Vanishing Species

The Unraveling Tapestry

Now that prairies are plowed under and deserts are filled with subdivisions, the net effect of this recent massive habitat destruction and wildlife slaughter is being assessed. An incomplete tally in the United States, including Hawaii, totals at least 99 species of animals and 240 plants presumed extinct during the past 400 years (Stein et al. 2000). This high rate of extinctions reflects the losses of species and ecosystems described in Chapter 1, as well as those of Hawaii. The Nature Conservancy, which established Natural Heritage Programs in every state to monitor native species, has compiled this and related data to alert the public of the urgent need to preserve the country’s natural heritage (Stein and Flack 1997; Stein et al. 2000). Its examination of the status of 20,439 US plants and animals found 7,817 species (38 percent) to be either vulnerable, imperiled or critically imperiled (Stein et al. 2000). These conclusions were published in a book co-authored with the Association for Biodiversity Information, entitled Precious Heritage: The Status of Biodiversity in the United States (Stein et al. 2000). This book also illustrates many of these beautiful plants and animals and threatened ecosystems. It found more species in danger than the 2000 IUCN Red List due to slightly different categories, such as imperiled and critically imperiled, rather than critical and endangered, used in IUCN lists. The latter organization also defines threatened species in terms of the rate of their decline, rather than their actual status.

Precious Heritage found endemic species, defined as those restricted to the bounds of the United States, and breeding endemics, or those breeding only in the United States, were even more threatened than those with wide distributions. Of the 875 endemic vertebrates in the lower 48 states, almost half (47 percent) are of conservation concern, compared to only 24 percent of all US vertebrate species (Stein et al. 2000). 90 percent of Hawaii’s endemics are imperiled in this study. Freshwater species such as mussels, crayfish, beetles and dragonflies are also in steep decline (Stein et al. 2000). More than 5,090 plants (33 percent of all native species) are threatened.

Other studies are examining natural ecosystems in the country. The National Biological Service of the US Department of the Interior reported in 1995 that during the 20th century alone, half the natural ecosystems of the lower 48 states became degraded to the point of endangerment (Stevens 1995). More than 1,700 biologists participated in this study, part of a massive biological survey of America’s plants and animals (Stevens 1995). Along with the loss of the tall grass prairies and oak savannahs, more than 60 million acres of longleaf pine forests in the Southeast have been cut, and much of this land has been planted with tree farms, creating biologically sterile regions. Northeastern old-growth hardwood forests, likewise, are critically endangered, and survive only in scattered remnants (Stevens 1995). Grasslands in Long Island, the Northeast and California are threatened ecosystems, as are coastal prairies in Louisiana and sedge meadows in Wisconsin. Streams in the Mississippi plain have been greatly damaged as well (Stevens 1995). Fifty-eight natural communities have declined by 85 to 98 percent, and 38 others have declined by 70 to 84 percent (Stevens 1995). The National Biological Service has identified 126 endangered species through this study. Each imperiled ecosystem is home to many threatened species, a reflection of their loss of habitat. This study underlined the importance of preserving large areas instead of small tracts of land, although the latter may be the only way to protect some highly endangered species, such as plants that have become greatly restricted in range.

A 1997 study by the joint United States and Canadian branches of the World Wildlife Fund (WWF), "A Conservation Assessment of the Terrestrial Ecoregions of North America," appraised the ecoregions of the continent including Hawaii (Luoma 1997). Ecoregions are areas defined by major habitat types and, unlike ecosystems, are confined to particular areas. Eastern old-growth forests, for example, are ecosystems scattered over a great area amongst other ecosystems, while southeastern conifer forests constitute an ecoregion. This study found 13 of the continent's 116 ecoregions to be imperiled "hot spots," harboring enormous biological diversity (Luoma 1997). These include Florida's pine scrub, the conifer forests of the Southeast, Appalachia’s mixed mesophytic forests, the
tallgrass prairie and California coastal sage and chaparral (Luoma 1997). These findings were echoed in the world survey of threatened areas with great biological diversity, *Hotspots*, sponsored by Conservation International (Mittermeier *et al*. 1999). The latter book is illustrated with spectacular color photographs of many disappearing landscapes and species of endangered hotspots, such as the California coastal region.

An inventory of rare, endangered and extinct North American plants and animals, being compiled by the National Biological Service, has verified that the impoverishment of America's natural ecosystems has affected not just isolated species, but entire communities of species. It predicts a steady increase in the number of threatened species because of continued destruction of natural habitats. Habitat loss is the greatest threat to US wildlife and plants, but trade, persecution and pollution play roles as well. Agriculture was ranked as the primary threat to native US species by The Nature Conservancy study, threatening about 45 percent of plants and animals, while development of land followed, threatening about 34 percent; water projects were the next major threat, and livestock grazing, pollutants, road building, logging and mining had important, but lesser, effects on species and ecosystems (Stein *et al*. 2000).

Threatened species tend to be located in certain "hot spots" in the United States. The one with the largest number of species is Hawaii, with 5,000 populations of species considered imperiled by The Nature Conservancy (Stein *et al*. 2000). In the continental United States, a preponderance of threatened species occurs in the Florida Panhandle, central Florida and the Florida Keys, the Appalachian Mountains, the Cumberlands and Southern Ridge, Cape Cod and Martha's Vineyard, southern California, the Pacific Northwest and southeastern Alaska, as mapped in *Precious Heritage. The Status of Biodiversity in the United States* (Stein *et al*. 2000; page 166). The Cumberlands and Southern Ridge and Valley of northern Alabama and southeastern Tennessee have the country's largest number of imperiled species—186—mainly as a result of the mussels, crayfish and freshwater snails of this region. The Central Appalachian Forest to the northeast has 154 threatened species, with a high percentage of aquatic species as well, including many rare salamanders and woodland plants. The Great Basin Desert of Utah and neighboring states is another species-rich area, with 113 threatened species, while the California South Coast sagebrush ecosystem has 138 threatened species found nowhere else on Earth (Stein *et al*. 2000). (See Grasslands, Shrublands and Deserts chapter).

The list of US species in danger of extinction grows longer each year, with a dramatic rise in the number of imperiled invertebrates in the 20th century. Fully 68 percent of freshwater mussels, more than 100 species, are threatened, making them the most endangered group of native animals. Fifty percent of native crayfish are threatened, according to the Nature Conservancy (Clancy 1997). The majority of surviving species are highly endangered from alteration of their clear, fast-flowing rivers and streams by federally sponsored dams, channeling and diking that have turned most waterways in the Southeast into muddy ditches and artificial lakes. Pollution and introduction of non-indigenous species of mollusks and crustaceans competing for food have also played roles in the decline of some of these mussels and crayfish. The Hawaiian Islands are home to a variety of colorful and endemic tree snails. Introduction of exotic snail species and habitat destruction have already extinguished many of these, and endangered others.

Many species of butterflies, which are important pollinators, are in decline. The Xerces Blue (*Glaucopsyche xerces*), a beautiful butterfly native to California, became extinct in the 1940s (Stein *et al*. 2000). Eight moth species and two other mainland butterflies are possibly extinct, as are 50 bee species native to Hawaii (Stein *et al*. 2000). Eight mainland butterfly species are critically endangered, and 109 are threatened, according to The Nature Conservancy (Stein *et al*. 2000). Dragonflies and damselflies, which predate the dinosaurs, have also lost ground. Two Hawaiian species are possibly extinct, and 79 more are considered imperiled (Stein *et al*. 2000).

Seventeen species of freshwater fish are extinct or possibly extinct, and the United States leads the world in the number of threatened freshwater fish: The Nature Conservancy lists 283 species (Stein *et al*. 2000). Habitat loss in the form of dams, river diversion and channeling, as well as pollution, has played major roles endangering these fish. Logging has destroyed many clear rivers and streams where salmon and trout breed. The majority of rivers and bodies of water are still polluted despite the Clean Water Act, and contaminants have caused malformations and high mortalities in fish populations. Introductions of non-indigenous fish for sport fishing have imperiled a large number
of species. Brown Trout from Europe and Rainbow Trout placed in areas where they are not native have severely threatened native trout, such as the Cutthroat Trout of western lakes and rivers. In many cases, multiple factors combine to push native fish toward extinction.

The United States is second only to Australia in the number of threatened reptiles and amphibians. The Nature Conservancy lists 51 imperiled reptiles and 82 imperiled amphibian species (Stein. 2000). This amounts to an estimated 40 percent of US amphibians, and 18 percent of native reptiles--extremely high rates. Amphibians are declining worldwide from various causes including habitat loss, pollution, disease, pesticides and ultraviolet radiation from thinning of the Earth's ozone layer.

The total of 71 US bird species that BirdLife International's research placed in various categories of threat includes 33 species from the Hawaiian Islands (BI 2000). The Nature Conservancy found an even greater number through their intensive Natural Heritage Program research: 83 species of birds at risk in the United States, or about 11 percent of all native species (Stein et al. 2000). This is a smaller percentage than for reptiles and amphibians but, when analyzed by region, a large percentage of Hawaii’s birds are threatened. A steady increase in the number of threatened birds has occurred in this century. The major causes threatening US mainland and seabirds are destruction of habitat, pesticides and pollution. In the Hawaiian Islands, introduced animals, disease and destruction of forests and wetlands are the major threats to endemic birds, as well as to plant life and invertebrate fauna.

The Nature Conservancy considers 65 species of US mammals, or about 16 percent of all native mammals, to be threatened (Stein et al. 2000). The loss of habitat from development, logging, livestock grazing, mining and other forms of destruction is the foremost threat to mammals. Added to this, pollution affects many aquatic mammals, and predator and rodent control programs to benefit livestock and agricultural interests affect foxes, wolves, and prairie dogs. A growing number of bats have been added to the list of threatened US mammals, an indication of a loss of habitat, as a result of caves being disturbed or vandalized, loss of large roosting trees to logging, pesticide use, and persecution by those not aware of bats’ ecological importance and who have exaggerated ideas of their supposed threats to humans.

Although lists of native North American threatened plants are far from complete, they reflect the rate at which ecosystems have become imperiled. The Nature Conservancy found 6,460 United States vascular plants to be imperiled (Stein et al. 2000). Of these, a very large number--1,385--are Critically Imperiled, 1,341 Imperiled and 3,338 species Vulnerable. Hawaii is a center for threatened plants. The 1997 IUCN Red List of Threatened Plants found a somewhat smaller number of threatened US plants; 4,488 species, or 29 percent of native plants. Still, the United States had the highest number of endangered plants of any country in the world (Walter and Gillett 1998). In terms of the percent of native plants that are threatened, only St. Helena, Mauritius, and the Seychelles had higher rates (Walter and Gillett 1998) Few countries of the world have legislation similar to the US Endangered Species Act, which has helped hundreds of endangered plants.

Many US plants are adapted to specific types of soil or microclimates, and human disturbances can threaten them. Prairie plants are among the most threatened. California’s grasslands have been reduced by more than 90 percent, leaving many endangered plants; it has many endemic species in its southern chaparral and shrubland, which are being bulldozed to make way for new housing developments. The state's mild climate and varied landscape have given rise to great diversity, which is extremely threatened. Of 25 presumed and 21 possibly extinct species in the state, about half, or 24, are plants (Stein and Flack 1997). Although endemic plants are not as numerous on the mainland as in some island habitats, North America is home to a great many unique and beautiful plants, which are finally beginning to receive the conservation attention they deserve.

Research is uncovering potential economic value in some native plants. One threatened US plant, the Scrub Mint (Dicerandra frutescens), yields a natural insecticide in its oil that repels a wide variety of insects, from ants to cockroaches (Aylsworth 1998). This white-flowered plant is presently restricted to a few hundred acres in central Florida, and it only came under scrutiny in the 1990s, when a Cornell biologist, Dr. Thomas Eisner, discovered its
potential as a natural insecticide (Aylsworth 1990). This mint may be protected from extinction in time, thanks in large part to Eisner's research.

In spite of some sizeable natural areas in the United States preserved by the Wilderness Act and as federal or state land holdings, the country has become increasingly urbanized and cultivated for agriculture. Americans have gradually altered the landscape so that much of it, especially in the East, now resembles Western Europe's heavily populated countries where wilderness has been all but eliminated.

Recent ecological research on the effects of suburban sprawl on the environment have shown it to crowd out as many species as more densely populated areas (Revkin 1997). Diversity of species declines in these areas as green lawns, manicured gardens and asphalt cover the land and pollute the ground water with pesticides, fertilizers and herbicides and kill off beneficial insects and other animals. Developers drain beaver ponds and wetlands and turn streams and rivers into concrete-lined ditches. With each acre lost, species decline. The brilliantly colored warblers and songbirds of eastern forests, for example, have been severely affected by fragmentation of both their breeding and wintering habitats. For the majority of such declining species, endangered listing comes only when they have been reduced to a small fraction of their original populations. The species that are listed by the IUCN or The Nature Conservancy in various categories of threat have reached a point where their very survival is at risk. In some cases, species, which were once described as naturally rare, are very restricted in distribution, especially plants and fish inhabiting desert springs or mollusks found only in a particular river system. For the majority of threatened US wildlife, however, their status a few hundred years ago would have been described as secure. It is all the more indicative of a crisis situation regarding American biodiversity that so many species, and such large percentages of their classes or types, are now headed toward extinction.

Should all US species currently threatened become extinct, a biological tragedy will take place. Preventing such a catastrophe has not yet captured the public's attention or involved a zealous effort on the part of the US government. Important work on biodiversity studies is being done by various federal agencies, but the major burden of activism regarding preservation of endangered species and the environment has fallen to private conservation organizations.

The WWF report entitled "A Conservation Assessment of the Terrestrial Ecoregions of North America," accuses the US government of "doing a worse job of protecting its biological resources than many poorer countries with few resources for biodiversity conservation" (Luoma 1997). It concludes that the wealthiest country in the world places the preservation of its natural resources among its lowest priorities.

Without detailed information on the biodiversity of this country, it will be impossible to protect it, yet funds are inadequate to carry out a comprehensive assessment. Many opponents of the biodiversity studies in Congress have expressed fear that they would be used to expand the list of species on the Endangered Species Act and obstruct development programs. They succeeded in blocking formation of the National Biological Service, which Clinton Administration Secretary of the Interior Bruce Babbitt had to create administratively. The constant deterioration of the land through development, pollution and introduction of exotic species makes these studies all the more timely. This is a critical time of rapid environmental destruction and a turning point for many species which, without urgent protective action, will follow the deadly trails of the Passenger Pigeon, Carolina Parakeet, Sea Mink and hundreds of other lost plants and animals.

The US Endangered Species Act is one of the strongest and most effective laws in the world and has been a model for similar legislation globally. Many countries, including Canada, still lack national endangered species laws. Although private organizations acquire habitat and carry out many important programs, the legal protection the Endangered Species Act provides is key to the protection of many endangered species and their habitats. It has been responsible for saving a number of species, including the California Condor (Gyps californianus), Black-footed Ferret (Mustela nigripes), Whooping Crane (Grus americana) and numerous other animals and plants. The law has helped fund research, captive breeding, protection in the wild, reintroduction programs, land acquisition and law enforcement protection.
The law must be reauthorized regularly by Congress, however, and at these times, efforts to weaken or even fail to authorize it threaten its effectiveness and very existence. The strong support the law has received from the US public is not always evident in the halls of Congress, where commercial interests and lobbyists have had considerable influence. To date, the law has survived, although it has been amended and weakened somewhat since its enactment. The blocking of listings on the Endangered Species Act by its opponents has become the major means of thwarting the Act. Lawsuits have been filed by both opponents and proponents of the law demanding either delisting of species or listing and critical habitat designation. A virtual impasse has resulted in a moratorium on listing new species which the Department of the Interior declared in 2000.

Many listings have been thwarted by commercial interests. In a recent case, a proposal to list the Lynx (*Lynx canadensis*) on the Endangered Species Act was not acted upon by the Fish and Wildlife Service without a lengthy struggle. This species has greatly declined from its once large range in the lower 48 states. Heavy trapping for its valuable fur and logging of its habitat of mature pine forests have reduced its populations to fewer than 1,000 animals. The majority of Lynx remain in Montana, Idaho, Washington and Maine. Although the Fish and Wildlife Service’s (FWS) own biologists found this population to be endangered, they were overruled by headquarters whose bureaucrats decided to refuse to list the species on the Endangered Species Act (Cushman 1998). Petitions by conservationists urging Endangered Species Act listing for the Lynx were ignored, and only when a lawsuit was filed against FWS did the tide begin to turn in this endangered cat’s favor. Conservationists won the suit in 1997, but the FWS, in an unprecedented action, declined to list the Lynx, stating that other species had higher priority for listing. Loggers and commercial timber companies oppose listing the Lynx, fearing that areas would be set aside as critical habitat where no tree cutting would be allowed, and many conservationists believed that FWS had succumbed to these pressures. Finally, in February 1998, the Service and several conservation groups reached an agreement to list the Lynx on the Endangered Species Act to take effect in 1999 (Cushman 1998). President Clinton declared a moratorium on new road building in national forests lands in 2000, which will greatly aid the Lynx and other threatened species of these forests, such as the Wolverine and Marten.

The Public Employees for Environmental Responsibility (PEER) issued a report in December 1997 accusing the FWS of failing to protect more than 300 species awaiting listing. Only listings of plants have increased in recent years, leaving a growing number of animals in need of federal listing (Stein *et al.* 2000). The Nature Conservancy’s biological surveys have uncovered a far greater number of endangered and threatened species in the United States than are listed by the Endangered Species Act, especially plants.

On the positive side, an increase in the number of endangered species added to the Endangered Species Act has been seen in recent years. The Endangered Species Act, in spite of shortcomings, is vital to the preservation of endangered species in the United States, and it is in grave danger of being weakened so much that it will become ineffective. Various proposals in 2001 made by the Bush Administration would make it nearly impossible for citizens to sue the government to force listing of endangered species (Jehl 2001). The majority of species on the Endangered Species Act were listed as a result of citizen suits (Jehl 2001, Gorov 2001). The Fish and Wildlife Service claims to be unable to perform its duties because of the large number of legal challenges. The law has not been reauthorized since 1991, and proposed changes might leave actions regarding endangered species to the discretion of the Department of the Interior, rather than basing them on biological status. Under the new plan, citizens could petition for listings, but the government would not have to respond promptly, nor would it have to act on designating critical habitats for endangered and threatened species (Gorov 2001). So little money—$6.4 million—is budgeted for listing that a stalemate is inevitable. Other proposals by the Bush Administration would cut overall spending on endangered species programs by $11 million, leaving the Office of Endangered Species without the means to accomplish its purpose (Gorov 2001).

A number of private organizations have aided in preserving endangered and endemic plants not listed on the Endangered Species Act. The Nature Conservancy and its state Natural Heritage Programs have purchased or arranged purchase of hundreds of thousands of acres of land for threatened plants. Arboretums and botanical gardens,
such as the Missouri and the New York Botanical Gardens, also are active in this regard. Lady Bird Johnson helped found the extremely effective organization, the National Wildflower Research Center, which aids in the conservation of wildflowers. In the northeast, the New England Plant Conservation Program has spent six years collecting seeds from some 500 rare plants for a seed bank. The New England Wild Flower Society has been instrumental in this program, and many sanctuaries throughout the region are preserving threatened plants.

The actions of individual states under their state endangered species laws and Natural Heritage Programs have also been crucial to the survival of many species that are threatened within a state or region, but might not qualify for federal listing. Programs to reintroduce Bald Eagles (*Haliaeetus leucocephalus*), Peregrine Falcons (*Falco peregrinus*), threatened fish and River Otters (*Lutra canadensis*) have brought back these species in many areas where they had been eliminated by pesticides, over-trapping, pollution or water projects. Many programs have involved cooperation between state and federal endangered species officials.

Habitat Conservation Plans (HCPs) are agreements worked out between landowners and the Fish and Wildlife Service for listed endangered species under a 1982 amendment to the Endangered Species Act. In essence, they are the result of deals made among developers, state and county officials, Fish and Wildlife Service representatives and local citizen groups on large tracts of land, in which portions of endangered species' habitats are protected, while development is allowed on the rest. HCPs are a permanent contract that cannot be amended, even if biological information is revealed showing that they were in error. These HCPs have been the center of much controversy, considered by some conservationists to compromise the principles of the Endangered Species Act, and by others to be an excellent means of protecting species. HCPs are not presently published in the *Federal Register* prior to signing by the Secretary of the Interior, which would subject them to public comment.

In 1997, a team of 119 scientists, financed by the National Science Foundation and the American Institute for Biological Sciences, carried out careful appraisals of signed HCPs and reported on their conclusions. They found that crucial scientific knowledge was lacking about many of the species involved in these agreements (Yoon 1997). They also found misuse of scientific methods and biological data which will end in harming, rather than helping, many species (Yoon 1997). Dr. Peter Kareiva, a University of Washington ecologist who organized the study, concluded that many HCPs should not have been written, and only about half correctly employed science (Yoon 1997). Of 206 HCPs examined in total, 44 of them in detail, one-third lacked information as basic as life span of species, and the vast majority did not include data on rates of population rise and decline and habitat changes (Yoon 1997). The most glaring problem seen by the scientists was the failure of HCPs to correctly assess the impact of losses to species' populations, mainly as a result of untested methods of appraising impacts. One plan proposed to protect Utah Prairie Dogs (*Cynomys parvidens*) by moving animals to a new location using a method already known to result in the deaths of 97 percent of the relocated animals within three months (Yoon 1997). An HCP for the Desert Tortoise (*Gopherus agassizi*) in Nevada allowed the killing of hundreds of these threatened reptiles by bulldozing their burrows and habitat, while protecting only minimal amounts of habitat.

A major problem faced by those trying to save endangered species is the fact that the vast majority live on privately owned land, and arrangements must be made with owners to insure the survival of these species. Many people believe that protecting these species involves major restrictions on the use of their land and, therefore do not want to enter into Habitat Conservation Plans. Ideally, however, protecting a threatened butterfly or plant on a private ranch, for example, would only involve identifying the habitat, the host plants for the butterfly, and preventing destruction through excavations or other major alteration of the land. In many cases, cattle grazing is compatible with protection of rare species, since the land is not plowed, which can destroy plant life. Ranchers in southern Arizona have cooperated in protecting the land through preventing overgrazing and maintaining riverbank vegetation and springs for rare frogs and birds. For many endangered species, conservation easements are an excellent solution for their protection. These easements involve the payment of funds to the landowner by private organizations, or local, state or federal governments to let the land remain undeveloped and help enhance it as wildlife habitat. This is an especially good solution for farmers who are afraid of losing their land after years of crop failure or low market prices. Innovation has marked many arrangements now being made to protect endangered and endemic species.
The US public as a whole supports the protection of endangered species, which helps explain the Endangered Species Act's survival under strong opposition. Polls conducted in November 1994 by Peter D. Hart Research Associates found that 57 percent of the public wanted to maintain the Endangered Species Act in its present form, and only 32 percent wanted to relax requirements. A September 1995 CNN poll asked which was more important, saving endangered species or saving jobs: 48 percent replied endangered species, and 40 percent, jobs. A Gallup poll carried out for CNN in April 2001 found that support remained strong. It asked Americans whether they supported environmental and wildlife protection even if it meant higher prices or more jobs, and again, a majority supported conservation. They were also asked to rank environmental protection in terms of its importance as an issue, and most placed it near the bottom of the list. When asked whether it would be an important issue in 25 years, however, the majority said it would be among the most important issues. This reflects a failure to understand the ongoing wave of extinctions that is eliminating many of the Earth's most fragile plants and animals and its possible effect on humans.

Thus, education is extremely important, especially its role in relating American lifestyles and waste of resources to the extinction and endangerment of species. A 2001 film, "Natural Connections" (Howard Rosen Productions, shown on PBS), addresses this issue as well as the gradual diminution of biodiversity. The overconsumption that Americans take for granted impoverishes nature in the US as well as in other countries that export their tropical hardwoods; cut flowers; leather from cows grazed in former rainforests; non-organic, sun-grown coffee; minerals; and handicrafts from scarce materials to this country. Other products are manufactured as a result of polluting the environment and, like coated paper cups or pulp magazines, are used once and thrown away. To maintain such a throw-away lifestyle, millions of trees are cut each year in the United States and elsewhere, disrupting ecosystems and threatening wildlife. Pollution is created from mines that poison rivers, and manufacturing and power plants that spew dioxin and greenhouse gases into the air. The urgency that gave rise to legislation early in the 20th century that protected native birds and other wildlife from overexploitation for commercial purposes was enacted after the extinctions of the Passenger Pigeon and Carolina Parakeet, and near-extinction of the American Bison (Bison bison) and other animals from 19th century slaughters. It would be tragic if a similar wildlife or environmental catastrophe were needed to spur strong action to preserve the world's genetic and biological heritage.

**Threatened Species of the World**

The 2000 IUCN Red List found 3,507 vertebrates and 1,928 invertebrates in high degrees of threat worldwide (Hilton-Taylor 2000). Plants classified as Critical, Endangered or Vulnerable totaled 5,611 species. These are minimum figures because only birds and mammals have been thoroughly examined for status. When assessments are carried out on the remaining species, the list will doubtless grow far longer.

Many of the most magnificent, graceful, beautiful and zoologically curious animals on Earth are threatened with extinction. A growing number of these, such as sea turtles, sharks and crocodiles, have survived virtually unchanged for hundreds of millions of years, and if not for the human activities that are pushing them toward extinction, they would likely survive millions more.

Almost all the graceful cranes, on Earth since the Miocene Epoch, are endangered from loss of habitat and hunting. The entire family of prehistoric-looking rhinoceros is teetering on the brink of extinction. New Zealand's extraordinary and primitive kiwis and ancient tuatara lizards, which have survived since the dinosaur epochs, may be lost in the next few decades. Eleven of the 16 species of penguins are now threatened, nine in higher categories (BI 2000). Seabirds of many types, including the majority of albatross, are now listed.
The most surprising finding was the high number of mammals listed: 2,046 species, of which 1,130 species were in higher categories of threat (Critical, Endangered and Vulnerable). Thus, of the approximately 4,000 species of mammals, 28 percent are highly threatened, and more than half are in some degree of threat. They are the most imperiled class of animals. Twelve percent of birds, or one in eight species, are listed in higher categories of threat (1,186 species), and an additional 809 species are in lesser categories (Near-Threatened, Conservation Dependent, or Data Deficient), totaling 1,995 species or about 18 percent of the world's birds (BI 2000). Reptiles are a group less well assessed, but 750 species are at risk in all categories, according to the 2000 IUCN Red List. Amphibians, which number about 4,550 species worldwide, have a minimum of 226 threatened species, and a large additional number that have not been thoroughly assessed. Likewise, very few marine fish are listed by the IUCN because so little is known of their status. Some progress is being made in assessing marine fish, especially coral reef fish and sharks and rays. By 2003, a complete assessment of the shark family is planned by IUCN (Hilton-Taylor 2000). Approximately 1,183 fish are listed in the most recent IUCN Red List in various categories of threat. The majority of these are freshwater species, which represent 6 percent of all known fish.

The rate at which animals and plants are declining has reached such proportions that even familiar species considered common with stable populations only a decade ago are now threatened. The African Lion (Panthera leo) and many African antelope, Giraffes and wildebeests are in serious decline, or exist only in parks and reserves, categorized as Conservation Dependent.

Animals listed as Near-Threatened or Data Deficient totaled 3,324 species, of which 2,364 species are vertebrates in the 2000 IUCN Red List. The grand total of 8,759 vertebrates in all categories comprises 20 percent of all mammals, birds, reptiles, amphibians and fish on Earth. In the early 1980s, only 1,000 vertebrates were listed by the IUCN. This means that in just 20 years, this total has risen by almost 900 percent.

Plants have been assessed in several reports. The 1997 IUCN Red List of Threatened Plants (Walter and Gillett 1998) was supplemented--and many species reassessed--by the 2000 IUCN Red List (Hilton-Taylor 2000). Plants from Cameroon, the Galapagos, Mauritius and South Africa were added to the 2000 list. A total of 6,932 plants were listed in all categories, 5,611 in higher categories of threat. In spite of these major undertakings, only conifers were thoroughly assessed. The 1997 study, using one type of definition based on status alone, found 30 percent of all conifers to be either Endangered or Vulnerable; the 2000 reappraisal, using new criteria, determined that 16 percent were threatened (Hilton-Taylor 2000). When far more species of plants are assessed, The Nature Conservancy study of US plants (Stein et al. 2000), which found one-third of plants to be threatened, may be indicative of a great decline in the world's plants.

As in the case of animals, many of the Earth's oldest species of plants are at high risk of extinction. Trees that predated the dinosaurs and survive in pockets in Chile, New Zealand, New Caledonia, Australia, New Guinea and parts of Southeast Asia are being destroyed, with little knowledge of their extreme botanical importance. Many of these are among the largest trees in the world, rivaling the Redwoods in height and the Sequoias in girth (see Forests chapter). Others, such as the monkey puzzle tree family, are extremely bizarre in appearance, and may contain important compounds for medicines. Beautiful primitive flowers, the protea, are also greatly threatened, with many species growing in South Africa. Tree ferns, palms and hundreds of orchid species are also highly threatened. The island of Mauritius has a large number of threatened plants, many of which are quite unique.

Many zoologists and conservationists are now resigned to the rising level of extinctions and believe that, within a century, 80 percent of all species living today will be extinct. Such predictions may be overly pessimistic, but unless the public is made more aware of the precarious status of a growing number of plants and animals and demands strong action, the prognosis may be fulfilled.
What is Threatening Species?

Human activities are at the root of virtually all extinction threats. Destruction of fragile habitats, wetlands, coral reefs, tropical and temperate forests, rivers and grasslands has accelerated in recent years due to human population increases and commercial exploitation of forests, ocean fish and other wildlife, as well as the introduction of non-native species, either intentionally or accidentally. The massive pollution and chemical contamination of air, water and soil--and even the atmosphere that surrounds the Earth--are altering the climate and bringing about unforeseen declines in wildlife and plants.
between 8.5 and 9.4 billion by 2050. While population growth has leveled off in parts of Europe, Russia and Australia, it continues to rise in the United States, mainly as a result of immigration. The highest rates of growth, 3 percent or more, occur in Africa, Asia and Latin America, where environmental deterioration has been severe. The similarity between the astronomic rise in human population and the extinction rate of animals and plants is not accidental.

Settlers in increasing numbers are entering tropical forests, grasslands and other wild areas teeming with wildlife, and clearing them for grazing livestock and planting crops. Loggers in the Brazilian and Central African rainforest wildernesses are building roads to transport entire forests of trees, some thousands of years old, to be sold in markets in North America, Europe and Asia. The roads open up the forests to settlers and hunters, endangering countless species of animals. Commercial exploitation of forests has increased rapidly since the 1980s, with logs turned into pulp for paper, expensive lawn furniture, paneling, shipping cartons, and even concrete molds that are used once by builders and thrown away. Rivers are becoming increasingly polluted from human waste that goes untreated in many parts of the world, and billions of people scratch out a living by subsistence farming, cutting trees for fuel and grazing livestock.

These poverty-stricken people have caused the limits of the Sahara and Sahel in Africa to expand by depleting wildlife and trees, and have razed forests in India, China, Indonesia, Thailand, Ecuador, Central America, Mexico and West Africa. Still, many go hungry because they have far outstripped what the land could supply sustainably. For the wealthier nations, an appetite for material goods and demand for a high standard of living have encouraged a market for precious resources, such as tropical lumber and wildlife products, that has expanded in recent years with the World Trade Organization (WTO) globalized economy. In order to repay loans granted to them by international funds, many poor nations strip their forests and grow exportable crops on the land. In the United States, urban sprawl and overexploitation of forests and other resources have threatened a host of animals and plants. Water is diverted for these new towns, endangering native fish and forests. In Arizona, the Sonoran Desert, a botanical world treasure, is now being destroyed by the expanding cities of Phoenix and Tucson.

The needs of the growing numbers of people worldwide have spawned many ill-conceived and environmentally destructive projects. Indonesia and Brazil opened up the most biologically rich forests on Earth to farming by people living in overpopulated cities. The soil is poor in tropical forests, and they must keep clearing land to find new areas for crops, gradually destroying vast areas once teeming with wildlife. China has moved people into western grasslands, where they have eliminated wildlife and caused massive erosion and desertification with agriculture and overgrazing of livestock. Dust storms from this region have been circling the globe in recent years. China has also commissioned the world's largest dam, Three Gorges--on the Yangtze River--in an attempt to control floods and generate electricity. In the process, a very rare freshwater dolphin, a sturgeon, and hundreds of rare plants will become extinct, and the dam's lake will fill with untreated sewage. The problem of overpopulation has not been well understood or coped with in the majority of countries where populations are now outstripping food supply.

In most parts of the world, however, people have deforested the habitats and killed prey species of wide-ranging wildlife that have nowhere else to go. Asian Elephants (Elaphus maximus) and Tigers (Panthera tigris), for example, have been deprived of habitat and food and crowded into areas too small for their requirements. When they rampaged into people's gardens or killed livestock, they were killed and their body parts sold for high prices. Both species are now endangered, their populations fragmented and in steep decline. This is a pattern that has been seen with large animals, especially predators, throughout the world. Animals or plants with low populations as a result of restricted habitat size or specialized requirements for survival have been pushed to the brink of extinction as humans moved into their habitats.

Only a few countries have national policies to encourage stable populations. In some countries with populations that far exceed the ability of the land to adequately sustain them, wars have broken out, providing an apocalyptic vision of a violent future for the Earth should present trends continue. A scientific study, Environmental Change and Violent Conflict (Homer-Dixon et al. 1993), predicted that as human populations increase and resources decrease, wars will
occur with ever greater frequency. Population Action International, a Washington, DC-based organization, calculated in 1997 that although human population growth has slowed somewhat, water resources remain under serious threat. This organization's report warns that by 2050, people in the Middle East and parts of Africa, where populations continue to grow at high rates, will be engaged in bitter, violent conflicts over water. The story of the Rwandan war, described later in this chapter, reflects this cause and effect. Overpopulation causes human suffering, permanent damage to the land from overuse, and the destruction of the very species that might prove life-saving. A few countries, such as Singapore, launched education programs decades ago, urging people to have smaller families for a better quality of life. The rate of population increase in this tiny country is now less than 1 percent, and literacy is 91 percent.

Medical advances preventing disease and early mortality in people around the world, combined with growth in agricultural output, have played a major role in the nearly four-fold rise in human population since 1900. The World Health Organization (WHO) has scoured the planet eradicating disease but is not required to educate people about birth control methods. This has decreased natural mortality and fueled population booms. The majority of international aid projects lack overview, coordination with one another and long-term planning. Supplying high-yield grain and financing irrigation projects to poor nations, without providing birth control education, results in a doubling of populations within a generation, which negates any rise in the standard of living and education levels. By encouraging livestock and agriculture in dryland areas, with little knowledge about the natural environment or its capacity to support large numbers of people, wildlife and plants are displaced or killed, and in years of drought, crop failures result, causing starvation. The human suffering brings international aid with emergency food, and instead of relocating people to other areas, these programs encourage replanting and a repetition of the misfortune.

Ethiopia and Somalia are examples of such policy failures. These countries were covered in a mosaic of grasslands and forests teeming with endemic wildlife early in the 20th century. An influx of large numbers of people and livestock, encouraged by aid programs, denuded this region to arid desert. The vast numbers of wildlife have largely disappeared or become endangered as the extensive grasslands, rivers, lakes and highland forests disappeared because of overgrazing, farming in areas too dry to produce crops and deforestation for firewood (see Grasslands, Shrublands and Deserts chapter). With low human and livestock population densities, these areas could have remained ecological treasures.

The Population Institute of Washington, DC, warns that although some countries have shown declining rates of population increase, especially those in Western Europe and North America, this will not result in an overall decline in world population because of greater human longevity, continued high birth rates in at least 74 countries and a high survival rate (Holmes 1997).

The top 10 countries in terms of overall numbers of people have 59 percent of the world's population. More than 30 percent of all births in 1997 took place in India, a country expected to overtake China as the world's most populous nation by 2050 (Holmes 1997). A 1997 World Bank report, "The World Food Situation: Recent Developments, Emerging Issues and Long-Term Prospects," concluded that food stocks are not keeping up with need (Crossette 1997b). Demand for meat is increasing, placing further stresses on natural systems since livestock consume enormous amounts of grasses and grain, cause damage to vegetation and often pollute water systems; grain production is reaching the limit of potential yields, especially in Asia (Crossette 1997b).

The most densely populated country in the world, Bangladesh, with 127.5 million people, has about half the population of the United States in an area the size of Wisconsin. It has a density of almost 3,000 people per square mile, and a population growth rate of 2 percent a year. Ninety percent of the people in Bangladesh's countryside are illiterate and malnourished in spite of decades of international aid projects. Bangladesh is now totally dependent on foreign aid for minimum nutrition, and the land is being worked to maximize yields, using large quantities of fertilizer, irrigation and pesticides. The once vast mangrove forests that serve as fish and shellfish nurseries, and habitat for Tigers and other endangered species, are being destroyed piecemeal, cut for firewood (Worker 1996).
Funds to encourage birth control around the world have been deleted from US budgets by those opposed to abortion, thus thwarting all types of programs of education, birth control methods and related issues. Most organizations working to lower birth rates around the world use almost no funds for abortion, yet they find their funds cut for all family planning programs. This obstructionism has been a major setback to those working to stabilize the world’s populations. The United Nations Population Fund has continued to carry out family planning programs, but with inadequate funds.

What is Threatening Species? Habitats Under Threat

Habitat destruction is the foremost threat to wildlife. In broad terms, more than 85 percent of IUCN-listed birds, mammals and plants are threatened by habitat destruction and degradation (Hilton-Taylor 2000). The greatest number of threatened species listed in the 2000 IUCN Red List inhabit terrestrial areas. They total 9,256 highly threatened species. The largest single terrestrial group is plants, with 5,607 species; birds follow, with 1,144 species; with mammals having only slightly fewer threatened species, 1,111 (Hilton-Taylor 2000). The vast majority of threatened birds and mammals are terrestrial species. The destruction of forests is the single most important threat to birds, affecting 75 percent (BI 2000). At least 900 of the 1,144 threatened birds inhabit tropical rainforests, with almost half of those species restricted to lowland rainforests, and 35 percent in montane rainforest (BI 2000). Authors of Threatened Birds of the World (BI 2000) found that the vast majority—86 percent—of rainforest birds cannot tolerate much habitat destruction, and 45 percent require near-pristine habitat. Only 3 percent are highly tolerant of habitat alteration (BI 2000). Unsustainable selective logging affects 31 percent of threatened birds. In many tropical forests, logging and forest burning are taking place without any restrictions, totally eliminating habitats of rare rainforest birds. A total of 4.5 million square kilometers, or 20 percent of the world’s forests, were cleared from 1960 to 1990 (BI 2000), and since then, forests—especially tropical forests—have continued their decline. Although some forests may return to old-growth hundreds or thousands of years in the future, much of the land is being converted to agriculture, grazing land, housing, cities, industry and roads and is unlikely ever to revert to forest.

Likewise, more than half, or about 57 percent, of threatened mammals inhabit tropical rainforests, 35 percent in lowland, and about 22 percent in montane rainforest (Hilton-Taylor 2000). Less than 10 percent of threatened birds and mammals are native to temperate mixed forests, coniferous forest and temperate broadleaf forests, according to the IUCN. A very small number of threatened mammals, about 3 percent, inhabit tropical degraded forest, a sign of the unsuitability of this habitat (Hilton-Taylor 2000).

Forests are also home to a wide variety of threatened frogs, salamanders, tree snails and insects, although studies of
which type of forest each inhabits have not been done by the IUCN. Many endangered plants are tropical species, native to islands such as Madagascar and Indonesia, where endemic plants such as orchids and palms abound, and habitat destruction is severe. The United States leads the world in threatened plant species, with 4,669 identified by the IUCN in its 1997 study (Walter and Gillett 1998) and 7,817 species listed by The Nature Conservancy (Stein et al. 2000). Many of the latter are in Hawaii, another tropical island with a high percentage of threatened plants. Lobelias are known for their beautiful flowers, and the ancestor species that arrived in the Hawaiian Islands radiated into 273 species, some of which grew to the heights of small trees. One-quarter are gone, and another 124 of the surviving species are threatened with extinction or possibly are extinct (Walter and Gillett 1998). Of the remaining lobelias, only 27 percent now have sizeable enough populations to keep them from extinction; the loss of their pollinators, most of whom were honeycreepers, is a major cause (Buchmann and Nabhan 1996). The honeycreepers lost their forest habitats to clearance by settlers, and as they faded into extinction--one species after another--lobelia plants they had pollinated disappeared or became endangered. These ecological webs exist throughout nature.

The IUCN found that 91 percent of plants identified as threatened were endemic, with their entire distribution restricted to a specific country (Walter and Gillett 1998). A total of 32,242 threatened or extinct species of plants occur in one country alone, while 2,368 occur in two countries, and only 709 plant species occur in more than two countries. Only scanty information on threatened plants is available from most countries in South America, Africa and Asia, which are expected to have large percentages of their native plants found to be threatened when assessed (Walter and Gillett 2000).

Grasslands, shrublands and savannahs are the second most important habitat for threatened birds, home to 383 species, or 32 percent of all listed species (BI 2000). Two-thirds of these birds inhabit shrublands; 43 percent, grasslands; and 8 percent, savannah (BI 2000). Three-fourths are tropical birds, whose habitats are threatened by livestock overgrazing, human settlement and farming (BI 2000). Some 17 percent of threatened mammals inhabit grasslands, while another 8 percent are shrubland species, and about 7 percent are native to desert and semi-desert (Hilton-Taylor 2000).

Freshwater habitats, such as rivers, marshes, bogs, streams and ponds are the second most important biome, after terrestrial, for threatened species. At least 1,946 threatened species, the largest number being fish (627 species) inhabit these areas (Hilton-Taylor 2000). Freshwater crustaceans (409 species) and mollusks (420 species) are major inhabitants of these aquatic areas, as are 131 amphibians, 111 reptiles, 78 birds and 31 mammals, according to the 2000 IUCN Red List. The United States, with its extensive water projects--dams, levees, diverted and channelized rivers--harbors large numbers of threatened crustaceans and mollusks, as discussed above.

Frogs make up the majority of threatened amphibians and have been in decline for several decades. Their habitats are being destroyed at an unprecedented rate as wetlands are filled in--half of US wetlands that were present in colonial times--are gone. Thailand has lost almost all its wetlands, and Southeast Asian lakes and marshes are being drained at an unprecedented rate, threatening frogs and other wildlife. Frogs have been on Earth for 190 million years, but at the present rate of decline, the majority of the approximately 4,500 species will be gone within decades. In addition to habitat loss, a variety of threats are eliminating them (see Non-Native Species, Trade and Pollution sections below).

What is Threatening Species? Non-Native Species Introductions

Invasive species, or alien, non-native animals and plants introduced into ecosystems, present the most important threat to plants. The large numbers of threatened species that have limited distributions are highly vulnerable to the possibility of invasive species eliminating them from the wild. Islands have the greatest percentage of their native plants in danger of extinction. St. Helena, a small island in the South Atlantic, leads these in percentages, with 13

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percent extinct or extinct in the wild, and 68 of 165 native plants and trees threatened (Walter and Gillett 1998). Livestock played a role in the extinctions and present status of many native plants (see Chapter 1). Mauritius follows, with 39.2 percent of native plants in danger, or 294 of 750 species (Walter and Gillett 1998). Other islands with many native plants threatened by exotic species include the Seychelles, Jamaica, French Polynesia, Pitcairn, Reunion and New Caledonia (Walter and Gillett 1998). Of the latter islands, all but French Polynesia and Pitcairn formed part of Gondwana, and many of the plants at stake are very ancient in origin.

One endemic Mauritian palm, *Hyophorbe amaricaulis*, has been reduced to a single plant. Although it grows vigorously and produces male and female flowers at different times, no fertile seeds are produced (Stearns and Stearns 1999). At the National Agricultural Station in Ireland, botanists cultivated the tiny embryonic growths found within the immature fruits; it is hoped that clones of the palm can be grown to adulthood (Parnell *et al.* 1986). Introduced animals and plants have taken over Mauritius and Rodrigues so completely that a number of species have been reduced to as few as two remaining plants.

Hawaii’s native forests and plants have fared poorly, too. Native sandalwood forests were cut by early settlers, endangering several species. The most fragrant of these trees, the Iliahi (*Santalum haleakalae*), is now restricted to the dry lava slopes of eastern Maui. Its carmine red clusters of flowers have the same aroma as its fragrant heartwood (Daws 1993).

Seven or eight types of lobelia plants of the genus *Delissea* once flourished in Hawaii, and all became extinct by 1966 except one, *Delissea undulata*, which had become reduced to only a few plants. Conservationists fenced these plants in 1967 from the browsing cattle and rooting pigs, and they were thought secure (Carlquist 1980), but by 1995, the species’ population had declined to a single plant. Botanists found it hanging by a few roots inside a sinkhole, the fence damaged and broken. The fence was repaired, and botanists are germinating seeds, hoping to prevent its extinction (Royte 1995). Another Hawaiian plant, *Cyanea pennatifida*, is in the same perilous status. Native to the mountains of Oahu, it also became reduced to a single plant, which was not producing its green flower. A botanist took a small sample of plant tissue and successfully cloned it in a test tube (Lipske 1997). Dozens of these plants have been cultivated from the slip, some of which were reintroduced into a preserve in 1995 (Lipske 1997).

Two hundred native Hawaiian plants are listed either on the US Endangered Species Act or are candidate species. Some 115 species have only 20 individual plants scattered in different areas or just one population of 50 or fewer plants in one location (Lipske 1997). Livestock and exotic plants have destroyed these plants and their habitats. One of these extraordinarily rare plants has been eliminated from all its original range, and the last members of the species cling to a single vertical cliff along the coast of Kauai, with its roots growing horizontally into rugged rocks (Carlquist 1980). This unusual lobelia, *Brighamia insignis*, has a thick, woody stem which tapers to a rosette of leaves, and it has lost its natural pollinator, which may have been a bird or an insect. Located 2,000 feet above crashing surf, it is out of reach of goats and pigs, but difficult for botanists to reach. This spectacular landscape is now this lobelia’s sole habitat. Each year, botanists Steve Perlman and Ken Wood risk their lives by scaling the cliff, using climbers’ ropes, to collect pollen from the plants with a brush. They then rappel to a neighboring plant to pollinate it, and months later, they must climb back up to collect the seeds, which are being placed into cultivation (Daws 1993; Royte 1995). Some of these seeds have successfully grown into plants at the National Tropical Botanical Garden on Kauai (Lipske 1997). This may be the most arduous and life-threatening plant conservation program in the world.

On the island of Guam, the forests have not been destroyed, but the bird life has been virtually eliminated by an insidious exotic animal that arrived in the 1960s or earlier. Several Brown Tree Snakes (*Boiga irregularis*) somehow secreted themselves in a shipment from their native Indonesia, and once on the island, they began to multiply. These snakes proved to be an environmental nightmare of the worst proportions, climbing trees and killing and consuming nestling and adult birds, and increasing at alarming rates. They have also caused major problems for the people of Guam. Ascending telephone poles, Brown Snakes short electrical wires. Between 1978 and 1990 alone, 1,000 power outages on the island were caused by these snakes (Jaffe 1994). A major threat to children, they enter homes, biting babies in cribs, and consuming pets. Untold millions of these snakes now live in virtually every environment in
Guam. By 1981, these snakes had eliminated native birds from most of the island except for a remote part in the north. The snakes obliterated nearly the entire avifauna of Guam, an estimated 750,000 birds. Once a verdant tropical island teeming with birds, the forests have fallen silent. Three birds became extinct: the Guam Flycatcher (*Myiagra freycineti*) and two distinct subspecies of birds that survive on other islands: the Guam Bridled White-eye (*Zosterops conspicillatus conspicillatus*) and the striking chestnut, black-and-white Guam Rufous Fantail (*Rhipidura rufifrons uraniae*) (Jaffe 1994). The flycatcher was the greatest loss because it left no subspecies on neighboring islands. The Guam Kingfisher (*Halcyon cinnamomina miyakoensis*) became extinct on the island as well, but fortunately, a small number had been taken into captivity. These kingfishers have been kept at several US zoos, but although they have produced some young, they have exhibited abnormal behavior, such as cannibalizing their chicks, and some have succumbed to avian tuberculosis.

The Guam Rail (*Gallirallus owstoni*) escaped extinction by a hair's breadth. The rail's population declined to about 2,000 birds by 1981, and in 1983, fewer than 100 remained; the last wild birds disappeared by 1987. The Guam Division of Aquatic and Wildlife Resources captured 19 rails in 1984 and, after captive breeding and holding, began releases in 1995 of 30 to 50 rails every three months on the neighboring island of Rota (Line 1995). Rota, a 209-square-mile island, is snake-free, but only one-fourth the size of Guam. Its forest is mainly intact (Line 1995). In 1999, the introduced Guam Rails bred on Rota for the first time (BI 2000). A small area of 24 hectares on Guam has been fenced off from snakes, and Guam Rails introduced there have also bred (BI 2000). About 180 birds survive in 14 zoos in the United States (BI 2000).

To date, no effective control has been found to rid Guam of the Brown Tree Snake. Metal bands on nesting trees of endangered birds and high-voltage electrical wires meant to kill them on contact have hardly made a dent in their populations. A native bird at the edge of extinction, the Marianas Crow (*Corvus kubaryi*), declined on Guam from 351 birds in 1981 to just seven in 1999 (BI 2000). On neighboring Rota, only 592 survived in 1995, down from 1,318 in 1981 (BI 2000). Guam still has a high percentage of forest cover and many aquatic habitats intact. Among the few mammals on Guam, the Marianas Flying-fox (*Pteropus mariannus mariannus*) has also declined, with a population in the mid-1990s of only about 300 animals. They suffered the effects of heavy hunting by the people of Guam for food, and the Brown Tree Snake is now killing juvenile bats. The endemic Guam Flying-fox (*Pteropus tokudae*) is now extinct, last seen in 1968. It was a probable victim of unrelenting hunting by natives for food but may have been killed off by the Brown Tree Snake. Shrews and other rodents and monitor lizards are disappearing from Guam as well (Jaffe 1994). Since many of the birds and bats served as pollinators of native trees and plants, these species may die out as a result.

Invasive species, mainly those introduced by humans onto islands, caused virtually all avian extinctions over the past few hundreds years. Today, almost 30 percent of threatened birds, or 298 species, are affected by introduced predators, particularly cats, rats, mongooses and other animals (BI 2000). Livestock introduced into avian habitats represents a major threat to 72 species of birds, and 71 bird species have been adversely affected by the introduction of invasive plants that eliminated the food or habitat of plants on which these birds depended (BI 2000). Pathogens, such as diseases and parasites, brought into avian habitats by various means threaten an additional 69 species of birds (BI 2000).

Introduced species threaten fewer mammals, about 69 species, or 10 percent of those listed by the 2000 *IUCN Red List* (Hilton-Taylor 2000). This may be because far fewer mammals inhabit islands, compared to the number of native birds, especially flightless ones. Even sizeable islands, such as New Zealand, had very few native mammals prior to human colonization. Madagascar is an exception, with a very large diversity of primates and other mammals, a large number of which are now extinct because of invasive species, along with many other factors (See Islands chapter).
What is Threatening Species? Persecution, Hunting and Trade

A total of 367 species of birds are threatened by hunting for food (233 species) and trapping for the cage bird trade (111 species) (BI 2000). The majority of birds that are threatened by meat and feather hunting are Asian pheasants, grouse, partridges, bustards, guans, megapodes and other large birds (BI 2000). The family of birds most threatened by trapping for the cage bird trade is the parrot family, Psittacidae, with 57 percent of threatened species trapped for this trade (BI 2000). These parrots are native to Mexico, Central and South America, Africa, Asia and Australia, and some have been pushed to the edge of extinction (See Trade chapter). The Spix's Macaw (Cyanopsitta spixii), for example, had been reduced from several hundred birds in the wild in Brazil to a single male when he, too, was illegally trapped in late 2000. This species is now extinct in the wild.

Hunting and capture for commercial purposes threatens 212 mammal species (Hilton-Taylor 2000). Many mammals have been endangered by hunting and persecution, including a number of large predators. The number of bats on the threatened list has grown dramatically in recent years, with many fruit bats threatened by killing for food, and others by vandals or those who persecute them for supposed threats to human health. Trade affects about 29 percent of threatened mammals (Hilton-Taylor 2000). Both the Asian (Elephas maximus) and African Elephant (Loxodonta africana) species have been reduced to endangered status primarily as a result of killing for their ivory and meat. The 1989 listing of the African Elephant on Appendix I of the Convention on International Trade in Endangered Species (CITES) succeeded in putting an end to more than 90 percent of trade in ivory, which was pushing this species rapidly toward extinction. Since then, the ban has been weakened by pressure from ivory traders, and CITES allowed trade in stockpiled ivory taken from smugglers in southern Africa. This had the immediate result of increasing poaching of elephants throughout the continent, in anticipation of a lifting of the ban.

All rhinoceros species, two native to Africa and three to Asia, are critically endangered. Populations of the five species together total only about 12,000 animals, a result of heavy hunting for their horns, which are used in Traditional Medicine (TM) and as handles for daggers in the Middle East (see Trade chapter). The toll of animal species killed for meat, trade and the TM market numbers in the millions, of which a growing number are threatened. Tigers, Leopards and other wild cats, snakes, pangolins, monkeys, birds of prey, deer, seahorses, and turtles, and many other species are killed to supply this market. The Tiger is poached throughout its range because its body parts are worth $10,000 or more when sold in this market and as trophies. This species is killed in parts of its range by slow-acting poisons and leghold traps for trade, and predator control when it has hunted livestock after its natural prey was killed off. Species like the Tiger, which require large territories and are suffering high mortality from hunting throughout its range, as well as loss of habitat, are in imminent danger of extinction. Several conservation programs are attempting to stem the tide in favor of the Tiger and reduce demand for its body parts in TM. Stricter laws are needed throughout the world, however, to protect endangered animals. The bushmeat trade is a major threat to Central and West African mammals and a wide spectrum of species in Southeast Asia (see Persecution and Hunting chapter).

A thriving trade in terrarium frogs has resulted in a worldwide market for many species of these amphibians. The world's largest frog, the Goliath Frog (Conraura goliath) of Central Africa, weighs 7.2 pounds and reaches a length of at least 32 inches; it is found along major rivers in dense tropical rainforest in Equatorial Guinea and southwest Cameroon (FWS 1991). Throughout its range it is very rare, and it has unusual habitat requirements. It needs rapids and cascades with sandy bottoms and very clean, oxygen-rich water; deforestation has reduced this habitat. Collectors have offered huge sums up to $2,500 for capture and export of Goliath Frogs--as personal pets or for public exhibition. One US dealer imported 50 of these frogs and attempted to enter them in the Frog Jump Jubilee in Calaveras County, California (FWS 1991). The Endangered Species Act lists this species as Threatened throughout its range. The IUCN lists it as Vulnerable on the 2000 IUCN Red List. Hundreds of other species are collected for
this trade, threatening many, including various mantella frogs of Madagascar, coveted for their golden color (See Islands chapter).

Although more reptiles than amphibians are killed for their skins, amphibians are now also being taken in large numbers for this purpose. In 1985, the United States imported more than 11,000 frog and toad hides and products worth $350,000 for the luxury trade in frog skin wallets, toad leather boots and other items (Fitzgerald 1989). Most of these skins come from a large Malaysian frog (*Rana macrodon*), but the Black-spined Toad (*Bufo melanosticus*) and other species are used as well (Fitzgerald 1989). Such products are extremely difficult to identify by species, making enforcement difficult.

Frogs are killed by the millions for high school biology class anatomy lessons, an unnecessary toll because computer programs and films now provide this information (see Projects section). For the restaurant trade, frogs are killed in even greater numbers. Indonesia and Vietnam are the major sources of frogs for restaurants and food markets in Europe and the United States. Prior to export bans, Bangladesh and India captured many millions of frogs each year for the restaurant trade. Several documentary films have recorded the process of removing the frogs' legs in Bangladesh and Indonesia; the same methods were used in each country. Once captured and gathered in large containers, the frogs' back legs are sliced off with a sharp knife or machete, and the still-living frogs are tossed into heaps, where they continue to struggle for long periods before dying. An increase in malaria was documented in Bangladesh after the frog trade caused declines in wild populations; the frogs had been controlling mosquito populations.

The Indian Bullfrog (*Rana tigerina*), a species native to southern Asia, was listed on Appendix II of CITES after heavy trade depleted it. Some of these shipments were seized: In July 1997, a shipment from Vietnam containing the legs of 450,000 Indian Bullfrogs was intercepted in Holland as a CITES violation; the container with the frogs' legs weighed almost 20 tons and was en route to a wholesaler in Canada. This shipment alone represented frogs from vast areas in Vietnam, depleting wetlands of these ecologically important amphibians. Even in US National Parks, frogs are commercially hunted. In Florida, for example, frog hunters in airboats capture millions of frogs during night hunts. In February and March 1996, 6 tons of frogs were taken from Big Cypress National Preserve for sale to restaurants and for private consumption, according to environmental groups which have petitioned the National Park Service (NPS) to end or limit this hunt (Dodds 1996).

The reptile product trade placed virtually all large crocodilians on the endangered list by the early 1970s after imports of millions of skins for luggage, shoes and handbags nearly caused extinctions of species in South America, Africa and Asia. Although controlled to some degree by CITES, a large percentage of trade is illegal, composed of protected species (see Trade chapter). The luxury trade in these products is now threatening many snakes as well as lizards, whose skins can be sold for very high prices. These reptiles, which play important roles in nature—culling rats and other rodents and preventing overpopulations of fish—are taken from the wild. Snakes are being captured in such numbers for this trade and for the Asian medicine and restaurant trades that they have disappeared from areas where they had been common. (See Endangered and Threatened Species of Mammals, Birds, Reptiles and Amphibians in the Appendix for an extensive list of these reptiles now threatened with extinction.)

**What is Threatening Species? Pollution and Disease**

Pollution by acid rain and acid from coal mines that drains into streams and rivers, heavy metals, PCBs, dioxin and other toxic chemicals, have killed off all life in waterways in many parts of the world. PCBs and pesticides have caused serious genetic malformations in frogs, birds and fish.
Frogs have been dying from fungal diseases and the indirect effect of other pollutants, which are eliminating entire species. Necropsies done on frogs from Australia and Panama, which were found dying, have revealed the presence of the same fungus, chytrid (Morell 2001). It is considered responsible for the extinction of several Australian frogs, including the extraordinary Gastric-brooding Frog (*Rheobatrachus silus*) and three other species, and has infected frogs in Panama as well, eliminating populations and possibly species (Morell 2001). This fungus has been detected in 44 species of Australian frogs and is apparently spreading in many parts of the world. Other fungi and viruses have eliminated frogs in the United States (Morell 2001). These diseases have long been in the environment, and it is not yet clear why they have become so toxic and virulent to frogs. Frogs have thin skin and easily absorb chemicals, making them vulnerable, but apparently their immune systems have been weakened, as well. Frogs and toads are also threatened by pesticides, which have been shown to cause grotesque deformities and mortality. Many types of pollution, including acid rain, heavy metals and fertilizers, have eliminated frogs in many parts of Europe and Canada (Morell 2001). Ultraviolet radiation (UV) suppresses frogs' immune systems and kills eggs as well as adults. Andrew Blaustein (1994), an American biologist, conducted experiments that proved UV to be responsible for wiping out many species of frogs in the US West who laid their eggs in the open. The eggs were thus exposed to this radiation, which has intensified as a result of the decrease in the ozone layer caused by chlorofluorocarbons, used by industry in air conditioners and refrigerators, among other industrial uses (see Aquatic Ecosystems chapter).

Hawaiian birds have been seriously affected by avian malaria, brought to the islands by captive cage birds, as discussed in Chapter 1. This disease continues to threaten the surviving species of native birds, and is a major cause of the wave of extinctions that is claiming one species after another of these beautiful songbirds (BI 2000). Several species, such as the Nukupu'u (*Hemignathus lucidus*), are now in Critical status, possibly extinct on both Kauai and Maui where, until the 1990s, a few birds were seen in their montane forests (BI 2000). Feral pigs in their habitats facilitate the spread of alien plants and introduced, disease-carrying mosquitoes (BI 2000).

**What is Threatening Species? Traits of Vulnerable Species**

By identifying the traits that characterize species likely to become endangered or fade to extinction, it is possible to afford them and their habitats extra protection and carefully monitor their status. The tragic losses of so many of these "red flag" species should be avoided in the future, and can be, with remedial action. Ideally, species should be conserved when their populations are still healthy, before they become genetically impoverished and their populations fragmented. The list below includes some of the characteristics many extinct and endangered species possess. Undoubtedly, the more we learn about the causes pushing wildlife and plants to extinction, the longer such a list will become.

1. **Endemic species**, or animals and plants that are restricted to a relatively small area, such as an island, are inherently vulnerable to extinction. They have incurred the greatest number of extinctions in the past 400 years. Changes in their habitat or losses to their populations can eliminate them. Many of these species were confined to areas that measured only a few square miles. Mainland species, likewise, can be endemic to small areas. The Slender-billed Grackle (*Cassidix palustris*) once inhabited a single marsh near Mexico City. The marsh was filled about 1910, spelling extinction for this bird. Many endangered species fall into this category.

2. **Specialization of habitat or diet** has caused much extinction. Animals that depend on a certain type of habitat or food source and cannot adjust to alterations, whether natural or human-caused, are extinction-prone. The Ivory-billed Woodpecker requires large expanses of old-growth forests with many dead and dying trees. The endangered Kirtland's Warbler (*Dendroica kirtlandii*) of Michigan will colonize only one type of forest: stands of jackpine trees that are eight to 22 years old on well-drained, sandy soil. This habitat must now be artificially maintained to prevent the bird's extinction. The Palila (*Loxoides bailleui*), a Hawaiian honeycreeper, is dependent on the mamane tree for...
feeding, which has declined as a result of logging and destruction of seedlings by introduced game species and livestock. Many endangered plants require specific soil type, climate, drainage and sunlight exposure. For those species that require unbroken stretches of habitat, such as old-growth forest, endangerment or extinction can result if the forest is fragmented.

3. Long lived species with low reproductive rates and low natural mortality are vulnerable to extinction. Fast-reproducing species that have many young at frequent intervals and high natural mortality rates tend to be more resilient to population losses and recover quickly if their habitat has not been destroyed. Not all vertebrates fall easily into these categories, but many do, and these groupings can be at least one indication that is useful in terms of predicting which species will become endangered when their populations are reduced. Slow-reproducing animals decline rapidly from losses in their numbers, and since they often do not breed until a relatively advanced age and have few young, many decline to extinction. In some cases, such animals do not recover their former abundance, or recover very slowly. A few of these animals, including sea turtles, lay many eggs, but only a small percentage of the hatchlings survive to adulthood. Although few of the now extinct animals were ever studied in the wild, enough is known of related species to guess that many fell into this category. The Steller's Sea Cow (Hydromalys stelleri), for example, was a member of the Order Sirenia of manatees and Dugongs. The surviving species have few natural enemies, do not breed until age 7 to 10 years old, and have only one young every five years. Hunting caused the extinction of Steller's Sea Cow in the space of a few years, eliminating the only cold-water member of this family. Hunting threatens surviving species of this family in many areas. Manatees and Dugongs are very slow-moving, making them easy targets. The Steller's Sea Cow may have numbered only a few thousand animals in its limited distribution near islands in the Bering Sea. Even when able to swim away, they refused to leave their mates, beaching themselves on the shores next to the slain mate. Such animals can probably not tolerate any hunting. Manatees and Dugongs, likewise, need strict protection.

Many large birds, including condors, eagles and large parrots such as macaws, have low reproductive rates. The Cuban Red Macaw (Ara tricolor), became extinct in 1885. If its breeding biology resembled other large macaws, it was long lived, reaching an age up to 80 years, had only one or two chicks a year and did not breed every year. Scientists have recently discovered that even in an immense national park in Peru, wild macaws produce so few young that any losses in their numbers cause declines in their populations. This helps to explain why so many birds of prey and parrots are endangered. Passenger Pigeons were long lived, laid only one egg, and may not have nested every year. Likewise, turtles and tortoises are long-lived, with at least one species, the Galapagos Tortoise (Geochelone nigra) documented as living to more than 165 years in captivity. Some shark species do not breed until the age of 20 years and produce only a few young.

4. Flightless birds and slow moving animals are helpless in the face of hunting pressure and predation by introduced predators and humans. Unwary animals, such as many island species that have evolved in the absence of predators fall into this category. Flightless birds, such as the Great Auk, Great Elephant Bird, Dodo, many Pacific Island rails and tortoises, are among species that lack defenses or cannot quickly escape predators, human or other. In addition to being flightless, many extinct birds lacked defensive behavior or the instinct to hide in underbrush as a result of their having evolved in predator-free environments. Predators introduced into their habitats, as occurred on many islands, soon eliminated them. Even the thick shells of tortoises were not effective defenses against predators such as rats, who ate young tortoises, and humans easily captured these slow-moving animals. Although our attitudes are more humane toward these vulnerable animals today than hundreds of years ago, tortoises and sea turtles are still killed for trade or by vandals for sport. Some surviving flightless birds on islands have official protection and a better future than they had in previous centuries, while others do not.

5. Large animals have been vulnerable to overhunting since the Pleistocene Epoch. In recent centuries, whales were added to the list of large species unable to escape guns or harpoons. The largest lemur and bird species of Madagascar were killed off by the Malagasy immigrants thousands of years ago, as were many large flightless birds by the Maori when they first arrived in New Zealand. Large animals are often killed merely because they make large targets or for trophies for those who enjoy slaughtering animals. Animals of large size require considerable amounts
of habitat and are, therefore, naturally more rare than species with smaller habitat requirements. When human populations rise and wilderness is replaced with towns and industry, large animals are the first to disappear, due either to loss of habitat and prey or because they are killed as potential threats. Most of the largest mammals on Earth are now on the endangered list of the 2000 IUCN Red List, including both species of elephants, all the rhinoceros species, and many large antelope and big cats such as the Tiger, Cheetah, Leopard and Lion. They have declined from hunting or persecution and are being crowded out of their habitats by human activities. Large animals are often keystone species at the top of their food chains or play important roles in ecosystems. Their absence is indicative of damaged or incomplete ecosystems. Elephants are important in spreading seeds of many plants through their dung, and large predators play a major role in the health and physical characteristics of their prey. The African savannahs without Lions, Leopards and Cheetahs would soon be overpopulated and overgrazed by their numerous prey species. The Elk of Yellowstone National Park became overpopulated in the absence of the Gray Wolf, and grazed certain plants so heavily that some bird species and other wildlife disappeared and certain tree species became rare. In spite of the wolves’ importance to ecosystems, they are killed with impunity by livestock owners and others who consider them threats.

6. Wild animals and plants which have a value as food, pets, ceremonial objects or marketable products to humans are prime candidates for extinction. The list of animals that have been hunted to extinction for food is long. Within the past 400 years, many large land tortoises, the Great Elephant Bird, moas, Steller's Sea Cow, Auroch and Quagga were all extinguished by hunting for food. The unique Huia bird of New Zealand had plumes that were sold for large sums, helping to drive its limited population to extinction. Hawaiian songbirds were hunted to extinction for their colorful feathers, which were used in ceremonial headdresses and capes. Within the past decade, trade has increased as a threat to wildlife with the rise in Asian economies. This has fueled the Traditional Medicine markets, which consume vast numbers of animals, threatening many of them. The vacuuming of the seas by commercial fisheries has resulted in depletions and endangerments. The once abundant sturgeon of the Caspian Sea, for example, sources of Beluga and other expensive caviar, are now critically endangered as a result of unrestricted fishing and poaching for the luxury gourmet market. The bushmeat markets of West and Central Africa sell tons of slaughtered monkeys, forest antelope, Chimpanzees, Gorillas and other wildlife, devastating species whose tropical forest habitats are being logged. Hunting for food is also a major threat as firearms become available to native peoples who once used primitive weapons. Southeast Asian wildlife is under siege by people who once hunted only for their own purposes but now find that a wide range of wildlife can be sold in local meat markets or for Traditional Medicine. They set nooses and traps, killing rare monkeys and antelope, birds, snakes, turtles and tortoises, pangolins and loris, clearing out the forests of wildlife. The pet trade is driving many colorful tropical birds, reptiles and primates to endangered status. Luxury goods, such as high-priced reptile products, provide an incentive to hunt--legally or illegally--lizards, crocodiles and snakes for this market, endangering many species. Trophy hunting of endangered species by wealthy hunters is a major threat to a growing number of animals, especially since the largest specimens are killed; these are the ones that should be left to breed. The higher the value of the animal or product, the greater the threat to that species.

7. Altruism, or the unselfish care for members of one's own species, highly admired as a human trait, has been fatal to many animals--the Passenger Pigeon, Dodo, Carolina Parakeet and Steller's Sea Cow, for example. In their evolutionary history, this behavior served to preserve bonds between animals and to frighten off predators. When confronted with guns or other weapons wielded by humans, however, animals that come to the aid of fallen mates or flockmates can be easily killed themselves. Refusal to leave their wounded fellows hastened the extinction of many species. Endangered species with these traits include wolves, gorillas, whales and elephants.

8. Species breeding in colonies or requiring large numbers of their own kind for protection, to locate food sources or for other means of survival, are vulnerable to extinction. The Passenger Pigeon was a colonial nesting bird and could only survive among large numbers of its own species, flocking and seeking food sources over large areas. When flocks were fragmented, these separated populations declined to critically low levels, even though their total numbers may have been in the tens of thousands. The Passenger Pigeon may have become critically endangered as soon as its migrations, feeding and nesting behavior were interrupted, even though it appeared to observers at the time
to be plentiful. These pigeons had longevity of several decades, and failure to reproduce would take some time to be noticed in the overall population. But when there is little or no introduction of young into a population over a period, it can suddenly crash with little warning, as the Passenger Pigeons did. Wild parrots tend to feed, roost and spend their time preening and in courtship as a flock. For some species, these flocks number in the thousands of birds. When netted or caught by various means for the pet trade, which threatens a large number of species, their flocks are broken up and they are no longer able to function as a group. Their breeding is curtailed or stopped altogether, and they may no longer fly in groups seeking fruiting trees or mineral licks when they fear being captured. Flamingos require large numbers of their own kind for feeding, flocking, migrations and breeding, and their populations crash if any of their survival requirements are not met.

Many species of birds have breeding strategies in which male birds will not breed unless they are able to display courtship behavior in the company of other males, vying for the approval of females. Birds of paradise, cocks of the rock in South America, prairie chickens and grouse of North America are among birds that display for the benefit of females, who choose among them. Such birds require specific conditions to breed, and habitat alterations, reductions in their populations or hunting pressure that keeps them from exposing themselves in the open can prevent their breeding.

Mammals, reptiles and amphibians also have male contests of strength, agility or other mark of superiority of species. Wild sheep and deer vie for females by head butting and challenging one another. Many types of tropical frogs emerge during the breeding season to form groups that display for one another for the benefit of females. Male Plowshare Tortoises joust with one another in attempts to upend the rival and will not breed if only a single male and a female are placed together. Without rivals for competitions, male breeding behavior may not be triggered, preventing reproduction.

Zoos and zoologists are only beginning to understand some of the instinctive responses necessary for breeding. Our traditional concept that a compatible pair of animals will reproduce is often incorrect, and populations of animals must not be allowed to be so reduced that their natural breeding behavior and other survival needs are not met.

Thus, while population numbers can provide important information about the status of a species, without additional information, such as the traits mentioned above, the data can be extremely misleading and inapplicable. The number of individuals surviving in a species, when known, must also be placed into a context greater than their rate of decline and habitat status. Unless the entire breeding biology, behavior and other aspects of species' survival needs are taken into account, extinction cannot be predicted, or status properly evaluated.

Some species now extinct suffered from several of the above factors, which hastened their extinction. The Passenger Pigeon, for example, required enormous amounts of food, mainly from nut-bearing trees in old-growth forests, and was relatively long-lived, killed for food and commercial sale, and lived colonially. Elephants and manatees are among endangered species with many vulnerable traits, including large size, altruism, slow-reproduction, low natural mortality and longevity. They are also slow-moving and valuable in trade and as food sources.

These traits indicate only vulnerability to extinction caused by humans, not species likely to become extinct through natural selection. Sea turtles, for example, have lived on Earth for more than 200 million years. By any standard, they are a superbly successful, adaptable species that, prior to recent exploitation, showed no signs of decline. Their vulnerability lies in their inability to flee rapidly in the water or while laying eggs onshore when preyed on by humans.

Many endemic species occupy very limited habitats and have small populations but have not been listed as threatened if their environments or populations have not declined. The majority of these species have prospered for thousands of years in stable environments, and only the intrusion of human-related activities and domestic animals upset this equilibrium. Such species are extremely vulnerable to even minor habitat destruction or hunting pressure.
and should be carefully monitored for losses in their populations.

Because of human technology and weaponry, all animals have become vulnerable. Animals that for thousands of years used natural camouflage, stealth and intelligence to escape from natural predators, have become easy prey for human hunters and fishermen. Predators, never in their evolutionary history preyed upon, now find themselves targeted by hunters, trappers and poisoners. Sonar locates fish schools and whales, and heat detectors and night-view binoculars observe animals in darkness. Cleverly constructed blinds hide hunters from view. Animal scents are used to lure wildlife, and hunters imitate animal sounds or use tape recordings of their calls to lure them to traps or within shooting range. Some hunters use the signals emitted by radio transmitters placed in wild animal collars by biologists for tracking, to hone in and pursue them to their deaths. Guns equipped with telescopic sights can fire at targets mile away, killing animals before they are even aware of the hunter. Other weapons include sophisticated traps, nets, snares, guns, harpoon guns and high speed vehicles and boats, with which people can run down, maim and kill even the swiftest and most intelligent animals. These devices give humans such an advantage that they render the natural protections animals have evolved over eons completely ineffective. Hunters are able to kill the fittest and strongest specimens through these means. In the process, we are changing the course of evolution from survival of the fittest to survival of animals that are tolerated by humans and those able to persist in an increasingly polluted, damaged and ecologically impoverished natural environment.

Those species whose populations have become greatly reduced are vulnerable to extinction through genetic impoverishment and inbreeding. Such species usually remain rare or gradually fade into extinction as fertility declines. The critical low level which results in extinction is different with each species and cannot be predicted with certainty.

Just as the story of North America's lost species and environments is illustrative of many similar tragedies, the account below of the civil war in Rwanda and the former Zaire encapsulates the major threats to wildlife and the environment. It also makes abundantly clear that the survival of humans, animals and the environment are intrinsically linked. The influence of countries that contribute foreign aid to poor nations half a world away, and interfere in their politics, is another important element that can greatly affect the survival of wildlife and the natural world.

Human Tragedy and the Looting of Virunga's Treasures: Page 1

The mist enshrouded Virunga Mountains of East Africa tower over dense highland vegetation. Far below, crystalline lakes ringed by marsh reeds glisten in the sun. Shy forest African Elephants walk along mountain paths in single file. Groups of endangered Mountain Gorillas (*Gorilla gorilla beringei*) feed in forest glades. Three hundred fifty of these magnificent animals, almost half their world population, reside here (Fisher 2001). The western edge of these mountains is protected in the vast 12,800 square mile Virunga National Park, bordering western Rwanda. Some 766 species of birds reside here, more than are native to the United States and Canada combined. Iridescent sunbirds feed on the flowers of giant lobelias, and more than 200 species of mammals live in the park (Bonner 1994). Many of the species native to the park are found nowhere else on Earth. This ecological treasure is Africa's first national park, set aside in 1925. Virunga was closed to visitors other than scientists until very recently. In the 1970s, it became a World Heritage Site, a designation by the United Nations Educational, Scientific and Cultural Organization (UNESCO) for places deserving special recognition and protection.

In the early spring of 1994, political upheaval in the region caused a civil war that wreaked massive ecological damage and loss of wildlife in this natural paradise. Rival tribes in neighboring Rwanda clashed violently after the country's President was killed in an airplane crash caused by a rocket launch (Wright 2001). There were suspicions
that his death had been arranged by his enemies. In an attempt to overthrow the minority-run Tutsi government, the Hutu majority began slaughtering Tutsi tribal members. Within months, more than 500,000 people, most of them Tutsis, were slaughtered in an appalling genocide that began with armed conflicts between army soldiers and rebels and accelerated to violence between neighbors. People of all ages were victims, many killed by slashes from machetes or battered to death with clubs. The Hutu failed in their attempt to overthrow the ruling Tutsi tribe and fled in panic west to neighboring Zaire, home of Virunga National Park.

Some 2 million Rwandan Hutu refugees flowed in a steady stream into eastern Zaire, just south of the park. Injured and starving, they crowded into camps where international aid organizations fed them and attempted to control cholera and other infectious diseases. Within days, scenes that might evoke visions of Dante's *Inferno* were televised by news organizations to viewers around the world. Gaunt, frantic people were seen scrambling frantically for food supplies or lying listlessly in the final stages of starvation and disease. Estimates of total mortality from the war, starvation and disease exceeded 1 million people (Wright 2001). Many of the surviving refugees were afraid to return to Rwanda and remained in the refugee camps or built settlements on hills near Virunga National Park. To supply firewood to these 700,000 or more refugees, 30,000 people went into the rainforest each day, cutting down tens of thousands of trees (Bonner 1994). Rwandan soldiers and others began a thriving business selling firewood throughout the refugee camps. By November 1994, 112 square miles of the park had become partly or completely deforested, and little was done by Zairean troops or park authorities to curb the destruction (Bonner 1994). One forest ranger said, "Trees used to block the views everywhere. Now I see hills I didn't even know existed." An estimated 230 truckloads of trees left the park every day (Salopek 1995).

In December 1994, the World Heritage Committee placed Virunga National Park on a list of "World Heritage in Danger." Along with the forest cutting, park wildlife was killed for food by both refugees and Zairean soldiers, who had gone unpaid for months by the failing government. In mid-1995, more than 12,000 of Virunga National Park's Hippopotamuses (*Hippopotamus amphibius*) were killed for their meat and their ivory teeth, reportedly by Zairean soldiers using semiautomatic weapons. By late September 1995, there were still 700,000 Rwandan refugees camped near the park, removing 600 metric tons of firewood from the park each day (Lang 1995). Michel Leusch, Environmental Coordinator for the United Nations High Commissioner for Refugees in nearby Goma, said, "The quantity of biomass may be recovered in time, but some things, like rare plants and animals, have disappeared and cannot be replaced" (Lang 1995).

The government of Zaire began closing refugee camps in January 1996, with more than 1 million refugees still resident in 40 camps along the border with Rwanda. Another 700,000 Rwandan refugees stayed in camps in Tanzania and Burundi (McKinley 1996). Although millions of dollars were donated to supply food and medication, no aid funds were allocated for alternate fuel for these refugees, such as solar cookers and propane gas stoves that would have helped prevent the devastation of Virunga's forests. This highlights the need for an international ecological rescue fund that could ameliorate such tragedies, as well as safeguard wildlife from slaughter. In late 1996, Zairean troops attempted to force the last of the Rwandan refugees back into their country, causing open warfare to break out, and the last of the United Nations relief workers were forced to abandon the area. By mid-1997, hundreds of thousands of Rwandan Hutus had dispersed through the forests of Zaire, living off the land. Thousands of Hutus, jailed on their return to Rwanda, were placed on trial in an international tribunal in 2001 for their actions during the massacre.

**Human Tragedy and the Looting of Virunga's Treasures: Page 2**

A major underlying cause of Rwanda's civil war and the great suffering of its people is its uncontrolled population growth. In 1973, Rwanda's population reached 3,980,000 in a country whose total area is only 10,169 square
miles—smaller than Maryland (Anon. 1975). This resulted in a ratio of 391 persons per square mile, one of the densest in the world. Populations continued to grow, however, and by 1992, they topped 8,206,000, with a density of 806 persons per square mile (Anon. 1994a). The country became increasingly crowded, as arable land became scarce. Competition for land had become intense. Much of Rwanda is eroded and barren, the thin tropical topsoil producing crops for only a few years after the forest has been cleared. Only 22 percent of the land remains forested (Wright 2001). Farmers slash and burn more forest for planting when land ceases to produce crops or grazing grasses. Steep, erodable slopes are being plowed right up to the limits of protected parks and reserves. The feuding between Hutu and Tutsi might have been peacefully settled if not for the extreme poverty and overpopulation. The average per capita income in 1999 was $720 per year (Wright 2001).

The war's massacres killed almost 1 million people, leaving an estimated 7.2 million people by 2,000, according to unofficial estimates (Wright 2001). Unless birth control becomes widely accepted in Rwanda, human populations will rise to an estimated 11 million people within a few decades. Some experts believe that nearly 22 million people will occupy Rwanda by 2020 (Anon. 1994a). By the latter estimate, there will be 2,163 persons per square mile in Rwanda, far more than its land can support. By contrast, the population density in the United States in 2000 was 76 persons per square mile, and Canada's, 8 persons per square mile (Wright 2001).

Human Tragedy and the Looting of Virunga's Treasures: Page 3

The effects of burgeoning human populations on wildlife and the once magnificent forests that covered the region have been tragic. Long before the forests of the Virunga Mountains became divided into the separate countries of Zaire, Rwanda and Uganda, and before the forests were replaced by agriculture in the latter two countries, thousands of Mountain Gorillas inhabited the region. As human populations rose, Gorillas declined to their present endangered status. These peaceful primates wander in the forest throughout most of the daylight hours, feeding on the luxuriant vegetation. As the largest and most powerful of all primates, the Gorilla male has an enormous chest, 20 inches across and up to 5.7 feet (1.75 meters) in circumference. He weighs up to 605 pounds, while females are much smaller, about half the weight of the male (Nowak 1999). The Mountain Gorillas' forests can become quite cold at night, and to adapt, they have developed longer, thicker hair than the Lowland and other races of Gorillas.

Gorillas travel in family groups led by silverbacks, named for the whitish-gray hair on their backs. These are the strongest and largest males, usually more than 20 years old, who guide and protect the band. Males compete for this role as soon as they are teenagers. Silverbacks father the babies in the family group, although sometimes females mate with "outside" males. These groups often travel long distances to locate fruiting trees and edible plants and tubers. Almost entirely vegetarian, Gorillas eat 40 pounds of food a day, feeding on 70 or more species of leaves, bark, fruit, roots, fungi, flowers and bamboo. They rarely drink water, obtaining moisture from the dew-laden plants, and the only animal matter they consume consists of insects. Gorillas consider army ants a delicacy and occasionally eat grubs and other insects.

In Rwanda's north, contiguous to Virunga National Park, where about 250 Mountain Gorillas survive, Volcanoes National Park, a 48-square-mile forest reserve, is home to about 100 Mountain Gorillas (Fisher 2001). The latter forest was once much larger, but the needs of agriculture had greater priority, and some 65 square miles were carved out of the park, squeezing the Gorillas into a fraction of their original range in the country.
In neighboring Uganda, the small Mgahinga Gorilla National Park, a 34-square-kilometer reserve, protects 40 more Mountain Gorillas. Some 25 kilometers north is a beautiful cloud forest, Bwindi Impenetrable Forest National Park, covering 330 square kilometers, in an area of high biological diversity (Butynski and Kalina 1993). This forest has the greatest number of trees of any in East Africa and so many endemic plants that it has been selected by the IUCN Plants Programme as one of Africa's most important forests (Butynski and Kalina 1993). Birds, butterflies, amphibians and reptiles found nowhere else inhabit the Bwindi Impenetrable Forest. It also protects a population of 300 Mountain Gorillas who have smaller bodies, longer limbs, hands and feet than those of Zaire: Their skulls and trunks differ also, and they are somewhat different genetically from other populations (Croke 1995, Drewes 1997). Scientists are now considering naming these Gorillas a separate subspecies. Destruction of forest and other habitats outside Uganda's and Rwanda's parks is extensive, making these last natural areas crucial to the survival of the Mountain Gorillas.

Uganda's decades of chaos under President Idi Amin decimated the wildlife of this lovely country bordering Lake Victoria. Murchison Falls and Queen Elizabeth National Park once had magnificent concentrations of elephants, hippos and other large mammals, but by 1997, little remained, having been slaughtered by rebel groups or refugees from neighboring countries (Drewes 1997). Uganda's Ministry of Tourism, Wildlife and Antiquities conducted an aerial survey of Uganda's remote northern regions to determine whether some wildlife might remain to restock other areas, but they found "absolutely nothing" (Drewes 1997). Uganda has recently made a commitment to restore its wildlife and has reintroduced many large ungulates, trucked in from Kenya, into its national parks.

Although Gorillas share more than 98 percent of human genes, making them, along with the two species of chimpanzees, our closest relatives, until the 1960s, they remained mysterious, threatening creatures in the view of the public, depicted as monsters in movies. During the 19th century, explorers and hunters killed them as ferocious symbols of savagery. The work of American biologists Dr. George Schaller and, later, Dian Fossey, who entered the forests of the Mountain Gorillas as observers and researchers, changed this image forever. Films and books of the National Geographic Society and others revealed the gentleness and intelligence of these magnificent primates to people around the world, and gradually, conservation programs began to replace trophy hunting.

Schaller, who began his research in the 1960s in Virunga National Park, wrote about these primates in The Mountain Gorilla, published in 1963 by the University of Chicago Press, and a popular version, The Year of the Gorilla, in 1964. He provided the first scientific observations of these remarkable animals and recalled his encounters with them in a 1995 National Geographic article:

*I approached them with empathy and respect, wanting nothing from them but peace and proximity. And they accepted my presence with an astounding generosity of spirit. The recent decades have been a turning point, indeed a revolution, in our relationship with animals. Humans have begun to overcome cross-species barriers, achieving intimacy with humpback whales, chimpanzees, lions, mountain sheep, wolves. The gorillas of popular image were a fantasy... No one who looks into a gorilla's eyes--intelligent, gentle, vulnerable--can remain unchanged, for the gap between ape and human vanishes; we know that the gorilla still lives within us. Do gorillas also recognize this ancient connection? (Schaller 1995).*

Vanishing Species
In the 1960s, Virunga National Park sheltered the largest population of Mountain Gorillas, numbering some 450. They declined to 275 by the 1970s, and to 250 by 1981, a result of poaching. The Mountain Gorilla Project, begun in 1978 by Schaller and a consortium of conservation organizations, including the New York Zoological Society and the African Wildlife Foundation, sought to stop the Gorilla's decline toward extinction. Funding went toward anti-poaching programs, education of local people, and ecotours (Schaller 1995). With non-threatening visitors to the park, many Gorillas grew tame. They were given names by park rangers and scientists and became familiar to tourists who came from around the world to see them. The conservation program and ecotourism succeeded in nearly eliminating poaching, and Virunga's Gorillas increased to 320 by the late 1980s (Schaller 1995). The Gorilla Project also operated in Uganda, where the government ejected 2,000 farmers from 3,500 acres, offering to compensate them with 10 percent of the revenue from tourists who come to see the gorillas (Salopek 1995).

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Fossey's early research was sponsored by the famed anthropologist Louis Leakey, who had earlier convinced Jane Goodall to go to Tanzania to study Chimpanzees (*Pan troglodytes*). Both researchers changed forever our views of these fellow primates. Fossey began her research in the 1970s in the mountains of Rwanda, making friends with a family of Mountain Gorillas. The silverback male of this troop, whom she named Digit, became so trusting that he was filmed by the National Geographic Society gingerly taking her pen and then her notebook, returning them to her, and then lying down and going to sleep by her side (see Video--Mammals). These immensely strong animals never harmed any of the thousands of people, from rangers and scientists to tourists, who visited the reserve over several decades. When they felt their family was threatened, they made shows of aggression, pounding their chests or rushing headlong through the bushes toward the potential threat, whether human or another male Gorilla, but stopping short of physical blows. Humans, however, misinterpreted their displays, shooting and killing many silverbacks.

Commercialization of Gorillas—the high value of their young in the exotic pet trade and the many thousands of dollars offered by zoos to obtain illegally captured specimens—has presented a major threat to the species for many decades. Local people enter parks and reserves to shoot adults guarding the young, remove the animals’ heads and hands, and grab the traumatized babies. Other Gorillas are killed accidentally by illegal wire snares set in the parks for antelope and small mammals. Although efforts had been made in many parks to stop the killing of Gorillas, not until December 1977 did international attention become focused on this grisly and cruel activity. Six Rwandans, with their hunting dogs, entered the reserve armed with spears to kill Gorillas. They encountered Digit, who boldly rushed at them, pounding his chest. This allowed his family to escape, but cost him his life. The Rwandans speared him five times until he died, and then cut off his head. Gruesome photos of Digit's headless body received enormous publicity in the media, causing shock and dismay in millions of people who had seen photos of him in gentle communication with Fossey, as well as films produced by the National Geographic Society about her research. His death served to inspire both compassion and renewed conservation efforts for these beleaguered primates.

Fossey's Karisoke Research Center expanded, and thousands of tourists came to glimpse the Mountain Gorillas in their forest home. The threat of poachers remained, however, and Fossey, after a fervent campaign to prevent further Gorilla killings, was herself killed. Her murder has never been conclusively solved, but Rwandans are the major suspects. She is buried in the reserve next to the grave of Digit. Fossey recounted her experiences with Gorillas in a book, *Gorillas in the Mist*, which was later made into a commercial film of the same title. The silverback star of this film was named Mrithi. Not long after the film was made, in May 1992, he, too, was shot and killed by Rwandan soldiers, surrounded by his family of 11. Even after being wounded, he managed to drag himself some 6 feet toward his attackers before collapsing and dying.
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During the 1980s, the country of Rwanda had adopted Mountain Gorillas as an international symbol of wildlife protection during the 1980s, and when civil war broke out in the spring of 1994, both sides promised to spare them—promises that were not kept. In April 1994, the Rwandan civil war forced the staff of biologists at the Karisoke Research Center to depart (Perlez 1994). By early July, most of the wardens of the Rwandan Office of Tourism and Volcanoes National Park fled also, but a few dedicated guards refused to leave the Gorillas and remained. Soon after, Rwandan soldiers entered the park and ransacked the offices, destroying records and books and throwing computers out windows but, fortunately, sparing the lives of the guards and the Gorillas. The war claimed at least one Gorilla that year, however, when a male named Mkono was killed by a buried land mine (Tuxill 1997).

The staff of Volcanoes National Park was devastated by the war. Two-thirds of Rwanda's park employees died or remained in exile after the war ended, and 48 of 50 vehicles were destroyed (Salopek 1995). When surviving employees returned, many of them having been rescued from the masses of people living in refugee camps, with the help of United Nations personnel, they were delighted to see the Mountain Gorillas again. Nshogoza, a park employee who has spent 18 of his 44 years at Karisoke and has known generations of Gorillas, told a National Geographic writer, "When I was a boy, I heard that gorillas were men who were very bad and who went to live in the forest. But the gorillas are better than us. They are peaceful. They have no tribes. When they fight, it is for a good reason. We cut one another with machetes for zero" (Salopek 1995). To honor these guards, the park received the $50,000 J. Paul Getty Wildlife Conservation Award in May 1996, the money to be managed by the International Gorilla Conservation Program. Some was spent detecting and defusing more than 75 mines and booby traps left after the war, and other funds restored tourism in the park.

The Mountain Gorillas of Virunga National Park had been safe for a decade, but in 1995, Rwandan refugees, probably members of the routed army, entered their misty, forest home. In August and September 1995, three Gorillas—two silverbacks and one female—were found shot to death at point-blank range. One of these, named Marcel by the park scientists, was the most popular of Virunga's Gorillas, totally tame and gentle. He was so habituated to tourists that they could approach within a few feet of him, and hundreds of films and photos had been taken of him over the years. The bodies of Marcel and his mate were found sprawled out on the ground, full of bullet holes. "If someone comes in with a gun, the gorillas won't move out of the way," said Popol Verhoestraete, a field officer for the conservation program (Lang 1995). The killers left the bodies intact. These two Gorillas died trying to save their baby from poachers, who allegedly planned to sell him to a zoo. The park guards finally located this young Gorilla and seized him from the poachers, who were arrested. They carried the baby, who had become terrified and disoriented, in a small cage back to the family group. Not knowing if the frightened young Gorilla could survive without his parents, they released him, prepared to recapture him if things did not go well. After hesitating, he heard the sounds of his family and ran to join them. The leaderless and traumatized family group moved off into the forest.

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Illegal snares have been threatening wildlife in these parks for generations. In the 1960s, Schaller saw two Gorillas in a group of 11 that had each lost one of their hands to snares (Schaller 1995). In Virunga National Park in mid-1995, a young male Gorilla was seen with a wire snare wrapped tightly around his foot, cutting off circulation, which threatened his life with septicemia (Salopek 1995). Just as the guards were preparing to capture him to remove
the snare, they saw a huge male silverback watching over him. They waited until the right moment and darted the young Gorilla with a tranquilizer, taking him to a local veterinarian, who saved the Gorilla's foot (Salopek 1995).

In another snare incident in 1995, a very young female Gorilla was caught by the wrist in a snare set by Rwandans who entered Virunga to trap forest antelope. A film by Bruce Davidson, "Mountain Gorilla," shown on the National Geographic Explorer television series (September 14, 1996), chronicled the trauma of this tiny Gorilla, who struggled in vain to free herself, crying out and screaming in fear and pain. The park rangers thought that she might have been in the snare, which was tied to a tree, at least 24 hours before they discovered her. She was surrounded by her family, but her relatives could not bite through the snare because it was made of strong nylon cord from food sacks donated to the refugees. The silverback male, Ndingutse, tried again and again to free the baby, and her mother held her to comfort her screams, but there was nothing they could do to release her. Finally, the park guards, who had been standing nearby, were able to approach when Ndingutse moved away for a moment, and cut the cord. She escaped, but faced the threat of becoming snared again, and the cord remained around her wrist, a threat to her circulation as she grew.

The snares are usually attached to bamboo poles, bent over to spring when set off. Davidson filmed Ndingutse's brother, a 7-year old named Luwawa, in an extremely intelligent and protective reaction to a snare he encountered. When Luwawa saw the snare, he circled it, obviously aware of what it was. Waiting for the rest of his family to arrive and witness the act, he reached over and snapped the pole like a twig, avoiding the noose and disarming it. Against guns, he had no defense, however. Soon after, Luwawa was found shot dead on the slopes of Virunga National Park. His brother Salama had been killed months earlier. Only his bones and skull, picked clean of meat, remained when park rangers found him. The slaughter of these silverbacks traumatized the five to 10 females in their groups and left the babies and young without a strong male to protect them. They became shy and confused, hiding from humans, and even other Gorillas. In 1996, another two Mountain Gorillas were killed, bringing the toll for the previous 17 months to 10, causing havoc and psychological trauma in the families left behind and irreparable genetic damage to these highly endangered animals. In neighboring Uganda, more of these gentle Gorillas died--four adults in Bwindi Impenetrable Forest were speared to death by poachers in 1995 (Salopek 1995). The expulsion of farmers to enlarge the park for Gorillas caused great resentment, and perhaps precipitated this carnage. Tourists who came to see the Mountain Gorillas in this new Bwindi National Park in March 1999 met disaster when Hutu rebels ambushed and killed eight people in one group. This was thought to be the end of Mountain Gorilla tourism in Uganda, but with increased protection of tourists, they are gradually returning. Poaching declined after the deaths of Gorillas and tourists, and by 2000, the Mountain Gorillas in the Virunga Mountains in both parks totaled 358 (Fisher 2001). Tourists coming to Rwanda's Volcanoes National Park are still in some danger when not in groups guarded by soldiers, however (Fisher 2001).

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The fact that Gorillas are gentle, kind and intelligent beings makes these cruelties all the more horrific. Millions of people saw a television report on August 16, 1996, showing Binty, a female Lowland Gorilla at a Midwestern US zoo, saving a little boy who had fallen into the exhibit and was lying unconscious; she picked him up and carried him gently to a door where keepers entered, setting him down in front of it. People were overwhelmed by her act of good will, as well as by her quick reaction. Many viewers had no idea that Gorillas would want to help a human in need, nor that she would use such good judgment in rescuing the boy, who recovered completely.

Koko, a captive Lowland Gorilla taught American Sign Language by Francine Patterson, president of the Gorilla Foundation, has learned some 800 signs and uses descriptive, imaginative language in naming unfamiliar objects, such as "finger-bracelet" for ring. She also paints, and when asked what one of her more colorful creations (reproduced on
page one of The New York Times) depicted, she signed "bird" (Boxer 1997). We are only beginning to learn about these primates, but without strong protection, they may soon become extinct in the wild at the hands of humans.

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Many Africans have little respect for Gorillas. Hunters in Cameroon, when asked by researchers why they shoot Gorillas, replied "What's wrong with killing a Gorilla? They're fierce." One of the hunters told reporter Michael McRae that he was sure Gorillas were plentiful: "In Cameroon there are a million Gorillas. Three weeks ago, I saw sixty in one day. I shot three and then stopped . . . Why should I feel bad for a Gorilla? He is just a stupid animal" (McRae 1997). Education and an alternate source of income might change the opinions of these hunters. They have the same views Westerners had before research studies and films introduced people to the true nature of these primates.

As far as their abundance, there are hardly a million Gorillas in Cameroon, in all of Africa or the world. Gorillas are declining toward extinction. Their total population is estimated at well under 100,000 and declining (McRae 1997). The Lowland Gorilla and Mountain Gorilla are considered separate species by the 2000 IUCN Red List, and both are classified Endangered. The US Endangered Species Act considers Gorillas to be a single species (Gorilla gorilla) and lists them as Endangered. Likewise, CITES lists Gorillas as a single species on Appendix I. The species is officially protected from hunting throughout its range, but national legislation is almost never enforced. The Lowland Gorilla is declining rapidly as a result of logging, killing for the bushmeat trade, and possibly ebola disease. Adults are often killed to obtain babies, which are traded on the black market to zoos in many countries. Hundreds of Lowland Gorillas are being slaughtered in Cameroon and other parts of their range, causing immeasurable trauma and cruelty to their close-knit societies, as well as ecological harm. The Moabi tree, a very important species for its fruits, seed oil, bark and wood, produces enormous seeds that Gorillas disperse (Tuxill 1997). African Forest Elephants are also crucial to the survival of Moabi trees, spreading their seeds, and they, too, are threatened with extinction.

The bushmeat trade is wiping out many other species of wildlife in wide areas around African villages. People set wire snares throughout the forest, into which rare deer, antelope, primates, wild pigs and a variety of animals blunder, struggling for days in great pain until the trappers arrive to kill them with knives. Even apart from the cruelty and conservation issues, the bushmeat and pet trades are not even lucrative. People make only a hand-to-mouth living from them, selling rare apes for a few dollars to traders, and other animals for a few cents. They are killing off their wildlife heritage while remaining in poverty.

Local people receive almost no benefit from logging, which is permanently devastating the old-growth forests. Tourists do not want to visit logged-over areas which have a fraction of the wildlife of unlogged forests and, in the case of clearcutting, an ugly, barren landscape. Trophy hunting, which is increasing in rainforests of Africa because of lobbying by the Safari Club and other organizations, is further reducing the wildlife. These hunters kill the largest and rarest animals--the prime specimens that should be left to perpetuate the species--and cause wildlife to become frightened and shy.

Mountain Gorillas are not killed for the bushmeat trade, but are shot for their body parts. None exist in captivity. These endangered gorillas are monitored within Rwanda's Volcanoes National Park by numerous researchers of the Karisoke Research Center, run by the Dian Fossey Gorilla Fund International. They are conducting a variety of different projects studying breeding, genetics and other aspects of their lives. One researcher noted the extreme devotion the Gorillas have for one another. Amahoro, meaning Peace, a 14-year-old silverback in the park, became lethargic and could not keep up with the group (Williamson 2001). Another male became his constant companion, and sometimes two males helped him along. The International Gorilla Conservation Programme was contacted for
veterinary assistance. A veterinarian arrived and examined Amahoro from a distance, because he was defended by two other males (Williamson 2001). The next day, he was barely able to move and began coughing; the troop gathered around him, chest-beating in anxiety (Williamson 2001). After calls to gorilla veterinarians in the United Kingdom and the United States, the veterinarian decided that his problem was an infection in need of antibiotic treatment, which was administered by dart; he recovered fully (Williamson 2001).

Because of the international importance of the Mountain Gorillas and their precarious status, researchers from the National Aeronautics and Space Administration (NASA) began scanning their habitat in August 1994 during a 10-day environmental space satellite mission (Anon. 1994b). Overlaying the NASA images with data collected from navigation satellites and standard topographical maps is now providing an extremely detailed overview of the Mountain Gorilla's habitat. The habitat now protected totals only 285 square miles, not a large area for the 658 remaining Mountain Gorillas.

One wonders what their lives were like thousands of years ago when they roamed over vast, montane forests undisturbed. They may have shown behavior that has disappeared under these new conditions. During some parts of the year, they might have frequented the lowlands, feeding on trees or other vegetation that has long ago disappeared, replaced by farmer's fields. It is possible that they are not receiving adequate nutrition from the plants in their reduced habitat. Their restricted ranges may be causing inbreeding. These Gorillas have suffered great psychological harm from the constant threat of death from hunters, never knowing when they may be confronted and killed. The loss of many family members to snares and shooting traumatized these sensitive and devoted primates.

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Another important Gorilla habitat in southern Zaire was invaded by many of the 400,000 Rwandan refugees who fled to this area in 1994. This magnificent protected area--Kahuzi Biega National Park--covers some 2,085 square miles (Jay 1994). It is also a World Heritage Site. The large mammals of this park were surveyed in 1994 by the Zairean Institute for the Conservation of Nature and the Wildlife Conservation Society (Jay 1994). Preliminary data indicated that the rare Grauer's Gorilla (Gorilla gorilla graueri), a subspecies of the Lowland Gorilla, was found in fairly large numbers--at least 1,000 animals (Jay 1994). Elephants were also numerous (Jay 1994), and the park has many rare birds (Collar et al. 1994). One camp of 50,000 refugees blocked a narrow corridor of forest that served as a migration route for elephants and lone male Gorillas between major sections of the park (Jay 1994). The Wildlife Conservation Society conducted a long-term study of the effects of hunting on wildlife in the park, supplemented by a 10-month United Nations probe, which released a report in April 2001 (Lauria 2001). Gorilla numbers have plummeted here also, killed for food and trophies. As ABC News filmed one of the few remaining Gorilla families in Kahuzi-Biega National Park during the summer of 2001, a male Silverback charged the camera crew. Only a decade ago, Gorillas were tame and securely protected in this area. The UN investigation determined that Rwandan forces and others have slaughtered all but two of 350 elephant families in the park for the illegal ivory trade (Lauria 2000). This poaching was part of an organized network of corruption now looting parks and natural areas in the renamed Democratic Republic of the Congo of diamonds, gold, timber and wildlife (Lauria 2001).

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In April 1995, a third natural area in Rwanda, Akagera National Park, became threatened when 700,000 cattle and 250,000 Tutsi herders moved 15 to 20 miles into the park (Lorch 1995). Because of a lack of arable land, Rwandans have sought out parks as the last remaining unoccupied territory. Akagera National Park, located on the eastern border of the country, has a wide variety of fragile habitats, from swamps and savannah to forest and hills, harboring
gazelles, Giraffes, African Elephants and Leopards (Lorch 1995). Rwandan authorities did not exclude the herders and their livestock but tried to convince them to cull their herds (Lorch 1995). In southern Rwanda's Nyungwe Forest, the Wildlife Conservation Society's colobus project, which protected groups of hundreds of these monkeys, was also devastated. In February 1995, investigators found that one-fourth of a 120-member colobus group had been killed during the war, many for their long fur, which was used in marriage rituals (Fine 1995). Researchers came upon animal snares and concluded that this national park would no longer be protected as such, but would become a multiple-use forest (Fine 1995).

Uganda’s rare wildlife also incurred losses from Rwanda's war and Burundi's civil strife in a ripple effect. An extremely endangered bird of the Virunga Mountains, the Congo Bay Owl (*Phodilus prigoginei*), was recently rediscovered after being thought extinct. Not seen since 1951, it was seen in Uganda's Itombwe forest in mid-1996 by scientists from the Wildlife Conservation Society. A type of barn owl, the Bay Owl was previously known only from a specimen collected in Zaire's Kivu province in 1951 (BI 2000, Hart 1996). The owl is restricted to a small area of mixed rainforest and savannah near the Rwandan border (BI 2000). Dr. John A. Hart, the zoologist who found the bird, saw farmers clearing the surrounding forest to create new farmland; they had entered the area seeking refuge from the civil wars in neighboring Rwanda and Burundi (Hart 1996). Although the total population of the Bay Owl is not known, it is presumed to be extremely small, and its future survival is uncertain. This area has no protected status and the entire known habitat of the endangered Congo Bay Owl is being degraded by clearing for livestock grazing and farming (BI 2000).

Some of Rwanda's refugees fled to Tanzania as well. More than 535,000 Rwandans traveled south into that country, staying in refugee camps near the border until December 1996, when the Tanzanian government demanded that they return to Rwanda. Former Hutu soldiers, fearing possible imprisonment for war crimes, convinced many refugees to travel east instead, into the heart of Tanzania's Burigi National Reserve. Once there, they stripped vegetation, killed large numbers of animals, began planting crops, and caused an increase in violent crime in local villages (AP 1996). At this point, the Tanzanian army routed them forcibly, and a stream of refugees many miles long was pushed back into Rwanda.

By 2001, a state of anarchy prevailed in the region, with these countries still at war. A United Nations report concluded that business and military leaders from Uganda and Rwanda were looting forests and parks in the Democratic Republic of the Congo for natural resources and meat (Lauria 2001). The New York-based International Rescue Committee reported in May 2001 that an estimated 2.5 million people have died as an indirect result of the previous three years of civil war in the Democratic Republic of the Congo (Salopek 2001). The fighting drove hundreds of thousands of people into the forests, where they lived off the land, dying of rampant disease and malnutrition in the rebel-held jungles (Salopek 2001). Gangs of poachers entered these rainforests, placing snares to capture elephants, Leopards, antelope, wild pigs, and monkeys for the bushmeat, fur and ivory markets in large cities. A camp of these poachers, many of whom come from neighboring countries, was encountered in the travels of Wildlife Conservation Society biologist Michael Fay. Fay and his group, including National Geographic Society filmmakers, came upon a sizeable camp with a very large Leopard skin stretched out on pegs, with hundreds of antelope and monkey bodies being cooked on open fires. Fay was so irate that he burned the entire camp and all the skins (shown on National Geographic Explorer, April 2001, entitled "Extreme Africa"). Although laws ban such killing, no game wardens patrol these forests, which were not part of a national park. Fay's intention in traveling across Central Africa, as described in *National Geographic* (Quammen 2001), was to show the world the great treasure being plundered by loggers and meat hunters before it is too late to save this large rainforest.
extremely uncertain. The region is a microcosm of struggles that may soon be commonplace as human populations continue to rise and compete for dwindling land and resources. Markets as far away as Europe and North America buy the timber, minerals and ivory that are being exploited here at the expense of the environment. At the present rates of loss, little wilderness or natural forest will remain anywhere in the world. The damage done to parks and reserves by tree cutting, clearing land, and killing native wildlife, especially for commercial purposes, devastates biodiversity and endangers species reliant on these refuges, which are often their last remaining habitats. The World Conservation Union issued a report in 2001 on the urgent need to protect the world's 17,000 large nature preserves from intrusion by poor farmers, who have nowhere else to go (Revkin 2001). Half of these preserves now have people cutting forests and tilling land in biological hotspots and areas with large numbers of endangered species (Revkin 2001). At least 900 million people earn less than $1 per day, and 630 million live in areas of high biological diversity, according to the report's author, Jeff McNeely (Revkin 2001). Organizations, such as Future Harvest, which co-authored the study, are attempting to help poor farmers by providing means to enrich soil through fertilizers and rotating crops to maintain corridors of undisturbed land as wildlife habitat, and to grow shade crops, such as coffee and cocoa, which maintain forests (Revkin 2001).

John Terborgh (1999), a Duke University scientist, chronicled massive destruction of parks by farmers, logging, livestock and squatters in *Requiem for Nature*. This book paints a gloomy picture of wanton neglect, insufficient funding and failure by governments to protect parks and reserves, many of which harbor endangered species and magnificent landscapes. In Peru, for example, national park officials in the capitol city were not even aware of the existence of the Cerros de Amotape National Park. When Terborgh visited the park, he found it had been logged by the army, and cattle grazed throughout. Yet this dry tropical forest is one of the most important centers for endemic plants and animals in the world (Terborgh 1999). Similar tragedies are occurring in Mexico, where logging trucks leave the spectacular montane Nevado de Colima National Park loaded with giant tree trunks, and cows consume all the new tree saplings from the few remaining old alder trees (Terborgh 1999).

In Colombia's Tayrona National Park, six park officials have been killed by rebels and squatters, drug traffickers, loggers and others, who are destroying it; 20 percent of Colombia's 22.2 million acres of parkland is in the hands of squatters or has been deeded to private interests (Terborgh 1999). Colombia has an extremely rich diversity of tropical birds and mammals, and much of the pressure on its parks is a result of the US market for drugs, which offers poor people a far greater income than they can earn through traditional farming. The Santa Marta region in Colombia's northeast has an extraordinary wealth of birds and other species found nowhere else. The endangered Santa Marta Parakeet (*Pyrrhura viridicata*); Santa Marta Sabrewing (*Campylopterus phainopeplus*), a hummingbird; and the Santa Marta Bush-tyrant (*Myiotheretes pernix*), a flycatcher, are among these (BI 2000). Conversion of forest to marijuana and coca plantations, compounded by US-sponsored government herbicide spraying programs to kill drug crops threaten these and other species of the area. Spraying contaminates the soil and water, and often the small aircraft destroy natural forest and traditional crops instead of the target drug crops. In March 2001, four governors from Colombian provinces protested the $1 billion US herbicide spraying program, saying it was jeopardizing the health and food supply of farmers (Marquis 2001). They asserted that the defoliation ruined food crops and alienated people from their national government, while not succeeding in curbing the narcotics trade (Marquis 2001). The Santa Marta region has already lost 85 percent of its forest habitat (BI 2000). Rebels have taken over much of the area, clearing forest for drug crops and killing members of native tribes, who have traditionally tried to protect the forest and wildlife.

The Democratic Republic of the Congo is in the early stages of a similar anarchy involving rebels and forest destruction. The late President Mobutu and other high officials acquired immense fortunes by siphoning off the nation's mineral and tax revenues and foreign aid funds. They purchased palaces and estates around the world and lived sumptuous lifestyles. Almost none of the revenue from the rich mineral industry went to public works, with the result that the majority of the country's people are illiterate and poorly fed and housed. Even the streets of the capital city are unpaved and littered with trash. Mobutu's personal fortune is estimated at $3 billion by some, and as much as $10 billion by others (Sachs and Rotberg 1997). This country had been a territory of Belgium, known as the Belgian Congo, prior to its independence in 1960. Over the next three decades, the United States and European nations
supported Mobutu's regime, which became increasingly autocratic and corrupt. Any opposition was quickly suppressed. By the mid-1970s, the country neared financial ruin (French 1997). The United States, the International Monetary Fund and the African Development Bank supported Mobutu's regime until the end of his reign (Rotberg 1997). The funds were spent mainly for military purposes and for Mobutu's personal enrichment.

Strong opposition to his regime came from an opponent, Laurent Kabila, who drove Mobutu from office in 1997 and renamed the country, the Democratic Republic of the Congo. Mobutu died September 7, 1997, in Morocco, where he had taken refuge. He left the country $14 billion in debt, a sum almost three times the country's gross national product (Sachs and Rotberg 1997). During the struggle among Mobutu's forces, Rwandans and Kabila's soldiers in Virunga National Park, four Mountain Gorillas were killed, one silverback and three members of his family. The International Gorilla Conservation Program reported that these Gorillas, who were tame and accustomed to tourists in Virunga National Park, were shot in crossfire when Rwandans entered the park and encountered Kabila's soldiers. Kabila was assassinated in 2000, replaced by his son, who was educated in Tanzania. He has moderated some of his father's extreme programs and appears to want to end the conflicts that are dividing the countries of Central and East Africa.

The new government plans to rebuild 50,000 kilometers (31,000 miles) of roads (Wallis 1998). Loggers supply local hunters with weapons, ammunition and a ready market for the meat of Gorilla, Chimpanzee and other protected and endangered species (Pearce 1995). In a growing trend, more and more Central and West African towns are becoming dependent on bushmeat. A study in the neighboring country of the Congo documented that a single town of 10,000 people consumed nearly 6 tons of wild animals every week (Counsell 1997). In Gabon, some 8 million pounds of bushmeat are sold annually, half in urban areas (Tuxill 1997). Recent research has determined that even selective logging has damaged ecosystems in tropical African rainforests, and hunting has eliminated keystone species, such as forest elephants, that spread the seeds of many forest trees (Counsell 1997). Logging also leads to uncontrolled hunting as roads open up wilderness areas.

The Democratic Republic of the Congo has major reserves of cobalt, copper, cadmium, diamonds, gold, and coltan, an extremely valuable material used in making cell phones and computer games. The mining of these resources has damaged large areas of forest as thousands of people vie for high-paying jobs. The mining is uncontrolled by the government, as deals are brokered between international corporations and rebel leaders or even with foreign governments, such as Rwanda, which controls the $250 million per year coltan trade.

Endangered Pygmy Chimpanzees, or Bonobos (Pan paniscus), are endemic to these forests in a relatively small portion of the Democratic Republic of the Congo, and their habitat is being decimated by loggers, who construct a maze of new roads (Kingdon 1997). Remarkably intelligent and peaceful, primatologists consider Bonobos to be unique in behavior and ecology; they represent a profoundly important example of evolution (De Waal 1997). Numbering only about 13,000 animals, they are declining and classified as Endangered by the IUCN. No major reserve has been set aside for them. Another rare animal of the region, the Bongo (Tragelaphus eurycerus), a beautiful, striped forest antelope, is listed as Endangered in the eastern part of its range in Kenya, and Near-Threatened in the Democratic Republic of the Congo, as logging operations have surrounded the boundaries of an important reserve for this species (Counsell 1997; Hilton-Taylor 2000).

Wildlife Conservation Society biologist Fay finished his 1,200-mile voyage through many unexplored regions of the Democratic Republic of the Congo and neighboring Gabon in the spring of 2001. He found Chimpanzees and Gorillas that had never seen humans and approached his group with curiosity, and other areas where these great apes were completely absent, perhaps as a result of ebola disease (Quammen 2001). Impenetrable swamps and miles of tangled shrub, giant trees alive with insects, birds and lizards, abundant signs of forest elephants and buffalo, networks of streams and spectacular vistas of vast waterfalls and distant mountains still exist in the region, yet loggers, gold miners, poachers and displaced people are increasing in number, destroying this wilderness bit by bit.

A sign of the future, should logging and bushmeat hunting continue, was a traumatized, orphaned monkey, tethered
on a rope in a hunter's camp. Seen by Fay's group, its photograph appears on the cover of *National Geographic* (March 2001). This young Mandrill (*Mandrillus sphinx*) had perhaps witnessed the slaughter of its entire family and was now in a strange and abusive environment without its fellows. This species is threatened in the wild and listed as Vulnerable by the IUCN. Among the largest of all monkeys, Mandrills weigh up to 54 kilograms and live only in the rainforests of Cameroon, Equatorial Guinea, Gabon and the Democratic Republic of the Congo (Nowak 1999). The adult male has an extremely dramatic appearance, his face spectacularly marked with electric blue ridges beneath his eyes, set off by a bright red stripe that goes down the middle of his nose and covers a large, round nose patch surrounding his nostrils. His face is framed by a mane of grizzled, olive-brown fur. The female is a somewhat smaller and less flamboyant version of the male. These are the only primates that move about on the ground in very large groups, numbering up to 600 animals. They feed on a large variety of plants, roots, fungi, invertebrates and, occasionally vertebrates (Kingdon 1997). Their sole habitat--undisturbed, primary rainforest--is disappearing rapidly. They are intensively hunted in some areas for the male's shaggy mane, which is used for capes and headdresses (Nowak 1999).

Mandrills are also killed for bushmeat, which is their most immediate threat, according to biologist Jonathan Kingdon (1997). Mandrill meat is more highly valued in these markets than beef, and hunters employ dogs, guns, spotlights, deep-freezers and trucks to harvest them, especially in the Democratic Republic of the Congo and Gabon (Kingdon 1997). These magnificent primates may be important seed dispersers, yet research has only begun on their wild ecology. They may vanish from their once vast realm before their role in the African rainforest is understood.

These ecological and political crises were long in the making. Decades ago, international funds such as the World Bank could have developed environmentally friendly industries, such as ecotourism, in Rwanda, Uganda and Zaire, with a large percentage of the profits going to local people. Aid organizations could have funded or encouraged these nations to promote literacy and conservation education and to provide birth control education. Foreign aid to Zaire by the United States and European countries could have gone toward helping the people of that country achieve economic independence, while promoting environmental protection.

**Human Tragedy and the Looting of Virunga's Treasures: Page 14**

There is worldwide interest and concern for the survival and conservation of the Mountain Gorillas and other wildlife of the Democratic Republic of the Congo, Rwanda and Uganda and an enormous potential market for ecotourism in many parts of these countries that would benefit both the people and the wildlife. Mountain Gorillas have attracted $10 million in tourism revenues to Rwanda (Tuxill 1997). The forests of all three countries, as well as those to the west in Cameroon, the Ivory Coast, the Congo (as distinct from the new Democratic Republic of the Congo), and Gabon harbor many zoological curiosities that could attract tourists, such as enormous Goliath Frogs, largest of all frogs, now threatened from over-collecting and habitat loss. Beautiful Congo Peafowl (*Afropavo congensis*), the only pheasant species in Africa, are endemic to the Democratic Republic of the Congo, resident in the Kahuzi-Biega National Park and several other reserves (BI 2000). Threatened by hunting, these large, crested birds would be a big attraction for bird-watchers. Other unusual wildlife, such as tiny forest antelope less than 2 feet tall, inhabit these rainforests, where towering trees draped in mosses and orchids have crested eagles nesting in their crowns. At the forest floor, blizzards of butterflies drink at streamside, while colorful lizards flit up tree trunks. One innovative approach to wilderness protection could acquaint people around the world with such natural treasures without their having to travel. It could also help local people with funding. It is the use of videocameras connected to satellites that record wildlife and landscapes for the Internet. Internet users pay small fees to tune into these videocameras and their websites. A large portion of the funds could be given to local people. This popular new technology has helped South African national parks with their expenses. Small cameras can be placed in extremely remote areas and can be operated on solar power. They have virtually no impact on the environment, unlike large numbers of ecotourists.
One method of protecting endangered forests, which play an important role in reducing global warming, is the US Initiative on Joint Implementation, which encourages public utility companies to invest voluntarily in forest conservation. Through the Carbon Sequestration Program, sizeable expanses of tropical forests, which absorb enormous amounts of carbon dioxide, are being protected. Wisconsin Electric Power Company, Detroit Edison, PacifiCorp and Cinergy donated $2.6 million in 1995 for a 15,035-acre forest in Belize, adjacent to the Rio Bravo Conservation and Management Area. American Electric Power in Indiana is cooperating with PacifiCorp and British Petroleum to protect 5 million acres of Bolivian forests from logging (Passell 1997). This approach protects large amounts of forest in a cost effective manner: the estimated cost of sequestering 1 ton of carbon this way is just 37 cents, less than 1 percent of most emissions-reducing technology, according to The New York Times (Passell 1997). General Motors has helped purchase 30,000 acres of forest in southeastern Brazil, home of the tiny Golden-lion Tamarin (Leontopithecus rosalia). More than 90 percent of this forest, known as the Atlantic Coastal Forest, has been destroyed, and it is one of the world's greatest centers of biodiversity (Mittermier et al. 1999). This program should be used in conjunction with reduction of emissions from power plants and vehicles--not as a substitute.

In another cooperative venture to save tropical rainforests, US chocolate makers are urging owners of small farms to grow cacao, a crop that is grown in the shade of large trees (Yoon 1998). A worldwide shortage of chocolate has resulted from the spread of diseases in large-scale cocoa plantations in tropical regions around the world. Such diseases do not spread or take root when crops are grown in smaller, shaded areas which have a natural diversity of plants and animals, including insect-eating birds and reptiles (Yoon 1998). With the world's sweetest tooth, the United States consumes 629,000 tons of chocolate per year, far outstripping its nearest competitor, Germany, where 285,000 tons are eaten annually, according to the International Cocoa Organization. The American Cocoa Research Institute, the Smithsonian Migratory Bird Center and various candy companies, including Mars, Cadbury, Nestle and Hershey, are all cooperating in strategies that promise to conserve tropical trees and wildlife, and grow cacao plants in ecological ways (Yoon 1998). Huge plantations of cacao in Brazil and elsewhere have lost as much as 80 percent of their crop to fungal and other diseases in recent years, diseases that often spread in large plantings of a single crop.

Scientists have long noted that birds are abundant in small forested cacao and organic coffee farms, and they are encouraging this new cooperation to protect tropical birds as well as the hundreds of species of North American and European birds that winter in tropical countries. Shade-grown, organic coffee is also helping to save rainforests. A trend away from traditional shade-grown coffee into new strains that are grown in the sun, has resulted in the clearing of millions of acres of rainforest to grow this coffee for markets such as the United States. To counter this trend, some organic companies, organizations and institutions, such as the Smithsonian, are taking a strong stand urging people to buy shade-grown coffee to protect rainforests and migratory birds from North America that winter in Latin American forests. This coffee is sold in many natural food markets and chains, such as Trader Joe's. The restaurants and coffeehouses, such as Starbucks, that still use sun-grown coffee should be encouraged to sell shade-grown coffee to help preserve forests and wildlife.

Debt-for-nature swaps can provide relief for countries saddled by debt from loans made by the World Bank and other international funds. Through these swaps, a portion of a nation's debt is paid by the donor, which may be a conservation organization or other entity, in exchange for the establishment of parks. These swaps have been undertaken in Madagascar and several other countries. A growing movement to convince donor countries to forgive these debts is being waged by conservation and human rights organizations. Should these debts be erased, much environmental degradation would be avoided, since many destructive programs are carried out solely to pay off debt. One such program, called "Avanca Brasil" or "Advance Brazil," envisions a massive development program in the Amazon Basin, crisscrossing the forest with roads and railroads and damming rivers to produce energy (EII 2001). A minimum of 28 percent of this great forest would be destroyed and, more likely, at least 42 percent (EII 2001). Just since 1995, 5 million acres of Amazon forest have been leveled for development (EII 2001). These forests, a major factor in preventing global warming through absorption of carbon dioxide, produce vast amounts of oxygen and harbor a large percentage of the world's biodiversity.
If no positive steps are taken, these last sizeable rainforests will be gone, and severe climatic and ecological harm will result. The great forests of Central Africa are also in the process of being destroyed. World-class national parks, such as Virunga, may be completely destroyed within a generation by illegal logging, squatters and bushmeat hunting.

Earth's Worth

Governments around the world grant logging or mining contracts on a daily basis. Thousand-year-old forests and wildernesses covering vast areas are bargained away in deals made between corporate representatives and government officials, often through bribery. The fates of the native wildlife and plants of these regions hinge on the type and level of exploitation. Wildlife, plants, and their habitats survive or die out as a result of decisions made by politicians, most of whom have no understanding of the importance of preserving diversity and extensive areas of natural landscape. At the present rate of destruction, wilderness will soon be gone, carved up and exploited for commercial purposes or destroyed by settlers.

Page 1 (Wealthy Countries)
Page 2 (Subsidies)
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Page 4 (United States)
Page 5 (Ecotourism Raises Economies)
Page 6 (Minority)
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Earth's Worth: Page 1

Citizens of the wealthiest countries represent some 20 percent of the world's peoples, but consume 80 percent of the planet's resources. The high standards of living that are enjoyed in North America, Western Europe and Japan depend in large part on importation of low-priced raw materials from poor countries. International corporations have few laws restricting their activities, which are causing major damage to forests, rivers, lakes and other environments. Moreover, the market provided by Europe and North America and, most recently, by some countries in East Asia, encourages fast-paced exploitation. Many of the recent logging contracts signed in Africa, Russia and South America have been negotiated to repay debts incurred from loans from the International Monetary Fund, World Bank or other funds. These loans are often for the construction of dams, factories or mines that primarily benefit third parties, such as large corporations. To repay the loans on schedule, countries are pressurized to exploit their natural resources, forests and minerals, which are sold at low prices. Such loans rarely help nations develop according to their avowed intention, but send poor countries into an ever escalating debt that requires more and more forest cutting and other exploitation for short-term gains.

The US government's foreign aid tends to encourage mega-projects that do not help the populations of developing countries. Development that is environmentally friendly, based on small-scale business or ecotourism, is of far greater value in helping people as well as preserving wildlife. The decades that have passed since the publication of E.F. Schumacher's 1973 book, Small is Beautiful. Economics as if People Mattered, have only validated the philosophy of helping people through small-scale grassroots programs. Economic development programs that respect both people and the environment by finding means through which people can be economically secure, maintain their culture and live in their ancestral regions without destruction to natural ecosystems, should be the model in the future. The concept of small-scale eco-development has been endorsed by various conservation organizations, and use of solar
cookers, bio-gas and fertilizer from livestock manure, development of crafts and other small-scale industries, education on crop rotation and use of crops adapted to particular areas, preserving forests to prevent erosion and not living in flood plains are examples of this approach. A wide variety of organizations are carrying out such programs in many parts of the world. Such approaches are also needed in North America and Europe, where conservation education has failed to teach such basic principles, and government officials lack basic knowledge about the environment.

Earth's Worth: Page 2

Subsidies provide another disincentive to conservation. On a worldwide basis, governments spend $700 to $900 billion per year on subsidies that actually encourage the destruction of forests and other natural areas (Grossfeld 1997). In the United States, the taxpayer pays for road building in national forests to enable logging companies to enter wilderness areas. The Forest Service charges these companies a fraction of the retail value of these trees—sometimes $10 or less for a giant tree worth $25,000. Yet almost no subsidies or tax benefits are paid for the use of recycled materials, such as paper, that would save the cutting of thousands of trees. For this reason, it is cheaper in the United States and many other countries to cut forests for paper than recycle used paper, and to obtain minerals from mines rather than from recycled metals. To further the lack of logic of this situation, one US government department encourages environmental destruction through taxpayer dollars subsidies for logging and mining, while others spend public funds to clean up the pollution and preserve species that become endangered from these activities.

A coalition of 26 organizations compiled information on US subsidies that have negative effects on the environment, entitled "Green Scissors '98." It found that the United States spends $49 billion every five years on subsidies and environmentally destructive programs. The report recommended drastic slashing in these "polluter pork" programs to protect the environment and save taxpayers billions of dollars of misspent money each year. The Institute for Research on Public Expenditure in the Netherlands produced a report in 1997 entitled Subsidizing Unsustainable Development: Undermining the Earth with Public Funds. After a lengthy examination of subsidies around the world, which range from inexpensive irrigation water to free land for settlers and mining operations, this study concluded that subsidies are economically counterproductive and disastrous to the environment, resulting in deforestation, overfishing, polluting and other destructive activities (Crossette 1997a). Many species are endangered as a byproduct of these subsidies.

Earth's Worth: Page 3

The gross national product of a country is considered the major yardstick by which economic success is measured, and the natural world is traditionally valued in terms of the revenues it produces when exploited. This rigid and limited evaluation was recently examined and found lacking by a team of 13 ecologists, economists and geographers, who analyzed the monetary value of ecological systems to human society. They sought to place specific values on 17 types of environmental services that 11 ecosystems provide to humans each year (Stevens 1997b). Among these ecosystems were open oceans, estuaries, seagrass and algae beds, coral reefs, tropical and temperate forests, grasslands and rangelands, tidal marshes and mangroves, wetlands, lakes and rivers (Stevens 1997b).

In a report published in the scientific journal Nature, these specialists estimated the total global value of these ecosystems and their production at $16 trillion to $54 trillion per year, with $33 trillion the most likely figure; by contrast, the gross national product (all the goods and services produced by the world's peoples each year) was estimated at a mere $18 trillion (Stevens 1997b). They rated the value of nature's climate regulation at $684 billion,
natural raw materials at $721 billion, pollination by natural pollinators at $117 billion, recreation and ecotourism provided by nature at $815 billion, soil retention and formation at $53 billion, water supply at $1.7 trillion, and food production at $1.4 trillion. Thus, ecosystems such as forests, which provide several of these ecological services, such as climate regulation, ecotourism, soil retention and water supply, are worth far more left standing than cut as lumber for short-term profit. Wildlife performs services as well, including natural pollination, attraction of ecotourism and recreation such as bird-watching, and others such as seed dispersal and soil enrichment. The linkages between particular ecosystems and local economies were systematically analyzed in this study; for example, the Louisiana shrimp catch depends on wetlands as nurseries, and these wetlands also provide flood control and other services in their overall value (Stevens 1997b).

If the costs of destroying these ecosystems were computed when development was considered, such as the loss in flood control and water pollution filtration by wetlands, the researchers concluded that society would be more likely to protect them from destruction. They pointed out that when a wetland is filled in for a shopping center, the dollar value of that habitat in preventing floods and cleansing water is not figured in, resulting in a gradual erosion of natural wealth (Stevens 1997b). The heavy rains that ravaged many parts of the world in 1997 and 1998, caused by El Nino's effect on the weather, produced floods and mudslides in areas where forests had been cut and wetlands filled. Hundreds of lives were lost, and property damage totaled billions of dollars. Areas with forest and extensive wetlands were hardly damaged. Some wetlands are being restored in the United States--river courses returned to natural curves, and flood plains protected from building, in the realization that the lost income from not developing these areas is more than compensated for by the protection from natural disaster they provide, which creates economic stability in developed areas located far from wetlands.

However important such economic analyses are in re-evaluating our destruction of ecosystems, preserving nature cannot be reduced to economic calculations. If this is the sole basis of conservation, it could lead to destructive manipulations in the environment designed to accommodate complex economic theories. The major lesson to be learned from these new ways of looking at Earth's use to humans is that we have grossly underestimated life-giving ecosystems and their wild fauna and flora. They have evolved over a period of millions of years, and we must respect and preserve them in as natural a state as possible.

Although people in the United States are far more aware of the ecological value of wetlands and forests, this seems to have had little effect on preserving such valuable ecosystems. Trees are still cleared on steep slopes and other fragile areas, for example. This causes landslides and mudslides and floods, resulting in destruction of homes, roads, farmland and other valuable assets, as well as siltation and pollution of waterways. Yet there is little thought given to banning this practice by law. The World Resources Institute in Washington, DC, has calculated that the loss of value from deforestation is four times as high as the value of the timber extracted, and the depletion of soils, forests and fisheries examined in this study resulted in a 25 to 30 percent reduction in potential economic growth (Stevens 1997b).

A 1997 collection of articles, *Nature's Services: Societal Dependence on Natural Ecosystems* (Island Press), edited by Dr. Gretchen C. Daily, a biologist at Stanford University, concludes that many ecosystems, once destroyed, are either irreplaceable or take thousands of years to replenish, such as ancient aquifers or old-growth forests. Daily concluded that we cannot afford to wait to act until we have disrupted the planet's life-support system beyond repair (Stevens 1997b). Some 20 scientists contributed to this book, including Dr. Norman Myers, author of many books on the value of wild plants to medicine and agriculture. He documented the multibillion-dollar insurance value that wild grains provide in disease resistance (Daily 1997). Katherine Ewel of the Forest Service discussed the lower cost of treating sewage in constructed wetlands, as compared to treatment plants, and Gary Nabhan and Stephen Buchmann found that wild pollinators save American farmers $1.6 billion annually (Daily 1997). This book's experts make a strong case for protecting environments in a natural state and provide evidence that we are only beginning to appreciate the complexity of these ecosystems. This can apply, for example, to commonly accepted mitigation rules used in US wetland-filling cases, in which a wetland is created for one that is destroyed. Ecologists consider that the natural wetland is far more complex and irreplaceable than the man-made one, and they should not be considered
equal under the law.

Earth's Worth: Page 4

In the United States, many politicians and businessmen have opposed environmental and endangered species legislation on the grounds that these laws reduce the profits of commercial ventures. They propose that every developer whose project is blocked by such legislation should receive financial compensation from public funds. These businessmen calculated the value of their financial loss on the appraised value of their land, and added potential profits lost. In 2001, for example, farmers in California sued the Fish and Wildlife Service to compensate for water it lost when a water allotment was diverted for endangered salmon and smelt (Russell 2001). The court ruled in favor of the farmers and ordered the government to pay them the value of the lost water, arguing that the government is constitutionally prohibited from taking property without paying for it (Russell 2001). This ruling could end in negating the effectiveness of habitat protection under the Endangered Species Act for lack of sufficient funding. Ecologically, farmers depriving endangered fish of habitat are impoverishing entire aquatic ecosystems and, in all probability, polluting waters with pesticides and other chemicals in the process. Yet if the value of maintaining the ecosystem in the San Francisco Bay area was calculated in terms of the millions saved in flood damage control, water purification, production of shrimp and other fish, the ecological values would far outweigh short-term commercial losses. If environmental protection laws were written in terms of ecological values, destroying natural ecosystems for the economic benefit of a few would not be allowed.

When the Northern Spotted Owl (Strix occidentalis caurina), native to old-growth forests in the Pacific Northwest, was listed as Threatened on the Endangered Species Act and large sections of its habitat protected, it became a focal point, polarizing pro-logging and anti-logging activists. Owl haters urged others to kill these birds, who were blamed for ending the logging industry, with bumper stickers such as "Kill an Owl, Save a Job." Such venom totally obscured the fact that the forests were being overcut and that logging jobs were destined to be cut anyway, as the last old-growth disappeared under the saw. A state in the heart of this owl's range, Oregon, found that decreasing logging ended in helping its economy; an influx of technological businesses provided better salaries than those paid for logging jobs (Egan 1994). The Governor of the state supported the logging restrictions as helping to maintain the overall quality of life in the state, preventing floods and attracting tourists, which are supplying another large segment of the state's revenues. Yet pro-business interests continue to fuel the fires, writing books which conclude that it is easy to understand why a landowner, having an eagle or Spotted Owl nesting, could be tempted to destroy a nest or even kill an endangered animal. Such people maintain that the owner of such land might be expected to destroy it by logging or development prior to designation of Critical Habitat for the species in order to be able to reap profits. The Northern Spotted Owl has, in fact, declined since it was listed on the Endangered Species Act, mainly as a result of Habitat Conservation Plans that have been detrimental to its populations, but also, very likely, illegal killing played a role.

One conservative critic of the Endangered Species Act noted that the Act "has undoubtedly caused the deliberate destruction of millions of other endangered plants and animals" (Jacoby 1998). This explains, according to the critic, why after 25 years, 97 percent of the endangered species list remains endangered (Jacoby 1998). If so many endangered animals are being killed deliberately, enforcement of the Act is urgently needed. Such attitudes are extremely detrimental to the survival of endangered species and should be addressed. Although many animals are being killed, the main reason these species remain endangered is a deteriorating environment and a half-hearted commitment on the part of the US government and the public to saving these threatened species.

A study of America's environmental laws and their effect on the economy was conducted by the nonprofit Institute for Southern Studies, a social policy research group. It concluded: "At the policy level, the choice is really not jobs versus the environment. The states that do the most to protect their natural resources also wind up with the strongest
Economies and best jobs” (Smothers 1994).

Earth's Worth: Page 5

Ecotourism and non-destructive recreational uses of nature are among the most valuable of all services nature provides, according to the study mentioned above, and many countries have seen dramatic rises in their revenues from tourism in recent years. In 1995, Botswana earned $100 million from tourism; South Africa reported $6 billion in tourism revenues. Kenya earned $452 million the same year, which paid the wages of 13 percent of its population. One tour company, the Conservation Corporation of Africa, or Conscorp, works out arrangements with local villages in which it promises to build schools and clinics near its lodges, employing many local people in the process. It also buys seeds for farmers to plant vegetables to sell to its lodges and brings villagers from the area into the reserve to educate them about wildlife and ecotourism. Conscorp runs some 22 small--but expensive--lodges in Africa from Kenya to Zanzibar, none of which allows game hunting; its revenues topped $30 million in 1996. Costa Rica, one of the world's primary ecotourist countries, has set aside 25 percent of its land for conservation, and ecotourism draws 1 million visitors per year, who spent some $800 million in the country (CNN special: "What Price Nature?" March 2001). This industry continues to grow at a rate of 20 percent a year, with visitors coming to its cloud forests, tree canopy tours and beaches where sea turtles nest.

In terms of the value of animals, the income from exploitation is dramatically lower than that from ecotourism. African Elephants, for example, when killed for trophies, earn some $4,000 to $20,000 for governments in fees, and the tusks sell for an average of $2,000 apiece. From ecotourism, however, an East African elephant produces an estimated $1 million during its 60 years (Currey and Moore 1994). A 1989 analysis found that the viewing value of tourists who come to Kenya to see elephants is estimated at a minimum of $25 to $30 million per year (Brody 1994). Tourists come from around the world to see these massive animals, and the governments of most African countries place a higher value on live elephants than dead ones. Trophy hunting also kills off the big bull elephants, which are the main breeding animals, as well as large matriarchs, who play a crucial role in guiding and protecting herds. These are the very elephants tourists come to see.

Endangered species in the United States also draw many tourists who travel long distances to see Whooping Cranes in their wintering marshes in Aransas, Texas; Gray Wolves in Yellowstone National Park; and California Condors newly reintroduced near the Grand Canyon.

Bird- and wildlife-watching and feeding have become major industries in the United States. A Fish and Wildlife Service survey found that in 1991, Americans who watched, photographed and fed birds and other wildlife spent $18.1 billion (Blom 1997). The spending generated nearly $40 billion in total economic activity and supported 766,999 jobs (Blom 1997). Equipment sales for wildlife appreciation totaled $10.6 billion, followed by $7.5 billion spent on travel-related goods and services, and $1.5 billion on wild bird feed (Blom 1997). A 1996 survey found that while only 3 million people in the United States hunted migratory birds, 25 million Americans were considered avid bird-watchers who would drive a mile or more to observe or photograph birds, and 50 to 60 million people in the
United States watch birds at their feeders.

The Fish and Wildlife Service found in a 1996 survey that wildlife watchers, fishers and hunters spent $100 billion on equipment, travel, and publications. When total economic profits were analyzed by the Fish and Wildlife Service in terms of hunters vs. bird-watchers, the bird-watchers spent some $14 billion on all aspects of bird-watching, while bird hunters spent $1.3 billion. *American Demographics* magazine estimated that an even greater amount, $18 billion, was spent by American birders on their hobby. In economic output, Ducks Unlimited, a hunting organization, estimated that bird hunting generated $3.6 billion, while non-consumptive use of birds earned $15.9 billion.

**Earth's Worth: Page 6**

Consumptive users of wildlife, such as hunters, make up a small minority of the public, approximately 14 million, or 5 percent, and fewer than 1 percent are trappers, yet these interests control state wildlife departments and heavily influence the Fish and Wildlife Service. The fees from hunting licenses fund the majority of state wildlife departments. These departments manage all wildlife within a state, in spite of the fact that only a small number are hunted or trapped, with the result that habitats are manipulated to benefit hunted animals, such as deer, by encouraging shrub and second-growth forest, while species needing old-growth forest, such as woodpeckers, decline as these forests are cut. Endangered species are conserved by state Natural Heritage Programs, but funding is often miniscule in comparison with the fees from hunting. Funding sources include income tax rebates, vanity license plate revenues and grants from general funds, but generally do not begin to fill the need for habitat acquisition, education and conservation programs and research. Greater funding is needed for these programs, perhaps through a small tax, such as the less than 1 percent sales tax in Missouri for wildlife and conservation programs. It generates more than $100 million annually. A tax for non-game and endangered species would provide major funding for these state programs, which fill an important role not played by federal Endangered Species Act programs.

The recent phenomenon of tropical forest ecotourism has produced other comparisons in revenues of exploitative vs. non-consumptive use of wildlife. Dr. Charles Munn, an ornithologist with the Wildlife Conservation Society is studying macaws in Peru's massive Manu National Park, which is the size of Massachusetts. He estimates that a wild macaw is worth $165,000 a year, based on revenues from the growing number of tourists who come to see these colorful, long-tailed parrots in spectacular flights (Munn 1992). A bird trapper receives only a few dollars for a wild macaw which, if sent to a pet store in Europe, might sell for $1,000. Income from the pet trade goes primarily to a small number of exporters, importers and retailers. It does not protect the habitat of the birds, nor does it pay for population surveys to prevent depletions. Moreover, from capture onward, these wild birds are treated very inhumanely, causing high rates of injury and mortality. The capture of wild birds for the pet trade is banned by the majority of the world's nations, but the few that continue it contribute to depletion of wild bird populations, smuggling, and their inhumane treatment (see Trade chapter).

Under Munn's calculations, the value of each macaw in the wild over the period of its life, which averages about 50 years or more, totals some $8,250,000--an enormous sum. This money flows into local economies of villages and towns near the park, local hotels, taxis, restaurants and other businesses. For many poor areas, such income provides much needed services and raises the standard of living. Tourist money is also spent in cities where visitors arrive, and constitutes a major portion of airlines' revenues. Manu National Park has been declared a Biosphere Reserve in recognition of its importance as a center of biodiversity. Its 7,000 square miles protect a large portion of Peru's tropical rainforest. Manu's ecotourism companies are considered models for sharing revenues with local people and protecting indigenous tribes (Munn 1994). These companies have tours geared toward viewing certain spectacular or endangered species, such as Giant Otters (*Pteroneura brasiliensis*) (Munn 1994).
Although some abuses of the land have resulted from ecotourism, including large numbers of people who can overwhelm delicate habitats, these situations are rare and can be rectified. Ecotourism helps far more animals and habitats than it hurts and, often in an indirect way. An important byproduct of tourism is the protection it accords animals in the areas visited, especially outside national parks and reserves, where most wildlife is on the decline. The presence of tourists tends to deter poachers, and in a growing number of areas, revenues accrue to local people from tourists use of restaurants, gift shops, taxis and other businesses. This encourages residents to cooperate in protecting the wildlife and the environment. This applies as much to African savannahs, as to North America or Europe. The non-profit Eco-Tourism Society, located in North Bennington, Vermont, distributes information on responsible travel that does not result in ecological damage and respects local residents. It recommends that tours share profits with residents.

Many conservation organizations now run ecotours and issue pamphlets, such as the National Audubon Society’s guidelines for environmentally responsible travel, which describes dangers to specific habitats, such as coral reefs, and suggests non-intrusive viewing and tours that enhance local conservation. Trade in local wildlife is prohibited. The Wildlife Conservation Society has proposed that a fee from tourists be set aside for a land bank to fund national parks in Central America.

As ecotourism rises in its importance to national economies, whale-watchers, tropical forest visitors, coral reef divers and others will demand pristine environments with diverse wildlife. This will be a strong force in favor of passage of strict environmental laws around the world. Moreover, the value of wilderness increases as more and more tourists seek out undeveloped areas. Governments should no longer consider wilderness as wasteland, but as a precious commodity.

The economical arguments in favor of preserving the natural world are strong, but we should be equally motivated by our affinities for our fellow creatures and the natural world. Our ties with nature are very deep and span millions of years. Modern technology has made us forget the awe with which we once regarded the Earth and has encouraged a false sense of superiority and complacency.

**Actions and Attitudes**

Biologists, conservationists, government officials and many members of the public are regarding the rise in the number of extinctions and endangered species with great alarm. The United Nations has found that species and habitats are being lost at an "unprecedented rate" (Stevens 1997c). The need for effective action has never been greater. Fortunately, concurrent with the general deterioration of the environment and wildlife populations, programs for the preservation of rare species have mushroomed, along with a new compassion for animals. These programs address the status of a small number of species, and if expanded to include a far greater percentage of threatened species, the extinction rate would decline.

Some conservation efforts to preserve endangered species have had remarkable success, while others have had mixed results. The expenditure of large sums of money to save some endangered species has not automatically resulted in an increase in their numbers. It is a common misconception that endangered species, once accorded legal and habitat protection, will survive and increase in number. Unfortunately, many species have died out in spite of conservation measures on their behalf. Through examination of failed programs, fewer mistakes can be made in the...
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The Javan Tiger (Panthera tigris sondaica), for example, was given legal protection and reserves in the 1920s and 1930s, yet it was poached to extinction. If a single facet of a conservation plan is lacking, faulty or unfunded, this can spell extinction for the animal or plant. A reserve for this Tiger was set aside too late, when it was nearly gone. As Indonesia's most heavily populated island, Java had little forested land left, and by 1972, only four or five Tigers survived (Matthiessen 1997). With a very limited population under constant threat from poachers and big game hunters, these Tigers needed intensive anti-poaching protection and biological surveys, which they never received. Without well-equipped and motivated park rangers, research and surveys, education of local people and the goal of conserving Tigers established as a major priority of the Indonesian government, there was no chance of saving these cats. The last Javan Tiger was seen in 1976 (Matthiessen 1997).

Since the 1970s, Tigers have experienced precipitous declines throughout their remaining Asian range. Killed for their "magical" bones and body parts, which are used for Traditional Medicine as well as for potions that are intended to impart virility and strength, these magnificent cats are snared, trapped, poisoned and shot in devastating numbers, estimated at a minimum of one Tiger per day of the fewer than 5,000 that survive. A Tiger is now worth at least $50,000 in Traditional Medicine, placing a price on the head of every wild Tiger. Many experts are predicting the Tigers' extinction outside of zoos within a few years. One program, however, has shown success in stemming this decline. In Russia's Far East, strong anti-poaching programs and intensive research and survey projects have halted the decline of the largest subspecies, the magnificent Siberian Tiger. This work has been funded by outside organizations including the Global Survival Network, a Washington, DC, organization, and other groups.

Only about 250 Siberian Tigers survived in the wild in the early 1990s, and with 50 or more being killed by poachers each year, their future seemed dim. The Russian government, in economic chaos, was unable to pay wardens a reasonable salary. Many resorted to illegalities to take advantage of the high value of dead Tigers. The open border with China brought an influx of smugglers and traders offering bribes of $5,000 or more to wardens and poor villagers for killing a Tiger. With the infusion of some $750,000 from conservation organizations since 1993 and help from the US Fish and Wildlife Service, well-armed and well-paid wardens now patrol most of the Siberian Tiger's habitat in modern vehicles. Without this outside funding, which must be continued indefinitely, poaching would have extinguished the remaining wild Siberian Tigers. Biological research on these Tigers is being carried out by the Idaho-based Hornocker Wildlife Institute, along with Russian scientists. These studies have surveyed their populations and obtained the first estimate of their habitat needs which, for males, is at least 450 square miles. One
female Siberian Tiger named Lena, being radio-tracked by these researchers, was killed by poachers. Her four young 
cubs would have starved to death, but they were located when signals were received from the still-operational radio 
collar, which had been cut off Lena's body and placed next to the cubs. The terrified and hungry cubs were taken into 
captivity, and the three survivors were sent to US zoos.

Siberian Tiger poaching is finally decreasing. Russian conservation groups are conducting educational programs 
for local people and investigating suspected poachers along with Russian government officials (GSN 1997). Recent 
population surveys indicate an increase in Siberian Tigers, and conservation plans are falling into place (Galster and 
Eliot 1999). The Tiger's prey of deer and wild boar has been heavily poached, and the plan calls for anti-poaching 
work to preserve these animals (GSN 1997). Tiger biologists have drawn up a plan for a huge sanctuary in the region, 
suggesting habitat corridors linking isolated Tiger populations, and proposing an end to clearcutting of forests (GSN 
1997). Without urgent protective measures, this magnificent cat will disappear. (See Forests chapter for more on this 
Tiger and its habitat).

**Actions and Attitudes: Page 2**

For some endangered animals, CITES has been crucial in preventing their extinction. After a prolonged 
controversy, the African Elephant was upgraded from Appendix II to Appendix I in 1989, which effectively ended the 
ivory trade that resulted in the slaughter of these intelligent animals, the toll reaching almost 1 million animals for the 
1970s and 1980s. The 1996 *IUCN Red List* classified the species as Endangered for the first time, upgraded from 
Vulnerable status in the 1994 *IUCN Red List*. This status was maintained in the 2000 *IUCN Red List*. The ivory trade 
reduced these slow-reproducing animals, who have a single calf only once every five years, from 3 to 5 million in the 
1930s and 1940s to only 300,000 to 500,000 today (Onishi 2001). The high price of ivory in the 1980s encouraged 
the poaching of elephants outside parks, and when these were killed off, poachers entered national parks, often armed 
with machine guns. Almost all the large bulls and most of the older females were killed for their tusks, leaving 
traumatized teenage elephants without leaders and protectors and orphaned infants who starved to death.

In the majority of African countries where elephants survive, they are zealously protected for their value in tourist 
revenue and for their ecological value as keystone species. Many officials of these countries have said that they do 
not want future generations to learn about elephants only through books. Yet several southern African 
countries--Namibia, Zimbabwe and Botswana--which stockpiled ivory from the 1980s trade and from culls carried out 
to limit elephants, succeeded in 1997 in convincing delegates at the CITES Conference to allow sale of 65 tons of this 
ivory to Japan. Japan's sponsorship of much of the costs of the 1997 Conference, which took place in Zimbabwe, 
paved the way for the decision. The President of Zimbabwe made personal requests to delegates to allow the sale. 
Although CITES authorities enacted controls on the conditions of the sale of this ivory, it was predicted that the 
decision would open the door to further killing of elephants and ivory smuggling. This proved correct. African 
Elephants began to be poached again during the late 1990s in Kenya, the Democratic Republic of the Congo and other 
countries. An elephant orphanage in Kenya received an unprecedented number of orphaned calves at this time. Their 
mothers had been killed for their ivory in national parks. Some of this ivory is sold locally, and much is smuggled out 
of Africa.

A large confiscation of tusks was made in Los Angeles in May 2001; these tusks, many of which were very small 
and obviously from young elephants, had been smuggled from Nigeria in hollowed-out furniture. This indicates that 
allowing some sale of ivory opens the door to unrestricted slaughter and smuggling that will place the species in a 
critical--and perhaps lethal--decline toward extinction. When ivory was allowed to be sold on a quota basis in the 
1970s, this "regulated" trade failed completely to prevent unregulated slaughter as the price soared. In many parts of 
Africa, poachers are killing elephants for a trade that may be resuming. Ivory is openly sold in Cameroon, and in 
Burkina Faso, a West African country north of Ghana, where only 3,000 to 4,000 elephants remain, ivory traders are
selling carvings and jewelry in the capital city (Onishi 2001). One trader even complained that sales had not
recovered as a result of the 1989 ivory ban, with larger carvings taking months to sell because tourists are no longer as
interested in buying ivory (Onishi 2001). When asked about the need to conserve these endangered animals, he said
that like humans, some die, but the species does not become extinct (Onishi 2001). Few Africans have been taught
about how close African Elephants came to extinction as a result of the ivory trade, nor about their key role in
spreading the seeds of trees and creating waterholes for wildlife. It is also likely that only a small percentage of
Africans are aware of the species’ immense intelligence and altruism. If these facts were better known, it is likely that
most Africans would want to protect these great animals. They are in imminent danger of disappearing from West
Africa.

As they attempt to forage in land that is now being tilled or used as grazing land, Asian and African Elephants are
killed and harassed by farmers and villagers outside national parks. Wildlife corridors are being proposed in many
parts of the world to ease such problems. As human populations grow, invading the last retreats of wildlife, parks and
reserves are becoming islands amid development, agriculture and cities. Without corridors of natural habitat linking
these islands, wildlife will decline in diversity and abundance. A new national park in Mozambique will link with
South Africa's Kruger National Park and provide a corridor and additional habitat for Kruger's elephant populations.
Other international parks in southern Africa have opened or are scheduled. Some conservationists have proposed that
these parks form the southern end of a wide corridor north to Kenya. This would be an excellent solution to the
decreasing habitat faced by many large mammals of eastern Africa. In the Western Hemisphere, the Atlantic Biological
Corridor Project and the Mesoamerican Biological Corridor seek to protect wide swaths of land between Mexico and
Colombia to prevent the extinction of wide-ranging animals, such as Jaguars and Cougars. Along Texas' border with
Mexico, most of an extremely biologically rich area has been plowed under, and the Fish and Wildlife Service is
trying to purchase the remnants of this once rich habitat to link it with adjacent habitat in Mexico for use by
endangered wildlife.

**Actions and Attitudes: Page 3**

In the American West, Grizzly Bears may someday be able to roam from Yellowstone to Yukon in a project known
as Y to Y, an immense corridor that would prevent the present isolation of this species into pockets of fragmented
habitat surrounded by hostile cattle ranchers. The Wildlife Conservation Society has initiated a program it calls
"Living Landscapes," which involves local people living in areas surrounding parks and reserves. It promotes the
conservation of animals that have ranges extending beyond the parks in order to help conserve these species, allowing
them to be part of functioning ecosystems. This sometimes involves curtailing their own hunting. White-lipped
Peccaries, for example, a type of wild pig, are important seed dispersers of trees in Latin American rainforests and
also create open spaces on the forest floor by rooting for food. Yet they are heavily hunted for their meat and pelts.
Only through an education program in which the local people themselves understand the effects of their hunting and
are permitted to manage the land, can the species and its habitat be protected. This organization is applying such
approaches to regional conservation in 50 sites in Latin America, Asia, Africa and North America (WCS 2001).

**Actions and Attitudes: Page 4**

Another fundamental element to the future survival of wildlife in a world crowded with humans is tolerance and a
belief that the Earth must be shared. Public opinion has been crucial in land use and protection of natural habitats and
landscapes so that wildlife and plants were allowed to survive, even in parts of the world with overcrowding where
land was at a premium. Fewer species are threatened in parts of the world where wildlife is respected and considered
part of the landscape. In Africa, wildlife flourished when native peoples were the guardians of the land, prior to the
18th century when Europeans entered as colonial rulers. European rule resulted in overhunting and development of large-scale ranches and farms that were fenced, creating a drastic decline in wildlife.

Native Americans have a less proprietary view of nature than Europeans, and many tribes believe in spiritual connections with trees and animals. They treat nature's assets as gifts, for which they express gratitude. In the intervening centuries since colonization of North America by Europeans who failed to respect nature, views have come full circle for many Americans. Wilderness and nature preservation have become high priorities, based on both scientific discoveries about how ecosystems function and a growing desire by people to appreciate nature. Some scientists believe that connections with nature have been an intrinsic part of human nature for millions of years. Dr. Edward O. Wilson calls this "biophilia," or "love of living things," and cites it as a primary human trait. Such ties to nature have nurtured new conservation zeal to help preserve disappearing wildlife and landscapes.

For some people, however, even the most basic ecological and evolutionary principles are refuted in favor of views that justify exploitation and species' extinctions. They describe conservationists as irrational "tree huggers," and animal lovers as "bunny huggers." Anti-environmentalists have formed organizations in the United States, operating collectively as the Wise Use movement. Many elected government officials share these views, and have voted for legislation that fails to protect endangered species and results in destruction of important wildlife habitat. US Congresswoman Helen Chenoweth, a Republican from Idaho, believes that there should be a public referendum regarding which animals can live and which will be allowed to go extinct (Egan 1996). Chenoweth stated to The New York Times: "A species goes out of existence every 20 seconds. Surely a new species must come into existence every 20 seconds. There's no way human beings can regulate that dynamic" (Egan 1996). Humans can, indeed, affect the "dynamic," as they have for millennia, and when species are lost, their loss is our loss. Evolutionary biologists would be dumbfounded at her statement. Although species are passing into extinction at a fast rate, new ones are not evolving every 20 seconds, nor even every 20 years or every 200 years, unless one considers the mutations of viruses and bacteria to be new species. Once the Tiger or Right Whale—or any of Earth's myriad species—becomes extinct, it is gone forever. The film "Jurassic Park," which concerned the recreation of dinosaurs from their DNA, is total fiction. Science has not found a way to clone species from DNA obtained from dead animals because the DNA becomes scrambled after death. Nor are such scientific feats anticipated in the near future.

**Actions and Attitudes: Page 5**

The basic problem that many people find in protecting endangered species is the question of land ownership and the inconvenience that they fear may result when animal or plant habitat is protected. Congresswoman Chenoweth would find agreement among many people living along the Massachusetts coast, who are unwilling to share the beaches with a tiny endangered bird. This bird has caused storms of controversy between its protectors and recreational beach users. The Piping Plover (*Charadrius melodus*), a shorebird, nests on sandy beaches along Eastern coasts, the Mississippi River and the Great Lakes. It has been crowded out of the majority of its nesting sites by the hordes of people who come to swim, sunbathe and drive off-road vehicles. Beaches have been altered or developed for various commercial purposes as well, including levee construction for flood control. In 1985, the species numbered only a few thousand birds and was listed on the Endangered Species Act as Endangered in the Great Lakes, and as Threatened elsewhere in its range. The numbers of this species along the Atlantic coast, from southern Canada to South Carolina, reached 1,377 birds in 1998, and throughout its range, only about 5,913 birds survive (BI 2000). In Massachusetts, where most beaches are public, local authorities and even federal and state enforcement officers were reticent to enforce the law to protect the nesting plovers. Even when parent birds managed to raise chicks, the chicks were often run over by vehicles when they fell into the deep ruts on the beach made by tire tracks, unable to climb up the six inches of vertical sand or flee an oncoming vehicle in time. Plans in 1989 to fence a portion of the beach in Plymouth to protect the nesting birds met with such anger and public protests from beach-users that they were abandoned. In 1991, only a single chick survived in the state, with few beaches strictly protected. Unleashed dogs
killed some of the chicks, but most were run over by cars and all-terrain vehicles.

On Nantucket island, a Massachusetts Audubon Society warden fenced in the nests of two Piping Plovers in 1994, causing such anger from off-road vehicle drivers that they called the police, who threatened to arrest the warden. Neither the state, which protects the species, nor the Fish and Wildlife Service came to the rescue of the Piping Plovers by supporting the actions of the warden. Vandals ripped down the protective fencing. Endangered Least Terns (*Sterna antillarum*) nesting on the same beach produced 24 chicks that year. In one day, 20 were run over. This finally convinced the local selectmen to close that portion of the beach to off-road vehicles, which allowed all eight Piping Plover chicks to survive. The citizens of Nantucket voted the following year to defeat a selectmen proposal to allow vehicle use on the beach, which would have exempted the area from state law protecting the plovers. In 1995, three pairs of Piping Plovers nested successfully on Nantucket, and state restrictions began going into effect to protect their nests.

In Massachusetts, nests increased from 139 in 1986, to 445 in 1995 (Allen 1996a). In a step backward, the state of Massachusetts eased restrictions on beach vehicles in 1996, giving what conservationists called "plover-squashing permits" (Allen 1996b). The Massachusetts Audubon Society estimated that at least 33 plovers would be legally killed each year under the new regulations. Another loss for Piping Plovers was the firing in September 1997 of the town of Plymouth's Beach Manager, who had spent more than a decade protecting these birds from off-road vehicles. This was done to appease recreational dune buggy users. The ban, which closed part of the beach until mid-August to allow the chicks to survive, was lifted. A civil complaint was filed in US District court in April 1998 to force the town of Plymouth to enforce the Endangered Species Act and protect nesting plovers. The following month, a judge ordered the town to prohibit off-road vehicles on the beach from May 19 through August 31, unless strict measures are enacted to protect the nesting birds.

At least one conflict concerning this endangered bird in 1997 had a happy ending. The Cape Cod town of Barnstable's Fourth of July fireworks were nearly canceled by the Fish and Wildlife Service for fear that they would disturb the nesting plovers. A local businessman offered the use of several barges from which to detonate the fireworks. The barges were towed far from shore, and the fireworks proceeded as scheduled. Conrad Troy, owner of Tucker-Roy Marine Towing and Salvaging, Inc., who had been contacted by the Massachusetts Audubon Society for his help, said; “If I was an endangered species, I would hope someone would come help me out. We can keep the piping plovers happy and the kids who want to see the fireworks happy” (Anand 1997).

These controversies are indications of a growing trend in which animals, especially endangered species, are no longer eliminated or killed in the United States without protest when they come into conflict with people. Listing a species on the Endangered Species Act is a major step. It is not an end in itself, however. Listing scarcely helped the plovers in the Plymouth beaches, however, because the law was not enforced when opposed by drivers of off-road vehicles and beach users. Only the combination of publicity, local support for the birds and demand for strict protection have resulted in protection of plover nests and habitat preservation. A large contingent of volunteers now works on behalf of these tiny birds. Such cases provide examples of what is needed to prevent extinctions.

Conflicts over protection of endangered species are sure to increase in the future. Only if the public support is stronger on behalf of wildlife than the influence of those who are indifferent or oppose endangered species protection, can endangered species survive. Public support for the less attractive and charismatic species, such as insects, fish, bats and nondescript plants, will come only through effective conservation education.
program sponsored by the Fish and Wildlife Service in cooperation with the Mexican government. The Kemp's Ridley (Lepidochelys kempi), smallest and rarest of all sea turtles, became endangered from killing for its meat and shell. Killed off by poachers in Texas, where it once nested, a long and difficult program was initiated to return these turtles to Padre Island. Thousands of eggs laid by the last 500 nesting females on the turtles' only remaining nesting beach along the Caribbean coast of Mexico were taken to Texas for hatching. It is not known how sea turtles learn to return to their natal beaches after spending many years at sea, and all precautions were taken to convince the hatchling turtles that they had been hatched in Texas, not Mexico. The eggs were not even allowed to touch the sand on their Mexican beaches. Between 1978 and 1988, when the program was halted for lack of visible success, a total of 22,000 eggs had been taken to Padre Island, hatched, kept in captivity until they were about a year old and then released to the sea. In 1996, to the delight of conservationists, two female Ridley Turtles that had been released 12 and 14 years previously, returned to lay eggs on Padre Island. They were recognized by a special marking the US Fish and Wildlife Service had made on each shell identifying the year the turtles were hatched. By 1999, 16 nests of returning Ridley Turtles were found by volunteers and members of the recovery team who monitor the beach 24 hours a day during the summer nesting season. This is the first known case of successful reintroduction of sea turtles. Numbers of these turtles have increased to about 9,000 in 2001, but they are still only a fraction of the 40,000 filmed nesting on a Mexican beach on a single day in the 1940s.

**Actions and Attitudes: Page 7**

Dramatic rescues of endangered species have become commonplace on the island of Mauritius through the efforts of teams headed by Dr. Carl Jones, a scientist working for the Wildlife Preservation Trust, founded by famed author and conservationist, Gerald Durrell. This island harbors some of the world's most endangered birds, and by the 1970s, conservationists had become resigned to the imminent extinction of several of these endemic birds and other endangered animals. In steep decline, they seemed to be following on the path of the Dodo. Crucial to the success of the efforts to reverse this trend was the agreement signed by the government of Mauritius with four conservation organizations in the 1980s, including the Wildlife Preservation Trust, to cooperate in preserving the island's natural heritage. A conservation program in the 1970s to protect the Mauritian Pink Pigeon (Columba mayeri) had failed, and the remaining 33 birds were dying off. Captive-bred birds failed to breed, and wild birds were dying from various causes. Jones arrived on the island in the 1980s and, after years of concerted effort in cooperation with a small staff, brought the wild population from a low of 10 birds to approximately 375 birds in 2000. Pink Pigeons now nest at four sites on Mauritius, and another on Ile aux Aigrettes, an islet off the coast (BI 2000). This spectacular increase was the result of a program in which exotic monkeys, rats, mongooses and feral cats were removed from the roosting and nesting grounds of these beautiful, pale pink birds. Captive-bred birds released to the wild were given food until they were independent, and nests were carefully monitored for predation, falling eggs and other mishaps (BI 2000). The program hopes to increase these pigeons to a population of 500 birds within five years.

The Mauritius Parakeet (Psittacula eques), once the most endangered parakeet in the world, became reduced to a total population of only six birds in 1978 (BI 2000). The captive-breeding program set up to preserve them in the 1970s was not successful, and the last wild birds were dying out. Jones and other experts in parrot breeding set up a new captive-breeding program and gave the few wild birds strict protection from the many threats that appeared almost certain to cause their extinction. These included an almost total loss of forest habitat, including old trees with nest holes; a lack of available food; monkeys and rats preying on nestlings; infestations by nest fly larvae; and competition for nest sites with various introduced birds and bees (BI 2000). In spite of these overwhelming odds, these lime green parakeets are making a slow recovery. A forest habitat of 8,000 acres has been made into a national park where exotic species have been excluded and captive breeding is now succeeding. At first, the wild parakeets refused to nest in boxes set out for them and would not try to find other nest sites if their nest tree were destroyed during hurricanes. Fortunately, a few pairs did nest, and habitat improvements were made, such as the planting of fruit trees as a food source. Through these and other efforts, the wild and captive populations rose to between 85 and
90 birds by 1997 (Hoyo et al. 1997). Numbers continued to rise, and by 2000, 106 to 126 birds survived (BI 2000). This is one of the world's most impressive conservation stories. The vast majority of birds whose populations have declined so drastically experience genetic impoverishment or become prone to other threats by failing to respond to conservation programs. The recent extinctions of Hawai'i's honeycreepers and other native birds are testament to the failure of many 11th-hour programs to conserve critically endangered birds. Although still listed as Critical by BirdLife International (2000) and the IUCN, the Mauritius Parakeet may be reclassified as Endangered, should present trends continue (BI 2000).

A third endangered bird of this island, the Mauritius Kestrel (*Falco punctatus*), a small falcon, numbered only four birds in 1974, coming the closest to extinction of any Mauritian bird. Yet today the species is numerous, having almost completely recovered. Through captive breeding and restocking birds to the wild using methods employed in the United States for Peregrine Falcons, and with the help of the Peregrine Fund, hundreds of captive-bred birds have been released to the wild and fed at release sites until they gradually sought wild prey. By 1995, these kestrels totaled 286 birds (Jones and Hartley 1995). Control measures have been successful in reducing exotic species that preyed on them. The population of Mauritius Kestrels reached 145 to 200 breeding pairs in 2000; the species totals from 500 to 800 individual birds who live in three subpopulations in various parts of the island (BI 2000). Jones has also worked to restore habitats for various endangered lizards that are captive bred at the headquarters of the Jersey Wildlife Preservation Trust. These small, iridescent geckoes had become restricted to out-islets, where they survived because introduced predators were absent. Unfortunately, rabbits were released on Round Island, habitat for several of these endangered reptiles, and they multiplied to pest proportions, leaving almost no natural vegetation. Many of these lizards were captured just in the nick of time, and bred in captivity, as the last of their habitat was being consumed. After removal of the rabbits and replanting of native species, these lizards are now being reintroduced.

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Specimens of a highly endangered fruit bat of the small Mascarene island of Rodrigues, the Rodrigues Flying-fox (*Pteropus rodricensis*), were captured for captive breeding when wild populations became threatened by killing for food by local people. It amazed researchers studying them when a female exhibited mid-wife protective behavior seen only in a few other animals, such as dolphins and elephants. One of the females in the process of a difficult breach birth was aided by the other, who fanned her, cradled her in her wings, and showed her the proper position to cling to the cage bar during the three-hour delivery (McFarling 1994). Wild populations of this species are listed as Critical by the 2000 *IUCN Red List*. Other flying foxes that once inhabited these islands are now extinct, and the Rodrigues Flying-fox is the last to survive. Without the emergency rescue of some of these foxes, the altruism and devotion of these animals would probably not have been recognized.

**Actions and Attitudes: Page 9**

The elimination of introduced animals, from goats, cattle and pigs to cats and exotic plants, has been carried out on many islands and island-like environments around the world to preserve native species on the brink of extinction. The governments of Australia and New Zealand, in particular, have rescued a number of critically endangered species. Lord Howe Island, located off the northeastern coast of Australia, once harbored diverse wildlife. After settlement, and introduction of rats and other exotic species, forest clearance and other threats, numerous extinctions of native animals occurred, and most of its surviving species are endangered. Efforts on the part of the government to return the island to its near-original state, with total protection of the remaining tropical forests, coral reefs and other habitats, is underway. Ecotourism has been developed on the island, but the number of visitors is kept at a level that will not harm the island's endemic fauna and flora. Cats may not be kept by the limited number of residents as pets.
because of their threat to native birds, and exotic animals are being eliminated from the wild. The endangered, flightless Lord Howe Rails (Gallirallus sylvestris), highly vulnerable to predation by cats and other predators, are now gradually increasing with strict protection. Once found throughout the island, these rails became restricted to mountain areas after they were eliminated by feral pigs, goats, cats, dogs and the introduced Masked Owl (Tyto novaehollandiae) elsewhere on the island. Captive breeding has been successful, and after work to eliminate exotic animals, these rails were reintroduced to several of their original habitats at lower elevations (BI 2000). The population numbers about 130 birds, with a potential living space for up to 220 birds (BI 2000).

In some cases, control programs for exotic species on islands are not done humanely. Wire snares and poison have been employed rather than live-catch traps, for example. Humane organizations should be consulted by governments to employ humane methods in ridding islands of non-native animals.

The Black Robin (Petroica traversi), a beautiful songbird resident on the Chatham Islands off New Zealand, numbered just five birds in 1980, with only one breeding pair (BI 2000). Rats and cats colonized the island after settlement, and deforestation had destroyed the species' habitat. A tree-planting project in which 120,000 trees were planted on Mangere Island, one of its prime habitats, was undertaken (BI 2000). Supplemental feeding and nest protection from introduced Starlings (Sturnus vulgarus) and seabirds, which were preying on them, helped somewhat. Real progress began with the use of an unusual program in which eggs of the Black Robin were placed in the nests of other species to raise them and allow the original female, who became known as "Old Blue" and lived 12 years, to lay more eggs. Birds of a related species, the Tomtit (Petroica macrocephala), raised these robins, and chicks were successfully reintroduced to Mangere Island (BI 2000). Such cross-fostering has failed with species such as the Whooping Crane, whose eggs were cross-fostered to Sandhill Cranes, because the chicks when mature, tried to mate with Sandhill Cranes instead of members of their own species, having become imprinted. In this case, the chicks bred with members of their own species, and numbers rose to 259 in 2000 (BI 2000). They were all descended from the original pair of birds. The New Zealand Department of Conservation, which had overseen the breeding program, found through DNA studies that the birds are nearly identical genetically (Hutching 1997). Further studies will attempt to discover immune responses and other signs of inbreeding, but outwardly, these robins are thriving, with a 70 percent survival rate and normal fertility (Hutching 1997). Species with such low genetic variability tend to be extremely vulnerable to extinction, having little ability to adjust to changes in their environment or food supply.

Actions and Attitudes: Page 10

More and more countries are taking a keen interest in the preservation of wildlife, and some have ancient protective traditions. The Asian country of Bhutan has a Buddhist ethic of not harming living things. It is the only Himalayan country to have protected the majority of its forests. Rhododendron species 40 feet tall grow there, and the rivers still flow clear, without erosion and siltation. Species that are rare elsewhere in the region still survive in Bhutan. One of its protected areas, Jigme Dorji National Park, is the size of Switzerland and preserves spectacular mountains and cascading waterfalls. It is part of a Bhutanese government plan to create a nationwide system of reserves to protect the country's natural heritage (Adams 1994). Although erosion and destruction of some of the native fir and rhododendron forests have occurred, Bhutanese people support the government's "go slow" approach to development and its plan to preserve wilderness (Adams 1994). A wintering population of endangered Black-necked Cranes (Grus nigricollis) is zealously protected by the Bhutanese who live in the valley where the cranes come each year; they regard the birds as integral to their lives and believe that, without them, their harvests will fail. These people miss the cranes calling when the birds migrate in the spring, and say that the valley seems empty and silent without them (Greenway 1997). The Environment Ministry watches over the cranes as well and is extremely strict about issuing permits for activities that might harm them.

New approaches may save some of these threatened tropical areas. Australia's Rainforest Information Center has
created an Internet website which plays rock and roll music; its sponsors pay to preserve the rainforest (EII 2001). The organization is focusing on saving several endangered forests in Ecuador, including Los Cedros Biological Reserve and portions of the Madre Selva (EII 2001). The Natural Resources Defense Council has created a list of BioGems (www.savebiogems.org), the 12 most endangered wildlands in North and Latin America. It publicizes threats, such as proposed dams and logging, to generate thousands of letters and e-mails to governments, loggers, utilities and others. The Macal River Valley in Belize, threatened by a dam project, has been saved through this program. The US Duke Energy International company decided to withdraw from Belize after the torrent of protests (NRDC 2001). Boise Cascade planned a major wood chip mill in Chile, which would have consumed 1,200 acres of endangered temperate rainforest a year, with endangered Alerce trees, the massive South American counterpart to the Sequoia. The forests also sheltered tiny Pudu deer and rare birds. The company announced that it would cancel its plans “as a result of unfavorable market conditions” (NRDC 2001). Conservation International (CI) played an important role in the designation by the South American country of Suriname of much of its vast interior, a pristine rainforest, as a reserve. CI, through its scientific studies, was able to show the country's leaders that, kept intact rather than being logged, this rainforest would prove far more valuable for future generations. This organization has accomplished similar feats in Bolivia and other parts of the world, where it also carries out important biological inventories.

An example of cooperating with local people for conservation of wildlife is the administration of the Mara Reserve of Kenya. This reserve is run by the Maasai people through a council which mandates that tourist funds go directly for social services of the tribe; in turn, the Maasai, who live outside the reserve, allow wildlife to move freely without fencing or harassment that is common elsewhere in Africa where livestock is raised (Gakahu 1994). In this reserve are endangered Cheetahs and Black Rhinos, along with 30 species of ungulates, including large numbers of elephants (Gakahu 1994). Local villages in many parts of Kenya are establishing landowner associations that receive funds from tourism to protect wildlife and benefit local economies (Gakahu 1994).

**Actions and Attitudes: Page 11**

Teaching people that their local wildlife is important to protect as a source of pride has had excellent results in a program in the Caribbean funded by RARE Center for Tropical Bird Conservation, an organization headquartered at Philadelphia’s Academy of Sciences. It has employed innovative education and conservation programs to preserve St. Lucia Parrots or Amazons (*Amazona versicolor*), the forests and other wildlife of the island. Biologist Paul Butler, who began this program, has instilled conservation enthusiasm and pride in the people of the island of St. Lucia for these beautiful and rare parrots. His dynamic program has resulted in the naming of this species as the national bird, as well as education programs so successful that children know its scientific name, habitat and need for protection. They enjoy singing songs about the parrots and dressing up in parrot costumes. The people of St. Lucia now understand that the forest and other wildlife must not be destroyed. Art and essay contests are conducted in schools and towns to publicize this parrot, and St. Lucia Parrots are used as logos for many businesses. Forest cutting has been banned, and a substantial portion of the island has been set aside in reserves. This has resulted in an increase from fewer than 300 to between 350 and 500 birds (BI 2000). The Saint Lucia government is dedicated to protecting the parrots and their habitat, and a new ecotourism industry has sprung up. These programs have meant an end to the rampant smuggling of these beautiful, rare parrots, an activity that had been thought uncontrollable because they could be sold for $20,000 per bird to collectors. Protecting the forest for the parrots also resulted in conserving other threatened wildlife of the island and precious watershed. Another native species, the spectacular Giant Swallowtail butterfly, is illustrated on billboards prominently located near towns with the message, “It's ours . . . take care!!!” (Lipske 1994). This approach to conserving endemic wildlife has been adopted on other Caribbean islands, and Butler trains local conservation officers and teachers to continue the programs elsewhere (Butler 1992, Lipske 1994). A film about these programs, “Caribbean Cool,” is described in the Video section, and RARE has published a manual, *Promoting Protection Through Pride*, with advice on how to carry out such programs.
Educating children to respect the environment and conserve endangered species leaves a lasting impression if begun in grade school and continued throughout schooling. Children have an innate sympathy and love for animals, and become enthusiastic conservationists. Education about national laws and native wildlife and plants of the region encourages students to have a lifelong desire to protect them and a sense of guardianship that results in opposition to actions that would harm them. Environmental education is required in about two-thirds of US states, from grade school onward. Some schools require special training in environmental science for all teachers. A few high schools are teaching courses in ecology for college credit. The North American Association for Environmental Education has issued detailed guidelines for educators to assess textbooks and other materials for fairness and accuracy, and review by experts (Cushman 1997).

Some conservation organizations have been formed by scientists, such as the highly effective International Crane Foundation and Bat Conservation International. Entertainers have also become involved in conservation. The rock music star Sting, for example, became concerned about the destruction of rainforests and founded the Rainforest Foundation, an organization to raise money to purchase or protect thousands of acres of this endangered habitat, while at the same time informing young people about the importance of these forests to the world. Students and concerned individuals have also founded organizations to protect individual species or particular environments, such as prairies or wetlands. These organizations have raised millions of dollars for rainforest protection and helped many endangered animals.

A number of effective conservation programs began as grassroots organizations established by an individual or a small group of people who wanted to protect a species. Individuals have educated, lobbied and helped raise funds for the purchase of habitat, making extremely important contributions to the preservation of threatened species. The beautiful bluebirds of North America were in steep decline until Lawrence Zeleny began his nesting box program. He popularized and distributed nesting boxes for bluebirds with an entry hole just a fraction of an inch too small for the aggressive European Starlings to enter. The latter birds are taking over the tree nest holes of all three species of North American bluebirds. Starlings are also a threat to several native species of woodpeckers. Through the nest box program promoted by Girl and Boy Scout troops and other organizations, these colorful birds have increased and may again be abundant, familiar residents of orchards, woodland edges and grasslands. Such citizen projects keep species in decline from reaching endangered status. Once endangered, a species' genetic diversity is threatened, and multi-million-dollar state and federal rescue programs, which are not always successful, must be set up to help them.

Only a small percentage of endangered species have such programs in place to aid their populations and protect their habitat, and individuals can make important contributions by volunteering for organizations working to preserve species and their habitats or by founding an ad hoc group. The majority of species listed on the 2000 IUCN Red List or on Natural Heritage would be far more likely to avoid extinction if conservation programs were created for them, with help from both individuals and organizations. The species most in need are invertebrates and plants, which form the majority of all endangered species and receive the least funding. Within each region or county, little-known endangered species may be fading out without the aid of any organization or individual. Organizations such as The Nature Conservancy, Conservation International, scientists with the IUCN or state Natural Heritage programs provide highly specific information on threatened species in various parts of the world.

Restoration of original ecosystems will become more and more important as natural landscapes decline. The Nature Conservancy, which has purchased millions of acres of land to preserve resident endangered plants and animals, reintroduced the American Bison to its 30,000-acre tallgrass prairie in Oklahoma, and is reintroducing native flowers, plants and animals to restore at least a portion of this magnificent ecosystem. After decades of failed bills proposed in Congress, legislation was finally enacted in 1996 establishing the nation's first tallgrass prairie park of more than 10,000 acres in Kansas. Individuals can also contribute to restoration of ecosystems. Books, such as "Noah's Garden. Restoring the Ecology of Our Own Back Yards," by Sara Stein (1993), and many magazine articles have called attention to the effects of suburbanization, and the poisoning of native wildlife with pesticides and herbicides used on lawns. They suggest means of bringing back natural ecosystems.
However effective private organizations are, they cannot begin to have the effect of preserving habitat that governments have. As the owner of millions of acres of parks and reserves, the US government plays a major role in habitat and species preservation. The Land and Water Conservation Fund was established in 1964 to purchase and preserve federal lands, with money coming from oil and gas leases on the coasts. Each year, some $900 million is deposited in this fund, and more than 5 million acres have been preserved in many threatened environments. In 1998, $699 million was approved for spending on land purchases, including $250 million for acquiring the ancient Headwaters Redwood Forest in California to save it from planned logging, as well as $65 million for the New World Mine site near Yellowstone National Park to save it from a huge Canadian gold mine.

National Wildlife Refuges are vital habitat for thousands of threatened and declining species and were first set aside during the Theodore Roosevelt Administration to protect endangered sea birds being killed for their plumes. Now refuges and preserves are key to the survival of Red Wolves, Bald Eagles, Whooping Cranes, Florida Panthers and numerous rare plants, butterflies and other wildlife. In many of these refuges, oil drilling and other exploitation occurs, causing damage to ecosystems and threatened wildlife. The protection these refuges receive is far less stringent than that of national parks and monuments. In some refuges, high-speed roads cut through the middle of marshes where an array of rails, turtles and wetland species end up run over by vehicles. In the largest refuge, the Arctic National Wildlife Refuge, most of the land is open to oil drilling, where water and air pollution have been severe problems. The calving ground of a herd of some 100,000 Caribou within the refuge has been proposed for oil drilling, in spite of the opposition of the majority of the US public. With greater support from the public, laws governing these refuges and their funding might be strengthened to better preserve wildlife.

Some imaginative solutions to the funding problem have been developed. A number of organizations have adoption programs for wild animals. Northern Right and Humpback Whales, for example, identified individually by their markings by scientists studying them, can be sponsored by members of the public, who are then informed of news about their adopted animal. The funds are applied to research and conservation of the species. Grizzly Bears, Tigers, Gray Wolves and other animals may be adopted through a growing number of organizations. Earthwatch, in Watertown, Massachusetts, sponsors thousands of research expeditions by scientists, many of them studying endangered species, through funds from volunteers who pay for the privilege of accompanying the scientists and helping in the research. Endangered species of Brazil's Atlantic Forest, Florida Manatees, rare butterflies and coral reefs are among the many projects Earthwatch helps fund. This organization also awards hundreds of scholarships to students, and teachers who participate can turn the experience into a study program for their students.

A great blossoming in natural history information has erupted in recent years. Internet websites, accessible to all, have been dedicated to endangered species research programs, biological studies, organizations devoted to helping animals and data compilations. The Internet sets up communications between people around the world, in which education, advice, and even funding help for threatened species and ecosystems can be arranged. Critical situations threatening species can be publicized immediately around the world. On the Internet, students and the public can follow the movements of individual sea turtles, great whales and many other animals equipped with radio transmitters sending signals to satellites. Libraries can be accessed, and websites set up by state, federal and private entities provide highly specific information on endangered species and the environment. Experts may be consulted through these sites. In a recent case, a man in Lebanon came upon an injured eagle with a gunshot wound; he took the bird...
home and logged on to the National Geographic Society's website (see Teachers Aids in the Appendix for lists of websites) to find Joe Blanton's "Glad You Asked" column. Blanton put him in touch with the Wildlife Center of Virginia, whose staff at its state-of-the-art animal hospital gave him advice on care for the eagle. The man reported that the bird recovered and was released (reported in National Geographic June 1997). The possibilities of educating and dispensing information around the world are enormous, and with imagination, many of the problems discussed above might be solved through the free interchange of ideas of people on the Internet.

The Internet is only one new tool for conservationists. Laser discs can combine films and books and be interactive in teaching about subjects such as endangered Chimpanzees. CD-ROMs, although not yet available for many endangered species, contain--on one disc--still photos, films and printed information about a species; heretofore one might have to visit many libraries, rent or buy films by mail and spend many hours to obtain such information sources.

Books, television programs and films about the natural world have opened new doors to the public in the past decade. Natural history films, in particular, are another major influence on education and even public policy. They present views of true wilderness, natural wildlife behavior and conservation lessons. They may have had a significant influence on convincing the public of the need to pass such laws as the Endangered Species Act. Films of the slaughter of spotted cats, American Alligator, and the plight of declining species around the world aroused many people to write their Representatives and Senators in support of legislation to prevent species from becoming extinct.

Films of truly wild places may have played a role in the growth in bird watching and ecotourism, and probably in the changes that have taken place in zoos, with barred cages giving way to more natural exhibits. Having seen films of these animals in the wild, the public was no longer content to see them in such unnatural conditions, behaving so abnormally. Situations once commonplace, such as a pacing Tiger in a barred cage, a single elephant in a dusty, small enclosure, rocking back and forth, now result in protests that have changed zoo exhibits and animal treatment for the better.

The crucial steps that must be taken in the future involve the dissemination of knowledge and concern about endangered species to the general public, who are poorly informed about the enormity and possible effects on their lives of issues such as overpopulation and disappearing species. Although public awareness has increased about environmental decay and the effect that humans have in causing species' extinctions and endangering them, most people still tend to act as if nature will bounce back and will continue to function normally, no matter how extreme the damage. This is a naive point of view. Scientists have not defined the threshold beyond which total ecological collapse will occur in any given area. Also unknown is the number of species that can be extinguished before biological systems become dysfunctional (Leakey and Lewin 1995).

Newspapers, television and other media should be encouraged to publicize these issues further, rather than catering to what they might consider the public's interest. As an example, US network television and newspapers have pointedly ignored human overpopulation and loss of biodiversity, while doing numerous stories on artificial means of having children, such as test tube babies and multiple births. On the positive side, new cable television channels in the United States, such as Animal Planet and BBC, add to the growing number of wildlife and environmental programs on PBS and the Discovery Channel. Unfortunately, these channels presently reach only a fraction of the audience of network television, preventing a better understanding by the public of the problems facing the world. The numbers of films being made and books written on endangered species and the environment have increased exponentially in the past decade, an indication of a growing enthusiasm for the natural world. Other indications of this trend are the rise in memberships in conservation and humane organizations, ecotourism, bird-watching, hiking and visits to national parks and preserves. If these concerns were better translated to activism and altering lifestyles to prevent harming the environment and wildlife, impending mass extinctions might be avoided.
Biodiversity Preservation

Preventing loss of diversity through the growing number and rate of extinctions is extremely important for the ecological stability of the planet. Unfortunately, it is not recognized as a key issue by the majority of people, nor by world leaders. The extraordinary wealth of plants and animals that are in the process of disappearing may represent between 5 and 30 million species, of which only about 1.3 million have been named (Wilson 1993). Insects alone may number more than 5 million species, with the majority of species living in tropical rainforests (Wilson 1993). These animals are key to the Earth's ecosystems, pollinating, fertilizing and aerating soil, and providing food for thousands of animals. Some 751,000 animal species have been identified, far more than the 248,428 plant species, yet these represent only about 15 percent of all living species, in the view of Dr. Edward O. Wilson in his classic 1993 book, *Biodiversity*. Each year, thousands of new species of insects and other invertebrates, hundreds of frogs and, surprisingly, primates, antelope and birds are discovered by science, often in disappearing habitats.

Worldwide, biological inventories, essential to the process of protecting biologically rich areas, receive inadequate funding. Wilson has estimated that more money is spent in New York City's bars in two weeks than studying biodiversity around the world each year (Farnsworth 1994). Some $57 billion is spent on drugs by Americans annually, according to the White House Office of National Drug Control Policy, while less than $1 billion are spent on inventories and biological studies, by some estimates. The lack of funding for biological surveys means that entire ecosystems are vanishing before they are even studied.

Just as many species are disappearing from neglect or uncaring development, scientists are finding and naming hundreds of new life forms, primarily through research programs of private universities and organizations. Ecosystems thought sterile, such as deep ocean environments, are now known to contain significant species diversity. Each descent of a submersible vehicle into these environments brings new discoveries, from beautiful, bioluminescent jellyfish many feet long to bizarre creatures that seem to have emerged from science fiction tales. Many of these newly described species represent previously unknown families, classes, and even phyla of animals.

Some deep sea creatures inhabit the boiling hot water emitted from cracks in the ocean floor, managing to survive what would be toxic to 99 percent of the world's animals. This environment may be similar to the one in which life itself was formed billions of years ago. These areas should be given high priority for government research funding. Studies about Earth's diversity should not be sacrificed in US federal spending projects such as NASA probes into the possible presence of microbial life on Mars. The discovery of the Mars fossil was given enormous publicity, and in early 1998, chemical studies proved that these supposed evidences of life were actually terrestrial contamination (Wilford 1998). This has not stopped the NASA program from searching for evidence of life on Mars. Tropical forests also represent frontiers to biologists in urgent need of research funding, with millions of species of birds, mammals, insects and other life forms yet undiscovered. They are proof of the importance and urgency of preventing extinctions and degradation of natural ecosystems.

Diversity is threatened by economic concerns that affect every country. Economists tend to consider revenue important—but not such intangibles as biological diversity. Yet history shows that cultures that protect their environment endure far longer than those that do not. Clive Ponting (1991), in *A Green History of the Earth*, makes this point clearly, citing the great civilizations of the past which died out after abusing the land by disrupting water supplies through deforestation, and causing imbalances in ecosystems that resulted in their decline.

Common sense about environment protection and a concern for future generations have inspired many countries and cultures to preserve biodiversity. Those cultures which have a strong bond with nature, especially a spiritual one, are the most likely to protect their environments and wildlife, even when they are impoverished and would profit from
exploiting it. With such people, economic arguments to protect nature are unnecessary, but for the vast majority of people today, short-term profits from nature are justifiable if an urgent economic need exists. In general, harm to the environment and biodiversity may be increasingly unacceptable, however. Polls taken in 2001 in the United States found strong support for environmental protection, with 58 percent of respondents believing that protecting plants and animals should take priority over preserving personal property rights, and nine in 10 saying that it is important for wilderness and open spaces to be preserved (Barabak 2001). Even when government leaders fail to act decisively to protect nature, these actions do not necessarily reflect the will of the majority.

A new activism on the part of the public and native peoples is resulting in many protections for wildlife and the environment. It is also resulting in new alignments of organizations and groups of people. Environmentalists and labor groups have united in opposing the anti-environmental aspects of the World Trade Organization, which caused member countries to reexamine their automatic endorsement of all trade to the exclusion of the environment, wildlife and job protection. Native tribes in British Columbia and conservation organizations united to publicize the impending destruction of thousand-year-old forests along the coast, home to the white "spirit bear." This coalition succeeded in 2001 in stopping logging and achieving permanent protection for some 1.5 million acres (NRDC 2001).

One proposed means of preserving wild animals and plants and their environments is the Convention on Biological Diversity, signed by more than 150 countries after it was presented at the 1992 Earth Summit held in Rio de Janeiro, Brazil. It went into effect in December 1993, after the 30th country, Mongolia, ratified it. It had been signed by 161 nations. Its purpose is to prevent extinctions and biological impoverishment, and it commits nations that ratify it to take actions to preserve species and ecosystems in the process of development.

The Convention requires nations to integrate conservation into economic and social policy to: promote the protection of entire ecosystems, set up protected areas, undertake biological inventories, preserve species throughout the country and restore degraded ecosystems. Many of the wealthy industrialized nations that do not support the Convention succeeded in having weakening clauses written into it, such as "as far as possible" and "as appropriate" (Stevens 1992). It states that nations have the "sovereign right to exploit their own resources pursuant to their own environmental policies." Even with its weaknesses, it remains the only international convention to have ever addressed the importance of preserving biological diversity, and as such, it sets a major precedent.

The success of the Convention on Biological Diversity will depend on how strictly it is interpreted. One clause places economic and social development, and the eradication of poverty, as the first priorities of developing countries. This could become an excuse to allow extinctions for the sake of "progress." For example, dam construction or forest clearance could be projects to alleviate poverty, but they would probably cause extinctions. The treaty also states that conservation efforts on the part of developing nations will depend on the flow of money from rich nations, although it recommends that the rich countries benefiting economically from exploitation of resources, such as pharmaceuticals, in poorer countries, should share these profits with the latter (Stevens 1992). It is this latter clause that many members of the US Congress opposed because US pharmaceutical companies did not wish to pay nations harboring medicinal plants. This is a major reason why the United States has not ratified the Convention.

To fund the programs of the Convention on Biological Diversity in developing countries, the Global Environmental Facility (GEF) has been set up, administered jointly by the United Nations Development Program (UNDP), the United Nations Environment Program (UNEP) and the World Bank. GEF raised some $2 billion from wealthy countries, and its administration has been criticized by both donor nations, which want it run in a similar manner to the World Bank, and many developing countries and environmentalists, who accuse it of "green washing" destructive environmental programs endorsed by the World Bank (Lewis 1994). The World Bank has been a major proponent of commercial logging in the last tropical rainforests of Central and West Africa, with disastrous consequences for both wildlife and native peoples.

This Convention is heavily influenced by rich donor countries, such as Japan, Canada, Norway and other European nations. Without strong opposition to the traditional approach of the World Bank in funding large dams, logging and
other such projects, the Convention will not fulfill its more positive potentials to conserve the Earth's biological heritage. Its success will depend on the strong participation of those truly interested in the preservation of nature and willing to encourage countries in this task.

At the end of the 20th century, a poll of biologists was taken, asking them what they considered the greatest threat facing the Earth today. By a wide margin, they chose the loss of biodiversity. The greatest challenge in the 21st century will be to inspire people to want to protect biological diversity, as some nations are doing. Costa Rica, for example, is engaged in a biodiversity program that will catalog virtually every resident animal and plant over the next decades and protect critical habitat areas. The United States, through the Natural Heritage Programs and hundreds of biologists whose work is compiled by the Association for Biodiversity Information, is making progress in its appraisal of the nation's biodiversity and conservation needs (Stein et al. 2000). Thousands of individuals are also playing a role by preserving or reintroducing native species into their local areas. In spite of great pressure to exploit the last rainforests and other fragile environments throughout the world, successes in preserving the immense treasure-trove of species that exists on Earth may be turning the tide.

Our lives depend on the proper functioning of the Earth's systems for processes such as photosynthesis, balance of oxygen and carbon, pollination of flowering plants and enrichment of the soil by organic materials. These systems require a large variety of species to function normally, and we are only beginning to understand the role of various organisms and which species are key to each ecosystem. It is not possible to say, therefore, that any species can become extinct without affecting vital life processes. By choosing which species shall survive and which are dispensable, based on economic considerations, as proposed by many politicians, is sheer folly. Irreparable damage may result from such attitudes, yet they are accepted by many governments of the world.

We are presently witnessing the breakdown of many ecosystems. Marine food chains are being destroyed by overfishing and pollution, interfering with the food supply for millions of people. Yet it seems that few of these ecological catastrophes were predicted when fishery or pollution limits were set. Likewise, wetlands are losing wading birds, frogs and fish—all natural insect controls—resulting in increases in insect-borne diseases such as malaria. Predator-prey relations are key to the health of forests and grasslands, preventing overgrazing by prey species that have lost their predators. Yet most wild cats and wolves are in decline, some close to extinction, allowing imbalances to occur. In a growing number of regions, large predators are either absent or so rare that they no longer perform their ecological role. In Yellowstone National Park, for example, the eradication of the Gray Wolf resulted in overpopulation of Elk, which over-browsed aspen and other plants that were habitat to a number of birds and other animals, resulting in their disappearance. Only with the reintroduction of wolves is the ecosystem returning to normal. The overpopulation of deer in the United States and their effect on preventing natural forest regeneration and destroying wildlife habitat is directly related to the extermination of their natural predators, wolves and Mountain Lions. In other cases, prey species, such as deer, antelope and other ungulates, are in steep decline, having been killed off by meat hunters or crowded out by livestock. These species often play important roles in dispersing seeds, as do bats, birds and rodents. One-fourth of all mammals, and one in 10 birds are imperiled. Among these are pollinators, seed dispersers, insect-eaters and prey for other species. The loss of this biodiversity is reaching such levels that it is not surprising so many ecosystems are imbalanced. It is even more alarming to contemplate that the majority of the world's reptiles, amphibians, marine fish and most invertebrates have not even been assessed by biologists.

Species' declines begin with local extinctions as they disappear from portions of their ranges. At this stage, their absence may be affecting ecological communities, but they will not be listed by the IUCN or any other listing authority until the species as a whole becomes threatened. The Gray Wolf disappeared from 90 percent of its US range before it was listed on the Endangered Species Act, by which time major ecological damage had already been done. Species receive protection, endangered listing and conservation attention at the latter stages of declines. The smaller the original range, the faster that species slides to extinction. Ecological effects can occur gradually and imperceptibly in some cases and, in others, quickly and dramatically. Most of the 34,000 plants listed by the IUCN as Threatened occupy restricted ranges and may have undergone slow declines as their pollinators and seed dispersers disappeared, or rapid declines if they were logged or their habitats destroyed. As the concept of saving ecosystems

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and their myriad plants and animals gains acceptance, the importance of preserving all the strands of this complex tapestry becomes clear. The tens of thousands of animals and plants listed by the 2000 IUCN Red List are an indication of a crisis situation, of nature going awry.

Astronauts orbiting the Earth have been overwhelmed by the beauty and fragility of the planet and its uniqueness in the universe. They have described environmental destruction visible from space. Shuttle astronaut Jay Apt (1996) spoke of seeing hundreds of pinpoints of bright lights at night that turned out to be fires emanating from forests in Africa, Madagascar and Borneo. A distant perspective enhances appreciation and desire to conserve our remarkable home. Instead of considering ourselves as separate from the environment, biologist Dr. Thomas E. Lovejoy has suggested, "We must behave as if we live within ecosystems, rather than perceiving nature as something confined to a few protected areas isolated within a degraded, human-dominated landscape" (Laurance and Bierregaard 1997).

Scientific study of Earth's diversity and ecology is in its early stages, and an exciting frontier awaits scientists in the ocean, tropical forests and other environments. Yet we are treating this precious living tapestry without the respect it deserves, and the unraveling of these intricate and delicate ecosystems will threaten our very existence.

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Now that prairies are plowed under and deserts are filled with subdivisions, the net effect of this recent massive habitat destruction and wildlife slaughter is being assessed. An incomplete tally in the United States, including Hawaii, totals at least 99 species of animals and 240 plants presumed extinct during the past 400 years (Stein et al. 2000). This high rate of extinctions reflects the losses of species and ecosystems described in Chapter 1, as well as the loss of biodiversity.
those of Hawaii. The Nature Conservancy, which established Natural Heritage Programs in every state to monitor native species, has compiled this and related data to alert the public of the urgent need to preserve the country's natural heritage (Stein and Flack 1997; Stein et al. 2000). Its examination of the status of 20,439 US plants and animals found 7,817 species (38 percent) to be either vulnerable, imperiled or critically imperiled (Stein et al. 2000). These conclusions were published in a book co-authored with the Association for Biodiversity Information, entitled Precious Heritage: The Status of Biodiversity in the United States (Stein et al. 2000). This book also illustrates many of these beautiful plants and animals and threatened ecosystems. It found more species in danger than the 2000 IUCN Red List due to slightly different categories, such as imperiled and critically imperiled, rather than critical and endangered, used in IUCN lists. The latter organization also defines threatened species in terms of the rate of their decline, rather than their actual status.

Precious Heritage found endemic species, defined as those restricted to the bounds of the United States, and breeding endemics, or those breeding only in the United States, were even more threatened than those with wide distributions. Of the 875 endemic vertebrates in the lower 48 states, almost half (47 percent) are of conservation concern, compared to only 24 percent of all US vertebrate species (Stein et al. 2000). 90 percent of Hawaii's endemics are imperiled in this study. Freshwater species such as mussels, crayfish, beetles and dragonflies are also in steep decline (Stein et al. 2000). More than 5,090 plants (33 percent of all native species) are threatened.

Other studies are examining natural ecosystems in the country. The National Biological Service of the US Department of the Interior reported in 1995 that during the 20th century alone, half the natural ecosystems of the lower 48 states became degraded to the point of endangerment (Stevens 1995). More than 1,700 biologists participated in this study, part of a massive biological survey of America's plants and animals (Stevens 1995). Along with the loss of the tall grass prairies and oak savannas, more than 60 million acres of longleaf pine forests in the Southeast have been cut, and much of this land has been planted with tree farms, creating biologically sterile regions. Northeastern old-growth hardwood forests, likewise, are critically endangered, and survive only in scattered remnants (Stevens 1995). Grasslands in Long Island, the Northeast and California are threatened ecosystems, as are coastal prairies in Louisiana and sedge meadows in Wisconsin. Streams in the Mississippi plain have been greatly damaged as well (Stevens 1995). Fifty-eight natural communities have declined by 85 to 98 percent, and 38 others have declined by 70 to 84 percent (Stevens 1995). The National Biological Service has identified 126 endangered species through this study. Each imperiled ecosystem is home to many threatened species, a reflection of their loss of habitat. This study underlined the importance of preserving large areas instead of small tracts of land, although the latter may be the only way to protect some highly endangered species, such as plants that have become greatly restricted in range.

A 1997 study by the joint United States and Canadian branches of the World Wildlife Fund (WWF), "A Conservation Assessment of the Terrestrial Ecoregions of North America," appraised the ecoregions of the continent including Hawaii (Luoma 1997). Ecoregions are areas defined by major habitat types and, unlike ecosystems, are confined to particular areas. Eastern old-growth forests, for example, are ecosystems scattered over a great area amongst other ecosystems, while southeastern conifer forests constitute an ecoregion. This study found 13 of the continent's 116 ecoregions to be imperiled "hot spots," harboring enormous biological diversity (Luoma 1997). These include Florida's pine scrub, the conifer forests of the Southeast, Appalachia's mixed mesophytic forests, the tallgrass prairie and California coastal sage and chaparral (Luoma 1997). These findings were echoed in the world survey of threatened areas with great biological diversity, Hotspots, sponsored by Conservation International (Mittermeier et al. 1999). The latter book is illustrated with spectacular color photographs of many disappearing landscapes and species of endangered hotspots, such as the California coastal region.

An inventory of rare, endangered and extinct North American plants and animals, being compiled by the National Biological Service, has verified that the impoverishment of America's natural ecosystems has affected not just isolated species, but entire communities of species. It predicts a steady increase in the number of threatened species because of continued destruction of natural habitats. Habitat loss is the greatest threat to US wildlife and plants, but trade, persecution and pollution play roles as well. Agriculture was ranked as the primary threat to native US species by The Vanishing Species
Nature Conservancy study, threatening about 45 percent of plants and animals, while development of land followed, threatening about 34 percent; water projects were the next major threat, and livestock grazing, pollutants, road building, logging and mining had important, but lesser, effects on species and ecosystems (Stein et al. 2000).

Threatened species tend to be located in certain "hot spots" in the United States. The one with the largest number of species is Hawaii, with 5,000 populations of species considered imperiled by The Nature Conservancy (Stein et al. 2000). In the continental United States, a preponderance of threatened species occurs in the Florida Panhandle, central Florida and the Florida Keys, the Appalachian Mountains, the Cumberlands and Southern Ridge, Cape Cod and Martha's Vineyard, southern California, the Pacific Northwest and southeastern Alaska, as mapped in Precious Heritage. The Status of Biodiversity in the United States (Stein et al. 2000; page 166). The Cumberlands and Southern Ridge and Valley of northern Alabama and southeastern Tennessee have the country's largest number of imperiled species--186--mainly as a result of the mussels, crayfish and freshwater snails of this region. The Central Appalachian Forest to the northeast has 154 threatened species, with a high percentage of aquatic species as well, including many rare salamanders and woodland plants. The Great Basin Desert of Utah and neighboring states is another species-rich area, with 113 threatened species, while the California South Coast sagebrush ecosystem has 138 threatened species found nowhere else on Earth (Stein et al. 2000). (See Grasslands, Shrublands and Deserts chapter).

The list of US species in danger of extinction grows longer each year, with a dramatic rise in the number of imperiled invertebrates in the 20th century. Fully 68 percent of freshwater mussels, more than 100 species, are threatened, making them the most endangered group of native animals. Fifty percent of native crayfish are threatened, according to the Nature Conservancy (Clancy 1997). The majority of surviving species are highly endangered from alteration of their clear, fast-flowing rivers and streams by federally sponsored dams, channeling and diking that have turned most waterways in the Southeast into muddy ditches and artificial lakes. Pollution and introduction of non-indigenous species of mollusks and crustaceans competing for food have also played roles in the decline of some of these mussels and crayfish. The Hawaiian Islands are home to a variety of colorful and endemic tree snails. Introduction of exotic snail species and habitat destruction have already extinguished many of these, and endangered others.

Many species of butterflies, which are important pollinators, are in decline. The Xerces Blue (Glaucopsyche xerces), a beautiful butterfly native to California, became extinct in the 1940s (Stein et al. 2000). Eight moth species and two other mainland butterflies are possibly extinct, as are 50 bee species native to Hawaii (Stein et al. 2000). Eight mainland butterfly species are critically endangered, and 109 are threatened, according to The Nature Conservancy (Stein et al. 2000). Dragonflies and damselflies, which predate the dinosaurs, have also lost ground. Two Hawaiian species are possibly extinct, and 79 more are considered imperiled (Stein et al. 2000).

Seventeen species of freshwater fish are extinct or possibly extinct, and the United States leads the world in the number of threatened freshwater fish: The Nature Conservancy lists 283 species (Stein et al. 2000). Habitat loss in the form of dams, river diversion and channeling, as well as pollution, has played major roles endangering these fish. Logging has destroyed many clear rivers and streams where salmon and trout breed. The majority of rivers and bodies of water are still polluted despite the Clean Water Act, and contaminants have caused malformations and high mortalities in fish populations. Introductions of non-indigenous fish for sport fishing have imperiled a large number of species. Brown Trout from Europe and Rainbow Trout placed in areas where they are not native have severely threatened native trout, such as the Cutthroat Trout of western lakes and rivers. In many cases, multiple factors combine to push native fish toward extinction.

The United States is second only to Australia in the number of threatened reptiles and amphibians. The Nature Conservancy lists 51 imperiled reptiles and 82 imperiled amphibian species (Stein. 2000). This amounts to an estimated 40 percent of US amphibians, and 18 percent of native reptiles--extremely high rates. Amphibians are declining worldwide from various causes including habitat loss, pollution, disease, pesticides and ultraviolet radiation from thinning of the Earth's ozone layer.
The total of 71 US bird species that BirdLife International's research placed in various categories of threat includes 33 species from the Hawaiian Islands (BI 2000). The Nature Conservancy found an even greater number through their intensive Natural Heritage Program research: 83 species of birds at risk in the United States, or about 11 percent of all native species (Stein et al. 2000). This is a smaller percentage than for reptiles and amphibians but, when analyzed by region, a large percentage of Hawaii's birds are threatened. A steady increase in the number of threatened birds has occurred in this century. The major causes threatening US mainland and seabirds are destruction of habitat, pesticides and pollution. In the Hawaiian Islands, introduced animals, disease and destruction of forests and wetlands are the major threats to endemic birds, as well as to plant life and invertebrate fauna.

The Nature Conservancy considers 65 species of US mammals, or about 16 percent of all native mammals, to be threatened (Stein et al. 2000). The loss of habitat from development, logging, livestock grazing, mining and other forms of destruction is the foremost threat to mammals. Added to this, pollution affects many aquatic mammals, and predator and rodent control programs to benefit livestock and agricultural interests affect foxes, wolves, and prairie dogs. A growing number of bats have been added to the list of threatened US mammals, an indication of a loss of habitat, as a result of caves being disturbed or vandalized, loss of large roosting trees to logging, pesticide use, and persecution by those not aware of bats ecological importance and who have exaggerated ideas of their supposed threats to humans.

Although lists of native North American threatened plants are far from complete, they reflect the rate at which ecosystems have become imperiled. The Nature Conservancy found 6,460 United States vascular plants to be imperiled (Stein et al. 2000). Of these, a very large number--1,385--are Critically Imperiled, 1,341 Imperiled and 3,338 species Vulnerable. Hawaii is a center for threatened plants. The 1997 IUCN Red List of Threatened Plants found a somewhat smaller number of threatened US plants; 4,488 species, or 29 percent of native plants. Still, the United States had the highest number of endangered plants of any country in the world (Walter and Gillett 1998). In terms of the percent of native plants that are threatened, only St. Helena, Mauritius, and the Seychelles had higher rates (Walter and Gillett 1998) Few countries of the world have legislation similar to the US Endangered Species Act, which has helped hundreds of endangered plants.

Many US plants are adapted to specific types of soil or microclimates, and human disturbances can threaten them. Prairie plants are among the most threatened. California's grasslands have been reduced by more than 90 percent, leaving many endangered plants; it has many endemic species in its southern chaparral and shrubland, which are being bulldozed to make way for new housing developments. The state's mild climate and varied landscape have given rise to great diversity, which is extremely threatened. Of 25 presumed and 21 possibly extinct species in the state, about half, or 24, are plants (Stein and Flack 1997). Although endemic plants are not as numerous on the mainland as in some island habitats, North America is home to a great many unique and beautiful plants, which are finally beginning to receive the conservation attention they deserve.

Research is uncovering potential economic value in some native plants. One threatened US plant, the Scrub Mint (*Dicerandra frutescens*), yields a natural insecticide in its oil that repels a wide variety of insects, from ants to cockroaches (Aylsworth 1998). This white-flowered plant is presently restricted to a few hundred acres in central Florida, and it only came under scrutiny in the 1990s, when a Cornell biologist, Dr. Thomas Eisner, discovered its potential as a natural insecticide (Aylsworth 1990). This mint may be protected from extinction in time, thanks in large part to Eisner's research.

In spite of some sizeable natural areas in the United States preserved by the Wilderness Act and as federal or state land holdings, the country has become increasingly urbanized and cultivated for agriculture. Americans have gradually altered the landscape so that much of it, especially in the East, now resembles Western Europe's heavily populated countries where wilderness has been all but eliminated.

Recent ecological research on the effects of suburban sprawl on the environment have shown it to crowd out as many species as more densely populated areas (Revkin 1997). Diversity of species declines in these areas as green
lawns, manicured gardens and asphalt cover the land and pollute the ground water with pesticides, fertilizers and herbicides and kill off beneficial insects and other animals. Developers drain beaver ponds and wetlands and turn streams and rivers into concrete-lined ditches. With each acre lost, species decline. The brilliantly colored warblers and songbirds of eastern forests, for example, have been severely affected by fragmentation of both their breeding and wintering habitats. For the majority of such declining species, endangered listing comes only when they have been reduced to a small fraction of their original populations. The species that are listed by the IUCN or The Nature Conservancy in various categories of threat have reached a point where their very survival is at risk. In some cases, species, which were once described as naturally rare, are very restricted in distribution, especially plants and fish inhabiting desert springs or mollusks found only in a particular river system. For the majority of threatened US wildlife, however, their status a few hundred years ago would have been described as secure. It is all the more indicative of a crisis situation regarding American biodiversity that so many species, and such large percentages of their classes or types, are now headed toward extinction.

Should all US species currently threatened become extinct, a biological tragedy will take place. Preventing such a catastrophe has not yet captured the public’s attention or involved a zealous effort on the part of the US government. Important work on biodiversity studies is being done by various federal agencies, but the major burden of activism regarding preservation of endangered species and the environment has fallen to private conservation organizations.

The WWF report entitled "A Conservation Assessment of the Terrestrial Ecoregions of North America," accuses the US government of "doing a worse job of protecting its biological resources than many poorer countries with few resources for biodiversity conservation" (Luoma 1997). It concludes that the wealthiest country in the world places the preservation of its natural resources among its lowest priorities.

Without detailed information on the biodiversity of this country, it will be impossible to protect it, yet funds are inadequate to carry out a comprehensive assessment. Many opponents of the biodiversity studies in Congress have expressed fear that they would be used to expand the list of species on the Endangered Species Act and obstruct development programs. They succeeded in blocking formation of the National Biological Service, which Clinton Administration Secretary of the Interior Bruce Babbitt had to create administratively. The constant deterioration of the land through development, pollution and introduction of exotic species makes these studies all the more timely. This is a critical time of rapid environmental destruction and a turning point for many species which, without urgent protective action, will follow the deadly trails of the Passenger Pigeon, Carolina Parakeet, Sea Mink and hundreds of other lost plants and animals.

The US Endangered Species Act is one of the strongest and most effective laws in the world and has been a model for similar legislation globally. Many countries, including Canada, still lack national endangered species laws. Although private organizations acquire habitat and carry out many important programs, the legal protection the Endangered Species Act provides is key to the protection of many endangered species and their habitats. It has been responsible for saving a number of species, including the California Condor (*Gyps californianus*), Black-footed Ferret (*Mustela nigripes*), Whooping Crane (*Grus americana*) and numerous other animals and plants. The law has helped fund research, captive breeding, protection in the wild, reintroduction programs, land acquisition and law enforcement protection.

The law must be reauthorized regularly by Congress, however, and at these times, efforts to weaken or even fail to authorize it threaten its effectiveness and very existence. The strong support the law has received from the US public is not always evident in the halls of Congress, where commercial interests and lobbyists have had considerable influence. To date, the law has survived, although it has been amended and weakened somewhat since its enactment. The blocking of listings on the Endangered Species Act by its opponents has become the major means of thwarting the Act. Lawsuits have been filed by both opponents and proponents of the law demanding either delisting of species or listing and critical habitat designation. A virtual impasse has resulted in a moratorium on listing new species which the Department of the Interior declared in 2000.
Many listings have been thwarted by commercial interests. In a recent case, a proposal to list the Lynx (*Lynx canadensis*) on the Endangered Species Act was not acted upon by the Fish and Wildlife Service without a lengthy struggle. This species has greatly declined from its once large range in the lower 48 states. Heavy trapping for its valuable fur and logging of its habitat of mature pine forests have reduced its populations to fewer than 1,000 animals. The majority of Lynx remain in Montana, Idaho, Washington and Maine. Although the Fish and Wildlife Service's (FWS) own biologists found this population to be endangered, they were overruled by headquarters whose bureaucrats decided to refuse to list the species on the Endangered Species Act (Cushman 1998). Petitions by conservationists urging Endangered Species Act listing for the Lynx were ignored, and only when a lawsuit was filed against FWS did the tide begin to turn in this endangered cat's favor. Conservationists won the suit in 1997, but the FWS, in an unprecedented action, declined to list the Lynx, stating that other species had higher priority for listing. Loggers and commercial timber companies oppose listing the Lynx, fearing that areas would be set aside as critical habitat where no tree cutting would be allowed, and many conservationists believed that FWS had succumbed to these pressures. Finally, in February 1998, the Service and several conservation groups reached an agreement to list the Lynx on the Endangered Species Act to take effect in 1999 (Cushman 1998). President Clinton declared a moratorium on new road building in national forests lands in 2000, which will greatly aid the Lynx and other threatened species of these forests, such as the Wolverine and Marten.

The Public Employees for Environmental Responsibility (PEER) issued a report in December 1997 accusing the FWS of failing to protect more than 300 species awaiting listing. Only listings of plants have increased in recent years, leaving a growing number of animals in need of federal listing (Stein *et al.* 2000). The Nature Conservancy's biological surveys have uncovered a far greater number of endangered and threatened species in the United States than are listed by the Endangered Species Act, especially plants.

On the positive side, an increase in the number of endangered species added to the Endangered Species Act has been seen in recent years. The Endangered Species Act, in spite of shortcomings, is vital to the preservation of endangered species in the United States, and it is in grave danger of being weakened so much that it will become ineffective. Various proposals in 2001 made by the Bush Administration would make it nearly impossible for citizens to sue the government to force listing of endangered species (Jehl 2001). The majority of species on the Endangered Species Act were listed as a result of citizen suits (Jehl 2001, Gorov 2001). The Fish and Wildlife Service claims to be unable to perform its duties because of the large number of legal challenges. The law has not been reauthorized since 1991, and proposed changes might leave actions regarding endangered species to the discretion of the Department of the Interior, rather than basing them on biological status. Under the new plan, citizens could petition for listings, but the government would not have to respond promptly, nor would it have to act on designating critical habitats for endangered and threatened species (Gorov 2001). So little money--$6.4 million--is budgeted for listing that a stalemate is inevitable. Other proposals by the Bush Administration would cut overall spending on endangered species programs by $11 million, leaving the Office of Endangered Species without the means to accomplish its purpose (Gorov 2001).

A number of private organizations have aided in preserving endangered and endemic plants not listed on the Endangered Species Act. The Nature Conservancy and its state Natural Heritage Programs have purchased or arranged purchase of hundreds of thousands of acres of land for threatened plants. Arboretums and botanical gardens, such as the Missouri and the New York Botanical Gardens, also are active in this regard. Lady Bird Johnson helped found the extremely effective organization, the National Wildflower Research Center, which aids in the conservation of wildflowers. In the northeast, the New England Plant Conservation Program has spent six years collecting seeds from some 500 rare plants for a seed bank. The New England Wild Flower Society has been instrumental in this program, and many sanctuaries throughout the region are preserving threatened plants.

The actions of individual states under their state endangered species laws and Natural Heritage Programs have also been crucial to the survival of many species that are threatened within a state or region, but might not qualify for federal listing. Programs to reintroduce Bald Eagles (*Haliaeetus leucocephalus*), Peregrine Falcons (*Falco peregrinus*), threatened fish and River Otters (*Lutra canadensis*) have brought back these species in many areas where
they had been eliminated by pesticides, over-trapping, pollution or water projects. Many programs have involved cooperation between state and federal endangered species officials.

Habitat Conservation Plans (HCPs) are agreements worked out between landowners and the Fish and Wildlife Service for listed endangered species under a 1982 amendment to the Endangered Species Act. In essence, they are the result of deals made among developers, state and county officials, Fish and Wildlife Service representatives and local citizen groups on large tracts of land, in which portions of endangered species’ habitats are protected, while development is allowed on the rest. HCPs are a permanent contract that cannot be amended, even if biological information is revealed showing that they were in error. These HCPs have been the center of much controversy, considered by some conservationists to compromise the principles of the Endangered Species Act, and by others to be an excellent means of protecting species. HCPs are not presently published in the Federal Register prior to signing by the Secretary of the Interior, which would subject them to public comment.

In 1997, a team of 119 scientists, financed by the National Science Foundation and the American Institute for Biological Sciences, carried out careful appraisals of signed HCPs and reported on their conclusions. They found that crucial scientific knowledge was lacking about many of the species involved in these agreements (Yoon 1997). They also found misuse of scientific methods and biological data which will end in harming, rather than helping, many species (Yoon 1997). Dr. Peter Kareiva, a University of Washington ecologist who organized the study, concluded that many HCPs should not have been written, and only about half correctly employed science (Yoon 1997). Of 206 HCPs examined in total, 44 of them in detail, one-third lacked information as basic as life span of species, and the vast majority did not include data on rates of population rise and decline and habitat changes (Yoon 1997). The most glaring problem seen by the scientists was the failure of HCPs to correctly assess the impact of losses to species’ populations, mainly as a result of untested methods of appraising impacts. One plan proposed to protect Utah Prairie Dogs (Cynomys parvidens) by moving animals to a new location using a method already known to result in the deaths of 97 percent of the relocated animals within three months (Yoon 1997). An HCP for the Desert Tortoise (Gopherus agassizi) in Nevada allowed the killing of hundreds of these threatened reptiles by bulldozing their burrows and habitat, while protecting only minimal amounts of habitat.

A major problem faced by those trying to save endangered species is the fact that the vast majority live on privately owned land, and arrangements must be made with owners to insure the survival of these species. Many people believe that protecting these species involves major restrictions on the use of their land and, therefore do not want to enter into Habitat Conservation Plans. Ideally, however, protecting a threatened butterfly or plant on a private ranch, for example, would only involve identifying the habitat, the host plants for the butterfly, and preventing destruction through excavations or other major alteration of the land. In many cases, cattle grazing is compatible with protection of rare species, since the land is not plowed, which can destroy plant life. Ranchers in southern Arizona have cooperated in protecting the land through preventing overgrazing and maintaining riverbank vegetation and springs for rare frogs and birds. For many endangered species, conservation easements are an excellent solution for their protection. These easements involve the payment of funds to the landowner by private organizations, or local, state or federal governments to let the land remain undeveloped and help enhance it as wildlife habitat. This is an especially good solution for farmers who are afraid of losing their land after years of crop failure or low market prices. Innovation has marked many arrangements now being made to protect endangered and endemic species.

The US public as a whole supports the protection of endangered species, which helps explain the Endangered Species Act's survival under strong opposition. Polls conducted in November 1994 by Peter D. Hart Research Associates found that 57 percent of the public wanted to maintain the Endangered Species Act in its present form, and only 32 percent wanted to relax requirements. A September 1995 CNN poll asked which was more important, saving endangered species or saving jobs: 48 percent replied endangered species, and 40 percent, jobs. A Gallup poll carried out for CNN in April 2001 found that support remained strong. It asked Americans whether they supported environmental and wildlife protection even if it meant higher prices or more jobs, and again, a majority supported conservation. They were also asked to rank environmental protection in terms of its importance as an issue, and most placed it near the bottom of the list. When asked whether it would be an important issue in 25 years, however, the
majority said it would be among the most important issues. This reflects a failure to understand the ongoing wave of extinctions that is eliminating many of the Earth's most fragile plants and animals and its possible effect on humans.

Thus, education is extremely important, especially its role in relating American lifestyles and waste of resources to the extinction and endangerment of species. A 2001 film, "Natural Connections" (Howard Rosen Productions, shown on PBS), addresses this issue as well as the gradual diminution of biodiversity. The overconsumption that Americans take for granted impoverishes nature in the US as well as in other countries that export their tropical hardwoods; cut flowers; leather from cows grazed in former rainforests; non-organic, sun-grown coffee; minerals; and handcrafts from scarce materials to this country. Other products are manufactured as a result of polluting the environment and, like coated paper cups or pulp magazines, are used once and thrown away. To maintain such a throw-away lifestyle, millions of trees are cut each year in the United States and elsewhere, disrupting ecosystems and threatening wildlife. Pollution is created from mines that poison rivers, and manufacturing and power plants that spew dioxin and greenhouse gases into the air. The urgency that gave rise to legislation early in the 20th century that protected native birds and other wildlife from overexploitation for commercial purposes was enacted after the extinctions of the Passenger Pigeon and Carolina Parakeet, and near-extinction of the American Bison (Bison bison) and other animals from 19th century slaughters. It would be tragic if a similar wildlife or environmental catastrophe were needed to spur strong action to preserve the world's genetic and biological heritage.

Threatened Species of the World

The 2000 IUCN Red List found 3,507 vertebrates and 1,928 invertebrates in high degrees of threat worldwide (Hilton-Taylor 2000). Plants classified as Critical, Endangered or Vulnerable totaled 5,611 species. These are minimum figures because only birds and mammals have been thoroughly examined for status. When assessments are carried out on the remaining species, the list will doubtless grow far longer.

Many of the most magnificent, graceful, beautiful and zoologically curious animals on Earth are threatened with extinction. A growing number of these, such as sea turtles, sharks and crocodiles, have survived virtually unchanged for hundreds of millions of years, and if not for the human activities that are pushing them toward extinction, they would likely survive millions more.

Almost all the graceful cranes, on Earth since the Miocene Epoch, are endangered from loss of habitat and hunting. The entire family of prehistoric-looking rhinoceroses is teetering on the brink of extinction. New Zealand's extraordinary and primitive kiwis and ancient tuatara lizards, which have survived since the dinosaur epochs, may be lost in the next few decades. Eleven of the 16 species of penguins are now threatened, nine in higher categories (BI 2000). Seabirds of many types, including the majority of albatross, are now listed.

The most surprising finding was the high number of mammals listed: 2,046 species, of which 1,130 species were in higher categories of threat (Critical, Endangered and Vulnerable). Thus, of the approximately 4,000 species of mammals, 28 percent are highly threatened, and more than half are in some degree of threat. They are the most imperiled class of animals. Twelve percent of birds, or one in eight species, are listed in higher categories of threat (1,186 species), and an additional 809 species are in lesser categories (Near-Threatened, Conservation Dependent, or Data Deficient), totaling 1,995 species or about 18 percent of the world's birds (BI 2000). Reptiles are a group less well assessed, but 750 species are at risk in all categories, according to the 2000 IUCN Red List. Amphibians, which number about 4,550 species worldwide, have a minimum of 226 threatened species, and a large additional number that have not been thoroughly assessed. Likewise, very few marine fish are listed by the IUCN because so little is known of their status. Some progress is being made in assessing marine fish, especially coral reef fish and sharks and rays.
By 2003, a complete assessment of the shark family is planned by IUCN (Hilton-Taylor 2000). Approximately 1,183 fish are listed in the most recent IUCN Red List in various categories of threat. The majority of these are freshwater species, which represent 6 percent of all known fish.

The rate at which animals and plants are declining has reached such proportions that even familiar species considered common with stable populations only a decade ago are now threatened. The African Lion (Panthera leo) and many African antelope, Giraffes and wildebeests are in serious decline, or exist only in parks and reserves, categorized as Conservation Dependent.

Animals listed as Near-Threatened or Data Deficient totaled 3,324 species, of which 2,364 species are vertebrates in the 2000 IUCN Red List. The grand total of 8,759 vertebrates in all categories comprises 20 percent of all mammals, birds, reptiles, amphibians and fish on Earth. In the early 1980s, only 1,000 vertebrates were listed by the IUCN. This means that in just 20 years, this total has risen by almost 900 percent.

Plants have been assessed in several reports. The 1997 IUCN Red List of Threatened Plants (Walter and Gillett 1998) was supplemented--and many species reassessed--by the 2000 IUCN Red List (Hilton-Taylor 2000). Plants from Cameroon, the Galapagos, Mauritius and South Africa were added to the 2000 list. A total of 6,932 plants were listed in all categories, 5,611 in higher categories of threat. In spite of these major undertakings, only conifers were thoroughly assessed. The 1997 study, using one type of definition based on status alone, found 30 percent of all conifers to be either Endangered or Vulnerable; the 2000 reappraisal, using new criteria, determined that 16 percent were threatened (Hilton-Taylor 2000). When far more species of plants are assessed, The Nature Conservancy study of US plants (Stein et al. 2000), which found one-third of plants to be threatened, may be indicative of a great decline in the world's plants.

As in the case of animals, many of the Earth's oldest species of plants are at high risk of extinction. Trees that predated the dinosaurs and survive in pockets in Chile, New Zealand, New Caledonia, Australia, New Guinea and parts of Southeast Asia are being destroyed, with little knowledge of their extreme botanical importance. Many of these are among the largest trees in the world, rivaling the Redwoods in height and the Sequoias in girth (see Forests chapter). Others, such as the monkey puzzle tree family, are extremely bizarre in appearance, and may contain important compounds for medicines. Beautiful primitive flowers, the protea, are also greatly threatened, with many species growing in South Africa. Tree ferns, palms and hundreds of orchid species are also highly threatened. The island of Mauritius has a large number of threatened plants, many of which are quite unique.

Many zoologists and conservationists are now resigned to the rising level of extinctions and believe that, within a century, 80 percent of all species living today will be extinct. Such predictions may be overly pessimistic, but unless the public is made more aware of the precarious status of a growing number of plants and animals and demands strong action, the prognosis may be fulfilled.

What is Threatening Species?

Human activities are at the root of virtually all extinction threats. Destruction of fragile habitats, wetlands, coral reefs, tropical and temperate forests, rivers and grasslands has accelerated in recent years due to human population increases and commercial exploitation of forests, ocean fish and other wildlife, as well as the introduction of non-native species, either intentionally or accidentally. The massive pollution and chemical contamination of air, water and soil--and even the atmosphere that surrounds the Earth--are altering the climate and bringing about
unforeseen declines in wildlife and plants.

Human Population Growth
Habitats Under Threat
Non-Native Species Introductions
Persecution, Hunting and Trade
Pollution and Disease
Traits of Vulnerable Species

Human Tragedy and the Looting of Virunga's Treasures
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What is Threatening Species? Human Population Growth
Burgeoning human populations provide the major impetus for destruction of the last havens for rare species. In 1650, when Dodos were still common on the island of Mauritius, the world's human population totaled about 500 million, half of India's present population. Two hundred years later, the number had doubled to 1 billion. In 1900, the world's population totaled 1.6 billion. Since then, it has taken shorter periods for the world's population to double, and at present it doubles approximately every 37 years. In 2000, 6 billion people lived on Earth, a number expected to rise to between 8.5 and 9.4 billion by 2050. While population growth has leveled off in parts of Europe, Russia and Australia, it continues to rise in the United States, mainly as a result of immigration. The highest rates of growth, 3 percent or more, occur in Africa, Asia and Latin America, where environmental deterioration has been severe. The similarity between the astronomic rise in human population and the extinction rate of animals and plants is not accidental.

Settlers in increasing numbers are entering tropical forests, grasslands and other wild areas teeming with wildlife, and clearing them for grazing livestock and planting crops. Loggers in the Brazilian and Central African rainforest wildernesses are building roads to transport entire forests of trees, some thousands of years old, to be sold in markets in North America, Europe and Asia. The roads open up the forests to settlers and hunters, endangering countless species of animals. Commercial exploitation of forests has increased rapidly since the 1980s, with logs turned into pulp for paper, expensive lawn furniture, paneling, shipping cartons, and even concrete molds that are used once by builders and thrown away. Rivers are becoming increasingly polluted from human waste that goes untreated in many
parts of the world, and billions of people scratch out a living by subsistence farming, cutting trees for fuel and grazing livestock.

These poverty-stricken people have caused the limits of the Sahara and Sahel in Africa to expand by depleting wildlife and trees, and have razed forests in India, China, Indonesia, Thailand, Ecuador, Central America, Mexico and West Africa. Still, many go hungry because they have far outstripped what the land could supply sustainably. For the wealthier nations, an appetite for material goods and demand for a high standard of living have encouraged a market for precious resources, such as tropical lumber and wildlife products, that has expanded in recent years with the World Trade Organization (WTO) globalized economy. In order to repay loans granted to them by international funds, many poor nations strip their forests and grow exportable crops on the land. In the United States, urban sprawl and overexploitation of forests and other resources have threatened a host of animals and plants. Water is diverted for these new towns, endangering native fish and forests. In Arizona, the Sonoran Desert, a botanical world treasure, is now being destroyed by the expanding cities of Phoenix and Tucson.

The needs of the growing numbers of people worldwide have spawned many ill-conceived and environmentally destructive projects. Indonesia and Brazil opened up the most biologically rich forests on Earth to farming by people living in overpopulated cities. The soil is poor in tropical forests, and they must keep clearing land to find new areas for crops, gradually destroying vast areas once teeming with wildlife. China has moved people into western grasslands, where they have eliminated wildlife and caused massive erosion and desertification with agriculture and overgrazing of livestock. Dust storms from this region have been circling the globe in recent years. China has also commissioned the world's largest dam, Three Gorges--on the Yangtze River--in an attempt to control floods and generate electricity. In the process, a very rare freshwater dolphin, a sturgeon, and hundreds of rare plants will become extinct, and the dam's lake will fill with untreated sewage. The problem of overpopulation has not been well understood or coped with in the majority of countries where populations are now outstripping food supply.

In most parts of the world, however, people have deforested the habitats and killed prey species of wide-ranging wildlife that have nowhere else to go. Asian Elephants (*Elaphus maximus*) and Tigers (*Panthera tigris*), for example, have been deprived of habitat and food and crowded into areas too small for their requirements. When they rampaged into people's gardens or killed livestock, they were killed and their body parts sold for high prices. Both species are now endangered, their populations fragmented and in steep decline. This is a pattern that has been seen with large animals, especially predators, throughout the world. Animals or plants with low populations as a result of restricted habitat size or specialized requirements for survival have been pushed to the brink of extinction as humans moved into their habitats.

Only a few countries have national policies to encourage stable populations. In some countries with populations that far exceed the ability of the land to adequately sustain them, wars have broken out, providing an apocalyptic vision of a violent future for the Earth should present trends continue. A scientific study, *Environmental Change and Violent Conflict* (Homer-Dixon et al. 1993), predicted that as human populations increase and resources decrease, wars will occur with ever greater frequency. Population Action International, a Washington, DC-based organization, calculated in 1997 that although human population growth has slowed somewhat, water resources remain under serious threat. This organization's report warns that by 2050, people in the Middle East and parts of Africa, where populations continue to grow at high rates, will be engaged in bitter, violent conflicts over water. The story of the Rwandan war, described later in this chapter, reflects this cause and effect. Overpopulation causes human suffering, permanent damage to the land from overuse, and the destruction of the very species that might prove life-saving. A few countries, such as Singapore, launched education programs decades ago, urging people to have smaller families for a better quality of life. The rate of population increase in this tiny country is now less than 1 percent, and literacy is 91 percent.

Medical advances preventing disease and early mortality in people around the world, combined with growth in agricultural output, have played a major role in the nearly four-fold rise in human population since 1900. The World Health Organization (WHO) has scoured the planet eradicating disease but is not required to educate people about
birth control methods. This has decreased natural mortality and fueled population booms. The majority of international aid projects lack overview, coordination with one another and long-term planning. Supplying high-yield grain and financing irrigation projects to poor nations, without providing birth control education, results in a doubling of populations within a generation, which negates any rise in the standard of living and education levels. By encouraging livestock and agriculture in dryland areas, with little knowledge about the natural environment or its capacity to support large numbers of people, wildlife and plants are displaced or killed, and in years of drought, crop failures result, causing starvation. The human suffering brings international aid with emergency food, and instead of relocating people to other areas, these programs encourage replanting and a repetition of the misfortune.

Ethiopia and Somalia are examples of such policy failures. These countries were covered in a mosaic of grasslands and forests teeming with endemic wildlife early in the 20th century. An influx of large numbers of people and livestock, encouraged by aid programs, denuded this region to arid desert. The vast numbers of wildlife have largely disappeared or become endangered as the extensive grasslands, rivers, lakes and highland forests disappeared because of overgrazing, farming in areas too dry to produce crops and deforestation for firewood (see Grasslands, Shrublands and Deserts chapter). With low human and livestock population densities, these areas could have remained ecological treasures.

The Population Institute of Washington, DC, warns that although some countries have shown declining rates of population increase, especially those in Western Europe and North America, this will not result in an overall decline in world population because of greater human longevity, continued high birth rates in at least 74 countries and a high survival rate (Holmes 1997).

The top 10 countries in terms of overall numbers of people have 59 percent of the world's population. More than 30 percent of all births in 1997 took place in India, a country expected to overtake China as the world's most populous nation by 2050 (Holmes 1997). A 1997 World Bank report, "The World Food Situation: Recent Developments, Emerging Issues and Long-Term Prospects," concluded that food stocks are not keeping up with need (Crossette 1997b). Demand for meat is increasing, placing further stresses on natural systems since livestock consume enormous amounts of grasses and grain, cause damage to vegetation and often pollute water systems; grain production is reaching the limit of potential yields, especially in Asia (Crossette 1997b).

The most densely populated country in the world, Bangladesh, with 127.5 million people, has about half the population of the United States in an area the size of Wisconsin. It has a density of almost 3,000 people per square mile, and a population growth rate of 2 percent a year. Ninety percent of the people in Bangladesh's countryside are illiterate and malnourished in spite of decades of international aid projects. Bangladesh is now totally dependent on foreign aid for minimum nutrition, and the land is being worked to maximize yields, using large quantities of fertilizer, irrigation and pesticides. The once vast mangrove forests that serve as fish and shellfish nurseries, and habitat for Tigers and other endangered species, are being destroyed piecemeal, cut for firewood (Worker 1996).

Funds to encourage birth control around the world have been deleted from US budgets by those opposed to abortion, thus thwarting all types of programs of education, birth control methods and related issues. Most organizations working to lower birth rates around the world use almost no funds for abortion, yet they find their funds cut for all family planning programs. This obstructionism has been a major setback to those working to stabilize the world's populations. The United Nations Population Fund has continued to carry out family planning programs, but with inadequate funds.
What is Threatening Species? Habitats Under Threat

Habitat destruction is the foremost threat to wildlife. In broad terms, more than 85 percent of IUCN-listed birds, mammals and plants are threatened by habitat destruction and degradation (Hilton-Taylor 2000). The greatest number of threatened species listed in the 2000 IUCN Red List inhabit terrestrial areas. They total 9,256 highly threatened species. The largest single terrestrial group is plants, with 5,607 species; birds follow, with 1,144 species; with mammals having only slightly fewer threatened species, 1,111 (Hilton-Taylor 2000). The vast majority of threatened birds and mammals are terrestrial species. The destruction of forests is the single most important threat to birds, affecting 75 percent (BI 2000). At least 900 of the 1,144 threatened birds inhabit tropical rainforests, with almost half of those species restricted to lowland rainforests, and 35 percent in montane rainforest (BI 2000). Authors of Threatened Birds of the World (BI 2000) found that the vast majority--86 percent--of rainforest birds cannot tolerate much habitat destruction, and 45 percent require near-pristine habitat. Only 3 percent are highly tolerant of habitat alteration (BI 2000). Unsustainable selective logging affects 31 percent of threatened birds. In many tropical forests, logging and forest burning are taking place without any restrictions, totally eliminating habitats of rare rainforest birds. A total of 4.5 million square kilometers, or 20 percent of the world’s forests, were cleared from 1960 to 1990 (BI 2000), and since then, forests--especially tropical forests--have continued their decline. Although some forests may return to old-growth hundreds or thousands of years in the future, much of the land is being converted to agriculture, grazing land, housing, cities, industry and roads and is unlikely ever to revert to forest.

Likewise, more than half, or about 57 percent, of threatened mammals inhabit tropical rainforests, 35 percent in lowland, and about 22 percent in montane rainforest (Hilton-Taylor 2000). Less than 10 percent of threatened birds and mammals are native to temperate mixed forests, coniferous forest and temperate broadleaf forests, according to the IUCN. A very small number of threatened mammals, about 3 percent, inhabit tropical degraded forest, a sign of the unsuitability of this habitat (Hilton-Taylor 2000).

Forests are also home to a wide variety of threatened frogs, salamanders, tree snails and insects, although studies of which type of forest each inhabits have not been done by the IUCN. Many endangered plants are tropical species, native to islands such as Madagascar and Indonesia, where endemic plants such as orchids and palms abound, and habitat destruction is severe. The United States leads the world in threatened plant species, with 4,669 identified by the IUCN in its 1997 study (Walter and Gillett 1998) and 7,817 species listed by The Nature Conservancy (Stein et al. 2000). Many of the latter are in Hawaii, another tropical island with a high percentage of threatened plants. Lobelias are known for their beautiful flowers, and the ancestor species that arrived in the Hawaiian Islands radiated into 273 species, some of which grew to the heights of small trees. One-quarter are gone, and another 124 of the surviving
species are threatened with extinction or possibly are extinct (Walter and Gillett 1998). Of the remaining lobelias, only 27 percent now have sizeable enough populations to keep them from extinction; the loss of their pollinators, most of whom were honeycreepers, is a major cause (Buchmann and Nabhan 1996). The honeycreepers lost their forest habitats to clearance by settlers, and as they faded into extinction--one species after another--lobelia plants they had pollinated disappeared or became endangered. These ecological webs exist throughout nature.

The IUCN found that 91 percent of plants identified as threatened were endemic, with their entire distribution restricted to a specific country (Walter and Gillett 1998). A total of 32,242 threatened or extinct species of plants occur in one country alone, while 2,368 occur in two countries, and only 709 plant species occur in more than two countries. Only scanty information on threatened plants is available from most countries in South America, Africa and Asia, which are expected to have large percentages of their native plants found to be threatened when assessed (Walter and Gillett 2000).

Grasslands, shrublands and savannahs are the second most important habitat for threatened birds, home to 383 species, or 32 percent of all listed species (BI 2000). Two-thirds of these birds inhabit shrublands; 43 percent, grasslands; and 8 percent, savannah (BI 2000). Three-fourths are tropical birds, whose habitats are threatened by livestock overgrazing, human settlement and farming (BI 2000). Some 17 percent of threatened mammals inhabit grasslands, while another 8 percent are shrubland species, and about 7 percent are native to desert and semi-desert (Hilton-Taylor 2000).

Freshwater habitats, such as rivers, marshes, bogs, streams and ponds are the second most important biome, after terrestrial, for threatened species. At least 1,946 threatened species, the largest number being fish (627 species) inhabit these areas (Hilton-Taylor 2000). Freshwater crustaceans (409 species) and mollusks (420 species) are major inhabitants of these aquatic areas, as are 131 amphibians, 111 reptiles, 78 birds and 31 mammals, according to the 2000 IUCN Red List. The United States, with its extensive water projects--dams, levees, diverted and channelized rivers--harbors large numbers of threatened crustaceans and mollusks, as discussed above.

Frogs make up the majority of threatened amphibians and have been in decline for several decades. Their habitats are being destroyed at an unprecedented rate as wetlands are filled in--half of US wetlands that were present in colonial times--are gone. Thailand has lost almost all its wetlands, and Southeast Asian lakes and marshes are being drained at an unprecedented rate, threatening frogs and other wildlife. Frogs have been on Earth for 190 million years, but at the present rate of decline, the majority of the approximately 4,500 species will be gone within decades. In addition to habitat loss, a variety of threats are eliminating them (see Non-Native Species, Trade and Pollution sections below).

What is Threatening Species? Non-Native Species Introductions

Invasive species, or alien, non-native animals and plants introduced into ecosystems, present the most important threat to plants. The large numbers of threatened species that have limited distributions are highly vulnerable to the possibility of invasive species eliminating them from the wild. Islands have the greatest percentage of their native plants in danger of extinction. St. Helena, a small island in the South Atlantic, leads these in percentages, with 13 percent extinct or extinct in the wild, and 68 of 165 native plants and trees threatened (Walter and Gillett 1998). Livestock played a role in the extinctions and present status of many native plants (see Chapter 1). Mauritius follows, with 39.2 percent of native plants in danger, or 294 of 750 species (Walter and Gillett 1998). Other islands with many native plants threatened by exotic species include the Seychelles, Jamaica, French Polynesia, Pitcairn, Reunion and New Caledonia (Walter and Gillett 1998). Of the latter islands, all but French Polynesia and Pitcairn formed part of Gondwana, and many of the plants at stake are very ancient in origin.
One endemic Mauritian palm, *Hyophorbe amaricaulis*, has been reduced to a single plant. Although it grows vigorously and produces male and female flowers at different times, no fertile seeds are produced (Stearns and Stearns 1999). At the National Agricultural Station in Ireland, botanists cultivated the tiny embryonic growths found within the immature fruits; it is hoped that clones of the palm can be grown to adulthood (Parnell et al. 1986). Introduced animals and plants have taken over Mauritius and Rodrigues so completely that a number of species have been reduced to as few as two remaining plants.

Hawaii’s native forests and plants have fared poorly, too. Native sandalwood forests were cut by early settlers, endangering several species. The most fragrant of these trees, the Iliahi (*Santalum haleakalae*), is now restricted to the dry lava slopes of eastern Maui. Its carmine red clusters of flowers have the same aroma as its fragrant heartwood (Daws 1993).

Seven or eight types of lobelia plants of the genus *Delissea* once flourished in Hawaii, and all became extinct by 1966 except one, *Delissea undulata*, which had become reduced to only a few plants. Conservationists fenced these plants in 1967 from the browsing cattle and rooting pigs, and they were thought secure (Carlquist 1980), but by 1995, the species’ population had declined to a single plant. Botanists found it hanging by a few roots inside a sinkhole, the fence damaged and broken. The fence was repaired, and botanists are germinating seeds, hoping to prevent its extinction (Royte 1995). Another Hawaiian plant, *Cyanea pennatifida*, is in the same perilous status. Native to the mountains of Oahu, it also became reduced to a single plant, which was not producing its green flower. A botanist took a small sample of plant tissue and successfully cloned it in a test tube (Lipske 1997). Dozens of these plants have been cultivated from the slip, some of which were reintroduced into a preserve in 1995 (Lipske 1997).

Two hundred native Hawaiian plants are listed either on the US Endangered Species Act or are candidate species. Some 115 species have only 20 individual plants scattered in different areas or just one population of 50 or fewer plants in one location (Lipske 1997). Livestock and exotic plants have destroyed these plants and their habitats. One of these extraordinarily rare plants has been eliminated from all its original range, and the last members of the species cling to a single vertical cliff along the coast of Kauai, with its roots growing horizontally into rugged rocks (Carlquist 1980). This unusual lobelia, *Brighamia insignis*, has a thick, woody stem which tapers to a rosette of leaves, and it has lost its natural pollinator, which may have been a bird or an insect. Located 2,000 feet above crashing surf, it is out of reach of goats and pigs, but difficult for botanists to reach. This spectacular landscape is now this lobelia’s sole habitat. Each year, botanists Steve Perlman and Ken Wood risk their lives by scaling the cliff, using climbers’ ropes, to collect pollen from the plants with a brush. They then rappel to a neighboring plant to pollinate it, and months later, they must climb back up to collect the seeds, which are being placed into cultivation (Daws 1993; Royte 1995). Some of these seeds have successfully grown into plants at the National Tropical Botanical Garden on Kauai (Lipske 1997). This may be the most arduous and life-threatening plant conservation program in the world.

On the island of Guam, the forests have not been destroyed, but the bird life has been virtually eliminated by an insidious exotic animal that arrived in the 1960s or earlier. Several Brown Tree Snakes (*Boiga irregularis*) somehow secreted themselves in a shipment from their native Indonesia, and once on the island, they began to multiply. These snakes proved to be an environmental nightmare of the worst proportions, climbing trees and killing and consuming nestling and adult birds, and increasing at alarming rates. They have also caused major problems for the people of Guam. Ascending telephone poles, Brown Snakes short electrical wires. Between 1978 and 1990 alone, 1,000 power outages on the island were caused by these snakes (Jaffe 1994). A major threat to children, they enter homes, biting babies in cribs, and consuming pets. Untold millions of these snakes now live in virtually every environment in Guam. By 1981, these snakes had eliminated native birds from most of the island except for a remote part in the north. The snakes obliterated nearly the entire avifauna of Guam, an estimated 750,000 birds. Once a verdant tropical island teeming with birds, the forests have fallen silent. Three birds became extinct: the Guam Flycatcher (*Myiagra freycineti*) and two distinct subspecies of birds that survive on other islands: the Guam Bridled White-eye (*Zosterops conspicillatus conspicillatus*) and the striking chestnut, black-and-white Guam Rufous Fantail (*Rhipidura rufifrons uraniae*) (Jaffe 1994). The flycatcher was the greatest loss because it left no subspecies on neighboring islands. The Guam Kingfisher (*Halcyon cinnamomina miyakoensis*) became extinct on the island as well, but fortunately, a small
number had been taken into captivity. These kingfishers have been kept at several US zoos, but although they have produced some young, they have exhibited abnormal behavior, such as cannibalizing their chicks, and some have succumbed to avian tuberculosis.

The Guam Rail (*Gallirallus owstoni*) escaped extinction by a hair's breadth. The rail's population declined to about 2,000 birds by 1981, and in 1983, fewer than 100 remained; the last wild birds disappeared by 1987. The Guam Division of Aquatic and Wildlife Resources captured 19 rails in 1984 and, after captive breeding and holding, began releases in 1995 of 30 to 50 rails every three months on the neighboring island of Rota (Line 1995). Rota, a 209-square-mile island, is snake-free, but only one-fourth the size of Guam. Its forest is mainly intact (Line 1995). In 1999, the introduced Guam Rails bred on Rota for the first time (BI 2000). A small area of 24 hectares on Guam has been fenced off from snakes, and Guam Rails introduced there have also bred (BI 2000). About 180 birds survive in 14 zoos in the United States (BI 2000).

To date, no effective control has been found to rid Guam of the Brown Tree Snake. Metal bands on nesting trees of endangered birds and high-voltage electrical wires meant to kill them on contact have hardly made a dent in their populations. A native bird at the edge of extinction, the Marianas Crow (*Corvus kubaryi*), declined on Guam from 351 birds in 1981 to just seven in 1999 (BI 2000). On neighboring Rota, only 592 survived in 1995, down from 1,318 in 1981 (BI 2000). Guam still has a high percentage of forest cover and many aquatic habitats intact. Among the few mammals on Guam, the Marianas Flying-fox (*Pteropus mariannus mariannus*) has also declined, with a population in the mid-1990s of only about 300 animals. They suffered the effects of heavy hunting by the people of Guam for food, and the Brown Tree Snake is now killing juvenile bats. The endemic Guam Flying-fox (*Pteropus tokudae*) is now extinct, last seen in 1968. It was a probable victim of unrelenting hunting by natives for food but may have been killed off by the Brown Tree Snake. Shrews and other rodents and monitor lizards are disappearing from Guam as well (Jaffe 1994). Since many of the birds and bats served as pollinators of native trees and plants, these species may die out as a result.

Invasive species, mainly those introduced by humans onto islands, caused virtually all avian extinctions over the past few hundreds years. Today, almost 30 percent of threatened birds, or 298 species, are affected by introduced predators, particularly cats, rats, mongooses and other animals (BI 2000). Livestock introduced into avian habitats represents a major threat to 72 species of birds, and 71 bird species have been adversely affected by the introduction of invasive plants that eliminated the food or habitat of plants on which these birds depended (BI 2000). Pathogens, such as diseases and parasites, brought into avian habitats by various means threaten an additional 69 species of birds (BI 2000).

Introduced species threaten fewer mammals, about 69 species, or 10 percent of those listed by the 2000 *IUCN Red List* (Hilton-Taylor 2000). This may be because far fewer mammals inhabit islands, compared to the number of native birds, especially flightless ones. Even sizeable islands, such as New Zealand, had very few native mammals prior to human colonization. Madagascar is an exception, with a very large diversity of primates and other mammals, a large number of which are now extinct because of invasive species, along with many other factors (See Islands chapter).

What is Threatening Species? Persecution, Hunting and Trade

A total of 367 species of birds are threatened by hunting for food (233 species) and trapping for the cage bird trade (111 species) (BI 2000). The majority of birds that are threatened by meat and feather hunting are Asian pheasants, grouse, partridges, bustards, guans, megapodes and other large birds (BI 2000). The family of birds most threatened by trapping for the cage bird trade is the parrot family, Psittacidae, with 57 percent of threatened species trapped for this trade (BI 2000). These parrots are native to Mexico, Central and South America, Africa, Asia and Australia, and
some have been pushed to the edge of extinction (See Trade chapter). The Spix’s Macaw (*Cyanopsitta spixii*), for example, had been reduced from several hundred birds in the wild in Brazil to a single male when he, too, was illegally trapped in late 2000. This species is now extinct in the wild.

Hunting and capture for commercial purposes threatens 212 mammal species (Hilton-Taylor 2000). Many mammals have been endangered by hunting and persecution, including a number of large predators. The number of bats on the threatened list has grown dramatically in recent years, with many fruit bats threatened by killing for food, and others by vandals or those who persecute them for supposed threats to human health. Trade affects about 29 percent of threatened mammals (Hilton-Taylor 2000). Both the Asian (*Elephas maximus*) and African Elephant (*Loxodonta africana*) species have been reduced to endangered status primarily as a result of killing for their ivory and meat. The 1989 listing of the African Elephant on Appendix I of the Convention on International Trade in Endangered Species (CITES) succeeded in putting an end to more than 90 percent of trade in ivory, which was pushing this species rapidly toward extinction. Since then, the ban has been weakened by pressure from ivory traders, and CITES allowed trade in stockpiled ivory taken from smugglers in southern Africa. This had the immediate result of increasing poaching of elephants throughout the continent, in anticipation of a lifting of the ban.

All rhinoceros species, two native to Africa and three to Asia, are critically endangered. Populations of the five species together total only about 12,000 animals, a result of heavy hunting for their horns, which are used in Traditional Medicine (TM) and as handles for daggers in the Middle East (see Trade chapter). The toll of animal species killed for meat, trade and the TM market numbers in the millions, of which a growing number are threatened. Tigers, Leopards and other wild cats, snakes, pangolins, monkeys, birds of prey, deer, seahorses, and turtles, and many other species are killed to supply this market. The Tiger is poached throughout its range because its body parts are worth $10,000 or more when sold in this market and as trophies. This species is killed in parts of its range by slow-acting poisons and leghold traps for trade, and predator control when it has hunted livestock after its natural prey was killed off. Species like the Tiger, which require large territories and are suffering high mortality from hunting throughout its range, as well as loss of habitat, are in imminent danger of extinction. Several conservation programs are attempting to stem the tide in favor of the Tiger and reduce demand for its body parts in TM. Stricter laws are needed throughout the world, however, to protect endangered animals. The bushmeat trade is a major threat to Central and West African mammals and a wide spectrum of species in Southeast Asia (see Persecution and Hunting chapter).

A thriving trade in terrarium frogs has resulted in a worldwide market for many species of these amphibians. The world's largest frog, the Goliath Frog (*Conraura goliath*) of Central Africa, weighs 7.2 pounds and reaches a length of at least 32 inches; it is found along major rivers in dense tropical rainforest in Equatorial Guinea and southwest Cameroon (FWS 1991). Throughout its range it is very rare, and it has unusual habitat requirements. It needs rapids and cascades with sandy bottoms and very clean, oxygen-rich water; deforestation has reduced this habitat. Collectors have offered huge sums up to $2,500 for capture and export of Goliath Frogs--as personal pets or for public exhibition. One US dealer imported 50 of these frogs and attempted to enter them in the Frog Jump Jubilee in Calaveras County, California (FWS 1991). The Endangered Species Act lists this species as Threatened throughout its range. The IUCN lists it as Vulnerable on the 2000 IUCN Red List. Hundreds of other species are collected for this trade, threatening many, including various mantella frogs of Madagascar, coveted for their golden color (See Islands chapter).

Although more reptiles than amphibians are killed for their skins, amphibians are now also being taken in large numbers for this purpose. In 1985, the United States imported more than 11,000 frog and toad hides and products worth $350,000 for the luxury trade in frog skin wallets, toad leather boots and other items (Fitzgerald 1989). Most of these skins come from a large Malaysian frog (*Rana macrodon*), but the Black-spined Toad (*Bufo melanosticus*) and other species are used as well (Fitzgerald 1989). Such products are extremely difficult to identify by species, making enforcement difficult.

Frogs are killed by the millions for high school biology class anatomy lessons, an unnecessary toll because
computer programs and films now provide this information (see Projects section). For the restaurant trade, frogs are killed in even greater numbers. Indonesia and Vietnam are the major sources of frogs for restaurants and food markets in Europe and the United States. Prior to export bans, Bangladesh and India captured many millions of frogs each year for the restaurant trade. Several documentary films have recorded the process of removing the frogs' legs in Bangladesh and Indonesia; the same methods were used in each country. Once captured and gathered in large containers, the frogs' back legs are sliced off with a sharp knife or machete, and the still-living frogs are tossed into heaps, where they continue to struggle for long periods before dying. An increase in malaria was documented in Bangladesh after the frog trade caused declines in wild populations; the frogs had been controlling mosquito populations.

The Indian Bullfrog (*Rana tigerina*), a species native to southern Asia, was listed on Appendix II of CITES after heavy trade depleted it. Some of these shipments were seized: In July 1997, a shipment from Vietnam containing the legs of 450,000 Indian Bullfrogs was intercepted in Holland as a CITES violation; the container with the frogs' legs weighed almost 20 tons and was en route to a wholesaler in Canada. This shipment alone represented frogs from vast areas in Vietnam, depleting wetlands of these ecologically important amphibians. Even in US National Parks, frogs are commercially hunted. In Florida, for example, frog hunters in airboats capture millions of frogs during night hunts. In February and March 1996, 6 tons of frogs were taken from Big Cypress National Preserve for sale to restaurants and for private consumption, according to environmental groups which have petitioned the National Park Service (NPS) to end or limit this hunt (Dodds 1996).

The reptile product trade placed virtually all large crocodilians on the endangered list by the early 1970s after imports of millions of skins for luggage, shoes and handbags nearly caused extinctions of species in South America, Africa and Asia. Although controlled to some degree by CITES, a large percentage of trade is illegal, composed of protected species (see Trade chapter). The luxury trade in these products is now threatening many snakes as well as lizards, whose skins can be sold for very high prices. These reptiles, which play important roles in nature--culling rats and other rodents and preventing overpopulations of fish--are taken from the wild. Snakes are being captured in such numbers for this trade and for the Asian medicine and restaurant trades that they have disappeared from areas where they had been common. (See ENDANGERED AND THREATENED SPECIES OF MAMMALS, BIRDS, REPTILES AND AMPHIBIANS in the Appendix for an extensive list of these reptiles now threatened with extinction.)

What is Threatening Species? Pollution and Disease

Pollution by acid rain and acid from coal mines that drains into streams and rivers, heavy metals, PCBs, dioxin and other toxic chemicals, have killed off all life in waterways in many parts of the world. PCBs and pesticides have caused serious genetic malformations in frogs, birds and fish.

Frogs have been dying from fungal diseases and the indirect effect of other pollutants, which are eliminating entire species. Necropsies done on frogs from Australia and Panama, which were found dying, have revealed the presence of the same fungus, chytrid (Morell 2001). It is considered responsible for the extinction of several Australian frogs, including the extraordinary Gastric-brooding Frog (*Rheobatrachus silus*) and three other species, and has infected frogs in Panama as well, eliminating populations and possibly species (Morell 2001). This fungus has been detected in 44 species of Australian frogs and is apparently spreading in many parts of the world. Other fungi and viruses have eliminated frogs in the United States (Morell 2001). These diseases have long been in the environment, and it is not yet clear why they have become so toxic and virulent to frogs. Frogs have thin skin and easily absorb chemicals, making them vulnerable, but apparently their immune systems have been weakened, as well. Frogs and toads are also threatened by pesticides, which have been shown to cause grotesque deformities and mortality. Many types of pollution, including acid rain, heavy metals and fertilizers, have eliminated frogs in many parts of Europe and Canada.
Ultraviolet radiation (UV) suppresses frogs' immune systems and kills eggs as well as adults. Andrew Blaustein (1994), an American biologist, conducted experiments that proved UV to be responsible for wiping out many species of frogs in the US West who laid their eggs in the open. The eggs were thus exposed to this radiation, which has intensified as a result of the decrease in the ozone layer caused by chlorofluorocarbons, used by industry in air conditioners and refrigerators, among other industrial uses (see Aquatic Ecosystems chapter).

Hawaiian birds have been seriously affected by avian malaria, brought to the islands by captive cage birds, as discussed in Chapter 1. This disease continues to threaten the surviving species of native birds, and is a major cause of the wave of extinctions that is claiming one species after another of these beautiful songbirds (BI 2000). Several species, such as the Nukupu'u (Hemignathus lucidus), are now in Critical status, possibly extinct on both Kauai and Maui where, until the 1990s, a few birds were seen in their montane forests (BI 2000). Feral pigs in their habitats facilitate the spread of alien plants and introduced, disease-carrying mosquitoes (BI 2000).

What is Threatening Species? Traits of Vulnerable Species

By identifying the traits that characterize species likely to become endangered or fade to extinction, it is possible to afford them and their habitats extra protection and carefully monitor their status. The tragic losses of so many of these "red flag" species should be avoided in the future, and can be, with remedial action. Ideally, species should be conserved when their populations are still healthy, before they become genetically impoverished and their populations fragmented. The list below includes some of the characteristics many extinct and endangered species possess. Undoubtedly, the more we learn about the causes pushing wildlife and plants to extinction, the longer such a list will become.

1. Endemic species, or animals and plants that are restricted to a relatively small area, such as an island, are inherently vulnerable to extinction. They have incurred the greatest number of extinctions in the past 400 years. Changes in their habitat or losses to their populations can eliminate them. Many of these species were confined to areas that measured only a few square miles. Mainland species, likewise, can be endemic to small areas. The Slender-billed Grackle (Cassidix palustris) once inhabited a single marsh near Mexico City. The marsh was filled about 1910, spelling extinction for this bird. Many endangered species fall into this category.

2. Specialization of habitat or diet has caused much extinction. Animals that depend on a certain type of habitat or food source and cannot adjust to alterations, whether natural or human-caused, are extinction-prone. The Ivory-billed Woodpecker requires large expanses of old-growth forests with many dead and dying trees. The endangered Kirtland's Warbler (Dendroica kirtlandii) of Michigan will colonize only one type of forest: stands of jackpine trees that are eight to 22 years old on well-drained, sandy soil. This habitat must now be artificially maintained to prevent the bird's extinction. The Palila (Loxoides bailleui), a Hawaiian honeycreeper, is dependent on the mamane tree for feeding, which has declined as a result of logging and destruction of seedlings by introduced game species and livestock. Many endangered plants require specific soil type, climate, drainage and sunlight exposure. For those species that require unbroken stretches of habitat, such as old-growth forest, endangerment or extinction can result if the forest is fragmented.

3. Long-lived species with low reproductive rates and low natural mortality are vulnerable to extinction. Fast-reproducing species that have many young at frequent intervals and high natural mortality rates tend to be more resilient to population losses and recover quickly if their habitat has not been destroyed. Not all vertebrates fall easily into these categories, but many do, and these groupings can be at least one indication that is useful in terms of predicting which species will become endangered when their populations are reduced. Slow-reproducing animals decline rapidly from losses in their numbers, and since they often do not breed until a relatively advanced age and...
have few young, many decline to extinction. In some cases, such animals do not recover their former abundance, or recover very slowly. A few of these animals, including sea turtles, lay many eggs, but only a small percentage of the hatchlings survive to adulthood. Although few of the now extinct animals were ever studied in the wild, enough is known of related species to guess that many fell into this category. The Steller's Sea Cow (Hydromalis stelleri), for example, was a member of the Order Sirenia of manatees and Dugongs. The surviving species have few natural enemies, do not breed until age 7 to 10 years old, and have only one young every five years. Hunting caused the extinction of Steller's Sea Cow in the space of a few years, eliminating the only cold-water member of this family. Hunting threatens surviving species of this family in many areas. Manatees and Dugongs are very slow-moving, making them easy targets. The Steller's Sea Cow may have numbered only a few thousand animals in its limited distribution near islands in the Bering Sea. Even when able to swim away, they refused to leave their mates, beaching themselves on the shores next to the slain mate. Such animals can probably not tolerate any hunting. Manatees and Dugongs, likewise, need strict protection.

Many large birds, including condors, eagles and large parrots such as macaws, have low reproductive rates. The Cuban Red Macaw (Ara tricolor), became extinct in 1885. If its breeding biology resembled other large macaws, it was long lived, reaching an age up to 80 years, had only one or two chicks a year and did not breed every year. Scientists have recently discovered that even in an immense national park in Peru, wild macaws produce so few young that any losses in their numbers cause declines in their populations. This helps to explain why so many birds of prey and parrots are endangered. Passenger Pigeons were long lived, laid only one egg, and may not have nested every year. Likewise, turtles and tortoises are long-lived, with at least one species, the Galapagos Tortoise (Geochelone nigra) documented as living to more than 165 years in captivity. Some shark species do not breed until the age of 20 years and produce only a few young.

Flightless birds and slow moving animals are helpless in the face of hunting pressure and predation by introduced predators and humans. Unwary animals, such as many island species that have evolved in the absence of predators fall into this category. Flightless birds, such as the Great Auk, Great Elephant Bird, Dodo, many Pacific Island rails and tortoises, are among species that lack defenses or cannot quickly escape predators, human or other. In addition to being flightless, many extinct birds lacked defensive behavior or the instinct to hide in underbrush as a result of their having evolved in predator-free environments. Predators introduced into their habitats, as occurred on many islands, soon eliminated them. Even the thick shells of tortoises were not effective defenses against predators such as rats, who ate young tortoises, and humans easily captured these slow-moving animals. Although our attitudes are more humane toward these vulnerable animals today than hundreds of years ago, tortoises and sea turtles are still killed for trade or by vandals for sport. Some surviving flightless birds on islands have official protection and a better future than they had in previous centuries, while others do not.

Large animals have been vulnerable to overhunting since the Pleistocene Epoch. In recent centuries, whales were added to the list of large species unable to escape guns or harpoons. The largest lemur and bird species of Madagascar were killed off by the Malagasy immigrants thousands of years ago, as were many large flightless birds by the Maori when they first arrived in New Zealand. Large animals are often killed merely because they make large targets or for trophies for those who enjoy slaughtering animals. Animals of large size require considerable amounts of habitat and are, therefore, naturally more rare than species with smaller habitat requirements. When human populations rise and wilderness is replaced with towns and industry, large animals are the first to disappear, due either to loss of habitat and prey or because they are killed as potential threats. Most of the largest mammals on Earth are now on the endangered list of the 2000 IUCN Red List, including both species of elephants, all the rhinoceros species, and many large antelope and big cats such as the Tiger, Cheetah, Leopard and Lion. They have declined from hunting or persecution and are being crowded out of their habitats by human activities. Large animals are often keystone species at the top of their food chains or play important roles in ecosystems. Their absence is indicative of damaged or incomplete ecosystems. Elephants are important in spreading seeds of many plants through their dung, and large predators play a major role in the health and physical characteristics of their prey. The African savannahs without Lions, Leopards and Cheetahs would soon be overpopulated and overgrazed by their numerous prey species. The Elk of Yellowstone National Park became overpopulated in the absence of the Gray Wolf, and grazed certain plants so
heavily that some bird species and other wildlife disappeared and certain tree species became rare. In spite of the wolves' importance to ecosystems, they are killed with impunity by livestock owners and others who consider them threats.

6. Wild animals and plants which have a value as food, pets, ceremonial objects or marketable products to humans are prime candidates for extinction. The list of animals that have been hunted to extinction for food is long. Within the past 400 years, many large land tortoises, the Great Elephant Bird, moas, Steller's Sea Cow, Auroch and Quagga were all extinguished by hunting for food. The unique Huia bird of New Zealand had plumes that were sold for large sums, helping to drive its limited population to extinction. Hawaiian songbirds were hunted to extinction for their colorful feathers, which were used in ceremonial headdresses and capes. Within the past decade, trade has increased as a threat to wildlife with the rise in Asian economies. This has fueled the Traditional Medicine markets, which consume vast numbers of animals, threatening many of them. The vacuuming of the seas by commercial fisheries has resulted in depletions and endangerments. The once abundant sturgeon of the Caspian Sea, for example, sources of Beluga and other expensive caviar, are now critically endangered as a result of unrestricted fishing and poaching for the luxury gourmet market. The bushmeat markets of West and Central Africa sell tons of slaughtered monkeys, forest antelope, Chimpanzees, Gorillas and other wildlife, devastating species whose tropical forest habitats are being logged. Hunting for food is also a major threat as firearms become available to native peoples who once used primitive weapons. Southeast Asian wildlife is under siege by people who once hunted only for their own purposes but now find that a wide range of wildlife can be sold in local meat markets or for Traditional Medicine. They set nooses and traps, killing rare monkeys and antelope, birds, snakes, turtles and tortoises, pangolins and lorises, clearing out the forests of wildlife. The pet trade is driving many colorful tropical birds, reptiles and primates to endangered status. Luxury goods, such as high-priced reptile products, provide an incentive to hunt—legally or illegally—lizards, crocodiles and snakes for this market, endangering many species. Trophy hunting of endangered species by wealthy hunters is a major threat to a growing number of animals, especially since the largest specimens are killed; these are the ones that should be left to breed. The higher the value of the animal or product, the greater the threat to that species.

7. Altruism, or the unselfish care for members of one's own species, highly admired as a human trait, has been fatal to many animals—the Passenger Pigeon, Dodo, Carolina Parakeet and Steller's Sea Cow, for example. In their evolutionary history, this behavior served to preserve bonds between animals and to frighten off predators. When confronted with guns or other weapons wielded by humans, however, animals that come to the aid of fallen mates or flockmates can be easily killed themselves. Refusal to leave their wounded fellows hastened the extinction of many species. Endangered species with these traits include wolves, gorillas, whales and elephants.

8. Species breeding in colonies or requiring large numbers of their own kind for protection, to locate food sources or for other means of survival, are vulnerable to extinction. The Passenger Pigeon was a colonial nesting bird and could only survive among large numbers of its own species, flocking and seeking food sources over large areas. When flocks were fragmented, these separated populations declined to critically low levels, even though their total numbers may have been in the tens of thousands. The Passenger Pigeon may have become critically endangered as soon as its migrations, feeding and nesting behavior were interrupted, even though it appeared to observers at the time to be plentiful. These pigeons had longevity of several decades, and failure to reproduce would take some time to be noticed in the overall population. But when there is little or no introduction of young into a population over a period, it can suddenly crash with little warning, as the Passenger Pigeons did. Wild parrots tend to feed, roost and spend their time preening and in courtship as a flock. For some species, these flocks number in the thousands of birds. When netted or caught by various means for the pet trade, which threatens a large number of species, their flocks are broken up and they are no longer able to function as a group. Their breeding is curtailed or stopped altogether, and they may no longer fly in groups seeking fruiting trees or mineral licks when they fear being captured. Flamingos require large numbers of their own kind for feeding, flocking, migrations and breeding, and their populations crash if any of their survival requirements are not met.

Many species of birds have breeding strategies in which male birds will not breed unless they are able to display
courtship behavior in the company of other males, vying for the approval of females. Birds of paradise, cocks of the rock in South America, prairie chickens and grouse of North America are among birds that display for the benefit of females, who choose among them. Such birds require specific conditions to breed, and habitat alterations, reductions in their populations or hunting pressure that keeps them from exposing themselves in the open can prevent their breeding.

Mammals, reptiles and amphibians also have male contests of strength, agility or other mark of superiority of species. Wild sheep and deer vie for females by head butting and challenging one another. Many types of tropical frogs emerge during the breeding season to form groups that display to one another for the benefit of females. Male Plowshare Tortoises joust with one another in attempts to upend the rival and will not breed if only a single male and a female are placed together. Without rivals for competitions, male breeding behavior may not be triggered, preventing reproduction.

Zoos and zoologists are only beginning to understand some of the instinctive responses necessary for breeding. Our traditional concept that a compatible pair of animals will reproduce is often incorrect, and populations of animals must not be allowed to be so reduced that their natural breeding behavior and other survival needs are not met.

Thus, while population numbers can provide important information about the status of a species, without additional information, such as the traits mentioned above, the data can be extremely misleading and inapplicable. The number of individuals surviving in a species, when known, must also be placed into a context greater than their rate of decline and habitat status. Unless the entire breeding biology, behavior and other aspects of species' survival needs are taken into account, extinction cannot be predicted, or status properly evaluated.

Some species now extinct suffered from several of the above factors, which hastened their extinction. The Passenger Pigeon, for example, required enormous amounts of food, mainly from nut-bearing trees in old-growth forests, and was relatively long lived, killed for food and commercial sale, and lived colonially. Elephants and manatees are among endangered species with many vulnerable traits, including large size, altruism, slow-reproduction, low natural mortality and longevity. They are also slow-moving and valuable in trade and as food sources.

These traits indicate only vulnerability to extinction caused by humans, not species likely to become extinct through natural selection. Sea turtles, for example, have lived on Earth for more than 200 million years. By any standard, they are a superbly successful, adaptable species that, prior to recent exploitation, showed no signs of decline. Their vulnerability lies in their inability to flee rapidly in the water or while laying eggs onshore when preyed on by humans.

Many endemic species occupy very limited habitats and have small populations but have not been listed as threatened if their environments or populations have not declined. The majority of these species have prospered for thousands of years in stable environments, and only the intrusion of human-related activities and domestic animals upset this equilibrium. Such species are extremely vulnerable to even minor habitat destruction or hunting pressure and should be carefully monitored for losses in their populations.

Because of human technology and weaponry, all animals have become vulnerable. Animals that for thousands of years used natural camouflage, stealth and intelligence to escape from natural predators, have become easy prey for human hunters and fishermen. Predators, never in their evolutionary history preyed upon, now find themselves targeted by hunters, trappers and poisoners. Sonar locates fish schools and whales, and heat detectors and night-view binoculars observe animals in darkness. Cleverly constructed blinds hide hunters from view. Animal scents are used to lure wildlife, and hunters imitate animal sounds or use tape recordings of their calls to lure them to traps or within shooting range. Some hunters use the signals emitted by radio transmitters placed in wild animal collars by biologists for tracking, to hone in and pursue them to their deaths. Guns equipped with telescopic sights can fire at targets mile away, killing animals before they are even aware of the hunter. Other weapons include sophisticated traps, nets,
snares, guns, harpoon guns and high-speed vehicles and boats, with which people can run down, maim and kill even the swiftest and most intelligent animals. These devices give humans such an advantage that they render the natural protections animals have evolved over eons completely ineffective. Hunters are able to kill the fittest and strongest specimens through these means. In the process, we are changing the course of evolution from survival of the fittest to survival of animals that are tolerated by humans and those able to persist in an increasingly polluted, damaged and ecologically impoverished natural environment.

Those species whose populations have become greatly reduced are vulnerable to extinction through genetic impoverishment and inbreeding. Such species usually remain rare or gradually fade into extinction as fertility declines. The critical low level which results in extinction is different with each species and cannot be predicted with certainty.

Just as the story of North America's lost species and environments is illustrative of many similar tragedies, the account below of the civil war in Rwanda and the former Zaire encapsulates the major threats to wildlife and the environment. It also makes abundantly clear that the survival of humans, animals and the environment are intrinsically linked. The influence of countries that contribute foreign aid to poor nations half a world away, and interfere in their politics, is another important element that can greatly affect the survival of wildlife and the natural world.

Human Tragedy and the Looting of Virunga's Treasures: Page 1

The mist-enshrouded Virunga Mountains of East Africa tower over dense highland vegetation. Far below, crystalline lakes ringed by marsh reeds glisten in the sun. Shy forest African Elephants walk along mountain paths in single file. Groups of endangered Mountain Gorillas \((\text{Gorilla gorilla beringei})\) feed in forest glades. Three hundred fifty of these magnificent animals, almost half their world population, reside here (Fisher 2001). The western edge of these mountains is protected in the vast 12,800-square-mile Virunga National Park, bordering western Rwanda. Some 766 species of birds reside here, more than are native to the United States and Canada combined. Iridescent sunbirds feed on the flowers of giant lobelias, and more than 200 species of mammals live in the park (Bonner 1994). Many of the species native to the park are found nowhere else on Earth. This ecological treasure is Africa's first national park, set aside in 1925. Virunga was closed to visitors other than scientists until very recently. In the 1970s, it became a World Heritage Site, a designation by the United Nations Educational, Scientific and Cultural Organization (UNESCO) for places deserving special recognition and protection.

In the early spring of 1994, political upheaval in the region caused a civil war that wreaked massive ecological damage and loss of wildlife in this natural paradise. Rival tribes in neighboring Rwanda clashed violently after the country's President was killed in an airplane crash caused by a rocket launch (Wright 2001). There were suspicions that his death had been arranged by his enemies. In an attempt to overthrow the minority-run Tutsi government, the Hutu majority began slaughtering Tutsi tribal members. Within months, more than 500,000 people, most of them Tutsis, were slaughtered in an appalling genocide that began with armed conflicts between army soldiers and rebels and accelerated to violence between neighbors. People of all ages were victims, many killed by slashes from machetes or battered to death with clubs. The Hutu failed in their attempt to overthrow the ruling Tutsi tribe and fled in panic west to neighboring Zaire, home of Virunga National Park.

Some 2 million Rwandan Hutu refugees flowed in a steady stream into eastern Zaire, just south of the park. Injured and starving, they crowded into camps where international aid organizations fed them and attempted to control cholera and other infectious diseases. Within days, scenes that might evoke visions of Dante's *Inferno* were televised by news organizations to viewers around the world. Gaunt, frantic people were seen scrambling frantically for food.
supplies or lying listlessly in the final stages of starvation and disease. Estimates of total mortality from the war, starvation and disease exceeded 1 million people (Wright 2001). Many of the surviving refugees were afraid to return to Rwanda and remained in the refugee camps or built settlements on hills near Virunga National Park. To supply firewood to these 700,000 or more refugees, 30,000 people went into the rainforest each day, cutting down tens of thousands of trees (Bonner 1994). Rwandan soldiers and others began a thriving business selling firewood throughout the refugee camps. By November 1994, 112 square miles of the park had become partly or completely deforested, and little was done by Zairean troops or park authorities to curb the destruction (Bonner 1994). One forest ranger said, "Trees used to block the views everywhere. Now I see hills I didn't even know existed." An estimated 230 truckloads of trees left the park every day (Salopek 1995).

In December 1994, the World Heritage Committee placed Virunga National Park on a list of "World Heritage in Danger." Along with the forest cutting, park wildlife was killed for food by both refugees and Zairean soldiers, who had gone unpaid for months by the failing government. In mid-1995, more than 12,000 of Virunga National Park's Hippopotamuses (Hippopotamus amphibius) were killed for their meat and their ivory teeth, reportedly by Zairean soldiers using semiautomatic weapons. By late September 1995, there were still 700,000 Rwandan refugees camped near the park, removing 600 metric tons of firewood from the park each day (Lang 1995). Michel Leusch, Environmental Coordinator for the United Nations High Commissioner for Refugees in nearby Goma, said, "The quantity of biomass may be recovered in time, but some things, like rare plants and animals, have disappeared and cannot be replaced" (Lang 1995).

The government of Zaire began closing refugee camps in January 1996, with more than 1 million refugees still resident in 40 camps along the border with Rwanda. Another 700,000 Rwandan refugees stayed in camps in Tanzania and Burundi (McKinley 1996). Although millions of dollars were donated to supply food and medication, no aid funds were allocated for alternate fuel for these refugees, such as solar cookers and propane gas stoves that would have helped prevent the devastation of Virunga's forests. This highlights the need for an international ecological rescue fund that could ameliorate such tragedies, as well as safeguard wildlife from slaughter. In late 1996, Zairean troops attempted to force the last of the Rwandan refugees back into their country, causing open warfare to break out, and the last of the United Nations relief workers were forced to abandon the area. By mid-1997, hundreds of thousands of Rwandan Hutus had dispersed through the forests of Zaire, living off the land. Thousands of Hutus, jailed on their return to Rwanda, were placed on trial in an international tribunal in 2001 for their actions during the massacre.

Human Tragedy and the Looting of Virunga's Treasures: Page 2

A major underlying cause of Rwanda's civil war and the great suffering of its people is its uncontrolled population growth. In 1973, Rwanda's population reached 3,980,000 in a country whose total area is only 10,169 square miles—smaller than Maryland (Anon. 1975). This resulted in a ratio of 391 persons per square mile, one of the densest in the world. Populations continued to grow, however, and by 1992, they topped 8,206,000, with a density of 806 persons per square mile (Anon. 1994a). The country became increasingly crowded, as arable land became scarce. Competition for land had become intense. Much of Rwanda is eroded and barren, the thin tropical topsoil producing crops for only a few years after the forest has been cleared. Only 22 percent of the land remains forested (Wright 2001). Farmers slash and burn more forest for planting when land ceases to produce crops or grazing grasses. Steep, erodable slopes are being plowed right up to the limits of protected parks and reserves. The feuding between Hutu and Tutsi might have been peacefully settled if not for the extreme poverty and overpopulation. The average per capita income in 1999 was $720 per year (Wright 2001).

The war's massacres killed almost 1 million people, leaving an estimated 7.2 million people by 2,000, according
to unofficial estimates (Wright 2001). Unless birth control becomes widely accepted in Rwanda, human populations will rise to an estimated 11 million people within a few decades. Some experts believe that nearly 22 million people will occupy Rwanda by 2020 (Anon. 1994a). By the latter estimate, there will be 2,163 persons per square mile in Rwanda, far more than its land can support. By contrast, the population density in the United States in 2000 was 76 persons per square mile, and Canada's, 8 persons per square mile (Wright 2001).

Human Tragedy and the Looting of Virunga's Treasures: Page 3

The effects of burgeoning human populations on wildlife and the once magnificent forests that covered the region have been tragic. Long before the forests of the Virunga Mountains became divided into the separate countries of Zaire, Rwanda and Uganda, and before the forests were replaced by agriculture in the latter two countries, thousands of Mountain Gorillas inhabited the region. As human populations rose, Gorillas declined to their present endangered status. These peaceful primates wander in the forest throughout most of the daylight hours, feeding on the luxuriant vegetation. As the largest and most powerful of all primates, the Gorilla male has an enormous chest, 20 inches across and up to 5.7 feet (1.75 meters) in circumference. He weighs up to 605 pounds, while females are much smaller, about half the weight of the male (Nowak 1999). The Mountain Gorillas' forests can become quite cold at night, and to adapt, they have developed longer, thicker hair than the Lowland and other races of Gorillas.

Gorillas travel in family groups led by silverbacks, named for the whitish-gray hair on their backs. These are the strongest and largest males, usually more than 20 years old, who guide and protect the band. Males compete for this role as soon as they are teenagers. Silverbacks father the babies in the family group, although sometimes females mate with "outside" males. These groups often travel long distances to locate fruiting trees and edible plants and tubers. Almost entirely vegetarian, Gorillas eat 40 pounds of food a day, feeding on 70 or more species of leaves, bark, fruit, roots, fungi, flowers and bamboo. They rarely drink water, obtaining moisture from the dew-laden plants, and the only animal matter they consume consists of insects. Gorillas consider army ants a delicacy and occasionally eat grubs and other insects.

In Rwanda's north, contiguous to Virunga National Park, where about 250 Mountain Gorillas survive, Volcanoes National Park, a 48-square-mile forest reserve, is home to about 100 Mountain Gorillas (Fisher 2001). The latter forest was once much larger, but the needs of agriculture had greater priority, and some 65 square miles were carved out of the park, squeezing the Gorillas into a fraction of their original range in the country.

Human Tragedy and the Looting of Virunga's Treasures: Page 4

In neighboring Uganda, the small Mgahinga Gorilla National Park, a 34-square-kilometer reserve, protects 40 more Mountain Gorillas. Some 25 kilometers north is a beautiful cloud forest, Bwindi Impenetrable Forest National Park, covering 330 square kilometers, in an area of high biological diversity (Butynski and Kalina 1993). This forest has the greatest number of trees of any in East Africa and so many endemic plants that it has been selected by the IUCN Plants Programme as one of Africa's most important forests (Butynski and Kalina 1993). Birds, butterflies, amphibians and reptiles found nowhere else inhabit the Bwindi Impenetrable Forest. It also protects a population of 300 Mountain Gorillas who have smaller bodies, longer limbs, hands and feet than those of Zaire: Their skulls and trunks differ also, and they are somewhat different genetically from other populations (Croke 1995, Drewes 1997). Scientists are now considering naming these Gorillas a separate subspecies. Destruction of forest and other habitats outside Uganda's and Rwanda's parks is extensive, making these last natural areas crucial to the survival of the
Mountain Gorillas.

Uganda's decades of chaos under President Idi Amin decimated the wildlife of this lovely country bordering Lake Victoria. Murchison Falls and Queen Elizabeth National Park once had magnificent concentrations of elephants, hippos and other large mammals, but by 1997, little remained, having been slaughtered by rebel groups or refugees from neighboring countries (Drewes 1997). Uganda's Ministry of Tourism, Wildlife and Antiquities conducted an aerial survey of Uganda's remote northern regions to determine whether some wildlife might remain to restock other areas, but they found "absolutely nothing" (Drewes 1997). Uganda has recently made a commitment to restore its wildlife and has reintroduced many large ungulates, trucked in from Kenya, into its national parks.

Human Tragedy and the Looting of Virunga's Treasures: Page 5

Although Gorillas share more than 98 percent of human genes, making them, along with the two species of chimpanzees, our closest relatives, until the 1960s, they remained mysterious, threatening creatures in the view of the public, depicted as monsters in movies. During the 19th century, explorers and hunters killed them as ferocious symbols of savagery. The work of American biologists Dr. George Schaller and, later, Dian Fossey, who entered the forests of the Mountain Gorillas as observers and researchers, changed this image forever. Films and books of the National Geographic Society and others revealed the gentleness and intelligence of these magnificent primates to people around the world, and gradually, conservation programs began to replace trophy hunting.

Schaller, who began his research in the 1960s in Virunga National Park, wrote about these primates in The Mountain Gorilla, published in 1963 by the University of Chicago Press, and a popular version, The Year of the Gorilla, in 1964. He provided the first scientific observations of these remarkable animals and recalled his encounters with them in a 1995 National Geographic article:

*I approached them with empathy and respect, wanting nothing from them but peace and proximity. And they accepted my presence with an astounding generosity of spirit. The recent decades have been a turning point, indeed a revolution, in our relationship with animals. Humans have begun to overcome cross-species barriers, achieving intimacy with humpback whales, chimpanzees, lions, mountain sheep, wolves. The gorillas of popular image were a fantasy . . . No one who looks into a gorilla's eyes--intelligent, gentle, vulnerable--can remain unchanged, for the gap between ape and human vanishes; we know that the gorilla still lives within us. Do gorillas also recognize this ancient connection? (Schaller 1995).

In the 1960s, Virunga National Park sheltered the largest population of Mountain Gorillas, numbering some 450. They declined to 275 by the 1970s, and to 250 by 1981, a result of poaching. The Mountain Gorilla Project, begun in 1978 by Schaller and a consortium of conservation organizations, including the New York Zoological Society and the African Wildlife Foundation, sought to stop the Gorilla's decline toward extinction. Funding went toward anti-poaching programs, education of local people, and ecotours (Schaller 1995). With non-threatening visitors to the park, many Gorillas grew tame. They were given names by park rangers and scientists and became familiar to tourists who came from around the world to see them. The conservation program and ecotourism succeeded in nearly eliminating poaching, and Virunga's Gorillas increased to 320 by the late 1980s (Schaller 1995). The Gorilla Project also operated in Uganda, where the government ejected 2,000 farmers from 3,500 acres, offering to compensate them with 10 percent of the revenue from tourists who come to see the gorillas (Salopek 1995).
Fossey's early research was sponsored by the famed anthropologist Louis Leakey, who had earlier convinced Jane Goodall to go to Tanzania to study Chimpanzees (*Pan troglodytes*). Both researchers changed forever our views of these fellow primates. Fossey began her research in the 1970s in the mountains of Rwanda, making friends with a family of Mountain Gorillas. The silverback male of this troop, whom she named Digit, became so trusting that he was filmed by the National Geographic Society gingerly taking her pen and then her notebook, returning them to her, and then lying down and going to sleep by her side (see Video--Mammals). These immensely strong animals never harmed any of the thousands of people, from rangers and scientists to tourists, who visited the reserve over several decades. When they felt their family was threatened, they made shows of aggression, pounding their chests or rushing headlong through the bushes toward the potential threat, whether human or another male Gorilla, but stopping short of physical blows. Humans, however, misinterpreted their displays, shooting and killing many silverbacks.

Commercialization of Gorillas—the high value of their young in the exotic pet trade and the many thousands of dollars offered by zoos to obtain illegally captured specimens—has presented a major threat to the species for many decades. Local people enter parks and reserves to shoot adults guarding the young, remove the animals’ heads and hands, and grab the traumatized babies. Other Gorillas are killed accidentally by illegal wire snares set in the parks for antelope and small mammals. Although efforts had been made in many parks to stop the killing of Gorillas, not until December 1977 did international attention become focused on this grisly and cruel activity. Six Rwandans, with their hunting dogs, entered the reserve armed with spears to kill Gorillas. They encountered Digit, who boldly rushed at them, pounding his chest. This allowed his family to escape, but cost him his life. The Rwandans speared him five times until he died, and then cut off his head. Gruesome photos of Digit’s headless body received enormous publicity in the media, causing shock and dismay in millions of people who had seen photos of him in gentle communication with Fossey, as well as films produced by the National Geographic Society about her research. His death served to inspire both compassion and renewed conservation efforts for these beleaguered primates.

Fossey’s Karisoke Research Center expanded, and thousands of tourists came to glimpse the Mountain Gorillas in their forest home. The threat of poachers remained, however, and Fossey, after a fervent campaign to prevent further Gorilla killings, was herself killed. Her murder has never been conclusively solved, but Rwandans are the major suspects. She is buried in the reserve next to the grave of Digit. Fossey recounted her experiences with Gorillas in a book, *Gorillas in the Mist*, which was later made into a commercial film of the same title. The silverback star of this film was named Mrithi. Not long after the film was made, in May 1992, he, too, was shot and killed by Rwandan soldiers, surrounded by his family of 11. Even after being wounded, he managed to drag himself some 6 feet toward his attackers before collapsing and dying.

During the 1980s, the country of Rwanda had adopted Mountain Gorillas as an international symbol of wildlife protection during the 1980s, and when civil war broke out in the spring of 1994, both sides promised to spare them—promises that were not kept. In April 1994, the Rwandan civil war forced the staff of biologists at the Karisoke Research Center to depart (Perlez 1994). By early July, most of the wardens of the Rwandan Office of Tourism and Volcanoes National Park fled also, but a few dedicated guards refused to leave the Gorillas and remained. Soon after, Rwandan soldiers entered the park and ransacked the offices, destroying records and books and throwing computers out windows but, fortunately, sparing the lives of the guards and the Gorillas. The war claimed at least one Gorilla.
that year, however, when a male named Mkono was killed by a buried land mine (Tuxill 1997).

The staff of Volcanoes National Park was devastated by the war. Two-thirds of Rwanda's park employees died or remained in exile after the war ended, and 48 of 50 vehicles were destroyed (Salopek 1995). When surviving employees returned, many of them having been rescued from the masses of people living in refugee camps, with the help of United Nations personnel, they were delighted to see the Mountain Gorillas again. Nshogoza, a park employee who has spent 18 of his 44 years at Karisoke and has known generations of Gorillas, told a National Geographic writer, "When I was a boy, I heard that gorillas were men who were very bad and who went to live in the forest. But the gorillas are better than us. They are peaceful. They have no tribes. When they fight, it is for a good reason. We cut one another with machetes for zero" (Salopek 1995). To honor these guards, the park received the $50,000 J. Paul Getty Wildlife Conservation Award in May 1996, the money to be managed by the International Gorilla Conservation Program. Some was spent detecting and defusing more than 75 mines and booby traps left after the war, and other funds restored tourism in the park.

The Mountain Gorillas of Virunga National Park had been safe for a decade, but in 1995, Rwandan refugees, probably members of the routed army, entered their misty, forest home. In August and September 1995, three Gorillas--two silverbacks and one female--were found shot to death at point-blank range. One of these, named Marcel by the park scientists, was the most popular of Virunga's Gorillas, totally tame and gentle. He was so habituated to tourists that they could approach within a few feet of him, and hundreds of films and photos had been taken of him over the years. The bodies of Marcel and his mate were found sprawled out on the ground, full of bullet holes. "If someone comes in with a gun, the gorillas won't move out of the way," said Popol Verhoestraete, a field officer for the conservation program (Lang 1995). The killers left the bodies intact. These two Gorillas died trying to save their baby from poachers, who allegedly planned to sell him to a zoo. The park guards finally located this young Gorilla and seized him from the poachers, who were arrested. They carried the baby, who had become terrified and disoriented, in a small cage back to the family group. Not knowing if the frightened young Gorilla could survive without his parents, they released him, prepared to recapture him if things did not go well. After hesitating, he heard the sounds of his family and ran to join them. The leaderless and traumatized family group moved off into the forest.

Human Tragedy and the Looting of Virunga's Treasures: Page 8

Illegal snares have been threatening wildlife in these parks for generations. In the 1960s, Schaller saw two Gorillas in a group of 11 that had each lost one of their hands to snares (Schaller 1995). In Virunga National Park in mid-1995, a young male Gorilla was seen with a wire snare wrapped tightly around his foot, cutting off circulation, which threatened his life with septicemia (Salopek 1995). Just as the guards were preparing to capture him to remove the snare, they saw a huge male silverback watching over him. The park guards finally located this young Gorilla and seized him from the poachers, who were arrested. They carried the baby, who had become terrified and disoriented, in a small cage back to the family group. Not knowing if the frightened young Gorilla could survive without his parents, they released him, prepared to recapture him if things did not go well. After hesitating, he heard the sounds of his family and ran to join them. The leaderless and traumatized family group moved off into the forest.

In another snare incident in 1995, a very young female Gorilla was caught by the wrist in a snare set by Rwandans who entered Virunga to trap forest antelope. A film by Bruce Davidson, "Mountain Gorilla," shown on the National Geographic Explorer television series (September 14, 1996), chronicled the trauma of this tiny Gorilla, who struggled in vain to free herself, crying out and screaming in fear and pain. The park rangers thought that she might have been in the snare, which was tied to a tree, at least 24 hours before they discovered her. She was surrounded by her family, but her relatives could not bite through the snare because it was made of strong nylon cord from food sacks donated to the refugees. The silverback male, Ndingutse, tried again and again to free the baby, and her mother held her to comfort her screams, but there was nothing they could do to release her. Finally, the park guards, who had been standing nearby, were able to approach when Ndingutse moved away for a moment, and cut the cord. She escaped, but faced the threat of becoming snared again, and the cord remained around her wrist, a threat to her circulation as
she grew.

The snares are usually attached to bamboo poles, bent over to spring when set off. Davidson filmed Ndingutse's brother, a 7-year old named Luwawa, in an extremely intelligent and protective reaction to a snare he encountered. When Luwawa saw the snare, he circled it, obviously aware of what it was. Waiting for the rest of his family to arrive and witness the act, he reached over and snapped the pole like a twig, avoiding the noose and disarming it. Against guns, he had no defense, however. Soon after, Luwawa was found shot dead on the slopes of Virunga National Park. His brother Salama had been killed months earlier. Only his bones and skull, picked clean of meat, remained when park rangers found him. The slaughter of these silverbacks traumatized the five to 10 females in their groups and left the babies and young without a strong male to protect them. They became shy and confused, hiding from humans, and even other Gorillas. In 1996, another two Mountain Gorillas were killed, bringing the toll for the previous 17 months to 10, causing havoc and psychological trauma in the families left behind and irreparable genetic damage to these highly endangered animals. In neighboring Uganda, more of these gentle Gorillas died--four adults in Bwindi Impenetrable Forest were speared to death by poachers in 1995 (Salopek 1995). The expulsion of farmers to enlarge the park for Gorillas caused great resentment, and perhaps precipitated this carnage. Tourists who came to see the Mountain Gorillas in this new Bwindi National Park in March 1999 met disaster when Hutu rebels ambushed and killed eight people in one group. This was thought to be the end of Mountain Gorilla tourism in Uganda, but with increased protection of tourists, they are gradually returning. Poaching declined after the deaths of Gorillas and tourists, and by 2000, the Mountain Gorillas in the Virunga Mountains in both parks totaled 358 (Fisher 2001). Tourists coming to Rwanda's Volcanoes National Park are still in some danger when not in groups guarded by soldiers, however (Fisher 2001).

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The fact that Gorillas are gentle, kind and intelligent beings makes these cruelties all the more horrific. Millions of people saw a television report on August 16, 1996, showing Binty, a female Lowland Gorilla at a Midwestern US zoo, saving a little boy who had fallen into the exhibit and was lying unconscious; she picked him up and carried him gently to a door where keepers entered, setting him down in front of it. People were overwhelmed by her act of good will, as well as by her quick reaction. Many viewers had no idea that Gorillas would want to help a human in need, nor that she would use such good judgment in rescuing the boy, who recovered completely.

Koko, a captive Lowland Gorilla taught American Sign Language by Francine Patterson, president of the Gorilla Foundation, has learned some 800 signs and uses descriptive, imaginative language in naming unfamiliar objects, such as "finger-bracelet" for ring. She also paints, and when asked what one of her more colorful creations (reproduced on page one of The New York Times) depicted, she signed "bird" (Boxer 1997). We are only beginning to learn about these primates, but without strong protection, they may soon become extinct in the wild at the hands of humans.

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Many Africans have little respect for Gorillas. Hunters in Cameroon, when asked by researchers why they shoot Gorillas, replied "What's wrong with killing a Gorilla? They're fierce." One of the hunters told reporter Michael McRae that he was sure Gorillas were plentiful: "In Cameroon there are a million Gorillas. Three weeks ago, I saw sixty in one day. I shot three and then stopped . . . Why should I feel bad for a Gorilla? He is just a stupid animal" (McRae 1997). Education and an alternate source of income might change the opinions of these hunters. They have
the same views Westerners had before research studies and films introduced people to the true nature of these primates.

As far as their abundance, there are hardly a million Gorillas in Cameroon, in all of Africa or the world. Gorillas are declining toward extinction. Their total population is estimated at well under 100,000 and declining (McRae 1997). The Lowland Gorilla and Mountain Gorilla are considered separate species by the 2000 IUCN Red List, and both are classified Endangered. The US Endangered Species Act considers Gorillas to be a single species (Gorilla gorilla) and lists them as Endangered. Likewise, CITES lists Gorillas as a single species on Appendix I. The species is officially protected from hunting throughout its range, but national legislation is almost never enforced. The Lowland Gorilla is declining rapidly as a result of logging, killing for the bushmeat trade, and possibly ebola disease. Adults are often killed to obtain babies, which are traded on the black market to zoos in many countries. Hundreds of Lowland Gorillas are being slaughtered in Cameroon and other parts of their range, causing immeasurable trauma and cruelty to their close-knit societies, as well as ecological harm. The Moabi tree, a very important species for its fruits, seed oil, bark and wood, produces enormous seeds that Gorillas disperse (Tuxill 1997). African Forest Elephants are also crucial to the survival of Moabi trees, spreading their seeds, and they, too, are threatened with extinction.

The bushmeat trade is wiping out many other species of wildlife in wide areas around African villages. People set wire snares throughout the forest, into which rare deer, antelope, primates, wild pigs and a variety of animals blunder, struggling for days in great pain until the trappers arrive to kill them with knives. Even apart from the cruelty and conservation issues, the bushmeat and pet trades are not even lucrative. People make only a hand-to-mouth living from them, selling rare apes for a few dollars to traders, and other animals for a few cents. They are killing off their wildlife heritage while remaining in poverty.

Local people receive almost no benefit from logging, which is permanently devastating the old-growth forests. Tourists do not want to visit logged-over areas which have a fraction of the wildlife of unlogged forests and, in the case of clearcutting, an ugly, barren landscape. Trophy hunting, which is increasing in rainforests of Africa because of lobbying by the Safari Club and other organizations, is further reducing the wildlife. These hunters kill the largest and rarest animals--the prime specimens that should be left to perpetuate the species--and cause wildlife to become frightened and shy.

Mountain Gorillas are not killed for the bushmeat trade, but are shot for their body parts. None exist in captivity. These endangered gorillas are monitored within Rwanda's Volcanoes National Park by numerous researchers of the Karisoke Research Center, run by the Dian Fossey Gorilla Fund International. They are conducting a variety of different projects studying breeding, genetics and other aspects of their lives. One researcher noted the extreme devotion the Gorillas have for one another. Amahoro, meaning Peace, a 14-year-old silverback in the park, became lethargic and could not keep up with the group (Williamson 2001). Another male became his constant companion, and sometimes two males helped him along. The International Gorilla Conservation Programme was contacted for veterinary assistance. A veterinarian arrived and examined Amahoro from a distance, because he was defended by two other males (Williamson 2001). The next day, he was barely able to move and began coughing; the troop gathered around him, chest-beating in anxiety (Williamson 2001). After calls to gorilla veterinarians in the United Kingdom and the United States, the veterinarian decided that his problem was an infection in need of antibiotic treatment, which was administered by dart; he recovered fully (Williamson 2001).

Because of the international importance of the Mountain Gorillas and their precarious status, researchers from the National Aeronautics and Space Administration (NASA) began scanning their habitat in August 1994 during a 10-day environmental space satellite mission (Anon. 1994b). Overlaying the NASA images with data collected from navigation satellites and standard topographical maps is now providing an extremely detailed overview of the Mountain Gorilla's habitat. The habitat now protected totals only 285 square miles, not a large area for the 658 remaining Mountain Gorillas.

One wonders what their lives were like thousands of years ago when they roamed over vast, montane forests.
undisturbed. They may have shown behavior that has disappeared under these new conditions. During some parts of
the year, they might have frequented the lowlands, feeding on trees or other vegetation that has long ago disappeared,
replaced by farmer's fields. It is possible that they are not receiving adequate nutrition from the plants in their reduced
habitat. Their restricted ranges may be causing inbreeding. These Gorillas have suffered great psychological harm
from the constant threat of death from hunters, never knowing when they may be confronted and killed. The loss of
many family members to snares and shooting traumatized these sensitive and devoted primates.

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Another important Gorilla habitat in southern Zaire was invaded by many of the 400,000 Rwandan refugees who
fled to this area in 1994. This magnificent protected area—Kahuzi Biéga National Park—covers some 2,085 square
miles (Jay 1994). It is also a World Heritage Site. The large mammals of this park were surveyed in 1994 by the
indicated that the rare Grauer's Gorilla (Gorilla gorilla graueri), a subspecies of the Lowland Gorilla, was found in
fairly large numbers—at least 1,000 animals (Jay 1994). Elephants were also numerous (Jay 1994), and the park has
many rare birds (Collar et al. 1994). One camp of 50,000 refugees blocked a narrow corridor of forest that served as a
migration route for elephants and lone male Gorillas between major sections of the park (Jay 1994). The Wildlife
Conservation Society conducted a long-term study of the effects of hunting on wildlife in the park, supplemented by a
10-month United Nations probe, which released a report in April 2001 (Lauria 2001). Gorilla numbers have
plummeted here also, killed for food and trophies. As ABC News filmed one of the few remaining Gorilla families in
Kahuzi-Biega National Park during the summer of 2001, a male Silverback charged the camera crew. Only a decade
ago, Gorillas were tame and securely protected in this area. The UN investigation determined that Rwandan forces
and others have slaughtered all but two of 350 elephant families in the park for the illegal ivory trade (Lauria 2000).
This poaching was part of an organized network of corruption now looting parks and natural areas in the renamed
Democratic Republic of the Congo of diamonds, gold, timber and wildlife (Lauria 2001).

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In April 1995, a third natural area in Rwanda, Akagera National Park, became threatened when 700,000 cattle and
250,000 Tutsi herders moved 15 to 20 miles into the park (Lorch 1995). Because of a lack of arable land, Rwandans
have sought out parks as the last remaining unoccupied territory. Akagera National Park, located on the eastern
border of the country, has a wide variety of fragile habitats, from swamps and savannah to forest and hills, harboring
gazelles, Giraffes, African Elephants and Leopards (Lorch 1995). Rwandan authorities did not exclude the herdsmen
and their livestock but tried to convince them to cull their herds (Lorch 1995). In southern Rwanda's Nyungwe Forest,
the Wildlife Conservation Society's colobus project, which protected groups of hundreds of these monkeys, was also
devastated. In February 1995, investigators found that one-fourth of a 120-member colobus group had been killed
during the war, many for their long fur, which was used in marriage rituals (Fine 1995). Researchers came upon
animal snares and concluded that this national park would no longer be protected as such, but would become a
multiple-use forest (Fine 1995).

Uganda's rare wildlife also incurred losses from Rwanda's war and Burundi's civil strife in a ripple effect. An
extremely endangered bird of the Virunga Mountains, the Congo Bay Owl (Phodilus prigoginei), was recently
rediscovered after being thought extinct. Not seen since 1951, it was seen in Uganda's Itombwe forest in mid-1996 by
scientists from the Wildlife Conservation Society. A type of barn owl, the Bay Owl was previously known only from
a specimen collected in Zaire's Kivu province in 1951 (BI 2000, Hart 1996). The owl is restricted to a small area of
mixed rainforest and savannah near the Rwandan border (BI 2000). Dr. John A. Hart, the zoologist who found the
bird, saw farmers clearing the surrounding forest to create new farmland; they had entered the area seeking refuge from the civil wars in neighboring Rwanda and Burundi (Hart 1996). Although the total population of the Bay Owl is not known, it is presumed to be extremely small, and its future survival is uncertain. This area has no protected status and the entire known habitat of the endangered Congo Bay Owl is being degraded by clearing for livestock grazing and farming (BI 2000).

Some of Rwanda's refugees fled to Tanzania as well. More than 535,000 Rwandans traveled south into that country, staying in refugee camps near the border until December 1996, when the Tanzanian government demanded that they return to Rwanda. Former Hutu soldiers, fearing possible imprisonment for war crimes, convinced many refugees to travel east instead, into the heart of Tanzania's Burigi National Reserve. Once there, they stripped vegetation, killed large numbers of animals, began planting crops, and caused an increase in violent crime in local villages (AP 1996). At this point, the Tanzanian army routed them forcibly, and a stream of refugees many miles long was pushed back into Rwanda.

By 2001, a state of anarchy prevailed in the region, with these countries still at war. A United Nations report concluded that business and military leaders from Uganda and Rwanda were looting forests and parks in the Democratic Republic of the Congo for natural resources and meat (Lauria 2001). The New York-based International Rescue Committee reported in May 2001 that an estimated 2.5 million people have died as an indirect result of the previous three years of civil war in the Democratic Republic of the Congo (Salopek 2001). The fighting drove hundreds of thousands of people into the forests, where they lived off the land, dying of rampant disease and malnutrition in the rebel-held jungles (Salopek 2001). Gangs of poachers entered these rainforests, placing snares to capture elephants, Leopards, antelope, wild pigs, and monkeys for the bushmeat, fur and ivory markets in large cities. A camp of these poachers, many of whom come from neighboring countries, was encountered in the travels of Wildlife Conservation Society biologist Michael Fay. Fay and his group, including National Geographic Society filmmakers, came upon a sizeable camp with a very large Leopard skin stretched out on pegs, with hundreds of antelope and monkey bodies being cooked on open fires. Fay was so irate that he burned the entire camp and all the skins (shown on National Geographic Explorer, April 2001, entitled "Extreme Africa"). Although laws ban such killing, no game wardens patrol these forests, which were not part of a national park. Fay's intention in traveling across Central Africa, as described in National Geographic (Quammen 2001), was to show the world the great treasure being plundered by loggers and meat hunters before it is too late to save this large rainforest.

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The future of wildlife in Rwanda, the Democratic Republic of the Congo and surrounding countries remains extremely uncertain. The region is a microcosm of struggles that may soon be commonplace as human populations continue to rise and compete for dwindling land and resources. Markets as far away as Europe and North America buy the timber, minerals and ivory that are being exploited here at the expense of the environment. At the present rates of loss, little wilderness or natural forest will remain anywhere in the world. The damage done to parks and reserves by tree cutting, clearing land, and killing native wildlife, especially for commercial purposes, devastates biodiversity and endangers species reliant on these refuges, which are often their last remaining habitats. The World Conservation Union issued a report in 2001 on the urgent need to protect the world's 17,000 large nature preserves from intrusion by poor farmers, who have nowhere else to go (Revkin 2001). Half of these preserves now have people cutting forests and tilling land in biological hotspots and areas with large numbers of endangered species (Revkin 2001). At least 900 million people earn less than $1 per day, and 630 million live in areas of high biological diversity, according to the report's author, Jeff McNeely (Revkin 2001). Organizations, such as Future Harvest, which co-authored the study, are attempting to help poor farmers by providing means to enrich soil through fertilizers and rotating crops to maintain corridors of undisturbed land as wildlife habitat, and to grow shade crops, such as coffee and cocoa, which maintain forests (Revkin 2001).
John Terborgh (1999), a Duke University scientist, chronicled massive destruction of parks by farmers, logging, livestock and squatters in *Requiem for Nature*. This book paints a gloomy picture of wanton neglect, insufficient funding and failure by governments to protect parks and reserves, many of which harbor endangered species and magnificent landscapes. In Peru, for example, national park officials in the capitol city were not even aware of the existence of the Cerros de Amotape National Park. When Terborgh visited the park, he found it had been logged by the army, and cattle grazed throughout. Yet this dry tropical forest is one of the most important centers for endemic plants and animals in the world (Terborgh 1999). Similar tragedies are occurring in Mexico, where logging trucks leave the spectacular montane Nevado de Colima National Park loaded with giant tree trunks, and cows consume all the new tree saplings from the few remaining old alder trees (Terborgh 1999).

In Colombia's Tayrona National Park, six park officials have been killed by rebels and squatters, drug traffickers, loggers and others, who are destroying it; 20 percent of Colombia's 22.2 million acres of parkland is in the hands of squatters or has been deeded to private interests (Terborgh 1999). Colombia has an extremely rich diversity of tropical birds and mammals, and much of the pressure on its parks is a result of the US market for drugs, which offers poor people a far greater income than they can earn through traditional farming. The Santa Marta region in Colombia's northeast has an extraordinary wealth of birds and other species found nowhere else. The endangered Santa Marta Parakeet (Pyrrhura viridicata); Santa Marta Sabrewing (*Campylopterus phainopeplus*), a hummingbird; and the Santa Marta Bush-tyrant (*Myiotheretes pernix*), a flycatcher, are among these (BI 2000). Conversion of forest to marijuana and coca plantations, compounded by US-sponsored government herbicide spraying programs to kill drug crops threaten these and other species of the area. Spraying contaminates the soil and water, and often the small aircraft destroy natural forest and traditional crops instead of the target drug crops. In March 2001, four governors from Colombian provinces protested the $1 billion US herbicide spraying program, saying it was jeopardizing the health and food supply of farmers (Marquis 2001). They asserted that the defoliation ruined food crops and alienated people from their national government, while not succeeding in curbing the narcotics trade (Marquis 2001). The Santa Marta region has already lost 85 percent of its forest habitat (BI 2000). Rebels have taken over much of the area, clearing forest for drug crops and killing members of native tribes, who have traditionally tried to protect the forest and wildlife.

The Democratic Republic of the Congo is in the early stages of a similar anarchy involving rebels and forest destruction. The late President Mobutu and other high officials acquired immense fortunes by siphoning off the nation's mineral and tax revenues and foreign aid funds. They purchased palaces and estates around the world and lived sumptuous lifestyles. Almost none of the revenue from the rich mineral industry went to public works, with the result that the majority of the country's people are illiterate and poorly fed and housed. Even the streets of the capital city are unpaved and littered with trash. Mobutu's personal fortune is estimated at $3 billion by some, and as much as $10 billion by others (Sachs and Rotberg 1997). This country had been a territory of Belgium, known as the Belgian Congo, prior to its independence in 1960. Over the next three decades, the United States and European nations supported Mobutu's regime, which became increasingly autocratic and corrupt. Any opposition was quickly suppressed. By the mid-1970s, the country neared financial ruin (French 1997). The United States, the International Monetary Fund and the African Development Bank supported Mobutu's regime until the end of his reign (Rotberg 1997). The funds were spent mainly for military purposes and for Mobutu's personal enrichment.

Strong opposition to his regime came from an opponent, Laurent Kabila, who drove Mobutu from office in 1997 and renamed the country, the Democratic Republic of the Congo. Mobutu died September 7, 1997, in Morocco, where he had taken refuge. He left the country $14 billion in debt, a sum almost three times the country's gross national product (Sachs and Rotberg 1997). During the struggle among Mobutu's forces, Rwandans and Kabila's soldiers in Virunga National Park, four Mountain Gorillas were killed, one silverback and three members of his family. The International Gorilla Conservation Program reported that these Gorillas, who were tame and accustomed to tourists in Virunga National Park, were shot in crossfire when Rwandans entered the park and encountered Kabila's soldiers. Kabila was assassinated in 2000, replaced by his son, who was educated in Tanzania. He has moderated some of his father's extreme programs and appears to want to end the conflicts that are dividing the countries of

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Central and East Africa.

The new government plans to rebuild 50,000 kilometers (31,000 miles) of roads (Wallis 1998). Loggers supply local hunters with weapons, ammunition and a ready market for the meat of Gorilla, Chimpanzee and other protected and endangered species (Pearce 1995). In a growing trend, more and more Central and West African towns are becoming dependent on bushmeat. A study in the neighboring country of the Congo documented that a single town of 10,000 people consumed nearly 6 tons of wild animals every week (Counsell 1997). In Gabon, some 8 million pounds of bushmeat are sold annually, half in urban areas (Tuxill 1997). Recent research has determined that even selective logging has damaged ecosystems in tropical African rainforests, and hunting has eliminated keystone species, such as forest elephants, that spread the seeds of many forest trees (Counsell 1997). Logging also leads to uncontrolled hunting as roads open up wilderness areas.

The Democratic Republic of the Congo has major reserves of cobalt, copper, cadmium, diamonds, gold, and coltan, an extremely valuable material used in making cell phones and computer games. The mining of these resources has damaged large areas of forest as thousands of people vie for high-paying jobs. The mining is uncontrolled by the government, as deals are brokered between international corporations and rebel leaders or even with foreign governments, such as Rwanda, which controls the $250 million per year coltan trade.

Endangered Pygmy Chimpanzees, or Bonobos (Pan paniscus), are endemic to these forests in a relatively small portion of the Democratic Republic of the Congo, and their habitat is being decimated by loggers, who construct a maze of new roads (Kingdon 1997). Remarkably intelligent and peaceful, primatologists consider Bonobos to be unique in behavior and ecology; they represent a profoundly important example of evolution (De Waal 1997). Numbering only about 13,000 animals, they are declining and classified as Endangered by the IUCN. No major reserve has been set aside for them. Another rare animal of the region, the Bongo (Tragelaphus eurycerus), a beautiful, striped forest antelope, is listed as Endangered in the eastern part of its range in Kenya, and Near-Threatened in the Democratic Republic of the Congo, as logging operations have surrounded the boundaries of an important reserve for this species (Counsell 1997; Hilton-Taylor 2000).

Wildlife Conservation Society biologist Fay finished his 1,200-mile voyage through many unexplored regions of the Democratic Republic of the Congo and neighboring Gabon in the spring of 2001. He found Chimpanzees and Gorillas that had never seen humans and approached his group with curiosity, and other areas where these great apes were completely absent, perhaps as a result of ebola disease (Quammen 2001). Impenetrable swamps and miles of tangled shrub, giant trees alive with insects, birds and lizards, abundant signs of forest elephants and buffalo, networks of streams and spectacular vistas of vast waterfalls and distant mountains still exist in the region, yet loggers, gold miners, poachers and displaced people are increasing in number, destroying this wilderness bit by bit.

A sign of the future, should logging and bushmeat hunting continue, was a traumatized, orphaned monkey, tethered on a rope in a hunter's camp. Seen by Fay's group, its photograph appears on the cover of National Geographic (March 2001). This young Mandrill (Mandrillus sphinx) had perhaps witnessed the slaughter of its entire family and was now in a strange and abusive environment without its fellows. This species is threatened in the wild and listed as Vulnerable by the IUCN. Among the largest of all monkeys, Mandrills weigh up to 54 kilograms and live only in the rainforests of Cameroon, Equatorial Guinea, Gabon and the Democratic Republic of the Congo (Nowak 1999). The adult male has an extremely dramatic appearance, his face spectacularly marked with electric blue ridges beneath his eyes, set off by a bright red stripe that goes down the middle of his nose and covers a large, round nose patch surrounding his nostrils. His face is framed by a mane of grizzled, olive-brown fur. The female is a somewhat smaller and less flamboyant version of the male. These are the only primates that move about on the ground in very large groups, numbering up to 600 animals. They feed on a large variety of plants, roots, fungi, invertebrates and, occasionally vertebrates (Kingdon 1997). Their sole habitat--undisturbed, primary rainforest--is disappearing rapidly. They are intensively hunted in some areas for the male's shaggy mane, which is used for capes and headdresses (Nowak 1999).
Mandrills are also killed for bushmeat, which is their most immediate threat, according to biologist Jonathan
Kingdon (1997). Mandrill meat is more highly valued in these markets than beef, and hunters employ dogs, guns,
spotlights, deep-freezers and trucks to harvest them, especially in the Democratic Republic of the Congo and Gabon
(Kingdon 1997). These magnificent primates may be important seed dispersers, yet research has only begun on their
wild ecology. They may vanish from their once vast realm before their role in the African rainforest is understood.

These ecological and political crises were long in the making. Decades ago, international funds such as the World
Bank could have developed environmentally friendly industries, such as ecotourism, in Rwanda, Uganda and Zaire,
with a large percentage of the profits going to local people. Aid organizations could have funded or encouraged these
nations to promote literacy and conservation education and to provide birth control education. Foreign aid to Zaire by
the United States and European countries could have gone toward helping the people of that country achieve
economic independence, while promoting environmental protection.

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There is worldwide interest and concern for the survival and conservation of the Mountain Gorillas and other
wildlife of the Democratic Republic of the Congo, Rwanda and Uganda and an enormous potential market for
etourism in many parts of these countries that would benefit both the people and the wildlife. Mountain Gorillas
have attracted $10 million in tourism revenues to Rwanda (Tuxill 1997). The forests of all three countries, as well as
those to the west in Cameroon, the Ivory Coast, the Congo (as distinct from the new Democratic Republic of the
Congo), and Gabon harbor many zoological curiosities that could attract tourists, such as enormous Goliath Frogs,
largest of all frogs, now threatened from over-collecting and habitat loss. Beautiful Congo Peafowl (Afropavo
congensis), the only pheasant species in Africa, are endemic to the Democratic Republic of the Congo, resident in the
Kahuzi-Biega National Park and several other reserves (BI 2000). Threatened by hunting, these large, crested birds
would be a big attraction for bird-watchers. Other unusual wildlife, such as tiny forest antelope less than 2 feet tall,
inhabit these rainforests, where towering trees draped in mosses and orchids have crested eagles nesting in their
crowns. At the forest floor, blizzards of butterflies drink at streamsides, while colorful lizards flit up tree trunks. One
innovative approach to wilderness protection could acquaint people around the world with such natural treasures
without their having to travel. It could also help local people with funding. It is the use of videocameras connected to
satellites that record wildlife and landscapes for the Internet. Internet users pay small fees to tune into these
videocameras and their websites. A large portion of the funds could be given to local people. This popular new
technology has helped South African national parks with their expenses. Small cameras can be placed in extremely
remote areas and can be operated on solar power. They have virtually no impact on the environment, unlike large
numbers of ecotourists.

One method of protecting endangered forests, which play an important role in reducing global warming, is the US
Initiative on Joint Implementation, which encourages public utility companies to invest voluntarily in forest
conservation. Through the Carbon Sequestration Program, sizeable expanses of tropical forests, which absorb
enormous amounts of carbon dioxide, are being protected. Wisconsin Electric Power Company, Detroit Edison,
PacifiCorp and Cinergy donated $2.6 million in 1995 for a 15,035-acre forest in Belize, adjacent to the Rio Bravo
Conservation and Management Area. American Electric Power in Indiana is cooperating with PacifiCorp and British
Petroleum to protect 5 million acres of Bolivian forests from logging (Passell 1997). This approach protects large
amounts of forest in a cost effective manner: the estimated cost of sequestering 1 ton of carbon this way is just 37
cents, less than 1 percent of most emissions-reducing technology, according to The New York Times (Passell 1997).
General Motors has helped purchase 30,000 acres of forest in southeastern Brazil, home of the tiny Golden-lion
Tamarin (Leontopithecus rosalia). More than 90 percent of this forest, known as the Atlantic Coastal Forest, has been
destroyed, and it is one of the world's greatest centers of biodiversity (Mittermier et al. 1999). This program should be
used in conjunction with reduction of emissions from power plants and vehicles--not as a substitute.
In another cooperative venture to save tropical rainforests, US chocolate makers are urging owners of small farms to grow cacao, a crop that is grown in the shade of large trees (Yoon 1998). A worldwide shortage of chocolate has resulted from the spread of diseases in large-scale cocoa plantations in tropical regions around the world. Such diseases do not spread or take root when crops are grown in smaller, shaded areas which have a natural diversity of plants and animals, including insect-eating birds and reptiles (Yoon 1998). With the world's sweetest tooth, the United States consumes 629,000 tons of chocolate per year, far outstripping its nearest competitor, Germany, where 285,000 tons are eaten annually, according to the International Cocoa Organization. The American Cocoa Research Institute, the Smithsonian Migratory Bird Center and various candy companies, including Mars, Cadbury, Nestle and Hershey, are all cooperating in strategies that promise to conserve tropical trees and wildlife, and grow cacao plants in ecological ways (Yoon 1998). Huge plantations of cacao in Brazil and elsewhere have lost as much as 80 percent of their crop to fungal and other diseases in recent years, diseases that often spread in large plantings of a single crop.

Scientists have long noted that birds are abundant in small forested cacao and organic coffee farms, and they are encouraging this new cooperation to protect tropical birds as well as the hundreds of species of North American and European birds that winter in tropical countries. Shade-grown, organic coffee is also helping to save rainforests. A trend away from traditional shade-grown coffee into new strains that are grown in the sun, has resulted in the clearing of millions of acres of rainforest to grow this coffee for markets such as the United States. To counter this trend, some organic companies, organizations and institutions, such as the Smithsonian, are taking a strong stand urging people to buy shade-grown coffee to protect rainforests and migratory birds from North America that winter in Latin American forests. This coffee is sold in many natural food markets and chains, such as Trader Joe's. The restaurants and coffeehouses, such as Starbucks, that still use sun-grown coffee should be encouraged to sell shade-grown coffee to help preserve forests and wildlife.

Debt-for-nature swaps can provide relief for countries saddled by debt from loans made by the World Bank and other international funds. Through these swaps, a portion of a nation's debt is paid by the donor, which may be a conservation organization or other entity, in exchange for the establishment of parks. These swaps have been undertaken in Madagascar and several other countries. A growing movement to convince donor countries to forgive these debts is being waged by conservation and human rights organizations. Should these debts be erased, much environmental degradation would be avoided, since many destructive programs are carried out solely to pay off debt. One such program, called "Avanca Brasil" or "Advance Brazil," envisions a massive development program in the Amazon Basin, crisscrossing the forest with roads and railroads and damming rivers to produce energy (EII 2001). A minimum of 28 percent of this great forest would be destroyed and, more likely, at least 42 percent (EII 2001). Just since 1995, 5 million acres of Amazon forest have been leveled for development (EII 2001). These forests, a major factor in preventing global warming through absorption of carbon dioxide, produce vast amounts of oxygen and harbor a large percentage of the world's biodiversity.

If no positive steps are taken, these last sizeable rainforests will be gone, and severe climatic and ecological harm will result. The great forests of Central Africa are also in the process of being destroyed. World-class national parks, such as Virunga, may be completely destroyed within a generation by illegal logging, squatters and bushmeat hunting.

**Earth's Worth**

Governments around the world grant logging or mining contracts on a daily basis. Thousand-year-old forests and wildernesses covering vast areas are bargained away in deals made between corporate representatives and government officials, often through bribery. The fates of the native wildlife and plants of these regions hinge on the type and level of exploitation. Wildlife, plants, and their habitats survive or die out as a result of decisions made by politicians, most
of whom have no understanding of the importance of preserving diversity and extensive areas of natural landscape. At the present rate of destruction, wilderness will soon be gone, carved up and exploited for commercial purposes or destroyed by settlers.

Page 1 (Wealthy Countries)
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Earth's Worth: Page 1

Citizens of the wealthiest countries represent some 20 percent of the world's peoples, but consume 80 percent of the planet's resources. The high standards of living that are enjoyed in North America, Western Europe and Japan depend in large part on importation of low-priced raw materials from poor countries. International corporations have few laws restricting their activities, which are causing major damage to forests, rivers, lakes and other environments. Moreover, the market provided by Europe and North America and, most recently, by some countries in East Asia, encourages fast-paced exploitation. Many of the recent logging contracts signed in Africa, Russia and South America have been negotiated to repay debts incurred from loans from the International Monetary Fund, World Bank or other funds. These loans are often for the construction of dams, factories or mines that primarily benefit third parties, such as large corporations. To repay the loans on schedule, countries are pressured to exploit their natural resources, forests and minerals, which are sold at low prices. Such loans rarely help nations develop according to their avowed intention, but send poor countries into an ever escalating debt that requires more and more forest cutting and other exploitation for short-term gains.

The US government's foreign aid tends to encourage mega-projects that do not help the populations of developing countries. Development that is environmentally friendly, based on small-scale business or ecotourism, is of far greater value in helping people as well as preserving wildlife. The decades that have passed since the publication of E.F. Schumacher's 1973 book, Small is Beautiful. Economics as if People Mattered, have only validated the philosophy of helping people through small-scale grassroots programs. Economic development programs that respect both people and the environment by finding means through which people can be economically secure, maintain their culture and live in their ancestral regions without destruction to natural ecosystems, should be the model in the future. The concept of small-scale eco-development has been endorsed by various conservation organizations, and use of solar cookers, bio-gas and fertilizer from livestock manure, development of crafts and other small-scale industries, education on crop rotation and use of crops adapted to particular areas, preserving forests to prevent erosion and not living in flood plains are examples of this approach. A wide variety of organizations are carrying out such programs in many parts of the world. Such approaches are also needed in North America and Europe, where conservation education has failed to teach such basic principles, and government officials lack basic knowledge about the environment.

Earth's Worth: Page 2

Subsidies provide another disincentive to conservation. On a worldwide basis, governments spend $700 to $900 billion per year on subsidies that actually encourage the destruction of forests and other natural areas (Grossfeld
In the United States, the taxpayer pays for road building in national forests to enable logging companies to enter wilderness areas. The Forest Service charges these companies a fraction of the retail value of these trees—sometimes $10 or less for a giant tree worth $25,000. Yet almost no subsidies or tax benefits are paid for the use of recycled materials, such as paper, that would save the cutting of thousands of trees. For this reason, it is cheaper in the United States and many other countries to cut forests for paper than recycle used paper, and to obtain minerals from mines rather than from recycled metals. To further the lack of logic of this situation, one US government department encourages environmental destruction through taxpayer dollars subsidies for logging and mining, while others spend public funds to clean up the pollution and preserve species that become endangered from these activities.

A coalition of 26 organizations compiled information on US subsidies that have negative effects on the environment, entitled "Green Scissors '98." It found that the United States spends $49 billion every five years on subsidies and environmentally destructive programs. The report recommended drastic slashing in these "polluter pork" programs to protect the environment and save tax payers billions of dollars of misspent money each year. The Institute for Research on Public Expenditure in the Netherlands produced a report in 1997 entitled Subsidizing Unsustainable Development: Undermining the Earth with Public Funds. After a lengthy examination of subsidies around the world, which range from inexpensive irrigation water to free land for settlers and mining operations, this study concluded that subsidies are economically counterproductive and disastrous to the environment, resulting in deforestation, overfishing, polluting and other destructive activities (Crossette 1997a). Many species are endangered as a byproduct of these subsidies.

Earth's Worth: Page 3

The gross national product of a country is considered the major yardstick by which economic success is measured, and the natural world is traditionally valued in terms of the revenues it produces when exploited. This rigid and limited evaluation was recently examined and found lacking by a team of 13 ecologists, economists and geographers, who analyzed the monetary value of ecological systems to human society. They sought to place specific values on 17 types of environmental services that 11 ecosystems provide to humans each year (Stevens 1997b). Among these ecosystems were open oceans, estuaries, seagrass and algae beds, coral reefs, tropical and temperate forests, grasslands and rangelands, tidal marshes and mangroves, wetlands, lakes and rivers (Stevens 1997b).

In a report published in the scientific journal Nature, these specialists estimated the total global value of these ecosystems and their production at $16 trillion to $54 trillion per year, with $33 trillion the most likely figure; by contrast, the gross national product (all the goods and services produced by the world's peoples each year) was estimated at a mere $18 trillion (Stevens 1997b). They rated the value of nature's climate regulation at $684 billion, natural raw materials at $721 billion, pollination by natural pollinators at $117 billion, recreation and ecotourism provided by nature at $815 billion, soil retention and formation at $53 billion, water supply at $1.7 trillion, and food production at $1.4 trillion. Thus, ecosystems such as forests, which provide several of these ecological services, such as climate regulation, ecotourism, soil retention and water supply, are worth far more left standing than cut as lumber for short-term profit. Wildlife performs services as well, including natural pollination, attraction of ecotourism and recreation such as bird-watching, and others such as seed dispersal and soil enrichment. The linkages between particular ecosystems and local economies were systematically analyzed in this study; for example, the Louisiana shrimp catch depends on wetlands as nurseries, and these wetlands also provide flood control and other services in their overall value (Stevens 1997b).

If the costs of destroying these ecosystems were computed when development was considered, such as the loss in flood control and water pollution filtration by wetlands, the researchers concluded that society would be more likely to protect them from destruction. They pointed out that when a wetland is filled in for a shopping center, the dollar value
of that habitat in preventing floods and cleansing water is not figured in, resulting in a gradual erosion of natural wealth (Stevens 1997b). The heavy rains that ravaged many parts of the world in 1997 and 1998, caused by El Nino's effect on the weather, produced floods and mudslides in areas where forests had been cut and wetlands filled. Hundreds of lives were lost, and property damage totaled billions of dollars. Areas with forest and extensive wetlands were hardly damaged. Some wetlands are being restored in the United States--river courses returned to natural curves, and flood plains protected from building, in the realization that the lost income from not developing these areas is more than compensated for by the protection from natural disaster they provide, which creates economic stability in developed areas located far from wetlands.

However important such economic analyses are in re-evaluating our destruction of ecosystems, preserving nature cannot be reduced to economic calculations. If this is the sole basis of conservation, it could lead to destructive manipulations in the environment designed to accommodate complex economic theories. The major lesson to be learned from these new ways of looking at Earth's use to humans is that we have grossly underestimated life-giving ecosystems and their wild fauna and flora. They have evolved over a period of millions of years, and we must respect and preserve them in as natural a state as possible.

Although people in the United States are far more aware of the ecological value of wetlands and forests, this seems to have had little effect on preserving such valuable ecosystems. Trees are still cleared on steep slopes and other fragile areas, for example. This causes landslides and mudslides and floods, resulting in destruction of homes, roads, farmland and other valuable assets, as well as siltation and pollution of waterways. Yet there is little thought given to banning this practice by law. The World Resources Institute in Washington, DC, has calculated that the loss of value from deforestation is four times as high as the value of the timber extracted, and the depletion of soils, forests and fisheries examined in this study resulted in a 25 to 30 percent reduction in potential economic growth (Stevens 1997b).

A 1997 collection of articles, *Nature's Services: Societal Dependence on Natural Ecosystems* (Island Press), edited by Dr. Gretchen C. Daily, a biologist at Stanford University, concludes that many ecosystems, once destroyed, are either irreplaceable or take thousands of years to replenish, such as ancient aquifers or old-growth forests. Daily concluded that we cannot afford to wait to act until we have disrupted the planet's life-support system beyond repair (Stevens 1997b). Some 20 scientists contributed to this book, including Dr. Norman Myers, author of many books on the value of wild plants to medicine and agriculture. He documented the multibillion-dollar insurance value that wild grains provide in disease resistance (Daily 1997). Katherine Ewel of the Forest Service discussed the lower cost of treating sewage in constructed wetlands, as compared to treatment plants, and Gary Nabhan and Stephen Buchmann found that wild pollinators save American farmers $1.6 billion annually (Daily 1997). This book's experts make a strong case for protecting environments in a natural state and provide evidence that we are only beginning to appreciate the complexity of these ecosystems. This can apply, for example, to commonly accepted mitigation rules used in US wetland-filling cases, in which a wetland is created for one that is destroyed. Ecologists consider that the natural wetland is far more complex and irreplaceable than the man-made one, and they should not be considered equal under the law.

**Earth's Worth: Page 4**

In the United States, many politicians and businessmen have opposed environmental and endangered species legislation on the grounds that these laws reduce the profits of commercial ventures. They propose that every developer whose project is blocked by such legislation should receive financial compensation from public funds. These businessmen calculated the value of their financial loss on the appraised value of their land, and added potential profits lost. In 2001, for example, farmers in California sued the Fish and Wildlife Service to compensate for water it lost when a water allotment was diverted for endangered salmon and smelt (Russell 2001). The court ruled in favor of
the farmers and ordered the government to pay them the value of the lost water, arguing that the government is constitutionally prohibited from taking property without paying for it (Russell 2001). This ruling could end in negating the effectiveness of habitat protection under the Endangered Species Act for lack of sufficient funding. Ecologically, farmers depriving endangered fish of habitat are impoverishing entire aquatic ecosystems and, in all probability, polluting waters with pesticides and other chemicals in the process. Yet if the value of maintaining the ecosystem in the San Francisco Bay area was calculated in terms of the millions saved in flood damage control, water purification, production of shrimp and other fish, the ecological values would far outweigh short-term commercial losses. If environmental protection laws were written in terms of ecological values, destroying natural ecosystems for the economic benefit of a few would not be allowed.

When the Northern Spotted Owl (*Strix occidentalis caurina*), native to old-growth forests in the Pacific Northwest, was listed as Threatened on the Endangered Species Act and large sections of its habitat protected, it became a focal point, polarizing pro-logging and anti-logging activists. Owl haters urged others to kill these birds, who were blamed for ending the logging industry, with bumper stickers such as "Kill an Owl, Save a Job." Such venom totally obscured the fact that the forests were being overcut and that logging jobs were destined to be cut anyway, as the last old-growth disappeared under the saw. A state in the heart of this owl's range, Oregon, found that decreasing logging ended in helping its economy; an influx of technological businesses provided better salaries than those paid for logging jobs (Egan 1994). The Governor of the state supported the logging restrictions as helping to maintain the overall quality of life in the state, preventing floods and attracting tourists, which are supplying another large segment of the state's revenues. Yet pro-business interests continue to fuel the fires, writing books which conclude that it is easy to understand why a landowner, having an eagle or Spotted Owl nesting, could be tempted to destroy a nest or even kill an endangered animal. Such people maintain that the owner of such land might be expected to destroy it by logging or development prior to designation of Critical Habitat for the species in order to be able to reap profits. The Northern Spotted Owl has, in fact, declined since it was listed on the Endangered Species Act, mainly as a result of Habitat Conservation Plans that have been detrimental to its populations, but also, very likely, illegal killing played a role.

One conservative critic of the Endangered Species Act noted that the Act "has undoubtedly caused the deliberate destruction of millions of other endangered plants and animals" (Jacoby 1998). This explains, according to the critic, why after 25 years, 97 percent of the endangered species list remains endangered (Jacoby 1998). If so many endangered animals are being killed deliberately, enforcement of the Act is urgently needed. Such attitudes are extremely detrimental to the survival of endangered species and should be addressed. Although many animals are being killed, the main reason these species remain endangered is a deteriorating environment and a half-hearted commitment on the part of the US government and the public to saving these threatened species.

A study of America's environmental laws and their effect on the economy was conducted by the nonprofit Institute for Southern Studies, a social policy research group. It concluded: "At the policy level, the choice is really not jobs versus the environment. The states that do the most to protect their natural resources also wind up with the strongest economies and best jobs" (Smothers 1994).
buys seeds for farmers to plant vegetables to sell to its lodges and brings villagers from the area into the reserve to educate them about wildlife and ecotourism. Conscorp runs some 22 small—but expensive—lodges in Africa from Kenya to Zanzibar, none of which allows game hunting; its revenues topped $30 million in 1996. Costa Rica, one of the world's primary ecotourist countries, has set aside 25 percent of its land for conservation, and ecotourism draws 1 million visitors per year, who spent some $800 million in the country (CNN special: "What Price Nature?" March 2001). This industry continues to grow at a rate of 20 percent a year, with visitors coming to its cloud forests, tree canopy tours and beaches where sea turtles nest.

In terms of the value of animals, the income from exploitation is dramatically lower than that from ecotourism. African Elephants, for example, when killed for trophies, earn some $4,000 to $20,000 for governments in fees, and the tusks sell for an average of $2,000 apiece. From ecotourism, however, an East African elephant produces an estimated $1 million during its 60 years (Currey and Moore 1994). A 1989 analysis found that the viewing value of tourists who come to Kenya to see elephants is estimated at a minimum of $25 to $30 million per year (Brody 1994). Tourists come from around the world to see these massive animals, and the governments of most African countries place a higher value on live elephants than dead ones. Trophy hunting also kills off the big bull elephants, which are the main breeding animals, as well as large matriarchs, who play a crucial role in guiding and protecting herds. These are the very elephants tourists come to see.

Endangered species in the United States also draw many tourists who travel long distances to see Whooping Cranes in their wintering marshes in Aransas, Texas; Gray Wolves in Yellowstone National Park; and California Condors newly reintroduced near the Grand Canyon.

Whales are extremely valuable in ecotourism. They are becoming major money-earners to the increasing numbers of whale-watching tours worldwide. In 1992, 37 countries conducted whale watching tours, and the United States alone earned $260 million. Since then, whale-watching has grown in popularity. A study by the International Fund for Animal Welfare found that in 1998, revenues from whale-watching exceeded $1 billion, with 9 million people participating in 87 countries and 500 communities. By contrast, a single Minke Whale sells for about $100,000 (Talmadge 2000), a one-time profit from these long-lived animals that is far less than they would produce during their lifetimes. Yet wealthy countries, such as Norway and Japan, are still killing whales, catering to whalers, who form a tiny segment of their populations.

Bird- and wildlife-watching and feeding have become major industries in the United States. A Fish and Wildlife Service survey found that in 1991, Americans who watched, photographed and fed birds and other wildlife spent $18.1 billion (Blom 1997). The spending generated nearly $40 billion in total economic activity and supported 766,999 jobs (Blom 1997). Equipment sales for wildlife appreciation totaled $10.6 billion, followed by $7.5 billion spent on travel-related goods and services, and $1.5 billion on wild bird feed (Blom 1997). A 1996 survey found that while only 3 million people in the United States hunted migratory birds, 25 million Americans were considered avid bird-watchers who would drive a mile or more to observe or photograph birds, and 50 to 60 million people in the United States watch birds at their feeders.

The Fish and Wildlife Service found in a 1996 survey that wildlife watchers, fishers and hunters spent $100 billion on equipment, travel, and publications. When total economic profits were analyzed by the Fish and Wildlife Service in terms of hunters vs. bird-watchers, the bird-watchers spent some $14 billion on all aspects of bird-watching, while bird hunters spent $1.3 billion. American Demographics magazine estimated that an even greater amount, $18 billion, was spent by American birders on their hobby. In economic output, Ducks Unlimited, a hunting organization, estimated that bird hunting generated $3.6 billion, while non-consumptive use of birds earned $15.9 billion.
Consumptive users of wildlife, such as hunters, make up a small minority of the public, approximately 14 million, or 5 percent, and fewer than 1 percent are trappers, yet these interests control state wildlife departments and heavily influence the Fish and Wildlife Service. The fees from hunting licenses fund the majority of state wildlife departments. These departments manage all wildlife within a state, in spite of the fact that only a small number are hunted or trapped, with the result that habitats are manipulated to benefit hunted animals, such as deer, by encouraging shrub and second-growth forest, while species needing old-growth forest, such as woodpeckers, decline as these forests are cut. Endangered species are conserved by state Natural Heritage Programs, but funding is often miniscule in comparison with the fees from hunting. Funding sources include income tax rebates, vanity license plate revenues and grants from general funds, but generally do not begin to fill the need for habitat acquisition, education and conservation programs and research. Greater funding is needed for these programs, perhaps through a small tax, such as the less than 1 percent sales tax in Missouri for wildlife and conservation programs. It generates more than $100 million annually. A tax for non-game and endangered species would provide major funding for these state programs, which fill an important role not played by federal Endangered Species Act programs.

The recent phenomenon of tropical forest ecotourism has produced other comparisons in revenues of exploitative vs. non-consumptive use of wildlife. Dr. Charles Munn, an ornithologist with the Wildlife Conservation Society is studying macaws in Peru's massive Manu National Park, which is the size of Massachusetts. He estimates that a wild macaw is worth $165,000 a year, based on revenues from the growing number of tourists who come to see these colorful, long-tailed parrots in spectacular flights (Munn 1992). A bird trapper receives only a few dollars for a wild macaw which, if sent to a pet store in Europe, might sell for $1,000. Income from the pet trade goes primarily to a small number of exporters, importers and retailers. It does not protect the habitat of the birds, nor does it pay for population surveys to prevent depletions. Moreover, from capture onward, these wild birds are treated very inhumanely, causing high rates of injury and mortality. The capture of wild birds for the pet trade is banned by the majority of the world's nations, but the few that continue it contribute to depletion of wild bird populations, smuggling, and their inhumane treatment (see Trade chapter).

Under Munn's calculations, the value of each macaw in the wild over the period of its life, which averages about 50 years or more, totals some $8,250,000--an enormous sum. This money flows into local economies of villages and towns near the park, local hotels, taxis, restaurants and other businesses. For many poor areas, such income provides much needed services and raises the standard of living. Tourist money is also spent in cities where visitors arrive, and constitutes a major portion of airlines' revenues. Manu National Park has been declared a Biosphere Reserve in recognition of its importance as a center of biodiversity. Its 7,000 square miles protect a large portion of Peru's tropical rainforest. Manu's ecotourism companies are considered models for sharing revenues with local people and protecting indigenous tribes (Munn 1994). These companies have tours geared toward viewing certain spectacular or endangered species, such as Giant Otters (Pteroneura brasiliensis) (Munn 1994).

Although some abuses of the land have resulted from ecotourism, including large numbers of people who can overwhelm delicate habitats, these situations are rare and can be rectified. Ecotourism helps far more animals and habitats than it hurts and, often in an indirect way. An important byproduct of tourism is the protection it accords animals in the areas visited, especially outside national parks and reserves, where most wildlife is on the decline. The presence of tourists tends to deter poachers, and in a growing number of areas, revenues accrue to local people from tourists use of restaurants, gift shops, taxis and other businesses. This encourages residents to cooperate in protecting the wildlife and the environment. This applies as much to African savannahs, as to North America or Europe. The non-profit Eco-Tourism Society, located in North Bennington, Vermont, distributes information on responsible travel that does not result in ecological damage and respects local residents. It recommends that tours
share profits with residents.

Many conservation organizations now run ecotours and issue pamphlets, such as the National Audubon Society's guidelines for environmentally responsible travel, which describes dangers to specific habitats, such as coral reefs, and suggests non-intrusive viewing and tours that enhance local conservation. Trade in local wildlife is prohibited. The Wildlife Conservation Society has proposed that a fee from tourists be set aside for a land bank to fund national parks in Central America.

As ecotourism rises in its importance to national economies, whale-watchers, tropical forest visitors, coral reef divers and others will demand pristine environments with diverse wildlife. This will be a strong force in favor of passage of strict environmental laws around the world. Moreover, the value of wilderness increases as more and more tourists seek out undeveloped areas. Governments should no longer consider wilderness as wasteland, but as a precious commodity.

The economical arguments in favor of preserving the natural world are strong, but we should be equally motivated by our affinities for our fellow creatures and the natural world. Our ties with nature are very deep and span millions of years. Modern technology has made us forget the awe with which we once regarded the Earth and has encouraged a false sense of superiority and complacency.

**Actions and Attitudes**

Biologists, conservationists, government officials and many members of the public are regarding the rise in the number of extinctions and endangered species with great alarm. The United Nations has found that species and habitats are being lost at an "unprecedented rate" (Stevens 1997c). The need for effective action has never been greater. Fortunately, concurrent with the general deterioration of the environment and wildlife populations, programs for the preservation of rare species have mushroomed, along with a new compassion for animals. These programs address the status of a small number of species, and if expanded to include a far greater percentage of threatened species, the extinction rate would decline.

Some conservation efforts to preserve endangered species have had remarkable success, while others have had mixed results. The expenditure of large sums of money to save some endangered species has not automatically resulted in an increase in their numbers. It is a common misconception that endangered species, once accorded legal and habitat protection, will survive and increase in number. Unfortunately, many species have died out in spite of conservation measures on their behalf. Through examination of failed programs, fewer mistakes can be made in the future.
The Javan Tiger (*Panthera tigris sondaica*), for example, was given legal protection and reserves in the 1920s and 1930s, yet it was poached to extinction. If a single facet of a conservation plan is lacking, faulty or unfunded, this can spell extinction for the animal or plant. A reserve for this Tiger was set aside too late, when it was nearly gone. As Indonesia's most heavily populated island, Java had little forested land left, and by 1972, only four or five Tigers survived (Matthiessen 1997). With a very limited population under constant threat from poachers and big game hunters, these Tigers needed intensive anti-poaching protection and biological surveys, which they never received. Without well-equipped and motivated park rangers, research and surveys, education of local people and the goal of conserving Tigers established as a major priority of the Indonesian government, there was no chance of saving these cats. The last Javan Tiger was seen in 1976 (Matthiessen 1997).

Since the 1970s, Tigers have experienced precipitous declines throughout their remaining Asian range. Killed for their "magical" bones and body parts, which are used for Traditional Medicine as well as for potions that are intended to impart virility and strength, these magnificent cats are snared, trapped, poisoned and shot in devastating numbers, estimated at a minimum of one Tiger per day of the fewer than 5,000 that survive. A Tiger is now worth at least $50,000 in Traditional Medicine, placing a price on the head of every wild Tiger. Many experts are predicting the Tigers' extinction outside of zoos within a few years. One program, however, has shown success in stemming this decline. In Russia's Far East, strong anti-poaching programs and intensive research and survey projects have halted the decline of the largest subspecies, the magnificent Siberian Tiger. This work has been funded by outside organizations including the Global Survival Network, a Washington, DC, organization, and other groups.

Only about 250 Siberian Tigers survived in the wild in the early 1990s, and with 50 or more being killed by poachers each year, their future seemed dim. The Russian government, in economic chaos, was unable to pay wardens a reasonable salary. Many resorted to illegalities to take advantage of the high value of dead Tigers. The open border with China brought an influx of smugglers and traders offering bribes of $5,000 or more to wardens and poor villagers for killing a Tiger. With the infusion of some $750,000 from conservation organizations since 1993 and help from the US Fish and Wildlife Service, well-armed and well-paid wardens now patrol most of the Siberian Tiger's habitat in modern vehicles. Without this outside funding, which must be continued indefinitely, poaching would have extinguished the remaining wild Siberian Tigers. Biological research on these Tigers is being carried out by the Idaho-based Hornocker Wildlife Institute, along with Russian scientists. These studies have surveyed their populations and obtained the first estimate of their habitat needs which, for males, is at least 450 square miles. One female Siberian Tiger named Lena, being radio-tracked by these researchers, was killed by poachers. Her four young cubs would have starved to death, but they were located when signals were received from the still-operational radio collar, which had been cut off Lena's body and placed next to the cubs. The terrified and hungry cubs were taken into captivity, and the three survivors were sent to US zoos.

Siberian Tiger poaching is finally decreasing. Russian conservation groups are conducting educational programs for local people and investigating suspected poachers along with Russian government officials (GSN 1997). Recent population surveys indicate an increase in Siberian Tigers, and conservation plans are falling into place (Galster and Eliot 1999). The Tiger's prey of deer and wild boar has been heavily poached, and the plan calls for anti-poaching work to preserve these animals (GSN 1997). Tiger biologists have drawn up a plan for a huge sanctuary in the region, suggesting habitat corridors linking isolated Tiger populations, and proposing an end to clearcutting of forests (GSN 1997). Without urgent protective measures, this magnificent cat will disappear. (See Forests chapter for more on this Tiger and its habitat).
Actions and Attitudes: Page 2

For some endangered animals, CITES has been crucial in preventing their extinction. After a prolonged controversy, the African Elephant was upgraded from Appendix II to Appendix I in 1989, which effectively ended the ivory trade that resulted in the slaughter of these intelligent animals, the toll reaching almost 1 million animals for the 1970s and 1980s. The 1996 IUCN Red List classified the species as Endangered for the first time, upgraded from Vulnerable status in the 1994 IUCN Red List. This status was maintained in the 2000 IUCN Red List. The ivory trade reduced these slow-reproducing animals, who have a single calf only once every five years, from 3 to 5 million in the 1930s and 1940s to only 300,000 to 500,000 today (Onishi 2001). The high price of ivory in the 1980s encouraged the poaching of elephants outside parks, and when these were killed off, poachers entered national parks, often armed with machine guns. Almost all the large bulls and most of the older females were killed for their tusks, leaving traumatized teenage elephants without leaders and protectors and orphaned infants who starved to death.

In the majority of African countries where elephants survive, they are zealously protected for their value in tourist revenue and for their ecological value as keystone species. Many officials of these countries have said that they do not want future generations to learn about elephants only through books. Yet several southern African countries--Namibia, Zimbabwe and Botswana--which stockpiled ivory from the 1980s trade and from culls carried out to limit elephants, succeeded in 1997 in convincing delegates at the CITES Conference to allow sale of 65 tons of this ivory to Japan. Japan's sponsorship of much of the costs of the 1997 Conference, which took place in Zimbabwe, paved the way for the decision. The President of Zimbabwe made personal requests to delegates to allow the sale. Although CITES authorities enacted controls on the conditions of the sale of this ivory, it was predicted that the decision would open the door to further killing of elephants and ivory smuggling. This proved correct. African Elephants began to be poached again during the late 1990s in Kenya, the Democratic Republic of the Congo and other countries. An elephant orphanage in Kenya received an unprecedented number of orphaned calves at this time. Their mothers had been killed for their ivory in national parks. Some of this ivory is sold locally, and much is smuggled out of Africa.

A large confiscation of tusks was made in Los Angeles in May 2001; these tusks, many of which were very small and obviously from young elephants, had been smuggled from Nigeria in hollowed-out furniture. This indicates that allowing some sale of ivory opens the door to unrestricted slaughter and smuggling that will place the species in a critical--and perhaps lethal--decline toward extinction. When ivory was allowed to be sold on a quota basis in the 1970s, this "regulated" trade failed completely to prevent unregulated slaughter as the price soared. In many parts of Africa, poachers are killing elephants for a trade that may be resuming. Ivory is openly sold in Cameroon, and in Burkina Faso, a West African country north of Ghana, where only 3,000 to 4,000 elephants remain, ivory traders are selling carvings and jewelry in the capital city (Onishi 2001). One trader even complained that sales had not recovered as a result of the 1989 ivory ban, with larger carvings taking months to sell because tourists are no longer as interested in buying ivory (Onishi 2001). When asked about the need to conserve these endangered animals, he said that like humans, some die, but the species does not become extinct (Onishi 2001). Few Africans have been taught about how close African Elephants came to extinction as a result of the ivory trade, nor about their key role in spreading the seeds of trees and creating waterholes for wildlife. It is also likely that only a small percentage of Africans are aware of the species' immense intelligence and altruism. If these facts were better known, it is likely that most Africans would want to protect these great animals. They are in imminent danger of disappearing from West Africa.

As they attempt to forage in land that is now being tilled or used as grazing land, Asian and African Elephants are killed and harassed by farmers and villagers outside national parks. Wildlife corridors are being proposed in many parts of the world to ease such problems. As human populations grow, invading the last retreats of wildlife, parks and
reserves are becoming islands amid development, agriculture and cities. Without corridors of natural habitat linking these islands, wildlife will decline in diversity and abundance. A new national park in Mozambique will link with South Africa's Kruger National Park and provide a corridor and additional habitat for Kruger's elephant populations. Other international parks in southern Africa have opened or are scheduled. Some conservationists have proposed that these parks form the southern end of a wide corridor north to Kenya. This would be an excellent solution to the declining habitat faced by many large mammals of eastern Africa. In the Western Hemisphere, the Atlantic Biological Corridor Project and the Mesoamerican Biological Corridor seek to protect wide swaths of land between Mexico and Colombia to prevent the extinction of wide-ranging animals, such as Jaguars and Cougars. Along Texas' border with Mexico, most of an extremely biologically rich area has been plowed under, and the Fish and Wildlife Service is trying to purchase the remnants of this once rich habitat to link it with adjacent habitat in Mexico for use by endangered wildlife.

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In the American West, Grizzly Bears may someday be able to roam from Yellowstone to Yukon in a project known as Y to Y, an immense corridor that would prevent the present isolation of this species into pockets of fragmented habitat surrounded by hostile cattle ranchers. The Wildlife Conservation Society has initiated a program it calls "Living Landscapes," which involves local people living in areas surrounding parks and reserves. It promotes the conservation of animals that have ranges extending beyond the parks in order to help conserve these species, allowing them to be part of functioning ecosystems. This sometimes involves curtailing their own hunting. White-lipped Peccaries, for example, a type of wild pig, are important seed dispersers of trees in Latin American rainforests and also create open spaces on the forest floor by rooting for food. Yet they are heavily hunted for their meat and pelts. Only through an education program in which the local people themselves understand the effects of their hunting and are permitted to manage the land, can the species and its habitat be protected. This organization is applying such approaches to regional conservation in 50 sites in Latin America, Asia, Africa and North America (WCS 2001).

Actions and Attitudes: Page 4
Another fundamental element to the future survival of wildlife in a world crowded with humans is tolerance and a belief that the Earth must be shared. Public opinion has been crucial in land use and protection of natural habitats and landscapes so that wildlife and plants were allowed to survive, even in parts of the world with overcrowding where land was at a premium. Fewer species are threatened in parts of the world where wildlife is respected and considered part of the landscape. In Africa, wildlife flourished when native peoples were the guardians of the land, prior to the 18th century when Europeans entered as colonial rulers. European rule resulted in overhunting and development of large-scale ranches and farms that were fenced, creating a drastic decline in wildlife.

Native Americans have a less proprietary view of nature than Europeans, and many tribes believe in spiritual connections with trees and animals. They treat nature's assets as gifts, for which they express gratitude. In the intervening centuries since colonization of North America by Europeans who failed to respect nature, views have come full circle for many Americans. Wilderness and nature preservation have become high priorities, based on both scientific discoveries about how ecosystems function and a growing desire by people to appreciate nature. Some scientists believe that connections with nature have been an intrinsic part of human nature for millions of years. Dr. Edward O. Wilson calls this "biophilia," or "love of living things," and cites it as a primary human trait. Such ties to nature have nurtured new conservation zeal to help preserve disappearing wildlife and landscapes.

For some people, however, even the most basic ecological and evolutionary principles are refuted in favor of views.
that justify exploitation and species' extinctions. They describe conservationists as irrational "tree huggers," and animal lovers as "bunny huggers." Anti-environmentalists have formed organizations in the United States, operating collectively as the Wise Use movement. Many elected government officials share these views, and have voted for legislation that fails to protect endangered species and results in destruction of important wildlife habitat. US Congresswoman Helen Chenoweth, a Republican from Idaho, believes that there should be a public referendum regarding which animals can live and which will be allowed to go extinct (Egan 1996). Chenoweth stated to The New York Times: "A species goes out of existence every 20 seconds. Surely a new species must come into existence every 20 seconds. There's no way human beings can regulate that dynamic" (Egan 1996). Humans can, indeed, affect the "dynamic," as they have for millennia, and when species are lost, their loss is our loss. Evolutionary biologists would be dumbfounded at her statement. Although species are passing into extinction at a fast rate, new ones are not evolving every 20 seconds, nor even every 20 years or every 200 years, unless one considers the mutations of viruses and bacteria to be new species. Once the Tiger or Right Whale--or any of Earth's myriad species--becomes extinct, it is gone forever. The film "Jurassic Park," which concerned the recreation of dinosaurs from their DNA, is total fiction. Science has not found a way to clone species from DNA obtained from dead animals because the DNA becomes scrambled after death. Nor are such scientific feats anticipated in the near future.

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The basic problem that many people find in protecting endangered species is the question of land ownership and the inconvenience that they fear may result when animal or plant habitat is protected. Congresswoman Chenoweth would find agreement among many people living along the Massachusetts coast, who are unwilling to share the beaches with a tiny endangered bird. This bird has caused storms of controversy between its protectors and recreational beach users. The Piping Plover (Charadrius melodus), a shorebird, nests on sandy beaches along Eastern coasts, the Mississippi River and the Great Lakes. It has been crowded out of the majority of its nesting sites by the hordes of people who come to swim, sunbathe and drive off-road vehicles. Beaches have been altered or developed for various commercial purposes as well, including levee construction for flood control. In 1985, the species numbered only a few thousand birds and was listed on the Endangered Species Act as Endangered in the Great Lakes, and as Threatened elsewhere in its range. The numbers of this species along the Atlantic coast, from southern Canada to South Carolina, reached 1,377 birds in 1998, and throughout its range, only about 5,913 birds survive (BI 2000). In Massachusetts, where most beaches are public, local authorities and even federal and state enforcement officers were reticent to enforce the law to protect the nesting plovers. Even when parent birds managed to raise chicks, the chicks were often run over by vehicles when they fell into the deep ruts on the beach made by tire tracks, unable to climb up the six inches of vertical sand or flee an oncoming vehicle in time. Plans in 1989 to fence a portion of the beach in Plymouth to protect the nesting birds met with such anger and public protests from beach-users that they were abandoned. In 1991, only a single chick survived in the state, with few beaches strictly protected. Unleashed dogs killed some of the chicks, but most were run over by cars and all-terrain vehicles.

On Nantucket island, a Massachusetts Audubon Society warden fenced in the nests of two Piping Plovers in 1994, causing such anger from off-road vehicle drivers that they called the police, who threatened to arrest the warden. Neither the state, which protects the species, nor the Fish and Wildlife Service came to the rescue of the Piping Plovers by supporting the actions of the warden. Vandals ripped down the protective fencing. Endangered Least Terns (Sterna antillarum) nesting on the same beach produced 24 chicks that year. In one day, 20 were run over. This finally convinced the local selectmen to close that portion of the beach to off-road vehicles, which allowed all eight Piping Plover chicks to survive. The citizens of Nantucket voted the following year to defeat a selectmen proposal to allow vehicle use on the beach, which would have exempted the area from state law protecting the plovers. In 1995, three pairs of Piping Plovers nested successfully on Nantucket, and state restrictions began going into effect to protect their nests.
In Massachusetts, nests increased from 139 in 1986, to 445 in 1995 (Allen 1996a). In a step backward, the state of Massachusetts eased restrictions on beach vehicles in 1996, giving what conservationists called "plover-squashing permits" (Allen 1996b). The Massachusetts Audubon Society estimated that at least 33 plovers would be legally killed each year under the new regulations. Another loss for Piping Plovers was the firing in September 1997 of the town of Plymouth's Beach Manager, who had spent more than a decade protecting these birds from off-road vehicles. This was done to appease recreational dune buggy users. The ban, which closed part of the beach until mid-August to allow the chicks to survive, was lifted. A civil complaint was filed in US District court in April 1998 to force the town of Plymouth to enforce the Endangered Species Act and protect nesting plovers. The following month, a judge ordered the town to prohibit off-road vehicles on the beach from May 19 through August 31, unless strict measures are enacted to protect the nesting birds.

At least one conflict concerning this endangered bird in 1997 had a happy ending. The Cape Cod town of Barnstable's Fourth of July fireworks were nearly canceled by the Fish and Wildlife Service for fear that they would disturb the nesting plovers. A local businessman offered the use of several barges from which to detonate the fireworks. The barges were towed far from shore, and the fireworks proceeded as scheduled. Conrad Troy, owner of Tucker-Roy Marine Towing and Salvaging, Inc., who had been contacted by the Massachusetts Audubon Society for his help, said; If I was an endangered species, I would hope someone would come help me out. We can keep the piping plovers happy and the kids who want to see the fireworks happy” (Anand 1997).

These controversies are indications of a growing trend in which animals, especially endangered species, are no longer eliminated or killed in the United States without protest when they come into conflict with people. Listing a species on the Endangered Species Act is a major step. It is not an end in itself, however. Listing scarcely helped the plovers in the Plymouth beaches, however, because the law was not enforced when opposed by drivers of off-road vehicles and beach users. Only the combination of publicity, local support for the birds and demand for strict protection have resulted in protection of plover nests and habitat preservation. A large contingent of volunteers now works on behalf of these tiny birds. Such cases provide examples of what is needed to prevent extinctions.

Conflicts over protection of endangered species are sure to increase in the future. Only if the public support is stronger on behalf of wildlife than the influence of those who are indifferent or oppose endangered species protection, can endangered species survive. Public support for the less attractive and charismatic species, such as insects, fish, bats and nondescript plants, will come only through effective conservation education.

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Another highly endangered species that nests on beaches has been the subject of a successful reintroduction program sponsored by the Fish and Wildlife Service in cooperation with the Mexican government. The Kemp's Ridley (Lepidochelys kempi), smallest and rarest of all sea turtles, became endangered from killing for its meat and shell. Killed off by poachers in Texas, where it once nested, a long and difficult program was initiated to return these turtles to Padre Island. Thousands of eggs laid by the last 500 nesting females on the turtles only remaining nesting beach along the Caribbean coast of Mexico were taken to Texas for hatching. It is not known how sea turtles learn to return to their natal beaches after spending many years at sea, and all precautions were taken to convince the hatchling turtles that they had been hatched in Texas, not Mexico. The eggs were not even allowed to touch the sand on their Mexican beaches. Between 1978 and 1988, when the program was halted for lack of visible success, a total of 22,000 eggs had been taken to Padre Island, hatched, kept in captivity until they were about a year old and then released to the sea. In 1996, to the delight of conservationists, two female Ridley Turtles that had been released 12 and 14 years previously, returned to lay eggs on Padre Island. They were recognized by a special marking the US Fish and Wildlife Service had made on each shell identifying the year the turtles were hatched. By 1999, 16 nests of returning Ridley Turtles were found by volunteers and members of the recovery team who monitor the beach 24 hours a day.
during the summer nesting season. This is the first known case of successful reintroduction of sea turtles. Numbers of these turtles have increased to about 9,000 in 2001, but they are still only a fraction of the 40,000 filmed nesting on a Mexican beach on a single day in the 1940s.

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Dramatic rescues of endangered species have become commonplace on the island of Mauritius through the efforts of teams headed by Dr. Carl Jones, a scientist working for the Wildlife Preservation Trust, founded by famed author and conservationist, Gerald Durrell. This island harbors some of the world's most endangered birds, and by the 1970s, conservationists had become resigned to the imminent extinction of several of these endemic birds and other endangered animals. In steep decline, they seemed to be following on the path of the Dodo. Crucial to the success of the efforts to reverse this trend was the agreement signed by the government of Mauritius with four conservation organizations in the 1980s, including the Wildlife Preservation Trust, to cooperate in preserving the island's natural heritage. A conservation program in the 1970s to protect the Mauritian Pink Pigeon (Columba mayeri) had failed, and the remaining 33 birds were dying off. Captive-bred birds failed to breed, and wild birds were dying from various causes. Jones arrived on the island in the 1980s and, after years of concerted effort in cooperation with a small staff, brought the wild population from a low of 10 birds to approximately 375 birds in 2000. Pink Pigeons now nest at four sites on Mauritius, and another on Ile aux Aigrettes, an islet off the coast (BI 2000). This spectacular increase was the result of a program in which exotic monkeys, rats, mongooses and feral cats were removed from the roosting and nesting grounds of these beautiful, pale pink birds. Captive-bred birds released to the wild were given food until they were independent, and nests were carefully monitored for predation, falling eggs and other mishaps (BI 2000). The program hopes to increase these pigeons to a population of 500 birds within five years.

The Mauritius Parakeet (Psittacula eques), once the most endangered parakeet in the world, became reduced to a total population of only six birds in 1978 (BI 2000). The captive-breeding program set up to preserve them in the 1970s was not successful, and the last wild birds were dying out. Jones and other experts in parrot breeding set up a new captive-breeding program and gave the few wild birds strict protection from the many threats that appeared almost certain to cause their extinction. These included an almost total loss of forest habitat, including old trees with nest holes; a lack of available food; monkeys and rats preying on nestlings; infestations by nest fly larvae; and competition for nest sites with various introduced birds and bees (BI 2000). In spite of these overwhelming odds, these lime green parakeets are making a slow recovery. A forest habitat of 8,000 acres has been made into a national park where exotic species have been excluded and captive breeding is now succeeding. At first, the wild parakeets refused to nest in boxes set out for them and would not try to find other nest sites if their nest tree were destroyed during hurricanes. Fortunately, a few pairs did nest, and habitat improvements were made, such as the planting of fruit trees as a food source. Through these and other efforts, the wild and captive populations rose to between 85 and 90 birds by 1997 (Hoyo et al. 1997). Numbers continued to rise, and by 2000, 106 to 126 birds survived (BI 2000). This is one of the world's most impressive conservation stories. The vast majority of birds whose populations have declined so drastically experience genetic impoverishment or become prone to other threats by failing to respond to conservation programs. The recent extinctions of Hawaii's honeycreepers and other native birds are testament to the failure of many 11th-hour programs to conserve critically endangered birds. Although still listed as Critical by BirdLife International (2000) and the IUCN, the Mauritius Parakeet may be reclassified as Endangered, should present trends continue (BI 2000).

A third endangered bird of this island, the Mauritius Kestrel (Falco punctatus), a small falcon, numbered only four birds in 1974, coming the closest to extinction of any Mauritian bird. Yet today the species is numerous, having almost completely recovered. Through captive breeding and restocking birds to the wild using methods employed in the United States for Peregrine Falcons, and with the help of the Peregrine Fund, hundreds of captive-bred birds have been released to the wild and fed at release sites until they gradually sought wild prey. By 1995, these kestrels totaled
286 birds (Jones and Hartley 1995). Control measures have been successful in reducing exotic species that preyed on them. The population of Mauritius Kestrels reached 145 to 200 breeding pairs in 2000; the species totals from 500 to 800 individual birds who live in three subpopulations in various parts of the island (BI 2000). Jones has also worked to restore habitats for various endangered lizards that are captive bred at the headquarters of the Jersey Wildlife Preservation Trust. These small, iridescent geckoes had become restricted to out-islets, where they survived because introduced predators were absent. Unfortunately, rabbits were released on Round Island, habitat for several of these endangered reptiles, and they multiplied to pest proportions, leaving almost no natural vegetation. Many of these lizards were captured just in the nick of time, and bred in captivity, as the last of their habitat was being consumed. After removal of the rabbits and replanting of native species, these lizards are now being reintroduced.

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Specimens of a highly endangered fruit bat of the small Mascarene island of Rodrigues, the Rodrigues Flying-fox (*Pteropus rodricensis*), were captured for captive breeding when wild populations became threatened by killing for food by local people. It amazed researchers studying them when a female exhibited mid-wife protective behavior seen only in a few other animals, such as dolphins and elephants. One of the females in the process of a difficult breach birth was aided by the other, who fanned her, cradled her in her wings, and showed her the proper position to cling to the cage bar during the three-hour delivery (McFarling 1994). Wild populations of this species are listed as Critical by the 2000 IUCN Red List. Other flying foxes that once inhabited these islands are now extinct, and the Rodrigues Flying-fox is the last to survive. Without the emergency rescue of some of these foxes, the altruism and devotion of these animals would probably not have been recognized.

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The elimination of introduced animals, from goats, cattle and pigs to cats and exotic plants, has been carried out on many islands and island-like environments around the world to preserve native species on the brink of extinction. The governments of Australia and New Zealand, in particular, have rescued a number of critically endangered species. Lord Howe Island, located off the northeastern coast of Australia, once harbored diverse wildlife. After settlement, and introduction of rats and other exotic species, forest clearance and other threats, numerous extinctions of native animals occurred, and most of its surviving species are endangered. Efforts on the part of the government to return the island to its near-original state, with total protection of the remaining tropical forests, coral reefs and other habitats, is underway. Ecotourism has been developed on the island, but the number of visitors is kept at a level that will not harm the island's endemic fauna and flora. Cats may not be kept by the limited number of residents as pets because of their threat to native birds, and exotic animals are being eliminated from the wild. The endangered, flightless Lord Howe Rails (*Gallirallus sylvestris*), highly vulnerable to predation by cats and other predators, are now gradually increasing with strict protection. Once found throughout the island, these rails became restricted to mountain areas after they were eliminated by feral pigs, goats, cats, dogs and the introduced Masked Owl (*Tyto novaehollandiae*) elsewhere on the island. Captive breeding has been successful, and after work to eliminate exotic animals, these rails were reintroduced to several of their original habitats at lower elevations (BI 2000). The population numbers about 130 birds, with a potential living space for up to 220 birds (BI 2000).

In some cases, control programs for exotic species on islands are not done humanely. Wire snares and poison have been employed rather than live-catch traps, for example. Humane organizations should be consulted by governments to employ humane methods in ridding islands of non-native animals.

The Black Robin (*Petroica traversi*), a beautiful songbird resident on the Chatham Islands off New Zealand,
numbered just five birds in 1980, with only one breeding pair (BI 2000). Rats and cats colonized the island after settlement, and deforestation had destroyed the species’ habitat. A tree-planting project in which 120,000 trees were planted on Mangere Island, one of its prime habitats, was undertaken (BI 2000). Supplemental feeding and nest protection from introduced Starlings (Sturnus vulgarus) and seabirds, which were preying on them, helped somewhat. Real progress began with the use of an unusual program in which eggs of the Black Robin were placed in the nests of other species to raise them and allow the original female, who became known as “Old Blue” and lived 12 years, to lay more eggs. Birds of a related species, the Tomtit (Petroica macrocephala), raised these robins, and chicks were successfully reintroduced to Mangere Island (BI 2000). Such cross-fostering has failed with species such as the Whooping Crane, whose eggs were cross-fostered to Sandhill Cranes, because the chicks when mature, tried to mate with Sandhill Cranes instead of members of their own species, having become imprinted. In this case, the chicks bred with members of their own species, and numbers rose to 259 in 2000 (BI 2000). They were all descended from the original pair of birds. The New Zealand Department of Conservation, which had overseen the breeding program, found through DNA studies that the birds are nearly identical genetically (Hutching 1997). Further studies will attempt to discover immune responses and other signs of inbreeding, but outwardly, these robins are thriving, with a 70 percent survival rate and normal fertility (Hutching 1997). Species with such low genetic variability tend to be extremely vulnerable to extinction, having little ability to adjust to changes in their environment or food supply.

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More and more countries are taking a keen interest in the preservation of wildlife, and some have ancient protective traditions. The Asian country of Bhutan has a Buddhist ethic of not harming living things. It is the only Himalayan country to have protected the majority of its forests. Rhododendron species 40 feet tall grow there, and the rivers still flow clear, without erosion and siltation. Species that are rare elsewhere in the region still survive in Bhutan. One of its protected areas, Jigme Dorji National Park, is the size of Switzerland and preserves spectacular mountains and cascading waterfalls. It is part of a Bhutanese government plan to create a nationwide system of reserves to protect the country's natural heritage (Adams 1994). Although erosion and destruction of some of the native fir and rhododendron forests have occurred, Bhutanese people support the government's "go slow" approach to development and its plan to preserve wilderness (Adams 1994). A wintering population of endangered Black-necked Cranes (Grus nigricollis) is zealously protected by the Bhutanese who live in the valley where the cranes come each year; they regard the birds as integral to their lives and believe that, without them, their harvests will fail. These people miss the cranes calling when the birds migrate in the spring, and say that the valley seems empty and silent without them (Greenway 1997). The Environment Ministry watches over the cranes as well and is extremely strict about issuing permits for activities that might harm them.

New approaches may save some of these threatened tropical areas. Australia's Rainforest Information Center has created an Internet website which plays rock and roll music; its sponsors pay to preserve the rainforest (EII 2001). The organization is focusing on saving several endangered forests in Ecuador, including Los Cedros Biological Reserve and portions of the Madre Selva (EII 2001). The Natural Resources Defense Council has created a list of BioGems (www.savebiogems.org), the 12 most endangered wildlands in North and Latin America. It publicizes threats, such as proposed dams and logging, to generate thousands of letters and e-mails to governments, loggers, utilities and others. The Macal River Valley in Belize, threatened by a dam project, has been saved through this program. The US Duke Energy International company decided to withdraw from Belize after the torrent of protests (NRDC 2001). Boise Cascade planned a major wood chip mill in Chile, which would have consumed 1,200 acres of endangered temperate rainforest a year, with endangered Alerce trees, the massive South American counterpart to the Sequoia. The forests also sheltered tiny Pudu deer and rare birds. The company announced that it would cancel its plans "as a result of unfavorable market conditions" (NRDC 2001). Conservation International (CI) played an important role in the designation by the South American country of Suriname of much of its vast interior, a pristine rainforest, as a reserve. CI, through its scientific studies, was able to show the country's leaders that, kept intact rather
than being logged, this rainforest would prove far more valuable for future generations. This organization has accomplished similar feats in Bolivia and other parts of the world, where it also carries out important biological inventories.

An example of cooperating with local people for conservation of wildlife is the administration of the Mara Reserve of Kenya. This reserve is run by the Maasai people through a council which mandates that tourist funds go directly for social services of the tribe; in turn, the Maasai, who live outside the reserve, allow wildlife to move freely without fencing or harassment that is common elsewhere in Africa where livestock is raised (Gakahu 1994). In this reserve are endangered Cheetahs and Black Rhinos, along with 30 species of ungulates, including large numbers of elephants (Gakahu 1994). Local villages in many parts of Kenya are establishing landowner associations that receive funds from tourism to protect wildlife and benefit local economies (Gakahu 1994).

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Teaching people that their local wildlife is important to protect as a source of pride has had excellent results in a program in the Caribbean funded by RARE Center for Tropical Bird Conservation, an organization headquartered at Philadelphia's Academy of Sciences. It has employed innovative education and conservation programs to preserve St. Lucia Parrots or Amazons (*Amazona versicolor*), the forests and other wildlife of the island. Biologist Paul Butler, who began this program, has instilled conservation enthusiasm and pride in the people of the island of St. Lucia for these beautiful and rare parrots. His dynamic program has resulted in the naming of this species as the national bird, as well as education programs so successful that children know its scientific name, habitat and need for protection. They enjoy singing songs about the parrots and dressing up in parrot costumes. The people of St. Lucia now understand that the forest and other wildlife must not be destroyed. Art and essay contests are conducted in schools and towns to publicize this parrot, and St. Lucia Parrots are used as logos for many businesses. Forest cutting has been banned, and a substantial portion of the island has been set aside in reserves. This has resulted in an increase from fewer than 300 to between 350 and 500 birds (BI 2000). The Saint Lucia government is dedicated to protecting the parrots and their habitat, and a new ecotourism industry has sprung up. These programs have meant an end to the rampant smuggling of these beautiful, rare parrots, an activity that had been thought uncontrollable because they could be sold for $20,000 per bird to collectors. Protecting the forest for the parrots also resulted in conserving other threatened wildlife of the island and precious watershed. Another native species, the spectacular Giant Swallowtail butterfly, is illustrated on billboards prominently located near towns with the message, "It's ours . . . take care!!" (Lipske 1994). This approach to conserving endemic wildlife has been adopted on other Caribbean islands, and Butler trains local conservation officers and teachers to continue the programs elsewhere (Butler 1992, Lipske 1994). A film about these programs, "Caribbean Cool," is described in the Video section, and RARE has published a manual, *Promoting Protection Through Pride*, with advice on how to carry out such programs.

Educating children to respect the environment and conserve endangered species leaves a lasting impression if begun in grade school and continued throughout schooling. Children have an innate sympathy and love for animals, and become enthusiastic conservationists. Education about national laws and native wildlife and plants of the region encourages students to have a lifelong desire to protect them and a sense of guardianship that results in opposition to actions that would harm them. Environmental education is required in about two-thirds of US states, from grade school onward. Some schools require special training in environmental science for all teachers. A few high schools are teaching courses in ecology for college credit. The North American Association for Environmental Education has issued detailed guidelines for educators to assess textbooks and other materials for fairness and accuracy, and review by experts (Cushman 1997).

Some conservation organizations have been formed by scientists, such as the highly effective International Crane Foundation and Bat Conservation International. Entertainers have also become involved in conservation. The rock
music star Sting, for example, became concerned about the destruction of rainforests and founded the Rainforest Foundation, an organization to raise money to purchase or protect thousands of acres of this endangered habitat, while at the same time informing young people about the importance of these forests to the world. Students and concerned individuals have also founded organizations to protect individual species or particular environments, such as prairies or wetlands. These organizations have raised millions of dollars for rainforest protection and helped many endangered animals.

A number of effective conservation programs began as grassroots organizations established by an individual or a small group of people who wanted to protect a species. Individuals have educated, lobbied and helped raise funds for the purchase of habitat, making extremely important contributions to the preservation of threatened species. The beautiful bluebirds of North America were in steep decline until Lawrence Zeleny began his nesting box program. He popularized and distributed nesting boxes for bluebirds with an entry hole just a fraction of an inch too small for the aggressive European Starlings to enter. The latter birds are taking over the tree nest holes of all three species of North American bluebirds. Starlings are also a threat to several native species of woodpeckers. Through the nest box program promoted by Girl and Boy Scout troops and other organizations, these colorful birds have increased and may again be abundant, familiar residents of orchards, woodland edges and grasslands. Such citizen projects keep species in decline from reaching endangered status. Once endangered, a species' genetic diversity is threatened, and multi-million-dollar state and federal rescue programs, which are not always successful, must be set up to help them.

Only a small percentage of endangered species have such programs in place to aid their populations and protect their habitat, and individuals can make important contributions by volunteering for organizations working to preserve species and their habitats or by founding an ad hoc group. The majority of species listed on the 2000 IUCN Red List or on Natural Heritage would be far more likely to avoid extinction if conservation programs were created for them, with help from both individuals and organizations. The species most in need are invertebrates and plants, which form the majority of all endangered species and receive the least funding. Within each region or county, little-known endangered species may be fading out without the aid of any organization or individual. Organizations such as The Nature Conservancy, Conservation International, scientists with the IUCN or state Natural Heritage programs provide highly specific information on threatened species in various parts of the world.

Restoration of original ecosystems will become more and more important as natural landscapes decline. The Nature Conservancy, which has purchased millions of acres of land to preserve resident endangered plants and animals, reintroduced the American Bison to its 30,000-acre tallgrass prairie in Oklahoma, and is reintroducing native flowers, plants and animals to restore at least a portion of this magnificent ecosystem. After decades of failed bills proposed in Congress, legislation was finally enacted in 1996 establishing the nation's first tallgrass prairie park of more than 10,000 acres in Kansas. Individuals can also contribute to restoration of ecosystems. Books, such as Noah's Garden. Restoring the Ecology of Our Own Back Yards, by Sara Stein (1993), and many magazine articles have called attention to the effects of suburbanization, and the poisoning of native wildlife with pesticides and herbicides used on lawns. They suggest means of bringing back natural ecosystems.

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However effective private organizations are, they cannot begin to have the effect of preserving habitat that governments have. As the owner of millions of acres of parks and reserves, the US government plays a major role in habitat and species preservation. The Land and Water Conservation Fund was established in 1964 to purchase and preserve federal lands, with money coming from oil and gas leases on the coasts. Each year, some $900 million is deposited in this fund, and more than 5 million acres have been preserved in many threatened environments. In 1998, $699 million was approved for spending on land purchases, including $250 million for acquiring the ancient Headwaters Redwood Forest in California to save it from planned logging, as well as $65 million for the New World...
National Wildlife Refuges are vital habitat for thousands of threatened and declining species and were first set aside during the Theodore Roosevelt Administration to protect endangered sea birds being killed for their plumes. Now refuges and preserves are key to the survival of Red Wolves, Bald Eagles, Whooping Cranes, Florida Panthers and numerous rare plants, butterflies and other wildlife. In many of these refuges, oil drilling and other exploitation occurs, causing damage to ecosystems and threatened wildlife. The protection these refuges receive is far less stringent than that of national parks and monuments. In some refuges, high-speed roads cut through the middle of marshes where an array of rails, turtles and wetland species end up run over by vehicles. In the largest refuge, the Arctic National Wildlife Refuge, most of the land is open to oil drilling, where water and air pollution have been severe problems. The calving ground of a herd of some 100,000 Caribou within the refuge has been proposed for oil drilling, in spite of the opposition of the majority of the US public. With greater support from the public, laws governing these refuges and their funding might be strengthened to better preserve wildlife.

Some imaginative solutions to the funding problem have been developed. A number of organizations have adoption programs for wild animals. Northern Right and Humpback Whales, for example, identified individually by their markings by scientists studying them, can be sponsored by members of the public, who are then informed of news about their adopted animal. The funds are applied to research and conservation of the species. Grizzly Bears, Tigers, Gray Wolves and other animals may be adopted through a growing number of organizations. Earthwatch, in Watertown, Massachusetts, sponsors thousands of research expeditions by scientists, many of them studying endangered species, through funds from volunteers who pay for the privilege of accompanying the scientists and helping in the research. Endangered species of Brazil's Atlantic Forest, Florida Manatees, rare butterflies and coral reefs are among the many projects Earthwatch helps fund. This organization also awards hundreds of scholarships to students, and teachers who participate can turn the experience into a study program for their students.
Books, television programs and films about the natural world have opened new doors to the public in the past decade. Natural history films, in particular, are another major influence on education and even public policy. They present views of true wilderness, natural wildlife behavior and conservation lessons. They may have had a significant influence on convincing the public of the need to pass such laws as the Endangered Species Act. Films of the slaughter of spotted cats, American Alligator, and the plight of declining species around the world aroused many people to write their Representatives and Senators in support of legislation to prevent species from becoming extinct.

Films of truly wild places may have played a role in the growth in bird watching and ecotourism, and probably in the changes that have taken place in zoos, with barred cages giving way to more natural exhibits. Having seen films of these animals in the wild, the public was no longer content to see them in such unnatural conditions, behaving so abnormally. Situations once commonplace, such as a pacing Tiger in a barred cage, a single elephant in a dusty, small enclosure, rocking back and forth, now result in protests that have changed zoo exhibits and animal treatment for the better.

The crucial steps that must be taken in the future involve the dissemination of knowledge and concern about endangered species to the general public, who are poorly informed about the enormity and possible effects on their lives of issues such as overpopulation and disappearing species. Although public awareness has increased about environmental decay and the effect that humans have in causing species’ extinctions and endangering them, most people still tend to act as if nature will bounce back and will continue to function normally, no matter how extreme the damage. This is a naive point of view. Scientists have not defined the threshold beyond which total ecological collapse will occur in any given area. Also unknown is the number of species that can be extinguished before biological systems become dysfunctional (Leakey and Lewin 1995).

Newspapers, television and other media should be encouraged to publicize these issues further, rather than catering to what they might consider the public's interest. As an example, US network television and newspapers have pointedly ignored human overpopulation and loss of biodiversity, while doing numerous stories on artificial means of having children, such as test tube babies and multiple births. On the positive side, new cable television channels in the United States, such as Animal Planet and BBC, add to the growing number of wildlife and environmental programs on PBS and the Discovery Channel. Unfortunately, these channels presently reach only a fraction of the audience of network television, preventing a better understanding by the public of the problems facing the world. The numbers of films being made and books written on endangered species and the environment have increased exponentially in the past decade, an indication of a growing enthusiasm for the natural world. Other indications of this trend are the rise in memberships in conservation and humane organizations, ecotourism, bird-watching, hiking and visits to national parks and preserves. If these concerns were better translated to activism and altering lifestyles to prevent harming the environment and wildlife, impending mass extinctions might be avoided.

**Biodiversity Preservation**

Preventing loss of diversity through the growing number and rate of extinctions is extremely important for the ecological stability of the planet. Unfortunately, it is not recognized as a key issue by the majority of people, nor by world leaders. The extraordinary wealth of plants and animals that are in the process of disappearing may represent between 5 and 30 million species, of which only about 1.3 million have been named (Wilson 1993). Insects alone may number more than 5 million species, with the majority of species living in tropical rainforests (Wilson 1993). These animals are key to the Earth’s ecosystems, pollinating, fertilizing and aerating soil, and providing food for thousands of animals. Some 751,000 animal species have been identified, far more than the 248,428 plant species, yet these represent only about 15 percent of all living species, in the view of Dr. Edward O. Wilson in his classic 1993 book, *Biodiversity*. Each year, thousands of new species of insects and other invertebrates, hundreds of frogs and,
surprisingly, primates, antelope and birds are discovered by science, often in disappearing habitats.

Worldwide, biological inventories, essential to the process of protecting biologically rich areas, receive inadequate funding. Wilson has estimated that more money is spent in New York City’s bars in two weeks than studying biodiversity around the world each year (Farnsworth 1994). Some $57 billion is spent on drugs by Americans annually, according to the White House Office of National Drug Control Policy, while less than $1 billion are spent on inventories and biological studies, by some estimates. The lack of funding for biological surveys means that entire ecosystems are vanishing before they are even studied.

Just as many species are disappearing from neglect or uncaring development, scientists are finding and naming hundreds of new life forms, primarily through research programs of private universities and organizations. Ecosystems thought sterile, such as deep ocean environments, are now known to contain significant species diversity. Each descent of a submersible vehicle into these environments brings new discoveries, from beautiful, bioluminescent jellyfish many feet long to bizarre creatures that seem to have emerged from science fiction tales. Many of these newly described species represent previously unknown families, classes, and even phyla of animals.

Some deep sea creatures inhabit the boiling hot water emitted from cracks in the ocean floor, managing to survive what would be toxic to 99 percent of the world's animals. This environment may be similar to the one in which life itself was formed billions of years ago. These areas should be given high priority for government research funding. Studies about Earth’s diversity should not be sacrificed in US federal spending projects such as NASA probes into the possible presence of microbial life on Mars. The discovery of the Mars fossil was given enormous publicity, and in early 1998, chemical studies proved that these supposed evidences of life were actually terrestrial contamination (Wilford 1998). This has not stopped the NASA program from searching for evidence of life on Mars. Tropical forests also represent frontiers to biologists in urgent need of research funding, with millions of species of birds, mammals, insects and other life forms yet undiscovered. They are proof of the importance and urgency of preventing extinctions and degradation of natural ecosystems.

Diversity is threatened by economic concerns that affect every country. Economists tend to consider revenue important—but not such intangibles as biological diversity. Yet history shows that cultures that protect their environment endure far longer than those that do not. Clive Ponting (1991), in A Green History of the Earth, makes this point clearly, citing the great civilizations of the past which died out after abusing the land by disrupting water supplies through deforestation, and causing imbalances in ecosystems that resulted in their decline.

Common sense about environment protection and a concern for future generations have inspired many countries and cultures to preserve biodiversity. Those cultures which have a strong bond with nature, especially a spiritual one, are the most likely to protect their environments and wildlife, even when they are impoverished and would profit from exploiting it. With such people, economic arguments to protect nature are unnecessary, but for the vast majority of people today, short-term profits from nature are justifiable if an urgent economic need exists. In general, harm to the environment and biodiversity may be increasingly unacceptable, however. Polls taken in 2001 in the United States found strong support for environmental protection, with 58 percent of respondents believing that protecting plants and animals should take priority over preserving personal property rights, and nine in 10 saying that it is important for wilderness and open spaces to be preserved (Barabak 2001). Even when government leaders fail to act decisively to protect nature, these actions do not necessarily reflect the will of the majority.

A new activism on the part of the public and native peoples is resulting in many protections for wildlife and the environment. It is also resulting in new alignments of organizations and groups of people. Environmentalists and labor groups have united in opposing the anti-environmental aspects of the World Trade Organization, which caused member countries to reexamine their automatic endorsement of all trade to the exclusion of the environment, wildlife and job protection. Native tribes in British Columbia and conservation organizations united to publicize the impending destruction of thousand-year-old forests along the coast, home to the white "spirit bear." This coalition succeeded in 2001 in stopping logging and achieving permanent protection for some 1.5 million acres (NRDC 2001).
One proposed means of preserving wild animals and plants and their environments is the Convention on Biological Diversity, signed by more than 150 countries after it was presented at the 1992 Earth Summit held in Rio de Janeiro, Brazil. It went into effect in December 1993, after the 30th country, Mongolia, ratified it. It had been signed by 161 nations. Its purpose is to prevent extinctions and biological impoverishment, and it commits nations that ratify it to take actions to preserve species and ecosystems in the process of development.

The Convention requires nations to integrate conservation into economic and social policy to: promote the protection of entire ecosystems, set up protected areas, undertake biological inventories, preserve species throughout the country and restore degraded ecosystems. Many of the wealthy industrialized nations that do not support the Convention succeeded in having weakening clauses written into it, such as "as far as possible" and "as appropriate" (Stevens 1992). It states that nations have the "sovereign right to exploit their own resources pursuant to their own environmental policies. Even with its weaknesses, it remains the only international convention to have ever addressed the importance of preserving biological diversity, and as such, it sets a major precedent.

The success of the Convention on Biological Diversity will depend on how strictly it is interpreted. One clause places economic and social development, and the eradication of poverty, as the first priorities of developing countries. This could become an excuse to allow extinctions for the sake of "progress." For example, dam construction or forest clearance could be projects to alleviate poverty, but they would probably cause extinctions. The treaty also states that conservation efforts on the part of developing nations will depend on the flow of money from rich nations, although it recommends that the rich countries benefiting economically from exploitation of resources, such as pharmaceuticals, in poorer countries, should share these profits with the latter (Stevens 1992). It is this latter clause that many members of the US Congress opposed because US pharmaceutical companies did not wish to pay nations harboring medicinal plants. This is a major reason why the United States has not ratified the Convention.

To fund the programs of the Convention on Biological Diversity in developing countries, the Global Environmental Facility (GEF) has been set up, administered jointly by the United Nations Development Program (UNDP), the United Nations Environment Program (UNEP) and the World Bank. GEF raised some $2 billion from wealthy countries, and its administration has been criticized by both donor nations, which want it run in a similar manner to the World Bank, and many developing countries and environmentalists, who accuse it of "green washing" destructive environmental programs endorsed by the World Bank (Lewis 1994). The World Bank has been a major proponent of commercial logging in the last tropical rainforests of Central and West Africa, with disastrous consequences for both wildlife and native peoples.

This Convention is heavily influenced by rich donor countries, such as Japan, Canada, Norway and other European nations. Without strong opposition to the traditional approach of the World Bank in funding large dams, logging and other such projects, the Convention will not fulfill its more positive potentials to conserve the Earth's biological heritage. Its success will depend on the strong participation of those truly interested in the preservation of nature and willing to encourage countries in this task.

At the end of the 20th century, a poll of biologists was taken, asking them what they considered the greatest threat facing the Earth today. By a wide margin, they chose the loss of biodiversity. The greatest challenge in the 21st century will be to inspire people to want to protect biological diversity, as some nations are doing. Costa Rica, for example, is engaged in a biodiversity program that will catalog virtually every resident animal and plant over the next decades and protect critical habitat areas. The United States, through the Natural Heritage Programs and hundreds of biologists whose work is compiled by the Association for Biodiversity Information, is making progress in its appraisal of the nation's biodiversity and conservation needs (Stein et al. 2000). Thousands of individuals are also playing a role by preserving or reintroducing native species into their local areas. In spite of great pressure to exploit the last rainforests and other fragile environments throughout the world, successes in preserving the immense treasure-trove of species that exists on Earth may be turning the tide.
Our lives depend on the proper functioning of the Earth's systems for processes such as photosynthesis, balance of oxygen and carbon, pollination of flowering plants and enrichment of the soil by organic materials. These systems require a large variety of species to function normally, and we are only beginning to understand the role of various organisms and which species are key to each ecosystem. It is not possible to say, therefore, that any species can become extinct without affecting vital life processes. By choosing which species shall survive and which are dispensable, based on economic considerations, as proposed by many politicians, is sheer folly. Irreparable damage may result from such attitudes, yet they are accepted by many governments of the world.

We are presently witnessing the breakdown of many ecosystems. Marine food chains are being destroyed by overfishing and pollution, interfering with the food supply for millions of people. Yet it seems that few of these ecological catastrophes were predicted when fishery or pollution limits were set. Likewise, wetlands are losing wading birds, frogs and fish—all natural insect controls—resulting in increases in insect-borne diseases such as malaria. Predator-prey relations are key to the health of forests and grasslands, preventing overgrazing by prey species that have lost their predators. Yet most wild cats and wolves are in decline, some close to extinction, allowing imbalances to occur. In a growing number of regions, large predators are either absent or so rare that they no longer perform their ecological role. In Yellowstone National Park, for example, the eradication of the Gray Wolf resulted in overpopulation of Elk, which over-browsed aspen and other plants that were habitat to a number of birds and other animals, resulting in their disappearance. Only with the reintroduction of wolves is the ecosystem returning to normal. The overpopulation of deer in the United States and their effect on preventing natural forest regeneration and destroying wildlife habitat is directly related to the extermination of their natural predators, wolves and Mountain Lions. In other cases, prey species, such as deer, antelope and other ungulates, are in steep decline, having been killed off by meat hunters or crowded out by livestock. These species often play important roles in dispersing seeds, as do bats, birds and rodents. One-fourth of all mammals, and one in 10 birds are imperiled. Among these are pollinators, seed dispersers, insect-eaters and prey for other species. The loss of this biodiversity is reaching such levels that it is not surprising so many ecosystems are imbalanced. It is even more alarming to contemplate that the majority of the world's reptiles, amphibians, marine fish and most invertebrates have not even been assessed by biologists.

Species' declines begin with local extinctions as they disappear from portions of their ranges. At this stage, their absence may be affecting ecological communities, but they will not be listed by the IUCN or any other listing authority until the species as a whole becomes threatened. The Gray Wolf disappeared from 90 percent of its US range before it was listed on the Endangered Species Act, by which time major ecological damage had already been done. Species receive protection, endangered listing and conservation attention at the latter stages of declines. The smaller the original range, the faster that species slides to extinction. Ecological effects can occur gradually and imperceptibly in some cases and, in others, quickly and dramatically. Most of the 34,000 plants listed by the IUCN as Threatened occupy restricted ranges and may have undergone slow declines as their pollinators and seed dispersers disappeared, or rapid declines if they were logged or their habitats destroyed. As the concept of saving ecosystems and their myriad plants and animals gains acceptance, the importance of preserving all the strands of this complex tapestry becomes clear. The tens of thousands of animals and plants listed by the 2000 IUCN Red List are an indication of a crisis situation, of nature going awry.

Astronauts orbiting the Earth have been overwhelmed by the beauty and fragility of the planet and its uniqueness in the universe. They have described environmental destruction visible from space. Shuttle astronaut Jay Apt (1996) spoke of seeing hundreds of pinpoints of bright lights at night that turned out to be fires emanating from forests in Africa, Madagascar and Borneo. A distant perspective enhances appreciation and desire to conserve our remarkable home. Instead of considering ourselves as separate from the environment, biologist Dr. Thomas E. Lovejoy has suggested, "We must behave as if we live within ecosystems, rather than perceiving nature as something confined to a few protected areas isolated within a degraded, human-dominated landscape" (Laurance and Bierregaard 1997).

Scientific study of Earth's diversity and ecology is in its early stages, and an exciting frontier awaits scientists in the ocean, tropical forests and other environments. Yet we are treating this precious living tapestry without the respect it deserves, and the unraveling of these intricate and delicate ecosystems will threaten our very existence.
References


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