

STATUS SUMMARY:
THE RED WOLF
(CANIS RUFUS)



U.S. FISH AND WILDLIFE SERVICE
ALBUQUERQUE, NEW MEXICO
1979

ENDANGERED SPECIES REPORT 7

COVER

Felicia - One of the first red wolves
born in captivity. The fate of the
species rests with the offspring of
the Red Wolf Captive Breeding Program.

Status Summary: The Red Wolf

(Canis rufus)

By

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Status Summary: The Red Wolf

(Canis rufus)

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Introduction

The red wolf (Canis rufus) is a little-known North American canine that once ranged over the southeastern United States, from the Atlantic Ocean to central Texas, and from the Gulf of Mexico to central Missouri and southern Illinois. It was first described by Bartram (1791) in the 18th century; however, until recently little factual information has been available on the species. It is known that the eastern subspecies (C. r. floridanus) became extinct early in this century (Young and Goldman, 1944). The western subspecies (C. r. rufus), thought by McCarley (1962) to be a hybrid form resulting from breeding between the coyote C. latrans and C. r. gregoryi and therefore not a valid taxon, is believed to have recently become extinct (Carley, 1975). Recent findings indicate that the only extant subspecies (C. r. gregoryi), once occurring from eastern Texas to eastern Mississippi, for all practical purposes is extinct in the wild (McCarley and Carley, 1979).

The initial decline of the species is believed to have been caused by increases in the human population, changes in land use during the early 1900's, and predator control activities. As the species declined

coyotes rapidly moved into western portions of the red wolf's range. In areas where some red wolves survived, reproductive isolation between the red wolf and coyote broke down and led to hybridization between the two species. This in turn led to the establishment of a hybrid swarm which invaded the final range of the red wolf in southeast Texas and southwest Louisiana.

Hybridization between the red wolf and coyote led to difficulties in identifying specimens and resulted in a questioning of the validity of the red wolf as a species. The subject was a major point of discussion among canine taxonomists for nearly ten years; however, the red wolf was eventually determined to be a valid taxon with the variance between it and the coyote being greater than differences between various coyote subspecies (Paradiso and Nowak, 1971; Nowak, 1973). The identity of individual live specimens was further confused in some areas of the remaining red wolf range by hybridization with dogs (C. familiaris) (Carley, unpub. data).

Although Young and Goldman (1944) mentioned the possibility of hybridization in the red wolf, it was assumed until the early 1960's that populations of C. r. rufus and C. r. gregoryi were still viable. "Wolf" reports were numerous throughout Texas, Oklahoma, Missouri, Arkansas, Louisiana, and Mississippi. However, McCarley (1962), based on his inability to locate wolf-like specimens in east Texas and west

Louisiana, concluded that the red wolf no longer inhabited much of its former range. An examination of Canis from that area soon confirmed McCarley's findings and the red wolf was listed as a Federally endangered species on March 11, 1967. In the meantime, Paradiso (1965, 1968) and Pimlott and Joslin (1968) discovered what were believed to be viable red wolf populations on the Gulf Coast in southeast Texas and southwest Louisiana. Their reports were soon verified through the capture of several canines that conformed to accepted museum specimens of the species.

Current Recovery Efforts

Although a limited Red Wolf Recovery Program was established in 1967, it was not until the passage of the Endangered Species Act of 1973 (Public Law 93-205; 87 Stat. 884) that the red wolf was selected for priority treatment. At that time an expanded program to save the species was initiated by the U.S. Fish and Wildlife Service in cooperation with the Louisiana Wildlife and Fisheries Commission and the Texas Parks and Wildlife Department. Early program findings confirmed that the red wolf was confronted by loss of habitat, loss of young to parasites, persecution by man, and an irreversible dilution of the gene pool by invading coyotes (Carley, 1975). By late 1975, it was concluded that it was no longer feasible to preserve the red wolf gene pool in its limited range in Texas and Louisiana. Once this decision had been made, the prime objectives of the program became to: 1) locate and capture as many red wolves as possible in an attempt to preserve the species in

captivity, and 2) explore the feasibility of re-establishing red wolf populations in areas of the species' historic range. It was recognized by all concerned that the active removal of specimens from Texas and Louisiana would hasten the demise of the species in the wild. However, since extinction in the two states appeared to be inevitable, removal of the few remaining wolves was determined to be the only practical means of preservation.

In November, 1973, a Red Wolf Captive Breeding Program was established through the Metropolitan Park Board of Tacoma at the Point Defiance Zoological Garden in Tacoma, Washington (Figures 1 & 2). The objectives of the program are to: 1) certify the genetic purity of wild caught wolves; 2) increase the number of genetically pure red wolves in captivity, and 3) maintain a continuing red wolf gene pool for re-establishment of the species in the wild and/or distribution to selected zoological gardens. Presently there are less than 30 wild caught adult red wolves in the breeding program. The first litters of pups were born at the Point Defiance Zoo in May, 1977 (Figure 3).

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Figure 1. Aerial view of the twelve 100 X 100 foot pens erected with a security fence as part of the Red Wolf Captive Breeding Program contracted to the Point Defiance Zoo at Tacoma, Washington.

RED WOLF

CANIS RUFUS GREGORYI

NORTH AMERICA'S RAREST MAMMAL.
ONLY A SMALL WILD POPULATION
REMAINS IN ISOLATED AREAS OF
TEXAS AND LOUISIANA. THIS
FACILITY IS DESIGNED FOR THE
CAPTIVE PROPAGATION OF THIS
ENDANGERED SPECIES. PART OF A
PROGRAM TO SAVE THE WOLVES
FROM EXTINCTION

Figure 2. Sign erected by the Metropolitan Park Board of Tacoma at the red wolf breeding facilities of the Point Defiance Zoo in Tacoma, Washington.

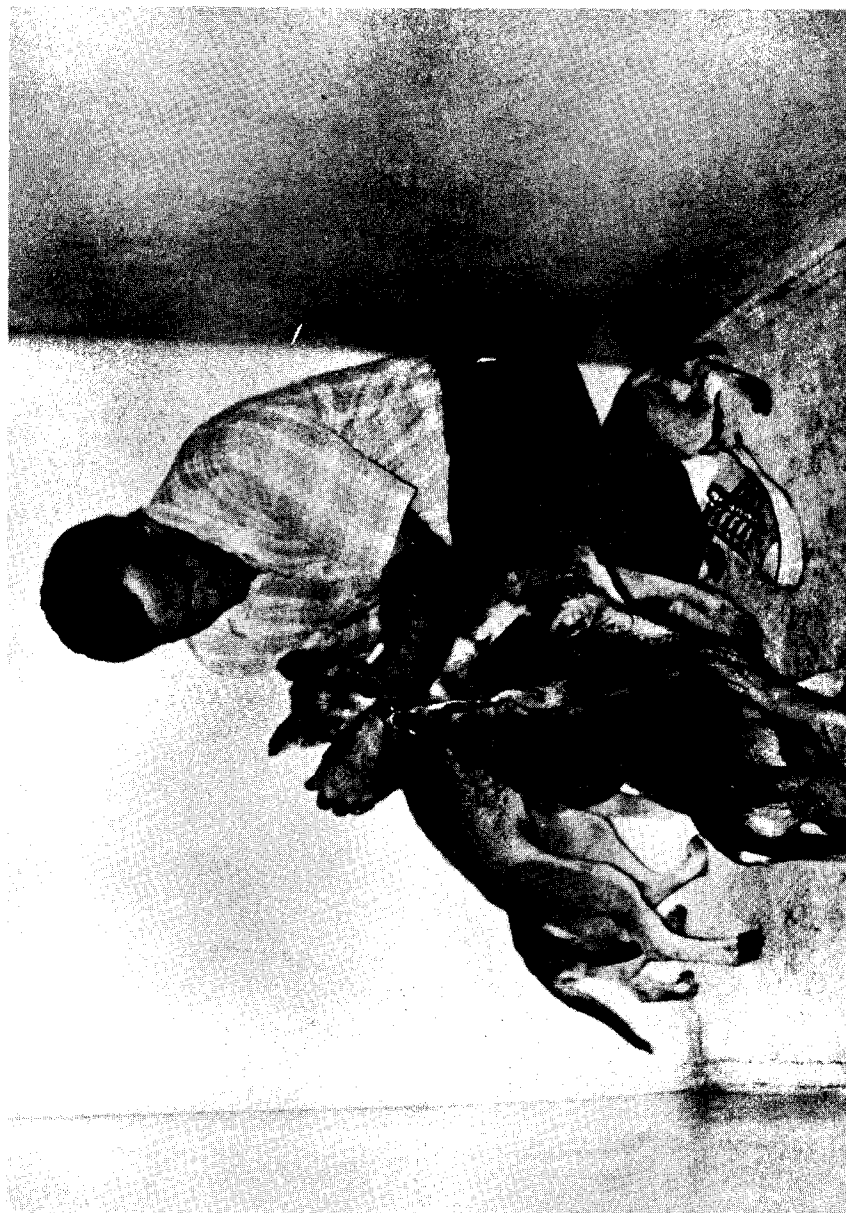


Figure 3. Wildlife Biologist C. J. Carley with an 83 day old (standing) and four 77 day old red wolf pups representing the first litters born to the Red Wolf Captive Breeding Program.

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each of the participating zoos will manage the breeding of the
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Experimental re-establishment of mated pairs of adult wild-caught red wolves has been tested on Bulls Island of the Cape Romain National Wildlife Refuge near Charleston, South Carolina (Carley, 1979; Carley In press). The results indicate it is possible to re-establish adult wild-caught red wolves in selected habitats in the wild. Observations on the opportunistic nature of wild canine species and their learning abilities, as well as limited experiments with wild-caught but captive-reared pups in Texas, also indicate that the establishment of captive-reared specimens in the wild is feasible. A search for, and evaluation of, possible sites for re-establishment of wild red wolf populations is underway within the historic range of the species.

Description

Taxonomic History

There has been a great deal of confusion over the identification of red wolves. As a result, a common misconception among biologist is that red wolves appear so similar to coyotes that only an expert can differentiate between the two. Such is not the case, the two species differ greatly and are readily distinguishable. The examination of hundreds of preserved and live canine specimens from throughout the red wolf range

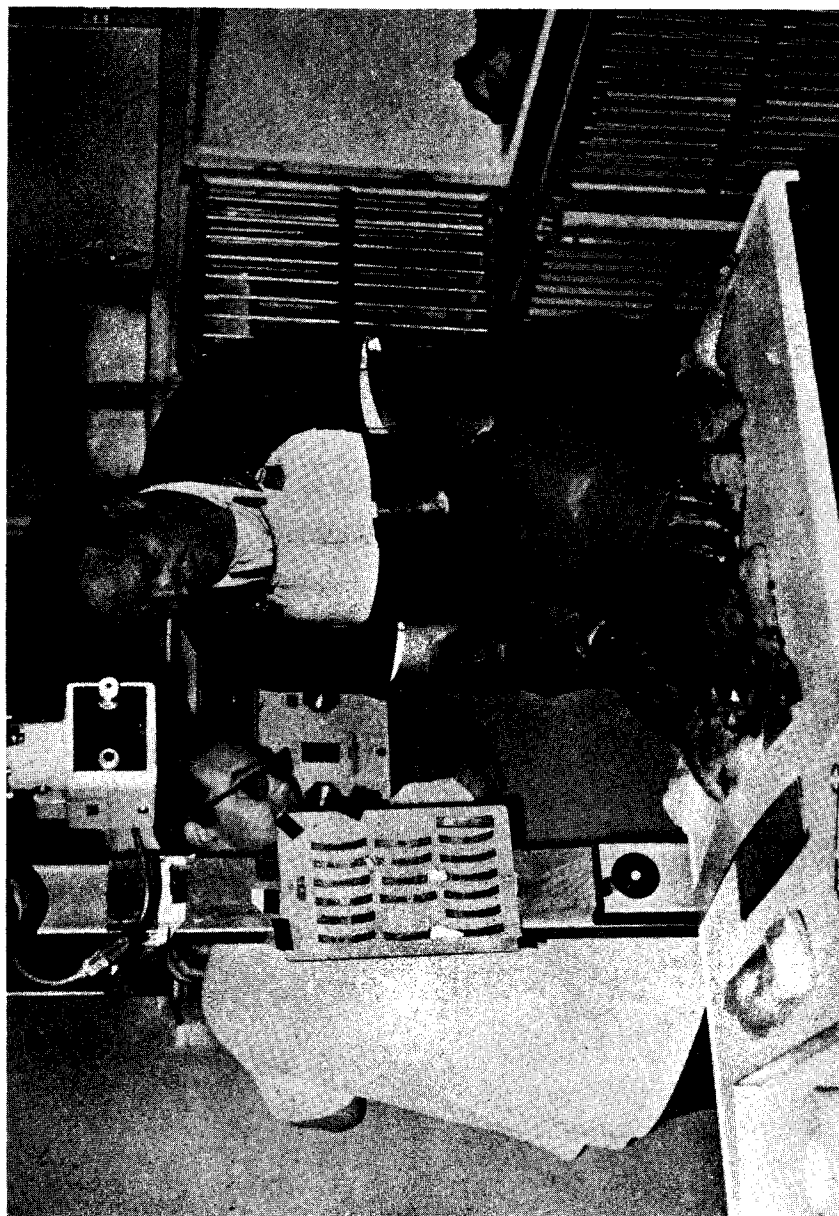


Figure 4. Drs. George Blanks (left) and Aaron Long (right) x-raying one of the first red wolf pups born in captivity. A sedated pup sleeps in the open cage to the right.

demonstrated that red wolves look like wolves, not coyotes or dogs. Confusion arises only when trying to separate wolf-like hybrid forms from pure red wolves.

The taxonomic confusion reported in most red wolf literature came about because of a failure to recognize the extent of hybridization between red wolves and coyotes during the early 20th century, particularly in the western subspecies of the red wolf, C. r. rufus. Many museum specimens representing this subspecies are actually hybrid forms and coyotes. The impression left by these specimens undoubtedly had a significant impact when Young and Goldman (1944) presented a description of the general characters of the species. It is notable that in their remarks for the species and the subspecies C. r. rufus, these respected authorities made the following comments:

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"Of these, the larger subspecies, gregoryi and niger, exhibit a remarkable approach in size and general proportions to the small eastern gray wolf, C. l. lycaon."*

* * *

- * The species Canis niger is now recognized as Canis rufus and the subspecies niger is now recognized as floridanus.

"Subspecies rufus in central Texas and Oklahoma, on the other hand, is so small and in general characters agrees so closely with C. latrans, which it overlaps in geographic range, that some specimens are difficult to determine."

* * *

"Close approach in essential details and the apparent absence of any invariable unit character suggest the possibility of hybridism in some localities in Texas."

Page 488.

"The small size of rufus is the principal character distinguishing it from the decidedly larger subspecies inhabiting territory to the eastward. The intergradation of rufus with gregoryi is clearly shown by specimens from eastern Texas, southeastern Oklahoma, and northwestern Arkansas. In these regions the transition from one subspecies to the other is rather abrupt. As already pointed out in remarks on the species, there appear to be no very tranchant (sic) or entirely dependable characters distinguishing in all cases small specimens of rufus from large ones of the coyote, Canis latrans; and the status of typical rufus in relation to the latter is, therefore, not entirely clear. However, as most specimens of the two species are readily recognizable, even where they occur at the same locality, possible hybridism, rather than regular intergradation, is indicated."

The last two quotations indicate that the authors were probably observing specimens taken from the hybrid swarm as it moved across Texas. It is now known that they were close to recognizing the cause of their confusion. However, the actual recognition of hybridization in the red wolf had to wait another 18 years for the observations of McCarley (1962), while appreciation for the taxonomic confusion brought about by hybridization waited 11 more years for the studies instigated by the establishment of the Red Wolf Recovery Program.

General Description

The general character descriptions presented by Young and Goldman (1944) adequately describe the red wolf if one de-emphasizes the "size comparatively small and form slender" statements and considers the red wolf, in general, as being intermediate in size between the coyote and gray wolf with some specimens being similar to small subspecies of the gray wolf such as C. l. lycaon and C. l. baileyi.

Because of hybridization and the resultant sympatric occurrence of specimens ranging in appearance from coyote-like to wolf-like, the Red Wolf Recovery Program has had to be quite selective in choosing specimens that represent the red wolf subspecies, C. r. gregoryi. As a result, some wolf-like specimens that were rejected may have been actual red wolves, but on the other hand, few if any hybrids have been included in the program. Therefore, the animals retained, on the average, may appear more wolf-like than some historically genetically pure red wolf specimens. These animals, however, undoubtedly contain genetic material representing the natural

variability exhibited by the wild historic red wolf population. The taxonomic variability of the historic population is not recorded in the literature.

The minimum standards which male and female wild-caught specimens were required to meet to be selected for captive preservation are reported in Table 1. Maximum taxonomic standards have not been established since the primary problem has been separating true wolves from wolf-like hybrids that resulted from breeding with the coyote, C. latrans. Reports from early trapping records indicate that the largest specimens of C. r. gregoryi did not weigh more than 80 pounds. The three largest specimens captured by the Red Wolf Recovery Program each weighed 76 pounds. However, because of occasional hybridization with various breeds of dogs (C. familiaris), large size in any of the taxonomic measurements does not necessarily indicate that a specimen is a true red wolf. A second set of criteria must then be used to search for dog characteristics that may be discernible through x-rays of the skull, physical appearance, breeding activity, and comparison of records of other specimens from the same locality.

Color Phases

The "normal phase" color description presented by Young and Goldman cannot be improved upon as a general description for the species.

"Color—Normal Phase: Upper parts, in general, a varying mixture of 'cinnamon-buff,' 'cinnamon,' or 'tawny' with gray and black; dorsal area more or less heavily overlaid with black, and black is conspicuously massed over the tail gland; muzzle, ears, and outer surfaces of limbs usually distinctly tawny; light post-humeral and nuchal bands varying in distinctness about as in the true wolves and coyotes; forearm with a narrow, more or less conspicuous, black line on anterior surface (present also in true wolf and coyote); under parts varying from whitish to 'pinkish buff;' tail tipped with black."

In common usage, we can think of the name "red wolf" as meaning the animal is usually redder than its northern cousin, the "gray wolf," C. lupus. However, the common name "red wolf" is misleading and the "tawny" character of the description is often over-emphasized. Most observers expect to see an animal as "red" as a red fox (Vulpes fulva). As pointed out by Nowak (1972), the term "red wolf" was originally used in reference to animals that lived in central and southern Texas. Then, when it became evident that these animals shared a consistency of key cranial and dental features with the wolves that ranged throughout the southeastern states, the designation "red wolf" came to be applied to all wolf-like canids of the region.

The "normal phase" color description does not present a viable means of identifying red wolves, since it is the common coat color pattern for canids of the south and southeast. As with most species, there is a normal variation of color with some red wolves appearing "tawny," "buff," or "gray." Gray wolves and coyotes show the same color variations. Coloration is also somewhat dependent on the habitat in which the animal is residing, the time of year, and the lighting conditions under which it is viewed. After a period of time, red wolves shipped to the captive breeding program in Tacoma, Washington, change color, put on a heavier coat, and become somewhat grayer with the white on the chest, legs, feet and muzzle becoming more pronounced (Figure 5).

For various reasons, the "black phase" of the red wolf has also been over-emphasized. In part, this probably results from the intriguing mystic nature that the human mind sometimes attributes to black animals. Undoubtedly, it is also partially based on the first description of the red wolf by Bartram (1791). He described the wolves of Florida as being "...perfectly black, except the females, which have a white spot on the breast...." This description is widely referenced and misstated. It is seldom mentioned that Bartram later described the animals as "...pied, black and white, and of other mixed colors." Audubon is reported to have distinguished black wolves as a species separate from the red wolf (Bailey, 1905).



Figure 5. A male red wolf in the breeding pens of the Red Wolf Captive Breeding Program at Tacoma, Washington. Wolves shipped to Tacoma change color, put on a heavier coat and become somewhat grayer with the white on the chest, legs, feet, and muzzle becoming more pronounced.

T. E. "Doc" Harris, former Supervisor of the Animal Damage Section of the Louisiana Wildlife and Fisheries Commission reported that when he started trapping in 1940, he found "black phase" wolves in swampy river basin habitats and the "tawny phase" in upland habitats (pers. comm.). He considered this to be the result of habitat natural selection. The Red Wolf Recovery Program has captured only one "black phase" canid, a 32 pound hybrid female trapped in December, 1977, in the heavily wooded bottomlands of the Neches River in Orange County, Texas. A pair of black phase canids captured in the Ozark National Forest in the late 1960's, and labeled as red wolves, were examined at the Little Rock Zoological Garden, Little Rock, Arkansas. The male weighed 31 pounds and was 24.5 inches at the shoulder, while the female weighed 29 pounds and was 22.5 inches at the shoulder. The animals were determined to be melanistic coyotes and the zoo records were changed accordingly. Offspring of these animals may be seen at Cheniere Lake Park, West Monroe, Louisiana (Figure 6). Melanism in coyotes has been reported by Halloran (1963), Ozoga and Harger (1966), Gipson (1976), and Mahan (1978). Melanism is not uncommon in gray wolves. We concur with Bailey (1905) who felt that occasional "black phase" red wolves represent a variation in color "...and show that only a minority of the individuals are entirely black." Red wolves, gray wolves, and coyotes, may be "red," "gray," or "black."



Figure 6. Melanistic offspring of a pair of coyotes that had been identified as "black phase" red wolves from the Ozark National Forest in Arkansas.

Habitat of Recent Range

Although the red wolf was once found in numerous habitats throughout the southeastern United States, its recent range was restricted to less than 900 square miles of extreme southeast Texas and less than 800 square miles of extreme southwest Louisiana. This range can be roughly described as the area south of Interstate Highway 10 in Jefferson and Orange Counties in Texas, and in Cameron and Calcasieu Parishes, Louisiana, west of Calcasieu Lake (Figure 7). Wolves, however, were found in only limited numbers in the southernmost reaches of even this area. Hybrids and coyotes were in the majority (McCarley and Carley, 1979).

The primary habitats within this area are coastal prairies and marshes. The prairie extends as a thin band of relatively high ground between the coastal marsh and the extensive forests of east Texas and western Louisiana. Forested lands extend northward from a line drawn roughly from Anahuac, Texas, to the northwest corner of Jefferson County and then eastward into Louisiana along Interstate Highway 10. Wooded areas also extend along bayous that traverse the prairie. Elevations within the area vary from 0 to 25 feet above sea level. Most of the coastal prairie, once characterized by tall bunch-grasses and the site of some of the earliest ranches in Texas, is in private ownership and is farmed intensively. The leading agricultural products of the area are cattle, rice, and soybeans. Petrochemical production is widespread and the area is becoming heavily industrialized.

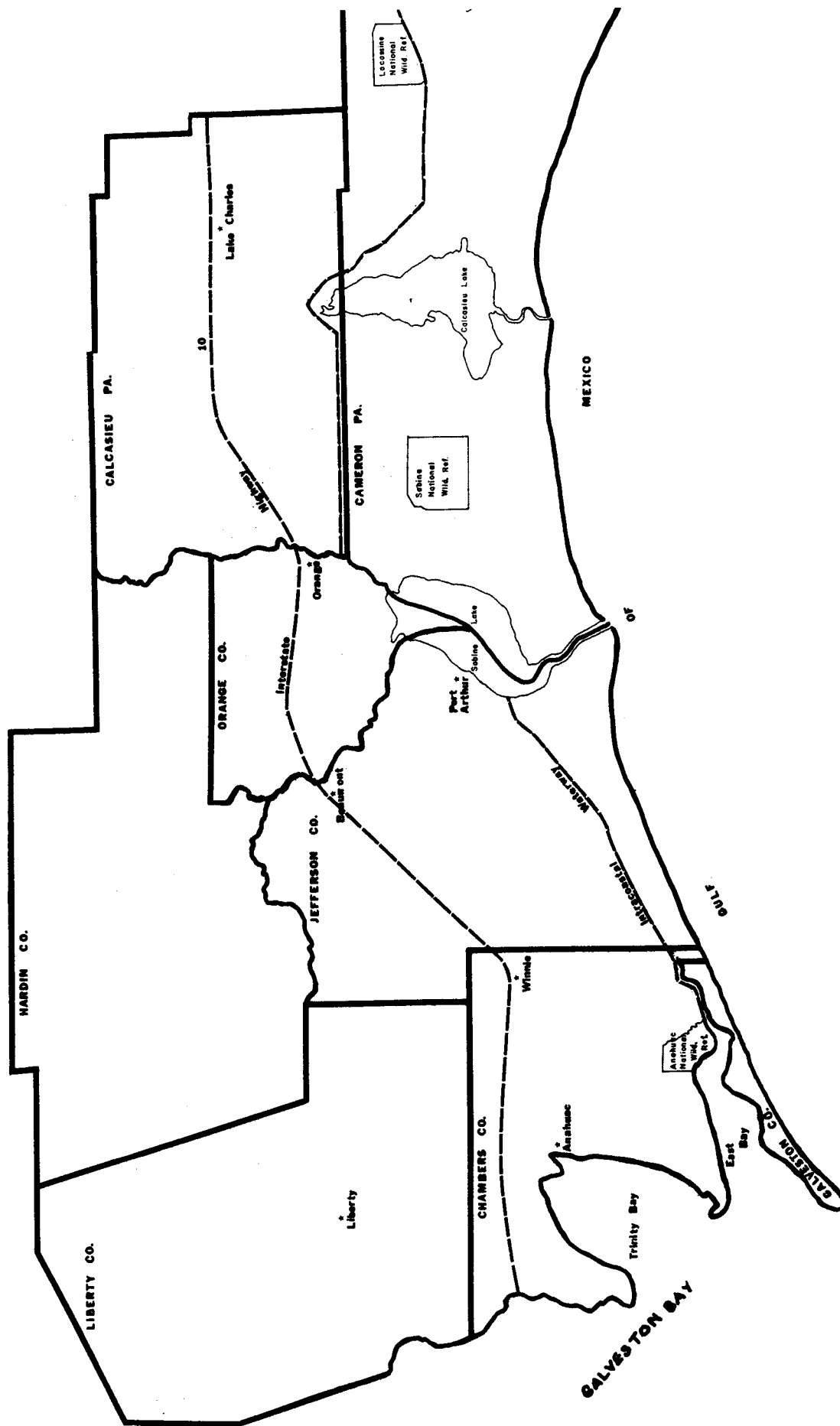


Figure 7. The present range of the red wolf is limited to an area south of Interstate Highway 10 and east from Jefferson County, Texas to Calcasieu Lake in Louisiana.

The coastal marsh, characterized by salt-tolerant grasses and sedges, starts as a narrow band along the northern edge of East Bay in Chambers County, Texas, and rapidly expands eastward. In general, it stretches from the Gulf of Mexico northward to a line starting at the tip of the peninsula separating Trinity and East Bays in Texas and extends eastward slightly north of and paralleling the Intracoastal Waterway to Calcasieu Lake, Louisiana. Most of Cameron Parish, west of Calcasieu Lake, is coastal marsh. The marsh, most of which is privately owned, is noted for its richness in alligators (Alligator mississippiensis), fur bearers such as nutria (Myocastor coypus), muskrats (Ondatra zibethicus), and raccoons (Procyon lotor), and its large flocks of wintering snow geese (Anser caerulescens). Petrochemical activity is widespread. Oil company roads, raised "cow walks," and levees permit ranchers to move herds of cattle into the area for winter grazing. Large areas of the marsh are burned each spring to remove dead vegetation and stimulate new growth. Waterfowl hunting is popular during the winter months (McCarley and Carley, 1979).

The climate is subtropical. A prevailing southeasterly wind maintains high relative humidity. The average annual rainfall is approximately 60 inches, while temperatures range from the high teens to 100° F. The area is subject to hurricanes. Thundershowers are common during the summer months, and days-long rainy periods occur in the winter when cold air masses encounter the moist Gulf air. Biting insects abound most of the year.

Life History

General

The details of the life history of the red wolf are lost in antiquity since no significant studies were made when viable wild populations still existed. Today such studies are limited because populations of wolves can no longer be found in the wild. The following generalities have been arrived at through literature surveys, personal communications, and the experiences of Red Wolf Recovery Program biologists.

The social structure of the red wolf is probably not as regimented as the pack system reported for gray wolves by Burkholder (1959), Mech (1966 and 1972), and others, or as unfettered as that suspected for coyotes (Knowlton, 1972; Riley and McBride, 1972). T. E. "Doc" Harris (pers. comm.) stated that the red wolves he observed in the 1950's exhibited a strong family bond. Howling surveys and radio telemetry studies conducted by the Red Wolf Recovery Program indicate that the animals travel in family groups. The Red Wolf Recovery Program often sighted lone wolves; however, groups of two or three were more common. The largest groups encountered consisted of seven animals. Groups tended to be larger in the fall when the current year's offspring were traveling with their parents.

The life span of the red wolf in the harsh environment of coastal southeast Texas and southwest Louisiana was short. The majority of the animals captured were estimated to be less than four years of age.

Occasional animals were found that appeared to be seven to eight years old. In captivity, with good care, the life span of red wolves should be about 14 years, similar to that of captive gray wolves or dog breeds of the same general size.

The primary habitat requirement for the red wolf in its final range was heavy vegetative cover. Radio telemetry studies and field observations by the Red Wolf Recovery Program indicated that the heavy cover provided along bayous and in fallow fields constituted the primary resting and denning areas of the species. During active periods the animals ranged out from these areas into rice fields and pastures. Access roads, dikes, and canal levees provided the primary travel routes through the area. It was not unusual to locate wolf sign far from cover along well-traveled roads (Carley, 1975). Canids of the area are often struck by vehicles when crossing major highways.

Wolves did not appear to be common in the coastal marshes. Although they ventured into the marsh along cattle walk-ways and oil field roads, the area did not appear suitable for habitation throughout the year. Wolves were more evident during the winter when mosquito populations and vegetative production are reduced.

Breeding and Denning

Reports of "strong" pair bonding in gray wolves are numerous (Mech, 1970; Fox, 1975). The relationship of mated red wolves in the wild is not known.

Translocated wolves, thought to be naturally mated pairs due to the circumstances of their capture, have stayed together. In captivity, paired red wolves appear to be fond of each other, often play together, and greet each other through typical canine mouthing and nuzzeling. Wild-caught adult wolves paired only two to three months prior to the breeding season have produced pups in captivity. A female captured with her suspected natural mate in October was placed in a pen with another pair of animals in January, her mate having died in December. The other pair of animals had been together since November; however, the male bred the new member of the trio, producing three pups. There was no indication that both females had been bred. All three adults tended the pups; no aggressive actions were observed between the two females. In another instance, a pair of wolves that had been together for several years, producing one litter of pups, were separated and placed with different mates. Although only 40 feet apart and able to view his former mate, the male bred with his new mate. There was no indication that his original mate was bred by her new companion. It is suspected that similar actions could be reported for gray wolves and coyotes in captivity.

As in the coyote, gray wolf, and dog, the gestation period for red wolves is 60 to 63 days. Pups are born in April or May. Thus far, litter sizes in captivity have ranged from two to six pups with an average of 3.85 per litter. Nowak (1972) reports accounts of as many as 12 pups.

In captivity both parents actively protect and play with the pups. Captive male red wolves have been observed to become aggressive toward their keepers even when pups were born to wolves in distant parts of adjacent pens. After a few days, the aggressive actions tended to subside. Although the wolves retreat and allow their keepers to approach the dens containing pups, they remain quite watchful and appear nervous. A pup yelping in one pen will draw the attention of all the wolves.

As reported by Nowak (1972), earlier accounts state that red wolves have been known to establish dens in hollow tree trunks, stream banks, former dens of other animals, and in coastal areas on sand knolls. Riley and McBride (1972) report denning occurring in drain pipes, culverts, and the banks of irrigation ditches. Recovery program biologists observed den excavations in sand knolls on the coastal prairie; however, no evidence of pups in the dens was ever found. A den located in a brush pile created during the construction of a golf course was used to rear a litter of hybrid pups. Due to poor drainage, a high water table, and commonly heavy showers along the coast, some of the dens were flooded. As evidenced by Riley and McBride (1972), in the flood-prone heavily vegetated habitat, most pups were probably born in grass "nests" located in areas of heavy cover. A diverse terrain would provide additional den sites and better protect the young.

Red wolves in captivity have excavated their own dens, used man-

made dens, or simply had their pups in shallow depressions, the latter case being common even when man-made dens were provided. When the keepers became concerned about the welfare of the captive-born pups during heavy rains and moved them to the dens provided, the female often returned the pups to their shallow nest. No captive-born pups are known to have died as a result of exposure to weather; however, it is suspected that without the protection of a den, several pups may have been lost to avian predators.

Food

The red wolf is an opportunistic predator, and as such, tends to eat prey species that present the greatest opportunity for capture. As reported by Stutzenbaker (1968), Russell and Shaw (1971), Riley and McBride (1972), and Shaw (1975), the common prey species utilized by wild canids in southeast Texas and southwest Louisiana are nutria (Myocastor coypus), swamp rabbit (Sylvilagus aquaticus), cottontail rabbit (S. floridanus), rice rat (Oryzomys palustris), cotton rat (Sigmodon hispidus), muskrat (Ondatra zibethicus) and raccoon (Procyon lotor). Historically, red wolves are reported to have killed razorback hogs (Sus scrofa) (Young, 1946) and deer (Odocoileus virginianus) (Young and Goldman, 1944). In addition, scats examined from wolves translocated to Bulls Island of the Cape Romain National Wildlife Refuge in South Carolina contained fox squirrels (Sciurus niger), American coot (Fulica americana), and parts of unidentified birds and small mammals. Red wolves, like coyotes and gray wolves, are carrion feeders.

Wolves in the Red Wolf Captive Breeding Program are maintained on a diet of high quality dry commercial dog food. Growing pups are provided large bones on which to gnaw.

Red wolves will prey on domestic livestock; however, such predation appears to be based on opportunity. Young calves (Bos taurus) less than 6 to 8 weeks of age, are susceptible to predation if not attended by a cow. Small barnyard animals, if allowed to run free, are also subject to predation. Recovery Program biologists observed red wolf predation on young calves, incapacitated cows, pigs, and barnyard fowl. The lack of a pack hunting structure and an abundance of smaller prey preclude the possibility of red wolves killing grown healthy cattle. Carrion feeding may lead some observers to conclude that livestock predation is a serious problem. Riley and McBride (1972) reported that ranchers in the range of the red wolf disagreed as to the seriousness of the wolf as a killer of cattle, a disagreement that never existed with the gray wolf. They interpreted the fact that there was disagreement among the ranchers as meaning that red wolves are not a serious predator of cattle.

Home Range

Shaw (1975) reported an average home range of 17 square miles for two female and five male canids involved in a telemetry study in the red wolf range in 1972. Riley and McBride (1972), by systematic tracking of three adult canids for one year, estimated the home range of a red wolf to be 25-50 square miles. In a telemetry study conducted in 1974, recovery program biologists concluded that male red wolves ranged over

an area of about 45 square miles, while the range of females averaged somewhat smaller (25-30 square miles) (Carley, 1975). Sub-adult home ranges appeared larger than those of adult animals. The home range of a red wolf is undoubtedly dependent upon the habitat in which it resides, the terrain, and the availability of prey. In southeast Texas and southwest Louisiana, it was evident that the wolves often traversed areas larger than required for the purposes of obtaining food. The general pattern appeared to be one of remaining in a relatively small area for a week to 10 days, with occasional overnight roundtrip explorations to other areas. Then the animal moved several miles to a new area where it remained for another week to 10 days. Such movements may have been the result of depleted food supplies in previously hunted areas. After several such relocations the animal usually returned to the original area occupied. A pattern similar to the above was also observed in translocated red wolves (Carley, In press).

Activity

Red wolves in the wild were observed to be predominantly nocturnal, with the highest levels of activity being from 8:00 p.m. to midnight (Carley, 1975; Shaw, 1975). There was a tendency toward diurnal activity during the winter. Figure 8 indicates a bimodal activity pattern similar to that reported for south Texas coyotes (Carley, 1973). Although the animals were most active shortly after sunset, there was a notable period of inactivity from about 1:00 a.m. to 3:00 a.m. followed by a period of

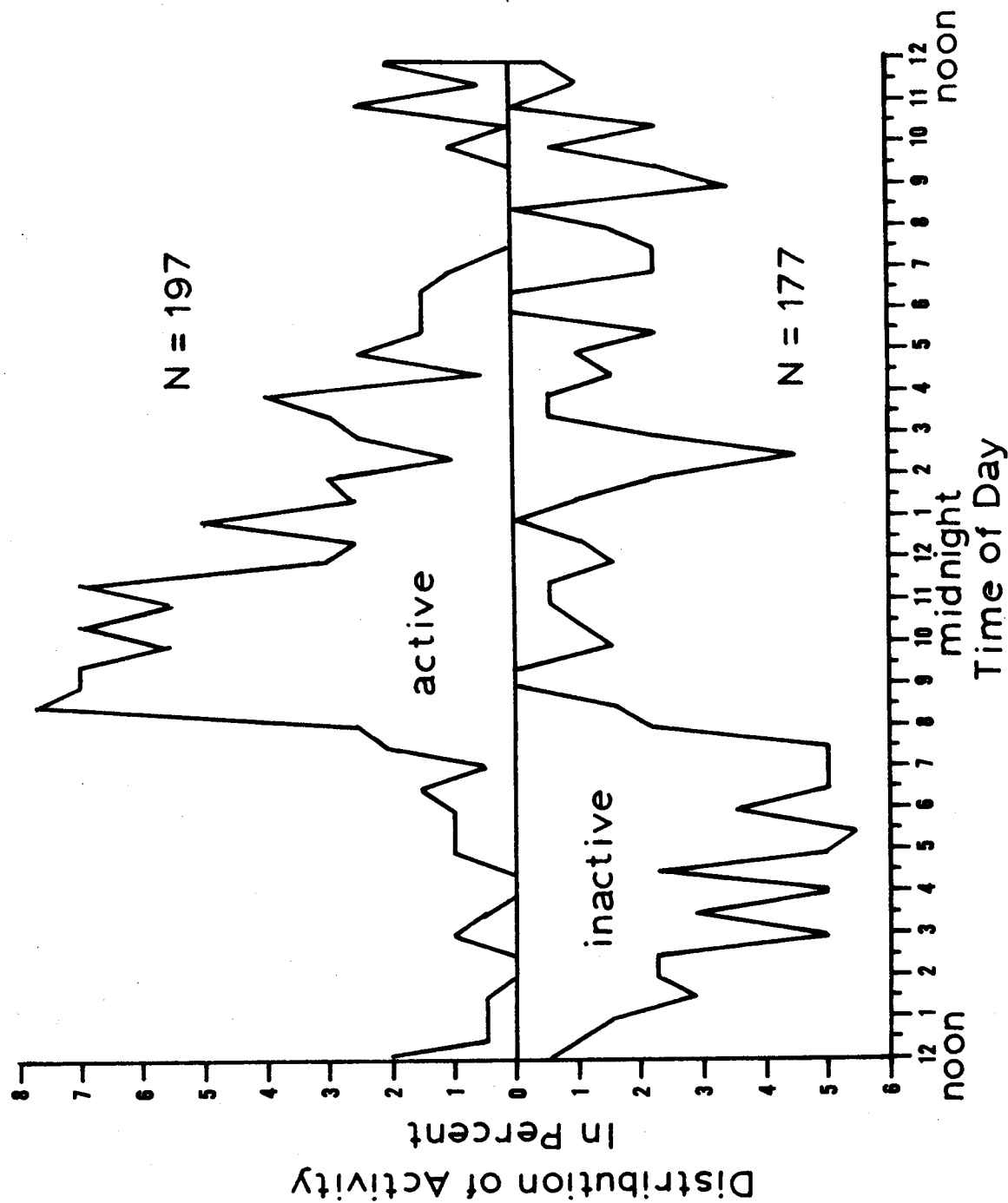


Figure 8. Percent distribution of periods of activity and inactivity of red wolves, as determined through radio telemetry observations made in April and May of 1974.

activity lasting until dawn. Thunderstorms or high winds have been observed to alter normal activity patterns.

Prospectus

Red Wolf Recovery Program field activities in the final range of the species in southeast Texas and southwest Louisiana will be concluded by September 30, 1980, due to the impracticality of attempting to capture the few wolves that may remain. For all practical purposes, the red wolf will then be extinct in the wild.

The Red Wolf Captive Breeding Program is continuing to certify wild-caught wolves and has produced certified red wolf offspring which will be made available for re-establishment attempts and transfer to qualified zoological gardens. Although red wolf genetic material can be maintained in captivity, the continued existence of the species in the wild depends on re-establishment in its historic range where it will be subjected to natural selective factors and display natural behavioral traits under the direction of a self-imposed social structure. Experiments in South Carolina and Texas demonstrated that red wolves can be re-established in the wild.

Potential translocation sites in the historic range of the species in the southeastern United States are being evaluated. Both island and mainland sites are being considered; however, potential long-range logistical problems indicate that mainland sites are preferable. Specific

plans for carrying out the first experimental re-establishment attempts will have to wait until the sites have been selected. Due to the controversial nature of wolves and the limited number of potential sites suitable for re-establishment it is unlikely that more than a few small scattered populations of red wolves will ever exist in the wild.

Acknowledgements

For fear of failing to recognize some individuals to whom I am indebted for this limited understanding of the red wolf, I have elected not to present a lengthy list of names. If such a list were presented, it would include just about everyone who has taken the time to discuss the various aspects of canines with me over the past decade. It would include, but not be limited to agriculturalists, concerned environmentalists, students of all ages, businessmen, educators, medical doctors, veterinarians, animal behaviorists, radiological technicians, hospital administrators, zoo keepers, fellow State and Federal biologists, parasitologists, bio-chemists, statisticians, writers, and not so oddly, numerous filling station attendants from throughout the country.

I wish to thank the Fish and Wildlife Service for providing me with the unique opportunity to unravel the mystery of an animal that could not even be positively identified and was on the brink of extinction due to complex and unusual circumstances. I also want to acknowledge my appreciation of the good natured support I have received from my work associates and supervisors in the Albuquerque Regional Office. It's not easy being a "wolf man" among a bunch of "plant," "bird," and "fish" nuts.

Of course I am indebted to my wife and family for the many inconveniences they have suffered during my six years of preoccupation with wolves. Most of all I wish to acknowledge the debt to my friends who unselfishly gave of themselves while assisting with the Red Wolf Field Recovery Program, the Red Wolf Captive Breeding Program and the South Carolina translocation experiment. Without their hours of physical discomfort, frustration, concern, and unswerving dedication, the Red Wolf Recovery Program would have failed. The program has often been at a point where the continued existence of the species would have been seriously jeopardized had any of them faltered in their efforts. There is still a great deal to be done; however, because of these people, we are at last in a position to accomplish our task.

Literature Cited

- Bailey, V. 1905. Biological Survey of Texas. North American Fauna, 25: 1-222.
- Bartram, W. 1791. Travels. Philadelphia, Pa. Pp. I+I-XXXIV + 1-522.
- Burkholder, B. L. 1959. Movements and behavior of a wolf pack in Alaska. J. Wildl. Mgmt. 23: 1-11.
- Carley, C. J. 1973. Development of coyote census techniques. Ann. Meet. Colo. Chapt. Wildl. Soc. and Colo. Sec. Range Mgmt. 13 p. Type-script.
- _____. 1975. Activities and findings of the red wolf field recovery program from late 1973 to 1 July 1975. U.S.F. & W. Report. Pp. 1-215.
- _____. 1979. Report and philosophy on red wolf translocations. Pp. 76-80. In Proceedings of the 2nd Symposium on Endangered North American Wildlife and Habitat June 1-5, 1977 (R. Lockwood, ed.). The Wild Canid Survival and Research Center, Inc., St. Louis, Missouri. Pp. 303.
- _____. In press. Report on the successful translocation experiment of red wolves (Canis rufus) to Bulls Island, South Carolina. In Proceedings of the Portland Wolf Symposium, Lewis and Clark College, Portland, Oregon, August 13-17, 1979 (J. Sullivan and P. Paquet, ed.). Garland STPM Press, New York.
- Gipson, P. S. 1976. Melanistic Canis in Arkansas. S.W. Nat. 21: 124-126.
- Halloran, A. F. 1963. A melanistic coyote from Oklahoma. S.W. Nat. 8: 48-49.
- Knowlton, F. F. 1972. Preliminary interpretations of coyote population mechanics with some management implications. J. Wildl. Mgmt. 32: 369-382.
- McCarley, H. 1962. The taxonomic status of wild Canis (Canidae) in the south central United States. S.W. Nat. 7: 227-235.
- _____, and C. J. Carley. 1979. Recent changes in distribution and status of wild red wolves (Canis rufus). U.S.F. & W. End. Sp. Rept. No. 4. Albuquerque, NM. Pp. i-v + 1-38.
- Mahan, B. R. 1978. Occurrence of melanistic canids in Nebraska. Trans. Neb. Acad. of Sci. 5: 121-122.

- Mech, L. D. 1966. The wolves of Isle Royale. U. S. Nat. Park Serv. Fauna Ser. 7. Pp. 210.
- _____. 1970. The wolf: the ecology and behavior of an endangered species. Nat. Hist. Press. Garden City, N.Y. Pp. 384.
- _____. 1972. Spacing and possible mechanisms of population regulation in wolves. Am. Zool. 12: 9 (abstract).
- Nowak, R. M. 1972. The mysterious wolf of the south. Nat. Hist. 81: 51-53, 74-77.
- _____. 1973. North American quaternary Canis. Unpd. Ph. D. diss., Univ. of Kansas. Pp. 380.
- Ozoga, J. J., and E. M. Harger. 1966. Occurrence of albino and melanistic coyotes in Michigan. J. of Mamm. 47: 339-340.
- Paradiso, J. M. 1965. Recent records of red wolves from the gulf coast of Texas. S.W. Nat. 10: 318-319.
- _____. 1968. Canids recently collected in east Texas with comments on the taxonomy of the red wolf. Am. Mid. Nat. 80: 529-534.
- _____, and R. M. Nowak. 1971. A report on the taxonomic status and distribution of the red wolf. U.S.D.I. Spec. Sci. Rept. Wildl. No. 145. Pp. 36.
- Pimlott, D. H., and P. W. D. Joslin. 1968. The status and distribution of the red wolf. Trans. N. Am. Wildl. and Nat. Resources Conf. 33: 373-389.
- Riley, G. A., and R. T. McBride. 1972. A survey of the red wolf (Canis rufus). U.S.D.I. Spec. Sci. Rept. Wildl. No. 162. Pp. 15.
- Russell, D. N., and J. H. Shaw. 1971. Distribution and relative density of the red wolf in Texas. Proc. 25th S. E. Assoc. Game & Fish Comm. 131-137.
- Shaw, J. H. 1975. Ecology, behavior, and systematics of the red wolf (Canis rufus). Unpb. Ph. D. diss., Yale Univ. Pp. 99.
- Stutzenbaker, C. D. 1968. Coastal marsh management survey job No. 6, Mottled duck status. Job progress report Federal Aid Project No. W-96-R-3. Pp. 9.
- Young, S. P. 1946. The wolf in North American history. Caxton Printers, Ltd., Caldwell, Idaho. Pp. 149.
- _____, and E. A. Goldman. 1944. The wolves of North America. (2 vols.). Am. Wildl. Inst., Washington, D.C. Pp. xx + 636.

TABLE 1. Minimum standards for adult male and female wild red wolves selected for captive breeding.

	<u>MALE</u>	<u>FEMALE</u>
Skull length	215 mm	210 mm
Zygomatic breadth	110 mm	110 mm
Weight	50 lbs (22.5 kg.)	42 lbs (19 kg)
Total length	53 in (1,346 mm)	51 in (1,295 mm)
Hind foot length	9 in (229 mm)	8 3/4 in (222 mm)
Ear length	4 3/4 in (120.6 mm)	4 1/2 in (114.3 mm)
Shoulder height	27 in (685.8 mm)	25.5 in (647.7 mm)
Brain/Skull Ratio	<23	<23.5

