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FROM THE EDITOR

The American chestnut declined quickly. In a mere 50 years it was virtually gone from eastern forests. There was little opportunity to examine the ecological niche that this mighty tree played in the natural ecosystems before that time. What interconnections did the American chestnut have with wildlife, insects and other trees and plants? We may never know the answer to these questions. Since the forest itself has changed, when we begin introducing the American chestnut back into eastern forests (hopefully within a decade), it will be to a different environment. Our reintroduction efforts may be hampered by a limited knowledge of potential ecological relationships, but we are doing our homework.

The American Chestnut Foundation seeks to fill in the gaps in our knowledge through the support of research efforts on existing stands, generally outside the original range of the American chestnut, where American chestnuts can exist free of blight for awhile. We also look at the lessons learned from similar efforts to reintroduce other species.

In the spring of 2000 The American Chestnut Foundation under the guidance of Dr. Hill Craddock, Vice President of the Science Cabinet, hosted a Symposium on Species Restoration at the Annual Meeting of the Association of Southeastern Biologists in Chattanooga, TN. Three of the five papers presented at that Symposium are published in this issue of *The Journal*. The purpose of the Symposium was to gather up the experiences from other efforts and identify those that may be useful in planning our efforts.

As you read about the longleaf pine, the whooping crane and the red wolf, you may wonder –0 how do these relate to the American chestnut? Each of these species once thrived before humans intervened and changed the landscape. Each has since languished, and each has a hope for a future in present ecosystems, thanks to human intervention.

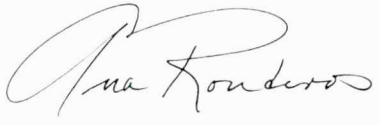
The three case studies presented here provide some insights into what elements might be beneficial for restoration of the American chestnut. Many innovative techniques have been used in efforts to reestablish the whooping crane, including separating flocks of cranes bred in captivity to ensure that disaster does not wipe them out. The American Chestnut Foundation's recent emphasis on establishing regional breeding centers

and capturing local genetic material may have a similar effect of protecting the restored American chestnut from future pests and diseases.

In the case of the red wolf, public information campaigns emphasizing the ecological and economic benefits of red wolves prior to the reintroduction of this predator – a perceived threat to livestock and pets – were found to be essential in garnering public support. Providing appropriate management information for those active in reintroductions also ensures success, as in the case of the longleaf pine where private landholders are provided guidance on proper management. The case studies all emphasize that, no matter the level of planning, there will always be setbacks and foibles, as in the accidental whooping-sandhill crane cross, a "whoophill" hybrid, that resulted from placing whooping crane eggs in sandhill nests in the hopes that the whooping cranes would learn to migrate from their foster parents.

As we begin to look at how to reintroduce the American chestnut, Dr. Carl Leopold introduces us to a book that captures the grandeur of chestnuts across the world. In his review of Professor Ernesto Vieitez Cortizo's compendium on chestnut, *El Castaño*, we are introduced to the age-old beauty of this tree and must surmise what legacy our present day efforts will produce hundreds of years into the future. In the center of this issue you will find a spread of color photographs that provide a glimpse at what *El Castaño* is all about.

And speaking of legacies, we also present a poem by Kally Bockenhauer, a fifth grader, whose family is itself forming a legacy of children ready to support future American chestnut reintroduction efforts.



THE AMERICAN CHESTNUT FOUNDATION SYMPOSIUM ON SPECIES RESTORATION

Held in occasion of the 61st Annual Meeting of the Association of Southeastern Biologists, April 5-8, 2000, Chattanooga, Tennessee.

J. Hill Craddock, Department of Biology and Environmental Sciences, University of Tennessee at Chattanooga.

The American Chestnut Foundation sponsored a symposium on species restoration as part of the 61st Annual Meeting of the Association of Southeastern Biologists (ASB 2000) held in early April 2000 in Chattanooga, Tennessee.

The purpose of the Symposium on Species Restoration was to draw on the experiences, successes and failures of other species restoration efforts. It is my belief that there are lessons to be learned from these efforts that can help TACF accomplish its mission; restoration of the American chestnut, *Castanea dentata*, to its former range in the eastern forests. The five papers that were presented at the Symposium were each very different from one another but all shared the sense of urgency that we feel for the American chestnut; we've got to do something before it's too late. Three of those papers are presented here in this issue of *The Journal.*

PHOTO BY T. A. WIEDWANDT

The scope of the Symposium included both plants and animals. A plant species on the verge of extinction was described in a case study of *Torrea taxifolia*, the rare and endangered Florida cedar. Sharon Hermann, of the Tall Timbers Research Station in Tallahassee, Florida reported on attempts to save *Torreya tax-*

ifolia. The loss of *T. taxifolia* may not appear to have the broad ecological significance of the chestnut blight pandemic, but many unanswered questions remain, especially concerning the basic biology and ecology of this troubled tree species.. The take-home message of Dr. Hermann's paper may well be that we cannot underestimate the enormity of the task at hand. The Florida cedar is disappearing from its native habitat despite the best efforts of researchers and cooperating land owners. This paper will appear in the Summer 2001 issue of *The Journal.*

David Loftis, Project Leader of the Bent Creek Experimental Forest in Asheville, NC, presented a silvicultural perspective on re-introducing American chestnut, based on the natural regeneration ecology of chestnut. Essential to the success will be a proper strategy for the conservation of chestnut genetic resources. A full report on the chestnut work of the Forest Service will be published in an upcoming issue of *The Journal.*

PHOTO COURTESY OF THE NATIONAL FISH AND WILDLIFE SERVICE

Dean H. Gjerstad, from Auburn University, spoke about the Longleaf Alliance, a regional effort to restore the longleaf pine ecosystem that was at the time of European settlement one of the most extensive forest types in southeastern North America. The longleaf story has many parallels to the American chestnut story and Dr. Gjerstadt conveys the message of cooperation and collaboration as the key to the species' restoration.

Animals were discussed in two of the Symposium papers. The social and political aspects of conservation and restoration were emphasized in the talk by Gary Henry, Red Wolf Coordinator for the US Fish and Wildlife Service. The recovery of red wolves (*Canis rufus*) gave us a set of guidelines for success based on lessons he learned in more than 20 years of work with the wild dogs.

George Archibald, director of the International Crane Foundation, gave a talk about efforts that have been underway to restore populations of

Whooping Cranes in North America, Siberian Cranes in western Asia and Wattled Cranes in South Africa. These great birds face seemingly insurmountable obstacles in their fight for survival. But the story of the whooping crane, saved from the brink of extinction in the 1940s, is an inspiration and a model for the conservation of other crane species throughout the world. Dr. Archibald's paper illustrates very well the importance of perseverance despite numerous setbacks, and the value of learning from mistakes, and how the future of the world's crane species will increasingly depend on international cooperation.

The American Chestnut Foundation published a poem written by Dakota Bockenhauer, at the time a fourth grader, in the Winter/Spring 1998 issue of *The Journal.* It was an inspiring endeavor. Not to be outdone by her brother, Kally Bockenhauer has also written a poem. She is a fifth grader at Mindoro-Melrose Elementary School in Mindor, WI. Kally read this poem as part of a presentation on the chestnut tree she gave at her school for Wisconsin Heritage Days.

Both Kally and her brother Dakota are very active helping their grandfather, member Ron Bockenhauer, take care of his chestnut trees. Each year the fourth grade class from their school comes for a field trip to the chestnut trees. Dakota started this when he was in fourth grade. Overall, 400 children have visited Ron Bockenhauer's chestnut trees.

SEED OF HOPE

by Kally Bockenhauer

I am just a little sprout,
awaiting to break the soil,
too helpless and fragile yet
to deal with nature's toil.

So underneath the blanket
of fallen leaves I must stay,
hidden from the squirrel,
an enemy of my prey.

In my parent's shadow,
I see them standing proud and tall,
I wonder if I'll make it
through the frosty fall.

Streaks of light shine on my head
and drips of dew splash on my face.
Winter has come and went
And spring has sprung by God's grace.

My parents say, I'm the seed of hope
and soon I too will be a mighty tree.
But from down here it is hard to tell
What the future holds for me.

memories

THE BIG, BEAUTIFUL CHESTNUT BOOK, EL CASTAÑO: A REVIEW

El Castaño, *by Professor Ernesto Vieitez Cortizo, President of the Real Academica Gallega de Sciencias and President of the Sociedad Española de Fisiologia Vegetal, with Maria Luisa Vieitez Madrinan and Francisco Javier Vieitez Madrinan*

Published in 1996 by EDILESA, Leon, España. 341pp. Color photographs by the author. Size: 12" x 30." Printed in Spanish.

Reviewed by Dr. Carl Leopold of the Boyce Thompson Institute of Plant Research, Ithaca, NY, and Ana Ronderos, TACF staff member.

To purchase, please contact: Caixa Nova, Obra Social y Cultural, Avda. de Pontevedra 7-9, 32005 Ourense, Spain, Fax: +34(9)88 38 91 74 or write, Director, Caja Provincial de Ahorros de Ourense, Calle Paseo 9, Orense, Spain.

Big and beautiful are the words that come to mind when one first sees *El Castaño*. In producing such a large, expansive book filled with photographs of old chestnut survivors from around the world, Professor Vieitez gives us each the opportunity to experience the grandeur of the chestnut. He succeeds in evoking a sense of awe similar to what one might experience when coming across an ancient chestnut in the woods. An experience that for those of us in the eastern United States only comes through travel – to the western states, Europe or Asia.

But he does much more than provide a glimpse of trees that have grown for generations. The photographs, mostly taken by Vieitez himself, provide a spectacular setting for a comprehensive review of the chestnut tree's systematics, ecology and life history, the forestry practices and social values which developed around it through the ages, and ultimately the pathology and demise of this spectacular tree.

Professor Vietez's discussion of chestnut science and research is thorough and wide-ranging. It begins with the worldwide distribution of the various species of the genus Castanea. He includes the differences and commonalties in physiology, flowering and pollination, and growth characteristics. The morphology of leaves, flowers and fruits, and the important role of mycorrhizae are illustrated in detail. Special attention is

given, of course, to the two primary fungal diseases that have spurred the decline of chestnuts, chestnut blight (*Cryphonectria parasitica*) in the U.S. and ink disease (*Phytophthora cinnamomi*, also known as phytophthora root rot) in Europe.

Professor Vietez's heartfelt discussion of the diseases attacking chestnuts begins:

> "One must say that this ... is the sad part of this book, dedicated as it is to a tree so extraordinary in its dimensions, economic value, cultural and scientific interest. We speak with sadness of this regression, caused by two such dramatic diseases as the cancer [chestnut blight] and the ink disease. The cancer represents a major ecological disaster, threatening the very existence of the American chestnut. The ink disease, in turn, is responsible for the ruination of the European chestnut."
>
> *El Castaño*, pg. 7

The rapid and dramatic loss of chestnut in North America is contrasted with the slower and sporadic erosion of the populations of chestnut in Spain and Europe. The efforts to circumvent the ravages of chestnut dis-

COURTESY OF ERNESTO VIEITEZ CORTIZO

The ridges that previously had been exploited has gold mines, are today a good refuge for chestnut, a place where it grows well as slash wood or as a nut tree. *El Castaño*, page 37.

COURTESY OF ERNESTO VIEITEZ CORTIZO

The Chestnut of Rozabales in Manzaneo (Ourense). At 1,000 years, it is considered the oldest in Galicia, Spain. *El Castaño*, page 34.

eases are outlined, particularly efforts at hybridization, vegetative propagation, breeding, grafting, virus hypovirulence, and culture in vitro. Perhaps the most impressive section is the detailed discussion of studies on propagation methods appropriate for chestnut — an area specifically developed by Professor Vieitez and his daughter Maria Luisa Vieitez Madrinan.

The book closes with a sample of chestnut-related poetry, artistic renderings of chestnut trees, and examples of chestnut wood marquetry, furniture, paneling, and statues. Some of the most handsome panels and doorways are taken from the famous Hostal de los Reyes Catolicos and the nearby Colegio de Fonseca in Santiago de Compostela.

El Castaño, like the tree, is big and beautiful, and much more than your average coffee-table book. It has the qualities of a true classic in science and cultural history. It is a comprehensive review of one of the most valuable and productive of forest trees, Castanea — one that can live almost as long as the the Sequoia (*Sequoiadendron giganteum*) and the Bristlecone pine (*Pinus aristata*). The slow destruction of chestnut is a tragic loss in contemporary time, both in North America and in Europe. Professor Vieitez's work enables us to realize the enormity of this loss. It is a timely and beautiful assemblage of accumulated knowledge and a tribute to his life's work.

AN EXCERPT FROM *EL CASTAÑO*

For some 400 million years, chestnut has been present on the surface of the earth. The thirteen species of existing chestnuts are distributed throughout the temperate zones of the Northern Hemisphere. Many towns of Europe, Asia, and America have one of these species in its landscape. Everyone speaks of the chestnut as if it were only one tree species. It is a tree with a common genus *Castanea*, but various species. When Americans speak of chestnut, they refer to *Castanea dentata*. For Europeans chestnut is *C. sativa*. When the Chinese think of chestnut, they are thinking of *C. mollissima*. For Japanese and Koreans, chestnut is *C. crenata*.

Chestnut is a tree that has been identified with the culture, customs, economy and sometimes the religion of different peoples. Rarely has it occurred that a tree like the chestnut, generally speaking, has been held in such esteem by millions of humans without regard to nationality. Curiously, all the countries within the range of the chestnut share an identification with this tree. It was one of the most loved by man: venerated by many peoples from time immemorial; sacred to the Chinese; mythified by million year old dynasties; loved by young populations such as that in America, because it was the "tree of all North Americans."

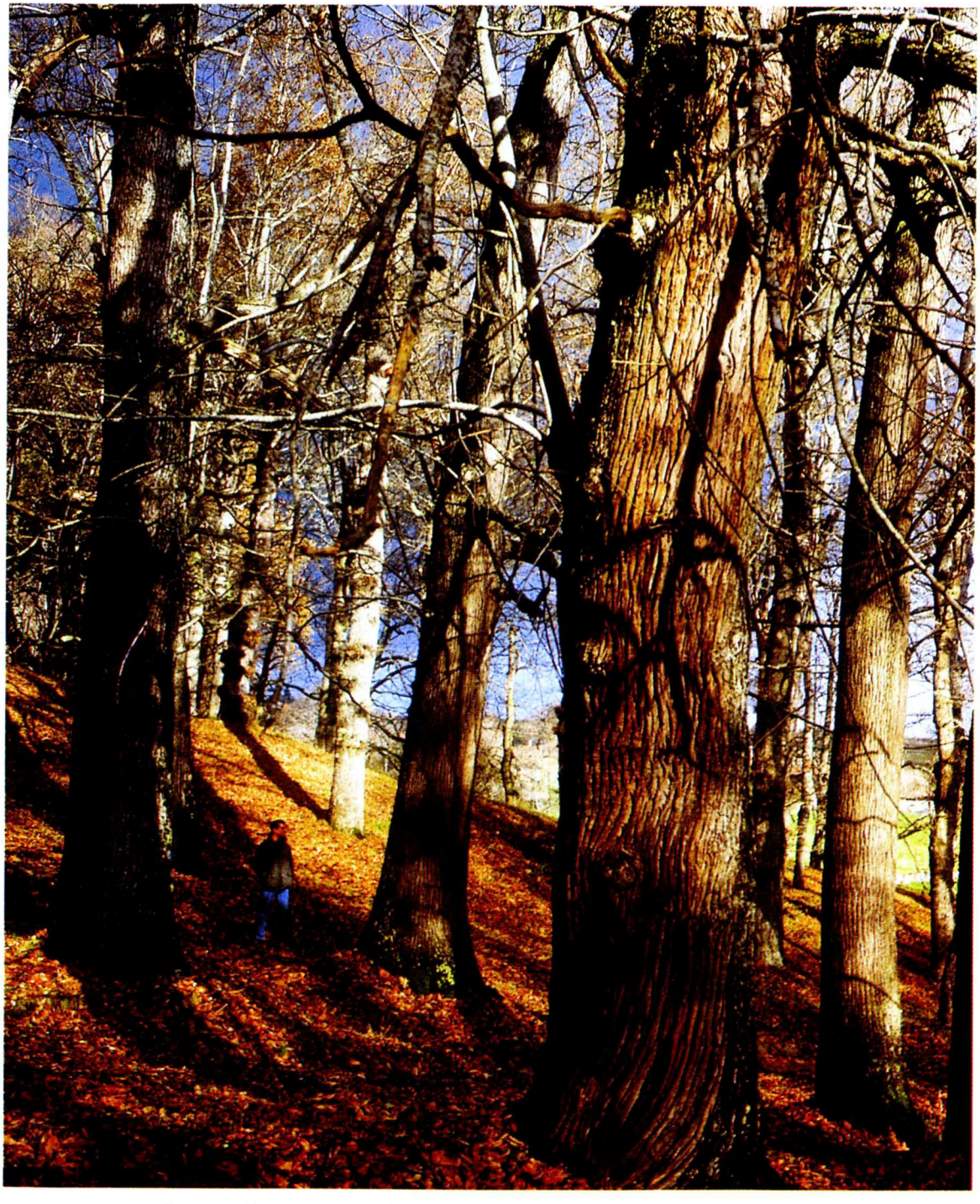
Chestnut was the news that shook entire countries, as in America, when chestnut played the lead role in the largest ecological disaster of all time, one brought about by chestnut blight. In less than half a century, blight left millions of lifeless chestnuts which extended for more than 400,000 km^2 [approximately 250,000 mi^2]. Gigantic chestnuts over 100 years old were dead, testaments of the great treasure that had gone, their presence asking for the collective effort of man to avoid extinction.

It was also news when ink disease ruined a huge portion of European chestnuts. It was a slow death, continued over centuries, alternating its virulence with periodic cycles of chestnut recuperation.

One and then another of the chestnut diseases caused humans to act in favor of this tree. From government agencies to chestnut research they made their concern be felt, due to the need to stand up to the damage caused by chestnut blight and ink disease.

El Castaño, page 1

Translated from Spanish by A. Ronderos



COURTES' OF ERNESTO VIEITEZ CORTIZO

Chestnuts *(Castanea sativa)* of the famous souto de Quintela, near Lalin (Pontevedra), with oak in the background. *El Castaño*, page 6.

COURTESY OF ERNESTO VIEITEZ CORTIZO

"Chestnut of a hundred horses." Sant Afio (Catania, Italia) considered the oldest in the world. It is thought to be over 3,000 years old. (Photo Lucio Bertoloti, from the book, *Gli aberi monumentali d'Italia*. Edizioni Abete. Roma, 1989, reprinted in *El Castaño*, page 31.)

COURTESY OF ERNESTO VIEITEZ CORTIZO

(Left) The remains of a hundred-year-old pollarded chestnut that has been converted into a public fountain... (Ourense - Baude) *El Castaño*, page 295.

(Below) Chestnut of souto de Santa - Rabelos at the Town Hall of Taboada (Lugo). *El Castaño*, page 26

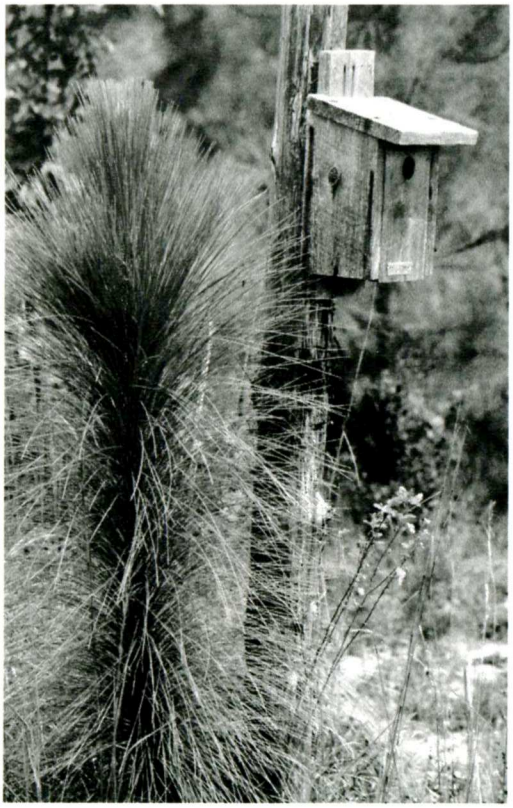
COURTESY OF ERNESTO VIEITEZ CORTIZO


science and natural history

THE LONGLEAF ALLIANCE: A REGIONAL RESTORATION EFFORT

Dean Gjerstad, Co-Director, The Longleaf Alliance and Professor, School of Forestry & Wildlife Sciences, Auburn University, AL

For most of the past 5000 years longleaf pine was the dominant species on an estimated 90 million acres of uplands ranging from southeast Virginia down the Atlantic Coast and across the Gulf Coast to east Texas. Today, less than 3 million acres are classified as longleaf forests. From a timber point of view, longleaf pine is superior to other southern pines in the production of high value wood products. Its growth form, with typically high form classes and straight boles, results in the production of a high percentage of poles, pilings and high quality logs. Longleaf is also resistant to many diseases, insects, and other damaging agents common to other southern pines. It is seldom damaged by fusiform rust, a serious pathogen in slash and loblolly pine; resists attack by southern pine beetles, and is very tolerant of fire throughout most of its life cycle. With so many attributes, why then has the longleaf forest been systematically harvested and then regenerated to loblolly or slash pine? The reasons for its precipitous decline are many and are rooted in the history of the South.



Landscape-scale fires that swept across most sites every 3-5 years maintained the prehistoric longleaf forests. European explorers described these forests as open, park-like stands with grassy ground cover containing little or no hardwood. As most early settlers were farmers, the forest required clearing to encourage settlement of the interior of the South. However, until the development of the steam engine in the mid-nineteenth century, only longleaf timber adjacent to waterways was accessible for harvesting. Large tracts of longleaf remained on the uplands out of reach of loggers. Longleaf timber harvesting peaked in the early 20th century when railroad logging reached the remaining large tracts. By 1930 railroad loggers had moved across the longleaf region with

little consideration for regenerating a new forest. When the longleaf timber was depleted, mills were closed and most lumbermen moved to the Pacific Northwest to log its virgin stands. However, a few pioneering foresters remained in the South, believing that longleaf regeneration was possible, an indication that longleaf can be managed profitably over a long period of time.

Although longleaf pine is considered to be a pioneer species, it does not demonstrate the aggressive regeneration characteristics noted of most pioneer species. In most years, mature longleaf trees produce few seed making natural regeneration difficult. Thus, as the virgin longleaf forests were harvested, few seed were available to regenerate the next forest. In addition, planting longleaf is more difficult because the "grass stage" seedling essentially has no stem. In addition, longleaf seedlings are inferior competitors. Weedy competition can retard growth, resulting in seedlings remaining in the grass stage for several years. However through current technology, the problems related to artificial regeneration have been, for the most part, overcome and landowners are able to successfully establish longleaf plantations. In addition, those landowners with existing longleaf stands can, through wise management, naturally regenerate most stands following harvest.

Another deterrent to the longleaf forest was the fire prevention effort instituted during the first half of this century. Fire was considered evil and most thought at that time that it should be prevented at all costs. However, the longleaf forest is a fire dependent ecosystem and the tree is very tolerant of fire during most stages of its development. Fire is important in preparing a proper seedbed prior to seed fall and germination. Fire is also important in controlling hardwood competition that impacts the survival and growth of longleaf seedlings. Many plant and animal species associated with longleaf are dependent on fire maintaining a savanna-like ground cover.

Forest management was initiated primarily in response to the pulp and paper industry that moved into the South during the 1950's and 60's. This industry created jobs and markets for timber, and played a vital role in the South's post-Depression economy. Unfortunately for the longleaf ecosystem, the emphasis of this industry was —and is— on wood fiber production. Although longleaf growth rates are competitive with those of other southern pine species on most sites over periods of 30 years or more, the best return on forest investment for companies whose product requires only fiber comes from highly productive short rotation plan-

tations, a kind of silviculture for which longleaf is not well suited. Tens of thousands of acres of abandoned cropland and cutover woodland were either deliberately reforested by planting slash or loblolly pine or naturally reseeded with these and other aggressive tree species, like sweetgum and water oak. The plant community associated with the fire-maintained longleaf ecosystem could not be sustained under these conditions and gradually disappeared, much like the prairies and savannas of the Midwest. Interestingly, a significant portion of the remaining longleaf has been conserved out of consideration for another natural resource of the longleaf ecosystem—bobwhite quail. Large quail-hunting reserves across the South began to use fire to manage the forest for that species in the late 1930s and continue that use today. As a result, some of the best remaining examples of the longleaf community exist on quail plantations.

Although fast growing species like loblolly and slash pine are ideal for the pulp and paper industry, many non-industrial private forest landowners prefer longleaf pine forests for their timber value and associated ecosystem that is aesthetically pleasing and is conducive to a diverse plant and animal community. However many of these landowners have not been able to readily obtain information and advice on longleaf management. A relatively new organization, The Longleaf Alliance, was established in 1996 with the express purpose of coordinating efforts to restore longleaf and its accompanying ecosystem on lands where they are compatible with the objectives of the landowner. The vast majority of forestland acreage in the Southeast is privately owned (e.g., nearly 95 percent in Alabama). Consequently, the Alliance directors felt that the greatest opportunity to significantly re-establish longleaf forests was on private lands. The restoration of a fully functioning longleaf ecosystem appeals to landowners in varying degrees. Recognizing that intact longleaf forest ecosystems are not likely to ever dominate the southeastern landscape again, the Alliance has adopted the philosophy that "better is better"; i.e., longleaf in any form is better than a cotton field; that longleaf and wiregrass are better than longleaf alone, that longleaf, wiregrass, and gopher tortoises are better than longleaf and wiregrass alone, etc.

This initiative resulted from the recognition that interest in the longleaf ecosystem and the tree itself was growing rapidly. Ecologists, foresters, wildlife biologists, landowners and land managers were searching for information or for an outlet to distribute what they had learned. A growing

body of anecdotal information, personal experience, and scientific data was being passed on fitfully and many publics were not being reached. The Longleaf Alliance was formed in an attempt to catalog and coordinate all of the initiatives currently underway and to serve as a clearinghouse for information on longleaf and longleaf forests for the general public.

The Longleaf Alliance is based at Auburn University's Solon Dixon Forestry Education Center in southern Alabama in the heart of the largest longleaf concentration left in the country. It is a nonprofit collaborative effort incorporating a broad community of similar interests in the longleaf forest system. Its structure is simple, its goals direct the establishment of a functional longleaf forest ecosystem to the extent feasible in today's southern forest environment.

Recognizing and emphasizing the importance of both the economic and ecological value of the longleaf forest broadens the appeal of the Alliance and gives it credibility with both the scientific and private communities. Members include researchers, outreach providers, landowners and managers, tree nurseries, state and federal natural-resource agencies, forestry and wildlife consultants, forest industries, and forestry service providers. The effort and the organization are regional in scope, and the Alliance now has members from every state in the longleaf region. The Alliance maintains and constantly updates databases on current longleaf related research, longleaf seedling nurseries, forestry and wildlife consultants with longleaf expertise, and pertinent research and demonstration sites. Publications produced by the Alliance to date have included proceedings from its regional meetings, a landowner's guide to management of longleaf forests, several research notes, and newsletters.

The Longleaf Alliance is funded through donations, memberships, and grants. Further information on the Alliance is available by writing The Longleaf Alliance, Rt. 7, Box 131, Andalusia, Alabama 36420, telephone 334-222-7779, fax 334-222-7779, and e-mail addresses johnson@forestry.auburn.edu, gjerstad@forestry.auburn.edu, or hainds@forestry.auburn.edu. There is also a Longleaf Alliance home page at http://www.forestry.auburn.edu/coops/la/la.html.

Longleaf has a place in the southern forest for many compelling reasons. However due to the severe decline in longleaf acreage, it is important that we act now if we desire to insure its continued presence and reverse the decline of this important component of our southern forest.

RESTORATION OF THE WHOOPING CRANE

George Archibald, Director, International Crane Foundation, E11376 Shady Lane Road, P.O. Box 447, Baraboo, WI 53913

The adult whooping crane (*Grus americana*) is pure white in color with black wingtips, black legs and feet, black facial markings, and has a bare patch of red skin on its white head. Standing up to 5 feet tall with a 7 to 8 foot wingspan, the whooping crane is the tallest bird in North America. Males average 16 pounds and females 14 pounds.

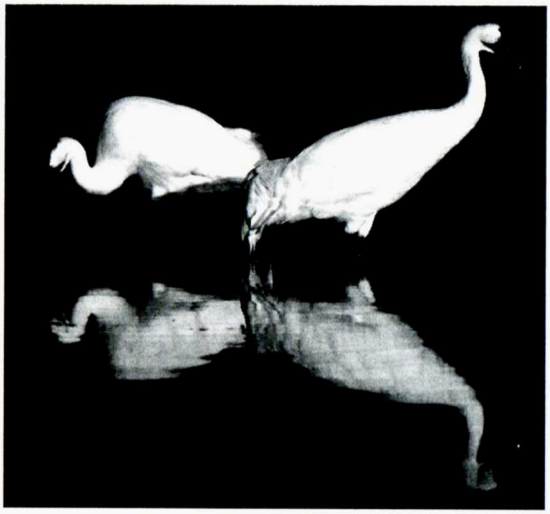


PHOTO BY LYNN STONE

The whooping crane's name was inspired by its loud, distinctive call, audible up to two miles away! This breathtaking bugle is created by resonance in the bird's 5-foot-long trachea (half of which is looped within the keel of the breastbone). Cranes call to communicate danger, to defend territory, and to reinforce pair bonds.

Whooping cranes mate for life and may live up to 25 years or more in the wild. On summer nesting grounds, a pair establishes a territory and performs elaborate courtship dances and rituals. If mating is successful, the female lays two eggs. Both the female and male take turns incubating eggs for a period of 29 to 30 days. Although both eggs may hatch, usually only one chick survives the first few months to reach fledging age.

Offspring learn the migration route by following their parents south in the fall and north the following spring. The chicks then join subadult "bachelor flocks" until they are 4 to 5 years old. It is within these bachelor flocks that pairing begins, often on the wintering grounds. A new pair will claim a nesting territory and begin to raise chicks of their own.

History

Fossilized remains of whooping cranes date back several million years. Evidence from the Pleistocene Epoch shows that whooping cranes were once scattered throughout a much wider geographic range, extending from central Canada south to Mexico, and from Utah to the Atlantic coast.

Early explorers and settlers recorded whooping cranes in six Canadian provinces, 35 U.S. states, and four Mexican states. Biologists estimate that there were between 700 and 1,400 whooping cranes alive in 1865. Their numbers dropped rapidly, however, and by 1890 the whooping crane had disappeared from the heart of its breeding range in the north central United States. By 1938, only two small flocks remained - one non-migratory flock in southwest Louisiana, and one migratory flock that nested in Canada and wintered in Texas.

A number of factors contributed to the whooping crane's dramatic decline. Shy and secretive birds, the whoopers were easily disturbed as European settlers expanded westward. Settlers, draining marshes and plowing prairies for agriculture, destroyed much of the bird's nesting habitat. As the number of whooping cranes declined, hunters, hobbyists, and museum collectors scrambled to acquire the rare specimens and their eggs. The toll from hunting was particularly high from 1870 to 1924, when over 250 whoopers were killed.

By the winter of 1941-42, the migratory flock had dwindled to only 13 adult birds and 2 juveniles. Meanwhile, the Louisiana population was reduced from 13 to 6 birds following a severe storm in 1940. One by one, the remaining Louisiana birds disappeared, until Mac, the sole survivor, was captured in 1950. Shortly after his transport and release in Texas, however, Mac was attacked by local whooping cranes defending their territory, and was later found dead.

Wood Buffalo National Park

In 1946, Robert Porter Allen was appointed by the National Audubon Society to study the life history of whooping cranes on the Texas wintering grounds, trace their migration route, and search for their nesting area. Allen searched thousands of square miles of Canadian wilderness before the breeding grounds were accidentally discovered in 1954. Returning from a forest fire near the Hay River, a fire crew sighted three whooping cranes from a helicopter. One year later, the nesting area was confirmed when Allen and Robert Stewart actually located a whooper nest.

Wood Buffalo National Park, straddling the border between the Canadian province of Alberta and the Northwest Territories, was established in 1922, chiefly for the preservation of the wood bison. Remote from any human disturbance, the park offered whoopers a deep and pristine wilderness in which to nest.

Whooping cranes arrive at Wood Buffalo from late April through May. Breeding pairs are often the first to arrive, returning to the same nesting territory each year.... Pairs nest in shallow ponds where they build large nest mounds from surrounding vegetation. Recurring droughts at Wood Buffalo pose many threats to the Whoopers. When drought occurs, nesting sites become more accessible to wolves, bears, and other predators.... The amount of food available also decreases. Because each pair returns to the same nesting area year after year, pinpointing nesting sites allows biologists to identify each family. With such a small flock, the genetic history of each individual is an important consideration in management decisions.

Aerial surveys located only 28 whooper nests at Wood Buffalo in the spring of 1994, down from 45 nests discovered the previous year. A late thaw may have prevented some pairs from nesting, and researchers suspect that a shrinking food supply on the Texas wintering grounds probably also contributed to the decline. Unable to build up sufficient fat reserves during the winter, pairs may have arrived at Wood Buffalo weak and chosen not to nest. In subsequent years, nesting attempts returned to previous levels with 49 documented in both 1997 and 1998.

From 1977 to 1988, chicks in Canada were color-marked with brightly colored, plastic leg bands. As a result, biologists were able to determine sex ratios in the wild population and age of first breeding. Another research breakthrough occurred in the autumn of 1981 when radio-tracking of Wood Buffalo cranes was initiated. Small radios attached to plastic leg bands were placed on chicks just before fledging, so that families could be followed during migration. These studies have produced valuable information on the duration, timing, and routes of migration, and on use of habitat.

Southward migration from Wood Buffalo begins in mid-September. Whooper parents with new chicks are usually the last to head south for the winter. The short summer season allows just enough time for the chicks to fledge before the cold weather arrives. The 2,500-mile migration route through Alberta, Saskatchewan, Montana, the Dakotas, Nebraska, Kansas, Oklahoma, and Texas takes approximately four to six weeks to complete....

Migration is a dangerous time for whooping cranes and other migratory birds. Up to 80% of the losses in the Wood Buffalo flock may occur during this period. Collisions with power lines are a leading cause of death, especially for inexperienced young birds.

Aransas National Wildlife Refuge

In December of 1937, President Franklin Roosevelt signed legislation to designate 47,215 acres of land near Rockport, Texas, as a wildlife preserve. This area, known as Aransas National Wildlife Refuge, protects much of the whooper's winter habitat. While at Aransas NWR, crane families defend a winter territory. On the refuge they find and eat small animals such as blue crabs, clams, and crayfish, as well as plant tubers and wild fruits.

Ongoing research and controlled burns on upland areas are performed to provide optimal foraging areas. Small animals and acorns are foods which are left exposed after a burn. Although Aransas NWR is protected and managed, habitat degradation is still a major threat to the cranes. By 1941, the Gulf Intracoastal Waterway was dredged through prime whooper habitat. Boat traffic on the canal has caused erosion of important tidal marsh, and contaminants have been detected in the water. Steps are being taken to reinforce damaged canal shoreline with cement mats.

During the first years following establishment of the refuge, the whooper population fluctuated near the brink of extinction. In subsequent years, numbers climbed slowly and new peak levels are being reached. Despite a windy storm in November 1998 which blew some migrating whoopers off course, officials at Aransas NWR counted 183 birds wintering in Texas in January 1999. This is a record number of whooping cranes.

Captives Breeding

The precarious status of the whooping crane prompted biologists to propose safeguarding the species through captive breeding. Beginning in 1967, eggs from the Aransas/Wood Buffalo flock were collected by biologists and used to establish captive populations and support experimental releases.

Since whooping cranes lay two eggs, but usually only one chick survives, one egg can be removed from each nest without decreasing the productivity of the wild flock. Both eggs are tested to ensure that one viable egg is left in the nest. If biologists encounter a nest where neither egg is viable, they replace one with a good egg taken from another nest. After each nest has been left with one healthy egg, the remaining eggs are taken into captivity. Due to the successful production of eggs from the captive flock, eggs are no longer being collected from the wild.

Captive breeding began to pay dividends in 1975, when whoopers at the U.S. National Biological Service's Patuxent Wildlife Research Center

(near Laurel, Maryland) first produced eggs of their own. Artificial insemination helped increase fertility of eggs, while sandhill cranes were used as surrogate incubators to improve the hatching success of the whooper eggs.

In 1989, Patuxent transferred 22 whooping cranes to the International Crane Foundation (ICF) in Baraboo, Wisconsin. Splitting the captive population between two locations reduced the chance that a single catastrophic storm or disease outbreak could wipe out the whole flock. As of early 1999, Patuxent's flock numbered 44, and ICF had 29. The breeding center at the Calgary Zoo had 21, the White Oak Conservation Center in Florida had one, and the San Antonio Zoo, four. The Audubon Center for Endangered Species Research in New Orleans has recently been approved as a whooping crane breeding facility and currently has two birds.

The Rocky Mountain Experimental Flock

In 1975, the U.S. Fish and Wildlife Service and Canadian Wildlife Service began an experiment to create a new flock of whooping cranes in the wild. Dr. Rod Drewien substituted whooping crane eggs into the nests of sandhill cranes nesting at Grays Lake National Wildlife Refuge in Idaho.

The goal of this cross-fostering experiment was to have the sandhills hatch and rear their larger cousins, then lead the young whoopers on migration to safe wintering grounds at Bosque del Apache National Wildlife Refuge in New Mexico. The 850-mile migration route along the Rio Grande in central New Mexico is shorter and easier than the 2,500 miles traveled by the Aransas/Wood Buffalo flock. In the beginning, this cross-fostering program looked promising, but eventually it proved unsuccessful. Even so, much valuable information was learned. The sandhill cranes hatched and raised the whooping crane chicks, and the whoopers did migrate with their new parents, but when the whoopers reached breeding age they did not pair with other whooping cranes. The whooper chicks probably imprinted on their sandhill crane foster parents. This "identity crisis" disrupted their ability to later pair and breed with other whooping cranes.

The Rocky Mountain population peaked at 33 birds in 1984-85. After the introduction of 289 eggs, further additions were stopped in 1989. As of February, 1999, a total of four whoopers remained in the Rocky Mountains. Two adults survived from the experimental flock, and two more were added in 1997 as a result of an experimental migration using an ultralight aircraft which led the whoopers to the wintering grounds at

Bosque del Apache. In addition, there is one whooper x sandhill hybrid (a "whoophill") living among the wild sandhills.

Release Programs

In December, 1986, a Whooping Crane Recovery Plan was adopted by crane biologists and officials from the United States and Canada. The Recovery Plan calls for increasing the Aransas/ Wood Buffalo flock to a minimum of 40 nesting pairs, and also to establish two other independent wild flocks of 25 pairs each.

The Whooping Crane Recovery Plan also calls for approximately 20 chicks to be released into Florida each year, forming the nucleus of a non-migratory population of whooping cranes. Since 1993, over 135 whooping cranes reared in captivity have been released into south-central Florida's Kissimmee Prairie. Although high mortality from predation by bobcats was experienced in the initial years that cranes were released, modification of rearing techniques and relocation of release sites helped reduce this problem. Approximately 73 of the released birds survived as of early 1999.

Because the cranes were raised in captivity by adult whoopers or by humans dressed in a crane costume, researchers do not expect the pairing problems which the whooping cranes at Grays Lake experienced. In 1996, two of the oldest whoopers (both 4 years old at the time) established a breeding territory, from which they excluded the locally abundant sandhill cranes and in which they built several nests. Unfortunately, no eggs have been laid yet, but this could be linked to the birds' youth and inexperience.

The Florida whoopers do not migrate, since they have no role model to teach them a route. By avoiding migration, they also avoid hazards such as power lines, hunters, and a lack of suitable stopover areas.

Meanwhile, experiments are underway to determine the best way to teach captive-bred cranes how to migrate. Kent Clegg, a rancher in Idaho, reared groups of sandhill and whooping cranes and taught them to fly behind his ultralight aircraft. In October 1997, he led 8 sandhills and 4 whoopers on an 800-mile migration to Bosque del Apache National Wildlife Refuge in New Mexico. Two whoopers and 2 sandhills were lost to accidents, hunters, and predators, but the surviving ultralight birds are fully incorporated into the wild, associating with wild cranes, utilizing river roosts and refuge corn fields, and joining the 6 surviving sandhills from earlier ultralight projects.

In Ontario, Canada, Bill Lishman (of "Fly Away Home" fame) and his team from Operation Migration, migrated with a group of sandhill cranes to Virginia in the fall of 1997. There are no wild sandhill cranes in that area of Virginia, and the experiment will help determine whether captive-reared, ultralight-led cranes will reverse the migration on their own, without the presence of wild cranes to stimulate the migration in spring.

Enduring harsh weather conditions and an ultralight-bird collision during flight training, a total of 7 sandhills made the trip and wintered in Airlie, Virginia. Six of the sandhills returned to Ontario on their own the following spring. The experiment was repeated in the fall of 1998, although the sandhills were transported by truck most of the way between Ontario and Airlie. It is hoped that these birds will also return north in the spring of 1999.

If these experiments succeed, the technique may be used to introduce a new flock of whoopers along a flyway between the United States and the prairie provinces of Canada.

When the Recovery Plan goals are reached, and all three flocks have been self-sustaining for a minimum of 10 years, the species will be downlisted to "threatened" status under the Endangered Species Act. Efforts to help the species will then continue, but at a diminished level.

If these plans are successful, then this magnificent bird will have been saved from the brink of extinction. The whooping crane will endure as a symbol of conservation and international cooperation, and as a reminder of the precarious balance between mankind and nature.

The IUCN has categorized whooping cranes as Endangered (proposed) while CITES has classified this species as Appendix I.

Further Reading:

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SPECIES RESTORATION—LESSONS FROM RED WOLF REINTRODUCTIONS

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Nineteen lessons learned from the red wolf recovery program that might be useful in other species restoration programs are presented.

Begin Considering Restoration Before the Taxon is on the Brink of Extinction. The red wolf was very close to extinction before anyone realized it. As a result, we lost the opportunity to study the animal in the wild and had to implement a recovery program based on limited biological information. This increases the time frame necessary to restore the species and the cost of restoration.

If Possible, Avoid Areas Inhabited by Closely Related Sympatric Species. The recent significant use of molecular biology to examine genetics and the evolutionary relationships between organisms has shown that introgression between related taxons is more common than once realized (Mayr 1970). Interbreeding between red wolves and coyotes was "the straw that broke the camel's back" with regard to the red wolf's future. Our first reintroduction in northeastern North Carolina worked very well until the eastward expansion of the coyote reached the area. Our second reintroduction was within areas inhabited by coyotes and was not successful in restoring red wolves.

Restore Species Within Their Historical Range. Extensive literature documents the havoc created by introducing species outside their historical range. Related to this are the impacts from species that were aided in expansion of their historical ranges by man's activities. A good example is the coyote, which has now expanded its range eastward to the Atlantic Coast and now compromises red wolf reintroduction attempts because of interbreeding risks.

Utilize Wild Stock if Available. The red wolf recovery program has revealed that restoration is much more difficult, time-consuming, and

expensive using captive animals. Despite best efforts to instill or maintain wildness in captive animals, some of them will become too tolerant of humans and their activities.

Develop and Test Reintroduction Techniques Before Attempting Restoration. The Service first released red wolves on an island to work out techniques. In 1976 a pair of red wolves was released on an island following a 5-week acclimation period. The female made it to the mainland within 1 week following release. A second attempt was made with another pair of animals in 1978; they were acclimated for 6 months before release. In this trial the animals remained on the island for about 11 months before being removed. These results illustrate the importance of the length of the acclimation period and the importance of testing techniques.

Build in Back-up Systems to Address All Possible Adversities. The old adage "if anything can go wrong it probably will" should be applied to reintroductions. An example would be loss of radio contact with red wolves due to telemetry equipment failures. Therefore, the first animals released, which were critical to the demonstration of our ability to monitor and manage the population, were equipped with a back-up telemetry system, consisting of abdominal transmitters, in case the radio collars malfunctioned.

Provide a Means for Captive Stock to Slowly Adjust to Wild Conditions. Captivity may affect the ability of the animals to live in the wild. In the case of red wolves, we attempted to address these problems by placing animals on island propagation sites where they could live, gain experience in the wild, and raise their pups to maturity.

Ensure That Sufficient Access is Available to Manage Populations. The importance of access will vary depending on the species, but it is significant for a large predator like the red wolf that can travel considerable distances in a short time. One of the problems encountered in one reintroduction that hampered our ability to manage the red wolf population was poor access.

Consider Potential Contributions of Private Land. It was originally thought that the restoration of red wolves would be dependent solely on public land, because private landowners would not want these animals on

their land. It became obvious early in the first reintroduction that Federal land was too small to contain a viable red wolf population. Individual red wolves moved onto private land within the first month, and agreements with landowners to allow red wolves on their property followed.

Minimize Impacts to Traditional Land Uses. People resent infringement on the traditional uses of the land. The northeastern North Carolina (NENC) reintroduction site centered on the Alligator River National Wildlife Refuge. The traditional land uses continued after the site became a national wildlife refuge, and this decision is believed to have positively affected public attitudes toward the reintroduction.

PHOTO COURTESY OF THE NATIONAL FISH AND WILDLIFE SERVICE

Remove Problem Animals. Although there is a contingent of the public that believes that wildlife were here first and should be given priority in all human/wildlife interactions, problem animals will cause a significant erosion of support unless they are removed promptly.

Compensate Private Landowners in Case of Economic Losses. Adverse economic impacts to landowners are not conducive to obtaining support from these individuals. The common adverse impact experienced from predators is depredation on domestic animals. Therefore, a compensation program was put in place to reimburse owners of domestic animals at fair market price for depredations by red wolves.

Coordinate With Other Potentially Impacted Agencies. Support from other agencies is important to the success of reintroductions. In the case of the red wolf, the state wildlife agencies are integral participants because of their responsibilities for resident wildlife species. The red wolf, as a predator, can impact resident species, and if and when the reintroduction is successful and recovery is achieved, the species would be delisted.

Conduct Extensive Outreach Efforts, Especially Targeting Potential Adversarial Groups. In 1979 the Tennessee Valley Authority offered Land Between The Lakes, which straddles the border between Tennessee and

Kentucky, as a potential reintroduction site. Evaluation of the area was conducted from 1981 to 1984, concentrating on the biological feasibility of the area and doing minimal outreach work. As a result, the project was opposed by many groups which translated to a lack of endorsement from the state wildlife agencies. For the next proposed reintroduction in NENC, we made plans to follow a biological evaluation with extensive outreach efforts over a 1-year period, which resulted in public support.

Emphasize Positive Impacts on Ecology and Economics. Economic studies showing tremendous possible returns from the presence of red wolves and the willingness of a majority of local residents to contribute financially to the program was publicized and is believed to have played a role in garnering support for the program (Mangun et al. 1997, Rosen 1997). Outreach efforts emphasized the ecological role of the red wolf and the resulting benefits. For example, the absence of the red wolf has contributed to the proliferation of mid-line predators, such as raccoons, skunks, opossums, and coyotes. Overpopulation, in turn, has resulted in excessive depredations by these predators on ground-nesting birds, such as quail, grouse, and turkey.

For Outreach Purposes, Take Advantage of Areas Where Human Use is High. Although human use can be detrimental to low and vulnerable populations of wildlife, it can be beneficial to public relations efforts because you can reach a lot of people. It also helps if people can see the animals; if they can see them, they can relate to them in a more personal way.

Be Consistent and Carry Through with What You Say. In rural communities many residents adhere to the old principle of a man keeping his word. Residents expect the same thing from all neighbors, including the government. This is a real problem in government agencies because of the turnover in personnel. The red wolf program is still haunted by the fact that a few local residents believe some commitments regarding management of the program were not followed.

Keeping your word is also important in individual relationships with residents. We have told local residents that we will respond promptly to possible red wolf depredations and will work with the landowner to determine the cause of the depredations, even if we have information indicating that

radio-collared red wolves are not involved. An example from NENC involved a resident who suffered depredations to domestic rabbits. A neighbor's dog was caught and determined to be the culprit. These efforts turned the owner's attitude toward the reintroduction program into a positive one.

Monitor Public Attitudes and Revise the Program, if Necessary, to Improve Attitudes. Although support for the reintroduction of red wolves was present when the releases began, the red wolf program continued to be plagued by negative publicity based on false information, misinterpretations, etc. This negative publicity was countered by conducting and publicizing public attitude surveys showing that the majority of people, and especially people in the immediate area of the reintroduction, supported the program (Mangun et al. 1997, Quintal 1995, Rosen 1997).

Be Realistic and Prudent With Funding. Reintroductions are very costly, and the amount of funding available for endangered species recovery is limited. In addition, we are public servants, who must use public funds wisely. Money can be redirected to higher priorities within a recovery program or made available to other endangered species, many of which are not adequately funded for recovery work.

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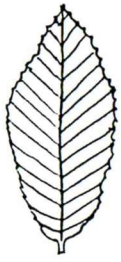


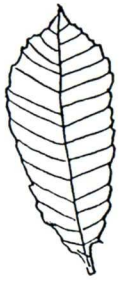


	CHINKAPIN	JAPANESE	EUROPEAN	CHINESE	AMERICAN
Leaf Taper to Stem	straight	curved	curved	curved	straight
Taper to tip	straight	curved	curved	curved	straight
Teeth	1-3 mm, small, sharp, no hook	Tiny, often only bristles, no hook	Big, sharp or rounded, no hook	Large or small, no hook	6mm, big, sharp, and often curved (hooked)
Leaf Underside	*Sun leaves noticeably hairy	Sun leaves noticeably hairy	Sun leaves noticeably hairy on some specimens but not others	Sun leaves obviously hairy	Sun leaves not hairy, long sparse hairs only on midrib
Twig (those that have overwintered at least one year)	hairy tips, purple or brownish grey	Pink to light red, large white **lenticels	Stout, dark, brown, small white lenticels	Hairy tips, Tan to pea green Large elliptical yellow lenticels	Slender, smooth, hairless reddish brown, small white lenticels
Bud	Up to 3 mm, downy dark red, pointed, longer than wide, sticks out from stem	Glossy brown, As long as it is wide (rounded)	Dark red, fat and globular	Hairy, tan, dull brown to black, rounded and flat against stem	Up to 6mm, smooth, reddish brown to yellow, pointed, or longer than it is wide, sticks out from stem.
Nut* **	1 nut, ½" tip pointed with a round cross section	2-3 nuts, 1-2" no sunburst pattern at base, moderate brown	2-3 nuts, 1-2 " no sunburst pattern, dark brown, black stripes	2-3 nuts, ¾- 2", rounded hairy tip, no sunburst pattern, often light brown	2-3 nuts, ½ -1", pointed tip, top ⅓ to ⅔ downy, sunburst at base
Taste** **	sweet	not sweet	starchy	sweet	sweet
Resistance to blight:	None	Moderate	Slight	High	None

*Sun leaves arethose leabes that are most exposed to the sunlight on a tree.
** A lenticel is an aerating organ on the surface of a twig or branch. They may appear as bumps on the surface of twigs.
*** Nut size may vary a lot within each species. Sizes provided are maximum possible.
****Taste refers to those commonly found in the U.S. and may not reflect that of all members of a species.
Be aware that all chestnuts can cross-pollinate, so that a tree that seems clearly of one species or another, may actually be a mix of two or more different types of chestnuts, known as hybrids. Please refer to TACF's website www.acf.org for more information on identifying American chestnuts.