

1997 Species Report Card

*The State of U.S.
Plants and Animals*



IN COOPERATION WITH THE
NATURAL HERITAGE NETWORK

A NatureServe™ Publication

1997 Species Report Card

The State of U.S. Plants and Animals

Citation: Bruce A. Stein and Stephanie R. Flack. 1997. *1997 Species Report Card: The State of U.S. Plants and Animals*. The Nature Conservancy, Arlington, Virginia.

ISBN: 1-886765-08-1












This publication is available on The Nature Conservancy's Web site at <http://www.tnc.org/science/library>.

© 1997 The Nature Conservancy



This publication is a product of NatureServe, which is made possible by Canon U.S.A.'s Clean Earth Campaign. The NatureServe program is designed to promote biodiversity conservation by raising public awareness and advancing scientific knowledge.


Contents

	Summary	1
	Vanishing Assets.....	3
	Life on Earth: What We Know	5
	Assessing Conservation Status	6
	State of the Nation's Species.....	8
	Where the Wild Things Aren't	12
	Exploration: Ten Key Discoveries	15
	San Gabriel Mountain Slender Salamander	16
	Hawaiian Cave Planthopper	16
	Shasta Owl's-Clover	17
	Jaguar	18
	Hells Canyon Rock Cress	18
	Laysan Duck	19
	Indiana Bat	20
	Cooley's Meadowrue	21
	Asian Longhorned Beetle	21
	White Wartyback Mussel	22
	Raising Our Grades	23
	Cited References	25
	Appendix: Species Status Table	26
	Credits and Acknowledgments	27



Rediscovery of the jaguar in New Mexico after a 90-year absence is one of the key discoveries highlighted in the 1997 Species Report Card.

Summary

ow are the nation's plants and animals faring? Which species are at greatest risk and most in need of special care to ensure their survival? Conservation of our natural resources often requires difficult choices, and in an era of limited resources we must have clear priorities that provide answers to questions such as these. The *1997 Species Report Card: The State of U.S. Plants and Animals* addresses this need by providing the latest figures on the condition of our species from the scientific databases of the Natural Heritage Network and The Nature Conservancy.

Healthy ecosystems are key to the survival of our native plants and animals and to the well-being of our economy. Unfortunately, these natural systems face mounting pressures, and, as a result, many of the species that depend on them have suffered serious declines.

The *1997 Species Report Card* assesses the condition of approximately 20,500 species of plants and animals, representing the most comprehensive appraisal available on the conservation status of

native U.S. species. These assessments are based on the biological inventory work of the state agencies participating in the Natural Heritage Network, The Nature Conservancy, and many collaborating scientific institutions.

The condition of the nation's species serves as a bellwether of the country's overall environmental health.

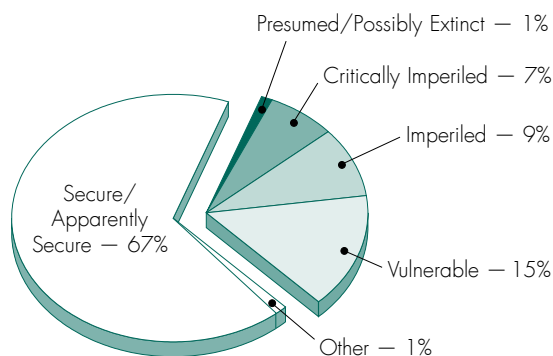
The Good News

About two-thirds of the nation's species in this report card receive satisfactory marks. These species appear to be relatively secure at present, although for some there may be cause for long-term concern. Included here are most species in such groups as birds and mammals.

The Bad News

About one-third of U.S. plant and animal species are of conservation concern. Certain groups of organisms receive particularly poor marks. Those animals that depend on freshwater habitats—mussels, crayfish, fishes, and amphibians—are in the worst condition overall. Flowering plants also receive low marks, with one-third of their many species in trouble, a disturbing 5,144 species.

For some, it may be too late—more than 500 U.S. species already may have disappeared forever. At least 110 species of plants and animals are known to be extinct, with another 416 missing and feared extinct. These losses have affected virtually every



One-third of U.S. plant and animal species are at risk of extinction.

U.S. state, but some are especially hard hit: Hawaii has suffered the greatest number of extinctions, followed by Alabama and California.

More than 500 U.S. species already may have disappeared forever.

Key Discoveries

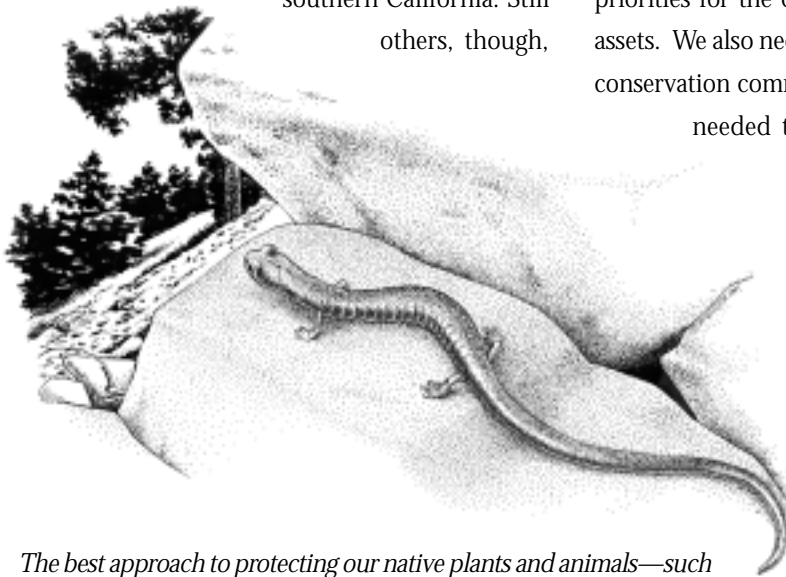
Ongoing biological exploration is essential to improve our understanding of the nation's plants and animals, and to help us protect these biological resources. This report card presents 10 key discoveries that are among the most important and interesting finds of 1996. Some bring good news, such as the rediscovery of the Shasta owl's-clover, a flower given up for gone. Others expand the frontiers of our knowledge, including discovery of a new, yet evolutionarily old, salamander from southern California. Still others, though,

bring bad news, like entry into the United States of yet another invasive pest, or reports that the last two individuals of a mussel species have joined the ranks of the living dead.

Raising Our Grades

The 1997 *Species Report Card* reflects not only the condition of the nation's plants and animals, but also how we as a society are doing at protecting our biological resources. While the United States has long been a world leader in conservation, this report card documents that a significant portion of the American flora and fauna is at risk. There is a particularly pressing need to search for possibly extinct species that may still exist and could benefit from immediate protection. To help relocate these missing species, this year the Conservancy has established the Canon Exploration Grants Program with support from Canon U.S.A.

For the sake of both our wild companions and ourselves, we have a responsibility to set priorities for the conservation of these vanishing assets. We also need to rededicate ourselves to the conservation commitment—public and private—needed to raise these grades and provide lasting protection for our biological inheritance.



The best approach to protecting our native plants and animals—such as the recently discovered San Gabriel Mountain slender salamander—is to conserve the ecosystems on which they depend.

Vanishing Assets



Reaching across the North American continent and out into the vast Pacific, the United States encompasses an exceptionally diverse and beautiful array of ecosystems. From majestic redwood forests to sweeping expanses of prairie grasslands, these natural systems soothe the eye and uplift the soul. But they do much more—healthy ecosystems increasingly are recognized as key to our own economic well-being. Unfortunately, these natural systems face mounting pressures as human activities whittle away at them in ways large and small. Bearing much of the burden of this ecological deterioration are the plants and animals that depend upon them for survival. Indeed, the condition of the nation's wild species serves as a bellwether of the country's overall environmental health.

Over geologic time extinction is a natural event as species give rise—or give way—to other species. This process is counterbalanced, however, by the evolution of new species of plants and animals. Through evolutionary history the interplay between these two processes has been responsible for increasing the overall diversity of life on Earth, and the array of biological resources on which humans depend.

But today's spate of human-induced extinctions is anything but natural. The pace of extinction now far exceeds anything seen in the fossil record since at least the end of the Cretaceous period when the dinosaurs disappeared. Current extinction rates are conservatively estimated to be at least 10,000 times greater than background levels.¹ Unfortunately, evolution of new species generally takes a very long time—measured in thousands or millions of years—and will not offset this rapid depletion

of our biological assets, which is occurring over mere decades.

Extinction represents the irretrievable loss of a species' unique genetic, chemical, and behavioral traits. These vanishing assets are not just a hypothetical concern. Extinction already may have been the fate of at least 526 U.S. species. Gone forever are such plants as the beautiful Sexton Mountain mariposa lily, and animals like the colorful and once-abundant Carolina parakeet.

But human-caused extinctions are not inevitable. Anyone who has admired the grace of a soaring bald eagle can appreciate what is at risk—and what can be done to reverse a slide toward extinction. Once severely jeopardized, the bald eagle is now on its way to recovery throughout most of its range. This turnabout is thanks to a concerted effort to protect the eagles themselves and the habitats they need to survive.



Now extinct, the Carolina parakeet once ranged throughout most of the eastern United States but succumbed to a combination of hunting and loss of its forest habitat.



Known from but a single Oregon locality, the extinct Sexton Mountain mariposa lily (Calochortus indecorus) apparently vanished under the asphalt of an interstate highway.

A national debate is now under way about the manner in which we as a society should protect our endangered living resources. All sides agree, however, that an essential ingredient in addressing this issue is reliable scientific information. Improved knowledge helps us to better define the problem and to frame solutions in ways that accomplish conservation goals in balance with

human needs and aspirations.

For more than 20 years the Natural Heritage Network—state agencies working together with The Nature Conservancy—has been making biological information available to improve decisions about conservation and economic development.² Building on and contributing to the long-term inventory efforts of the scientific community, the Natural Heritage Network seeks to discover and document the condition of the nation's biological resources. By doing so, the network provides a biological early-

Improved scientific knowledge helps accomplish conservation in balance with human needs and aspirations.

warning system, identifying those species and ecosystems at risk while options are still available to protect them.

The 1997 *Species Report Card*, based on information developed by this public-private partnership, presents the latest findings on the state of our nation's species to assist in setting priorities for their lasting protection.

Life on Earth: What We Know



Among the greatest gaps in contemporary scientific understanding is the answer to a seemingly simple question: How much life exists on Earth? An international team of scientists working under the auspices of the United Nations recently estimated that approximately 1.75 million species worldwide are known to science.³ Considering the number of species likely to exist, but yet to be formally catalogued, these researchers calculate that around 14 million species may actually exist. Compared to other parts of the world, and particularly the tropics, the U.S. biota is relatively well known. For the United States, Harvard University biologist E. O. Wilson estimates that scientists have described and named upward of 100,000 native species.⁴ The actual number of U.S. species is certain to be far higher given the large gaps in scientific knowledge even in the United States.

We report here on the 1997 conservation status of 20,439 species native to and regularly occurring in the United States. This represents 13 major groups of plants and animals that have been classified and studied in sufficient detail to allow comprehensive assessments of the status for all their species (Table 1). This information is drawn from the Natural Heritage Central Databases, which in total contain scientific data on more than 28,000 U.S. species and an additional 11,000 subspecies and varieties. [Note: The term “species” often is used in a broad sense to refer to species as well as subspecies and varieties. In this report we use the term in its more restrictive taxonomic sense, including only fully distinct species.]

Although the approximately 20,500 species treated in this report constitute only one-fifth of known U.S. species, this sample encompasses those groups of plants and animals that are best known,

many of which are dominant components of our ecosystems. Included are all vertebrate animals, for instance, birds, fishes, and mammals; all vascular plants, such as flowering plants, conifers, and ferns; and selected groups of invertebrates. Invertebrates—animals without backbones, like insects, crustaceans, and snails—represent the largest number of species overall, but very little is known about the vast majority of them. For that reason, only those few invertebrate groups for which reasonably complete conservation status information exists are included here. Also not included in this analysis are non-vascular plants (such as mosses and lichens), fungi, and microorganisms (such as bacteria and viruses). Again, these groups are less well known, and comprehensive status information does not yet exist that would allow us to include them in this comparison.

TABLE 1

NUMBER OF NATIVE U.S.
SPECIES TREATED IN REPORT

VERTEBRATES

Mammals	418
Birds	776
Reptiles	278
Amphibians	242
Freshwater Fishes	822

INVERTEBRATES

Butterflies/Skippers	600
Crayfishes	330
Freshwater Mussels	305
Dragonflies/Damselflies	450
Tiger Beetles	110

PLANTS

Ferns	546
Conifers	115
Flowering Plants	15,447

TOTAL	20,439
--------------	---------------

Assessing Conservation Status



Which species are thriving, and which are at the brink of extinction? These are crucial questions for targeting conservation toward those species and ecosystems in greatest need. To answer these questions, the Natural Heritage Network and The Nature Conservancy have developed a consistent method for evaluating the health and condition of both species and ecological communities. This assessment leads to the designation of a conservation status rank—for species this provides an approximation of their risk of extinction.^{5,6}

Rare species are particularly vulnerable to both human-induced and natural hazards. As a result, rarity is a key predictor of extinction potential. Although rarity may seem a straightforward concept, it is complex to characterize. For this reason, natural heritage biologists evaluate four distinct characteristics of rarity for each species when assessing its conservation status: the total population size, or number of individuals of the species; the number of different populations or occurrences of the species; the extent of its habitat; and the breadth of the species' geographic range. Considerations other than rarity also are factored into conservation status determinations. Population trend—whether a species' numbers are increasing, stable, or declining—is a key factor for rare and common species alike. Extinction, after all, is simply the ultimate decline in population numbers. Threats to the species, human and natural, also must be considered since these are important predictors of future decline.

Conservation status ranks are based on a one to five scale (Table 2), ranging from critically imperiled (G1) to demonstrably secure (G5). Species

known to be extinct, or missing and possibly extinct, also are recorded. In general, species classified as vulnerable (G3) or rarer may be considered to be “at risk.”

Conservation status assessments must be continually reviewed, refined, and updated. During 1996 alone, natural heritage and Conservancy scientists reappraised and updated the status of almost 3,000 species. Natural heritage biologists rely on the best available information in making and documenting conservation status determinations, including such sources as natural history museum collections, scientific literature and previously published reports, and other documented sightings by knowledgeable biologists. To augment this

TABLE 2

DEFINITION OF CONSERVATION STATUS RANKS

GX	PRESUMED EXTINCT not located despite intensive searches
GH	POSSIBLY EXTINCT of historical occurrence; still some hope of rediscovery
G1	CRITICALLY IMPERILED typically 5 or fewer occurrences or 1,000 or fewer individuals
G2	IMPERILED typically 6 to 20 occurrences or 1,000 to 3,000 individuals
G3	VULNERABLE rare; typically 21 to 100 occurrences or 3,000 to 10,000 individuals
G4	APPARENTLY SECURE uncommon but not rare; some cause for long-term concern; usually more than 100 occurrences and 10,000 individuals
G5	SECURE common; widespread and abundant

Note: “G” refers to global, or rangewide status. National (N) and State (S) status ranks also are assessed.

existing knowledge, heritage biologists conduct extensive field inventories and population censuses, especially targeting those species thought to be imperiled or for which few existing data are available. Most changes in status assessments tend to reflect this improved scientific understanding of the actual condition of the species.

Designed to assist in setting research and

protection priorities, these conservation status ranks are biological assessments rather than legal categories. They do not confer legal protection, as do listings under the U.S. Endangered Species Act. Natural heritage status ranks are, however, among the factors evaluated by the U.S. Fish and Wildlife Service in identifying which species warrant consideration for protection under the Act.

A NATURAL PARTNERSHIP

The task of evaluating and assigning conservation status ranks is shared among the more than 500 scientists participating in the Natural Heritage Network along with many collaborating biologists from other scientific institutions. The Natural Heritage Network is a unique institutional collaboration—computerized biodiversity inventory programs dedicated to collecting, managing, and sharing information about species and ecosystems at risk. Operating in all 50 U.S. states, Canada, Latin America, and the Caribbean, individual heritage data centers typically are part of state agencies charged with natural resource or wildlife management. To assist in land-use planning and environmental review, and to target conservation efforts, the individual natural heritage data centers maintain detailed maps and computer records for locations of the most imperiled species found within their state. Each year these programs respond to more than 80,000 requests for such information. (See back cover for addresses of participating state agencies and programs, or visit their Internet home pages at <http://www.heritage.tnc.org>.)

State of the Nation's Species



Overall, almost one-third (31.9 percent) of the 20,439 U.S. species assessed are of conservation concern (Figure 1). One percent of these plants and animals are presumed or possibly extinct, 6.5 percent are classified as critically imperiled, 8.8 percent as imperiled, and 15.4 percent as vulnerable. The 13 groups of plants and animals considered in detail here have fared very differently. The proportion of species at risk (GX-G3) in these groups ranges from a high of 67.9 percent for freshwater mussels—representing the worst overall condition—to a low of 14.6 percent for birds (Figure 2).

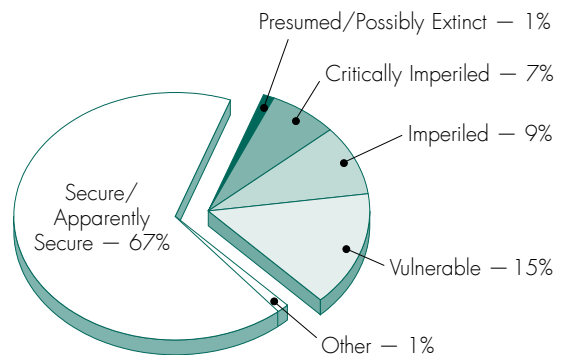
The most striking pattern from these conservation status assessments is the dire condition of those species that depend on freshwater aquatic systems or wetlands for all or part of their life cycle. The four leading groups in terms of proportion of species at risk—freshwater mussels, crayfish, amphibians, and freshwater fish—all depend on rivers, streams, or lakes.

Freshwater mussels in particular have been extraordinarily hard hit, with more than two-thirds of these species of conservation concern. Leading all groups in the proportion of species at risk, one in 10 of these bivalves already may have vanished. Although these creatures are little known to the general public, they are one of the United States' biological treasures: More species of freshwater mussels are found in this country than anywhere else in the world. Mussels also are highly sensitive to water pollution and streambed alterations, and for this reason serve as excellent indicators of the overall health of rivers and streams.

Flowering plants, though, are the organisms in greatest peril when considering sheer number of species. The one-third (33.3 percent) of at-risk flowering plant species translates into a sobering 5,144 species (Appendix, Table 3). Among the most conspicuous features of our natural environment, plants form the basis for the world's food chain through their ability to capture energy from sunlight. The nearly 15,500 native species of flowering plants in the United States come in a dazzling array of forms, from the wildflowers that brighten springtime to the aspen and maple that enliven woodlands in autumn. But because many wild plants are adapted to very specific soil types or microclimates and grow only in very restricted areas, they are especially vulnerable to direct human disturbances.

Good news this year is that a comprehensive reassessment of crayfish, based on newly available information, indicates that while still in serious trouble, these animals are doing better overall

FIGURE 1



One-third of U.S. plant and animal species are at risk of extinction.

than previously thought. After reevaluating the condition of each of the 330 U.S. species of crayfish, we find that just over one-half (51 percent) are now considered to be at risk, a decrease from the previous at-risk assessment of almost two-thirds (65 percent).

Causes of Imperilment

While some species are naturally rare, many imperiled species were once more abundant and have declined primarily because of human activities. People have seriously affected most ecosystems in the United States, directly or indirectly influencing the ability of these native species to thrive. The most serious human impacts include habitat destruction or degradation, the introduction of invasive non-native species, pollution, and over-harvesting of wild species.

The leading cause of imperilment is habitat degradation and destruction. While outright habitat destruction is usually quite obvious, alteration and degradation of sensitive habitats can be subtle, often occurring over long periods of time

and escaping notice. To those plants and animals that depend for survival on those habitats, the results may be just as fatal as complete habitat destruction. Degradation of habitats can occur in various ways, including direct alteration, fragmentation, changes in the water quality or quantity in streams and rivers, and the elimination of key natural ecological processes, such as periodic burns in fire-adapted ecosystems.

Non-native species pose an especially serious but often under-appreciated threat. These invasive

Habitat destruction, invasive non-native species, pollution, and over-harvesting are the most serious threats to wild species.

species are indigenous to other countries or regions, but have been introduced beyond their natural ranges intentionally or inadvertently through

human actions. Invasive aliens can be particularly damaging to those native species that already are vulnerable as a result of other factors; in some instances they may provide the final push toward extinction. The influence of non-natives is accentuated on islands, such as the Hawaiian archipelago, where native species are particularly susceptible to the competition, predation, disease, and ecosystem changes that these aliens cause.

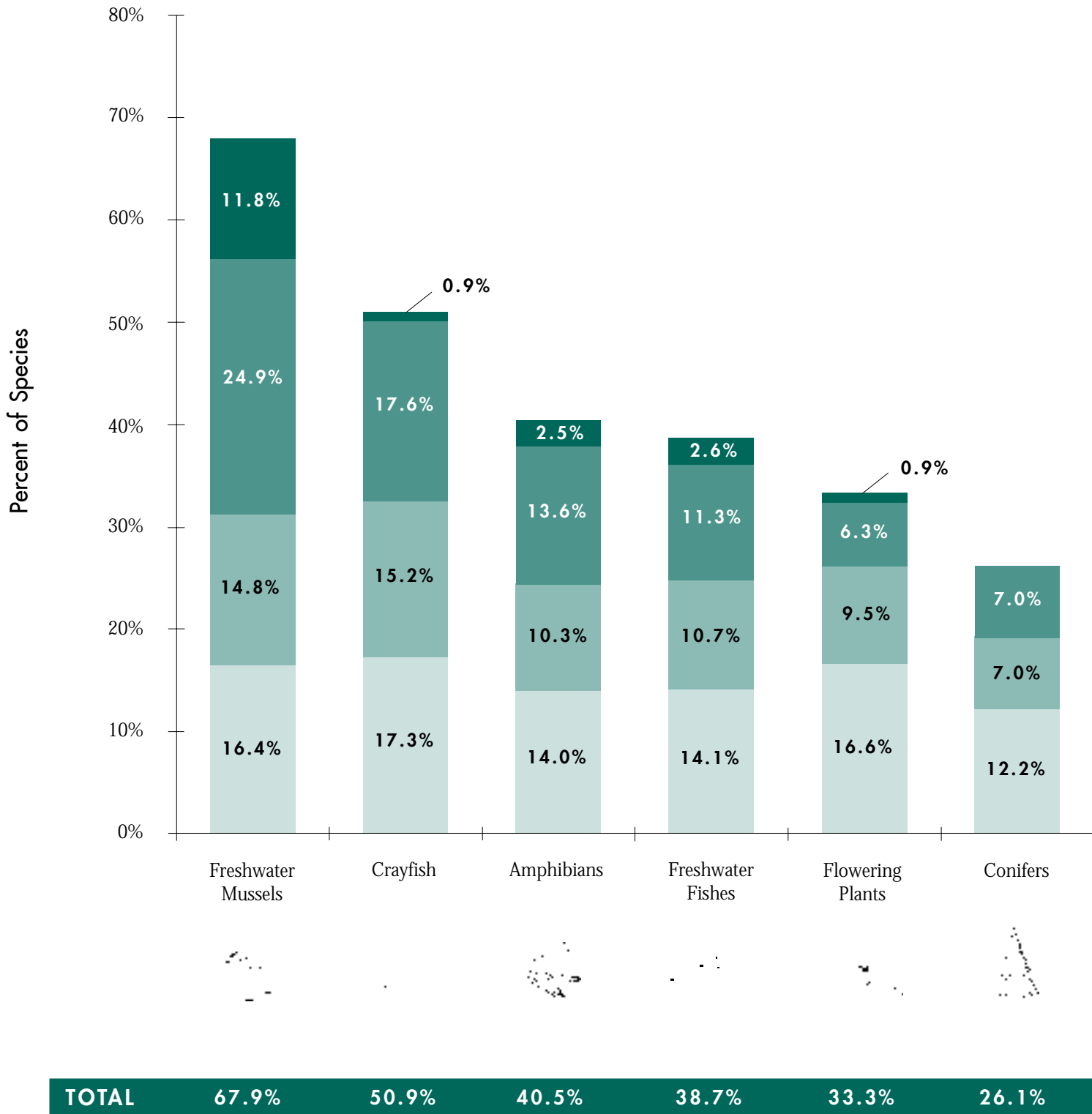
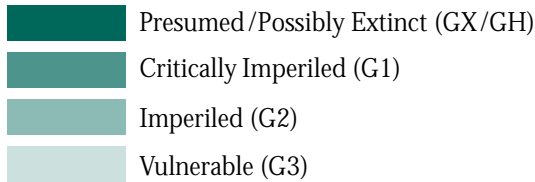


FIGURE 2 Proportion of Species at Risk by Plant and Animal Group

This graph displays the percent of species of conservation concern in each of 13 major plant and animal groups. Species groups are arranged in order of relative risk, with those in greatest danger at left. Species at risk include those with conservation status of vulnerable, imperiled, critically imperiled, or extinct; intensity of color denotes severity of risk. For the number of species included in each conservation status category, see Appendix, Table 3.

Species at Risk



Where the Wild Things Aren't



Extinction is the ultimate consequence of imperilment. Documenting extinctions, though, can be extremely difficult. In some ways it is like searching a haystack for a needle that *isn't* there anymore. For this reason, we are very cautious in listing species as presumed extinct (GX) unless exhaustive searches of all suitable habitat have been carried out and there is no more cause for hope. Those species suspected of being extinct but warranting further searches are ranked in the more conservative category of possibly extinct (GH).

For the 13 groups of plants and animals this report assesses in detail, 76 species meet the stricter criteria of presumed extinct, with another 160 falling into the possibly extinct category (Appendix, Table 3). Including those groups of invertebrate animals and nonvascular plants for which we have only partial coverage, the Natural Heritage Central Databases record a total of 526 U.S. species as extinct or missing, including 110 presumed extinctions and another 416 species that are missing and possibly gone.

Birds have been particularly affected by extinctions, even though they rank overall as the least threatened group analyzed in this report. With 21 species of birds presumed extinct, they lead all other groups in this unenviable category. Other particularly extinction-prone groups include freshwater mussels (19 extinctions), freshwater fishes (17 extinctions), and flowering plants (13 extinctions). Snails, although not detailed in this report because of still incomplete information, also exhibit

extremely high extinction levels. With preliminary data showing 21 presumed extinctions, snails rival birds for the dubious distinction of most species lost.

The relationship between presumed (GX) and possible (GH) extinctions, however, is tightly linked to the intensity of research effort directed toward a particular group. Thus, because of the intense amateur and professional interest directed toward birds, of the 26 bird species considered presumed or possibly extinct, the continued survival of only five remain unresolved. The many thousands of

plant species receive far less intense scrutiny. For this reason, only 13 species have met the strict criteria required for listing as extinct (GX),

whereas another 125 are regarded as possibly extinct (GH), but in need of additional searches before that conclusion would be justified.

*At least 110 U.S. species
are known to be extinct
with another 416 missing.*

Extinctions in America

Virtually every state has been affected by species extinctions, although these losses have not occurred uniformly across the nation. States with large numbers of extinct or missing species tend to have either high overall numbers of species (many of which may be very localized), an inherently fragile flora and fauna, or intense human alteration of the landscape. Extinctions in the United States have been especially prominent in the Pacific islands and sweep across the continent in a southerly arc from the Pacific Coast to the Southeast. Figure 3 charts the number of species lost from each state in the nation based on all 526 presumed and possibly

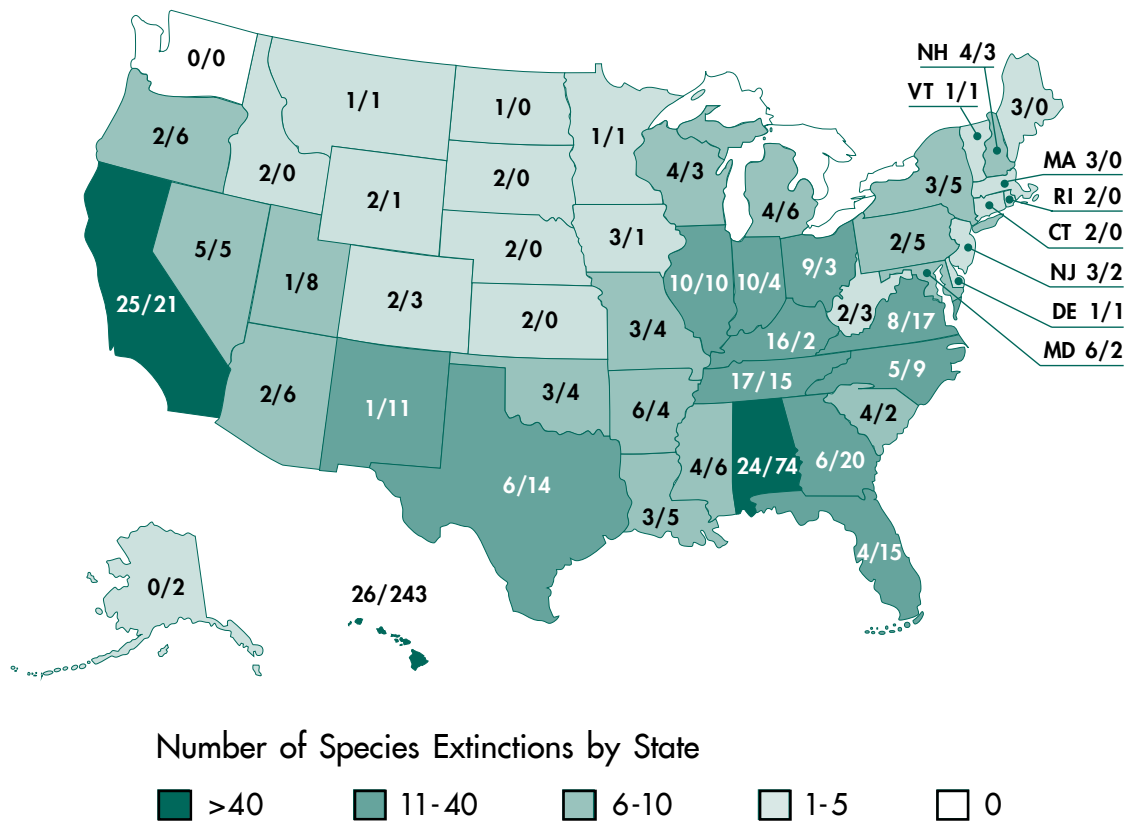


FIGURE 3
Where the Wild Things Aren't

Hawaii, Alabama, and California lead the nation in number of extinctions. This map charts the number of presumed or possibly extinct species that have been lost from each state. Inset numbers refer to each state's presumed/possibly extinct (GX/GH) species. Figures are based on the 526 U.S. species recorded in the Natural Heritage Central Databases as presumed or possibly extinct.

extinct species recorded in the Natural Heritage Central Databases. This reflects the distribution of global extinctions—that is, species that have disappeared completely—not just species that have been extirpated from one state but still exist in another.

Hawaii tops the list with 269 presumed or possibly extinct species, reaffirming its position as the extinction capital of the United States. The number of extinctions is all the more extraordinary given the relatively small overall number of native species that occur in Hawaii. Because of the archipelago's isolation, most of its species are

unique to Hawaii, having evolved from very few original colonists. The absence of continental predators and competitors also makes these native Hawaiian species especially susceptible to the kinds of outside disturbances introduced first by the Polynesian immigration and later by European colonists. Of the 26 presumed species extinctions (GX) that have occurred since European colonization, 15 are birds and the remaining 11 are land snails. The 243 species known only from historical records include 135 invertebrates (among them 51 bees and 48 land snails) and 105 plants. As more groups of Hawaiian invertebrates are assessed, these figures

unfortunately are sure to grow. On the bright side, because many parts of the Hawaiian Islands have yet to be inventoried thoroughly, hope remains that some of these missing species may be rediscovered.

Perhaps surprising to many, Alabama tops the list of extinction-prone states on the mainland with 98 species gone. Twenty-four of this southern state's former inhabitants are presumed extinct, with an additional 74 catalogued as missing and possibly extinct. Alabama is home to an exceptionally rich freshwater fauna, thanks to an ancient and complex geological terrain and more than 235,000 miles of waterways spanning three major river basins. The state was also never

scoured by Pleistocene-epoch glaciers, allowing the flora and fauna to continue diversifying during this period of major geologic perturbations.⁷ Unfortunately, many of these rivers and streams, which successfully weathered the vicissitudes of the Ice Age, have now been dammed and otherwise severely altered, leading to high levels of imperilment and extinction especially among freshwater mussels and aquatic snails.

California, true to its reputation as a trendsetter, is the third most extinction-prone state in the

nation with 46 species extinctions. In many ways California is an ecological island juxtaposed along the western rim of the continent. The state's restless geological history has produced a multitude of habitats, which in turn have given rise to a wonderfully diversified suite of plant and animal species. Many of these species are found only in California, and often are restricted to quite localized areas. The Golden State's explosive human population growth, though, has had a severe impact on many of the

wild landscapes that support these unusual plants and animals. Flowering plants especially have been hard hit in California: of the 25 presumed and 21 possibly

extinct species in the state, about half (24) are plants.

At the other end of the spectrum are several states, especially in the Northeast and upper Midwest, that have been little affected by species extinctions. Washington is the only state for which our databases show no recorded extinctions at the full-species level. This bit of good news for the Pacific Northwest is counterbalanced, however, by the region's precipitous declines in runs of salmon and other anadromous fish, which have resulted in the loss of at least 100 distinct fish populations.⁸

*On the U.S. mainland,
Alabama tops the list of
extinction-prone states.*

Exploration: Ten Key Discoveries



The age of exploration is far from over. While the broad outlines of life on Earth are now in focus, biologists continue to make discoveries, large and small, filling out the fundamental knowledge about our fellow inhabitants on this planet. For instance, an entirely new phylum of animals was recently discovered—an organism as different from other animals as are humans from earthworms—residing in all places on the whiskers of Norwegian lobsters.⁹

While not all discoveries are so dramatic, protecting plants and animals relies on the work of modern-day biological explorers to reveal the distribution, abundance, and basic identity of our nation's species. We present here 10 key discoveries made or reported during 1996 that add to the fabric of our knowledge and help us better assess the state of the nation's plants and animals.

Conservation efforts are only as effective as the knowledge on which they are based. Fortunately, a small but dedicated community of professional and amateur biologists is committed to furthering knowledge about biodiversity. Especially important in this effort are the institutions that undertake and support basic inventory and taxonomic classification efforts, including universities, botanical gardens, zoos, natural history museums, and a variety of state and federal agencies. Natural Heritage programs and The Nature Conservancy rely upon the findings of these institutions and also carry out extensive field surveys of their own to locate and document species of conservation concern. And as a rancher's discovery of a jaguar in New Mexico illustrates, members of the public with an intimate knowledge

of the land also have much to contribute.

The 10 discoveries that follow, from both field and laboratory, represent a few of the most important and interesting finds of the past year. Some bring good news, such as rediscovery of plants previously thought to be extinct or that have been long lost to science. Others expand the frontiers of our knowledge, including discovery of new species or illumination of unknown evolutionary mechanisms. Still other findings bode ill for the nation's ecological systems, such as the entry into the United States of yet another damaging alien pest, or reports of species that, while not yet gone, appear to be on an irreversible path to extinction. On the whole, however, these discoveries demonstrate the central role that continued inventory and exploration have in our ability to conserve the nation's biological resources.

1996 DISCOVERIES

NEW TO SCIENCE

San Gabriel Mountain Slender Salamander
Hawaiian Cave Planthopper

SPECIES REDISCOVERIES

Shasta Owl's-Clover
Jaguar
Hells Canyon Rock Cress

EXPLORING WITH NEW TECHNOLOGIES

Laysan Duck

MAKING DO IN UNUSUAL PLACES

Indiana Bat
Cooley's Meadowrue

ALIEN INVADERS

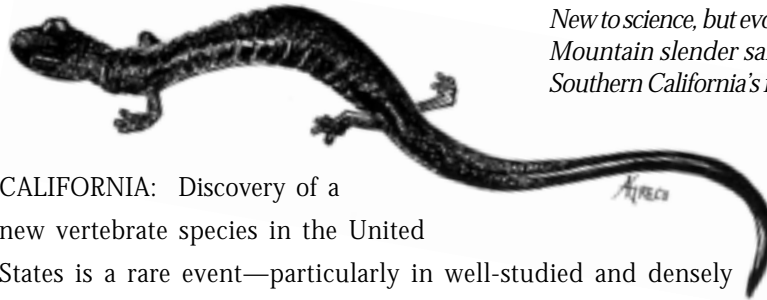
Asian Longhorned Beetle

THE LIVING DEAD

White Wartyback Mussel

San Gabriel Mountain Slender Salamander

Conservation Status: CRITICALLY IMPERILED



New to science, but evolutionarily ancient, the San Gabriel Mountain slender salamander is a recent addition to Southern California's imperiled biota.

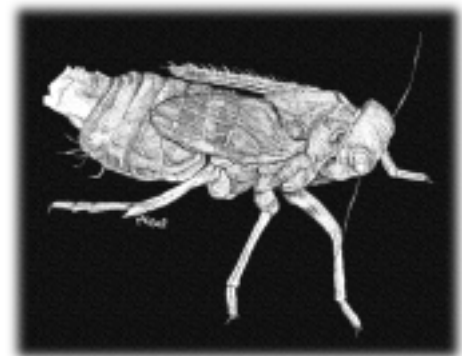
CALIFORNIA: Discovery of a new vertebrate species in the United States is a rare event—particularly in well-studied and densely populated areas. This makes the recent description of *Batrachoseps gabrieli*, a new salamander species, all the more exciting.¹⁰ While searching coniferous forests in the San Gabriel Mountains of Los Angeles County, David B. Wake, director of the Museum of Vertebrate Zoology, University of California, Berkeley, discovered a distinctive yet unknown salamander. But while new to science, the San Gabriel Mountain slender salamander has an old pedigree: It belongs to the evolutionarily ancient plethodontid group of lungless salamanders. Genetic and biochemical laboratory analyses also confirm the antiquity of this newly discovered species, suggesting it diverged from its closest relatives between eight million and 13 million years ago. Living secretively beneath rocky talus, the salamander so far has been found at only a handful of sites within the Angeles National Forest. With fewer than 100 known individuals this new—yet old—salamander species now joins the ranks of Southern California's diverse but imperiled fauna.

Hawaiian Cave Planthopper

Conservation Status: YET TO BE DETERMINED

HAWAII: While the evolutionary roots for many species go back millions of years, other species are of much more recent origin. *Oliarus polyphemus*, a distant relative of the cicada, inhabits lava caves only on the geologically young island of Hawaii and offers a fascinating example of such rapid speciation.¹¹ Entomologists Hannelore Hoch of

Inhabiting geologically young lava tubes, the Hawaiian cave planthopper appears to be rapidly differentiating into several new species.



Distinctive courtship songs from two different caves, as reflected by the sonograms at right, indicate that these planthoppers are reproductively isolated—a prerequisite for speciation.



Berlin's Humboldt University Natural History Museum and Frank G. Howarth of Hawaii's Bishop Museum are investigating this highly specialized cave insect, which is blind, flightless, and lacks pigment. These researchers found that not only do planthoppers have an unusual method of calling for mates—they transmit signals that travel through tree roots rather than through the air—but that the courtship calls are different in each of the seven caves they studied on the island of Hawaii.¹² These distinct songs make it likely that each population is reproductively isolated, with each cave consequently harboring a new and previously unrecognized species. Although Hawaii's forests and other native ecosystems long have been viewed as biological treasures, only in the past few decades have the island's caves and their unique life-forms become the focus of conservation concern. The rapid speciation suspected to occur in these planthoppers provides an added impetus to protect these intriguing ecosystems, along with additional clues as to where and how.

Species Rediscoveries

Shasta Owl's-Clover

Conservation Status: CRITICALLY IMPERILED

CALIFORNIA: Over the past 150 years the Shasta owl's-clover (*Orthocarpus pachystachyus*) has been an elusive plant, and had been given up for gone. Until its rediscovery in 1996, this petite wildflower had been seen only twice—not because it had disappeared, as it turns out, but because botanists were looking for it in the wrong places. First described in 1848 by the eminent Harvard botanist Asa Gray, the plant was not collected again until 1913. Known only from these two reports from the Shasta Valley of northern California, it could not be relocated despite repeated searches of the moist meadows where it was thought originally to have been found. In May of last year, botanist Dean Taylor of the University of California, Berkeley, succeeded where others had failed. He rediscovered the evasive plant not by looking in the vernal pools and wet swales where other botanists had searched, but on the higher, drier ground of a sagebrush-covered hillside. But even in this habitat the wildflower appears to be extraordinarily rare. Taylor was able to find only eight individual plants of the owl's-clover. Although as a species the Shasta owl's-clover has been retrieved from presumed extinction, given its precarious existence on a single sagebrush hillside, we can't say that it is yet out of the woods.



Given up for extinct, the Shasta owl's-clover was rediscovered more than 80 years after it was last seen.

Jaguar

U.S. Conservation Status: CRITICALLY IMPERILED

NEW MEXICO: For the first time in more than 90 years North America's largest wild cat, the jaguar (*Panthera onca*), has been seen roaming the mountains of New Mexico. On March 7, 1996, cowboy and tracker Warner Glenn was out in search of mountain lions when to his great surprise he instead encountered a jaguar.¹³ Glenn captured on film his dramatic encounter in the rugged Peloncillo Mountains of New Mexico's southwestern bootheel.

A jaguar was last sighted—and killed—in New Mexico in 1905, although over the past 40 years there have been seven confirmed reports of jaguars in neighboring Arizona. Since Glenn's original sighting,

he has seen additional jaguar tracks, indicating the species' continuing presence in the Peloncillo Mountains. Historical records suggest that jaguars regularly occurred in the United States and were not just drifters from Mexico; indeed, prior to World War II, jaguars, including females and young, were a fairly widespread occurrence in Arizona. Nonetheless, the jaguar is classified only as a foreign species under the U.S. Endangered Species Act, although the U.S. Fish and Wildlife Service currently is reevaluating that designation. Fortunately, the remote area in which the Peloncillo jaguar was sighted is part of a region where many local ranching families, working together as the Malpai Borderlands Group, are involved in protecting both the natural environment and traditional ranch lifestyles. Based on Glenn's extraordinary encounter, the group has established a jaguar protection fund with the hope that these magnificent cats will again take their place as part of the borderlands ecosystem.



The jaguar, North America's largest cat, has returned to the mountains of New Mexico where it was photographically documented by a local rancher.

Hells Canyon Rock Cress

Conservation Status: CRITICALLY IMPERILED

OREGON: In yet another West Coast rediscovery, a plant species that had slipped through the cracks for more than 85 years has been found in a rocky outcrop of eastern Oregon. The Hells Canyon rock cress (*Arabis hastatula*) was first described in 1910, but because the original specimen available for study had only immature fruits, botanists were unsure if it was really a distinct species. As a result, this small, purple-flowered member of the mustard family faded from view and was excluded from regional plant lists. Reed Rollins of Harvard University's Gray Herbarium recently resurrected the species as part of a comprehensive new study of the mustard family in North America.¹⁴ Rollins had uncovered a 1952 specimen of the

After being resurrected from taxonomic obscurity, the Hells Canyon rock cress was relocated growing high on the cliffs of a remote Oregon wilderness area.

plant with mature fruits, confirming that the species was indeed distinctive. With this information, Oregon Natural Heritage Program director Jimmy Kagan forged a partnership with staff of the Wallowa Whitman National Forest to search for the little-known flower. Their 1996 fieldwork both relocated the population where the 1952 sample was collected and uncovered an additional nine occurrences of the species, all along a single band of cliffs high in Oregon's Hells Canyon Wilderness Area. While *Arabis hastatula* is extremely rare, with fewer than 1,000 individual plants known, there appear to be few threats to the species. Indeed, the very isolation that allowed the plant to escape the notice of botanists for so long should help to ensure its continued survival.



Exploring with New Technologies

Laysan Duck

Conservation Status: CRITICALLY IMPERILED

HAWAII: Modern DNA analysis techniques not only help to solve human crimes, but also can shed light on the mysteries of the origin and past distribution of wild species. In the case of the Laysan duck (*Anas*



laysanensis), a federally listed endangered species, DNA analysis is enabling scientists to reconstruct the past, both figuratively and literally. Found only on Laysan Island, a remote 900-acre blip in the Pacific Ocean lying more than 800 miles west of the main Hawaiian Islands chain, this duck has been hovering at the brink of extinction. Any species dependent on a single locality leads a tenuous existence, and the Laysan duck is no exception. The small number of remaining birds is vulnerable to fluctuations in population size; for instance, fewer than

150 birds survived a 1993 drought. To determine whether the duck once was distributed more widely, a research team from the Smithsonian Institution and Clemson University led by Alan Cooper analyzed the DNA content of fossil Hawaiian duck bones.¹⁵ Comparing DNA from ancient bones on the main Hawaiian Islands with DNA from the present-day Laysan duck, the researchers found that the bird was once widespread throughout the archipelago. The duck apparently was one of the many Hawaiian bird species that disappeared following the Polynesian colonization of Hawaii between 400 and 600 AD. With this evidence in hand, biological justification exists that may help ensure the Laysan duck's long-term survival through reintroducing the bird to other islands, now known to be part of the species' former range.

Making Do in Unusual Places

Indiana Bat

Conservation Status: IMPERILED

OHIO: Rare species sometimes can turn human disturbances to their advantage. An abandoned mine in Ohio has surfaced as the state's single largest bat colony.¹⁶ Among the inhabitants discovered in this mine is the Indiana bat (*Myotis sodalis*), a federally listed endangered species that for more than 40 years had not been found hibernating in Ohio. Virgil Brack, contracted by the Ohio Division of Wildlife, led a bat survey team to census a Preble County limestone mine on February 3, 1996. The researchers discovered more than 25,000 hibernating bats, including 9,298 of the imperiled Indiana bats. This endangered species shares these quarters with a variety of other bats, including little brown bats (*Myotis lucifugus*), eastern pipistrelles (*Pipistrellus subflavus*), big brown bats (*Eptesicus fuscus*), and northern long-eared bats (*Myotis septentrionalis*). Although the privately owned mine is being used for storage, the Division of Wildlife is working with the owner to provide additional protection to the colony. The owner is considering erecting a gate across the mine entrance to prevent people from disturbing the bats, and posting interpretive signs highlighting the conservation importance of the site. The discovery of this colony suggests that, while no substitute for protecting natural bat caves, specific management tools, such as building internal walls and partitions, might be used in other mines to increase their habitat value, enticing more bats to take up residence in these man-made caverns.



Ohio's largest bat colony, newly discovered in an abandoned limestone mine, is also significant for harboring almost 10,000 endangered Indiana bats.

Cooley's Meadowrue

Conservation Status: CRITICALLY IMPERILED

NORTH CAROLINA: Even rare plants occasionally can survive in highly disturbed ecosystems. In the early 1980s, botanist Alan Weakley of the North Carolina Natural Heritage Program was searching the state for an unusual type of wet pine savanna that is known to support a number of rare plant species. Visiting one potential site identified from soil, geology, and topographic maps, Weakley was disappointed to find the area recently clear-cut and the soil overturned. Further disturbed by construction of a network of ditches, the site was subsequently abandoned. Revisiting the site in 1996, Richard LeBlond, also a botanist with the heritage program, was surprised and delighted to find that, although the area remained treeless, the rare plants had reappeared. Among 17 rare plant species discovered at the site was Cooley's meadowrue (*Thalictrum cooleyi*), a federally listed endangered species in the buttercup family. This newly discovered meadowrue colony is only the 12th population of the species currently known to exist. The meadowrue and other rare species apparently were able to recolonize from dormant seeds because, despite the disturbances, the site's basic water regime survived intact. As a result of this discovery, the heritage program is working with the North Carolina Department of Transportation, owner of the site, to develop a strategy not only to protect but to restore this rare wet savanna ecosystem.



The surprising reappearance of Cooley's meadowrue at a site severely disturbed more than a decade ago gives hope for the long-term survival of the species.

Alien Invaders

Asian Longhorned Beetle

Status: NON-NATIVE IN THE UNITED STATES

NEW YORK: Not all species discoveries are good news. In August 1996 a longhorned beetle (*Anoplophora glabripennis*) native to Asia was discovered in New York attacking trees in Brooklyn and the Long Island community of Amityville.¹⁷ This pest insect is found naturally in Japan, Korea, and China, where it kills a wide variety of trees, including elms, poplars, and willows. Boring into the wood, the insect harms the trees' vascular system, leaving them vulnerable to other parasites and to weather damage. The inch-long beetles most likely entered the United States in wood packing materials used to import sewage pipes from China. In New York this longhorned beetle already has been found on willow, horse-chestnut, and maple species. Unchecked,

the non-native insect could spread widely throughout the United States, with devastating ecological and economic consequences. New York State has already imposed a quarantine restricting the removal of untreated host material from the two affected areas, and should soon begin removing, chipping, and burning all infested trees. While prevention is the best and most cost-effective approach to non-native species invasions, early detection through regular biological monitoring offers the next best hope, allowing the possibility of eradication before new pests have spread. Even though the outcome of this infestation is still uncertain, had the beetle not been discovered early in its destructive path, control and management efforts would be far more costly and have less potential for success.

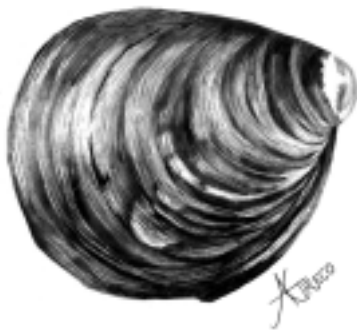


The Asian longhorned beetle, a tree-killing pest, has slipped into the United States and could cause widespread damage unless quickly eradicated.

The Living Dead

White Wartyback Mussel

Conservation Status: CRITICALLY IMPERILED



Pushed to the brink of extinction by changes to its river habitat, the last of the white wartyback mussels have joined the ranks of the living dead.

TENNESSEE: Although some species may be able to cope with habitat disturbances, others, such as the white wartyback mussel (*Plethobasus cicatricosus*), cannot and are propelled inexorably toward extinction. Once found widely in the Ohio River system, including the Cumberland and Tennessee Rivers, the white wartyback has disappeared throughout virtually all of its former range. Water pollution has taken its toll, but even more devastating has been the series of dams and impoundments built throughout the region since the 1920s. These dams have changed the downstream water flow, converting the shallower, moving waters that sustained the mussel into a series of deep, silty lakes. Neither the mussel nor the host fish it requires to reproduce can survive in these deeper, lake-like conditions.

For the white wartyback, these changes to its riverbed habitat have pushed the species into functional extinction. Despite searches, the last two living white wartybacks were observed in 1987 below Pickwick Dam, Tennessee. Based on the size and condition of their shells, these were two old adults that—unable to reproduce—had already joined the ranks of the living dead.

Raising Our Grades



The 1997 *Species Report Card* is a reflection both of the condition of the plants and animals in the United States and of how we as a society are doing at protecting our natural inheritance. The decline and extinction of U.S. species is not just a theoretical possibility; as this report documents, it may already have happened more than 500 times, affecting virtually every state. These numbers are sure to grow if human activities continue to degrade our nation's ecosystems. There are, however, actions that we can take to halt this slide toward biological impoverishment.

Conserve the Ecosystems on Which Species Depend

The best approach to protecting the nation's plants and animals is to conserve the ecosystems on which they depend. With destruction or degradation of habitat being the leading cause of species declines, ecosystem conservation efforts offer the greatest hope for protecting entire suites of species. Ecosystem approaches that embrace both natural and working landscapes offer a way to sustain wildlife and support responsible human uses of these systems.

Improve Understanding of Vanishing Flora and Fauna

Limited public and private conservation funding makes it imperative to set clear priorities for conservation. What species are at risk, where are they found, and what threatens them? Key to successfully answering these questions and planning effective conservation actions is research on the taxonomy, distribution, and ecology of the nation's vanishing flora and fauna. The resulting

improvements in understanding the status of these plants and animals help increase our options for their protection—and our confidence that resources are being targeted most efficiently.

Protect Those Species at Greatest Risk

While focusing on still-healthy ecosystems affords the best preventive medicine for species protection, we must also tend to the critical care needs of those plants and animals at greatest risk. Among the highest priorities for conservation action are those 15 percent of the American biota that are ranked as imperiled or critically imperiled. Because so few locations exist for most of these rarities, conservation options are limited and special effort must be made to protect those lands and waters where they still exist. Given the very small total range of some of these species, many of which are plants, localized conservation efforts can be enormously effective at sustaining these species over the long term. Many more options are available for conservation of the 15 percent of species that are regarded as vulnerable but have not yet become imperiled. These species have larger population sizes and often wider ranges, allowing for more flexibility in incorporating their protection into overall conservation planning efforts.

Launch Searches to Relocate Missing Species

For those species that have slipped into extinction, it already is too late. There is a pressing need, though, to search for those species known only from historical records (status rank GH) that may not yet be extinct. Clarifying their status as either

extinct or still alive is a major priority, and those rediscovered merit immediate conservation attention. To help address this important need, the Conservancy has established the Canon Exploration Grants Program, an initiative supporting needed survey and inventory work to relocate those missing species. This program is supported by Canon U.S.A.'s Clean Earth Campaign, which makes possible The Nature Conservancy's NatureServe program.

Remember the Little and Less Glamorous Creatures

For many people the term "endangered species" conjures images of whales, grizzly bears, and peregrine falcons. Significant as are these awe-inspiring creatures, ecologically it is mostly the little or less glamorous species that run the world: the butterflies that pollinate our wildflowers, the trees that provide food and shelter for our songbirds, and the humble beetles that help recycle our wastes into nutrients. For this reason we cannot afford to

ignore the condition and conservation of species with which we are less familiar, or those for which we have yet to ascribe a dollar value.

Instill a Commitment to Conservation

The American people have inherited a rich and diverse biological legacy, one that we hold in trust for our children. The United States has long been committed to the protection and responsible management of these biological resources and indeed has been a world leader in promoting these concepts. Nonetheless, as pointed out by this *1997 Species Report Card*, a significant portion of the American flora and fauna is at risk. For the sake of both our wild companions and ourselves, we have a responsibility to attend to our collective homework. We must rededicate ourselves to the conservation commitment—public and private—needed to raise our grades and provide lasting protection for our biological inheritance.

Cited References

- ¹ Lawton, J.H. and R.M. May. 1995. *Extinction Rates*. Oxford University Press, Oxford.
- ² Groves, C.R., M.L. Klein and T.F. Breden. 1995. Natural heritage programs: Public-private partnerships for biodiversity conservation. *Wildlife Society Bulletin* 23(4): 784-790.
- ³ Heywood, V.H. (ed.). 1995. *Global Biodiversity Assessment*. Cambridge University Press, Cambridge.
- ⁴ Eisner, T., J. Lubchenco, E.O. Wilson, D.S. Wilcove and M.J. Bean. 1995. Building a scientifically sound policy for protecting endangered species. *Science* 268: 1231-1232.
- ⁵ Master, L.L. 1991. Assessing threats and setting priorities for conservation. *Conservation Biology* 5: 559-563.
- ⁶ Stein, B.A., L.L. Master, L.E. Morse, L.S. Kutner and M. Morrison. 1995. Status of U.S. species: Setting priorities for conservation. Pp. 399-400 in: E.T. LaRoe et al. (eds.), *Our Living Resources*. U.S. Department of Interior, Washington, DC.
- ⁷ Lydeard, C. and R.L. Mayden. 1995. A diverse and endangered aquatic ecosystem of the Southeast United States. *Conservation Biology* 9(4): 800-805.
- ⁸ Nehlsen, W., J.E. Williams and J.A. Lichatowich. 1991. Pacific salmon at the crossroads: Stocks at risk from California, Oregon, Idaho and Washington. *Fisheries* 16(2): 4-21.
- ⁹ Funch, P. and R.M. Kristensen. 1995. Cycliophora is a new phylum with affinities to Entoprocta and Ectoprocta. *Nature* 378: 711-714.
- ¹⁰ Wake, D.B. 1996. A new species of *Batrachoseps* (Amphibia: Plethodontidae) from the San Gabriel Mountains, Southern California. *Los Angeles County Museum Contributions in Science* 463: 1-12.
- ¹¹ Hoch, H. 1996. The Hawaiian cave planthopper (Homoptera Cixiidae): A model for rapid subterranean speciation? Abstract 11-065 in: *Proceedings 20th International Congress of Entomology, Florence, Italy*.
- ¹² Hoch, H. and E.G. Howarth. 1993. Evolutionary dynamics of behavioral divergence among populations of the Hawaiian cave-dwelling planthopper *Oliarus polyphemus* (Homoptera: Fulgoroidea: Cixiidae). *Pacific Science* 47(4): 303-318.
- ¹³ Glenn, W. 1996. *Eyes of Fire: Encounter with a Borderlands Jaguar*. Printing Corner Press, El Paso, Texas.
- ¹⁴ Rollins, R.C. 1993. *The Cruciferae of Continental North America*. Stanford University Press, Stanford, California.
- ¹⁵ Cooper, A., J. Rhymer, H.F. James, S.L. Olson, C.E. McIntosh, M.D. Sorenson and R.C. Fleischer. 1996. Ancient DNA and island endemics. *Nature* 381: 484.
- ¹⁶ Swanson, D. 1996. Ohio's bat cave. *Wild Ohio* 7(3): 10-12.
- ¹⁷ Mastro, V. and J. Cavey. 1996. *Anoplophora glabripennis*, an Asian longhorned beetle. APHIS Science Advisory Panel Report for October 25. 7 pp.



Appendix: Species Status Table

TABLE 3

Number of Species by Conservation Status	Conservation Status Rank								Total
	GX Presumed Extinct	GH Possibly Extinct	G1 Critically Imperiled	G2 Imperiled	G3 Vulnerable	G4 Apparently Secure	G5 Secure	Other*	
VERTEBRATES									
Mammals	1	0	9	21	38	91	258	0	418
Birds	21	5	27	18	42	76	587	0	776
Reptiles	0	0	8	9	33	46	181	1	278
Amphibians	3	3	33	25	34	40	104	0	242
Freshwater Fishes	17	4	93	88	116	145	354	5	822
VERTEBRATE TOTAL	42	12	170	161	263	398	1,484	6	2,536
INVERTEBRATES									
Butterflies/Skippers	1	2	8	16	74	171	306	22	600
Crayfish	1	2	58	50	57	90	69	3	330
Freshwater Mussels	19	17	76	45	50	44	46	8	305
Dragonflies/Damselflies	0	2	7	27	47	86	267	14	450
Tiger Beetles	0	0	5	2	15	16	59	13	110
SELECTED INVERTEBRATE TOTAL	21	23	154	140	243	407	747	60	1,795
VASCULAR PLANTS									
Ferns	0	4	27	22	65	162	244	22	546
Conifers	0	0	8	8	14	30	55	0	115
Flowering Plants	13	121	975	1,467	2,568	4,426	5,669	208	15,447
VASCULAR PLANT TOTAL	13	125	1,010	1,497	2,647	4,618	5,968	230	16,108
TOTALS	76	160	1,334	1,798	3,153	5,423	8,199	296	20,439

* Other includes species not yet ranked

Data Source: Natural Heritage Central Databases. Botanical data compiled and edited by Larry E. Morse with the assistance of Nancy B. Benton, Martha Martinez, and Gwendolyn Thunhorst. Zoological data compiled by Lawrence L. Master, Geoffrey Hammerson, Melissa Morrison, Dale F. Schweitzer, and Miriam L.E. Steiner. This 1997 summary table includes substantial new status data compiled by Chris Taylor (Illinois Natural History Survey) on crayfishes, by Tom Watters (Ohio Biological Survey) on freshwater mussels, and by John T. Kartesz (North Carolina Botanical Garden) on vascular plants. These conservation status ranks and their supporting documentation are developed in cooperation with the state agency-based Natural Heritage Network.



Credits

Authors: Bruce A. Stein and Stephanie R. Flack

Design and Production: Nicole S. Rousmaniere

Illustrations: Angela Greco, Summary, p. 16 (top), 18, and 22 (bottom); Frank Lang, p. 4; Megan Grey Rollins, p. 3, 16 (bottom), 17, 19, 20, 21, and 22 (top); and Kate Spencer, p. 2

Web Production: Angela Greco

Research Assistance: Nancy B. Benton, Robert M. Chipley, Jeffery A. Lerner, Lawrence L. Master, Melissa Morrison, Larry E. Morse, Chris B. Reynolds, Miriam L.E. Steiner, and Gwendolyn Thunhorst



Acknowledgments

This report card would not be possible without the work of the many state Natural Heritage Data Center staff, Nature Conservancy staff, and other scientific collaborators who assisted in developing the conservation status data upon which this report is based.

We also would like to thank the following reviewers for their thoughtful comments: Thomas Breden, Geoffrey Hammerson, Deborah B. Jensen, Christine A. De Joy, Lawrence L. Master, Pat Mehlhop, Larry E. Morse, Maria Naehu, Tom Smith, Mark L. Shaffer, and William Stolzenberg. Steven Ahlstedt, Roxanne Bittman, Jimmy Kagan, Carol DiSalvo, Frank G. Howarth, Scott Miller, Linda Pearsall, Bernie Raimo, and David B. Wake provided assistance with identification and documentation of discoveries profiled in this report.

We gratefully acknowledge Canon U.S.A., Inc., which makes possible publication of this report as part of the Conservancy's NatureServe program.

State Natural Heritage Data Centers

Conservation Science Division
The Nature Conservancy
1815 N. Lynn St.
Arlington, VA 22209
(703) 841-5300

Association for Biodiversity Information
P.O. Box 1737
3421 M Street, NW
Washington, DC 20007

Alabama Natural Heritage Program
Huntingdon College
1500 E. Fairview Avenue
Montgomery, AL 36106
(334) 834-4517

Alaska Natural Heritage Program
707 A Street, Suite 208
Anchorage, AK 99501
(907) 257-2702

Arizona Heritage Data Mgmt. System
Arizona Game & Fish Department
2221 W. Greenway Road
Phoenix, AZ 85023
(602) 789-3612

Arkansas Natural Heritage Commission
Suite 1500, Tower Building
323 Center Street
Little Rock, AR 72201
(501) 324-9150

California Natural Heritage Division
Department of Fish & Game
1220 S Street
Sacramento, CA 95814
(916) 322-2493

Colorado Natural Heritage Program
Colorado State University
254 General Services Building
Fort Collins, CO 80523
(970) 491-1309

Connecticut Natural Diversity Database
Department of Environmental Protection
79 Elm Street, Store Level
Hartford, CT 06106-5127
(203) 424-3540

Delaware Natural Heritage Program
Dept. of Nat. Res. & Env. Control
4876 Hay Point Landing Road
Smyrna, DE 19977
(302) 653-2880

District of Columbia Nat. Her. Program
U.S. National Park Service
13025 Riley's Lock Road
Poolesville, MD 20837
(301) 427-1354

Florida Natural Areas Inventory
1018 Thomasville Road
Tallahassee, FL 32303
(904) 224-8207

Georgia Natural Heritage Program
Georgia Department of Natural Resources
2117 U.S. Highway 278 S.E.
Social Circle, GA 30279
(706) 557-3032

Hawaii Natural Heritage Program
The Nature Conservancy of Hawaii
1116 Smith Street, Suite 201
Honolulu, HI 96817
(808) 537-4508

Idaho Conservation Data Center
Department of Fish & Game
600 South Walnut Street, Box 25
Boise, ID 83707
(208) 334-3402

Illinois Natural Heritage Division
Department of Natural Resources
524 South 2nd Street
Springfield, IL 62701
(217) 785-8774

Indiana Natural Heritage Data Center
Department of Natural Resources
402 West Washington Street, Room W267
Indianapolis, IN 46204
(317) 232-4052

Iowa Natural Areas Inventory
Department of Natural Resources
Wallace State Office Building
Des Moines, IA 50319
(515) 281-8524

Kansas Natural Heritage Inventory
Kansas Biological Survey
2041 Constant Avenue
Lawrence, KS 66047
(913) 864-3453

Kentucky Natural Heritage Program
Kentucky State Nature Preserves
Commission
801 Schenkel Lane
Frankfort, KY 40601
(502) 573-2886

Louisiana Natural Heritage Program
Department of Wildlife & Fisheries
P.O. Box 98000
Baton Rouge, LA 70898
(504) 765-2821

Maine Natural Areas Program
Department of Conservation
93 State House Station
Augusta, ME 04333
(207) 287-2211

Maryland Natural Heritage Program
Department of Natural Resources
Tawes State Office Building, E-1
Annapolis, MD 21401
(410) 974-2870

Massachusetts Natural Heritage
& Endangered Species Program
Division of Fisheries & Wildlife
Route 135
Westborough, MA 01581
(508) 792-7270

Michigan Natural Features Inventory
Mason Building, 5th floor
Box 30444
Lansing, MI 48909
(517) 373-1552

Minnesota Nat. Her. & Nongame Research
Department of Natural Resources
500 Lafayette Road, Box 7
St. Paul, MN 55155
(612) 297-4964

Mississippi Natural Heritage Program
Museum of Natural Science
111 North Jefferson Street
Jackson, MS 39201
(601) 354-7303

Missouri Natural Heritage Database
Dept. of Conservation
P.O. Box 180
Jefferson City, MO 65102
(314) 751-4115

Montana Natural Heritage Program
1515 E. 6th Avenue
Helena, MT 59620
(406) 444-3009

Nebraska Natural Heritage Program
Game & Parks Commission
P.O. Box 30370
Lincoln, NE 68503
(402) 471-5421

Nevada Natural Heritage Program
Dept. of Conservation & Natural Resources
1550 E. College Parkway, Suite 145
Carson City, NV 89710
(702) 687-4245

New Hampshire Nat. Heritage Inventory
Dept. of Resources & Economic Dev.
P.O. Box 1856
Concord, NH 03302
(603) 271-3623

New Jersey Natural Heritage Program
Office of Natural Lands Management
22 South Clinton Avenue, CN404
Trenton, NJ 08625
(609) 984-1339

New Mexico Natural Heritage Program
University of New Mexico
2500 Yale Boulevard, SE, Suite 100
Albuquerque, NM 87131
(505) 277-1991

New York Natural Heritage Program
Dept. of Environmental Conservation
700 Troy-Schenectady Road
Latham, NY 12110
(518) 783-3932

North Carolina Heritage Program
Dept. of Environ., Health & Nat. Res.
P.O. Box 27687
Raleigh, NC 27611
(919) 733-7701

North Dakota Natural Heritage Inventory
Parks & Recreation Dept.
1835 Bismarck Expressway
Bismarck, ND 58504
(701) 328-5357

Ohio Natural Heritage Program
Department of Natural Resources
Fountain Square, Building F-1
Columbus, OH 43224
(614) 265-6453

Oklahoma Natural Heritage Inventory
Oklahoma Biological Survey
111 East Chesapeake Street
University of Oklahoma
Norman, OK 73019
(405) 325-1985

Oregon Natural Heritage Program
The Nature Conservancy of Oregon
821 SE 14th Ave.
Portland, OR 97214
(503) 731-3070

Pennsylvania Nat. Diversity Inventory-East
34 Airport Drive
Middletown, PA 17057
(717) 948-3962

Pennsylvania Nat. Diversity Inventory-West
Western Pennsylvania Conservancy
316 Fourth Avenue
Pittsburgh, PA 15222
(412) 288-2777

Pennsylvania Nat. Div. Inventory-Central
Bureau of Forestry
P.O. Box 8552
Harrisburg, PA 17105
(717) 783-0388

Rhode Island Heritage Program
Department of Environmental Management
23 Promenade Street, 3rd floor
Providence, RI 02908
(401) 277-2776

South Carolina Heritage Trust
Wildlife & Marine Resources Dept.
P.O. Box 167
Columbia, SC 29202
(803) 734-3893

South Dakota Natural Heritage Data Base
SD Department of Game, Fish & Parks
523 E. Capitol Avenue
Pierre, SD 57501
(605) 773-4227

Division of Natural Heritage
Dept. of Environment & Conservation
401 Church Street
Nashville, TN 37243
(615) 532-0431

Utah Natural Heritage Program
Division of Wildlife Resources
1596 West North Temple
Salt Lake City, UT 84116
(801) 538-4761

Vermont Nongame & Nat. Her. Program
Fish & Wildlife Department
103 S. Main Street, 10 South
Waterbury, VT 05671
(802) 241-3700

Virginia Division of Natural Heritage
Department of Conservation & Recreation
1500 E. Main Street, Suite 312
Richmond, VA 23219
(804) 786-7951

Washington Natural Heritage Program
Department of Natural Resources
P.O. Box 47016
Olympia, WA 98504
(360) 902-1340

West Virginia Natural Heritage Program
Department of Natural Resources
Ward Road, P.O. Box 67
Elkins, WV 26241
(304) 637-0245

Wisconsin Natural Heritage Program
Department of Natural Resources
101 S. Webster Street, Box 7921
Madison, WI 53707
(608) 266-7012

Wyoming Natural Diversity Database
1604 Grand Avenue, Suite 2
Laramie, WY 82070
(307) 745-5026