

## Red Wolf (*Canis rufus*)

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### Introduction

The red wolf (*Canis rufus*) is one of only two wolf species currently recognized in the United States. The other is the gray wolf (*Canis lupus*). Described as a zoological and conservation dilemma, the red wolf is one of the most endangered mammals in the world. Wild red wolf populations were nearly lost in the 1960's before protection of the species began. Red wolves once roamed throughout the eastern United States. Only when European settlers arrived, modified the habitat, and began to persecute the red wolf, did the wolf begin declining. The red wolf was relegated to marginal habitats and due to the decrease in their numbers and an increase in coyote numbers, they began interbreeding with coyotes. In the 1970's, scientists removed all known red wolves from the wild and placed them in captive breeding programs. With protection and management the species is recovering, but the red wolf still has a long way to go.



Figure 1. US Fish & Wildlife Service Photo.

### Taxonomy

Family: Canidae  
Subfamily: Caninae  
Genus: *Canis*  
Species: *rufus*

The taxonomic status of the red wolf has been hotly debated in recent years. It was once proposed that the red wolf was a hybrid between gray wolves and coyotes. Others have suggested that it is a subspecies of the gray wolf. However, recent DNA evidence supports the conclusion that while the red wolf is genetically very similar to the eastern timber wolf (*Canis lupus lycaon*) it is a distinct taxonomic entity. Current evidence suggests that red wolves hybridize extensively with coyotes and perhaps the gray wolf.



Figure 2. US Fish & Wildlife Service Photo.

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Some authors have suggested the red wolf originated thousands of years ago as a hybrid between coyotes and gray wolves. It eventually separated itself by exploiting new habitats in the southeastern U.S. and developing unique species characteristics. Fossil evidence discovered in Florida indicates the red wolf may have originated 750,000 years ago. Scientists reached consensus at a recent meeting of wolf biologists and geneticists that *C. rufus* and *C. lupus lycaon* are more similar to each other genetically than to either the gray wolf or coyote (*Canis latrans*). They concluded that the designation of red wolves as a species is justified. As such it is fully protected as an endangered species by the Endangered Species Act.

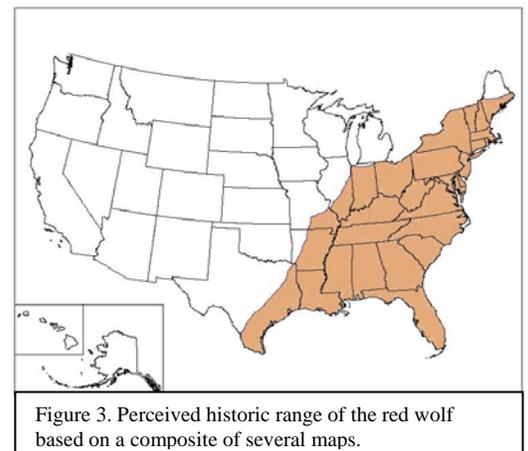
## Status

The red wolf was listed as endangered in 1967. It was one of the first mammals placed on the Endangered Species List in 1973. Due to hybridizing with coyotes and the possibility that the red wolf genes were being swamped by the hybridization, all red wolves were captured in the remaining Texas/Louisiana population. Out of 400 animals captured only 14 were found to be true red wolves and used for captive breeding. The red wolf was considered extinct in the wild in 1980. Although recent reports of red wolf or red wolf/coyote hybrids in Texas, with video support, bring this designation into question. The Red Wolf Recovery Project initiated a reintroduction of red wolves at the Alligator River National Wildlife Refuge (ARNWR) in 1987. Since that time the population has increased to 110-130 individuals in the wild. Red wolves currently occupy 1.5 - 1.7 million acres in northeastern North Carolina. The red wolf is an endangered species throughout its range, except where the red wolves have been set up as experimental, nonessential populations (NEP). These occur in Tyrrell, Beaufort, Dare, Hyde, and Washington counties in North Carolina. In the 1990's, an experimental population was established in the Great Smoky Mountains National Park. This release was abandoned and all red wolves removed from the wild. The red wolf is listed on the International Union for the Conservation of Nature's (IUCN) Red List as critically endangered. Red wolves are also listed in Appendix I ("most endangered") by the Convention on International Trade in Endangered Species (CITES). The status of the red wolf has been challenged numerous times; however, the species is maintained as endangered.

Eighty-nine known red wolves were tracked, trapped, observed or monitored at the ARNWR during the first part of 2011, according to the U.S. Fish & Wildlife Service (USFWS) quarterly report. This population consists of 29 known packs, containing 69 wolves and 13 breeding pairs. Other individuals are solitary and not associated with recognized packs. There are an estimated 175-190 red wolves in captivity.

## Distribution

Historically, the red wolf occurred from south central Texas to Florida and north through Indiana, Ohio, and Pennsylvania (Figure 3). It is now believed that the historic range extended into New England as far north as south-central Maine. Currently, the red wolf inhabits a 5 county area encompassing nearly 1.7 million acres in northeastern North Carolina. In addition, captive red wolves are located in over 40 captive facilities across the United States and Canada. Many of the captive facilities provide viewing opportunities (<http://www.fws.gov/redwolf/facilities.html>). There is also anecdotal evidence, possibly supported by video that red wolves or red wolf/coyote hybrids may occur in Texas.



## Description

The red wolf is a specialized carnivore. Red wolves function as a top predator in its ecosystem. It is the second largest canid in the United States, with only the gray wolf being larger. Their size ranges from 45 to 80 pounds. Males average 10% larger than females. Total length ranges between 50-70 inches (nose to tip of tail; 100-130 cm). Adults range in weight between 44-84 pounds for males (20-38 kg) and 40-66 pounds for females (18-36 kg). Adults are well adapted to the climate of the southeast. They have large ears for heat dispersion and undergo an annual molt. The summer coat is lighter or thinner than the winter coat. The coloration of the wolf tends to be brownish, buff, or cinnamon with grey and black on the back and tail. The muzzle size, and eye-shape contribute to the red wolf's wolf-like appearance. The underside of the wolf is cream to whitish, with the same color occurring around the muzzle. The red wolf has 42 teeth with a dental formula of  $3/3 - 1/1 - 4/4 - 2/3$ . Red wolves are unfortunately mistaken for coyotes, especially when they are younger. They are shot incidentally by hunters pursuing deer or other species. Occasionally, they may be caught by trappers. Due to their legal designation as a non-essential experimental population, they may be legally shot on private lands.

## Biology and Ecology

Most of the information we have regarding red wolves and their ecology is based on what has been learned from studying captive and reintroduced populations. Little scientific information regarding red wolf ecology was collected before their capture and removal from the wild.

**Reproduction:** Male and female red wolves reach sexual maturity at different ages. Females are able to reproduce as young as 11 months. Males begin reproducing at 22 months. Male reproduction may also be influenced by conspecifics (other members of their species). Mating occurs in February and March, gestation lasts 61-63 days, and peak litter season is Mid-April to Mid-May. Litters range in size from 1-10 pups (the average is 6.6). The largest litter sizes occur in red wolf adults that are 5-6 years old. Dens are created as burrows in canal banks and agricultural fields and as shallow depressions in dense vegetation. Fertility of the females increases from 11 months to 9 years and then drops to zero by year 11. Fertility in males increases from 2 years to 11 years and then drops off to zero at 15 years.

**Feeding:** Historical diet analysis from Texas indicates nutria (*Myocastor coypus*), rabbits, and rodents were the main food sources for red wolves. In North Carolina the red wolf diet consists of 86% white-tailed deer (*Odocoileus virginianus*), raccoons (*Procyon lotor*), and rabbits (*Sylvilagus* sp.). Red wolves will hunt alone or in packs. They are mostly nocturnal with crepuscular (dawn and dusk) peaks of activity. The red wolf also has a metabolism similar to other wolves in that they are adapted for a feast/famine existence. This means they can survive for many days on a minimal intake of food (famine) and then gorge themselves on a fresh kill (feast). On very rare occasions (3 times since 1987), red wolves have been responsible for livestock depredations.

**Behavior:** Red wolves normally live in family groups or packs which include a dominant breeding pair and offspring from previous years. Lone red wolves are not uncommon and tend to occur when mates have died or have been killed. Family groups will maintain a territory through scent marking. They will defend their territory from other canids. Offspring typically disperse into unoccupied areas at two years of age. Red wolves will occupy a territory of  $17.8 - 87.2 \text{ mi}^2$  ( $46-226 \text{ km}^2$ ), depending on food resource availability.

**Habitat:** Little is known about specifics of red wolf habitat in historic times due to the species' range being severely reduced prior to scientific investigations into habitat use. Based on the wide species

range that they occupied historically the red wolf likely utilized many different habitat types. Evidence suggests that red wolves occupied bottomland river forests and swamps of the Southeast. The reintroduced red wolves currently live among habitat types ranging from agricultural field to pocosins. In areas with lower human densities, lower road densities, and lower coyote densities or coyote management, the red wolf is likely to be able to adapt and thrive. Agricultural field also seem to be important during pup-rearing.

**Enemies:** Adult red wolves have no predators in the wild. However, young or injured red wolves may be killed by black bears (*Ursus americanus*), alligators (*Alligator mississippiensis*), raptors, and coyotes. Red wolves also compete with coyotes, red wolf/coyote hybrids, and to a lesser degree black bears and alligators. Humans are detrimental to red wolves because they persecute them, modify their environment, and deplete the prey supply. Coyotes are a significant threat to red wolves because they interbreed with red wolves. This dilutes the red wolf gene pool and creates hybrids. The coyote is the main reason the red wolf almost became extinct in the 1970's. The Red Wolf Recovery Project is intensively using an adaptive management technique to avoid hybrid litters. Also, coyotes inhabiting space that can be used by red wolves are often removed.

**Lifespan:** Red wolves in captivity have lived to be 15 years of age. In the reintroduced population, the survival differs among red wolves depending upon age, pack status, and wild/island/captive born. Red wolves in the wild have lived as long as 7-8 years. Average annual survival of any red wolf is 78% per year.

## **Disease and Parasites**

The red wolf is subject to some of the same diseases and parasites as other canid species. The most important diseases affecting the red wolf are various forms of canine parvovirus, canine distemper, and demodectic and sarcoptic mange. Even with vaccination programs currently underway in the NEP, studies have shown that the antibody titers are not detectable in the population. This means red wolves are still at risk of canine parvovirus infection. Other diseases and parasites include leptospirosis, Lyme disease, rabies, hookworm, heartworm, and tick paralysis. Red wolves appear to be able to live with hookworms, as they are not significant sources of mortality. It appears that red wolves may be adapted to survive heartworm infestations. All adult red wolves tested for heartworms have been found to be infected with heartworms. However, heartworms do not seem to be a significant cause of mortality. Tick paralysis has occurred, but it is rare. Red wolf pup deaths resulting from disease also include systemic parasitism, cardiovascular anomalies, septicemia, or parasitic pneumonia. In captivity, adult red wolves are also known to display physical anomalies such as retinal atrophy, eye problems, neoplastic tumors (50% that are fatal are lymphosarcoma), and gastrointestinal disease. It is unknown if these anomalies were historically typical in native red wolves or if the incidence is higher due to reduced genetic diversity or hybridization. The role of disease as a mortality factor in wild red wolves is uncertain.

## **Economic Value**

Economic studies have shown that the red wolf population can bring millions of dollars via ecotourism to the 5 counties they occupy. People want to know that wolves are in the wild. There are many people that come to the Alligator River National Wildlife Refuge and surrounding areas in an attempt to glimpse a wild red wolf. While sightings are rare, visitors want the opportunity for a sighting or at least to hear the wolves howl.

Additional economic values come from the red wolf preying upon nuisance species such as nutria (*Myocaster coypus*), raccoons, marsh rabbits (*S. palustris*), and rodents, which can cause damage

to agricultural crops, levees, and farm equipment. Red wolves prey on white-tailed deer which may be beneficial to farmers and homeowners but is often unpopular with hunters. Red wolves may also reduce predation on ground-nesting birds, such as bobwhite quail (*Colinus virginianus*) and wild turkey (*Meleagris gallopavo*). This happens when red wolves kill or displace raccoons, fox, and coyote. The results may be to increase hunting opportunities and/or wildlife viewing opportunities for other species.

## **Medicinal Value**

Wolves have been used for traditional medicinal purposes since the Middle Ages. Recently there have been reports that folk medicine still poses threats to canid species. Although red wolf specifics were not reported, wild canids in various cultures are used to treat nearly 28 different medical conditions in humans. The specific value of red wolves in traditional Native American medicine is unknown. In other cultures, various wolf parts are used for folk medicine including the heart, eyes, fat, blood, bile, bone, viscera, and meat.

## **Legal Aspects**

The red wolf population in North Carolina was designated as a NEP by the USFWS. Status updates regarding the NEP designation are published periodically in the Federal Register. In 1995, federal funding for the red wolf recovery program was nearly eliminated. Legislation in North Carolina proposed to eliminate all federal funding and was narrowly defeated. Additionally, there have been multiple times throughout the Red Wolf Recovery Program's existence when the red wolf has been challenged as to the validity of its place on the Endangered Species List. These include petitions to delist it in January 1992 and December 1997. USFWS review of these petitions concluded that the scientific and commercial information in the petitions was not substantial. Therefore the species listing was maintained. The wild population at ARNWR is the only free-ranging wild population in the world. Currently the USFWS is investigating the suspected illegal take of two wolves found dead in Hyde County, NC. Maximum criminal penalties for unlawful taking of a red wolf are one year imprisonment and \$100,000 fine per individual.

## **Control to Reduce**

Currently, management efforts in the NEP are to increase the red wolf population and increase their habitat. However, if red wolves become a problem, live trapping is conducted to relocate the individual. If the red wolf demonstrates a credible threat to human safety or livestock and cannot be caught and relocated, take of the red wolves is permitted under the NEP designation. During the breeding seasons, if pups are found to be hybrid individuals after genetic analysis, then they are captured and removed from the population as well.

## **Major Threats**

Humans and coyotes are the main threats to the red wolf population. Vehicle collisions with red wolves accounted for 14% of red wolf deaths between 1999 and 2006. As more roads are built or roads are widened, the red wolf will be further impacted and vehicle collisions will increase. The collisions unevenly affect young red wolves, which impacts future generations. The other main human-related source of red wolf mortality is gunshot. Gunshot mortality accounted for 22% of red wolf deaths between 1999 and 2006, and disproportionately affects adult red wolves. Gunshot mortalities resulted in loss of 23 litters and the production of 4 hybrid litters between 1999 and 2006. Additionally, the loss of

adult red wolf breeders reduces future success of the recovery program. When red wolves are removed from their territories they are more likely to be replaced by coyotes or hybrids than red wolves. Although many of the coyotes and hybrids in the area are sterilized, hunters import coyotes into the NEP area and they escape into the wild where they can breed with red wolves. Some hunting groups continue to import coyotes for use in confined space hunting areas call “fox” pens. Coyotes often escape these pens. While many people disagree with this activity, it has been historically difficult to change local tradition.

Hybridization with coyotes is one of the greatest threats to the wild red wolf population. Currently, adaptive management techniques are used to remove coyotes from some areas, while sterilizing others and keeping them as “space holders” until additional red wolves can be released in the area. For the foreseeable future, only with continued intensive management is the red wolf likely to survive the threat of genetic swamping by coyotes.

## Management to Enhance

Management of negative effects caused by additional habitat fragmentation and construction in the area of the red wolf NEP are constantly monitored. A planned airstrip construction within the NEP area was recently abandoned after it was decided that it would negatively affect the red wolf population. A current management initiative is that the North Carolina Department of Transportation has purchased 40 satellite GPS collars for red wolves to determine the effects widening a highway would have on the red wolf population. Additional sites will be necessary to reach the recovery goals set forth in the species recovery plan. These sites are to be assessed in 2011-2013 so that additional red wolf populations may be created.

Education is essential to red wolf recovery. With better education and support, fewer wolves may be killed by gunshot, ensuring more successful potential litters and future red wolf generations. Furthermore, as the red wolf population continues to expand westward, the management of coyotes will be essential to the continued recovery of the red wolf.

## Human Use

**Native Americans:** Native Americans likely used the red wolf pelt, bones, and possibly meat. Wolf remnants have been found in Native American middens in North Carolina. The wolf is an integral part in Native American culture and mythology. The wolf is admired for its devotion to its pack, for its superior cooperative hunting skills and for its defense of territory against outsiders. Some Native Americans believed wolves could bring healing powers, luck, and peace and harmony to tribal members.

**Colonists:** Colonists may have used the pelt of this species. Historical records in eastern North Carolina from the 1700’s indicate bounties were paid for wolf pelts in the area. However, these bounties likely were related to efforts to control red wolves and other predators.

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