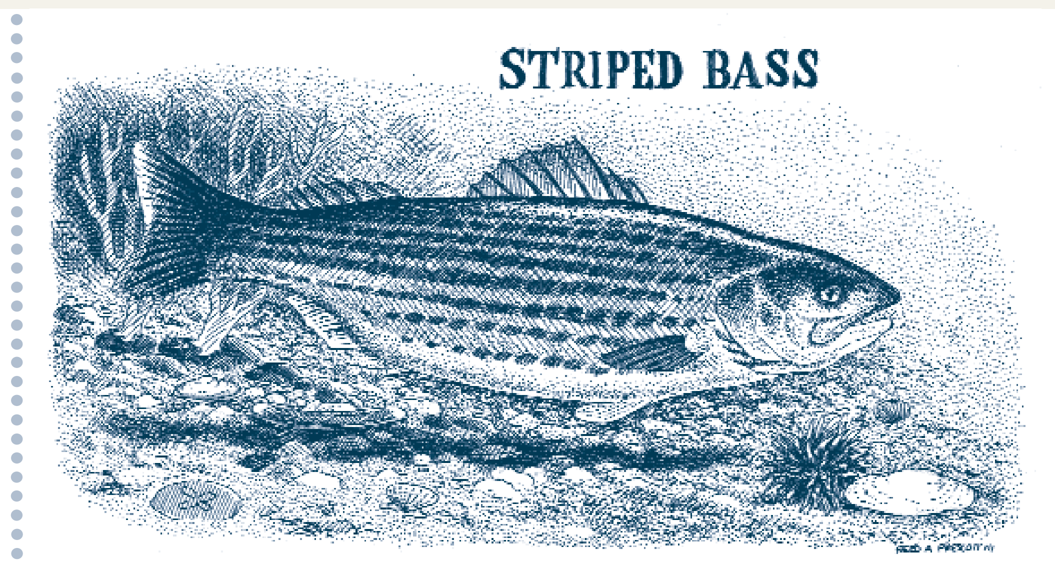
State bull trout conservation plans have been adopted or are currently being drafted. State fish and wildlife agencies have also undertaken monitoring and inventory efforts, have restricted fishing for bull trout, and placed seasonal closures in spawning areas. Restoring the quality and connectivity of cold-water streams is critical to reviving isolated bull trout populations, which requires the cooperation of state, federal, tribal, and private landowners across watersheds. As bull trout management receives more attention, there are already some positive signs. In 1998, for instance, biologists recorded the highest counts of spawning nests, or redds, in the Flathead and Swan river drainages in western Montana since 1991, largely attributed to angling restrictions, enforcement, public education, and improved stream flows.[198]

Striped Bass: Research Aids Recovery

Valued by recreational anglers and commercial fishermen alike, the striped bass is native to the Atlantic Seaboard and northern Gulf of Mexico. The largest breeding populations are concentrated along the mid-Atlantic coast. Also known as rockfish or stripers, striped bass are anadromous, migrating from the ocean to spawn in rivers. Some populations also move into freshwater to feed. In the 1970s and 1980s, populations declined at an alarming rate, particularly in Chesapeake Bay. The commercial catch dropped from a record 14.7 million pounds in 1973 to only 1.7 million pounds by the early 1980s, which translated into a loss of 7,000 jobs and $220 million in 1980.[199]

In response, Congress enacted the Emergency Striped Bass Act in 1979 to investigate the causes of decline and recommend restoration strategies. Researchers found that the fish were especially vulnerable when newly hatched to a combination of lethal threats, including toxic pollutants, acid rain that dissolves aluminum from soils into the water, and chlorinated effluents that impacted zooplankton, the bass fry's food base. Overfishing

THE STRIPED BASS IS ONCE AGAIN A FAVORITE QUARRY FOR ANGLERS.

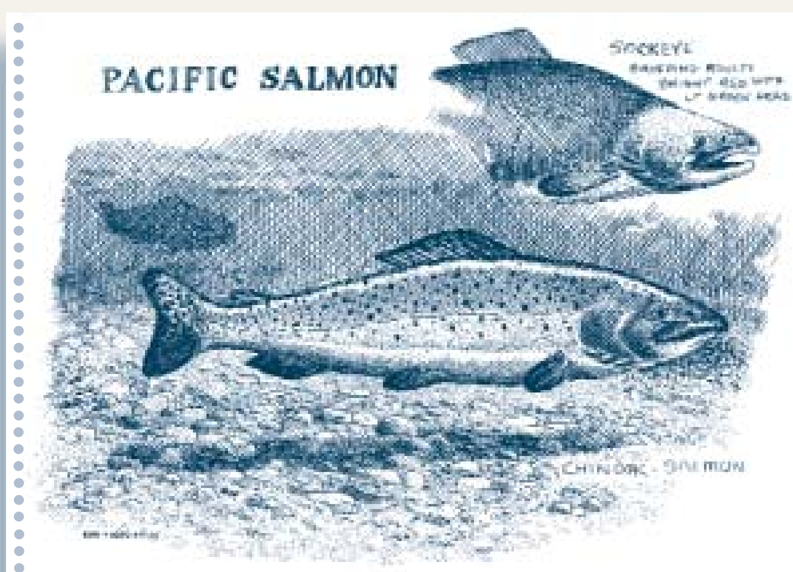


also made the stripers more susceptible to pollution problems and to natural fluctuations of water temperature in spawning beds.

States imposed strict harvest restrictions, and some a total ban on striped bass fishing to reduce the pressure on spawning females. This fishing moratorium was instrumental in allowing populations to recover. A coast-wide stocking program and tagging effort was also initiated in 1985 to supplement wild populations and to survey catch rates and natural mortality. Nearly 9 million hatchery-raised fish provided managers with a picture of the striper's population dynamics and migration patterns. By 1993, striped bass stocks were on the rise again. An annual survey of young-of-year showed the highest spawning success since 1954. Today, populations are once again stable. Although monitoring continues, commercial and sport fishing have resumed, and the striped bass is once again a favorite quarry for anglers.[200]

Pacific Salmon: A Race Against Time

"Pacific salmon" refers to any of seven major species of salmon, including chinook salmon, coho salmon, chum salmon, pink salmon, sockeye salmon, coastal sea-run cutthroat, and steelhead. Untold millions of these anadromous fish once migrated from a life at sea into freshwater rivers and streams of the Pacific Northwest to spawn, returning to their natal streams as far as 900 miles inland. Salmon spawn in cold, clear rivers and streams with clean gravel beds. Some, such as sockeye, may spend up to three years in freshwater as juveniles before migrating to the ocean. The teeming abundance of salmon fueled a vibrant and thriving Native American culture and over the past century supported a multi-million dollar fishing industry. The seasonal pulse of migrating protein also enriched river ecosystems, providing a major food and nutrient source for aquatic organisms, streamside plants, predators, and even the next generation of young fish, indirectly nourishing the entire food web.[201]



The extent of salmon declines in California, Idaho, Oregon and Washington came to the fore with a 1991 American Fisheries Society summary indicating that at least 106 once abundant and distinct salmon populations, or stocks, have become extinct. At least 214 existing stocks are now at risk. Each stock is genetically adapted to the local conditions of a particular spawning stream and season. Of the 214 stocks at risk, nearly 50% are thought to be highly interbred with hatchery stocks, which can reduce the fitness and survival of naturally-spawning native salmon.[202] Twenty-four "evolutionarily significant units" (ESU) of six salmon species have now been listed as threatened or endangered under the Endangered Species Act. Another 10 ESUs are proposed for listing.[203]

The cumulative impacts of overfishing, competition with hatchery fish, an extensive system of dams and other barriers to migration on every major waterway, and habitat destruction from siltation, loss of streamside vegetation, forestry practices, road construction, mining, urban development, grazing and cultivation have brought about the collapse of salmon stocks. Over the last 30 years, roughly 72,000 jobs were lost as the salmon fishery declined.[204] Hatchery programs, fish ladders at dams, trucking juvenile salmon downstream, and other management efforts to increase stocks have so far been insufficient to slow salmon losses.

There may be no more challenging, divisive, far-reaching or complex wildlife management issue facing the nation today than the future of Pacific salmon. Virtually every resident and public and private interest in the Pacific Northwest is a stakeholder in the decisions made for salmon management. Yet to successfully recover salmon also means recovering the health of the Northwest's river systems for hundreds of other species—an investment in our own future and well-being.

A Nation of Champions for Nature

As a nation, we have repeatedly demonstrated our commitment to sustaining the natural world in which we live and the United States is seen as a world leader in nature conservation. Americans remain strong supporters of environmental protections, especially to provide a healthy and beautiful environment for their families and to conserve the environment for future generations. For instance:

- 89% percent of Americans describe themselves as concerned about protecting wildlife.[205]
- 62% believe that environmental protection and economic development can work together.[206]
- 71% would choose environmental protection over economic development where compromise is impossible.[207]
- 56% feel that federal funding should be shifted to support environmental programs.[208]

A survey in Arizona found that the majority of citizens would put wildlife protection before other uses of undeveloped lands. For example, 56% placed wildlife protection before public recreation and 77% before mining.[209] Indeed, only 17% of Americans think that current laws go too far, while 46% believe current environmental laws still do not go far enough.[210]

The Next Steps

This report has visited many of our conservation success stories and highlighted the problems we face for protecting our wildlife heritage. The repeated themes in wildlife declines are habitat loss and degradation, alien species invasions, and overharvesting. Again and again, wildlife managers encounter a lack of information and financial resources for sound management.

Most importantly, all wildlife needs habitat that conserves the interactions and interdependencies among animals, plants, and the ecological processes that ebb and flow with the seasons. Sustaining wildlife requires protecting and restoring the broad ecosystems in which these species occur: deserts, wetlands, riparian areas, lakes, coasts, streams, forests, and grasslands. Our tightly interwoven tapestry of human and natural communities presents us with enormous challenges to meet the needs of wildlife as well as other land uses.

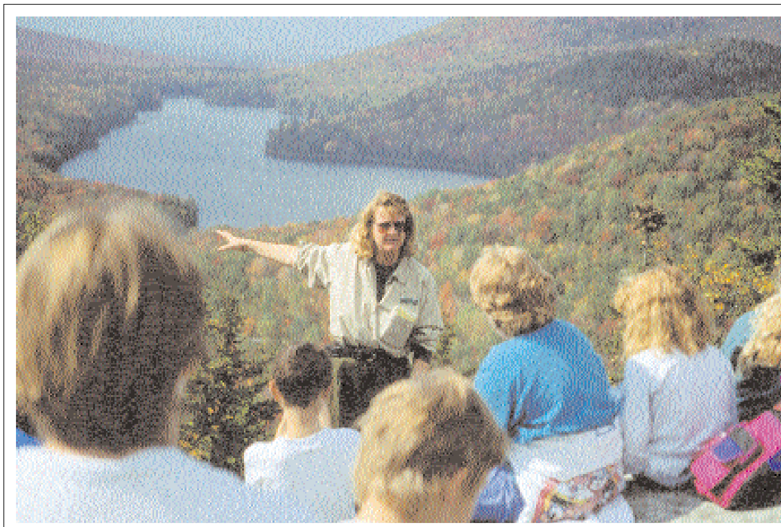
Multiplying human stresses and demands on wild areas and habitats demand creative solutions in an increasingly complex world. Wildlife management requires inventive problem-solving, partnerships, community will, regulation, money, research, and the dogged work of pounding out practical strategies within the broad spectrum of demands on land and resources. Wildlife needs cross many boundaries, and management solutions require planning across landscapes and cooperation among many stakeholders, oftentimes tailoring efforts to different land management and ownership goals.

ART WOLFE©

We must renew our commitment to our wildlife heritage and leave our grand-children the gift of a thriving natural world.

Tremendous opportunities lay before us. We are at a pivotal point for reversing declining trends and restoring the health of our wildlife communities and ecosystems. How can we sustain this wildlife legacy for our children's children?

- Invest in management and conservation for all species. We must broaden the scope of our wildlife programs to include the great diversity of animal and plant species and sustaining the health of natural communities.
- Invest in research and monitoring to help form our decisions. We still have many gaps in knowledge and need better understanding of species and their ecosystems to address declines and build better management tools.
- Invest in conservation and management of open spaces and natural areas. Habitat conservation is preventive medicine to protect the greatest number of species in the most cost-effective way.
- Invest in sustaining ecosystems and ecological processes. Attention to the natural functions of ecosystems and interdependencies among species will help us prevent species' declines and maintain the systems human communities depend upon.
- Invest in the broad view, planning across water-sheds and ecological regions. Understanding the interrelationships between communities and their landscapes helps us become better stewards of the places in which we live and the natural communities around us.



VERMONT DEPARTMENT OF FORESTS, PARKS AND RECREATION

- Invest in building partnerships among stake-holders. The most effective strategies incorpo-rate the interests of diverse constituents. Broad coalitions are coming together to meet wildlife conservation goals at all levels.
- Invest in room for recreation. As demands for outdoor recreation opportunities increase, we need to make room for the broad spectrum of recreation interests and develop tools to manage conflicting needs.
- Invest in environmental education for tomor-row's citizens. The interest in nature education programs continues to grow and good steward-ship begins with understanding.

What will the coming decades bring? We have a remarkable foundation of conservation laws, restoration successes, and scientific management on which to build. We also have great needs for improving our understanding of species and their ecosystems and learning new strategies for man-agement. With habitat protection and enhance-ment, managed harvests, knowledge gained from research and surveys, and conservation partner-ships, we can build the tools needed to restore and sustain wildlife populations.

We are now faced with a choice to make for wildlife, for ourselves, and for coming generations. It is a choice to invest in the diversity of life, to invest in keeping common species common, and to make room for wildlife and wild nature within the diverse American tapestry. If we do so, we will strengthen the fabric of natural systems that not only sustains the myriad diversity of species in North America, but ensures our own health, well-being, and prosperity. Now, as we begin a new century, we must renew our commitment to our wildlife heritage and leave our grandchildren the gift of a thriving natural world.

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New York Department of Environmental Conservation
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