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Cover: At Great Swamp NWR in New Jersey, Indiana bats roost during summer under loose tree bark. (See story on page 10.)
©Merlin D. Tuttle/Bat Conservation International

Opposite page: Sunrise at Okefenokee NWR in Georgia, a refuge for a variety of wildlife, including endangered species such as red-cockaded woodpeckers.

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.

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

Oases for Endangered Species

by Greg Siekaniec

*I*t's no exaggeration to say that the National Wildlife Refuge System, the country's premier land stewardship system, is vital to many endangered species. More than 280 of the country's 1,320 endangered or threatened species make these 550 oases of natural habitat their home. Fifty-nine of these refuges were created specifically to protect species at risk.

Refuges actively manage the environment for these and other creatures,

controlling water levels and salt content in sensitive estuaries, replanting native vegetation, clearing invasives, restoring wetlands, and staging controlled burns. But the contribution of national wildlife refuges to vulnerable plants and animals goes beyond habitat conservation.

Working in tandem with other government agencies and wildlife groups, refuge biologists study plant life cycles and animal nesting and foraging habits, monitoring vulnerable populations by

Endangered wood storks nest in the upper branches of trees at Harris Neck National Wildlife Refuge in Georgia.



John and Karen Hollingsworth

methods as low-tech as visual inspection and as high-tech as radio and satellite telemetry.

They take part in captive breeding programs, help guard against diseases, and go to great lengths (and depths, in the case of endangered Ohio River mussels) to aid in species recovery programs. Visitor services staff meanwhile incorporate the emerging science into outreach programs, educating the public about the creatures they are protecting and the need for conservation measures large and small.

Thanks in part to refuge-based efforts, 21 species (including, famously, the bald eagle and, less famously, Eggert's sunflower) have recovered enough to be removed from Endangered Species Act protection, and 17 others have been upgraded in status from endangered to threatened. New threats loom, however, from development pressure, climate change, and habitat fragmentation. And even in the absence of such threats, species recovery can be a long and tricky business, given some creatures' low birth rates and slow maturation cycles.

A collaborative effort of the Fish and Wildlife Service's National Wildlife Refuge System and the Endangered Species program, this special issue of the *Endangered Species Bulletin* looks at Refuge System activities on behalf of several endangered species, from Indiana bats to ocelots in Texas. The stories illustrate some of the formidable challenges involved in wildlife protection. They also show the dedication and zeal with which refuge staffers face those challenges – and the fascination they have with the creatures they are striving to help. See if you agree.

Greg Siekaniec is the Chief of the Service's National Wildlife Refuge System.

A Safe Harbor for Beach Wildlife

The Bon Secour National Wildlife Refuge on Alabama's Gulf Coast was established in 1980 to preserve more than five miles (eight kilometers) of intact coastal strand, one of the most imperiled and dynamic habitats in the country. These dynamic dunes provide habitat for the endangered Alabama beach mouse (*Peromyscus polionotus ammobates*) and three listed species of nesting sea turtles.

Bon Secour, translated from French as "safe harbor," also provides habitat for more than 370 species of birds. Many of these are migratory species that complete their arduous journey from South and Central America to North America to breed each year. Bon Secour is the first land these long-distance migrants encounter after flying across the Gulf of Mexico. The diverse habitats of the refuge, from coastal strand to pine flatwoods and mixed hardwoods, provide food, cover, shelter, and resting areas for these weary travelers.

Bon Secour hosts thousands of visitors each year. It provides excellent opportunities for nature study and environmental stewardship to everyone from elementary students to senior "snowbird" visitors. The refuge benefits from a growing network of volunteers and the support of an established Friends organization. Because one of the purposes of the refuge is to serve as a living laboratory, Bon Secour also hosts university groups, interns, graduate students, and scientists throughout the year. All are invited to take part.



George Gentry

Rare beach dune habitat supports the endangered Alabama beach mouse at Bon Secour National Wildlife Refuge.

Bringing a Butterfly Back From the Brink

by Susan Morse

As refuges go, it's not much to look at: a sandy patch of scrub land in urban central California, wedged between a row of industrial complexes and the San Joaquin River. But unassuming Antioch Dunes National Wildlife Refuge is the world's last holdout of a finicky species: the Lange's metalmark butterfly (*Apodemia mormo langei*).

Whether the species will survive is not yet clear. But human intervention may, at long last, be improving its odds.

Metalmark butterflies – fragile and brightly colored – are named for their grey, or metallic-tinged, wing tips. Unlike many other butterflies that can produce several generations of offspring each year, the Lange's metalmark breeds only once annually. For reasons that are not well understood, it sticks close to home. It's also a fussy customer. It will take nectar from various plant species, but for its host plant it prefers a single variety of buckwheat – naked stem buckwheat (*Eriogonum nudum* ssp. *auriculatum*) – found on the refuge.

Such habits have helped put the butterfly in a precarious spot.

Steady declines in the metalmark's numbers led to its federal listing in 1976, when it was one of the first insects to be protected under the Endangered Species Act. But the species seemed headed for extinction when, in 2006, the total population dropped to 158, down from 5,976 in 1997.

Even more alarming was the peak count – a key measure butterfly experts, or lepidopterists, use to assess and compare the reproductive health of a species from year to year. Once a week in August through September, they count the number of butterflies that emerge as adults from the chrysalis, the enclosure in which the caterpillar transforms into an adult butterfly. The number of butterflies counted builds weekly and then crests and falls, forming a bell curve. The peak count is the highest of the weekly emergence counts.

A Lange's metalmark butterfly perches on naked stem buckwheat, its preferred host plant.



Louis Terrazas/FWS

In 2006, the peak count was just 45. Fish and Wildlife Service staff decided there was no more time to lose.

Biologists to the Rescue

During the next year's breeding season, biologists captured nine egg-bearing females and placed them in two breeding facilities – one at Moorpark College, the other at University of California-Riverside. In August 2008 scientists released 30 adults, 25 larvae, and five pupae (cocoons) produced from that initial stock onto the refuge. It marked the first successful breed-and-release program for this species.

The next test will be the 2009 peak count. Even apart from the captive breeding effort, there's reason for hope. The 2007 peak count was 89, and it grew to 132 in 2008.

Why the fuss over one species most of us will never see? The metalmark's predicament is "a snapshot of the health of a particular habitat or community," says refuge wildlife biologist Susan Euing. The loss of such a key pollinator species could set off a chain reaction leading to the decline of other species within that community. "Pollinators like butterflies, bees, bats, and birds are incredibly important for any given habitat to succeed," she adds.

So, while the refuge awaits this year's peak butterfly count, refuge biologists are working on another front, trying to give the butterfly's host plant, the naked-stem buckwheat, more of a fighting chance against invasive vetch species and other enemies.

"We've got a lot of invasive species, but vetch is the biggest problem because it totally smothers buckwheat," says refuge wildlife specialist Louis Terrazas. "It also endangers our other two endangered plants," the Contra Costa wallflower (*Erysimum capitatum* var. *angustatum*) and Antioch Dunes evening primrose (*Oenothera deltoides* ssp. *howellii*).

Working with the California Conservation Corps, high school students, and volunteers, refuge staff pull vetch plants, and then cut them with

weed trimmers. "It's really labor intensive," says Terrazas. "Plus, it's difficult because you have the two endangered plants plus buckwheat out there, which could have butterflies on it. So you've got to be careful where you step, where you set equipment, be careful not to pull the wrong thing." Using herbicides would be problematic. "If we spray, there might be drift that kills endangered plants or butterflies," says Terrazas. "It's a predicament."

Wanted: More Sand

This past fall and winter, staff and volunteers trimmed non-native grasses and planted more than 6,000 buckwheat seedlings. It's all part of an effort to restore a dune ecology more hospitable to buckwheat.

The challenges are formidable, says Euing. "Most of the sand has been mined away to make brick since 1850s," she says. "We're down to hardpan," which favors invasives. Native plants prefer big wind-blown dunes that move and are easily disturbed.

In a land-clearing experiment with the University of California-Davis, the refuge last year set aside two five-acre (two-hectare) plots for grazing by 14

head of cattle. "There are lots of native seeds out there," says Euing. "They just have trouble competing with grasses and invasives. So if we could take off the top layer of invasives by grazing, it may allow native plants to come up on their own."

The refuge has also had some success managing for fire. Wildfires over the last decade have destroyed acres of butterfly habitat, but there's been no fire on the refuge for almost three years.

The metalmark's future is uncertain, but Terrazas prefers to look on the bright side. "The population has come back up – not in a spectacular fashion, but it's come back up a little bit in the last two years," he says. "It's going in the right direction. So we can take a little credit."

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Jana Johnson and her son Max join the Urban Wildlands Group staff in releasing 30 gravid female Lange's metalmark butterfly adults last August at Antioch Dunes National Wildlife Refuge.



Louis Terrazas/FWS

Ocelots and the Heritage of Texas

by Karen Leggett

“If we lose the ocelot in Texas, we lose a major part of our heritage. We lose one of our own,” says Sonia Najera, program manager with The Nature Conservancy (TNC) and an active member of the Friends of Laguna Atascosa National Wildlife Refuge. These smaller cousins of leopards once ranged from South America northward as far as Louisiana and Arkansas. Now, only two small and isolated breeding populations are known to remain in the U.S., both in southernmost Texas.

Ocelots (*Leopardus pardalis*) in Texas thrive in dense thornscrub habitats, but in the 1930s, large-scale brush clearing made way for cropland, and the cats were gradually restricted to smaller and smaller parcels of land. They now make do on a handful of private lands and a portion of the Laguna Atascosa Refuge, which hosts the only known U.S. breeding population on public land. The other known Texas breeding population occurs on private land in Willacy County. Recent monitoring data suggest each population may include as few as two to six adult females.

There was great excitement in December 2008, when a trip camera snapped an image of an ocelot with her kitten at Laguna Atascosa. It was the first ocelot kitten documented on the refuge since 1997. This kitten and the adult male and female in the same territory are all being monitored now. “We know other kittens have been born on the refuge since the late ‘90s,” says refuge biologist Jody Mays, “but this is the first time a female ocelot and her young have been



Ocelot kittens provide hope that the species may survive in Texas.

photographed together.” In April 2009, another ocelot kitten was photographed with a trip camera in Willacy County. This evidence of ongoing reproduction in both populations gives biologists hope that ocelots in the U.S. can still be saved from extinction.

Ocelots in Texas are threatened by habitat loss and fragmentation, vehicle accidents, and inbreeding. To find enough habitat and resources to survive and reproduce, ocelots are forced to traverse a growing gauntlet of obstacles. Small fragments of habitat are criss-crossed with roads, cleared areas, housing developments, and fences. Collision with vehicles is the leading documented cause of ocelot deaths in Texas.

Because ocelots in the U.S. survive on small pockets of land, inbreeding

has led to a loss of genetic diversity. Genetic evidence indicates that the last known breeding populations in Texas have become isolated from each other and from ocelot populations in Mexico. These conditions leave ocelots in the U.S. vulnerable to disease, genetic defects, and extinction from catastrophic events like hurricanes or climate change. One option being considered to address this problem is translocation, which could add new ocelots to existing populations.

For the first time in nearly two decades, the Ocelot Recovery Team is revising the 1990 recovery plan. New research on habitat connectivity, genetic health, mortality, and patterns of activity and reproduction will permit updated, data-driven recommendations.

Partners Promote Recovery

The Friends of Laguna Atascosa National Wildlife Refuge have been active partners in ocelot conservation. Up to 4,000 people attend the annual Ocelot Conservation Festival in Harlingen, Texas. In 2009, the Friends group also hosted the first Landowner Appreciation Dinner, complete with a private showing of a live ocelot from the Cincinnati Zoo. The Friends' "Adopt an Ocelot" program has generated more than \$30,000 for conservation projects since 1997. This program provides supplemental fresh water for ocelots and other wildlife during droughts, stipends for ocelot research interns, and money for research equipment (such as the trip camera that photographed the new ocelot kitten at Laguna Atascosa).

The Service is working with the Texas Department of Transportation to install wildlife crossings under roads to allow ocelots and other wildlife to cross safely. One wildlife crossing is nearly complete. Eleven more are proposed for the road that crosses the main Laguna Atascosa Refuge unit.

The Service's South Texas Refuge Complex is also working with partners such as TNC and the Environmental Defense Fund (EDF) to protect and restore native brush habitat and to create habitat corridors that connect existing populations and protected areas. Native brush habitats are difficult to restore and may take 20 to 40 years to become suitable for ocelots. The Lower Rio Grande Valley National Wildlife Refuge and TNC have established their own native plant nurseries that grow up to 45 species and more than 150,000 seedlings per year. These plants will be used to help restore the thick Tamaulipan thornscrub that was once prevalent in South Texas and provided the most desirable habitat for ocelots and other wildlife.

The South Texas Refuges Complex also partners with Mexican agencies such as the Comisión Nacional de Áreas Naturales Protegidas to create and protect habitat corridors for ocelots and other wildlife to travel between the

refuges in Texas and protected areas in Mexico.

Private landowners are also vital conservation partners. EDF and the U.S. Department of Agriculture's Conservation Reserve Program are helping to implement SAFE (State Acres for Wildlife Enhancement), a new program that rents cropland from landowners for up to 15 years and pays up to 90 percent of the cost of restoring thornscrub habitat on that land. EDF, which provides technical assistance to the landowners during the restoration process, expects to enroll the first landowner in the SAFE program this year.

"It's a slow process," says EDF wildlife expert Karen Chapman, "but every little bit of restored habitat helps. Five hundred acres of high quality habitat could support a pair of breeding ocelots," adding that the great collaboration among conservation groups, landowners, and government agencies may be the key to ocelot recovery in Texas.

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Another endangered species that benefits from the south Texas refuges is the northern aplomado falcon.



© Glenn Mills/Texas Parks and Wildlife

New Disease Threatens Bat Conservation

by Susan Morse

When it comes to Northeastern bats, there are many things researchers still don't know, including, most critically, what causes the fungus that scientists suspect is killing these creatures and how to stop it.

And then there are the things the rest of us think we know:

Bats are blinder than your Aunt Nellie.

Bats often have rabies.

Bats are pests.

Wrong.

Wrong.

And dead wrong.

Bats actually have excellent vision. At night, they supplement it with a kind of sonar. Sounds they emit, inaudible to the human ear, bounce off objects and help them find their prey.

The incidence of rabies in bats is small; an estimated one-half of one percent – or one bat out of 200 – has rabies. The great majority (70 percent) of bats feed on insects; most of the rest eat fruit and pollen.

Far from being pests, these under-appreciated creatures promote human health and comfort by pollinating fruits and flowers, and providing a potent natural control for mosquitoes and other night-flying insects. Some 80 medicines we use come from plants that need bats to survive.

But bats need help. The endangered Indiana bat (*Myotis sodalis*) is a case in point. Despite its Hoosier handle, the bat is found throughout the Ohio River Valley and as far east as Vermont. Increasingly, though, it's being found sick or dead. Earlier this year, concerned that disturbance of hibernacula – bat hibernation areas – was making bats sick, the Fish and Wildlife Service closed caves in 17 states to the public. But bats have continued to decline. And now, a deadly disease known as white-nose syndrome has spread beyond the Northeast into Virginia and West Virginia.

Changing Habits in New Jersey

On the Great Swamp National Wildlife Refuge near Morristown, New Jersey – just 25 miles from Manhattan's Times

An Indian bat submits to measurement and inspection by a gloved researcher.



Marilyn E. Kitchell/USFWS

Square – biologists and volunteers are racing to study the ecology of some recently discovered Indiana bat colonies before disease wipes them out.

Leading the effort is Great Swamp park ranger Marilyn Kitchell, who devoted her master's thesis to the roosting habits of Indiana bats after scientists confirmed the species was on the refuge in summer 2005. The refuge's 7,700 forested, stream-crossed acres (3,335 hectares) seemed like suitable habitat. But the bat's presence was unproven until deputy refuge manager Sharon Marino scraped together the funding to conduct a four-night search.

How could the creatures have eluded previous notice? Easily. They're tiny; each weighs just one-quarter of an ounce (seven grams) and span maybe seven inches (17 centimeters) with wings spread. They're also nocturnal. And even trained researchers have a hard time distinguishing them from another species, the little brown bat (*Myotis lucifugus*).

You also have to know when and where to look. The Indiana bats that inhabit Great Swamp are summer residents only; in the winter, they hibernate in mines and caves outside the refuge. In summer, females roost in tightly packed colonies under the peeling bark of dead and dying trees or healthy trees like the shagbark hickory (*Carya ovata*).

For refuge staff, the awareness of the bats' presence has meant rethinking conservation activities. The effect on nesting songbirds is no longer the only consideration when it comes to habitat management on the refuge.

"For instance," says Kitchell, "if we need to take down trees, now we think: 'What time of year is that happening and will it have any impact on the Indiana bats?'" Ditto for plans to tear down an old barn. "Now we're not going to take the barn down in the summertime because the bats are using it," Kitchell says.

The refuge is just beginning its work on a Comprehensive Conservation Plan that will help set priorities and guide



Marilyn Kitchell holds a bat caught in a mist net used for study purposes at Great Swamp National Wildlife Refuge.

conservation efforts over the next 10 to 15 years.

Volunteer nature interpreter Judy Schmidt has incorporated the Indiana bat in her talks to refuge visitors. "I ask them if they know that bats are mammals," she says. "And then I ask them, 'How many night-flying insects do you think one bat would eat in one night?'" The answer she's after: about 500. "And then I say, 'That mosquito the bat eats isn't there to bite you, and that's why they're so important.' They love it."

What does it take to study Indiana bats? Stamina – and lots of help.

Tagging is a key step. Researchers put up tall, fine-mesh nets called mist nets across streams and trails. They open the nets between 9 p.m. and 2 a.m. and check them every 5 to 10 minutes. When they find a bat, they carefully pick it out and weigh it. Then they determine its species, maturity, sex, and reproductive status, and band it. If it's a repro-

ductively active female, they also attach a radio transmitter so it can lead researchers to daytime roost trees and to streams over which bats forage at night.

But where to put the nets? That's where help comes in. Volunteers, many of them members of the nonprofit Friends of Great Swamp, conduct echo-location surveys, using a device to detect and record the number of bats calls emitted in 15-minute intervals. Researchers use the results to tell if a site is good to net. Volunteers also conduct "emergence counts," sitting beneath a roost tree at night and counting every bat that comes out – the only way to estimate a summer bat population.

The refuge's Friends are critical to data collection, says Kitchell.

The work, she says, is "very labor intensive. It's also very, very rewarding." Bats, she says, "are such amazing creatures. The public just doesn't understand

how neat they are and how important a role they play in the ecosystem.”

White-nose Syndrome

Lately, Kitchell is helping state biologists study how white nose syndrome is affecting New Jersey bats hibernating off the refuge in abandoned mines. The work isn't encouraging. "Mortality is upwards of 90 percent in an affected site," she says.

Worse, she says: "We know our bats are now affected. We found a dead bat in the mine with one of our bands on it. We put the band on in July."

Scientists have confirmed the presence of a fungus, *Geomyces* sp., in the bats, but don't know for sure if the fungus is what's making them sick, or, if so, how it's transmitted. Affected bats cluster abnormally, fly around when they're supposed to be in a deep torpor, lose adipose (fat) tissue, and basically starve to death before they emerge from hibernation, she says. Their muzzles are covered with a growth of white fungus.

This year will be the first season in which the refuge will be able to see the effects on the summer Indiana bat population. "We don't know what we're going to find," Kitchell says.

"We all want to know how to treat it, how to stop it," she continues. "I just don't think an answer is that close, unfortunately. The disease is moving, spreading. If we don't figure out something soon, we're going to be looking at very significant losses, including potentially the loss of some species. It's just a terrible thing. It's huge."



(above): Little brown bats in a New York cave exhibit signs of white-nose syndrome.

(below): A researcher removes a bat from a mist net used to facilitate bat study.



Nancy Heaslip/New York Department of Environmental Conservation

Marilyn E. Kitchell/USFWS

Biologists Track Sea Otter Decline

by Kendall Slee

The ironically named Near Islands at the western point of Alaska's Aleutian archipelago are some of the most remote lands in the far-flung Alaska Maritime National Wildlife Refuge. They are far from any commercial airstrip or seaport, and more than 1,500 miles (about 2,415 kilometers) from Homer, where the refuge headquarters and visitors center are based.

For the U.S. Fish and Wildlife Service's Alaska Marine Mammals Management Office in Anchorage, monitoring sea otters (*Enhydra lutris*) and other marine mammals around the Near Islands and other Aleutian Islands might not be possible without support from the Alaska Maritime Refuge's research vessel, the M/V *Tiglox* (pronounced (TEKH-lah — the Unangan or Aleut word for eagle).

A mother sea otter and her pup are caught in a live trap set by USFWS biologists examining otters in the Aleutian Islands.



USFWS

“The *Tiglax* is really the lifeline out there. If you want to get to the islands in the Aleutian chain, there’s no other way to get all the way out there,” says Douglas Burn, supervisory wildlife biologist for the Marine Mammals Management Office. The Service’s wildlife biologists use the *Tiglax* as a base from which to survey and examine live sea otters around the Near Islands and another island group in the central Aleutians. After counting sea otters for eight to 12 hours in a small skiff, the biologists return to the *Tiglax* every evening to dine, sleep, and prepare for the next day of surveys.

The *Tiglax*, commissioned in 1987, spends May through October voyaging the waters along the vast Alaska Maritime Refuge, which is composed of more than 2,500 islands, spires, rocks, and coastal headlands spanning thousands of miles and four time zones. The vessel typically covers about 10,000 miles (16,090 km) each year. This year, the

Tiglax will support field camps for bird research on seven remote locations, invasive species removal on some islands, and other research by international teams of biologists, entomologists, volcanologists, geologists, and archeologists from a variety of government agencies and universities.

“The *Tiglax* supports the refuge’s objective of managing trust resources and serving as a forum for international research,” says wildlife biologist Jeff Williams, who is responsible for reviewing research proposals and scheduling space on the 22-passenger vessel. The Marine Mammals Management Office’s research is a natural fit since sea otters are one of the refuge’s threatened species, he notes.

Maritime Mystery

Sea otters, the world’s smallest marine mammals, live in shallow coastal waters, mostly feeding on bottom-dwelling invertebrates such as crabs, octopi, and urchins. They spend most of their lives in the water, where they mate, bear their young, feed, and socialize. They



Former USFWS employee Angela Doroff and USGS veterinarian Dan Mulcahy release a sea otter from the *Tiglax* after a live examination.

are known to wrap themselves in kelp as an anchor while resting. Sea otters float together in groups of anywhere from a few to 100.

There are three recognized subspecies. The Russian northern sea otter (*Enhydra lutris lutris*) ranges from the Kuril Islands to the Commander Islands in the western Pacific Ocean. The southern sea otter (*Enhydra lutris*

neris) is found off the coast of Central California. The largest group – and the focus of the widest conservation efforts – is the northern sea otter (*Enhydra lutris kenyoni*), native to Alaska and the Pacific west coast from the Aleutian islands to northern Oregon. The estimated 73,000 members of this group now make up 90 percent of the world’s sea otters.



The M/V *Tiglax*, Alaska Maritime National Wildlife Refuge's research vessel, near its home port of Homer, Alaska.

Behind that statistic is a bloody history. The head count represents a comeback from the early 1900s, after fur hunters had driven all three subspecies almost to extinction. The world sea otter population, once estimated at 300,000, fell below 2,000, scattered in tiny remnant groups. Survivors inhabited only a fraction of their historical range.

With the end of commercial hunting, sea otters began to recover, recolonizing some of their former territory. But land development and pollution, particularly in the form of oil spills, have exacted a toll. The 1989 Exxon Valdez spill of 11 million gallons of crude oil into Prince William Sound, for example, killed more than 3,900 sea otters.

In recent years, the population of northern sea otters has once again shown a steep pattern of decline. In 2005, these sea otters were listed federally as threatened under the Endangered Species Act. They join the southern sea otter, which was already listed as a threatened species.

Worrisome Trend

In 1992, Service biologists conducted the first population survey of northern sea otters in Alaska in 27 years. This air survey showed that the animals had

recolonized all of the Aleutian Islands, but in the core areas where they had been abundant in 1965, their numbers had dropped by about half. The worrisome declines continued in surveys through 2004.

At first, scientists viewed the Service findings with skepticism. "To many people, it seemed that there was no way sea otters in such a remote, pristine environment could have suffered such a population decline," said Burn. But skepticism gave way to alarm as surveys by other scientists confirmed the Service findings.

It is not clear why the sea otter population in southwestern Alaska is plummeting. Their food supply appears ample, and scientists who have examined the animals have found no signs of unusual disease. One hypothesis by James Estes, a marine ecologist at the University of California at Santa Cruz, is that killer whales are preying more on sea otters because their traditional quarry of Steller sea lions and harbor seals is scarcer.

A Cooperative Effort

To track disease and toxins and perhaps solve the mystery, Marine Mammals Management biologists have examined

the carcasses of more than 100 sea otters each year since 2002. The specimens help the scientists establish a health baseline that may prove useful if the species' decline spreads beyond southwestern Alaska. Alaska Maritime Refuge staff and an intern collect more than 60 of the carcasses from the beaches of Kachemak Bay in south-central Alaska.

Alaska Maritime Refuge wildlife biologist Leslie Slater and biological technician Arthur Kettle have spent many hours collecting and shipping otter carcasses to Marine Mammals Management. They race the clock and tides, even on weekends, because fresh carcasses have the most research value. "They are really unsung heroes," say Marine Mammals Management office biologist Verena Gill, who manages the study of sea otter disease.

Together, the efforts aim at gaining a better understanding of the threats to recovery for sea otters in southwestern Alaska. The Service has convened a team of experts to help develop a recovery plan by late 2009. "Alaska Maritime Refuge and the *Tiglax* will have a key role in implementing that recovery plan," Burn predicts.

Kendell Slee is a free-lance writer with long experience in conservation reporting.

Mississippi's Sandhill Cranes

by Susan Morse

At the Mississippi Sandhill Crane National Wildlife Refuge, there's no mistaking the subspecies to which the refuge owes its existence. The graceful long-legged grey birds (*Grus canadensis pulla*) that pioneering wildlife biologist Aldo Leopold famously described as "nobility in the midst of mediocrity" leap

and bow and dance and pose, showing off their six-foot (1.8 meter) wingspans.

Thanks to staff efforts, sandhill cranes on the 19,000-acre (7,690-hectare) Gulf Coast refuge now number more than 100, up from a low of 35 to 40 in the 1970s. The refuge and adjacent lands are the last places on earth where you

can see this endangered subspecies in the wild. Once scattered along the Gulf coastal plain from southern Louisiana east into Mississippi and Alabama, the stately four-foot- (1.2 m-) tall birds almost became extinct after fire suppression changed their habitat.

Stately Mississippi sandhill cranes are recovering slowly from near extinction, thanks to careful monitoring and captive breeding.



USFWS

But since 1975, when it became the first national wildlife refuge created under the authority of the Endangered Species Act, the Mississippi Sandhill Crane Refuge has labored to restore the bird.

Tactics have included supplementing the wild flock with captive-bred chicks, monitoring the birds with radio transmitters, and using controlled fires and tree removal to clear and maintain the wet pine savannah habitat the Mississippi sandhill crane needs. Biologists have also made progress on a more dramatic front: artificial insemination. The technique permits the preservation of underrepresented genetic bloodlines, which is important in a crane population this small.

Last year, “Cryochick I” was released on the refuge after being conceived in 2007 from frozen sperm at the Audubon Institute’s Species Survival Center. He lived for 18 months before succumbing to predators. A chick’s first year in the wild is its toughest, and chicks hatched in captivity have a higher mortality rate (30 percent) than wild-raised chicks (about 20 percent) – a comparative disadvantage that biologists are hoping to improve.

A second chick conceived by artificial insemination was found to have a heart murmur and was never released. Scientists have decided against further such experiments for now to avoid depleting banked stores of sandhill crane semen. But having the option is encouraging.

“What was once theoretical is now very practical,” says Mississippi Sandhill Crane supervisory wildlife biologist Scott Hereford.

Fragile Success

Meanwhile, the sandhill crane’s fragile success story remains dependent on continued human intervention. To see why, look at the 2008 nesting stats.

“We had 33 nests, 25 pairs” of birds, for the spring-summer nesting season, reports Hereford. That’s up from a low of just five or six breeding pairs in the 1970s. Cranes typically lay one or two

eggs, but rarely does more than one chick survive. How many hatchlings lived long enough to fly in the fall of 2008 – the step that biologists say marks recruitment into the adult bird population?

The answer is three, says Hereford. The rest fell prey to coyotes, bobcats, foxes, hawks, and other predators. “That’s the sad part,” he says. “There’s very little natural recruitment. That’s probably our biggest challenge: how to increase chick survival.”

One way the refuge staff is promoting recruitment is by continuing its work toward restoring savannah habitats through controlled burns and mechanical clearing. The idea is to open up the area “so the birds are able to see the predators and fly to safety, if necessary,” says Hereford. “We try to burn October to May, weather-permitting.”

That means humidity must be in a narrow range – low enough so a fire will burn but not so low that it can’t be managed safely. Likewise, wind speed and direction must be ideal. Gusts are a problem, but there must be enough wind from the right direction to propel the fire and move smoke up and away from Interstate 10 and other roads, as well as adjacent communities.

The more crowded and urbanized the surrounding area becomes, the harder it is to meet conditions for prescribed burns.

Refuge staff treated more than 6,000 acres (2,430 ha) with prescribed burns in 2008. Staff also hired workers to mechanically clear thousands of acres of shrubs and trees, primarily slash pine, from refuge lands.

Refuge employees have also created roost ponds and built water control structures to increase nesting habitat during spring. Development in areas surrounding the refuge has altered water flow and disturbed historic crane roosts. Cranes generally prefer to roost in open water, which separates them from many land-based predators. Cranes typically will not nest during a drought or will give up nesting prematurely.

Assisted Reproduction

Even before the refuge was created, researchers had begun efforts to save the cranes. In 1965, they started a captive breeding program by occasionally removing “surplus” crane eggs – the second viable egg from a two-egg nest – and hatching and rearing the chicks, first at the Patuxent Wildlife Research Refuge in Maryland and later at the Audubon Species Survival Center in Louisiana and the White Oak Conservation Center in Florida. Every year since 1981, experts have released captive-raised birds on Mississippi Sandhill Crane Refuge in the world’s largest crane release program. Nineteen juveniles were released last winter.

Before release, captive-reared birds are fitted with leg bands and radio transmitters. They are also furnished with temporary wing restraints meant to keep them earth-bound during a one-month acclimation period. During this time, which is needed for them to develop what biologists call “site fidelity” (recognition of a habitat as home), they are placed in one of several uncovered pens. The pens protect them from predators while allowing older cranes to drop by and check out the newest members of the flock.

Once the wing restraints are removed, the captive-reared birds are free to join the older birds in flight. Refuge biologists monitor the cranes year-round to better understand their movements, nesting habits, responses to refuge management efforts, and causes of death.

Will that be enough to ensure the subspecies’ survival? Time will tell.

The Life of a Piping Plover

by Len Deibert

“**T**hey are like cotton balls on toothpicks...little puffs of foam.”

For wildlife biologist Connie Mueller, piping plovers (*Charadrius melodus*) are “amazing little birds, lovable to look at.”

But the tiny shorebirds are in constant peril. Only an estimated 6,000 nest in the United States, mainly in the Great Plains and along Atlantic Coast beaches. Mueller and her colleagues at the Lostwood National Wildlife Refuge in North Dakota are creating what she calls “a fabulous success story” in restoring its piping plover population.

In the alkali lakes area (which includes five national wildlife refuges from northeast Montana to central North Dakota), the piping plover population has nearly doubled in the last five years, according

to Mueller. The plover population grew from 236 pairs in 2003 to 427 pairs in 2008.

Life is tough for the small but tenacious birds. Mueller has seen them endure weather ranging from snow and hail to 90-degree temperatures on a sun-baked beach. The birds make their nests, or scrapes, on sparsely vegetated or gravel beaches adjacent to alkali wetlands. Their eggs face attacks from natural enemies, including foxes, skunks, and raccoons, as well as winged predators such as red-tailed hawks, gulls, and crows.

Even a human footprint can be a death trap for the fragile young birds after hatching, says Mueller. In addition, the small speckled eggs blend in with the sand and often are stepped on by people who do not see them.

The birds nearly disappeared in the 19th century because of hunting for the millinery trade. Today, the piping plover is more often heard than seen. Its piping is a soft, whistling peep-peep or peep-lo. Plovers are smaller than a robin, yet they navigate and fly thousands of miles when migrating from the United States and Canada to the Gulf Coast or Mexico.

The birds were federally listed in 1986. The Northern Great Plains and Atlantic Coast populations are classified as threatened, and the Great Lakes population is endangered.

Along the Atlantic Coast, important habitat for the plovers is disappearing because of commercial and residential development and recreation on the shoreline. There, people are the biggest threat.

Natural and human-caused hazards often abound for piping plovers.



Gene Nieminen



USFWS

Refuge biologists and seasonal technicians place protective wire cages around piping plover nests.

A Different Story at Lostwood

The story is dramatically different in the northern Great Plains, as experienced by Mueller and the team at Lostwood National Wildlife Refuge in North Dakota. There, Mueller says, people are the bird's greatest protector.

The 26,904-acre (10,880-hectare) Lostwood Refuge has been designated by the American Bird Conservancy as "a globally important bird area" that provides breeding habitat for piping plovers. The habitat at Lostwood includes alkali wetlands and surrounding shoreline, river channels and associated sandbars, and islands--- habitat for courtship, nesting, foraging, sheltering, and brood-rearing.

The refuge is a land of rolling hills with short grass and mixed grass prairies with numerous potholes, or small wetlands. The goal is to preserve the prairie ecosystem to the approximate conditions found in the early 1900s.

At Lostwood Refuge, the staff "has developed a strong attachment to the birds," fostering a commitment to see the plovers survive and flourish, Mueller says. The goal is to create "nearly problem-free hatching." As part of their

duties, five employees and 12 seasonal hires (highly-trained wildlife biology technicians) comb the land each spring. They identify plover pairs and then locate, mark, monitor, and protect the nests. Each pair lays four eggs, one egg every other day until the clutch is complete during the May-June nesting season.

To prevent attacks from predators, wire-mesh cages are placed around the nests. Netting is used to cover the top of the cages to prevent raptors and other birds from attacking the nesting area. In the vast alkali core from northeast Montana to central North Dakota, some 400 to 500 cages are used as barriers around nests. On the refuge itself, about 100 cages protect nests.

Conservation efforts "are growing the pool," according to Mueller. She says environmental conditions at Lostwood Refuge are attracting plover offspring to return to their original habitat.

The veteran wildlife biologist says, "The Nature Conservancy has been a wonderful partner with the refuge by buying land for prime nesting areas and providing funds to hire two seasonal employees." (More than 50 protected

nests are on land owned by The Nature Conservancy.)

Mueller also emphasizes, "We couldn't do it without private landowners." About 60 percent of the plovers around Lostwood Refuge nest on the land of more than 100 cooperating owners.

"The birds are living in their (landowners') backyard.... Out of the goodness of their hearts, with no restrictions, no remuneration, without recognition... they allow us uninterrupted access to their land to cage and monitor the birds... One of the most dominant aspects of the refuge program is our neighbors!"

Len Deibert is a veteran journalist and freelance writer in Washington, D.C.

Bringing Life to a Poisoned River

by Susan Morse

Convincing people of the need to protect endangered mammals – polar bears, ocelots, sea lions, to name a few – usually isn't a hard sell. Even butterflies make claims on public sympathies, thanks to vivid colors or habits seen as endearing.

But a bivalve? A lowly two-shelled mollusk?

Skeptics tend to become believers at the Ohio River Islands National Wildlife Refuge, a string of islands stretching nearly 400 miles (about 645 kilometers) along the upper Ohio. There, scientists, refuge staff, and volunteers are making extraordinary efforts to save two endangered freshwater mussel species: the fanshell (*Cyprogenia stegaria*) and pink

mucket (*Lamprolaima abrupta*). A federal mandate is not the only motivation. There's also the knowledge that the mollusks in question are vital to public health in West Virginia and eight neighboring states, even if many people don't realize it.

"Mussels are the river's natural filtering system," explains Ohio River Islands Refuge biologist Patricia Morrison. They help to remove silt and particles from cloudy pools and return clear water to the river. Morrison says the river is noticeably more turbid without mussels.

Along the Ohio River, native bivalves have taken a double whammy. The pink mucket and the fanshell were already listed as endangered species when, in the mid-1990s, invasive zebra mussels (*Dreissena polymorpha*) from Europe slipped into the waterway and outcompeted native mussels for food. Then, in 1999, an industrial discharge wiped out all mussels along a five-mile (eight-km) stretch of river. Fanshells, pink muckets, and 24 other native mussel species succumbed.

A lawsuit filed by the federal departments of Justice and Interior, along with the Environmental Protection Agency and the states of Ohio and West Virginia, charged a metal plating company with violations of the Clean Water Act. The suit was settled in 2007. One outcome was a \$2.04 million award to restore the river's decimated mussel, fish, and snail populations. The refuge's partners in the project include three fish hatcheries (two of them federal facilities), the West Virginia and Ohio departments of natural

Biologists at the Ohio River Islands NWR conduct research on endangered mussels.



USFWS

resources, and the Fish and Wildlife Service's West Virginia field office. Kentucky will join the project later.

Last year – the project's first – saw two main goals met:

1) the reintroduction of common (non-endangered) mussels to the chemical spill area to prove the area is safe for endangered mussels. (Some 6,000 common adult mussels have made the move; later this year, biologists plan to add juveniles.)

2) the beginning of regular, long-term monitoring of the health of the recovering mussel beds.

Both operations are trickier than they sound due to the peculiarities of the mussel life cycle and the depth of the river. And then there's the fussing with crazy glue. (More on that in a minute.)

Holding Out for the Right Ride

To survive and reproduce, mussels need more than a nontoxic freshwater supply. They need fish – drum, bass, catfish, and other species. For many mussel species, the babies don't hang around home; the larvae hitch rides on fish for weeks or months, drawing nutrition from the fish tissue until growing large enough to drop off in a new location. So the West Virginia and Ohio Departments of Natural Resources have had to make sure adequate fish stock is available. And not just any fish stock. One reason the pink mucket and fanshells are rare is that they're particular about their host fish. The fanshell, for example, prefers darters and sculpins, while the pink mucket uses bass and walleye.

Federal fish hatcheries in White Sulphur Springs, West Virginia, and Genoa, Wisconsin, and a third facility tied to the Columbus Zoo and Ohio State University, propagate the mussels, infest selected fish with mussel larvae, and grow the mussels to a stockable size.

One positive sign: river monitoring has shown some juvenile common mussels in the spill area. "That area experienced 95 to 100 percent mortality," says Morrison. "So any juveniles that turn up there are coming from somewhere else" in the river.

Replacing and monitoring 6,000 mussels in the riverbed is also challenging when the average river depth is 20 to 25 feet (6 to 7.6 meters). That calls for boats and scuba divers. Morrison herself made 80 dives last year. Volunteers, including two retired chemical engineers, play a critical role, captaining the boats, filling the scuba tanks, and helping divers in and out of the water. "If it weren't for them, I don't know how we'd manage our aquatic program," says Morrison.

The standard way to monitor an individual mussel and see how it fares from year to year is to tag it. How? In this case, apply a small drop of crazy glue, then stick on a plastic tag. "Within 15 seconds, you can put them right back in the water," says Morrison. "That way, when we come back to our monitoring, we can say, 'That's a juvenile we put in in 2009.'"

By 2010, biologists are hoping to bring in adult pink muckets and fanshell mussels from Kentucky. Some will go directly into the river. Others will detour to hatcheries for controlled breeding and propagation.

Worth the Effort

Is saving two rare species of mussels worth so much bother?

"In a word, yes," says Morrison. The more sensitive species are to water quality and habitat change, the more we need them as monitors of aquatic health and a stable river-bottom ecosystem.

"The endangered mussels represent holes in the fabric of our ecosystem," she continues. "Is it true that these species have always been uncommon in their community and therefore they won't be missed? No. In fact, in some relatively intact aquatic systems, such as the upper Allegheny River in Pennsylvania, or the Licking and Green rivers in Kentucky, endangered mussels are among the dominant members of the mussel community. But they are gone from the rest of their historic range" within the Ohio and Mississippi river basins.

Gathering adult common mussels for brood stock now occupies much of



A diver helps replace and monitor mussels in a recovery area.

Morrison's time. "We collect them and hold them. Then, when hatcheries are ready for them, the females go off to the different culture facilities, so [workers] can remove mussel larvae, put them on the fish, and get them to grow and transform."

Scientists plan to continue monitoring the mussels long after the project ends. They will have to do so if they are going to see an individual mussel through its lifespan. The pink mucket, a member of the most highly evolved mussel family, can live 50 or 60 years. A fanshell can make it to 30 or 40.

By 2022, when the project's last monitoring is scheduled to take place, biologists would like to see at least 5,000 young pink muckets and 5,000 young fanshells established in mussel beds on and adjacent to the refuge.

"It sounds like job security," laughs Morrison, "or at least a project I can work on until retirement."

A Challenging Future for the Steller's Eider

by Susan Morse

Recovering a threatened species is never easy, but some challenges are particularly formidable. Try monitoring a migratory duck population across a vast, remote region with a notoriously harsh climate. Factor in unrestricted hunting in a nearby foreign country. Throw in a database in need of an update and tracking instruments that seem to make your animal more vulnerable to predators. On top of that, consider that your species is at high risk for a virus that threatens people as well as birds.

Those are just some of the challenges facing the Izembek National Wildlife Refuge, near the tip of the Alaska

Peninsula, in trying to recover a sea duck called the Steller's eider (*Polysticta stelleri*). The Alaska breeding population of Steller's eiders has been listed as threatened since 1997.

Steller's eiders have become scarcer in recent decades, nearly disappearing from their Alaskan nesting areas. Only an estimated 70,000 remain out of the 200,000 that once wintered along the Alaska Peninsula. New survival data, now being compiled, is not expected to change the picture.

No one knows why the drop has occurred, but researchers at Izembek are well situated to study the problem. Others joining them in trying to unravel the mystery include the U.S. Fish and Wildlife Service's Migratory Bird Management office in Anchorage, our Fairbanks field office, our Alaska Sea Life Center in Seward, and the Alaska Department of Fish and Game.

Since 1961, refuge biologists have captured and banded the birds during the fall when 20,000 or more arrive to molt in Izembek Lagoon. Students and volunteers help. The data generated provide wildlife managers with important population and survival rate information. Weather permitting, refuge staffers also conduct aerial surveys of birds wintering along the icy peninsula.

One theory for the eider's decline blames over-hunting in Siberia and other areas where some of the birds breed. The theory is based on a study showing male eiders have a lower survival rate than females. "Males arrive at molting areas before females...so males may take

Steller's eiders are herded into pens for banding at Izembek National Wildlife Refuge.



USFWS

the brunt of the hunting pressure,” says Izembek Refuge biologist Kristine Sowl.

Lead poisoning from the ingesting of lead shotgun pellets accumulated in breeding grounds may be another culprit. Lead poisoning is known to affect a related species, the spectacled eider, as well as other waterfowl. In the 1980s, the use of lead shot on national wildlife refuges was banned after it was implicated in the deaths of bald eagles that fed on poisoned waterfowl. A nationwide ban on lead shot for waterfowl hunting began in 1991.

Other possible threats cited in the Service’s 2002 Steller’s Eider Recovery Plan include exposure to oil and other contaminants; a drop in mussels, clams, and other marine invertebrates that eiders feed on; and collisions with fishing boats. But, as the plan notes, “the species’ marine ecology is poorly understood.”

Fifty Years of Data

In 2005, the Izembek Refuge launched a new database to boost research capability. The system now incorporates almost 50 years of banding data – information

that has become scattered in several Excel spreadsheets, hindering data compilation and analysis.

The improvement of data management is particularly noticeable, says Sowl, if you’re checking the history of a 20-year-old bird that’s gone through several individually numbered aluminum bands. When salt water corrodes a band, the bird gets a new one, weather permitting.

In the past, to follow a bird’s history, you had to know every band number it had. “With the new database,” explains Sowl, “you can plug in any of the band numbers, and up will pop the same bird, because it is identified with a unique number in the database. It doesn’t matter how many bands it’s had – you will always be able to find it. That has really simplified looking up capture histories.”

Refuge staff had also considered an additional step: putting the database online so other researchers could add their data. But the programmer died before achieving that goal and the refuge has yet to find his successor. Until recently the software program automatically exported banding-schedule data to the U.S. Geological Survey’s

Bird Banding Laboratory. Then the lab changed its software. So that’s one more item on the need-to-fix list.

There are also questions about how a road-building project approved by Congress earlier this year will impact Steller’s eiders. (The project is subject to the completion of an Environmental Impact Statement and a subsequent finding by the Secretary of the Interior that it is “in the public interest.”) Before building begins, biologists have several questions: What path do the eiders take in their night flights across the narrow peninsula? Will this path put them at risk of striking construction equipment? Will public use along this road change eider movements?

To find out, researchers have tried tracking the birds with portable transmitters. But they stopped when they found the transmitters – whether because of their weight or for other reasons – appeared to make the wintering birds more vulnerable to eagle predation. “Transmitters are wonderful tools, but you need the transmitters to match the bird,” says Sowl.

Izembek Refuge cooperates with other researchers monitoring the birds for avian flu. Steller’s eiders are considered at high risk of carrying the virus, which experts fear could jump from birds to humans and cause a pandemic. So far, Izembek’s eiders have come up clean. Eiders captured at nearby Nelson Lagoon have had some low-pathogenic virus, but not the high-pathogenic variety that’s of most concern.

Where does all this leave Izembek Refuge’s researchers? Worried, but determined to decode the eider’s mysteries and work around challenges as they find them.

“What we’re finding out,” says Sowl, “is that the eiders are more complicated than we thought they were going to be.”

Amber Wagner, an administrative technician at Izembek NWR, and maintenance worker Bill Pickett read and record an eider band.



Al Trout/USFWS

Replanting a Tallgrass Prairie

by Susan Morse

Step foot on the Neal Smith National Wildlife Refuge in south-central Iowa and it's hard to miss a sense of mission. Over the past 17 years, the refuge has drawn acclaim for returning 3,000 acres (1,215 hectares) of Midwest corn and bean fields to a landscape closer to what early 19th century settlers saw. The return of rare native plants that once covered parts of 14 states has made these lands capable of supporting other long-absent species, including elk, and bison, and rare breeds of birds and butterflies.

True, the Neal Smith Refuge is no longer the world's largest tallgrass prairie reconstruction; that distinction has been claimed by Glacial Ridge National Wildlife Refuge in Minnesota. But there's more than size at stake. By any

standards, Neal Smith's is a remarkable success story, one in which project leader Nancy Gilbertson rightly takes pride.

Just don't use the word "restored" to describe the fragile prairie environment she and many others at the refuge are still laboring to recreate. Gilbertson and her fellow prairie enthusiasts take the long view on restoration of an ecosystem that developed over thousands upon thousands of years.

"We have 3,000 acres out of our 5,600 that have been planted," she'll correct you if you slip and use the "r" word. "I won't use that word 'restored' til I'm about 10,000 years old."

The prairie reconstruction effort has become a powerful environmental education tool and a veritable regional industry for scientists, university students (whose professors build curricula around the project), volunteers, schoolchildren, and Scout troops.

Elementary and middle school students hand-harvest the seeds of native grasses, plant them in a greenhouse on the refuge, and tend the seedlings until they're ready for transplanting on refuge lands.

Youngsters swoop across the fields, swinging butterfly nets to help with a monarch butterfly tagging program in which the United States, Canada, and Mexico take part. The refuge is a rest stop on the monarchs' fall migration to Mexico. In the spring, on their return trip, the butterflies lay eggs on several species of native milkweed found on the prairie. Refuge staffers put a tiny sticker on the wings of captured butterflies to track their migration, and the kids release them. The activity "gives the

Native plants cover a tallgrass prairie restoration site at Neal Smith National Wildlife Refuge.



Tom Prall



Young students help plant prairie species at Neal Smith NWR.

kids a chance to explore the prairie and find all kinds of things that they can show their classes, such as animal skulls. They all really love it,” says Visitor Services manager Cheryl Groom.

Signs of Progress

When Neal Smith Refuge staff and volunteers cut non-native trees, Scouts stack the wood for burning. Wildfires — part of the original prairie ecosystem — used to do the job. But fire suppression over the past century and a half allowed trees to take root. Now, regular controlled burns play a part in thinning the non-native growth.

Staff at the refuge see progress in the return of nesting grassland birds. The first Henslow’s sparrow (*Ammodramus henslowii*) nest was discovered on the refuge in 2001, says Gilbertson. “Every year, we find more nests, so that’s exciting.”

With the refuge’s help, some rare butterflies have also made a comeback. Using seeds and plant stock found on prairie remnants, refuge staff planted several thousand prairie violets (*Viola pedatifida*). Then they brought back gravid (pregnant) females of the regal fritillary butterfly (*Speyeria idalia*), a

striking orange and black variety whose young feed on the violets. At first, the staff set large cages over the violets and the butterflies, which the state of Iowa has designated a species of concern. Now the butterflies are found throughout the refuge.

Increasingly, however, the refuge is waging a war against invasive species — a threat, says refuge research coordinator Pauline Drobney, that didn’t exist a couple of hundred years ago. Staff and volunteers are hand-pulling noxious exotics before they choke out native plants, and applying herbicide where necessary. Two particular targets are *Sericea lespedeza*, a shrubby legume native to Asia, and Canada thistle (*Cirsium arvensis*), a perennial with a vigorous rootstock.

Refuge visitors begin their orientation to the land’s origins and complex plant and animal interrelationships at the refuge’s spacious visitor’s center, a facility equipped with classrooms, an exhibit area, a theater, and a bookstore.

Says Drobney, “I don’t think we truly teach about prairie. The best thing we can do is provide an experience for people to find it themselves. They have to really touch it to have it catch hold of them. As Rayford Ratcliff, a volunteer who used

to work out here, once told me, ‘To really understand prairie, you have to get your back up agin’ it.’ He was right. You have to let yourself get in it, and let it get into you.”

Learning Patience

Why does restoration of a prairie landscape matter? Drobney waxes philosophic:

“Ultimately, these ecosystems are the things that allow life on earth to exist.... It would be a pretty grim place, even in terms of surviving, without the functions we are given from native ecosystems.”

Take native pollinators, for example: butterflies, bees, hummingbirds, bats, and moths. Make the land less hospitable to them and you can measure the loss in fruit and flowers.

There’s a visual richness, too, provided by fields of native big bluestem (*Andropogon gerardii*) and golden Indian grass (*Sorghastrum nutans*) waving in the wind. And then there’s history. For Iowans, says Drobney, prairie is “part of who we are really.... One of the things that tend to hook people [on prairie restoration] is knowing their ancestors came through this landscape and this is what it was like.”

The hard part is having patience.

Says Gilbertson, “What I have to keep in perspective is that prairie restoration doesn’t happen in a few years or even 20 years. Yes, it’s not a cornfield anymore, but....” she says, drawing out the last word and leaving it hanging.

“I have to remind myself of something John Madson said. He was an Iowa native who was considered the father of the modern prairie restoration movement. He said, ‘Be patient; have faith; and don’t mind the dirt under your fingernails.’”

Restoring Habitat at Pearl Harbor

by Ken Foote



The 'opae 'ula (*Halocaridina rubra*) is a freshwater shrimp found only in Hawai'i.

At first glance, the area resembles an African savanna, but one marked with invasive species such as mesquite (*Prosopis* spp.), Indian marsh fleabane (*Pluchea indica*), and buffleggrass (*Cenchrus ciliaris*) dominating the landscape. A closer inspection reveals an ancient raised limestone coral reef and remnants of the last remaining coastal dryland plant communities on the Hawaiian island of O'ahu.

This harsh, sun-drenched landscape is home to the Kalaeloa Unit of the Pearl Harbor National Wildlife Refuge. Located west of Honolulu on the 'Ewa Plain, Kalaeloa was part of the former

Barbers Point Naval Air Station until it was added to the National Wildlife Refuge System to protect native plants, including two endangered species – an 'akoko (*Chamaesyce skottsbergii* var. *kalaeloana*) and the 'Ewa hinahina (*Achyranthes splendens* var. *rotundata*).

Although Kalaeloa has been heavily altered by agricultural, military, residential, and commercial activities, U.S. Fish and Wildlife Service biologists and land managers are working to restore the unique habitats native to this once pristine subtropical dry forest. Continuing habitat restoration activities include the removal of invasive plant species and the

(below): A completely filled in anchialine pool prior to restoration.

(opposite page): Initial cleaning of anchialine pool with heavy equipment.



Aaron Nading/USFWS

propagation and out-planting of native dryland plants, including endangered and threatened species.

In addition to subtropical dry forest restoration, the Service is restoring another unique and rare habitat known as anchialine pools. Anchialine pools are landlocked brackish ponds located close to the shoreline and connected to the ocean by subterranean tunnels. On O‘ahu, anchialine pools are generally found in karst formations rather than lava fields like those found on Maui and the island of Hawai‘i. Karst is the type of topography that forms when raised limestone reefs are subjected to the movement of groundwater over and through the reef. The weak carbonic acid found in ground water slowly dissolves the limestone, creating large holes, channels, and bumpy surfaces. One of the largest such formations on O‘ahu is the ‘Ewa karst.

The major threats to anchialine pools and the shrimp species that inhabit them are habitat degradation and destruction, nonnative invasive species, and over-collection of the shrimp for the aquarium trade. In the past, most of Kalaeloa’s anchialine pools have been filled in with sediment and coral rubble.

In 2005, Phase I of a project to restore anchialine pools within the Kalaeloa Unit rehabilitated an anchialine pool and led to the successful recruitment of two color phases of an anchialine pool shrimp known as ‘opae ‘ula (*Halocaridina rubra*), a species at risk. Found only in Hawai‘i, ‘opae ‘ula can reach 10 to 15 years of age, an unusually long lifespan for a tiny crustacean. This species is approximately 0.5 inches (1.27 centimeters) in length and occurs in a range of colors – red, pink, white, light yellow/clear, and banded (red/clear). Kalaeloa is the only location in Hawai‘i where two distinct genetic lineages of ‘opae ‘ula are found to coexist at the same site.

Based on the success of Phase I, Phase II sought to expand the number of restored pools at sites that would benefit both ‘opae ‘ula and another anchialine pool shrimp, *Metabetaeus lohena*, which is a candidate for Endangered Species



Mike Yamamoto/DAR

Treasures From an Ancient Past

The restoration of anchialine pools at Kalaeloa uncovered some hidden treasures that are just beginning to open a window to the area's ancient past. While removing the debris, Service personnel found fossilized bird bones, some from species never before seen. To date, scientists have uncovered fossilized bones of an extinct hawk (first time reported as a fossil on O'ahu), a long-legged owl, Hawaiian sea eagle, petrel, two species of crow, Hawaiian finches, Hawaiian honeyeaters, and the moa nalo (a turkey-sized, flightless goose-like duck—the largest native Hawaiian bird). Further work is needed to confirm the identification and



J. Hiromasa/USFWS

age of each species. The Service is working with representatives from the Smithsonian Institution and Bernice P. Bishop Museum to properly clean, store, preserve, and identify the bones.



M. Silbermagle/USFWS

Adonia Henry cleaning out anchialine pool with water and pump.

Act protection. Restored pools were also targeted as potential translocation sites for the orangeblack Hawaiian damselfly (*Megalagrion xanthomelas*), another listing candidate.

In March 2008, Lorena Wada and Aaron Nadig, biologists with the Service's Pacific Islands Fish and Wildlife Office, and Jason Hanley, Invasive Species Strike Team Leader with the Hawai'i and Pacific Islands National Wildlife Refuge Complex, led the project to restore 12 anchialine pools. Personnel from the Service's Hawaiian Refuges and Ecological Services offices, the Hawai'i Division of Aquatic Resources, and the State Natural Area Reserve contributed over 800 hours of work during the first 6 months of the project.

Using heavy equipment, pumps, and hand tools, they removed coral rubble and soil blocking the pools. This work successfully restored natural tidal fluctuations in the pools, which allowed native anchialine pool shrimp to quickly recolonize the sites. In May 2008, the



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A healthy anchialine pool with a close up of native shrimp.

first ‘opae ‘ula were observed in one of the newly restored pools. ‘Opae ‘ula have now been seen in eight of the restored sites. As of September 1, 2009, 11 anchialine pools have been restored.

Future plans include monitoring ‘opae ‘ula, continuing data collection on water quality, evaluating the pools as potential reintroduction sites for the orangeblack damselfly, and evaluating future translocation sites for *Metabetaeus lohena*. The work being accomplished at anchialine pools also provides a unique opportunity for partnerships and educational outreach.

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BOX SCORE

Listings and Recovery Plans

as of October 2, 2009

GROUP	ENDANGERED		THREATENED		TOTAL LISTINGS	U.S. SPECIES W/ PLANS
	U.S.	FOREIGN	U.S.	FOREIGN		
 MAMMALS	70	255	15	20	360	59
 BIRDS	75	182	15	6	278	85
 REPTILES	13	66	24	16	119	38
 AMPHIBIANS	14	8	11	1	34	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	410	529	164	44	1,147	471
 FLOWERING PLANTS	573	1	143	0	717	633
 CONIFERS	2	0	1	2	5	3
 FERNS AND OTHERS	26	0	2	0	28	28
PLANT SUBTOTAL	600	1	146	2	749	664
GRAND TOTAL	1,011	530	310	46	1,897*	1,135

TOTAL U.S. ENDANGERED: 1,011 (411 animals, 600 plants)

TOTAL U.S. THREATENED: 310 (164 animals, 146 plants)

TOTAL U.S. LISTED: 1,321 (575 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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