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ENDANGERED *Species* BULLETIN

January/February 2003

Vol. XXVIII No. 1



One hundred years ago, President Theodore Roosevelt took a small step that launched the modern conservation movement. By executive order, he protected Pelican Island, Florida, as a bird sanctuary to protect its dwindling bird life from the onslaught of plume hunters during what is now known as the Feather Wars. From that modest beginning, the National Wildlife Refuge System has grown to almost 95 million acres with refuges across all of the United States. Larger than the National Park System but not as well known, the Refuge System plays a vital role in conserving our Nation's biological diversity. In this edition of the Bulletin, we look at a few examples of how refuges help to protect and recover endangered species.



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On the Cover

A variety of bird species are protected at Pelican Island NWR, the cornerstone of the National Wildlife Refuge System.

Photo by George Gentry/USFWS

Opposite page

The Yukon Delta NWR in Alaska is important nesting habitat for the listed Steller's and spectacled eiders, as well as many other migratory birds.

USFWS photo



The Endangered Species Bulletin welcomes manuscripts on a wide range of topics related to endangered species. We are particularly interested in news about recovery, habitat conservation plans, and cooperative ventures. Please contact the Editor before preparing a manuscript. We cannot guarantee publication.

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A Century of Conservation

by Dan Ashe



In honor of the 100th anniversary of the National Wildlife Refuge System, the U.S. Postal Service has issued a commemorative stamp.

Throughout 2003, the National Wildlife Refuge System celebrates 100 years of extraordinary growth and achievement. A century has passed since President Theodore Roosevelt established the first refuge at Pelican Island, Florida, sparking the American wildlife conservation movement. For those of us who work for the U.S. Fish and Wildlife Service, there could hardly be a more significant or gratifying anniversary.

The National Wildlife Refuge System has been called America's best-kept secret. During this centennial year, we will change that and, by spreading the word, help it become recognized for what it truly is, one of America's greatest national treasures and a resounding success in wildlife conservation.

Of all the incredible things that our wildlife refuges are and do, one of the proudest is our far-reaching and historic efforts in protecting and recovering endangered and threatened species. It's easy to forget that the Endangered Species Act, which is widely regarded as the world's most powerful wildlife conservation law, gives the Fish and Wildlife Service a responsibility of almost overwhelming scope, urgency and complexity: restoring our nation's imperiled animal and plant species to a secure status and conserving the ecosystems upon which all of them, and all of us, depend.

The Service and the Refuge System have responded to this challenge by forging a variety of strategic partnerships with zoos and aquaria, private landowners, nonprofit organizations, interested individuals, and state and local governments. The results have been immensely successful and involved a great deal of

hard, behind-the-scenes work.

These partnerships have helped turn species such as the California condor (*Gymnogyps californianus*), Mexican wolf (*Canis lupus baileyi*), and black-footed ferret (*Mustela nigripes*) from almost certain extinction toward the road to recovery. They have also helped save dozens of important but less "charismatic" species, such as the southwest willow flycatcher (*Empidonax traillii extimus*) and the American burying beetle (*Nicrophorus americanus*).



Right: Cabeza Prieta NWR provides crucial habitat for the endangered Sonoran pronghorn.

Photo by John and Karen Hollingsworth



This centennial celebration gives us an opportunity to reflect on the power of individuals to change society. It also leads us to ask some fundamental questions: Why does America need a system of conservation lands? Why do we need federal laws to protect wildlife? How did all of this come about?

In the late 1800s, Americans began waking to the fact that our wildlife resources were in trouble. Years of unchecked exploitation saw many species we consider common today, like deer and turkey, dwindling. The bison and the passenger pigeon were nearing extinction. In Florida, populations of pelicans, egrets, spoonbills, and other water birds were suffering from pressure by commercial market hunters. Bird plumes, which were used to adorn women's hats and other items in the fashion industry, were worth more than gold. Conservationists, including hunters and anglers, became alarmed by this wholesale commercial slaughter of birds, and faced market hunters in what has become known as "The Feather Wars."

In 1901, conservationists, led by the American Ornithological Society and the

Florida Audubon Society, convinced Florida to pass legislation to protect nongame birds. Audubon also hired three wildlife wardens in Florida to stop market hunting. One was Paul Kroegel, a German immigrant and boat builder who had settled in Sebastian, Florida, in 1881. He made his home on a ridge looking out at Pelican Island, the last rookery for brown pelicans on the east coast of Florida and took an interest in protecting the birds. Kroegel is the only warden who survived the Feather Wars. The other two were murdered.

Kroegel became acquainted with Frank Chapman, a member of the American Ornithological Union and the curator at the American Museum of Natural History in New York, and demonstrated to Chapman the plight of the pelicans and other birds. It was Chapman who convinced President Theodore Roosevelt that the federal government needed to take action.

On March 14, 1903, without fanfare, President Roosevelt signed an executive order establishing Pelican Island as a federal bird reservation, the precursor to a designation of a National Wildlife

Left: Pelican Island's first guardian, Paul Kroegel, with one of his charges.

USFWS photo

Above: A team of biologists relocates Aleutian Canada geese on Buldir Island, part of the Alaska Maritime NWR. This refuge and others were instrumental in the species' recovery.

USFWS photo



Okefenokee NWR in southern Georgia contains a vast bog with numerous islands and lakes. Among its residents are listed species such as the wood stork, red-cockaded woodpecker, and bald eagle.

Photo by George Gentry/USFWS

Refuge or NWR. Kroegel was hired to become the first refuge manager and was paid the sum of \$1 a month. With a badge, a gun, and a boat, Kroegel stood watch over Pelican Island until the 1920s. President Roosevelt would go on to establish an additional 54 refuges during his two terms as President.

Tiny, mangrove-covered Pelican Island was the birthplace of an idea unique in the world: that wildlife and wild places should be protected for their own sake and for the benefit of the American people. It was a proclamation on behalf of a nation with an emerging consciousness about the value of things wild and free. From this humble start, the National Wildlife Refuge System has emerged.

Today, the system has grown to nearly 95 million acres (38 million hectares), an

area about the size of Montana. It now includes 540 refuges and more than 3,000 waterfowl production areas spread across the 50 states and several U.S. territories.

This network of strategically located habitats protects 260 endangered species, safeguards breeding and resting places for millions of migratory birds, and conserves premier fisheries and coastal habitats for marine mammals. Over the years, the habitats provided by refuges played important roles as professional wildlife managers restored once depleted populations of white-tailed deer, whooping cranes, elk, wild turkeys, crocodiles, wood ducks, pronghorn antelope, Aleutian Canada geese, Key deer, and a host of others. At the same time, the Refuge System conserves a stunning array of the nation's ecosystems, including tundra, desert, forest, great rivers, marshes, mountains, prairies, estuaries, and coral reefs. Each year, nearly 40 million people—nature lovers, birders, hikers, photographers, hunters, anglers, and others—visit our National Wildlife Refuges.

Of the 1,262 animal and plant species in the U.S. listed as threatened or endangered (as of February 1, 2003), an astonishingly high percentage occur on National Wildlife Refuges. These refuges not only protect wildlife but also provide opportunities for intensive habitat management, if needed, and for experimentation with recovery methods under controlled conditions.

Habitat management for endangered species on refuges can serve as a model for adjacent landowners. Many refuges have formed partnerships with their neighbors to conserve or even enhance wildlife habitat on their lands, using tools such as the Service's Safe Harbor Program. Under a Safe Harbor Agreement, property owners can manage their lands in ways that benefit or attract listed species while maintaining the right to change their land management in the future without penalty.

To date, 59 National Wildlife Refuges have been established primarily for the

benefit of endangered and threatened species, although many other refuges provide important habitat for listed species as well. In Nevada, for example, the Service created the Ash Meadows NWR to protect a unique system of desert springs, associated wetlands, and alkaline desert uplands that harbor 24 species of animals and plants found nowhere else in the world.

Central Florida's Lake Wales Ridge, a patchwork of remnant, sandy scrub habitats on a prehistoric shoreline, has one of the highest concentrations of endemic species in North America, including 22 listed plants and four listed animals. The Service is in the process of acquiring some of the best remaining sites to add to the Lake Wales Ridge NWR for these vulnerable species.

One of our newest refuges is the Bayou Teche NWR in Louisiana. Located at the southern extreme of the biologically rich Atchafalaya River floodplain, this is the only refuge in the country specifically established to conserve the threatened Louisiana black bear (*Ursus americanus luteolus*). It also benefits migratory birds and a variety of other wildlife and plants.

Some of our recovery stories are exciting front-page news, like the whooping crane (*Grus americana*) migration following the ultra-light aircraft between Wisconsin's Necedah and Florida's Chassahowitzka NWRs. Some are successes won from decades of hard work, such as the recovery and delisting of the Aleutian Canada goose (*Branta canadensis leucopareia*), which breeds on islands in the Alaska Maritime NWR and winters on the San Luis NWR in California. Others examples are not widely known, such as the work that goes on at the National Panther Refuge in Florida.

I could share so many stories about the passion and dedication of refuge employees in their struggle to help endangered and threatened species. One that is particularly memorable was a night on the beach at Blackbeard Island NWR on the Georgia coast. My family was able to join me, and my two kids were absolutely mesmerized as our biotech, Debbie Barnard, worked to determine the success of sea turtles that had hatched on the beach the previous evening. She worked so hard, and so long into the night, and with such



Above top: A refuge biologist installs an artificial nesting cavity at Piedmont NWR for the endangered red-cockaded woodpecker.

Photo by John and Karen Hollingsworth

Below: Balcones Canyonlands NWR in central Texas protects vital habitat for two endangered songbirds, the golden-cheeked warbler and the black-capped vireo.

Photo by Chuck Sexton/USFWS



Left: A profusion of wildflowers blankets Merced NWR in California's Central Valley. The refuge also provides habitat for a variety of rare animals, including fairy shrimp and the San Joaquin kit fox.

USFWS photo

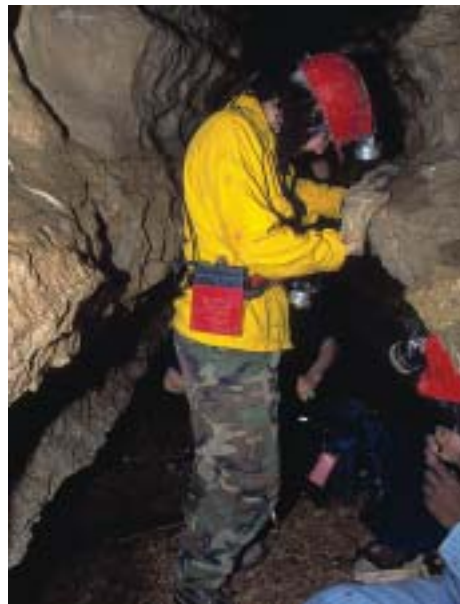


Top: Also established by President Theodore Roosevelt, Three Arch Rocks on the Oregon coast is the oldest refuge west of the Mississippi. It provides an undisturbed sanctuary for tufted puffins, other seabirds, and several species of marine mammals, including the endangered Steller's sea lion.

Photo by David Pitkin/USFWS

Right: Not all wildlife refuges are above ground. Here, researchers survey for the threatened Ozark cavefish in a cavern within the Ozark Plateau NWR.

USFWS photo



obvious dedication that my daughter later said, "Dad, you must pay her a lot of money." A priceless moment to teach a child about the value of personal accomplishment and hard work. I must admit, though, that I told my daughter that we don't pay her nearly enough. Just recently, I visited Charles M. Russell NWR in Montana. The refuge staff and I discussed many issues concerning management of that wonderful refuge, but what impressed me the most was the deep and pervasive concern about steep and unexplained declines recently

observed in the population of reintroduced black footed ferrets. Nothing is more challenging and rewarding to a land manager than nurturing a species that is precariously perched on the brink of extinction. Nothing is more sobering than losing that battle.

Most of us tend to forget about the simple pleasures of slowing down and getting out into nature. During this year's centennial celebration, I'd like to help change that. In these fast-paced and troubled times, our wildlife refuges can be places of peace and reflection for all Americans. There is a refuge located within an hour's drive of every major U.S. city, and I'd like more Americans to take that drive and reconnect with the natural world.

Refuges are living, breathing places where the ancient rhythms of life can still be heard, where nature's colors are most vibrant, and where time is measured in seasons. They are gifts to ourselves and to generations unborn—simple gifts unwrapped each time a birder lifts binoculars, a child overturns a rock, a hunter sets a decoy, or an angler casts the waters.

There are many challenges ahead for our Refuge System and the remarkable diversity of wildlife it nurtures and protects. What price are we willing to pay to maintain our wild lands and biological heritage? What price are we willing to pay to expand and improve these precious holdings?

As we celebrate during 2003 the remarkable success of the National Wildlife Refuge System, we should heed Theodore Roosevelt's vision and warning: "Wild beasts and birds are by right not the property merely of the people who are alive today," he said, "but the property of the unknown generations, whose belongings we have no right to squander." For all of us who care about the future of wildlife in America, those words remain as much a call to action today as they were 100 years ago.

Dan Ashe is Chief of the National Wildlife Refuge System.

Hakalau Forest National Wildlife Refuge

by Barbara Maxfield

Although it's only a "teenager" in the National Wildlife Refuge System, the 32,700-acre (13,230-hectare) Hakalau Forest National Wildlife Refuge (NWR) on the Big Island of Hawai'i stands among the leaders in endangered species recovery as we celebrate our centennial year. With eight endangered bird species, an endangered bat, and at least six endangered plant species, the refuge harbors one of the highest numbers of listed species within the system. But perhaps more remarkable is the progress the refuge staff has overseen during its short history.

Hakalau Forest NWR was created in 1985 to protect endangered forest birds and their rainforest habitat. Located on the windward slope of Mauna Kea between the elevations of 2,500 and 6,500 feet (760 and 1,980 meters), the refuge contains some of the finest remaining stands of native rainforest in the state. However, at the time of purchase, the native forest merged into about 4,000 acres (1,620 ha) of open grassland at higher elevations, where rainfall decreases. The grassland area was forested 200 years ago, before cattle and ranching were established on the Big Island.

The refuge staff's philosophy has always been that the best way to conserve the native forest birds is to restore their habitat, so 16 years ago it embarked on a major habitat rehabilitation effort. Since 1987, more than 252,000 native trees have been planted on the refuge, including about 208,000 koa (*Acacia koa*) trees and more than 1,300 endangered plants.

"We've had tremendous support from the State's Division of Forestry and

Wildlife, whose Waimea tree nursery propagated many of our koa seedlings, the U.S. Forest Service, the Big Island Resource Conservation and Development Office, *AMERICAN FORESTS*, and the Natural Resources Defense Council," says refuge manager Richard Wass. "The technical assistance, funding, and support these partners provided have energized our reforestation program."

An onsite greenhouse has supplied most of the planting materials since 1997, particularly the endangered species. The refuge horticulturist developed highly successful propagation techniques for *Clermontia pyramidalis*, *Cyanea shipmanii*, *Cyrtandra tintinnabula*, *Phyllostegia racemosa*, and *Phyllostegia velutina*, all listed plant species with four or fewer populations left in the world. *Clermontia lindseyana*, which is not as rare but still endangered, also has been propagated from seeds found on the refuge and planted in the wild.

Wass gives volunteers most of the credit for replanting efforts within the refuge. Led by refuge staff, volunteer groups from schools, Scouts, conserva-



The 'akiapala'au, an endangered Hawaiian forest bird.

Photo © Jack Jeffrey

A portrait of the contributions the National Wildlife Refuge System has made toward endangered species recovery would not be complete without mention of the island ecosystems of the Pacific. From low sandy coral islets to high rainforests, the 11 National Wildlife Refuges in the Hawaiian archipelago support more than 55 threatened and endangered animal and plant species. Though each is special in its own right, perhaps the most unique is Hakalau Forest National Wildlife Refuge, the only high elevation tropical rainforest found within the Refuge System.



Intact habitat at Hakalau Forest NWR
USFWS photo

tion organizations, and service clubs have been gathering seeds and planting native trees and shrubs for the past 15 years. Last year, 875 volunteers donated 6,344 hours of service to Hakalau Forest, making the long trek up Mauna Kea over rough four-wheel-drive trails to spend their weekends working.

Significant effort also has gone into alien species control. Forty-five miles (72 kilometers) of fencing have been installed and maintained, creating eight “feral ungulate management units.” Feral and domestic cattle (*Bos taurus*) have been completely removed from seven of those units, and only about six head remain in the eighth unit. Four units are now free from damage by feral pigs (*Sus scrofa*), while two others have low pig populations remaining. Feral ungulates

are known to consume native plants, facilitate dispersal of alien plants, and cause erosion. Pigs in particular create breeding grounds for mosquitos (*Culex quinquefasciatus*), which carry avian pox and malaria. These diseases are one of the primary threats to the island’s native forest birds. It is worth noting that the mosquitos and both of these diseases were introduced inadvertently to the Hawaiian Islands.

Eradication of invasive weeds such as gorse (*Ulex europaeus*), banana poka (*Passiflora mollissima*), and Florida blackberry (*Rubus argutus*) is another challenge faced by staff, contractors, and volunteers. To date, about 80 percent of the gorse has been removed from the refuge. The more accessible areas of the refuge are nearly “poka free,” thanks to

hundreds of hours of volunteer labor. The area infested with Florida blackberry is shrinking, with the assistance of funding from the U.S. Forest Service.

But are these efforts helping? Endangered species recovery is usually a slow, long-term process, so it is particularly gratifying to the refuge staff to see remarkable results over the past 17 years. Last year, it announced the first known sighting of an endangered forest bird—a juvenile ‘akiapola‘au (*Hemignathus munroi*)—within rehabilitated habitat on the refuge. The chick was heard calling from an area planted with koa trees in 1995. This year, the refuge biologist boasts that the staff now finds ‘akiapola‘au family groups in planted groves and corridors of koa on a regular basis.

A draft report on Hawaiian forest bird species modeling by the U.S. Geological Survey's Pacific Island Ecosystem Research Center offers more good news, at least for four species. Using data gathered since the mid-1970s, it concludes that the Hawai'i 'amakihi (*Hemignathus virens virens*, not a listed species) population is widespread and sizable, with approximately 68,650 birds

in Hakalau Forest. The rare ‘akiapola‘au population is very small, with about 800 birds within the refuge, but the population appears to be relatively stable.

For two other endangered forest birds, the Hawai'i 'akepa (*Loxops coccineus*) and the Hawai'i creeper (*Oreomystis mana*), scientists found increasing populations over a 24-year period. About 5,000 'akepa and 9,100 Hawai'i creepers are thought to occur within the refuge. Results for nine additional forest birds species are expected soon.

"These endangered forest birds avoid open areas and even open forest canopy areas," explains Wass. "With less than 20 years of effort, we've demonstrated that recreating habitat for these species is possible. We have a long road ahead of us, but think of what could be here at Hakalau Forest for the Refuge System's tricentennial celebration!"

Barbara Maxfield is Chief of External Affairs for the Service's Pacific Islands Office in Honolulu, Hawaii (email barbara_maxfield@fws.gov; telephone 808/541-2749).



Cyanea shipmanii is one of the endangered plants being propagated at Hakalau Forest NWR.

USFWS photo



Reforestation of cleared lands at Hakalau Forest NWR.

USFWS photo

by Lauri S. Munroe

Refuges Are a Flight Path to Recovery



Operation Migration cranes follow ultra lite craft.

International Crane Foundation

*I*n 1903, at the time the National Wildlife Refuge System was getting its start at Pelican Island, whooping cranes (*Grus americana*) could be seen migrating over the eastern United States. In the next decade, however, the flock dwindled and disappeared. Now, in the System's centennial year, whooping cranes once again grace the Eastern skies, thanks in part to National Wildlife Refuges (NWRs) and the people who manage and support them.

In 1999, the Whooping Crane Eastern Partnership, a group of government agencies and nonprofit organizations, including the Fish and Wildlife Service, developed a plan to reestablish an Eastern flock of migratory whooping cranes. Integral to the plan's success are breeding and wintering areas and migration stopovers. Necedah, Chassahowitzka, Muscatatuck, and Horicon NWRs help to fill these needs.

Following a trial run with nonendangered sandhill cranes (*Grus canadensis*), whooping cranes were guided by ultralight aircraft from Necedah NWR in Wisconsin to Chassahowitzka NWR in Florida in 2001. After wintering at Chassahowitzka, five birds returned unaided to Necedah. They were the first of their species to migrate instinctively over the eastern U.S. in almost 100 years. As the fall of 2002 approached, researchers hoped the cranes would fly south unassisted, while a new flock of whoopers trailed ultralights.

Hosting whooping cranes and the people associated with them is a huge responsibility. Providing for birds, biologists, pilots, crew, media, and the public is no small feat. Dedicated refuge staff, volunteers, and Refuge Friends

groups have supplied time, money, and labor to make the project a success.

On the ground, the first priority is protecting the cranes from predators and curious people. Refuge staff built large, fully enclosed pens at remote sites at both Necedah and Chassahowitzka. Armored wire fencing with additional electrified strands deters assaults by everything from alligators to bobcats. At Necedah, staff constructed both night- and day-pens, as well as flight training areas, at four locations.

The pen at Chassahowitzka, located in a salt marsh, was particularly challenging to construct. Workers struggled with deep mud and tidal fluctuations. Materials were transported by airboat. Refuge volunteers and friends, members of the local Audubon Society, and staff from other Service offices and the state-owned preserve north of the refuge all pitched in to complete the work. Jerry Shields, a maintenance worker at Chassahowitzka at the time, helped design and build the pen. "It was very frustrating; sometimes we were up to our chests in muck," he said. "But any part I played in bringing the whooping cranes back to Florida was worthwhile."

Refuge habitat management plans were modified to provide open areas for the cranes. Fire staffs from the Lower Suwannee, St. Marks, and Okefenokee NWRs traveled to Chassahowitzka to clear dense stands of marsh vegetation, providing the open habitat the cranes need. In 2001, crews burned more than 2,000 acres (810 hectares), four times the average for the refuge. Airboats and helicopters brought firefighters to the remote area where the cranes were kept. Staff at Necedah burned in excess of 4,000 acres (1,620 ha) and used a

hydro-ax to remove vegetation from hundreds more.

Keeping tabs on the cranes can be a full-time job. Richard Urbanek, a biologist at Necedah NWR, monitors the birds using radio and satellite telemetry. He followed the sandhill cranes in 2001 and the whooping cranes on their journey north the following year. He continues to track the adult whoopers while they are on the refuge. Urbanek has studied cranes for the Service for 20 years and pioneered techniques in reintroducing them to the wild.

"I found my niche with cranes," he said. "I love working with the birds."

Supporting the cranes is only half the story. The refuges provide vehicles, fuel, and housing for non-Service biologists and pilots working on the project. Members of the staff are on-call for maintenance and repair needs. Refuge staffs have struggled to satisfy the public's hunger for information about the cranes, often working seven days a week. The numbers of visitors, phone calls, and email messages have risen dramatically. Media from around the world have covered the story. Refuges have hosted numerous special events. "The office staff has been deluged with inquiries," said Larry Wargowsky, refuge manager at Necedah.

Muscatatuck NWR in Indiana has also played an important role in the project. The refuge serves as a stopover point during the fall migration, providing both birds and humans a place to rest and feed. Although 35 private landowners currently allow use of their properties for overnight stays during the migration, the refuge ensures a centrally located, long-term staging area.

While not formally part of the reintroduction plan, Horicon NWR in Wisconsin supported the project in 2002. After returning to Necedah, one of the adult cranes moved slightly south to summer at Horicon. There it found freshwater marsh habitat and solitude.

The cranes have many friends in the Refuge System. The Friends of Chassahowitzka, a nonprofit organiza-

tion, sponsored both public and private events celebrating the arrival of the cranes in Florida in 2001. In 2000, the Friends of Necedah received a \$25,000 grant to remodel pens, create an additional training site, build an underground observation blind, develop educational materials, and purchase radio and



satellite transmitters. Friends of Necedah President Tracey Allen believes, "This work is important for Necedah and the whole Refuge System."

During the Refuge System's centennial, its contribution to the recovery of endangered species like the whooping crane is another cause for celebration. As Jim Kraus, refuge manager at Chassahowitzka NWR, puts it, "The crane project has validated the Refuge System as a tool in saving endangered species. It's important to have a network of lands where major, long-term recovery efforts can take place."

At Necedah Refuge, Larry Wargowsky agrees that habitat is crucial and points out that people are also important. "This has been a commitment for our whole staff for the past three years."

Lauri S. Munroe is a Wildlife Biologist in the Service's Twin Cities Regional Office (612/713-5479; email lauri_munroe@fws.gov).



Pens were constructed at the Chassahowitzka (above) and Necedah NWRs to protect whooping cranes from predators.

USFWS photos

An Amphibious Assault

by Cheri M. Ehrhardt



A loggerhead hatchling emerges from its nest.

USFWS photo

Standing at night atop a dune on Florida's Atlantic coast, you hear the ocean waves rolling onto the sandy shore and feel the sea spray on your face. The moonlight plays and flickers in the waves. It is soothing and peaceful.

Then, the amphibious assault begins. Dark forms move onto the shore. They lumber forward, intent on their target. Elements of the assault force range from the size of a child's tricycle to the occasional small all-terrain vehicle.

As the moonlight brightens, you realize that this amphibious assault force is actually composed of sea turtles. Their target is Archie Carr National Wildlife Refuge, a 20.5-mile (33-kilometer) stretch of beach located in east-central Florida between Melbourne Beach in Brevard County and Wabasso Beach in Indian River County. Congress authorized the refuge in 1989 to protect sea turtle

populations and their nesting habitat. The refuge was named after the late Dr. Archie F. Carr, Jr., in honor of his contributions to the conservation of sea turtles and Florida's ecology. Hosting about 1,000 sea turtle nests per mile, the refuge provides habitat each year for 22,000 nests of loggerhead, green, and leatherback sea turtles. In fact, the refuge protects the most important sea turtle nesting beaches in the United States, with 25 percent of all loggerhead and 35 percent of green sea turtle nests.

Adjacent to the refuge is an important juvenile sea turtle nursery within the Pelican Island National Wildlife Refuge

Right: A member of the "amphibious assault" team, this female loggerhead prepares to dig her nest.

USFWS photo



and the Indian River Lagoon (which we regard as our nation's most biologically diverse estuary). But these lands are not just for sea turtles. At least 38 federally and state listed threatened and endangered species (including 8 reptiles, 10 birds, 4 mammals, and 16 plants) rely on the mix of lands and waters in the refuge, including maritime hammock, coastal scrub, dune, and beach habitats (see Table 1). It also contains at least 30 archaeological sites (primarily Ais Indian shell middens, with 4 burial mounds).

The Archie Carr Refuge is a unique example of cooperation and partnership for the conservation of unique habitats for endangered species. This is especially evident when looking at the checker-board of ownership within the refuge's overall acquisition boundary, which includes publicly held natural lands and other lands already converted to use for residential and commercial purposes. Given the ongoing development pressure in this area, the Service recognized the need to protect the remaining natural lands. Those lands purchased prior to the formation of the refuge under the State of Florida's Save Our Coasts and Beach and Riverfront programs served as the nucleus for the refuge. To date, the partner agencies and organizations have spent over \$100 million on land acquisitions for the refuge. Many more agencies and organizations have been involved in the refuge since before its creation (see Table 2).

Today, this stretch of barrier island includes natural lands administered or owned by the Fish and Wildlife Service, State of Florida, Brevard County, Indian River County, the RK Mellon Foundation, and private landowners. Nevertheless, despite the support, dedication, and involvement of the wide variety of partners, over 40 percent of the lands located within the refuge's proposed acquisition boundary have already been developed, predominantly for high end residential and commercial uses. This development is fueled by Florida's human population growth, which has expanded from 13 million in 1990 to



over 16 million today. Scrub habitat has declined such that only one family of Florida scrub-jays remains in the vicinity of the refuge. The foredune habitat of the southeastern beach mouse also has suffered greatly from development and dune erosion.

Human development and disturbances are multiplying, furthering habitat loss and fragmentation. Human impacts to these beaches include an escalation of lighting along the beach, beach access points, nighttime public use of the beach, commercial and residential development on the barrier island, commercial fishing, recreational boating (including the personal watercraft popularly known as jet skis), beach

Archie Carr NWR, an "island" of habitat on Florida's rapidly developing Atlantic coast.

USFWS photo

Table 1. The Archie Carr National Wildlife Refuge supports a variety of federally (FWS) and state (FWC) listed species: at least 15 federally threatened or endangered species and 38 species listed by the State of Florida as endangered, threatened, of special concern, or commercially exploited, including 8 reptile, 10 bird, 4 mammal, and 16 plant species.

<i>Scientific Name</i>	<i>Common Name</i>	<i>FWS (15)</i>	<i>FWC (38)</i>
Reptiles (8)			
<i>Caretta caretta</i>	Atlantic Loggerhead Sea Turtle	T	T
<i>Chelonia mydas mydas</i>	Atlantic Green Sea Turtle	E	E
<i>Dermochelys coriacea</i>	Leatherback Sea Turtle	E	E
<i>Drymarchon corais couperi</i>	Eastern Indigo Snake	T	T
<i>Lepidochelys kempii</i>	Kemp's Ridley Sea Turtle	E	E
<i>Eretmochelys imbricata imbricata</i>	Atlantic Hawksbill Sea Turtle	E	E
<i>Gopherus polyphemus</i>	Gopher Tortoise		SSC
<i>Nerodia clarkii taeniata</i>	Atlantic Salt Marsh Snake*	T	T
Birds (10)			
<i>Aphelocoma coerulescens</i>	Florida Scrub-jay	T	T
<i>Charadrius melodus</i>	Piping Plover	T	T
<i>Falco sparverius paulus</i>	Southeastern American Kestrel		T
<i>Falco peregrinus tundrius</i>	Arctic Peregrine Falcon		E
<i>Haematopus palliatus</i>	American Oystercatcher		SSC
<i>Haliaeetus leucocephalus</i>	Southern Bald Eagle	T	T
<i>Mycteria americana</i>	Wood Stork	E	E
<i>Pelecanus occidentalis</i>	Brown Pelican		SSC
<i>Rynchops niger</i>	Black Skimmer		SSC
<i>Sterna antillarum</i>	Least Tern		T
Mammals (4)			
<i>Balaena glacialis</i>	Right Whale	E	E
<i>Megaptera novaeangliae</i>	Humpback Whale	E	E
<i>Peromyscus polionotus niveiventris</i>	Southeastern Beach Mouse*	T	T
<i>Trichechus manatus</i>	West Indian Manatee	E	E
Plants (16)			
<i>Acrostichum danaeifolium</i>	Giant Leather Fern		CE
<i>Asclepias curtissii</i>	Curtis' (Sandhill) Milkweed		E
<i>Crossopetalum ilicifolium</i>	Christmas Berry		E
<i>Encyclia tampensis</i>	Butterfly Orchid		CE
<i>Ernodea littoralis</i>	Beach Creeper		T
<i>Hexalectris spicata</i>	Crested Coralroot		E
<i>Lantana depressa</i>	Pineland Lantana		E
<i>Myrcianthes fragrans</i> (= <i>Eugenia simpsonii</i>)	Simpson Stopper		T
<i>Opuntia stricta</i>	Shell Mound Prickly Pear Cactus		T
<i>Osmunda cinnamomea</i>	Cinnamon Fern		CE
<i>Peperomia humilis</i>	Pepper (no common name)		E
<i>Scaevola plumieri</i>	Inkberry		T
<i>Tillandsia balbisiana</i>	Inflated (Reflexed) Wild Pine		T
<i>Tillandsia utriculata</i>	Giant Wild Pine; Giant Air Plant		E
<i>Verbena maritima</i>	Coastal Vervain		E
<i>Verbena tampensis</i>	Tampa Vervain		E

*Historically (but not recently) found at the Refuge

Key: E = Endangered T = Threatened SSC = Species of Special Concern CE = Commercially Exploited

erosion, and elevated nutrient loading and pollution in nearby waterways. Other threats include large storms and nest predation; the main predators at sea turtle nests are raccoons and ghost crabs, while ground nesting birds are heavily affected by feral and free ranging domestic cats. In some sections within the developed areas of the beach, predation claims up to 100 percent of sea turtle nests.

But things are looking up for the refuge. Historically, the Archie Carr and Pelican Island refuges were managed by just one man and one boat. More recently, they received permanent staff to assist the Refuge Manager: a Biologist, a Biological Technician, and a Refuge Ranger. Term or temporary staff include an Administrative Assistant, seasonal Biological Technician, and a Refuge Operations Specialist. Working with the partners, the new staff will help ensure that we continue to protect these special beaches.

Later in the summer, when the amphibious assault is just a memory, millions of sea turtle hatchlings will bubble out of the sand from their warm underground nests. The moon's glow on the water will guide them back to the ocean and the Gulf Stream to begin the process anew.

For more information about the Archie Carr NWR, contact the Refuge Manager, Paul Tritaik at 772/562-3909, ext. 244. Cheri M. Ehrhardt, AICP, is the Natural Resource Planner at the Merritt Island NWR Complex.



Observing a nesting loggerhead.

USFWS photo

Table 2. Refuge Partners

Brevard Zoo
 California Turtle and Tortoise Society
 Caribbean Conservation Corporation
 Columbus Zoo
 Defenders of Wildlife
 Disney Corporation
 Florida Affinity, Inc.
 Florida Defenders of the Environment
 Friends of the Carr Refuge
 Greenpeace
 Hubbs-Sea World Research Institute
 Indian River Land Trust
 International Fund for Animal Welfare
 Marine Resources Council
 national, Florida, and local Audubon societies
 national, Florida, and local Sierra clubs
 National Wildlife Federation
 The Nature Conservancy
 New York Turtle and Tortoise Society
 Ocean Conservancy
 RK Mellon Foundation
 The Sea Turtle Center
 Sea Turtle Preservation Society
 Sea Turtle Survival League
 The Wilderness Society

by Linda Laack

Community Helps Save Laguna Atascosa's Wildlife



A pair of aplomado falcons comes to rest on a yucca at Laguna Atascosa NWR while ocelot kittens await their mother. Both species are among the diverse array at wildlife breeding at the refuge.

Top photo by Tim Cooper, bottom photo by Linda Laack

While piping plovers (*Charadrius melodus*) search for flies along the shore of the Laguna Madre on the south Texas coast, a pair of aplomado falcons (*Falco femoralis*) rests atop a nearby yucca and scan the grasslands for prey. A quarter-mile away lies a recumbent ocelot (*Leopardus pardalis*) hidden beneath a dense canopy of thorny brush, relaxing after an active night of hunting. Despite such disparate lifestyles and habitat needs, these endangered species all reside at the Laguna Atascosa National Wildlife Refuge. The 65,000-acre (26,000-hectare) refuge is not only home to nine endangered or threatened species, it is also an important wintering waterfowl area, a Western Hemisphere Shorebird Reserve Network site, and—at 410 species—boasts a greater variety of bird life than any occurs on other National Wildlife Refuge.

The diversity of wildlife at Laguna Atascosa is related to its unique network of habitats: intertwining coastal prairies and Tamaulipan thornscrub interspersed with brackish and freshwater wetlands. These habitats stretch along a pristine shoreline adjoining the Laguna Madre, a hypersaline lagoon between the refuge and South Padre Island. Each of these habitat types has its own association of species.

The aplomado falcon prefers the coastal prairie. Once a common component of the grasslands of the southwestern United States, it declined dramatically during the early 1900s and was extirpated in the United States by the 1950s. The Fish and Wildlife Service listed it as endangered in 1986. The Peregrine Fund, Inc. (PF), a nonprofit organization dedicated to conserving birds of prey, has taken the lead in recovering this species. The PF has a

captive breeding population of aplomado falcons at its World Center for Birds of Prey in Boise, Idaho. The captive birds provide a source of chicks for reintroduction into the wild. The PF has released 812 young falcons into South Texas since 1985. Many of these released birds are now nesting and rearing young in the wild. In 2002, 27 nests were located in south Texas.

Laguna Atascosa has provided financial and logistical support, vehicle and equipment use, and housing for PF field staff since the inception of the reintroduction efforts. The PF initially focused its efforts at the refuge, but it quickly ran into a “good” problem. The release sites at Laguna Atascosa were becoming occupied by breeding pairs, requiring the PF to look for additional release sites elsewhere. Since most aplomado falcon habitat in Texas is privately owned, it was important to partner with landowners. In 1997, the PF and the Service developed a plan for the reintroduction of aplomado falcons known as a Safe Harbor Agreement for private landowners. This agreement provides protection for landowners from potential land-use restrictions imposed by the Endangered Species Act and has allowed access to more than one million acres (404,000 ha) of privately owned habitat for reintroduction efforts. In addition to private lands, the PF started releasing aplomado falcons at nearby Matagorda Island and Aransas NWRs, and they are now nesting on these refuges, too.

In contrast to the open spaces that appeal to aplomado falcons, ocelots are denizens of the concealing tangle of vegetation found in thornscrub communities. Laguna Atascosa is one of the last

strongholds for these rare felines in the United States. We estimate that fewer than 100 ocelots remain in the U.S., all in south Texas. About 30 to 40 live in and around the refuge. The same year the ocelot was listed as endangered (1982), the first radio-telemetry ocelot study in Texas was initiated to learn about their natural history and habitat requirements. For 20 years, Laguna Atascosa staff, volunteers, and visiting researchers have monitored the Laguna Atascosa population by tracking the movements of 5 to 10 radio-collared ocelots annually.

As with many species, the main cause for the decline of the ocelot in south Texas has been habitat loss and fragmentation. Conversion to farmland took a heavy toll, particularly during the mid-1900s. Today, however, urban sprawl is a greater threat. Programs have been started to protect habitat on private lands near the refuge. In 1992, the Service signed a cooperative agreement with an irrigation district near the refuge whereby the district agreed to clean their irrigation ditches from only one side, leaving the other side of the ditches vegetated so ocelots could freely travel along them. In addition, the Service has acquired easements on more than 2,500 (1,010 ha) acres of private land near the refuge, allowing landowners to continue their normal ranching practices but ensuring that ocelot habitat will be secure in the future. Laguna Atascosa also participates in a collaborative effort between landowners, Texas Parks and Wildlife Department, and several nonprofit groups to restore small but critical tracts of ocelot habitat near the refuge on previously cleared areas.

The Service also works with the Texas Department of Transportation (TxDOT) to reduce ocelot road mortality. Being struck by vehicles is the leading cause of death for ocelots in Texas. The Service and the TxDOT are trying to reduce this danger by constructing underpasses in key ocelot crossings. Several underpasses have already been installed and more are planned for the future.

The nonprofit organization, Friends of Laguna Atascosa National Wildlife Refuge, is also involved in ocelot conservation. Its volunteers started an "adopt-an-ocelot" program to raise funds for these cats. For a small donation, people receive an information packet and can "adopt" one of the radio-collared ocelots. The Friends group also sponsors an annual ocelot festival which involves the local community in ocelot conservation. About \$30,000 has been raised for ocelots with these two activities. Friends of Laguna Atascosa enhances this money by partnering with other groups, matching funds for the purchase and restoration of habitat.

Every endangered species program needs to involve landowners and local communities. After years of effort, the aplomado falcon, the ocelot, and many other species at Laguna Atascosa are benefitting from these activities. Though often a struggle, these programs have proven to be some of the most rewarding and beneficial aspects of endangered species work in south Texas.

Linda Laack is Wildlife Biologist at Laguna Atascosa NWR (956/748-3607, linda_laack@fws.gov).

Linda Laack with a collared ocelot.
Photos by Tim Cooper



by Philip A. Frank, Barry
W. Stieglitz, Jay Slack, and
Roel R. Lopez

The Key Deer: Back From the Brink



Photo by John and Karen Hollingsworth

The Key deer (*Odocoileus virginianus clavium*) is the smallest subspecies of the white-tailed deer, and it occurs on only a few islands in the Lower Florida Keys at the southern tip of the Florida peninsula. Hunting Key deer was popular in the 1920s, leading local residents and conservationists to fear it was on the brink of extinction. Concern about these animals came to national attention through a 1934 cartoon by “Ding” Darling, who referred to them as “toy” deer. This dramatic illustration showed these tiny deer being forced from their thick island forests into the ocean where they were killed by dogs and club-wielding men.

In 1939, the State of Florida banned the hunting of Key deer, though illegal hunting continued. Numbers fell to about 100 deer in the 1940s. In 1947, public sentiment was again stirred by 11-year-old Glenn Allen from Miami. Allen organized Boy Scouts and others in a letter-writing campaign that led to the establishment of National Key Deer Refuge in 1957. The refuge provides protection for Key deer, several other threatened and endangered species, and a diversity of semi-tropical plants and animals. The approximately 8,600 acres (3,475 hectares) includes 2,280 acres (920 ha) of federally designated Wilderness. Although legal protection for Key deer began in 1939, the Key deer was formally listed as endangered by the U.S. Fish and Wildlife Service in 1967 under a precursor to the Endangered Species Act of 1973.

The recovery plan for the Key deer is contained within the 1999 South Florida Multi-Species Recovery Plan. The efforts identified in the plan are intended to improve the status of the Key deer by

protecting, managing, and restoring habitat, increasing population size, and expanding the Key deer’s range. Habitat protection in the form of land acquisition has been quite successful, with State and local agencies contributing significant lands to those previously acquired by the Service. For example, acquisition on Big Pine and No Name Keys, the core range of the Key deer, has resulted in the protection of approximately 70 percent of these two islands. While future acquisitions are anticipated, the bulk of the quality habitat on these critical islands has been acquired. Habitat management for Key deer includes prescribed fire, invasive plant control, and habitat restoration. The National Key Deer Refuge has an active habitat management program that includes State and municipally owned lands as well as Service owned lands. In addition, a Habitat Conservation Plan being prepared for Big Pine and No Name Keys by Monroe County and the State of Florida is nearly complete, and will result in the protection of virtually all significant Key deer habitat in the core area. The progress that has been achieved in protecting habitat on the core islands, both through fee simple acquisition and regulatory measures, has resulted in increased security for the Key deer population as a whole.

The early legal protections afforded Key deer, along with habitat protection and management by the refuge and its partners, have dramatically improved the core population of Key deer. A study of Key deer (Lopez 2001) estimated the total population is between 700 and 800, with the population on Big Pine Key and No Name Keys estimated to be 600 and another 100 to 200 on other islands.

Additional data on herd population dynamics, patterns of browse and the condition of the vegetation, and the prevalence of density-dependent diseases observed in the population also suggest that the Key deer may be at or near their biological carrying capacity on Big Pine and No Name Keys.

A major part of the recovery plan for the Key deer that has not yet been initiated involves ensuring that Key deer are distributed throughout their historic range, rather than concentrated on Big Pine and No Name Keys. The historic range of the Key deer extended from Little Pine Key to Key West, a distance of approximately 40 miles (64 kilometers), and the current range includes approximately 26 islands from Big Pine Key to Sugarloaf Key. Populations of Key deer at the western edge of the range have declined dramatically since the 1970s, and only a few deer inhabit Sugarloaf and Cudjoe Keys (Lopez 2001). The Service has committed to implementing this aspect of the recovery plan by augmenting the existing Key deer populations on Sugarloaf and Cudjoe Keys with individuals taken from Big Pine and No Name Keys. In addition to a direct numerical increase in these small populations, the augmentations will enhance the limited gene pool of these largely isolated populations.

A previous translocation in 1999 that involved moving three Key deer from Big Pine Key to Little Pine Key was unsuccessful; two of the three translocated deer swam back to Big Pine Key. Because of this homing behavior, Key deer will be translocated to Sugarloaf and Cudjoe Keys using “soft release” techniques, where deer are maintained in enclosures for several months to assist in developing site fidelity. We anticipate moving approximately eight deer (equal numbers of males and females) per year to each island in each of three consecutive years. All translocated deer will be fitted with radio transmitters that will allow biologists to monitor them. Success will be measured by the survival and reproduction of the translocated deer.



THE SMALLEST SPECIES OF DEER IN NORTH AMERICA. ALONE, UNGUARDED AND ON THE WAY OUT!

We hope that this translocation effort will ensure the persistence of these small but important populations and represent a major step in the ongoing efforts to recover the Key deer.

Philip A. Frank is Project Leader of the National Key Deer Refuge (Big Pine Key, Florida); Barry W. Stieglitz is the Deputy Chief, Division of Conservation Planning & Policy for the National Wildlife Refuge System (Arlington, Virginia); Jay Slack is the Project Leader for the FWS South Florida Ecological Services Office (Vero Beach, Florida), and Roel R. Lopez is an Assistant Professor in the Department of Wildlife and Fisheries at Texas A & M University (College Station, Texas).

References:

- Lopez, R.R. 2001. Population ecology of the Florida Key deer. Ph.D. Dissertation. Texas A&M University, College Station. 202 pp.
- U.S. Fish and Wildlife Service. 1999. South Florida Multi-Species Recovery Plan, Key Deer Recovery Plan. U.S. Fish and Wildlife Service, Vero Beach, Florida.



Top: This 1934 cartoon by “Ding” Darling sparked national concern for the Key or “toy” deer.

Above: Researchers release a collared Key deer.

USFWS photo

by Erin Kulynycz

Research on Fox Squirrel Reaps Rewards

National Wildlife Refuges, such as Chincoteague NWR in Virginia, have been instrumental in providing habitat and contributing to the knowledge of Delmarva fox squirrels (*Sciurus niger cinereus*). At Chincoteague, University of Maryland Eastern Shore graduate students (who are also U.S. Fish and Wildlife Service employees) have conducted valuable research on the local squirrel population.

The Delmarva fox squirrel is one of the largest tree squirrels in the Western Hemisphere, achieving a body mass of 0.8 to 1.4 kilograms (1.8 to 3 pounds). It once ranged throughout the Delmarva Peninsula of Delaware, Maryland, and Virginia, and up into southeastern Pennsylvania and southern New Jersey. This squirrel prefers to forage and travel

on the ground and selects mature forests with relatively open understories.

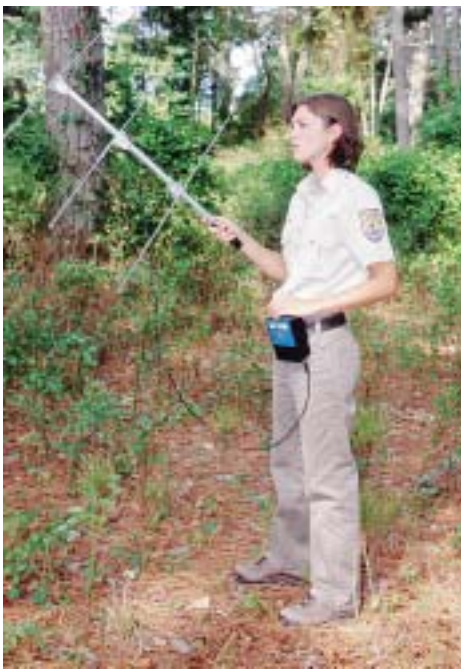
The primary cause for the decline of this species, which led to its 1967 listing as endangered, is the loss of these open mature forests in the region. Its range has been reduced to 10 percent of its historic distribution, where remnant populations are restricted to discontinuous areas on the Delmarva Peninsula. However, recent indications show its status is improving, and we may someday see it recovered. An important step toward recovery is research, so biologists can learn more about the species and monitor the effects of management activities on the populations.

As part of the recovery program for Delmarva fox squirrels, 30 squirrels were released at Chincoteague from 1969 to 1971. Research conducted by Service Biologist Kendra Willett in 2001 indicates that this translocation site was successful and that Chincoteague is now home to a stable population of Delmarva fox squirrels. Willett focused her study on the effects on the squirrels of timber that was removed because of an infestation of southern pine beetles (*Dendroctonus frontalis*). In addition, she learned about home range, population size, and monitoring techniques.

To assess the population, Willett and refuge staff trapped squirrels in the spring and fall using cage traps baited with pecans. Each squirrel was marked using Passive Integrated Transponder (PIT) tags, which are inserted under the skin for individual identification. These tiny cylindrical capsules contain microchips with copper coils. The microchip is encoded with a 10-digit identification number and is only activated with a scanner; therefore, a PIT tag can have a

USFWS photo





Left: Erin Kulynycz tracks radio-collared Delmarva fox squirrels.
Photo by Robert E. Wilson

lifespan of 99 years. Using this technology, each squirrel received a permanent identification number that aids with monitoring the population and individuals. Willett's comparisons to standard ear tags demonstrated that PIT tags are a superior way to mark the squirrels because of a lower rate of loss and lack of effect on the animal's health or activities. Ear tags, which can be torn from the ears and cause infections, are no longer used by the refuge because of Willett's findings. Based on the capture pattern of individual squirrels, Willett used population models to estimate the number of Delmarva fox squirrels at Chincoteague NWR at approximately 180 squirrels.

Another important component to Willett's research was home range analysis. Refuge staff attached radio-collars to individual squirrels and tracked them to assess the response to timber harvest. (Using radio collars allows biologists to track the animals frequently from a distance without subjecting them to undue disturbance.) Biological technicians recorded the locations using Global Positioning System (GPS) units. These locations were entered into a Geographic Information System (GIS) computer program to determine the home range size and the types of habitat that are most important to the squirrels.

Willett found no changes in home range size due to the removal of infested trees. This indicates that the population has the necessary resources in the available habitat to maintain stability. Fundamental to the recovery program is the translocation of squirrels off the refuge to suitable sites. The population at Chincoteague could be used for future translocations if it continues to be viable.

Ongoing research focuses on improving habitat at Chincoteague by studying the effects of prescribed fire on Delmarva fox squirrel habitat use. Because the squirrels prefer open understories and mature trees, biologists hope to use prescribed fire to reduce the thick vine and shrub layer of the forest. Through techniques similar to those used by Willett, movements of squirrels between a burned and unburned site will be compared. Refuge staff also conducted vegetation surveys to determine changes in composition due to fire. Mast trees important to the squirrels are red maples (*Acer rubrum*), loblolly pines (*Pinus taeda*), and oaks (*Quercus* spp.). The removal of understory vegetation, such as greenbrier (*Smilax rotundifolia*), would aid in the movement and predator vigilance of the Delmarva fox squirrel. This study will be the first of its kind to assess the effects of prescribed fire on fox squirrels. We hope the fire, planned for the spring of 2003, will provide a new tool for managers and landowners to improve the status of Delmarva fox squirrels and make habitat more suitable throughout the region.

Future studies will test high-tech methods to improve capture techniques. Innovative methods such as using DNA analysis on hair samples taken by "sticky traps," rather than actually catching squirrels, will be studied as well as using cameras and laser sensors at bait sites to assess the presence of Delmarva fox squirrels in new areas.

Erin Kulynycz works at the refuge through the Student Career Experience Program (757/336-6122, email: erin_kulynycz@fws.gov).

by Cathy Henry

Refuge for an Ice Age Survivor



Shell markings are used in mark/recapture studies to monitor the snail's population.

USFWS photo

A tiny snail, a relict from the last great ice age, finds its home on a cool, rocky slope near the coldwater streams, cliffs, valleys, and sinkholes that make up the Driftless Area National Wildlife Refuge in Iowa. The endangered Iowa Pleistocene snail (*Discus macclintocki*) has known the meaning of refuge in more ways than one. Known from fossil records to have existed 400,000 years ago, it is one of many glacial relict species that are found in the region of northeast Iowa, northwest Illinois, southeast Minnesota, and southwest Wisconsin called the driftless area.

The rugged driftless area got its name because of early geologists' inability to find evidence of glacial drift. Though much of the area was indeed covered by glaciers about 500,000 years ago, it was bypassed by subsequent glaciers. The Iowa Pleistocene snail found its current home with desirable temperature, moisture, and food resources about 10,000 years ago as ice age conditions moderated. Certain slopes, usually north facing, are covered with a talus layer that allows ice-cooled air to exit from underground cracks and fissures. Upland sinkholes contribute to the air flow regime and are an important component of a unique system called an algific talus slope, meaning a cold producing rocky slope. Even when the outside air temperature is 90 degrees F (32 degrees C), ground temperatures on these slopes range from close to freezing (32 degrees F, or 0 degrees C) to about 55 degrees F (13 degrees C). Although the slopes will freeze in winter, the temperatures are moderated.

The Iowa Pleistocene snail now occurs nowhere else in the world but at 37 algific talus slopes in Iowa and Illinois. It was thought to be extinct until discovered in 1955 in northeast Iowa, and it was listed in 1977 as endangered. The snail is no bigger than a shirt button in diameter. It lives in the leaf litter, preferring a diet of birch and maple leaves. The snail shares its habitat with a



Right: The Northern wild monkshood is just one of the rare plants protected on the Driftless Area NWR.

Photo by Bob Clearwater



Diagram courtesy of The Nature Conservancy

host of rare and disjunct plants associated with cool habitats. The Northern wild monkshood (*Aconitum noveboracense*), a threatened plant, also grows on these sites. It is a member of the buttercup family (Ranunculaceae) and derives its name from the hood shape of its flowers, which are adapted for bumblebee pollination. Occurring on approximately 114 sites in Iowa, Wisconsin, Ohio, and New York, monkshood also grows on similar cool moist habitats such as sandstone cliffs.

The 775-acre (315-hectare) Driftless Area National Wildlife Refuge was established in 1989 to protect habitats of the Iowa Pleistocene snail and Northern monkshood. The primary objective of their respective recovery plans is providing protection for remaining colonies. Once lost, the specialized habitat cannot be restored. Concern over threats to the habitat stem from logging, grazing, filling of sinkholes, agricultural runoff, roads, and quarries. The invasion of garlic mustard (*Alliaria petiolata*) has emerged as another threat in recent

years, and the potential effects of modern global warming are yet another concern.

The refuge consists of scattered tracts of land in northeast Iowa ranging from 6 to 208 acres (2.4 to 85 ha) in size. Algific talus slopes range in size from a few square meters to 0.5 mile (0.8 km) in length. Adjacent sinkholes are also targeted for acquisition since they feed the underground system with water and airflow. Buffer areas around the slope are included when possible. Refuge partners are also protecting algific talus slopes. The Nature Conservancy, Iowa Natural Heritage Foundation, Mississippi Valley Conservancy, the Iowa Department of Natural Resources, County Conservation Boards in Iowa, and public agencies in Ohio and New York own and protect habitat for these species. Further acquisition by the refuge is planned to help meet recovery goals. A 1993 expansion proposal is being considered under recently initiated comprehensive conservation planning for the refuge to include counties in



Golden saxifrage

Photo by Bob Clearwater

Minnesota where the threatened Leedy's roseroot (*Sedum integrifolium* spp. *leedyi*) occurs. Listed in 1992, this plant occurs on only four sites in southeast Minnesota and three in New York. Refuge expansion would provide more protection for the Northern monkshood and other glacial relict snails as well. In a cooperative effort with the refuge, Iowa

Right: Nature Conservancy intern Connie Dettman and refuge biologist Cathy Henry monitoring Iowa Pleistocene snails.

USFWS photo



and Wisconsin recently received Endangered Species Act-section 6 recovery funding to purchase two Northern monkshood sites.

At least eight other glacial relict snail species are also protected on these sites. Species like the midwest Pleistocene vertigo (*Vertigo hubrichti hubrichti*) may be more rare than the Iowa Pleistocene snail. Protection of algific talus slopes may help prevent the need for threatened or endangered status for these other snails and plants like the golden saxifrage (*Chrysosplenium iowense*).

There are over 300 algific talus slopes in the driftless area, with varying species components. Private landowners are stewards of many algific talus slopes. Landowners with endangered species on their property have been contacted by the refuge and The Nature Conservancy. Funding under the Service's Endangered Species Landowner Incentives Program allowed voluntary fencing to be completed to exclude cattle from five algific talus slopes.

Of course, the goal is recovery. To gauge progress over the years, we are monitoring the Northern monkshood and experimenting with monitoring methods for the Iowa Pleistocene snail. A mark-recapture study was initiated in 2000 with the assistance of Iowa State University. The Nature Conservancy of Iowa placed an intern at the refuge office recently to conduct monitoring and work on TNC preserves. The Iowa DNR has assisted with monitoring and identification of acquisition sites. With all of these efforts, barring effects of global warming, these species can someday be recovered as secure representatives of ice age history.

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“Habitats” Featured on *Geography Action!*

by Nancee Hunter



Reaching over 70 million people annually with messages of conservation and stewardship, the National Geographic Education Foundation's *Geography Action!* program has been successful in promoting community-based stewardship projects that promote conservation of our sustainable resources. This year, the *Geography Action!* program will partner with the National Fish and Wildlife Foundation and the U.S. Fish and Wildlife Service to focus on "Habitats."



The list at the left provides a sampling of the many resources available on the *Geography Action!* web site. This site was developed to help educate teachers and students, their families, and community members about habitat diversity (focusing on both terrestrial and marine habitats), the current threats to natural habitats, and habitat protection and restoration. With an underlying focus on geographic interconnectedness, the content will have a special focus on National Wildlife Refuges (in conjunction with the centennial of the National

Wildlife Refuge System). Other highlights will include endangered species, loss of wild habitats, current issues related to habitats, and wildlife issues in general.

Beyond the classroom, the Society's Education Foundation will work with educators in such organizations as federal land management agencies, conservation organizations, botanical gardens, and zoos and aquaria to craft an educational outreach program that educates, inspire, and excites the public about the habitats upon which both wildlife and people depend. The centerpiece of this campaign is the "Be a Habitat Hero" challenge. Students are encouraged to identify and participate in select activities, from building a backyard or schoolyard habitat to volunteering at a local park or refuge. As they become actively involved in meaningful stewardship projects, the urgency, necessity, and spectrum of intervention should become apparent, reinforcing messages of habitat conservation.

For more information about this program, visit the *Geography Action!* website at www.nationalgeographic.com/geographyaction.

Nancee Hunter is the Program Manager for the National Geographic Society's Education Foundation (email: nhunter@ngs.org, 202/775-6740).

Bringing Tiger Beetles Together

by Michelle Babione



Puritan tiger beetle
Photo by Phil Nothnagle

*P*uritan tiger beetles (*Cicindela puritana*) are found in only two places in the world: the Connecticut River in New England and a small part of the Chesapeake Bay in Maryland. This unusual species has already disappeared from most of its historical range in New England, and Maryland populations are threatened by habitat loss and degradation (U.S. Fish and Wildlife Service 1993). Due to declining populations and continuing threats, the Puritan tiger beetle was listed in 1990 as a threatened species.

The Puritan tiger beetle lives on sandy shores along fresh and brackish watercourses. It has a two-year life cycle, spending 23 months of its life underground as a larva. This efficient predator plugs the top of its tunnel with its flat head and attacks unsuspecting insects when they wander too close. The larva uses hooks along its sides as an anchor to prevent it from being dragged out of its tunnel.

As an adult, the tiger beetle is one of the top insect predators on the beach. It uses its large eyes to identify its prey, runs after it at burst speed, and then pauses, apparently to relocate its quarry. This behavior of running interspersed with pausing and looking has led researchers to believe that tiger beetles run so fast that they cannot see to follow their prey (Pearson and Vogler 2001).

The tiger beetle's prowess as a hunter is comparable to its tenacity as a courtier. Even though its copulation requires only a few minutes, male Puritan tiger beetles have been documented riding the backs of females for up to 6 hours (Davis 2002). Because it is likely that a male's sperm will be used to fertilize the female's eggs only if he was the last to mate with her, one theory for this

guarding behavior is that it safeguards the male's contribution.

Unfortunately, this prolonged coupling makes a mating pair largely immobile and therefore highly susceptible to interference from humans. In Massachusetts, more than 150 people per day have been observed using the sunny Connecticut River beaches that Puritan tiger beetles call home (Abbott 2001). Beachgoers disrupt copulation behaviors and disperse the beetles as the insects pursue other activities critical to their survival, such as hunting (personal observation).

For the last six years, the Silvio O. Conte National Fish and Wildlife Refuge, the Fish and Wildlife Service's New England Field Office, the Massachusetts Natural Heritage and Endangered Species Program, and the Connecticut Department of Environmental Protection have worked together to fund research



Right: The beetle and one of its beach habitats.

Top photo by Phil Nothnagle; bottom photo by Michelle Babione

and management on the precarious populations of Puritan tiger beetles in New England. All of the species' New England habitat falls within Conte NWR.

The Chesapeake Bay shoreline is the stronghold for this species. New England populations are less numerous and have experienced a precipitous decline in the past century. The construction of dams and other habitat losses along the Connecticut River have reduced the number of documented populations in the region from 11 to 2 (U.S. Fish and Wildlife Service 1993).

The two remaining New England populations are in Massachusetts and Connecticut. Connecticut boasts the larger of the two populations, with 947 adults counted in 2001 (Davis 2001). When the Massachusetts population was discovered in 1987, 100 to 200 adults were observed, but population sizes in recent years have been much lower, wavering from 32 to 41 adults per year between 1998 and 2001 (Davis 2001). This population of Puritan tiger beetles has become precariously close to becoming extirpated.

Because of low numbers, researchers proposed that the adult beetles in Massachusetts may be having a difficult time finding each other and reproducing on the long beach (approximately 2,600 feet, or 790 meters), which is regularly crowded with sunbathers. Three years ago, it was decided to augment the Massachusetts population with beetles from the Connecticut site. In 2000, 38 larvae were translocated to Massachusetts (Nothnagle 2001), supplemented by 60 in 2001 (Nothnagle 2002) and 65 in 2002 (Davis 2002).

The augmentation seems to be working. In 2002, adult counts in Massachusetts reached a record total of 112 individuals (Davis 2002). We hope the larger population size will increase the probability of reproductive success. This is an important step toward the ultimate goal of 500 to 100 adults in two populations in Massachusetts (U.S. Fish and Wildlife Service, 1993).



Eileen West, a refuge volunteer, posts a sign marking beetle habitat.

Photo by Beth Goettel

Research conducted in Connecticut has shown that the limiting factor for successful Puritan tiger beetle survival is sand grain size (Omland, 2002). This is critical information for management, because it helps managers decide the best places for reintroduction. A number of sites in Connecticut have been found to be suitable habitat for Puritan tiger beetle reintroduction. The Service is currently funding this work in the hope of finding a suitable location for a new population.

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Literature Cited

- Abbott, B. 2001. The last known Puritan tiger beetle population in Massachusetts. A report submitted to the U.S. Fish and Wildlife Service Silvio O. Conte National Fish and Wildlife Refuge. Turners Falls, MA.
- Davis, C. M. 2001. Monitoring and census of the Puritan tiger beetle (*Cicindela puritana*): Connecticut River locations. Unpublished report to the U.S. Fish and Wildlife Service Silvio O. Conte National Fish and Wildlife Refuge, Turners Falls, MA.
- Davis, C. M. 2001. Puritan tiger beetle *Cicindela puritana* G. Horn (Coleoptera: Cicindela): monitoring of populations in Connecticut in 2001. Unpublished report to the Connecticut Department of Environmental Protection, North Franklin, CT.
- Davis, C. M. 2002. Monitoring and census of the Puritan tiger beetle (*Cicindela puritana*) along the Connecticut River. Unpublished report to the U.S. Fish and Wildlife Service Silvio O. Conte National Fish and Wildlife Refuge, Turners Falls, MA.
- Nothnagle, P. J. 2001. Population augmentation of the Puritan tiger beetle in Massachusetts. Unpublished report to the U.S. Fish and Wildlife Service Silvio O. Conte National Fish and Wildlife Refuge, Turners Falls, MA.
- Nothnagle, P. J. 2002. Population augmentation of the Puritan tiger beetle, *Cicindela puritana*, through transplantation of larvae to Massachusetts. Unpublished report to the U.S. Fish and Wildlife Service Silvio O. Conte National Fish and Wildlife Refuge, Turners Falls, MA.
- Omland, K. S. 2002. Larval habitat and reintroduction site selection for *Cicindela puritana* in Connecticut. Accepted, *The Northeastern Naturalist*.
- Pearson, D. L., and A. P. Vogler. 2001. Tiger beetles: the evolution, ecology, and diversity of the cicindelids. Cornell University Press. New York, NY.
- U.S. Fish and Wildlife Service. 1993. Puritan Tiger Beetle (*Cicindela puritana* G. Horn) Recovery Plan. Agency Draft. Hadley, Massachusetts. 43 pp.

by Hailey B. Hartman

Share the Beach: Teamwork for Turtles



**Loggerhead hatchlings head
for the ocean.**

USFWS photo

*F*ive blurry faces peer expectantly over the edge of a black tarp at a seemingly insignificant indentation in the sand. The silvery moonlight illuminates their anxious faces and the rippling, multifaceted surface of the nearby sea. Suddenly, the grains of sand shift, ever so slightly, and a tiny dark green flipper pokes out. Secretive smiles are shared all around the group and a quiet elation is felt by all present. Moments later, a little head emerges and tiny black eyes blink at the light while the sea turtle hatchling lays motionless, with only half of its small body visible. The little loggerhead is exhausted, but it still has a much greater journey ahead of it tonight. For now, the only thought on anyone's mind is one of simple joy: after months of waiting, the babies are finally here.

"Share the Beach" is a sea turtle conservation program, the result of the collaborative efforts in Alabama of the Fish and Wildlife Service's Daphne Ecological Services Field Office and Bon Secour National Wildlife Refuge; Gulf State Park; and numerous volunteers along the Alabama Gulf coast. Our mission is to monitor, protect, and minimize impacts to sea turtles and their hatchlings as part of a larger effort to enhance successful nesting along the Alabama coast. These goals are achieved through a variety of approaches, always combining biology with education so that the benefits of the activities extend beyond the actual relocation, hatching, or excavation of a nest.

The impact of the Share the Beach program on sea turtle nesting and



Photo by David Goethe

hatching is difficult to assess, as 2002 was only the program's second year. However, if you were to ask one of the many invaluable community volunteers, you would likely hear a response that resounds with praise for the program. Share the Beach functions primarily on the assumptions that people simply love these turtles, realize the detrimental effects that certain human activities have caused, and wish to contribute to sea turtle recovery.

Each morning during nesting season, volunteers and interns patrol more than 35 miles (56 kilometers) of Alabama's coastline, hoping to spot distinctive sea turtle "crawls" or tracks left in the sand by the nesting females. They then identify a potential nest area within the crawl, and dig carefully—using their hands in flipper-like motion—for the eggs. Once the eggs are found, initial data measurements are taken, a predator screen is placed in the sand column between the top layer of eggs and the surface of the sand, and the nest is marked by stakes, flagging tape, and yellow signs identifying it as protected under the Endangered Species Act. Most of the sea turtle nests along the Gulf Coast are dug by loggerheads (*Caretta caretta*), although some may be from green (*Chelonia mydas*) or Kemp's ridley (*Lepidochelys kempii*) sea turtles.

After 55 days of incubation, a black tarp is placed around the nest to limit light pollution, a trench is dug to funnel hatchlings straight into the sea, and our waiting begins. Each night for approximately the next 20 days, the nest receives the utmost attention of the Share the Beach program participants. "Nest-sitting" requires a generous donation of time, but the end result is well worth the effort. Volunteers use stethoscopes to listen for hatchling movements inside the nests and learn to recognize visual clues, such as a depression in the sand, indicating that hatching time is near. All observations are recorded in a waterproof notebook kept at each nest for that purpose.

The magical night (or occasionally day) of hatching typically arrives soon after the scratching sounds increase and a depression becomes apparent. According to textbook descriptions, nearly all the turtles in one clutch should emerge *en masse* in their exodus to the sea. However, this year, it appears that our hatchlings didn't bother reading the textbook! Hatching episodes have spanned multiple nights, from over 100 hatchlings in the span of half an hour, to the other extreme of trickling out one or two hatchlings over the course of five or six nights. All in all, it is a miraculous experience in which to participate, one that never fails to inspire the observer with a sense of wonder.

It's not just the Share the Beach volunteers that get to experience these events. Numerous beach visitors out for a late night stroll have happened upon a hatching and walked away enraptured with sea turtles. At the same time, these visitors are educated about how they can help protect these magnificent creatures. Thus, the message and passion of conservation are spread with every tiny turtle trek to the sea, and we can hope that one day our little bit of effort will have helped these great mariners of the deep along the road to recovery.

Hailey B. Hartman was a sea turtle intern/SCA conservation associate at Bon Secour NWR during the 2002 sea turtle season.



Hailey Hartman delights in examining a newly hatched loggerhead.

USFWS photo

by Steve Hensley

The Treasures of the Ozark Plateau



Top: Ozark big-eared bat

Photo by Brenda Clark



Bottom: Ozark cave crayfish

Photo by Steve Hensley

The Ozark Plateau ecosystem of eastern Oklahoma, western Arkansas, and southern Missouri boasts an exceptional assemblage of important hardwood forests, high quality rocky bottom clear streams, and unique springs and caves. It is also one of the fastest developing areas in the nation. In 1986, to conserve some of the region's richest biological resources, Congress established the Ozark Plateau National Wildlife Refuge.

The refuge is vital to ensuring the recovery of endangered and threatened Ozark cave species, reducing the need for future listing of additional species, and protecting large continuous stands of Ozark forest essential to interior forest nesting migratory birds. This refuge and additional areas are being protected through a partnership including private landowners, conservation and caving organizations, universities, tribes, and state and federal conservation agencies. With the help of these partners, management agreements have been developed with private landowners, and easements and lands have been purchased from willing sellers. The result is an ecosystem approach to protecting a variety of resources dependant on the Ozark's karst topography.

The Ozark Plateau NWR now consists of 10 tracts in Adair, Delaware, and Ottawa Counties, Oklahoma, totaling about 3,000 acres (1,215 hectares). Most are remote blocks of mature oak-hickory forest on the southwest edge of the Ozark Plateau bordering the Boston Mountains. They are underlain by Boone chert, a geological formation of alternating limestone and flint layers eroded to form steep hills, incised valleys, and prominent bluffs. Much of the drainage

is underground, feeding a number of springs and caves. The refuge encompasses much of the drainage from a number of high gradient, rocky bottom, spring-fed Ozark streams.

Federally listed threatened or endangered species and species of concern that benefit from the refuge are the endangered Ozark big-eared bat (*Corynorhinus townsendii ingens*), gray bat (*Myotis grisescens*), and Indiana bat (*Myotis sodalis*); the threatened Ozark cavefish (*Amblyopsis rosae*); and species of concern like the eastern small-footed bat (*Myotis leibii*), southeastern bat (*Myotis austroriparius*), southeastern big-eared bat (*Corynorhinus rafinesquii*), longnose darter (*Percina nasuta*), Ozark cave crayfish (*Cambarus aculabrum*), Bowman's cave amphipod (*Stygobromus bowmani*), Ozark cave amphipod (*Stygobromus ozarkensis*), bat cave isopod (*Caecidotea macropoda*), and Ozark chinquapin (*Castanea pumila* var. *ozarkensis*).



Right: Bill Howard, Conservation Chairman for the Tulsa Regional Oklahoma Grotto (TROG), examines one of the refuge caves.

Photo by Steve Hensley

Since 1981, the Oklahoma gray bat maternity colony population has increased from 56,600 to almost 150,000. Five gray bat maternity caves have been gated to prevent disturbance. Three of the caves maintain populations of about 10,000 bats each during the summer, and two maintain populations of around 20,000 each. The Ozark big-eared bat population in eastern Oklahoma and western Arkansas appears to be stable at about 2,000, with a few new sites continuing to be found. The Ozark cavefish and Ozark cave crayfish seem to be stable, although actual population sizes are unknown.

Caves and the creatures that live in them are greatly misunderstood. To many people, caves are just dark and forbidding places, and even researchers can find caves relatively inaccessible and difficult to study. But caves, their recharge areas, and surrounding habitats are extremely important to certain species. The wildlife of these caves serves as an indicator of the Ozark's environmental quality because it suffers from a number of the same factors affecting the human environment. Ground water quality is vital to the health of most cave dwellers as well as to the region's people who rely on wells for water. Some cave species provide more direct benefits to humans. For example, a colony of 20,000 endangered gray bats will eat about 160 pounds (73 kilograms) of night flying insects per night. Over the course of a summer, that is nearly 10 tons of insects. Many of these are mosquitoes, flies, and moths that are disease vectors or agricultural pests.

In addition to cave-dwelling species, the refuge protects a number of other valuable Ozark resources. These include habitat for about 200 species of migratory birds, as well as geological, archeological, historical, and paleontological resources that provide rich scientific and educational opportunities. Because of the sensitive nature of the Ozark Plateau resources, public use, educational programs, and scientific research are limited to the least intrusive activities. In one refuge cave, a palaeontologist is



Ozark cavefish

Photo by Art Brown

excavating a Pleistocene tapir skeleton. Survey teams are searching for unknown caves, mapping known caves, and documenting baseline conditions for environmental contaminants, vegetation, aquatic cave invertebrates, amphibians and reptiles, birds, small mammals, and listed bats and cavefish. Surveyors in one refuge cave have mapped 8.5 miles (13.5 kilometers) of passage, making it the longest known cave in Oklahoma and Arkansas. In addition, research is being conducted on ground water quality, cave salamander distribution, and bat genetics.

To conserve these valuable Ozark resources for future generations, it will be necessary for the refuge to continue protecting large stands of Ozark forest (including caves, springs, streams, recharge areas, and neotropical migratory bird habitat), improving public understanding of these resources, controlling access to important caves, developing and maintaining public/private partnerships, continuing resource surveys, and evaluating the need to protect additional resources that are vulnerable to this region's rapid development.

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The Dynamic Dunes

by Claudia Frosch



USFWS photo

As the sun sets over Bon Secour National Wildlife Refuge on Alabama's Gulf Coast, the silhouettes of the sea oats that grow on the frontal dunes, swinging slightly in the wind, stand in a breathtaking contrast to the deep red of the sky. This is the time when visitors to Bon Secour take their last photographs before the refuge closes for the night. It is also the time when one of its major beneficiaries comes to life: the endangered Alabama beach mouse (*Peromyscus polionotus ammobates*).

Light brown above with the white on its belly coming all the way up to the eyes, this elusive little creature of the night spends the daytime in burrows, waiting to come out and feed under the cover of darkness. Huge eyes and ears are custom-fit for a life in the shadows, and it is hard not to call it cute. However, their lifestyle makes beach mice almost impossible to be spotted in the wild, and very few people other than researchers have ever had the privilege to see one in its natural environment. Most people are not even aware of their existence, much less of their plight.

Beach mice are probably one of the most truly representative inhabitants of coastal dune ecosystems along the Gulf Coast, and as such are well adapted to living in a constantly changing environment. Sand dunes are highly dynamic, building up and eroding away with wind and water, and they can even be destroyed by hurricanes that frequent the area. Historically, beach mice would show the same dynamics as their habitat; local populations may suffer severely, but in the natural process of dune regeneration after a major impact, mice

would recolonize those areas from the surrounding, intact habitat. This strategy worked for the mice when they still occurred widely along the Gulf Coast, from Fort Morgan in the west to Perdido Pass in the east. However, in modern times, with increased beachfront development, habitat losses and fragmentation have had severe impacts on the Alabama beach mouse, which is now limited to a few isolated populations in the western portion of its original range. With decreasing patches of habitat, and increasing distance in between them, recolonization after destruction of a local population becomes highly unlikely, thus leaving the species as a whole extremely vulnerable to extinction. It is because of Bon Secour NWR, which protects some of the last remaining intact coastal ecosystems, that the Alabama beach mouse still survives.

Anyone who has ever been to the beaches of Bon Secour NWR will remember the view of the dunes, starting with the young, and still growing, primary dunes on the beach and stretching all the way back over more heavily vegetated secondary and tertiary dunes



Alabama beach mouse habitat at Bon Secour NWR.

Photo by George Gentry

on to the most “mature” oak-overgrown scrub dunes. While the preferred beach mouse habitat seems to be in primary and secondary dunes, recent research has shown that the older, interior parts of the system are also an important factor for the survival of the mice, especially as a retreat during critical times (such as hurricanes). Bon Secour NWR may be the last place on the Fort Morgan peninsula where one can still find this full successional spectrum of dunes of different ages.

The policy at Bon Secour is not only to preserve habitat but also to enhance it. In a continuing effort to help build back the dunes after several hurricanes in the 1990s, refuge personnel and volunteers install sand fences on the beach. These fences, in sea turtle-friendly 10-foot (3-meter) sections, are angled at about 45 degrees in order to capture the major prevailing winds (northwest and southeast). The wind that passes through the fence will slow down, causing the sand it carries to drop and settle around the fence, beginning the formation of a new dune. Scientific studies are documenting the recolonization by vegetation and monitoring its effect on beach mice.

The need for more research is significant, as many questions relating to beach mice, their habitat, and their ecology remain unanswered due to the elusive nature of these small, nocturnal animals. Bon Secour NWR serves as a natural laboratory, offering the site and facilities to enhance our knowledge about the Alabama beach mouse. At the same time, information is made available to the public in order to promote the mouse’s plight.

As the sun appears again on the horizon, the Alabama beach mouse is ready to retire into its burrow. Tomorrow will bring another night, hopefully one of countless more that will see beach mice survive to make their living in the dunes. As long as their remaining habitat is safeguarded within the boundaries of Bon Secour NWR, there is certainly hope.

Claudia Frosch is an Endangered Species Research Technician for Auburn University and is stationed at Bon Secour NWR in Gulf Shores, Alabama. In addition to her work with beach mice, Claudia volunteered more than 1,900 hours on other refuge projects in 2002.

Bon Secour NWR was established in 1980 to preserve more than 5 miles (8 km) 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 and three listed species of nesting sea turtles. Bon Secour, translated locally to mean “safe harbor,” provides habitat for more than 370 species of birds. Many of these are migratory species that complete the 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 over the Gulf of Mexico. The diverse habitats of the refuge, from 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 hosts university groups, interns, graduate students and scientists throughout the year.

by Heidi Hanlon

This Partnership is for the Birds!

The U.S. Fish and Wildlife Service (Cape May National Wildlife Refuge), U.S. Coast Guard (Loran Support Unit or LSU, not to be confused with the “Fighting Tigers” of Baton Rouge), and New Jersey Department of Environmental Protection (Division of Fish and Wildlife, Endangered and Nongame Species Program) have come together for a partnership to protect the federally threatened piping plover (*Charadrius melodus*). It began when the Coast Guard transferred 490 acres (200 hectares) of its land to the Cape May NWR in 1999, establishing the new “Two Mile Beach Unit”.

Cape May NWR was established in 1989 when 90 acres (36 ha) were acquired from The Nature Conservancy. The refuge is located in Cape May County, New Jersey, and includes the Delaware Bay Division, the Great Cedar Swamp Division, and the Two Mile Beach Unit. Cape May NWR currently

consists of 10,500 acres (4,250 ha) and is growing to reach its approved acquisition boundary of 21,000 acres (8,500 ha).

The refuge is located in one of the Atlantic Flyway’s most active flight paths, which makes it an important link in the vast network of protected wildlife habitat nationwide. Its value for the protection of migrating birds and their habitat continues to increase as the southern New Jersey area becomes developed. In 1992, the Delaware Bay wetlands within the refuge were designated one of 17 sites in the United States as a Wetland of International Importance under the Ramsar Convention. The refuge is also part of the Western Hemisphere Shorebird Reserve Network. Cape May Peninsula is considered by many as one of the “top 10 birding hot spots” in the country because of its migrating shorebirds, songbirds, raptors, and American woodcock (*Scolopax minor*).

The Two Mile Beach Unit is located within Lower Township, south of Wildwood Crest, where the beach is lined with condominiums and, in the summer, thousands of vacationers. To provide a feeding, resting, and nesting area for the beach-dependent birds, its beachfront is closed to all access from April 1 to September 30. Consequently, it is a haven for nesting and migrating shorebirds.

The Two Mile Beach Unit opened a series of trails on July 1, 2002, that lead visitors from the northern boundary behind the dunes and out the southern boundary to the adjacent LSU beach. The trail system also has two observation platforms to allow visitors to view shorebirds on the beach and other wildlife such as dolphins and brown pelicans (*Pelecanus occidentalis*) in the

Photo by Joe Brandt





Piping plover nests and eggs blend into the sand so well that they are vulnerable to being crushed by people using the beach during the nesting season.

Photo by John Gavin

ocean. This was done to maintain the integrity of the refuge beach for beach nesting and feeding shorebirds and to connect the public access on the Two Mile Beach Unit to the adjacent properties of Wildwood Crest and the LSU.

Since the opening of the trail system, the Cape May NWR and LSU have been working closely together to make sure symbolic fencing (posts connected by string and flagging) surrounds each nest with appropriate informative signs. This fencing is important to the survival of beach nesting bird species since these birds make depressions in the sand on the beach in which to lay their very well camouflaged, sand-colored eggs. Both agencies provided materials and manpower to put up the symbolic fencing. The partnership also enforced greater communication so that both agencies were always aware of birds using the beach and of chicks that may venture outside of the fenced areas to feed at the ocean's edge.

The Cape May NWR partners with the New Jersey Department of Environmental Protection to survey, monitor, and keep accurate records of federally and state listed species. The state has also provided technical support, manpower, and materials for establishing symbolic fencing at the Two Mile Beach Unit and LSU.

The New Jersey Department of Environmental Protection also partnered with the Service to provide an informa-

tion session for LSU and Cape May NWR employees on state and federally listed species that are seen on the beaches: the piping plover, least tern (*Sterna antillarum*), and black skimmer (*Rynchops niger*). Both agencies talked about how to identify the species, what their nests look like, their threats, fines, and penalties for the take of these species, and other issues regarding shorebirds and terns.

The 2002 beach nesting bird season at the Two Mile Beach Unit was a success with nesting by two piping plover pairs, a peak of 97 least tern pairs, and two American oystercatcher (*Haematopus palliatus*) pairs. Three piping plovers, 50 least terns, and one oystercatcher were raised. Black skimmers also attempted to nest and will hopefully be successful in the future. The numbers of beach nesting birds have increased since 2000 when there was only one piping plover, one least tern, and one American oystercatcher nest observed; two piping plover, two least tern, and one American oystercatcher chick resulted. The Service, Coast Guard, and New Jersey Department of Environmental Protection are committed to continuing this partnership for even greater success in the future.

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Beach protection has already benefitted the piping plover and other beach nesting birds.

Photo by Heidi Hanlon

by Amanda L. Avery

Hard Work Brings Results at Chincoteague



A piping plover chick walks the beach at Chincoteague NWR.

USFWS photo

Following the 1986 listing of the piping plover (*Charadrius melodius*) as a threatened species, Chincoteague National Wildlife Refuge, like other Atlantic coast refuges, developed an intensive monitoring and management plan for this beach-dwelling species. Implementation of the plan at Chincoteague NWR has yielded some impressive results.

Under the plan, off-road vehicles are prohibited from driving on potential plover nesting grounds on the refuge from March 15 to September 1 each year. In March and April, refuge staff conduct prenesting surveys, which involve searching the beaches for plover arrivals. Later, during the nesting season, biologists observe adult plover behavior. Once plovers display defensive behavior, such as piping and false incubation, the staff observes from a distance using binoculars or spotting scopes to see if the birds return to their nests. Upon discovery, nests are checked every few days to document egg loss. Nest visits

increase as the hatch date nears. Monitoring of newly hatched broods is intense for the first 6 to 8 hours of life, but later the broods are monitored only every 2 to 3 days until fledging. Management of piping plovers includes control of predators such as red foxes, raccoons, gulls, and crows.

Despite the increase in monitoring and management efforts from 1988 to 1998, fledgling success continued to fluctuate from year to year and fall short of the 1996 Piping Plover Recovery Plan's recommended rate of 1.5 chicks fledged per pair. Prior to 1999, plover fledge rates at the refuge exceeded the

Right: Chincoteague NWR staff sets up a piping plover nest enclosure.

Photo by Robert E. Wilson



recommended rate only once. Upon review of the previous 10 plover seasons (1988-1998), the major limiting factors on the refuge were found to be weather and predation. While the weather is beyond our control, predation can be managed. If the refuge staff could concentrate its efforts into minimizing the threat from predators, then maybe Chincoteague's piping plover fledge rate could reach the recovery plan's recommended rate on a consistent basis.

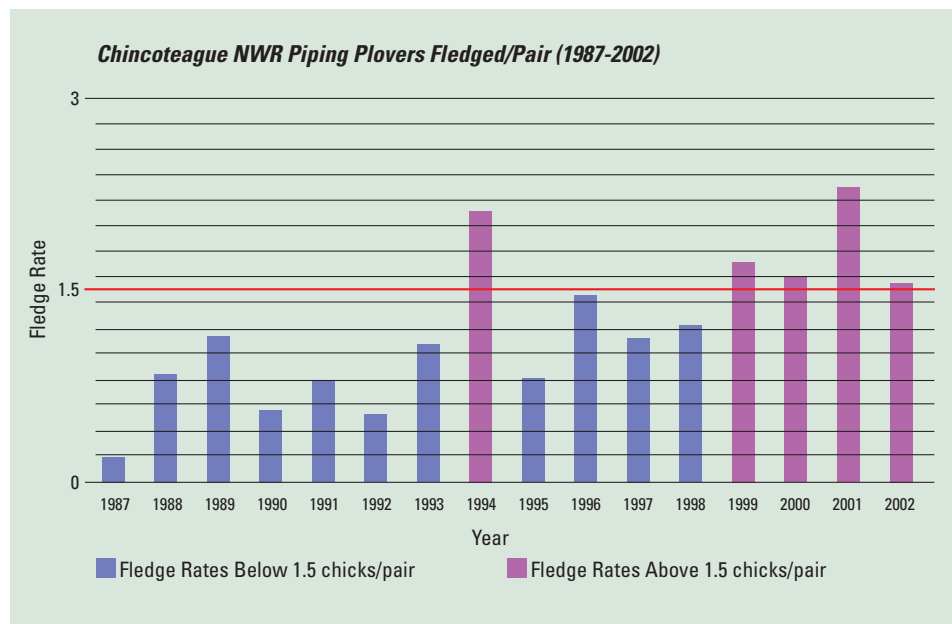
During the 1999 season, Chincoteague NWR further intensified its piping plover predator management and increased the amount of time spent monitoring nests and broods. Active trapping of foxes and raccoons on traditional plover nesting sites began in January and continued through July. Rope and "Area Closed" signs placed around plover nesting areas prevented off-road vehicle and pedestrian disturbance at plover nesting grounds from mid-March until the last chick of the season fledged. During the brood season, a staff member conducted avian predator control seven days a week, as gulls were suspected in many cases of lost chicks. Monitoring also increased, with interns being posted at the most vulnerable section of piping plover habitat, the Overwash, from 5:00 a.m. to 10:00 p.m. Interns located broods twice a day and chased gulls and crows out of the nesting area. All other broods on the refuge were located once a day until they fledged.

These intensified efforts came at considerable expense. In order to save money, the refuge hired eight interns for a \$100 per week stipend and provided housing. Even so, however, it still costs the refuge \$10,000 to run and support the rest of the piping plover program. Fortunately, for the past four years, the Service's Delmarva River/Delmarva Coastal Ecoteam has come to the rescue and provided financial support for this important recovery project.

This new, intensified monitoring approach has benefitted Chincoteague's piping plover program in several ways. The most prominent improvement has



Adult piping plover
USFWS photo
















been the increased fledge rates. For the past four seasons (1999-2002), the refuge has attained the 1996 Piping Plover Recovery Plan's goal of 1.5 fledglings per nesting pair (Figure 1). Most of this is due to the increased presence of staff and interns for monitoring piping plover nesting areas. This allowed time to concentrate on identifying the causes and times of nest and chick loss. The chance of not being able to locate broods because of movement decreased. If pedestrians and off-road vehicles pass into plover areas, interns and law enforcement can quickly resolve the situation. Because interns remained near plover nesting areas, public education also increased; visitors could inquire as to why sections of the beach were closed and thus learn more about the piping plover.

Figure 1: Fledge rates for piping plover chicks on Chincoteague NWR from 1987 to 2002.

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BOX SCORE

Listings and Recovery Plans as of January 31, 2003

GROUP	ENDANGERED		THREATENED		TOTAL LISTINGS	U.S. SPECIES W/ PLANS
	U.S.	FOREIGN	U.S.	FOREIGN		
 MAMMALS	65	251	9	17	342	53
 BIRDS	78	175	14	6	273	77
 REPTILES	14	64	22	15	115	32
 AMPHIBIANS	12	8	9	1	30	14
 FISHES	71	11	44	0	126	96
 SNAILS	21	1	11	0	33	22
 CLAMS	62	2	8	0	72	57
 CRUSTACEANS	18	0	3	0	21	13
 INSECTS	35	4	9	0	48	29
 ARACHNIDS	12	0	0	0	12	5
ANIMAL SUBTOTAL	388	516	129	39	1,072	398
 FLOWERING PLANTS	570	1	144	0	715	572
 CONIFERS	2	0	1	2	5	2
 FERNS AND OTHERS	26	0	2	0	28	28
PLANT SUBTOTAL	598	1	147	2	748	602
GRAND TOTAL	986	517	276	41	1,820*	1,000

TOTAL U.S. ENDANGERED: 986 (388 animals, 598 plants)

TOTAL U.S. THREATENED: 276 (129 animals, 147 plants)

TOTAL U.S. LISTED: 1,262 (517 animals**, 745 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.

** Nine animal species have dual status in the U.S.

ENDANGERED
Species
BULLETIN

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

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