

# Red Wolf

*Canis rufus* (Audubon and Bachman, 1851)

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## CONTENT AND TAXONOMIC COMMENTS

Because many hybrids with the gray wolf (*Canis lupus*) and the coyote (*C. latrans*) were known, the validity of the red wolf as a distinct species was questioned by McCarley (1962), Lawrence and Bossert (1967), and Clutton-Brock et al. (1976). Paradiso and Nowak (1972a) suggested that hybridization occurred as a result of habitat disruption caused by human development. Nowak (1970), Atkins and Dillon (1971), Paradiso and Nowak (1973), and Ferrell et al. (1980) provided evidence to show validity of the species. However, Hall (1981) and Wayne and Jenks (1991) noted that specimens examined had genotypic characteristics related to either gray wolves or coyotes. Wilson and others (2000) suggested that the red and gray wolf share a common lineage with the coyote in North America and are best considered conspecifics. Nowak (2002) conducted morphometric analyses of red wolf skulls and presented the case for retaining the red wolf as a separate species. Baker and others (2003) recognized the red wolf as a separate species, whereas Wilson and Reeder (2005) listed the red wolf as a subspecies of the gray wolf. Although the taxonomic status remains unclear, there is evidence to support *C. rufus* as a unique species (Kelly et al. 2004). Currently, the U. S. Fish and Wildlife Service recognizes the red wolf as a distinct species under the Endangered Species Act, and afford it full protection under federal law.

Three subspecies were recognized by Goldman (1937, 1944) and Hall (1981): *C. r. gregoryi*, *C. r. floridanus*, and *C. r. rufus*. The subspecies used for the reintroduction effort into North Carolina is *C. r. gregoryi* (Kelly et al. 2004). The life history of the red wolf is reviewed by Paradiso and Nowak (1972b, 1982) and Carbyn (1987).

## DISTINGUISHING CHARACTERISTICS

The red wolf is intermediate in size between the gray wolf and coyote. Measurements are: total length, 135–165 cm; tail, 34.5–43.0 cm; hind foot, 21–25 cm; ear, 12–13 cm; weight, 16–41 kg. The dorsal pelage is variable in coloration and generally is reddish-buff interspersed with gray and black. Melanism is common (Whitaker and Hamilton 1998). The tail is bushy and tipped with black; the belly, nose, and throat are whitish-buff. The muzzle, ears, nape, and outer

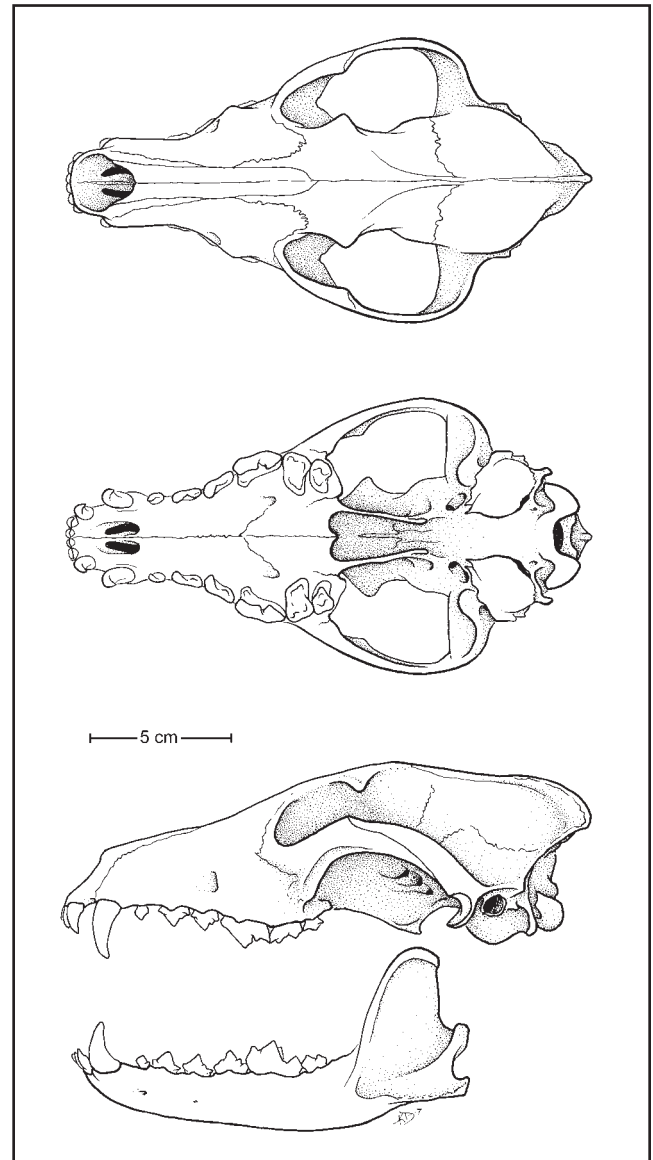


Figure 1. Dorsal, ventral, and lateral view of cranium and lateral view of mandible of *Canis rufus* from Newton County, Arkansas (USNM 235599, female).

surfaces of the legs are tawny to cinnamon-buff. The skull is elongate with a narrow rostrum, and can be distinguished from a coyote skull based on size. The coyote skull usually is less than 210 mm long and 110 mm wide, whereas the wolf skull often exceeds those dimensions. The dental formula is I 3/3, C 1/1, P 4/4, M 2/3 = 42 (Figure 1). See keys for details.

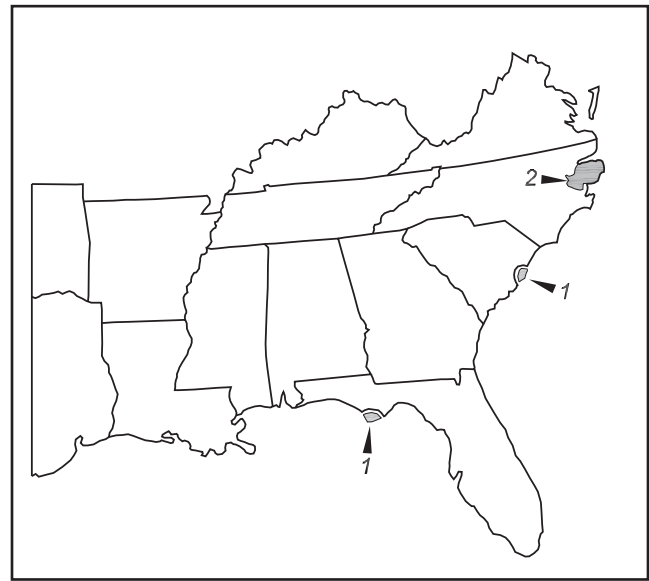
## CONSERVATION STATUS

The red wolf has a global rank of Critically Imperiled. (NatureServe 2007). It is considered Critically Imperiled in North Carolina and South Carolina. It is Presumed Extirpated in the remaining states in the South; however, an island propagation site occurs on an barrier island in Florida. The U. S. Fish and Wildlife Service (U. S. Department of the Interior 2007) lists the red wolf as Endangered, with a recovery plan approved for the species (USFWS 1989). The reintroduced population in North Carolina is considered Experimental Non-essential, a designation that permits the U. S. Fish and Wildlife Service to manage the population and promote recovery in a manner respectful of the needs and concerns of local citizens (Parker and Phillips 1991).

## DISTRIBUTION

The red wolf historically roamed an extensive range including southern Illinois, Indiana and Pennsylvania south to Florida and west to central and southern Texas (Harper 1942, Young and Goldman 1944, Nowak 1979, Hall 1981, Choate et al. 1994, Wilson et al. 2000). From the early 1800s through the middle 1900s, indiscriminate predator control, extensive land clearing, expanding human populations, and declining prey populations (Crawford et al. 2001) reduced the range of the red wolf to the forested bottoms and coastal marshes of southeastern Texas and southwestern Louisiana (Paradiso 1965, 1968; Pimlott and Joslin 1968, Nowak 1970). The resulting changes to the landscape favored the eastern expansion of the coyote into historic red wolf territory, fostering a breakdown of the red wolf social structure. As a result, hybridization occurred as the wolf found it increasingly difficult to locate conspecifics (Nowak 1979, Crawford et al. 2001).

By 1976, the remaining red wolves in coastal Louisiana had been removed from the wild with the goal of establishing a captive breeding program and eventually restoring the species to portions of their historic range (Carley 1979). Point Defiance Zoo and Aquarium in Tacoma, Washington was established as the red wolf captive breeding center (Crawford et al. 2001). The program was successful and the first mainland repatriation of red wolves occurred in 1987 on Alligator River National Wildlife Refuge and adjacent U. S. Department of Defense land in northeastern North Carolina (Parker 1987, Phillips and Parker 1988, Parker and Phillips 1991). The 5-county area covering 688,259 hectares of public and private land includes Dare, Hyde, Tyrrell, Beaufort, and Washington counties. Island propagation sites were subsequently established on Bulls Island, South



**Figure 2. Distribution of *Canis rufus* in the South: (1) Island propagation sites; (2) Reintroduction counties.**

Carolina (1987); Horn Island, Mississippi (1989); and St. Vincent Island, Florida (1990) to supply wild-reared wolves for the mainland restoration effort (van Manen et al. 2000). Horn Island was eventually dropped as a propagation site (B. Fazio, U. S. Fish and Wildlife Service, personal communication). A second mainland repatriation effort initiated in 1991 within the Great Smoky Mountains National Park, Tennessee was terminated seven years later due to the high rate of pup mortality from disease, predation from the coyote, and malnutrition (Lucash et al. 1998).

## ABUNDANCE STATUS

The current free ranging populations are a result of these restoration efforts (Figure 2). There are over 100 red wolves in the wild population in northeastern North Carolina, comprising 18–22 packs (B. Fazio, U. S. Fish and Wildlife Service, personal communication). Each wolf pack typically includes a dominant breeding pair and offspring from previous years. Bulls Island, Cape Romain National Wildlife Refuge in South Carolina and St. Vincent Island National Wildlife Refuge, Florida remain as island propagation sites. Each island retains one family of wolves; the size ranges from 2–6 animals depending on field management decisions. Young born on the islands are either fostered as pups or translocated at 18 months of age into the wild population in North Carolina. Approximately 160–180 wolves are in captivity at 38 facilities throughout the United States and Canada (B. Fazio, U. S. Fish and Wildlife Service, personal communication) for reproduction and

conservation genetics research. The breeding program maintains genetic diversity and provides wolves for release into the wild population.

## PRIMARY HABITATS

Given the historical distribution of the red wolf, it is probable that the species used a variety of habitats. The former population in Texas and Louisiana inhabited bayous, fallow fields, coastal prairies, and marshes (Carley 1979, Kelly et al. 2004). There is evidence that the species inhabited densely vegetated habitats such as the bottomland hardwood forests and swamps in the South (Paradiso and Nowak 1972a). Reintroduced wolves in North Carolina have made extensive use of habitats ranging from agricultural lands, pocosins, and loblolly pine (*Pinus taeda*) and pond pine (*P. serotina*) forests. The wolf is a habitat generalist, occurring where sufficient prey occur along with their basic needs for shelter and breeding (B. Fazio, U. S. Fish and Wildlife Service, personal communication). The red wolf is territorial; home range size varies from 46–226 km<sup>2</sup> depending upon habitat and prey density (Phillips et al. 2003). Red wolves require large tracts of land relatively free from human activity, heavily used highways, and livestock.

## REPRODUCTION

Age at sexual maturity for the red wolf has been reported at 3 years (Paradiso and Nowak 1972b) and as young as 22 months (Phillips et al. 2003). Breeding occurs in February and March with gestation lasting 61–63 days; average litter size is 1–8 pups (Crawford et al. 2001). Peak whelping dates occur from mid-April to mid-May (Paradiso and Nowak 1972b). Pregnant females may establish several dens. Some dens are shallow surface depressions located in dense vegetation where the water table is high, while other dens are deep burrows in wind rows between agricultural fields or in canal banks; dens have also been found in hollowed out bases of large trees (Phillips et al. 2003). One litter per year is produced by the dominant pair (Kelly et al. 2004). Dispersal typically occurs before individuals reach two years of age (Phillips et al. 2003).

## FOOD HABITS

The red wolf is an opportunistic predator and will take prey items that are available (Crawford et al. 2001). Common prey species in Louisiana and Texas included nutria (*Myocastor coypus*), eastern cottontail (*Sylvilagus floridanus*), swamp rabbit (*S. aquaticus*), marsh rice rat (*Oryzomys palustris*), hispid cotton rat (*Sigmodon hispidus*), common muskrat (*Ondatra zibethicus*), small domestic animals, and carrion (Stutzenbaker 1968, Russell and Shaw 1971, Riley and

McBride 1972). Red wolves in South Carolina consume fox squirrel (*Sciurus niger*), American coot (*Fulica americana*), and other birds (Carley 1979). In North Carolina, white-tailed deer (*Odocoileus virginianus*), northern raccoon (*Procyon lotor*), and marsh rabbit (*S. palustris*) comprise 86% of the diet (Phillips et al. 2003); frogs and turtles are also taken (Venters 1989). The red wolf is primarily a nocturnal hunter with crepuscular peaks of activity (Kelly et al. 2004).

## ASSOCIATED SPECIES

In addition to its primary prey, the red wolf occurs in habitats occupied by a variety of species. These include the Virginia opossum (*Didelphis virginiana*), American beaver (*Castor canadensis*), eastern gray squirrel (*Sciurus carolinensis*), common gray fox (*Urocyon cinereoargenteus*), northern river otter (*Lontra canadensis*), American mink (*Mustela vison*), and bobcat (*Lynx rufus*). It is preyed upon by the American alligator (*Alligator mississippiensis*) on St. Vincent Island, Florida (Whitaker and Hamilton 1998). The red wolf has been observed killing young American black bears (*Ursus americanus*; Kelly et al. 2004). Research is underway to determine the degree of competition for prey and habitat between the red wolf and coyote.

## VULNERABILITY AND THREATS

The introgression of coyote genes into the red wolf population is the principal threat to recovery (Stoskopf et al. 2005). Although hybridization with coyotes was a factor in the red wolf's initial demise in the wild, it was not detected as a problem in the North Carolina population until the early 1990s (Phillips et al. 1995). Vehicle mortality accounts for 18% of known red wolf deaths (Kelly et al. 2004). Human-induced mortality (e.g., gunshot, traps, and poison) in the reintroduced population accounts for approximately 17% of red wolf deaths (Kelly et al. 2004). The red wolf is susceptible to viral diseases including rabies, canine distemper, parvovirus, and hepatitis (Crawford et al. 2001). Commonly occurring helminths include canine heartworm (*Dirofilaria immitis*) and hookworm (*Ancylostoma caninum*); neither appears to be a significant source of mortality (Phillips and Scheck 1991). Mortality related to demodectic mange and infestation from the American dog tick (*Dermacentor variabilis*), lone star tick (*Amblyomma americanum*), and black-legged tick (*Ixodes scapularis*) have also occurred (Kelly et al. 2004).

## MANAGEMENT SUGGESTIONS

Continued success has established northeastern North Carolina as a permanent red wolf recovery site. (Crawford et al. 2001). The outlook continues to be

positive; coyote genetic intrusion into the red wolf population has been largely controlled (Stoskopf et al. 2005). Improved genomic testing protocols are available for assessing alleles (Miller et al. 2003). There is no evidence that inbreeding depression has been a major obstacle to the success of the recovery effort (Kalinowski et al. 1999). The primary recovery focus is protecting and promoting the growth of a self-sustaining, non-hybridizing population in the wild and sustaining an active captive component (Stoskopf et al. 2005).

Biological factors such as prey abundance, habitat availability and socioeconomic factors such as agricultural practices and land ownership patterns are important considerations for future reintroduction sites. Those limiting the restoration of the red wolf include conflicts with humans, political opposition, potential livestock depredation, increasing coyote populations, and uncertain taxonomic status (Crawford et al. 2001). Although the red wolf can flourish in a wide variety of habitats, the support of the public is a requisite for its successful recovery.

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