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ENDANGERED Species BULLETIN

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Our third annual Highlights edition of the Endangered Species Bulletin contains selections from our three 2008 on-line editions. First, you'll find articles on "The Year of the Frog," which was an effort by zoos, government agencies, and conservation organizations to focus attention on the threats facing the world's amphibians. Next, we present stories illustrating the important work of Indian tribal governments in conserving imperiled species. We close with some examples of the research conducted by U.S. Geological Survey scientists in support of wildlife conservation and recovery.

ENDANGERED Species BULLETIN

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Cover: The distinct population segment of the fisher (*Martes pennanti pacifica*) in California, Oregon, and Washington is a candidate for Endangered Species Act protection. The Hoopa Tribe in California is conducting research on its status (see story on page 28).
credit: ©Tom Vezo/naturepl.com

Inside cover: Habitat of the golden frog in Panama (story on page 7).
credit: Paul Crump/Houston Zoo, Inc.

The Endangered Species Bulletin is an on-line publication. Three electronic editions are posted each year at www.fws.gov/endangered/bulletin.html, and one highlights edition is published each year. To be notified when a new on-line edition has been posted, sign up for our list-serv by clicking on "E-Mail List" on the Bulletin Web page.

The Bulletin welcomes manuscripts on a wide range of topics related to endangered species. We are particularly interested in news about recovery actions and conservation partnerships.

Please send us your comments and ideas! E-mail them to us at esb@fws.gov.

IN THIS ISSUE

by Paul Boyle and Shelly Grow

The Global Amphibian Crisis

2008 YEAR OF THE FROG

A crisis of enormous proportions faces the world's amphibian species. At present, we estimate that about one-third of the more than 6,000 known amphibian species are at risk of extinction. This likely underestimates the real number since data are lacking on many species from Africa, Southeast Asia, and other regions. Several causes underlie this massive decline, but a crucial element is the very nature of amphibians; their skin must always be moist and it literally breathes, so they are especially vulnerable to environmental contaminants. Habitat destruction, disease, pollution, climate change, and other expanding human-related impacts have an entire class of the animal kingdom in serious decline.

Frogs hold great cultural significance. They figured prominently in ancient Egyptian and Greek mythology, as well as more recent folklore. Today's well-known character Kermit the Frog, whose motto is "It isn't easy being green," may have had an early premonition of the crisis frogs face today. Frogs were traditionally used for studying anatomy, physiology, neurobiology, and pharmacology, and were used globally in the 20th century for pregnancy tests. Today, as we see amphibian species in serious decline, frogs are like the "canary in the coal mine" – a class of animals more sensitive than most, potentially signaling an impending environmental calamity.

The severe decline of amphibians occurring today can be compared with the mass extinction of dinosaurs 65 million years ago. Yet, while most people know of the sudden disappearance of dinosaurs, few remember that when the

The Mississippi distinct population segment of the dusky gopher frog (*Rana capito sevosa*) is listed as endangered.

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dinosaurs disappeared, almost 70 percent of the other species on Earth disappeared with them. There could be truth in the notion of amphibians as an early indicator of environmental chaos. However, unlike the demise of dinosaurs, many of the impacts that threaten amphibians are of human origin.

The most serious threat to amphibians is habitat loss and widespread habitat fragmentation. Loss of rainforest and other crucial habitats to agricultural and other human development is devastating habitats crucial to amphibian survival worldwide. Pollution from mine drainage, pesticides, fertilizers, and other organic compounds is present in every earthly ecosystem. Amphibians are particularly susceptible to the effects of organic molecules since their skin is so much more permeable than that of other animals. A disease caused by the pathogenic fungus *Batrachochytrium dendrobatidis* is spreading undaunted, with few amphibian species showing resistance. The chytrid disease typically results in mass die-offs where often more than 50 percent of amphibian species are extirpated within six months, while other species persist with relatively minor reductions. Meanwhile, amphibians are also affected by harvesting for food and the pet trade, predation, and invasive introduced species.

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The flatwoods salamander (*Ambystoma cingulatum*) is a threatened amphibian native to parts of the U.S. lower southeastern Coastal Plain.

What is Being Done?

The Amphibian Specialist Group of the World Conservation Union (IUCN), the World Association of Zoos and Aquariums, and IUCN's Conservation Breeding Specialist Group have formed a partnership called the Amphibian Ark.

The Oregon spotted frog (*Rana pretiosa*) is a candidate for listing under the Endangered Species Act.

Dana Payne

Peruvian stubfoot harlequin frog (*Atelopus peruensis*). Described as new to science in 1985, this species underwent massive declines in the 1990s, and is now possibly extinct.

The mission of the Amphibian Ark is ambitious: "working in partnerships to ensure the global survival of amphibians, focusing on those that cannot be safeguarded in nature." As explained on its Web site (www.amphibianark.org), it coordinates *ex-situ* (off-site or captive-breeding) programs by partners around the world, along with efforts to protect or restore species in their natural habitats. The Association of Zoos & Aquariums (AZA) in North America and the world's other professional zoo and aquarium associations have joined in this massive effort, working in partnership with other conservation organizations to save imperiled amphibians.

In one of the largest collaborations of its kind, these organizations have called for a global effort to save amphibians and have named 2008, a leap year, as "The Year of the Frog." The Year of the Frog is a global awareness and fundraising campaign to support long-term amphibian conservation and to change the human behaviors that threaten amphibians.

Zoos and aquariums offer unique expertise to the Amphibian Ark effort because of their history of successfully managing captive populations of animals. They also have broad experience with reintroducing captive-bred animals into the wild, translocating animals for conservation purposes, and developing the infrastructure and facilities required to safely quarantine, breed, and maintain amphibian populations for the long term.

This special issue of the *Endangered Species Bulletin* shares some examples of what zoos and aquariums, the Fish and Wildlife Service, and other agencies and organizations are doing, and plan to do over the next several years, to fight the loss of amphibians. We seek to engage as many partners in the effort as possible and to target hotspots where amphibian extinction is on the rise. We are also working to increase both the physical infrastructure required to conserve amphibians in captive populations, through which the living genetic stock of imperiled species can be saved while conditions in the wild are improved, and the professional capacity to keep these precious representatives of the amphibian world safe for future generations.

Like its professional counterparts around the world, the AZA is working to expand the capacity of its 219 accredited member institutions to respond vigorously to amphibian declines locally, regionally, and around the world. We also seek to support the efforts of government conservation agencies in responding to the global amphibian crisis. All of this work aims to build strong partnerships, increase the professional and structural capacity for saving amphibians, and ensure the success of this crucial worldwide effort.

Dr. Paul Boyle is Senior Vice President for Conservation at the AZA, where he leads its animal conservation and conservation education programs. Shelly Grow (SGrow@aza.org; 301-562-0777) is a conservation biologist with AZA focusing on increasing the capacity and the diversity of partnerships for responding to the amphibian crisis. The AZA is headquartered at 8403 Colesville Road, Suite 710, Silver Spring, Maryland 20910.

Project Golden Frog

by Vicky Poole

The brilliantly colored golden frogs native to the cloud forests of Panama are culturally significant to the people of that nation, as revered as the bald eagle is in the United States. They have long been considered lucky by Panamanians, who commonly use figurines and live frogs to promote hotels and restaurants.

Panamanian golden frogs (*Atelopus zeteki*), or PGFs, have been recognized as a distinct species from the similar-looking harlequin frog (*Atelopus varius*) based on a unique skin toxin, zetekitoxin, and bioacoustical differences. In addition to vocalizing, PGFs communicate by "semaphoring," a limb-waving behavior that may have evolved to allow these frogs to locate others near waterfalls for breeding, where loud background noise renders their gentle vocalizations inaudible.

A. zeteki has been listed in Appendix I of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) since 1975 and as endangered (as *A. varius zeteki*) under the U.S. Endangered Species Act (ESA) since 1976. Factors affecting golden frog populations include collecting for

Two golden frogs in amplexus, a form of sexual reproduction seen in frogs wherein the male grasps the female from behind and externally fetilizes the eggs as they are deposited.

John Kast

A lone Panamanian golden frog in habitat.

Panamanian zoos and hotels, as well as for the illegal pet trade; deforestation; and stream sedimentation resulting from logging and farming. An even greater threat is the amphibian disease chytridiomycosis, which is caused by the pathogenic fungus *Batrachochytrium dendrobatidis*. This disease was first observed in the mountains of central Costa Rica, where it may have caused the extinction of the golden toad (*Bufo periglene*). It has since advanced southeastward through the cooler mid- to high-elevation mountain forests of Central America, decimating entire populations of amphibians. As of 2007, the disease in Panama was documented as far eastward as El Valle de Anton, the type locality (the location from where the first described specimen was collected) of *A. zeteki*, raising the odds that both golden frog species may soon be extinct in the wild.

In response to the impending chytrid crisis, a group of concerned biologists convened in 1998 to form Project Golden Frog/Proyecto Rana Dorada (PGF/PRD), a conservation consortium involving numerous Panamanian and U.S. institutions. The primary goals of PGF/PRD are to preserve the golden frog by establishing a captive breeding colony and to use the attractive frog as a flagship species for spotlighting general amphibian decline issues. Specific initiatives of PGF/PRD include field studies, captive management, education, and financial support of other related efforts. PGF/PRD field studies have led to natural history information, genetics research, and population monitoring, all of which has also benefitted the management of golden frogs in captivity (Lindquist, et al., 2007; Zippel et al., 2007).

As the first step, *ex situ* populations of both golden frog species were established in zoos and aquariums in the U.S. and Canada. To ensure genetic viability, permits were first obtained in 1998 from Autoridad National del Ambiente de Panamá (ANAM) to collect and export specimens from unprotected remnant populations outside two national parks where these frogs occur. Since 2001, 20 pairs of adults and more than 70 juvenile golden frogs have been collected and imported under two CITES/ESA permits issued to the Maryland Zoo in Baltimore (formerly the Baltimore Zoo) and the Cleveland Metroparks Zoo. As a result of breeding at 10 Association of Zoos and Aquariums (AZA) institutions, including significant successes at the Detroit Zoological Gardens and the two facilities permitted to collect and import the frogs, there are now more than 2,000 captive-bred golden frogs in breeding groups at almost 50 institutions in the U.S. and Canada. Breeding recommendations and specimen placement for both species are coordinated by the Population Manager at the Maryland Zoo in Baltimore. A regional studbook is maintained for three distinct populations of golden frogs to track genetic relatedness. (Due to permit restrictions, individuals of *A. zeteki* are available only to AZA-accredited institutions.)

Project Golden Frog uses a variety of strategies to inform the public and educate herpetologists. The bilingual Web site www.projectgoldenfrog.org offers information about the species, the project, and captive husbandry. Through U.S. and local students and zoo/aquarium personnel, PGF/PRD offers opportunities for training in applied field techniques in Panama. The 2003 national educators' conference in Panama featured a golden frog conservation workshop for school teachers, where classroom curricula developed by the PGF/PRD education specialist at SeaWorld-Orlando was distributed. Golden frog graphics have been created and installed at two zoos in Panama, and brochures warning about chytrid fungus, and explaining techniques for disinfecting field gear and equipment, have been posted in areas where the fungus was found as a means to help minimize the disease's spread.

Although most PGF/PRD personnel costs have been underwritten by many AZA institutions and universities in the U.S. and Panama, members have obtained more than 20 grants to fund specific field and education program

needs. These included the acquisition of a designated field vehicle, which sports the color and pattern of the golden frog to help foster public awareness. With the decline of golden frogs in Panama, PGF/PRD has also become a granting program, using golden frog fundraising surplus to offer awards to other related frog initiatives under the umbrella of the Atelopus Conservation Trust (ACT).

Once captive husbandry techniques for golden frogs were established by AZA institutions in the U.S., PGF/PRD recognized the need to develop a facility in Panama that could replicate the project's efforts for golden frogs and house "insurance" colonies of 12 other critical endemic amphibians impacted by the chytrid fungus. The Houston Zoo committed to building and staffing this much-needed facility, which will serve as a center for rescue, quarantine, treatment, and public education. Construction of the El Valle Amphibian Conservation Center (EVACC), situated on the grounds of the small, private El Nispero Zoo in the village of El Valle de Anton, was completed in 2007.

Beginning in the summer of 2006, zoo and aquarium personnel and volunteers from around the world have come together in El Valle to collect amphibians for EVACC. They tested and treated all specimens they collected for chytrid. The golden frogs at EVACC will be included in the studbook along with the U.S. specimens so that genetic diversity can be maximized throughout the entire *ex situ* population. The long-term goal is to create a zoo population from which golden frogs can be returned to the wild if all i*n situ* (wild) populations become extinct and when the chytrid fungus is no longer a threat to these species. We estimate this goal to be 5 to10 years away. EVACC is a potential site for staging reintroductions prior to release and/or establishing in-country breeding pairs from which offspring can be used. Current research by the Cleveland Metroparks Zoo and Mount Union College in Ohio on the development of chytrid-resistant bloodlines of golden frogs, which would be based on antimicrobial skin peptides, may also prove valuable to any repatriation efforts.

Although many organizations and individuals have contributed to the golden frog program achievements listed above, the cooperation between U.S. and Panamanian government agencies and personnel has been vital to success. We hope that the communication and cooperation among program coordinators and government agencies can serve as a model for developing responses to the continuing crisis of global amphibian declines.

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The El Valle Amphibian Conservation Center in Panama is a center for rescue, treatment, research, and conservation.

Paul Crump/Houston Zoo, Inc.

Chiricahua Leopard Frog Inches Towards Recovery

by Jim Rorabaugh, Melissa Kreutzian, Mike Sredl, Charlie Painter, Roberto Aguilar, Juan Carlos Bravo, and Carter Kruse

Recovery – it is the most important part of endangered species conservation. For most species, considerable funding and staff resources are needed to overcome years of population declines and habitat degradation. Despite the limited resources available, and with a lot of help from our friends and partners, such as state wildlife agencies, federal land managers, ranchers and other private landowners, Turner Enterprises, Phelps Dodge Corporation, the Phoenix Zoo, Arizona-Sonora Desert Museum, the Fort Worth Zoo, Nature Conservancy, Sky Island Alliance, and universities, we have put together a recovery program for the threatened Chiricahua leopard frog (*Lithobates chiricahuensis*). To augment the scarce funds available for recovery activities, we have engaged the Fish and Wildlife Service's Partners for Fish and Wildlife Program and applied for grants from foundations. We and our very dedicated host of partners are slowly making progress towards the recovery of this species.

A Chiricahua leopard frog from the Pajarito Mountains in Arizona near the Mexican border.

Jim Rorabaugh

The Chiricahua leopard frog is a large, often green, spotted frog that historically was common in the mountains and high valleys of central and southeastern Arizona, west-central and southwestern New Mexico, and southward in the Sierra Madre Occidental and associated sky islands of northeastern Sonora and western Chihuahua, Mexico. We know of 469 historical localities. Declines were first noted in the early to mid-1970s, and today the species is only known to exist at about 41 localities in Arizona and 30 to 35 localities in New Mexico. Its status in Mexico is poorly known, but Chiricahua leopard frogs have declined to some extent there as well. The Mexican government lists it as *amenazada* (threatened).

The causes of the decline are not always clear, and several interacting factors are often at play, but experts on the Chiricahua leopard frog generally agree that predation by introduced species (especially American bullfrogs, sport fishes, and crayfish) and an apparently introduced fungal skin disease (chytridiomycosis) that is killing frogs and toads around the globe are the leading causes.

Other problems, such as loss and degradation of wetlands, recent catastrophic wildfires, drought, and contaminants, have contributed to the decline.

The Chiricahua Leopard Frog Recovery Plan was completed in early 2007. It was developed in an open process with a technical team that provided top-notch scientific expertise, while three stakeholder groups kept the process grounded in the social, economic, and nuts-and-bolts realities of achieving recovery on the ground. Key elements include protecting the remaining populations and habitats, establishing new populations, monitoring progress, research, public outreach, and adaptive management.

The primary threats – introduced predators and chytridiomycosis – are not easily addressed. We can control predators at small sites, but eliminating them from large, complex systems is often impossible with current technology. Except for taking precautions not to spread the disease ourselves, we are only beginning to understand how we might deal with chytridiomycosis. Some frog populations are persisting with the disease, especially at warmer and lower sites, and they could provide key insights into how to manage the disease. We

Duke Klein (Forest Service biologist), at left, and Mike Sredl (Arizona Game and Fish Department) build pond habitat for Chiricahua leopard frogs in the Tonto National Forest, Arizona.

Jim Rorabaugh

are looking into several questions: are the frogs developing resistance to the disease, are there environmental factors allowing their persistence, or both? We have experimented with eliminating the disease from habitats but are a long way from solving that problem. Our strategy for now has been to try to maintain the remaining populations and begin reestablishing populations and improving habitats in places where introduced predators and disease are absent or manageable. These reintroductions typically involve collecting egg masses from the wild, hatching the eggs and head-starting tadpoles at the Phoenix Zoo or other facilities, and releasing late-stage tadpoles or metamorph frogs. Limited wild-to-wild movements of egg masses and frogs, as well as captive propagation, have also been employed. We have honed our techniques and protocols over the past 12 years, and most reestablishments now successfully result in breeding populations.

Combining outreach and recovery, students and their parents from Sierra Vista, Arizona, assist in a release of frogs that were headstarted at the Phoenix Zoo.

Jim Rorabaugh

These recovery actions have been facilitated by 1) a special rule under section 4(d) of the Endangered Species Act that allows incidental take of frogs resulting from operation and maintenance of livestock waters on non-federal lands, 2) Safe Harbor Agreements with the Arizona Game and Fish Department and the Malpai Borderlands Group (a progressive group of conservation ranchers), and 3) programmatic grazing consultations with involved federal agencies on public lands. The 4(d) rule and Safe Harbor Agreements help us build trust with ranchers and private landowners, while the programmatic consultations provide a framework within which we can move forward on recovery with the Forest Service, Bureau of Land Management, and livestock grazing permittees. Artificial water sources developed for cattle have become important habitats for Chiricahua leopard frogs, so tools that help us work in partnership with ranchers are critical to recovery.

On Ted Turner's Ladder Ranch in New Mexico and at a high school in Douglas, Arizona, captive propagation and head-starting facilities are under construction. Thanks to the Arizona Game and Fish Department, Tonto National Forest, and Phoenix Zoo, aggressive efforts to restore habitats and reestablish populations are rebuilding a metapopulation (a group of spatially separated populations that exchange individuals through immigration and

Elizabeth Slown

Anna Slown (left) and Hannah Jacobsen (right) model the Chiricahua leopard frog tattoo that was produced for outreach about this threatened amphibian.

emigration) of Chiricahua leopard frogs near Young, Arizona. Meanwhile, the Phoenix Zoo and the Arizona-Sonora Desert Museum near Tucson are cautiously breeding the last remaining frogs from the Coconino National Forest and the Santa Rita Mountains in Arizona for reestablishment at multiple sites. Major habitat restoration programs underway at two sites in southeastern Arizona and one in the bootheel of New Mexico will benefit Chiricahua leopard frogs and other imperiled wetland species. We are also working with Mexican partners to build capacity for amphibian conservation in northwestern Mexico. In August 2008, we will hold a workshop at a private reserve in northern Sonora owned by Naturalia (a Mexican conservation group) to instruct Mexican biologists on survey protocols and techniques for captive husbandry, propagation, and headstarting of amphibians.

Restoring an imperiled species is not an easy process, but with hard work from many partners, we are beginning to see how the Chiricahua leopard frog might one day be secure again. Recovery is still a distant destination, but the journey has begun.

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by Jill Utrup and
Kim Mitchell

The Ozark Hellbender: Out from Under a Rock

What lurks below the clear waters of Ozark streams? Well, it's not pretty, but it is pretty cool. The Ozark hellbender (*Cryptobranchus alleganiensis bishopi)*, which can reach a length of about 2 feet (0.6 meters), is one of the largest salamanders in the world.

These strictly aquatic salamanders are found only in Ozark streams of southern Missouri and northern Arkansas. Most of their life is spent beneath rocks in fast-flowing streams. They come out from under their rocks at night to eat crayfish and in the fall to mate. It takes them 5 to 8 years to reach sexual maturity, and they live 25 to 30 years in the wild (55 years in captivity). Males and females may prey upon their own and others' eggs.

The Ozark hellbender is one of the largest salamanders in the world.

Jill Utrup/USFWS

Jill Utrup/USFWS

With numerous threats to these amphibians and their habitat, Ozark hellbenders are declining in numbers throughout their range. Because of the hellbender's long lifespan, it took some time before researchers recognized the rapidity of the decline. Even in areas that until recently were thought to have healthy, stable populations, numbers have plummeted. Particularly disconcerting is the fact that most populations have only older individuals. The lack of juveniles indicates that there has been little to no reproduction for several years.

What happened? The Ozark area is famous for its beauty and fast, clear rivers, which are fun to canoe, kayak, and fish. But that clear water and pretty scenery can be deceiving. The story of the Ozark hellbender's decline is an all too familiar one – increased siltation, water quality degradation, and increased impoundments.

To add insult to injury, the highly infectious chytrid fungus is proving fatal to an ever-increasing number of amphibians throughout the world. Over 75 percent of hellbender deaths that occurred in the St. Louis Zoo's captive population from March 2006 through April 2007 were due to this disease. This prompted the testing of Missouri's wild Ozark hellbenders.

The results showed that the chytrid fungus was present in all remaining populations of the Ozark hellbender in Missouri. Testing continued in Missouri during the 2007 field season and began in Arkansas. Researchers view chytrid as one of the most, if not the most, challenging threat to the survival of this subspecies, whose population size is estimated at no more than 590 individuals.

Additionally, abnormalities in Ozark hellbenders are becoming increasingly more severe. Although these abnormalities have not been linked conclusively with the presence of chytrid, considering that the types of abnormalities documented (e.g., lesions, digit and appendage loss, epidermal sloughing) are similar to the symptoms of the chytrid fungus, it is possible that there is a connection.

In 2001, the Ozark hellbender was designated a candidate for Endangered Species Act protection. Even though this subspecies is on a path to extinction, with the current budget situation and listing backlog, it is not likely to be considered for listing under the Act within the next few years.

There is hope for the Ozark hellbender, however, because conservation efforts have already begun. A group of dedicated professionals formed the Ozark Hellbender Working Group shortly after the species became a listing candidate. Original members were researchers and agency personnel with common interests in hellbender conservation. Staff from hatcheries, zoos, and other interested parties later joined. The group has collaborated on field work and initiated research projects, including studies to determine the primary threats. It is also developing a comprehensive conservation strategy that will include a captive propagation protocol, an outreach strategy, and a watershed protection plan.

Growing interest in the species' status has spurred the establishment of biennial Hellbender Conservation Symposiums. Three have been held so far, with the first in 2003 and the latest in 2007. They provide opportunities for conservationists to share information and discuss topics such as status and

Jeff Brigler/Missouri Department of Conservation

distribution reports, current research, captive breeding programs, survey and monitoring protocols and techniques, and other efforts. Focused research and collaboration between researchers and natural resource managers are necessary to reverse the decline of hellbender populations, and the symposiums are a perfect venue for kick-starting that collaboration.

Several ongoing research projects are directed at learning how best to decrease threats and increase hellbender survival in the wild and in captivity. Researchers at the University of Missouri-Rolla are evaluating overall health conditions, reproductive hormones, and contaminants present in adult and juvenile hellbenders through hematology and serum chemistry work. Survival and movements of resident adult and released captive-reared hellbenders are being studied by researchers from the University of Missouri (Columbia) and Missouri Department of Conservation. The Missouri Department of Conservation and the St. Louis Zoo have been collaborating in developing a propagation protocol for the Ozark subspecies. Missouri protects hellbenders by requiring a permit for their collection, and in 2003 the state listed the hellbender as endangered. As part of the public outreach program, there are now signs throughout the range of the hellbender alerting recreationists that hellbenders are harmless and should be left alone or released unharmed if caught by anglers.

The recovery of aquatic species is particularly challenging because the threats are usually difficult to identify and address. The Ozark hellbender's situation is also a sign of the times in endangered species conservation, as global threats such as climate change add to local environmental problems. Conservationists are rising to these challenges by looking beyond agency and geographical boundaries to collaborate and share resources, make the most of limited dollars, and persevere.

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Conserving Columbia Spotted Frogs in Nevada

by Chad Mellison

Columbia spotted frogs (*Rana luteiventris*) in the Great Basin of Nevada have been a candidate for Endangered Species Act protection since 1993. Most populations in this region are small and highly fragmented, and are highly vulnerable to changes in their environment. Development of water sources, poor grazing practices, certain mining activities, and the introduction of non-native species have contributed to habitat degradation and fragmentation. Emerging fungal diseases such as chytridiomycosis and the spread of parasites also threaten some populations, as do the effects of climate change (such as drought) and random events like wildfires. The potential for listing the Columbia spotted frog as a threatened or endangered species prompted an array of interests to develop a multi-party conservation agreement and strategy in order to make listing unnecessary.

Columbia spotted frogs are found at scattered locations from southeast Alaska down through British Columbia, eastern Washington and Oregon, as well as in northern Idaho, Montana, Wyoming, Utah, and Nevada. In Nevada, populations occur in three distinct areas: the Toiyabe Mountain Range in Nye County (Toiyabe subpopulation), the Ruby Mountain and Jarbidge-Independence Ranges in Elko County (Northeast subpopulation), and the Deep Creek drainage in White Pine County, Nevada, and Toole County, Utah (West Desert population). The West Desert population is managed by the Utah Division of Wildlife Resources and the U.S. Fish and Wildlife Service's Utah Fish and Wildlife Office.

Columbia spotted frogs are closely associated with clear, slow-moving or ponded surface waters with little shade and relatively constant water temperatures. Reproducing populations occur in habitats characterized by springs, floating vegetation, and larger bodies of pooled water (e.g., oxbows, lakes, stock ponds, beaver-created ponds, seeps in wet meadows, backwaters). In colder portions of their range, Columbia spotted frogs will use areas where water does not freeze, such as spring heads and undercut streambanks with overhanging vegeta-

A Columbian spotted frog using its newly created habitat.

Jim Harvey/Humboldt-Toiyabe National Forest

tion. Females usually lay egg masses in the warmest areas of a pond, typically in shallow water, and clutch sizes vary in size from 150 to 2,400 eggs. Successful egg production and metamorphosis into adult frogs are susceptible to habitat variables such as temperature, depth and pH of water, the amount of cover, and the presence of predators.

Upper photo: Construction of Horseshoe Pond begins.
Lower photo: Horseshoe Pond after completion.

Chad Mellison/USFWS

Chad Mellison/USFWS

Adult Columbia spotted frogs measure 2 to 3 inches (5 to 8 centimeters) from snout to vent, with females being larger than males. They are light brown, dark brown, or gray dorsally, with small spots. Ventral coloration can differ among populations and may range from yellow to salmon; however, very young individuals may have very pale, almost white ventral surfaces. The head may have a dark mask with a light stripe on the upper jaw, and the eyes are turned slightly upward. Male frogs have swollen thumbs with darkened bases.

Conservation Agreement and Strategy

A 10-year Conservation Agreement and Strategy (CAS) was signed in September 2003 for both the Northeast and the Toiyabe subpopulations of the Columbia spotted frog in Nevada. Signatories included the Bureau of Land Management, Nevada Department of Wildlife, Nevada Natural Heritage Program, Nye County, U.S. Fish and Wildlife Service, U.S. Forest Service, and the University of Nevada - Cooperative Extension. The partners agreed to conduct inventories to establish distribution and abundance, assess threats, maintain legal protection for the frog, implement conservation actions identified in the agreement, conduct research to support conservation of the species, and increase public awareness of, and appreciation for, the Columbia spotted frog.

The conservation agreements and strategies identify actions that federal, state, and local agencies will take to reduce threats, improve degraded habitat, and restore natural functions associated with riparian systems. While directly improving frog habitat, these actions will also benefit other aquatic species and improve natural hydrological functions.

By the end of 2007, 8 percent of the tasks listed in the Northeast CAS were completed and an additional 74 percent of the tasks had been initiated at some level. Additionally, 22 percent of the identified tasks listed in the Toiyabe Mountains

Chad Mellison/USFWS

Chad Mellison/USFWS

Upper Photo: Newly created pond habitats can be seen in this valley on Warners Ranch.
Lower photo: Columbian spotted frogs are already benefitting from the new ponds.

CAS were completed and an additional 68 percent of the tasks had been initiated at some level. For example, the availability of adequate habitat was identified as a limiting factor for the Toiyabe Mountains subpopulation. In response, a habitat enhancement project completed in the fall of 2004 included the construction or improvement of 22 ponds in Indian Valley Creek. A variety of designs were used to create breeding, rearing, and over-wintering habitat. Biologists are monitoring the effectiveness of this project.

Since the CASs were signed, annual egg mass surveys have been conducted and mark-recapture surveys have been performed during the summer. These surveys are a collaborative effort of all signatories to the agreements. Data gathered during the annual surveys will be used to track population trends, assess threats, determine the effectiveness of habitat restoration projects, and provide information on survival, growth, and movement of Columbia spotted frogs in the Great Basin. If the agreements are successful, it may become unnecessary to list these frogs as threatened or endangered.

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by Kate Symonds

Ranchers Restore Amphibian-friendly Ponds

East of the San Francisco Bay area, in the arid hills of California's inland Coast Ranges, ponds have become magnets for wildlife, large and small. Two small but notable inhabitants of these ponds are the California red-legged frog (*Rana draytonii*) and California tiger salamander (*Ambystoma californiense*). Both species are federally listed as threatened amphibians and are endemic to California, where they have adapted to seasonal and historic changes in their habitat.

The California tiger salamander, marked by a striking black-and-yellow pattern, spends all but a few months

California red-legged frog.

USFWS

each year in the uplands, deep in rodent burrows. When enough rain falls, they emerge from the uplands and sometimes travel as far as 1.3 miles (2 kilometers) to seek breeding ponds.

California red-legged frogs are the largest native frog in the western United States and are believed to be the inspiration for Mark Twain's short story, "The Celebrated Jumping Frog of Calaveras County." They breed in ponds and creeks with slow-moving water, and remain there year-round. They will, however, travel up to 2 miles (3.2 km) in search of a moist shelter.

Livestock ponds

The Alameda County Resource Conservation District (RCD) estimates that nearly all of the 650 ponds in eastern Alameda were created by cattle ranchers prior to the 1960s. As natural streams and freshwater wetlands were lost to intensive agricultural practices and development, tiger salamanders and red-legged frogs have increasingly come to rely on livestock ponds for breeding habitat. Ponds also provide breeding habitat for other amphibians, including the Pacific tree frog (*Hyla regilla*) and western toad (*Bufo boreas*), as well as habitat for mammals, reptiles, and birds.

Not all livestock ponds provide favorable conditions for amphibians. Some are small and dry out before amphibian breeding cycles are complete. Others are large and retain water year round, but support non-native predators such as warm water fishes and bullfrogs. Many ponds, having reached the end of their usefulness for livestock, are filling in with sediment and have become choked with cattails, while others have spillways and berms that are eroding or have washed out altogether.

Livestock pond repair projects can require permits from up to six regulatory agencies. The rising costs to obtain environmental permits and repair livestock ponds to current standards often cause ranchers to abandon the ponds in favor of less expensive options, such as installing solar power pumps, tanks, and troughs. With natural habitat reduced, allowing livestock ponds to fail could have serious consequences for the future of California tiger salamanders and red-legged frogs, as well as for many other pond-dependent species.

Ranchers and pond restoration

Several Alameda ranchers have become interested in pond restoration because they continue to value the ponds as an important part of the landscape and recognize their value to wildlife. In the past year, the Alameda County RCD and the federal Natural Resources Conservation Service (NRCS) have been working with regulatory agencies to develop a coordinated permit-streamlining program for pond restorations. Ranchers now have "one-stop shopping" to obtain permits and funding for pond projects and other rangeland projects. The Fish and Wildlife Service's permit incorporates a wildlife-friendly pond design and describes management measures such as keeping ponds free of fish and bullfrogs, protecting ground squirrel burrows as aestivation (a period of inactivity during summer months) habitat for salamanders and frogs, and continuing managed grazing, as well as measures to reduce impacts to listed species during pond repair projects.

Safe Harbor Agreement

To help alleviate ranchers' concerns that restoring amphibian-friendly livestock ponds may increase their regulatory burden under the Endangered Species Act (ESA), the Service has worked with the RCD, NRCS, and Environmental Defense to issue one of its first programmatic Safe Harbor Agreements. Ranchers who participate in this program have assurances they will incur no extra regulatory obligations under the ESA if they restore and maintain ponds and surrounding uplands in a way that benefits the red-legged frog and the tiger salamander.

Service assistance

To help offset the ranchers' costs of paying for pond-repair projects, the Service's Sacramento Fish and Wildlife Office is providing technical and cost-share assistance to the RCD through the Endangered Species Recovery Program, the Partners for Fish and Wildlife Program, and the Private Stewardship Grant Program. Funding is also provided by the NRCS, California Coastal Conservancy, and National Fish and Wildlife Foundation. To date, eight livestock ponds have been restored, and several more restorations are planned for 2008 and beyond.

The support for pond restoration underscores the importance of rangeland habitats to the recovery of imperiled amphibians and many species of plants, invertebrates, reptiles, birds, and mammals in California.

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Kate Symonds

The restored Alameda Sweet Pond.

Partners in Amphibian and Reptile Conservation

by Ernesto Garcia,[1]
Priya Nanjappa Mitchell,[2] and
Dede Olson[3]

Tom Biebighauser

An adult red-legged frog (*Rana aurora*) using restored wetlands at Sooke, Vancouver Island, BC, Canada.

With amphibians and reptiles declining more dramatically than any other vertebrate group on the planet, what can be done? Around the globe, efforts are underway to determine the causes and develop solutions to amphibian and reptile declines, extinctions, and range reductions. Partners in Amphibian and Reptile Conservation (PARC) leads a United States-based effort dedicated to "keeping common species common," thus averting the need to list more species as endangered.

Established in 1999, with a mission to conserve amphibians, reptiles, and their habitats through public/private partnerships, PARC has gained momentum through its first decade and has its strategy for success charted to the year 2020.

A partnership of citizens, scientists, and resource managers, PARC includes representative of 11 federal agencies, all U.S. states, several Canadian provinces, tribes, conservation organizations, universities, professional and hobbyist herpetological organizations, research laboratories, environmental consultants, nature centers, zoos, and the forest products, energy and pet trade industries. Anyone can be an active member. PARC's emphasis is on the conservation of both amphibians and reptiles (i.e., herpetofauna), and its focus extends beyond species that are imperiled.

PARC has regional working groups in the Southeast, Northeast, Midwest, Northwest, and Southwest, in addition to several active state groups. Recent efforts initiated with partners in Mexico, Canada, and the Caribbean are broadening PARC's reach.

The challenges facing amphibians and reptiles today include the loss, fragmentation, and alteration of habitats; environmental contamination; global climate change; disease; unsustainable use; and invasive species. PARC members address specific threats at the regional and national levels through the development of science-based products and services designed to guide herpetofaunal conservation. They also invite the participation of "non-traditional" partners.

Science-Based Products and Services

Responding to the greatest threat facing amphibians and reptiles, PARC launched its flagship conservation tool, the award-winning Habitat Management Guidelines Technical Series (www.parcplace.org/habitat_management_guide). These guides are unique in that they consider not only "ideal" recommendations but also "maximizing compatibility" recommendations for use when conservation of herpetofauna or habitat is not an activity's primary management objective.

To address the lack of information on the status of many amphibians and reptiles, and to assist resource managers who do not have expertise in herpetology, PARC developed an Inventory and Monitoring Handbook that provides field-tested, peer-recommended survey techniques for all U.S. and Canadian herpetofauna (www.parcplace.org/inventory_monitoring).

In addition, PARC provides informational brochures aimed at increasing environmentally responsible behavior towards amphibians, reptiles, and their

habitats (visit www.parcplace.org/publications_resources.html).

Among PARC's newer conservation tools is a suite of "train-the-trainer" courses to accompany the Habitat Management Guidelines and Inventory and Monitoring Handbook. This is being expanded to increase state and local training opportunities and to facilitate capacity-building for those engaged in management.

PARC symposia and conferences bring researchers, managers, and other stakeholders together for discussions on how to address some of the world's most serious conservation challenges. A successful 2007 PARC co-sponsored symposium, Amphibian Declines and Chytridiomycosis: Translating Science into Urgent Action, convened more than 200 participants from nine countries representing four continents. Additional PARC symposia on conservation topics of global significance are being considered.

National Conservation Initiatives

National initiatives bring PARC members and partners together on specific emerging topics. A Roads Task Force was chartered to partner with transportation agencies in addressing passage, connectivity, collision, and other transportation issues that affect amphibian and reptile habitat and mortality. PARC launched a Development Subgroup to work with developers and builders in addressing the effects of residential and commercial development. Another initiative, Important Herp Areas, aims to promote and to help prioritize protection, restoration, or acquisition of critical areas for priority species. A Relocation, Reintroduction, Translocation, and Headstarting Task Team is developing information to guide moving animals when this approach is necessary.

The newest addition to the partnership mission is "Friends of PARC," a non-profit organization that secures and distributes funds to implement PARC's strategic goals. It affords citizens and corporations an opportunity to make tax-free contributions for herpetological conservation.

2020 Vision

The successes PARC has achieved to this point can be credited to its broad base of support, the visionary and flexible nature of its partnerships, and its adaptability to new needs and opportunities. In its second decade, PARC will focus on emerging issues such as climate change, disease, and other global threats to herpetofauna. PARC is expanding its partnerships beyond geographic and political borders, and plans to integrate with other habitat-based conservation efforts to benefit other wildlife. Because effective conservation cannot be accomplished without partners, these cross-cutting efforts will be key to maintaining healthy amphibian and reptile populations until 2020 and beyond.

In one example of a PARC project, Northwest PARC co-chair Elke Wind partnered with Tom Biebighauser from the Center for Wetlands and Stream Restoration September 2008 to improve habitat for amphibians on Vancouver Island, British Columbia. The objective of the project, funded by BC Hydro, was to build small wetlands that could be used by native amphibians to compensate for habitat lost from historic dam and reservoir construction. Wind approached Island Timberlands, the private forestry company owning lands around the reservoir, who readily agreed to participate in the construction of nine wetlands. Biologists hope the threatened red-legged frog (Rana aurora) will use the new wetlands for breeding. Reproduction by this declining species has been confirmed by Wind and Dr. Purnima Govindarajulu (BC Ministry of Environment herpetologist) at two other wetlands Biebighauser created in 2005 near Sooke on Vancouver Island. Wind and Biebighauser also instructed a successful wetland construction workshop for the project, attended by representatives from consulting companies, government, and other organizations.

Shallow depression filled with logging debris that held water only for short periods.

Debris was removed and the depression deepened. Wetland plants were returned, along with some woody debris, and the area was seeded with winter wheat to prevent erosion.

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by Patrick Durham

Restoring a Vital Partnership

I am delighted to introduce this edition of the *Endangered Species Bulletin* highlighting the important work of Indian tribal governments in helping to protect, preserve, and restore threatened and endangered Species. In these pages, you will find stories about how Native Americans from across the United States are integrating their unique cultural and traditional values with modern biological management principles to make a difference for conservation.

It is critical that the Fish and Wildlife Service, as a world leader in species and habitat conservation, continue to seek out and support many and diverse partners. Indian Country offers tremendous collaborative opportunities for the Service in a variety of ways.

First and foremost, Indian tribes have a special sovereign status with the U.S. as domestic dependent nations, and the Service has a trust responsibility to honor this trustee-to-beneficiary relationship. The special status of Indian people and their duly elected governments is distinctly political in nature, and should not be confused with the rights afforded to racial or other minority constituencies.

There are 567 federally recognized tribes in 34 states with 56 million acres in tribal trust and 44 million acres owned by

A Tribal Wildlife Grant is helping the Pyramid Lake Paiute Tribe to conserve two listed fishes, the Lahontan cutthroat trout (below) and the cui-ui.

© Michael Graybrook

USFWS

The Lower Brule Sioux Tribe received a Tribal Wildlife Grant in 2003 to work toward the restoration of the black-footed ferret on tribal lands. As one member of the tribe said, "The ferret is one of the animals we used in our medicine. Bringing back the buffalo was the first step; the return of the ferret is the final step."

Alaska Native corporations, totaling more than 100 million acres. The vast area and diversity of Indian Country suggests that Indian tribes are natural partners in the conservation and recovery of federally protected species.

Today, Indian Country is abundant with pristine wilderness and a host of environmentally valuable restoration sites. In 2000, the Bureau of Indian Affairs surveyed 120 tribes and catalogued more than 150 listed species on their reservations.

In 1997, the secretaries of the Interior and Commerce signed Secretarial Order 3206, "American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act." This order was designed to clarify the responsibilities of the departments of the Interior and Commerce, and their agencies, when Endangered Species Act actions may affect Indian lands, tribal trust resources, or the exercise of American Indian tribal rights. Service representatives should all become acquainted with this guidance, which is posted at; http://www.fws.gov/endangered/tribal/Esatribe.htm.

I have touched on the special status of tribes, the scope and condition of their vast ecological resources, and our guidance in the implementation of the Endangered Species Act in Indian Country. True, these are all great reasons for the Service to be fully engaged with Indian tribes, but to me, there is something more magical happening.

In 2003, when our competitive Tribal grant program was launched (see http://www.fws.gov/nativeamerican/grants.html), we intentionally left very broad sideboards in identifying project priorities. Our tribal partners had great latitude in proposing creative conservation solutions from a Native American perspective. We discovered that when we sat down at the table and talked about conservation priorities with our tribal partners, we have far more in common than not. In fact, many of our Tribal Wildlife Grants have supported endangered species conservation projects on tribal lands. You will read about some of these projects in this issue.

Most of us have chosen to work with the Service because of our love of nature and the outdoors. As this continent's first people, Native Americans have a common cultural thread that places a religious reverence on the connection to the natural world. The Lakota word *Oyate*, meaning "all of my relations," refers not only to family relations but to kinship to all people, plants, and creatures of the earth. It speaks of reverence for the land itself and of our dependence on it. *Oyate* is the spirit of "place" and, in many ways, speaks to the mission of the Service.

The stories that follow represent some of our shared conservation goals and priorities with Indian tribes. As we continue to explore and expand opportunities for Indian tribes to share in accomplishing what is important to the Service, we also have an opportunity and obligation to support tribes in their fish and wildlife conservation efforts.

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by Sarah E. Rinkevich

Apache Leader Promotes Tribal Conservation Rights

Sarah Rinkevich

Ronnie Lupe, Chairman of the White Mountain Apache Tribe.

The Apache word *ni* holds the dual meaning of "mind" and "land," illustrating the connection to "place" that the Apache people carry with them. It's no surprise that the White Mountain Apache Tribe's chairman, Ronnie Lupe, would advocate ardently for conservation of the 1.6 million-acre (65,000-hectare) Fort Apache Indian Reservation in Arizona.

Lupe became chairman of the White Mountain Apache Tribe in 1966 and entered the ongoing struggle to make tribal sovereignty a reality. Tensions over endangered species issues reached a crescendo in the 1990s. The Endangered Species Act was being implemented in ways that conflicted with Indian rights to exercise authority over their lands. The White Mountain Apache Tribe sought to overcome this problem and achieve recognition of sovereignty on its lands. In the early 1990s, Chairman Lupe began a dialogue with Mollie Beattie, who had been named the new Director of the U.S. Fish and Wildlife Service. On June 28, 1994, the Service released "The Native American Policy of the U.S. Fish and Wildlife Service." This policy (see http://www.fws.gov/nativeamerican/Native%20American%20Policy.pdf) articulated the government-to-government relationship the Service would have with Native American governments. Later that year, Lupe and Beattie signed the first of its kind "Statement of Relationship" that recognized the tribe's aboriginal rights, sovereign authority, and institutional capacity to self-manage its lands.

Other tribes asked Lupe how he did it. He told me, "I don't want to glorify myself. I had a lot to do with it but it was not me alone. Mollie had a lot to do with it." Recalling his conversation with Beatty in a small park in Washington, "I told her, you think you have a strict rule, but we have more strict rules than your provision under [the Endangered Species Act]. Ours far exceeds what you're after."

Chairman Lupe and the White Mountain Apache Tribe received considerable national publicity for this achievement. The Statement of Relationship became the catalyst for the historic 1997 Joint Secretarial Order 3206, "American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act," which was signed by secretaries of the Interior and Commerce. The order clarifies the federal government's responsibilities under the Endangered Species Act, recognizes the exercise of tribal rights, and ensures that Indian tribes do not bear a disproportionate burden for the conservation of listed species.

I had the unique opportunity to discuss Secretarial Order 3206 recently with Chairman Lupe, who offered insight about how and why the order came to be.

He recalled with sadness the closing of timber operations across the Southwest in the 1990s when the Mexican spotted owl (*Strix occidentalis lucida*) was listed as a threatened species under the Endangered Species Act. Given the effects on the tribal economy, Lupe went

straight to Washington, D.C., and met with Beattie. He said that he extolled to her the serenity of the White Mountain Apache homeland, explaining it was still pristine. "As stewards of our area, the White Mountain Apache people are one with the land. And all of these endangered species are very sacred to our ways because they correlate with our culture and tradition."

From that meeting, the idea for Secretarial Order 3206 was born. "It wasn't easy," Lupe said. "For the first time, Indian Tribes were consulted. The order was not behind our back. We set the tone of it as Indian Tribes."

When I asked about the most important endangered species issue on the reservation, Chairman Lupe related struggles with the reintroduction of the Mexican gray wolf (*Canis lupus baileyi*) and the conflicts with cattle operations and trophy elk hunts. He told me that the tribe would like to have more flexibility in management of the wolf on their reservation. "A lot can be said about the wolf being released on our reservation – by cattle owners, by tribal members. Yet in our own existence, there is a relationship that we have with the animals, a different kind of relationship from the outside world."

When I asked Lupe about how the relationship between the Service and the Tribe could be improved, he described the importance of continuity. When governments are ever-changing, he said, continuity can be lost. He imparted the need to record and archive historical events such as the development of Secretarial Order 3206. As he put it, "We need to make recordings for ourselves so that continuity is there, and if anyone wants to listen, four years from now, eight years from now, or 10 years from now, they will know. The relationship with the government as Indian Tribes is becoming so very important today."

Chairman Lupe graciously explained other issues, but paramount was his concern for his people. "Mostly, we think about our children, retaining our way of life, retaining our language. We want our people to learn the Apache language. There are sacred words in Apache that cannot be translated into English. We've gone through a lot of challenges, and I've seen so many changes."

Bill Radke/USFWS

Mexican spotted owl.

He related that he enjoys telling stories to the Apache children and articulates the importance and use of an Apache story. "Our own stories tell our children discipline and obedience. We don't tell the children what to do, we just tell a story – around a camp fire, and you listen. And the story tells you how to live, discipline yourself, and how to avoid danger. The stories are all about that, the upbringing, the discipline, the sacredness, the ways of the Apache."

In one word, *ni* is a story. When uttered from the lips of Lupe, it speaks of a sacred relationship and a discipline we can all embrace.

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by Mark Higley

Hoopa Tribe Leads in Fisher Conservation

The Hoopa Valley Indian Reservation, the largest reservation in California, is located in a remote area of Humboldt County approximately 90 miles (145 kilometers) south of the Oregon border. Composed of 90,000 acres (36,422 hectares), it is surrounded by the Klamath-Trinity mountains. The reservation is centered on the tribe's ancestral homelands in the Hoopa Valley and is bisected by the Trinity River. The Hupa people have occupied these lands for thousands of years.[1]

Although all living things are held sacred in the tribe's traditional culture, it was not until the listing of the northern spotted owl (*Strix occidentalis caurina*) as a threatened species in 1990 that the tribe hired a wildlife biologist. The Bureau of Indian Affairs (BIA), an agency of the U.S. Department of the Interior, had been in charge of the tribe's forest and natural resources management until 1989, when the tribe exercised its sovereignty and became self-governing. The BIA's forest management had emphasized economics over tribal cultural concerns, at the expense of wildlife and most other natural resources. The tribe's economy is almost entirely timber-based, with an annual harvest of approximately 9.3 million board-feet of old-growth Douglas-fir. However, the tribe takes a holistic approach as it struggles to balance cultural values and socio-economic needs on a land base that represents only a fraction of its original territory.

Since 1992, the BIA has provided base funding to the tribe for the purposes of Endangered Species Act (ESA) compliance and surveys and monitoring for northern spotted owls through the tribe's self-governance compact. The tribe's struggling economy makes it difficult to fund wildlife programs on its own, no matter how important wildlife species are to the people and their culture.

When the U.S. Fish and Wildlife Service launched the Tribal Wildlife

Whidehch, "Little Sister" in the Hupa language, on the day of her release from captivity. She was bottle fed for three weeks and held in large enclosures until demonstrating that she could readily capture and kill natural prey.

Mark Higley, Hoopa Tribal Forestry

[1]The Reservation, town, and location are referred to as "Hoopa," while the people are referred to as the "Hupa People."

Grants (TWG) and Tribal Landowner Incentive (TLIP) programs to provide much needed funding for wildlife work, the Hoopa Tribe was ready. These grant programs have benefited many tribes nationwide, and the Hoopa Tribe has been successful in obtaining both TLIP and TWG grants. The TWG grants have been focused primarily on researching the status of the fisher (*Martes pennanti pacifica*).

The focus on the fisher stems from its cultural importance to the tribe; its hides are used in making ceremonial dance regalia. A "distinct population segment" (a term sometimes used under the ESA to delineate a separate portion of a species that requires different treatment by the law) of the fisher within California, Oregon, and Washington is a candidate for federal protection under the ESA. Because of the fisher's cultural importance, the potential for federal listing, and the animal's association with older forest habitats, the Hoopa Tribe has taken an active approach in collecting information about the fisher on tribal lands. The information collected will help shape future forest management decisions and will prepare the tribe for working with the Service on revisions to the tribe's forest management plan.

Starting in 1992, surveys conducted across most of the reservation found that the fisher was quite abundant compared with surveys conducted elsewhere. During 1996 to 1998, a radio-telemetry study was conducted on a 21-square-mile (55-square-km) area of the southeast portion of the reservation. Researchers captured 56 fishers (36 females, 20 males) to radio collar and, in some cases, replace old collars. The main emphasis of this study was to identify and describe fisher rest sites, although some reproductive dens also were found.

Objectives of the first TWG grant included several ambitious tasks, including the study of den site selection and the feasibility of studying fisher dispersal. To accomplish these tasks, tribal members and others involved in the project set out to radio-collar 15 to 20 adult females. Modeling of rest and den site selection variables will help the tribe develop habitat protection guidelines for the fisher. In addition, we attempted to mark each fisher kit produced in these dens with a passive integrated transponder (PIT) tag so that they might be identified when they grew large enough to be fitted with radio transmitters prior to their dispersal.

During more recent trapping efforts, we quickly learned that fishers were much less abundant than from 1996 to 1998. We struggled to capture 14 females in our first year, even after expanding the study area. In fact, we documented a significant decline in the fisher population by using camera stations to photograph ear-tagged animals in the portion of the recent study area that overlaid the 1996-1998 study area. In addition to the population decline, we found that the sex ratio had changed from nearly two females per male to one per male.

We captured and tagged 85 juvenile and adult fishers between 2004 and 2007, and radio-collared 42. Our close monitoring of these animals over the years has given us some insight into the causes of fisher mortality. During the current study, we have witnessed 16 mortalities (13 females and three males). One was

Chuck Goddard removes a fisher kit from a den so that a PIT tag can be injected beneath the skin. Similar tags are commonly used to mark pets.

Mark Higley, Hoopa Tribal Forestry

killed by a vehicle and three we suspect died from disease. The other 12 deaths (11 females and one male) were the result of predation. Suspected predators include bobcats, mountain lions, and canids (coyotes and domestic dogs). Throughout much of the fisher's range, predation is not considered an important source of mortality; however, in our region, body size is substantially smaller, and there are plenty of larger predators.

Of the 28 fisher kits marked prior to weaning, we recaptured and radio collared nine. Five of the eight collared kits have established home ranges, two dropped their collars during dispersal, and two died, most likely from disease. Three of the eight were born in March 2007 and later radio collared. One of these was actually rescued from a den after its mother was lost to predation. The young animal was bottle fed for three weeks, then held at an off-exhibit display at the Sequoia Park Zoo in Eureka, California. She was then transferred to an enclosure in the woods at Hoopa within her mother's home range, where she was introduced to natural live prey. She was released October 3, 2007, and remained in her mother's home range until December 3, when she began to move northwest and left the reservation. On December 30, she slipped out of her collar, and we were unable to recapture her due to snowy weather that made access to the area impossible. The other two kits born in 2007 were sisters. One of them dispersed to the south and established a home range near the town of Willow Creek, and the other has remained in her mother's home range. The two older female kits produced litters of kits in 2008 on the reservation.

The Hoopa Tribe has formed a partnership with the non-profit Wildlife Conservation Society, which has provided the director for the fisher research project. In addition, the tribe has collaborated with Humboldt State University and the non-profit Integral Ecology Research Center to better understand mortality causes and the role of disease in fisher ecology. These partnerships, and additional financial support and technical assistance from the Fish and Wildlife Service's Yreka Field Office and the U.S. Forest Service's Redwood Science Laboratory, have resulted in many advances in the knowledge of fisher ecology.

The stakeholders on Indian lands (tribal members) often live on the same lands managed for commercial resource extraction. On tribal lands like the Hoopa Valley Indian Reservation, culture, tradition, subsistence, and recreational use take precedence over purely economic gain. But implementation of forest management plans on tribal lands must continue due to the strong economic need. We believe that, if tribes were afforded sufficient funding for ecological monitoring programs, the effectiveness of tribal management would be documented and would eventually provide an example of effective forest management that could be emulated on federal lands.

Mark Higley, the Hoopa Tribe's wildlife biologist since 1991, can be contacted at mhigley@hoopa-msn.gov.

Tribal member Aaron Pole holding a newly radio-collared juvenile female that was PIT tagged at 5 weeks of age while in a den with two siblings. She eventually dispersed only a couple of miles from her natal area.

Mark Higley, Hoopa Tribal Forestry

Restoring Endangered Species on the Pueblo of Santa Ana

by Catherine Nishida and Nathan Schroeder

The Pueblo of Santa Ana is located in north-central New Mexico and encompasses over 79,000 acres (32,000 hectares) of trust land. Six miles (9.6 kilometers) of the Rio Grande flow through the Pueblo's boundaries. Historically, the Rio Grande was a perennial, winding, and braided waterway meandering across a floodplain that was miles wide. The low, sandy banks often experienced flooding and deposition of alluvial material high in nutrients that helped support a healthy riparian ecosystem. In the southwest, such areas of riparian forest along the river floodplains are called bosques, from the Spanish word for woodlands. A healthy bosque ecosystem includes cottonwood (*Populus deltoides wislizeni*) gallery forests with understories of coyote and black willow (*Salix* spp.).

More than 100 years of waterway modification for flood control has changed the Rio Grande into a river that is straighter, narrower, and more incised. The increase in incision and water flow has altered channel bed substrates from fine sandy sediments to gravel-dominated bottoms. The construction of dams for flood control and ditches for irrigation has reduced the channel sediments and annual flooding events upon which the bosque depends. Over time, the native cottonwood and willow ecosystem was invaded by introduced Russian olive (*Elaeagnus angustifolia*) and saltcedar (*Tamarix ramosissima*).

The Rio Grande silvery minnow (*Hybognathus amarus*) is one of the most endangered fish species in North America. It occupies less than five percent of its historical habitat in the Rio Grande due to damming and channelization. Changes in the river corridor and loss of riparian habitat also have reduced populations of the endangered southwestern willow flycatcher (*Empidonax traillii extimus*) and a candidate for listing, the western yellow-billed cuckoo (*Coccyzus americanus occidentalis*). Both subspecies are neotropical migrants that require densely vegetated riparian habitats for breeding.

The Santa Ana Rio Grande Restoration Program is an ecosystem-based restoration program that

A yellow-billed cuckoo uses the restored habitat at the confluence of the Rio Jemez and Rio Grande.

Glenn Harper

Tod Caplan

The confluence of the Rio Jemez and Rio Grande in 2001, prior to habitat restoration.

was started in 1998 by the Pueblo's Department of Natural Resources. The program is designed to restore a healthy, functioning Rio Grande ecosystem by reversing the negative impacts on riparian and aquatic ecosystems caused by flood control and channelization. Collaborations with federal and state agencies and non-profit organizations have focused on riparian restoration, habitat creation, and endangered species monitoring.

The Santa Ana Pueblo employs a philosophy of passive and active management along the Rio Grande. By allowing the river to create natural habitat through riparian vegetation regeneration and by mechanically removing invasive species, the river profile is being transformed. Along one bank, the Pueblo has removed all "jetty jacks," large metal structures that were installed in the 1950s and 1960s to straighten the river. Removing the jetty jacks allowed the Pueblo to recontour sections of the riverbank, which creates a lower floodplain that helps to reduce channel incision. The recontoured sections have experienced natural revegetation. In addition, the Pueblo has created backwater areas and swales that are planted with native vegetation. The backwater areas increase potential habitat for the Rio Grande silvery minnow, which requires slow-moving currents for spawning. Preliminary surveys (2005–2006) for the minnow on the Pueblo have shown an increase from earlier captures (1995–2000).

Like the Rio Grande silvery minnow, the southwestern willow flycatcher has benefited from habitat changes on the Pueblo. Exploratory surveys in 2001 detected only migratory willow flycatchers. During the summer of 2005, the Santa Ana Pueblo started surveying all suitable riparian habitats within its boundaries for willow flycatchers. After three years of baseline standardized surveys, detections of migratory willow flycatchers have significantly increased from original 2001 estimates. More importantly, southwestern willow flycatchers started residing on the Pueblo in 2006. These new resident flycatchers are defending territories within naturally regenerating riparian vegetation at the confluence of the Rio Jemez and the Rio Grande. This confluence supported very little vegetation in 2001 but is now densely vegetated. The Pueblo used this riparian regeneration as an example to grade the riverbank in an adjacent area to increase sediment deposition. This will create the same type of natural regeneration and expand the available riparian area in hopes that more southwestern willow flycatchers will take residence.

Yellow-billed cuckoos have been detected on the Pueblo since 2001. After three years of standardized surveys for yellow-billed cuckoos, the Pueblo has had fluctuating numbers of detections and estimates of population size. Yellow-billed cuckoos are known to be loosely territorial and to move opportunistically following ephemeral resource abundances. Cuckoos are secretive and often unresponsive to playbacks of taped cuckoo calls. Oscillations in population

numbers make multi-year studies critical to understanding any population trends.

In 2006, the Pueblo confirmed successful breeding for one pair of yellow-billed cuckoos. The nest was located four meters (13 feet) above the ground in an old-growth saltcedar within the dense riparian vegetation along the Rio Jemez. The Pueblo will continue yellow-billed cuckoo surveys in known high-usage areas for two more years. This will provide five years of baseline survey data while allowing more time for population monitoring. With five years of data collection, population trends should become more apparent.

Through funding from the Fish and Wildlife Service's Tribal Landowner Incentive Program, the Pueblo has been able to collect baseline data on the southwestern willow flycatcher, western yellow-billed cuckoo, and Rio Grande silvery minnow. Restored areas will be actively managed and enhanced as more is learned about the habitat preferences of the Pueblo's population of these three species through long-term monitoring.

Catherine Nishida, Wildlife Program Manager, and Nathan Schroeder, Restoration Division Manager, both of whom work in the Pueblo of Santa Ana's Department of Natural Resources, can be reached at 505-867-0615.

The confluence of the Rio Jemez and Rio Grande in 2005, after restoration activities began.

Kathy Brodhead

by Sarah E. Rinkevich

Traditional Ecological Knowledge

Polar bears (*Ursus maritimus*) are marine mammals that primarily inhabit the ice-covered sea of the Northern Hemisphere but also use both marine and terrestrial habitats for feeding, denning, breeding, and seasonal movements. On May 15, 2008, the U.S. Fish and Wildlife Service listed the polar bear as a threatened species under the Endangered Species Act due to loss of habitat because of receding sea ice. For the Service, however, managing polar bears is nothing new; it has been the agency's responsibility under the Marine Mammal Protection Act since 1972.

In 1993, the Secretary of the Interior directed the Service to enhance its management by developing a habitat conservation strategy for polar bears in Alaska. The Service sought out local knowledge of polar bear habitat needs to ensure that recommendations set forth in the strategy were based on the best information available. Recognizing and using local knowledge to manage fish and wildlife is consistent with the Service's

A polar bear hide on a drying rack. Subsistence hunting, which is not considered a significant threat to the polar bear's survival, is allowed under the recent listing rule.

USFWS

Native American Policy to seek partnerships with Native governments and involve them in Service activities.

Such local knowledge is often termed Traditional Ecological Knowledge (or TEK). Although there is no universally accepted definition of TEK, the term describes the knowledge acquired by indigenous and local cultures about their immediate environment and includes the cultural practices that build on that knowledge. TEK incorporates an intimate and detailed knowledge of plants, animals, and natural phenomena; the development and use of appropriate technologies for hunting, fishing, trapping, agriculture, and forestry; and a holistic knowledge or "world view" that parallels the scientific discipline of ecology. It is often associated with a reliance on oral traditions.

While TEK accumulates over centuries, its expression at any point reflects the time scales that are discernible to people, from daily animal habits to landscape changes over a human lifetime. Information provided by Native hunters knowledgeable of polar bear habitat was used to develop the Habitat Conservation Strategy for Polar Bears in Alaska, which was completed in 1995. The Service, in cooperation with the Alaska Nanuuq Commission, regional Native corporations, and village councils, visited 12 villages in northern and northwestern coastal Alaska to speak with Native hunters about polar bear habitat use. Villages were selected for the consistency of harvest patterns and their location within polar bear habitat. Service biologists held discussions with Native hunters who were selected by their village council for their knowledge of local polar bear ecology and habitat.

Sixty-one hunters participated in the discussions held by the team that was developed the conservation strategy. The primary objective of the Native knowledge discussions was to identify the areas polar bears use within each village's hunting range. The team transcribed oral information and created maps. The maps subsequently identified important areas used by polar bears for feeding, denning, and seasonal movements, information that was not previously available in scientific literature. For example, polar bear habitat is highly variable because ice is directly affected by wind and ocean currents. When wind direction changes, lead systems (linear areas of open water within ice) and ice edges change, dramatically altering the accessibility and desirability of an area to the bears. Denning locations, which are relative to snow depth and deposition, also vary annually. Hunter responses often reflected this variability through statements such as "this lead is present when the wind blows from the south."

Local knowledge had not been incorporated into a management plan for marine mammals until development of the 1995 Habitat Conservation Strategy for Polar Bears in Alaska (U.S. Fish and Wildlife Service 1995). The Strategy continues to serve as a primary tool for polar bear habitat management, including the identification of important denning areas for land use planning activities involving the oil and gas industry in polar bear habitat in Alaska. The use of TEK also alerted scientists to the importance of marine mammal carcasses as a food source for polar bears during the fall open water period. This led to a ground-based study to better understand foraging patterns and coastal use by polar bears. Further, the Service used TEK to produce a polar bear population estimate for the 2007 listing proposal. Native knowledge and scientific information can help the Service explore the close association between polar bears, pack ice movements, and the overall importance of leads and active ice critical to polar bears. TEK may also play a significant role in research into seasonal movements of adult male polar bears, for which scientific information is lacking.

Traditional ecological knowledge is complementary to western science, not a replacement for it. Admittedly, integrating indigenous and western scientific ways of knowing and managing wildlife is difficult to achieve, but TEK has played an important role in the successful management of several other Arctic wildlife species. For example, the Inuit people provided information about the winter ecology of eiders (Somateria mollistima sedentaria). Inuit knowledge of winter concentrations of eiders suggested a more efficient means for biologists to monitor eider population size in southeastern Hudson Bay.

As it plans future conservation efforts for the polar bear, the Service will continue to work with indigenous and other local people to collect and make good use of their unique ecological knowledge.

Reference

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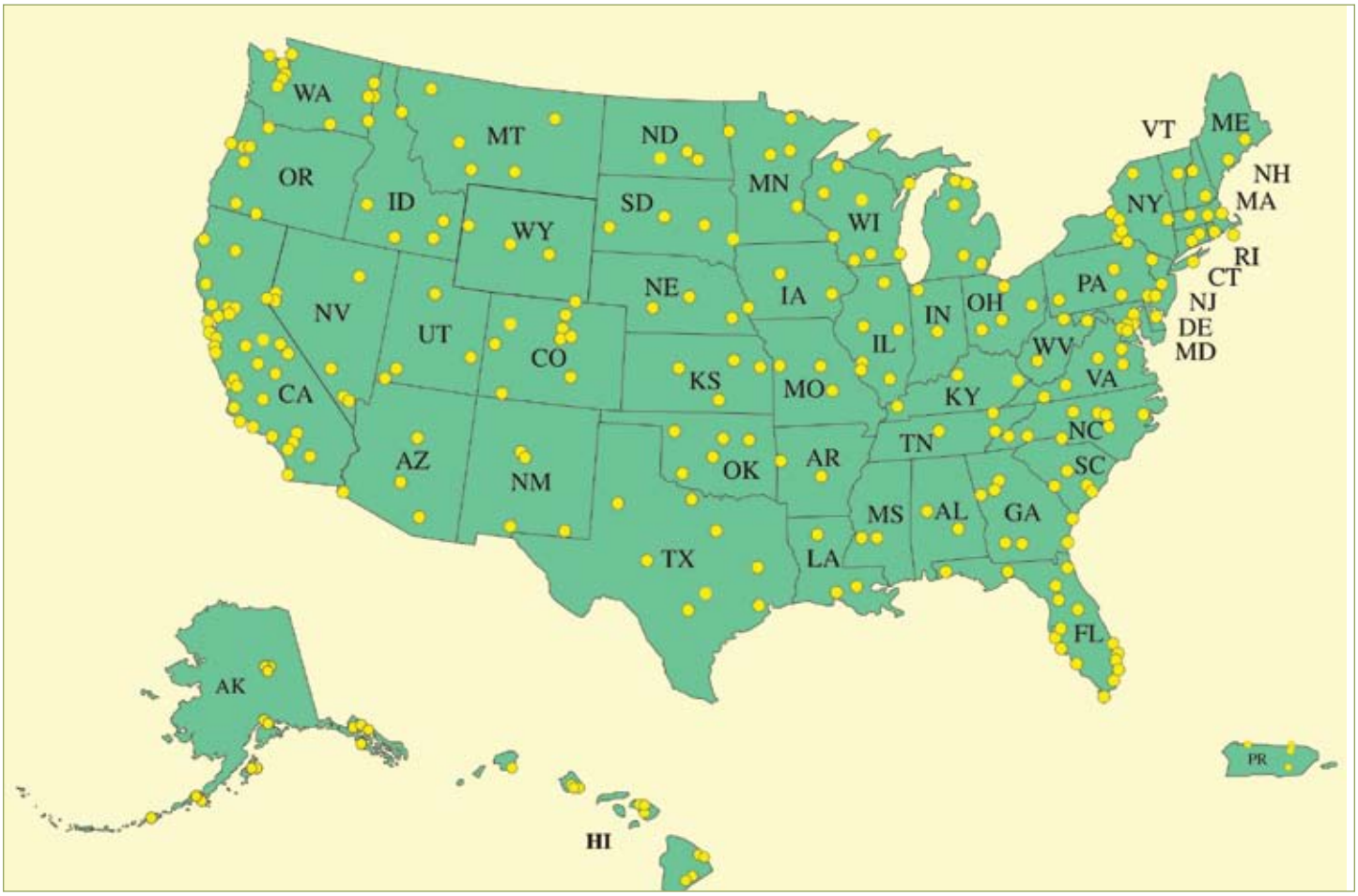
by Rachel Muir and
J. Michael Scott

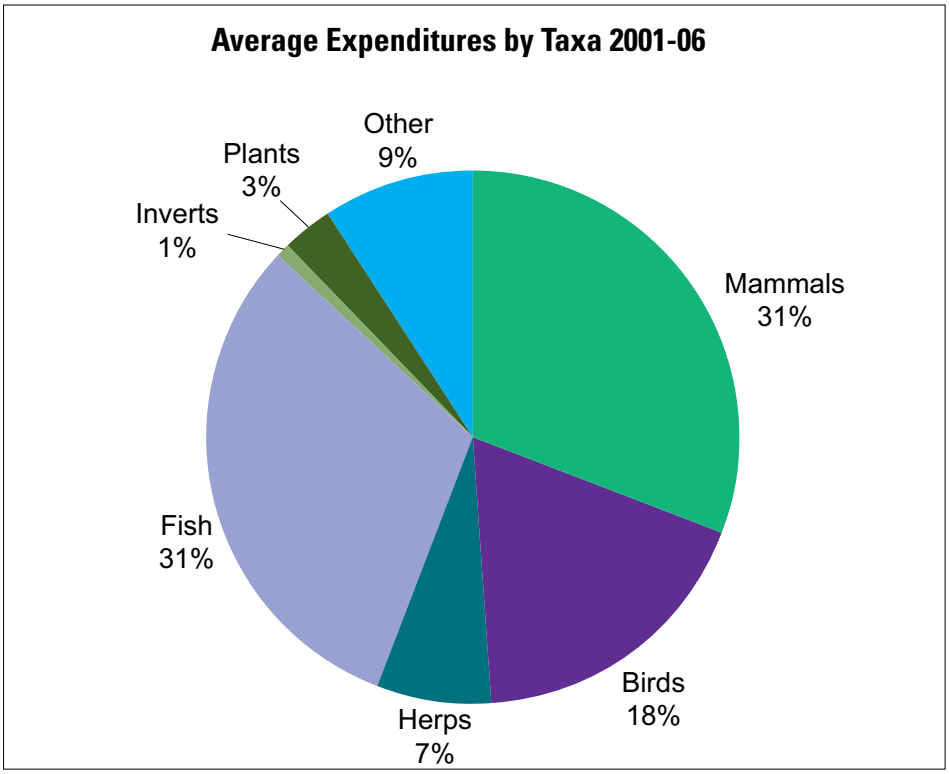
A Natural Connection: USGS and Endangered Species Research

USGS
science for a changing world

The U.S. Geological Survey (USGS) is an independent science agency within the U.S. Department of the Interior (DOI). USGS scientists conduct research on diverse topics in geology, biology, water, and such earth hazards as earthquakes and volcanic eruptions. Many of our research issues are in the headlines, such as our studies of earthquakes and floods. Our research is also used to support decisions on the listing and recovery of animals and plants under the Endangered Species Act (ESA). USGS biologists provide scientific information to assist other agencies in conserving endangered species, based on a foundation of three strategies:



Location of major USGS Offices and Science Centers and Cooperative Research Units.



Percentage of expenditures for listed species by taxa, 2001-2006. Direct USGS expenditures per year during that period ranged from $11 million to $14 million.

1. USGS provides peer-reviewed, independent, and unbiased science of the highest quality.

The USGS has no regulatory or land and water management responsibilities; our sole job is to provide quality science and data to our governmental and non-governmental partners and the public. The steps our agency takes to ensure the quality of our science and open access to our science products makes USGS a trusted resource for government and the public. Our work takes place in science centers, field stations, and Cooperative Fish and Wildlife Research Centers from Maine to Hawaii and American Samoa to Alaska. The USGS dedicated more than $14 million dollars to support research on listed species in 2007. It also conducts significant research on species proposed for listing and candidate species in support of the U.S. Fish and Wildlife Service and other partners.

Government agencies and the public have entrusted the USGS to provide unbiased science and data to inform difficult decisions regarding endangered species on listing, delisting, and habitat planning for charismatic species such as polar bears (*Ursus maritimus*), spotted owls (*Strix occidentalis*), and West Indian manatees (*Trichechus manatus*). However, we conduct research on lesser known species as well, such as the endangered Chiricahua leopard frog (*Lithobates chiricahuensis*), which is found only in the southwestern mountains of the U.S. and Mexico; Mead's milkweed (*Asclepias meadii*), a prairie plant of the central Midwest; and the elkhorn coral (*Acropora palmata*), a reef-building species of the Caribbean. The USGS funded research on more than 150 endangered and threatened species in 2007. Studying all the 1,343 species listed (as of July 23, 2008) as threatened or endangered under ESA would be a daunting task. However, in addition to our research targeted to specific endangered species, the USGS works to expand our knowledge regarding the ecosystems that endangered species and all species depend on. In this way, we are able to stretch our resources and develop the basic science that broadly informs endangered species conservation.

2. USGS maintains long-standing interactions with the natural resource agencies that have responsibility for managing listed species and their habitats.

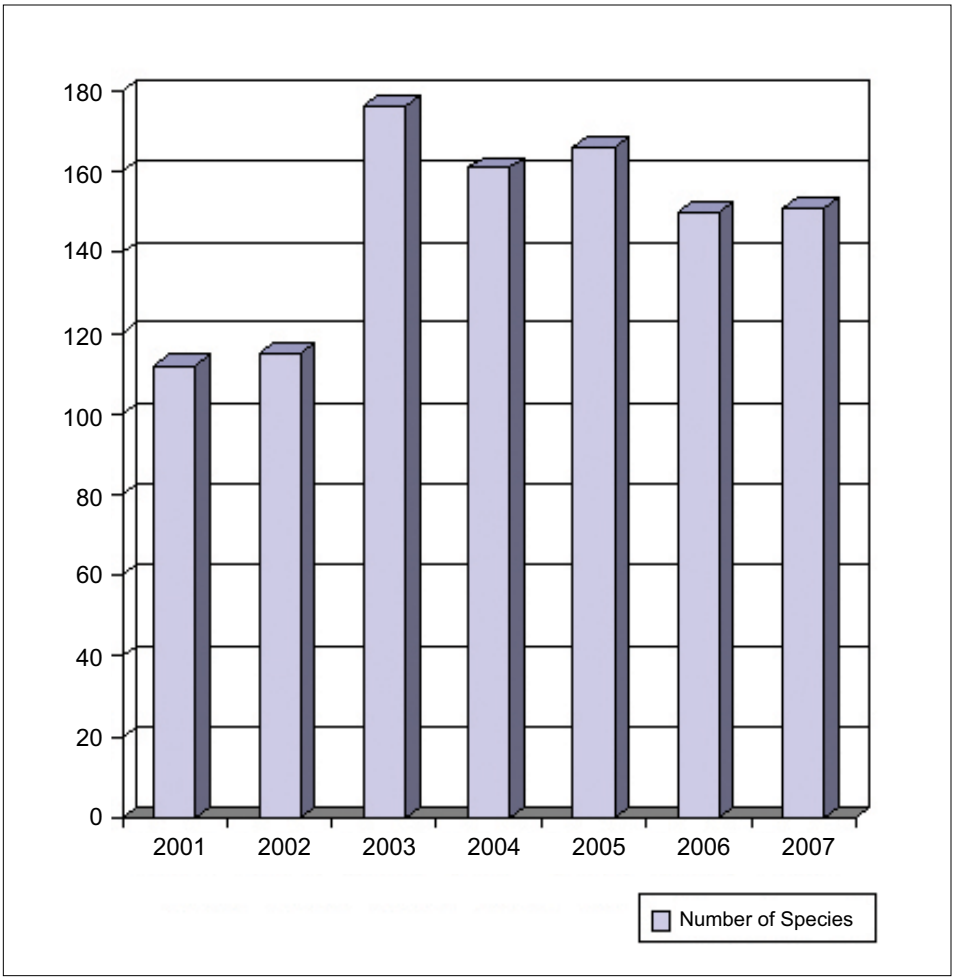
The USGS has a long-standing relationship with our sister agencies in DOI1. In fact, many of our researchers began their careers in the National Park Service, Fish and Wildlife Service, or Bureau of Land Management and came to the USGS through the consolidation of DOI research capabilities into the National Biological Survey (NBS). In 1994, the NBS changed from an independent agency to become the Biological Research Discipline of the USGS. Many of our offices and research facilities are located within national parks or other

public lands, and many adjoin the offices of other federal agencies. We also work closely with state and local partners in setting research priorities.

The ties of USGS scientists to endangered species research date back before passage of the ESA. Prior to 1973, future USGS scientists working at Fish and Wildlife Science Centers and Cooperative Research Units collaborated on recovery options for declining species, and accounts of their research are among the early papers published in the *Endangered Species Bulletin*.[1] Two of the scientists from these early research efforts, David Mech and Mike Scott, continue their work today as USGS scientists. Their stories, including their current research and continued links to our partners, are told below:

Dr. Mech, a mammalogist with the USGS Northern Prairie Wildlife Research Center, began studying wolves in 1958 and joined the Department of the Interior in 1969, prior to passage of the Endangered Species Act. Since then, the recovery of the gray wolf (*Canis lupus*) in the northern Rocky Mountain states and the upper Midwest has been one of the success stories of the ESA. In 1970, there were only about 650 gray wolves in the contiguous 48 states, and the Mexican wolf (*C. l. baileyi*) and the red wolf (*Canis rufus*) were nearly extinct in the wild. Since then, gray wolves have rebounded to the point that populations are estimated at over 4,000 in the upper Midwest and 2,000 in the northern Rocky Mountain region. Wild populations of the Mexican wolf in the southwest and red wolf in the Southeast have been reestablished. Mech attributes research success in large part to the cooperation of land management partners such as the National Park Service, Fish and Wildlife Service, and Forest Service. "Having parks and other public lands available had been a wonderful and key resource for our wolf research," he says, "and having the cooperation of agency resource managers has been one of the keys to recovery."

Dr. J. Michael Scott is another pioneer in endangered species research still active in USGS research activities. His early research was in the Hawaiian Islands, where he worked with the National Park Service and other federal and state agencies in conducting the Hawaii Forest Bird Survey. Their task was to determine the distribution, abundance, habitat associations, and status of Hawaiian forest birds. Results of that effort were used to establish Hakalau Forest National Wildlife Refuge.[2] Later, he served as leader of the California Condor Research Center, and today he is working with Fish and Wildlife Service biologists on recovering endangered species, assessing the biological diversity and health of the National Wildlife Refuge System, and studying the conservation



Number of species on which USGS conducted research (2001 through 2007).

status of species and ecosystems in a changing environment.

3. The USGS research portfolio is principally landscape-based, multi-disciplinary, and long-term.

The USGS contributes to understanding the status and trends of our Nation's imperiled species and other natural resources. Our research may be specifically targeted to a single question – such as, where and for how long does the endangered pallid sturgeon (*Scaphirhynchus albus*) live along the 2,341 miles (3,767 kilometers) of the Missouri River? – or toward more general science questions, such as how do migratory birds and native plants respond to climate change?

The USGS conducts landscape-level science because the science questions of today are large and complex. Many of the threats to species are not local impacts but the result of regional- or even global-scale habitat changes. The Breeding Bird Survey, a cooperative effort between USGS and the Canadian Wildlife Service's National Wildlife Research Centre, is one example of monitoring and research combined to address continental scale changes in wildlife populations (see http://www.pwrc.usgs.gov/BBS/). Nevertheless, research is still needed on "the basics," meaning the specific life history requirements, status and trends, and genetics of single species. The leadership of USGS scientists in the developing field of conservation genetics is of particular importance to endangered species conservation. Conservation genetics is a vital tool to identify species and subspecies and to evaluate the genetic diversity of populations of plants or animals, a key to their survivial.[3]

The major USGS disciplines of Biology, Geography, Geology, and Water Resources address many of the basic information needs for where listed species occur, what threats they face, and how they can be protected in a landscape being transformed rapidly and directly by urbanization, or more gradually by climate change. Scientists of all the USGS disciplines are improving our capacity to integrate scientific expertise in our agency. Our new strategic plan, "Facing Tomorrow's Challenges – USGS Science in the Decade 2007-2017," identifies the big questions we face in preserving ecosystems, researching climate change, providing a scientific foundation for energy and water management and use, protecting human health, and assessing and anticipating the effects of natural hazards.

Increasingly, the conservation of endangered species will hinge on an understanding of how ecosystems work and how they respond to changes in temperature patterns, land use, human and wildlife populations, disease, and invasive species. We are working to improve the information and models we use to predict changes in habitat and wildlife populations. Endangered species research needs will be met through multi-disciplinary programs such as the USGS Global Climate Change Research Program http://geochange.er.usgs.gov/. However, we will continue supporting endangered species-related research through programs such as the Science Support Program (http://biology.usgs.gov/ssp/), and the Gap Analysis Program (http://gapanalysis.nbii.gov/portal/server.ptto).

Our basic and applied science supports the Nation's ability to anticipate large scale change in ecosystems and help prevent the loss of animal and plant species that might result from such changes.

USGS

In 1969, Dr. David Mech began pioneering research on gray wolves. Here, in September 1970, he injects a young wolf using a syringe on a stick in preparation for attaching a radio collar.

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[1]*Endangered Species Technical Bulletin*, 1977, Vol. 2. No.11, pp. 6-9. "Patuxent's Endangered Wildlife Research Program."

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Rachel Muir (rachel_muir@usgs.gov, 703-648-5114) coordinates imperiled species for the Biological Research Discipline of the USGS in Reston, Virginia. J. Michael Scott (mscott@usgs.gov, 208-885-6960) is a biologist with the USGS and Unit Leader of the Idaho Cooperative Fish and Wildlife Research Unit, Moscow, Idaho.

by Kathryn McEachern

Recovering Endemic Plants of the Channel Islands

At the California Channel Islands, off the state's southern coast, cold waters from the north mix with warmer waters from the south. Each of the eight Channel Islands, which were never connected to the mainland, developed unique floras as colonizing plants adapted to their new island homes. This part of California is one of only five Mediterranean climate regions in the world, characterized by hot, dry summers and cool, wet winters. Thus, the islands support a truly unusual assemblage of plants and animals found nowhere else.

The northern five islands comprise Channel Islands National Park, estab-

Santa Cruz Island live-forever (*Dudleya nesiotica*).

K. Chess/USGS

Taxon	Status*	Total populations	Islands**
Herbaceous Annuals			
Hoffmanns's slender-flowered gilia *(Gilia tenuiflora* ssp. *hoffmannii)*	E	2	SRI
Santa Cruz Island chicory *(Malacothrix indecora)*	E	6	SCI, SRI, SMI
Island malacothrix *(Malacothrix squalida)*	E	1	SCI
Island phacelia *(Phacelia insularis* var. *insularis)*	E	1	SRI, SMI
Santa Cruz Island lace pod *(Thysanocarpus conchuliferus)*	E	8	SCI
Herbaceous Perennials			
Hoffmann's rock cress *(Arabis hoffmannii)*	E	5	SCI, SRI, (AI)
Succulent Perennials			
Santa Cruz Island live-forever *(Dudleya nesiotica)*	T	1	SCI
Santa Barbara Island live-forever *(Dudleya traskiae)*	E	10	SBI
Small Shrubs			
Soft-leaved paintbrush *(Castilleja mollis)*	E	2	SRI
Sea-cliff bedstraw *(Galium buxifolium)*	E	8	SCI, SMI, (SRI)
Island rushrose *(Helianthemum greenei)*	T	36	SCI, SRI, SCT
Full Shrubs			
Santa Rosa Island manzanita *(Arctostaphylos confertiflora)*	E	3	SRI
Island barberry *(Berberis pinnata* ssp. *insularis)*	E	5	SCI, (AI , SRI)
Santa Cruz Island bush mallow *(Malacothamnus fasciculatus* var. *nesioticus)*	E	4	SCI

* T means threatened; E means endangered.
** AI = Anacapa Island, SBI = Santa Barbara Island, SCI = Santa Cruz Island, SCT = Santa Catalina Island, SMI = San Miguel Island, SRI = Santa Rosa Island; parentheses () indicate presumed extirpated.

Table 1 . Listed plants of Channel Islands National Park.

lished by Congress in 1980. Programs to protect the islands' flora and fauna and restore habitat damage caused by earlier management began shortly after the park's creation. The park islands support 75 endemic plant taxa, 14 of which are listed as threatened or endangered under the Endangered Species Act.

From the beginning, the restoration of the Channel Islands was a daunting task. For about 150 years, these islands had been used for ranching, and large areas of native scrub and woodland were converted to stands of non-native annual grasses. An important first step was the removal of non-native grazing animals

K. Chess/USGS

Santa Cruz Island lace pod (*Thysanocarpus conchuliferus*).

from the islands. This task, nearly complete, is a major step toward ecosystem recovery.

For the last decade, U.S. Geological Survey (USGS) research has focused on gaining the scientific knowledge needed for recovering the listed plant taxa, searching for remaining populations, sampling their habitats, monitoring population changes and distribution, and conducting recovery experiments. Our research approach has asked three basic questions:

- Where are the listed plants found now?
- How are their populations doing?
- Are there threats that we can identify and do something about?

We use the answers to develop recovery actions, along with our partners in management, the National Park Service, the Santa Barbara Botanic Garden, the University of California Reserve System, the U.S. Fish and Wildlife Service, and The Nature Conservancy.

The 14 listed plant taxa span a range of life histories, from tiny annuals that complete their life in one year to slow-growing shrubs that can live for decades (Table 1). Although they differ vastly in stature and longevity, they have all had to contend with the same environmental challenges. For example, each of the listed taxa evolved in response to a particular suite of environmental factors that made them successful at reproducing in the unique conditions found on the Channel Island environments. The ranching that had been practiced for decades before establishment of the park changed their ecosystems, reducing their populations and restricting them to a few small patches of the specialized habitat.

The largest native mammal on the islands is an endemic fox, so the island endemic plants did not evolve mechanisms for coping with the grazing and trampling of large grazing animals. Invasive plants, intentionally introduced for forage and crops or accidentally brought to the islands, became widespread. Most of the endemic plants were unable to cope with the combination of grazing impacts and aggressive invasive species, and these natives became trapped in ever-shrinking habitats. Ultimately, they became endangered because they were reduced to a very low number of populations with only a few plants each, isolated from one another and from unoccupied but otherwise good patches of habitat.

Almost all of these endangered plants grow best in shaded locations, or in places with substantial amounts of fog, such as coastal bluffs or terraces. Climate change is shifting these moisture patterns, with the result that a few of the endangered taxa are not able to reproduce as well as before. The effects of these ecological changes – grazing, invasive species, and climate change – can be seen in the listed plants today. However, our monitoring and research results are showing us ways to help them recover, now that non-native animals are being

taken off the islands and we have begun to control invasive plant species. Our goal is to help the native plants reoccupy enough of their former ranges and grow in population size so that they can become resilient enough to cope with continuing environmental challenges, such as those anticipated with climate change.

The good news for these rare Channel Island plants is that the raw material for recovery is still there. Most rare plant populations known earlier in the 1900s still persist, even though they are small. Their habitats are usually dominated by more common native plants, some of which appear to be expanding into the surrounding areas, thereby creating additional shaded habitat suitable for colonization by these rare plant species. Our studies show that most of the endemic taxa produce seeds that germinate readily, and we have found ways to encourage more seed production by such actions as hand pollination or by weeding competitive, non-native plants. Some native plant populations may be able to expand on their own as habitats recover.

Another successful recovery technique has been to find suitable but unoccupied habitats for many of the endangered plants. That enables us to "jump start" recovery by establishing new populations in places where it might take years for these plants to colonize on their own. So far, we have had good success developing new populations of two taxa from seeds and cuttings. We have also documented that existing populations of a few native taxa have expanded soon after non-native animal removal. We have high hopes that ecosystem recovery spurred by the non-native animal removal programs will stimulate recovery of these endemic plants, and we are developing ways to help those taxa that have problems recovering on their own. USGS research is guiding rare plant management in the Channel Islands National Park, and together with our partners, we are translating our research results into successful recovery actions.

K. McEachern/USGS

Island rushrose (*Helianthemum greenei*).

D. Rodriguez/NPS

Santa Rosa Island manzanita (*Arctostaphylos confertiflora*).

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by Steven T. Knick and
Ruth W. Jacobs

Conserving Bird Communities in the Sagebrush Sea

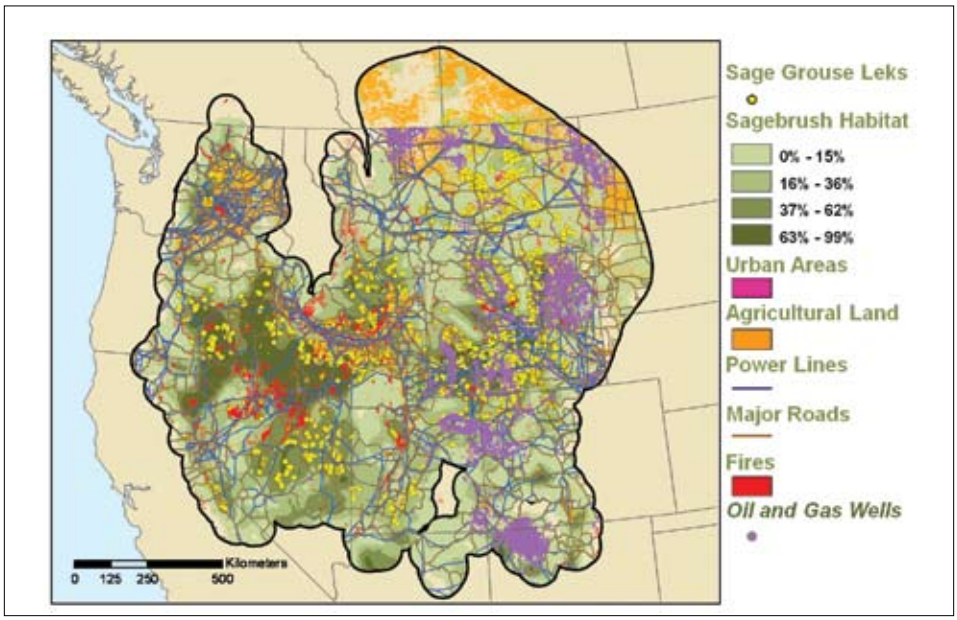
The sagebrush ecosystem, which occupies about 120 million acres (485,600 square kilometers) across 14 western states and 3 Canadian provinces, is one of the largest in North America, and one of its most imperiled. Decades ago, warnings began to appear about the loss of sagebrush habitats and the consequences for biodiversity. Today, many species of shrubland birds are declining, some severely. The greater sage-grouse (*Centrocercus urophasianus*), which

An example of sagebrush habitat in Central Nevada.

Steve Knick/USGS

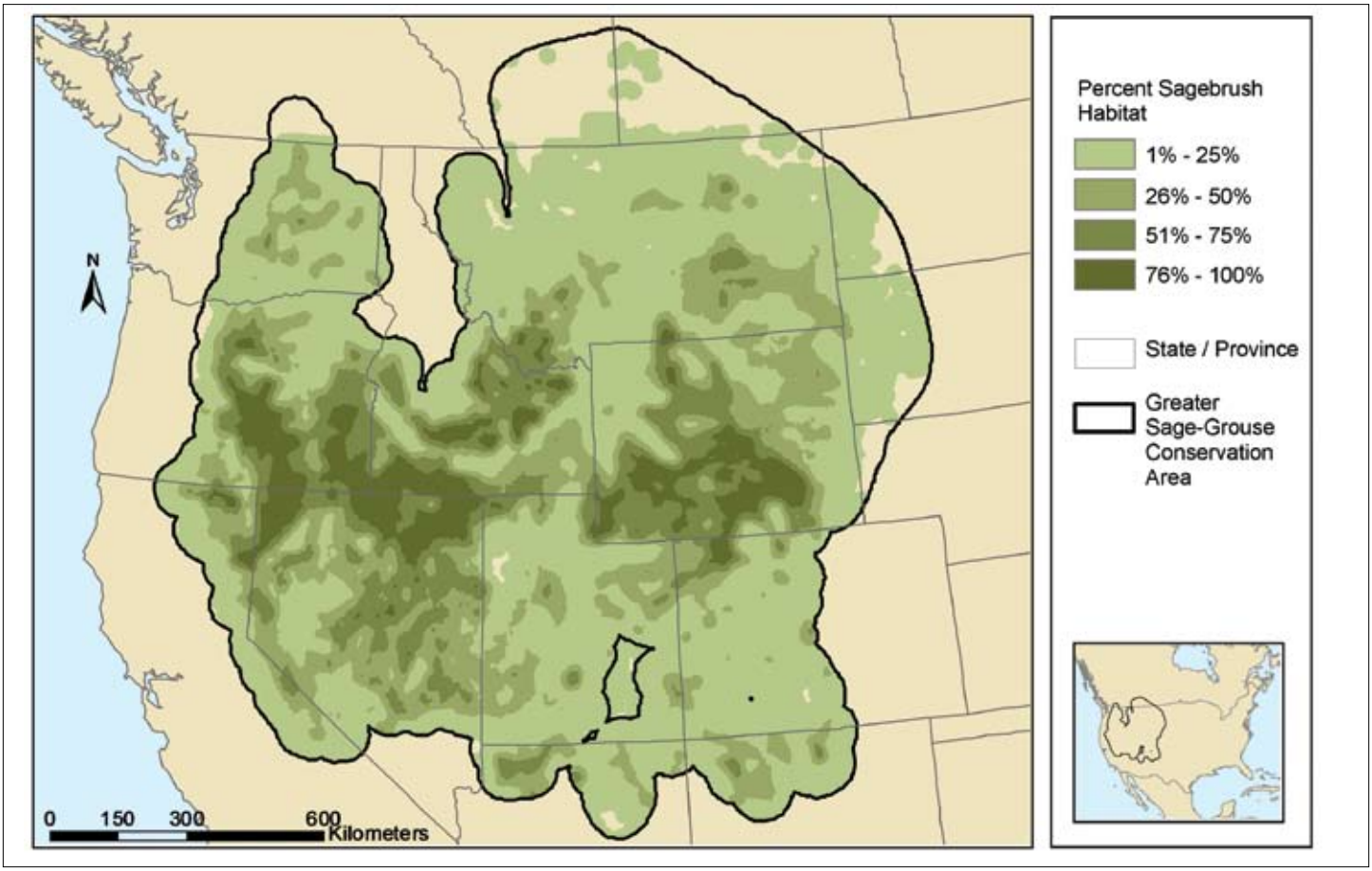
depends on sagebrush habitats to survive, is again being considered for listing under the Endangered Species Act. To be successful in conserving this ecosystem and the birds that depend upon it, managers need a better understanding of how human use is affecting sagebrush habitats, which habitat components are most critical, the importance of wintering grounds and migration pathways, and how to monitor and estimate bird population trends.

First, managers need more information regarding how human uses, such as oil and gas development or livestock grazing, are affecting sagebrush habitats. As part of a 2004 conservation assessment for sage-grouse, a partnership of state, federal, and university scientists conducted such an analysis. For more than a year, they compiled and analyzed data from thousands of sources to identify, characterize, and quantify the dominant factors (such as agriculture, energy development, and grazing) that influence sagebrush habitats. They systematically documented that almost



Combined breeding and wintering ranges of Brewer's sparrow, sage sparrow, sage thrasher, green-tailed towhee, and gray flycatcher (reprinted from Knick et al. 2003 with permission from Cooper Ornithological Society).

Approximate current distribution of sagebrush habitats in western North America. The map represents the percent of the landscape dominated by sagebrush habitats.



© Terry Steele

Greater sage-grouse.

all sagebrush habitats used by sage-grouse were influenced by one or more significant land uses. They also described how land uses can act synergistically. For example, those uses that cause the spread of fire-prone invasive plants, such as cheatgrass (*Bromus tectorum*), can result in increasing the size and frequency of fires that ultimately convert even more sagebrush habitat to grasslands. The analysis (available at http://sagemap.wr.usgs.gov/) also produced data for use in visualizing habitat change and in conducting additional studies. The result is a valuable baseline for future assessments of sagebrush habitats and other ecosystems in the western United States.

A second research need is basic information about food, cover, space, and water. Surprisingly, little of such information is known for many species of shrubland birds other than sage-grouse, a game bird in many states. Because of new tools to characterize large landscapes, scientists also are learning that the spatial variability in these habitat requirements is an important predictor of population distributions. From a study of shrubland birds and habitat that took three summers and required driving over thousands of miles of dirt roads throughout the Intermountain West, scientists documented that shrubland bird communities were arranged along two major habitat gradients; one ranged from grasslands, through sagebrush shrublands, into juniper woodlands, and the other covered the spectrum from large intact landscapes to highly fragmented systems. The characteristics that determined bird distribution and abundance were precisely aligned with the kinds of habitat changes occurring in sagebrush habitats. These extensive studies show that the distribution of native bird species depends principally on two factors: whether the habitats are predominantly grassland or sagebrush and how much disturbance from human activities have affected the sites.

A third research need emphasizes a better understanding of the importance of wintering grounds and migration pathways. For many species of birds, events during the wintering period may be a significant or even dominant factor in population trends. Obtaining the necessary information to evaluate the influence of the winter period has not been possible using traditional methods because few birds that are leg-banded on research studies are ever recaptured, and the tiny transmitters that can be used on shrubland birds have extremely limited signal strength and battery life. A new technique, based on analyzing feathers for concentrations of stable isotopes, is being used by scientists to link wintering and breeding grounds for shrubland birds. Molting birds replace their feathers on the breeding range each year during the summer. The proteins used to build the new feathers have subtle differences in levels of carbon and nitrogen that vary across the breeding range. Therefore, feathers collected from birds captured and released on the winter

range retain this environmental signature that connects them to their summering range. From this study, managers will have essential information to consider the continental scale of influences on the birds breeding in sagebrush habitats.

A fourth research need is to improve methods for estimating bird population trends. Currently, the only consistent range-wide data are collected by the USGS Breeding Bird Surveys. However, these surveys are not adequate to estimate many of the regional population trends that can be related to changes in habitat. Coordination, data-collection protocols, analysis procedures, technical support for data analysis, and data management are critical tasks to be considered. Technological advances for data recording also are needed, combined with new ways of information analysis involving disparate datasets.

Natural resource agencies have a daunting task to manage and restore sagebrush habitats and the associated species. Cumulative effects of land use and habitat change, coupled with long-term changes from climate change, could result in a large-scale collapse of this vast western landscape. Information systematically collected in the four areas of research described above can be crucial in raising awareness in the scientific community, among land managers, and ultimately of the American public about the challenges and the opportunities associated with conservation of this ecosystem and others. Although specialized skills and data-processing resources are needed to undertake such large-scale studies, that support is available in federal and state research organizations and universities. Most important may be the mindset to better appreciate the value of sagebrush ecosystems and to commit the resources necessary to undertake the studies and apply the knowledge gained for conservation actions.

The four research topics were presented in a paper published in The Condor in 2003. A reference for this paper and the two completed studies used as examples is provided below:

Connelly, J.W., Knick, S.T., Schroeder, M.A., Stiver, S.J., 2004, Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats: Unpublished report of Western Association of Fish and Wildlife Agencies, p. 610. (Available at http://sagemap.wr.usgs.gov/conservation_assessment.htm

Knick, S.T., Dobkin, D.S., Rotenberry, J.T., Schroeder, M.A., Vander Haegen, M., Van Riper, C., 2003, Teetering on the edge or too late? Conservation and research issues for avifauna of sagebrush habitats: Condor, v. 105, p. 611-634.

Knick, S.T., Rotenberry, J.T., Leu, M., 2008, Habitat, topographical, and geographical components structuring shrub-steppe bird communities: Ecography, v. 31, p. 389-400.

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by Anthony R. DeGange

Ice, Climate Change, and Wildlife Research in Alaska

What do polar bears, Pacific walrus, spectacled eiders, and Kittlitz's murrelets have in common? In a word – ice! Although the effects of climate change can now be observed almost anywhere in the United States, nowhere are the effects more prominent than in Alaska, where unprecedented rates of sea ice loss, tidewater glacier recession, coastal erosion, permafrost degradation, and other landscape changes presage major changes to Alaska wildlife populations.

Climate change will play an increasingly significant role in future decisions related to the Endangered Species Act (ESA), and research is critical to understand how wildlife and their habitats will change as the climate continues to

USGS

Pacific walrus.

Steve Amstrup

warm. These four ice-related species exemplify the diverse approaches to research undertaken by biologists in the U.S. Geological Survey's Alaska Science Center (ASC) to help unravel the mysteries associated with climate change and wildlife in Alaska.

The summer of 2007 set another record in sea ice loss in the Arctic since satellite measurements began in 1979. Two species are emblematic of Arctic sea ice: the polar bear (*Ursus maritimus*) and the Pacific walrus (*Odobenus rosemarus*). The Secretary of the Interior announced the listing of polar bears as threatened under the ESA on May 14, 2008. Polar bears depend on sea ice for much of their life history needs. They mate and den on sea ice, travel on sea ice, and feed almost exclusively on seals captured from the sea ice surface. Pacific walrus are currently the subject of a petition to list under the ESA.

Polar Bear

The ASC's polar bear research team, under the direction of Steve Amstrup and George Durner, has been studying polar bears in Alaska for several decades. This extensive research record now enables comparisons of denning behavior, size and condition, and survival between periods when sea ice was abundant over the productive continental shelf and recent years, when it has been absent for increasingly longer periods of time. ASC biologists have documented a shift in the proportion of dens on sea ice to land in response to changing sea ice conditions, as well as declines in some measurements of body size and condition. Perhaps one of the most critical findings was the ability to link survival of polar bears to sea ice. In other words, survival of polar bears was higher in years when sea ice covered the continental shelf for longer periods of time, presumably because bears continued to have access to ice seals, their preferred prey. A similar relationship between sea ice and survival was also documented by ASC biologists, in collaboration with their Canadian colleagues, for polar bears in Western Hudson Bay, Canada.

In 2007, in response to requests from the Fish and Wildlife Service (FWS) and the Secretary of the Interior, the ASC assembled an international, interdisciplinary team of polar bear scientists, sea ice experts, and computer modelers to conduct analyses to help inform the listing decision on polar bears. In addition to understanding the current status of several polar bear subpopulations in Alaska and Canada, the team developed population and habitat models using sea ice forecasts from climate models to understand how the Southern Beaufort Sea polar bear population and polar bear sea ice habitat will change with future declines in sea ice.

The results of this study suggest a bleak outlook for polar bears. Polar bears were forecasted to decline throughout all of their range during this century, but the severity of the decline will depend upon the status of sea ice where they reside. In areas of seasonal sea ice, or where sea ice is receding far north of the continental shelf each summer and fall, extirpation was forecast as the most likely outcome for polar bears by mid-century. Polar bears were predicted to persist longer in areas of northern Canada and Greenland where sea is expected to be more stable. The ASC will continue its long-term studies of polar bears to evaluate and test the predictive models it recently developed. This is critical as sea ice continues to recede at unprecedented levels in the Arctic.

Pacific Walrus

Pacific walrus are even more inaccessible and difficult to work on than polar bears. Developing and implementing a suitable method to estimate the population size of this species has been a dominant research focus for ASC scientists Chad Jay and Mark Udevitz and their colleagues, Doug Burn and Suzann Speckman of the FWS. With the survey data collection complete and analysis underway, the ASC has shifted its focus to better understanding the effects of climate change and diminishing sea ice on walrus. For example, it developed a satellite tag that could be remotely applied to walrus by using a crossbow from a small boat. This precluded the need for sedating walrus on sea ice – a dangerous proposition for walrus and researchers alike. With the recent additions of a saltwater switch and a pressure sensor to the tag, the ASC can now document where a particular walrus is, how much time it spends hauled out on land or sea ice, and where and for how long it is foraging. This will enable future comparisons of foraging efforts between walrus hauled out on land and those that remain on the sea ice.

Like polar bears, Pacific walrus spend a considerable portion of their annual cycle on sea ice. After breeding on sea ice in the Bering Sea in spring, many males migrate to terrestrial haul-outs in Bristol Bay, Alaska, and on the Chukotka Peninsula in Russia. Females and their dependent young, in contrast, stay on the ice as it recedes into the Chukchi Sea, where they use sea ice as a moving platform from which they dive to the sea-floor bottom to feed on such invertebrates as clams. Research suggests that loss of sea ice in summer and fall, particularly over the continental shelf of the Beaufort and Chukchi seas, is having a pronounced effect on this species.

In 2007, sea ice in the Chukchi Sea receded far over the deep water polar basin. Satellite tagging revealed that walrus stayed over the shallow water

USGS

continental shelf where they had access to foraging areas for as long as possible by using small remnant ice flows for resting. Eventually, the ice disappeared and walruses used terrestrial haul-outs in Chukotka and Northwestern Alaska in unprecedented numbers. This behavioral change concerns wildlife managers and researchers for two reasons: walrus on land are at risk from disturbance, and reports from Chukotka suggest that many walruses were trampled during stampedes caused by human disturbances in fall 2007. Walrus also may increasingly compete with each other for food in the nearshore zone as they become concentrated in nearshore haulouts.

Marc Romano

Two radio-tagged Kittzlitz's murrelets at Glacier Bay, Alaska.

Birds

A discussion of climate change and wildlife in Alaska would be incomplete without mention of two unusual bird species also associated strongly with ice: the threatened spectacled eider (*Somateria fischeri*), which winters within the pack ice in shallow waters of the northern Bering Sea, and the Kittlitz's murrelet (*Brachyramphus brevirostris*), a small seabird that visits nearshore waters in summer and is associated with tidewater glaciers.

When research began on spectacled eiders, the wintering ground of this species was one of the great mysteries of ornithology in North America. In Alaska, that mystery was solved by ASC scientists Margaret Petersen and Dan Mulcahy, and Bill Larned of the FWS, with one of the first applications of implantable satellite transmitters. Since then, Petersen and Paul Flint of the ASC, and Chris Franson of USGS National Wildlife Health Center, used small portable x-ray devices to discover that spent lead shot deposited by waterfowl hunters on one of the eider's principal breeding grounds in Alaska was likely a critical factor affecting the survival of adult eiders.

ASC biologists are about to embark on a new satellite telemetry study of spectacled eiders in Alaska. The research will investigate how eiders are using nearshore areas of the Chukchi Sea that could be affected by oil and gas exploration and development. Equally important, the project also will allow investigators to reexamine how the eider's sea ice winter habitat in the northern Bering Sea may have changed since its discovery in the mid 1990s. This could be critical as commercial fisheries expand northwards towards critical habitat for wintering spectacled eiders.

The Kittlitz's murrelet, the only ESA listing candidate in Alaska, remains one of the most enigmatic of seabirds. Most of the world's population of this species, and all of North America's, breeds, molts, and winters in Alaska. They are locally abundant during the summer, nest solitarily, and probably disperse offshore over the continental shelf in winter. In southcentral and southeast Alaska, populations are usually associated with tidewater glaciers. Kittlitz's murrelets probably number fewer than 20,000 in Alaska. Steep declines in their population have coincided with the recession of Alaska's tidewater glaciers in recent decades, but the exact nature of the relationship between birds and glaciers is unknown. This question is under investigation in the Kenai Fjords of southcentral Alaska by ASC biologists John Piatt and Yumi Arimitsu. Piatt is also collaborating with Vernon Byrd, Bill Pyle, and other FWS biologists to investigate the breeding biology of murrelets at Attu Island and Kodiak Island in southwestern Alaska.

A warming climate is causing rapid changes to Arctic ecosystems. Some plant and animal species will respond favorably to these changes, others will not. This poses unprecedented challenges to fish and wildlife managers. As these research vignettes indicate, wildlife research has an important role to play in wildlife conservation in a changing Arctic, and they highlight the continuing need for a strong partnership between the FWS and the USGS.

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by Michael Casazza,
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The California Clapper Rail and Multispecies Recovery Planning

The California clapper rail (*Rallus longirostris obsoletus*) lives in remnant tidal marshes of San Francisco Bay, where less than 20 percent of the historic tidal wetlands remain. Listed as an endangered species in 1970 by the Fish and Wildlife Service (FWS), this enigmatic bird faces a myriad of threats, including habitat loss due to urban encroachment, sea-level rise caused by climate change, alteration of native habitats by invasive plants, non-native predators, and exposure to mercury and other pollutants. The FWS is in the process of revising the existing recovery plan for California clapper rails and is including the rail in a multispecies recovery plan directed towards imperiled salt-marsh ecosystems. Sound scientific information is critical to the success of any recovery plan, but even more so when dealing with complex multiple-species interactions within an ecosystem.

USGS biologists place a small radio transmitter on an endangered California clapper rail to track its movements.

Sebastian Kennerknecht

Secretive and wary, rails are a challenge for biologists to observe and study. In 2007, U.S. Geological Survey (USGS) scientists worked with the support of the FWS, State Coastal Conservancy, and East Bay Regional Parks to initiate a project using radio-telemetry to examine aspects of the ecology of the California clapper rail in San Francisco Bay marshes. The initial study focused on home-range size, habitat requirements, survival rates, breeding success, and movement patterns. The birds were captured using a variety of techniques, including drop-door traps, flushing the birds into open water and plucking them from the bay with salmon nets, or simply capturing the birds by hand. The rails were then fitted with tiny backpack transmitters.

Radio-tracking was an essential tool to study these elusive birds as they travel through the dense vegetation and intricate tidal marsh channels, which criss-cross the marsh like a spider web.

Locations of rails could be monitored from over a kilometer away. The transmitters were equipped with sensors that indicated whether or not each bird was alive, enabling each bird's survival to be closely monitored. Rails were tracked daily across tide cycles, often multiple times each day, to better understand the relationship between habitat use and movements with respect to tides. Frequent monitoring also allowed scientists to identify predators, such as raptors, introduced red foxes (*Vulpes vulpes*), raccoons (*Procyon lotor*), and feral cats (*Felis catus*). Rail transmitters were recovered from unusual locations, including the nest of a northern harrier (*Circus cyaneus*), under several inches of soil (where it was presumably buried by a fox), and at a feeding station for a feral cat along the bay shoreline. The identification of major predators supported FWS recovery planning by providing solid evidence to guide predator-management strategies.

Another aspect of this ongoing study examines habitat relationships. Scientists use a highly accurate global positioning system to map tidal channels and model the habitat use of radio-marked rails in relation to the location, width, and depth of these channels. Home ranges are being calculated for each radio-marked bird during breeding, post-breeding, and wintering periods. Together with information about annual movement, this information will help managers understand how much habitat these birds need to survive as well as determine how population densities vary with different habitat structure.

The results from this research program are providing new, detailed information about the clapper rail, which can be applied to a multi-species recovery plan being established for the remaining tidal wetlands of the San Francisco Bay region. The data will be integrated with findings for other endangered tidal marsh species, such as the salt marsh harvest mouse (*Reithrodontomys raviventris*). Future recovery efforts may include potential reintroduction of rails to restored marshes, a goal that not long ago seemed highly unlikely. By increasing our knowledge of the movements and ecology of California clapper rails, we hope to provide the foundation for the continued protection and recovery of other tidal marsh species and their native habitats.

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A California clapper rail fitted with a backpack radio-transmitter and ready for release back to its tidal marsh home.

Sebastian Kennerknecht

by Paul C. Banko[1], Chris Farmer[2], Kevin W. Brinck[2], David L. Leonard, Jr.[3], and Jay Nelson[4]

Surveys Reveal Decline of the Palila

The endangered palila (*Loxioides bailleui*) is a flagship species of Hawaiian forest bird conservation. Due mainly to long-term ecological research by U.S. Geological Survey (USGS) biologists and many hundreds of volunteers from Hawai'i, the mainland, and around the world, more is known about palila than any other Hawaiian forest bird species. Palila exemplify the special vulnerability of many other Hawaiian birds to extinction. Thus, it is especially troubling that palila are declining despite receiving the longest sustained dedicated funding for research and management of any Hawaiian forest bird species.

A palila works to remove a māmane seed pod. The selected pod will be bitten off at the stem, after which the bird will move to a suitable perch where it will hold the pod against the branch with one foot and rip open the pod with its bill, exposing the seeds. The bird extracts each seed by removing the exposed seed coat and digging out the tender immature seeds with its bill.

Photo by Jack Jeffrey.

Over the past five years, palila have declined by over 50 percent, from an estimated 6,523 birds in 2003 to only 3,076 in 2008, according to multi-agency surveys. Additionally, the range of the palila has contracted during the past 20 years and is now less than 5 percent of its historic range. Palila numbers have been monitored annually since 1980, longer than any other Hawaiian bird species, and the 2008 population estimate has fallen to levels not seen since the early 1990s. Especially significant is that the 2008 palila survey represents the fifth consecutive year of declining numbers, whereas no previous decline exceeded two years.

Palila, like other extinct and endangered Hawaiian birds, have specialized feeding requirements, with unusual bill shapes and sizes and low reproductive capacity. Among the larger Hawaiian Islands, palila are the sole surviving species of an extraordinary guild of about 21 species of Hawaiian honeycreepers (an endemic subfamily of finches) that specialized on seeds or small fruits. Food specialization may have contributed to the vulnerability of bird species to introduced predators, diseases, competitors, and habitat stressors. Recovering from alien threats is especially difficult for specialists because they lay few eggs and they spend long periods incubating their eggs and caring for their young.

Historically, palila ranged from Mauna Kea to Hualālai and Mauna Loa volcanoes on Hawai'i Island, but they are becoming increasingly restricted to the western slope of Mauna Kea above 6,000 feet (1,830 meters) in elevation.

Their range contraction has followed the long-term destruction of māmane (*Sophora chrysophylla*) forests by cattle ranching and feral populations of other browsers. Māmane trees produce seed pods that are the primary food of palila, but introduced ungulates, particularly sheep, goats, and cattle, eat the leaves and young shoots of māmane. Browsing damages adult trees, and retards forest regeneration by removing seedlings and saplings. To protect māmane forests and the watersheds of Mauna Kea, territorial foresters removed nearly 47,000 sheep, 1,500 pigs, and 800 goats between 1937 and 1947. However, sheep populations quickly grew back to damaging levels, resulting in federal court orders to eradicate them and other browsers from palila critical habitat. This prompted another round of ungulate removal, which has been in progress for nearly three decades. Thinning populations of ungulates has allowed limited māmane regeneration to occur, but palila will not benefit until saplings have grown to the larger-sized trees that they prefer, which requires at least 30 years. Moreover, as long as māmane continues to be damaged or killed by browsing, the forest and the palila population cannot be expected to fully recover.

The 2006 U.S. Fish and Wildlife Service (USFWS) Revised Recovery Plan for Hawaiian Forest Birds discusses major threats that should be eliminated or minimized to protect palila and promote their recovery. Among the most serious dangers are the continued browsing of māmane by the non-native sheep within critical habitat, potential destruction of māmane forest by fire, degradation of habitat by invasive weeds and introduced plant diseases, predation by feral cats, and the spread of alien insect pests that reduce caterpillars, which are an important food of young palila. Notably, palila are not affected in their present high-elevation range by introduced bird diseases like malaria and pox, which are significant threats to native birds in lower elevation habitats. Disease may eventually affect the palila if global warming allows blood parasites and mosquitoes to move upslope. Another concern is that climate change could result in more frequent and severe droughts, which reduce māmane pod crops and reduce palila survival and reproduction.

With support from the Federal Highway Administration to compensate for impacts associated with rerouting a road through palila critical habitat, the USGS experimentally reestablished a small breeding population of palila in formerly-occupied habitat on northern Mauna Kea near Puʻu Mali. From 1996 to 2006, USGS biologists transported 188 wild palila from the core population on the western slope to Puʻu Mali. Additionally, the Zoological Society of San Diego has released 21 captive-reared palila near Puʻu Mali, with support from Hawaiʻi Division of Forestry and Wildlife (DOFAW), USFWS, and USGS. This small experimental population is not currently self-sustaining, but it has yielded valuable information for palila recovery. Other research for restoring and protecting palila and their habitat has led to recent management action, such as removing feral cats and planting māmane seedlings by DOFAW biologists on lands temporarily withdrawn from cattle ranching. USFWS is providing funds for fighting fires, reducing browsing threats, and fencing a portion of critical habitat, and USGS continues research to improve our understanding of how to restore and protect palila habitat.

Given that critical habitat designation, federal court orders, and concerted research have not prevented the recent decline of the palila population, more effective recovery methods are needed. Preventing yet another extinction in Hawaiʻi will require further vigorous, sustained efforts to reduce alien threats, restore habitat, and expand the range and population of the palila.|

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by Jim Knox

The Scientist Within Us All

Virtually all of us in the field of wildlife conservation owe our respective career paths to select adults who took time out of their busy lives to kindle our spark of interest in wildlife. If we reflect, we can remember their impact.

I was in third grade. Aware of my growing fascination with wild creatures, my sister's homeroom teacher, Mr. Muccio, encouraged me to tag along and attend a free flight raptor presentation "with the big kids" in the middle school's auditorium. I still remember two things with great clarity: the ease with which the Harris hawk banked over my head and the patience with which the presenter answered my question as she secured her birds for travel.

A young citizen scientist at work.

Chris Clark/Connecticut's Beardsley Zoo

It is this sharing – this spirit of encouragement and cooperative learning – that is the human link between our conservation efforts and our public's desire, and ability, to assist these efforts. This "shoulder to shoulder" approach to conservation, the lifeblood of citizen science, levels the field of play for the expert and the devoted novice alike. It establishes common goals for all and engenders the kind of teamwork that can surmount the most formidable barriers. Citizen science embodies the pledge and the partnership we extend to every person who passes through our gates.

For 10 years, Connecticut's Beardsley Zoo has been a proud participant in the Connecticut Amphibian Monitoring Project (C.A.M.P.). Conservation professionals and volunteers from ages 8 to 88 have slogged through wetlands season after season in a comprehensive, 15-year effort to document amphibian presence and diversity throughout Connecticut. Zoo staff and volunteers have joined forces with fellow professional/citizen teams representing conservation partners such as the Connecticut Department of Environmental Protection (DEP), Ansonia Nature and Recreation Center, and Yale University's Peabody Museum of Natural History.

The benefits to such citizen science are numerous: data acquisition; augmentation of knowledge; enhanced ability to implement sound conservation policy; strengthened ties among communities, conservation facilities, and agencies; improved public conservation literacy and advocacy…even scientific discovery.

In fact, C.A.M.P. citizen scientists, including students, scouts, and families, have verified an astounding 127 new town records representing 22 amphibian species throughout Connecticut, 12 species of salamanders and 10 species of frogs and toads. Under the expert eyes and mentoring of conservation professionals, hundreds of volunteers have compiled this revised and comprehensive statewide amphibian distribution record that had eluded the most accomplished individual herpetologists. Furthermore, thanks to these citizen scientists, full locality data for endangered, threatened, and special concern species have been submitted to Connecticut's Environmental and Geographical Information Center for inclusion in its Natural Diversity Database.

Citizen science is frequently a matter of perspective. When we walk through the door at the end of our day, we shed our roles as directors, curators, educators, and keepers to assume roles like dad, mom, neighbor or friend. Ultimately, however, we all assume the role of citizen. How many times have we been tapped to speak to a civic group or share some of our expertise with a local conservation or school group? In the supermarket, in the post office, or on the street, we pass our anonymous counterparts: countless individuals who possess invaluable experience, skills, and resources to offer conservation and education initiatives. In the absence of citizen science, this collective wellspring of talent, ability and energy remains largely untapped.

As all conservationists know, field conservation is ultimately, only as effective as the acceptance and participation of the local people. Why should "backyard" conservation be any different? From Bridgeport to Borneo, local people have always, and will always, make all the difference. It is this duality of science and citizenship, or "the human side of things," that transforms conservation from the abstract to the tangible for so many.

Chris Clark/Connecticut's Beardsley Zoo

Citizen science volunteers of all ages are the lifeblood of numerous amphibian conservation projects nationwide.

Gregory Watkins-Colwell, Museum Assistant in the Division of Vertebrate Zoology at Yale University's Peabody Museum of Natural History, provides the perspective of both scientist and father.

"I got involved with C.A.M.P. because appreciation of biodiversity begins in your own backyard. It is important to me that my children grow up knowing the sounds of spring peepers and the joy of finding a red elf in the woods. One doesn't have to go to Panama to find amphibians in peril."

Similar sentiments are echoed by other contributors. When she's not serving as the Registrar for Connecticut's Beardsley Zoo, Linda Tomas volunteers her time and organizational expertise as a C.A.M.P. Site Coordinator and Search Leader. For Linda, the benefits are all too tangible.

"I find this project to be several things to me: fun, enriching, a great learning experience, a great way to get children and their parents outside working as a team. I feel honored to be able to help with the research. Amphibians are an important indicator of the environment's health. I feel this project, with its hands-on approach, helps connect people with the environment around them. I look forward to the final results but I will definitely miss the early Saturday morning searches with the volunteers I have truly come to know and appreciate."

Citizen-based conservation efforts hold enormous potential to establish mutually beneficial partnerships, promote conservation literacy and advocacy, and produce discovery. Yet there is one more benefit, and it is no small matter. Every once in a great while, we achieve something wonderful and far-reaching. We return the favor we received so long ago when we share our love of wildlife to touch the life of a child.

Jim Knox is a Zoo Educator at Connecticut's Beardsley Zoo and hosts Wild Zoofari, a new PBS children's wildlife series filmed at the world's premiere zoos and aquariums.

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Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota, Utah, and Wyoming	Stephen Guertin, Regional Director	303-236-7920 http://www.fws.gov/mountain-prairie

ALASKA REGION—REGION SEVEN 1011 E. Tudor Rd., Anchorage, AK 99503

Alaska	Geoff Haskett, Regional Director	907-786-3542 http://www.fws.gov/alaska

CALIFORNIA/NEVADA—REGION EIGHT 2800 Cottage Way, Sacramento, CA 95825

California and Nevada	Renne Lohoefner, Regional Director	916-414-6464 http://www.fws.gov/cno

BOX SCORE

Listings and Recovery Plans as of February 23, 2009

GROUP	ENDANGERED U.S.	ENDANGERED FOREIGN	THREATENED U.S.	THREATENED FOREIGN	TOTAL LISTINGS	U.S. SPECIES W/ PLANS
MAMMALS	70	256	14	20	360	57
BIRDS	75	179	15	6	275	85
REPTILES	13	66	24	16	119	38
AMPHIBIANS	13	8	11	1	33	17
FISHES	74	11	65	1	151	102
SNAILS	24	1	11	0	36	30
CLAMS	62	2	8	0	72	70
CRUSTACEANS	19	0	3	0	22	18
INSECTS	47	4	10	0	61	40
ARACHNIDS	12	0	0	0	12	12
CORALS	0	0	2	0	2	0
ANIMAL SUBTOTAL	409	527	163	44	1,143	508
FLOWERING PLANTS	572	1	143	0	716	633
CONIFERS	2	0	1	2	5	3
FERNS AND OTHERS	26	0	2	0	28	28
PLANT SUBTOTAL	600	1	146	2	749	662
GRAND TOTAL	1,009	528	309	46	1,892*	1,133

TOTAL U.S. ENDANGERED: 1,009 (409 animals, 600 plants)
TOTAL U.S. THREATENED: 309 (163 animals, 146 plants)
TOTAL U.S. LISTED: 1,318 (572 animals**, 746 plants)

* Separate populations of a species listed both as Endangered and Threatened are tallied once, for the endangered population only. Those species are the argali, chimpanzee, leopard, Stellar sea-lion, gray wolf, piping plover, roseate tern, green sea turtle, saltwater crocodile, and olive ridley sea turtle. For the purposes of the Endangered Species Act, the term "species" can mean a species, subspecies, or distinct vertebrate population. Several entries also represent entire genera or even families.

** Eleven U.S. animal species and five foreign species have dual status.

ENDANGERED Species BULLETIN

U.S. Department of the Interior
Fish and Wildlife Service
Washington, D.C. 20240

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