

Red Wolf
(*Canis rufus*)
5-Year Status Review:
Summary and Evaluation



Photo: E. Kelvington

U.S. Fish and Wildlife Service
Red Wolf Recovery Program
Southeast Region
Atlanta, Georgia

February 2024

5-YEAR STATUS REVIEW

Red Wolf (*Canis rufus*)

GENERAL INFORMATION

Current Classification: Endangered

Lead Field Office: Red Wolf Recovery Program, Emily Weller, Program Coordinator.

Reviewers:

Lead Regional Office: Atlanta Regional Office, Carrie Straight (404) 679-7226.

Red Wolf Recovery Program: North Carolina Program Manager, Joe Madison (252) 475-8259.

Date of original listing: March 11, 1967 (32 FR 4001). The red wolf was originally listed as “threatened with extinction” under the Endangered Species Preservation Act of October 15, 1966 (80 Stat. 926).

Methodology used to complete the review: In accordance with section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act), the purpose of a status review is to assess each threatened species or endangered species to determine whether its status has changed and if it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants. The U.S. Fish and Wildlife Service (Service) evaluated the biology, habitat, and threats of the Red Wolf (*Canis rufus*) to inform this status review. In conducting this 5-year review, we relied on the best available information pertaining to historical and contemporary distributions, life histories, genetics, habitats, and threats of this species. We announced initiation of this review and requested information in a published Federal Register notice with a 60-day comment period on May 13, 2022 (87 FR 29364). We received public comments in the form of 11,148 form letters, and 6 additional individual emails during and shortly after the open comment period. These comments are addressed in Appendix A. Summary of Public Comments. We used a variety of information resources, including monitoring reports, surveys, and other scientific and management information. Specific sources included the final rule listing this species under the Act, peer reviewed scientific publications, unpublished field observations by Federal, State, and other experienced biologists, unpublished studies and survey reports, and notes and communications from other qualified individuals.

FR Notice citation announcing the species is under active review:
May 13, 2022 (87 FR 29364)

Species’ Recovery Priority Number at start of 5-year review ([48 FR 43098](#)): 5C. At the time of listing Red Wolf was recognized as a species with a high degree of threat and a low recovery potential. The “C” indicates that the species’ recovery in conflict with construction or other development projects or other forms of economic activity.

Review History: Two previous 5-year reviews were signed on September 28, 2007, and April 23, 2018 (Service 2007 and 2018a, respectively). Both reviews recommended that the species remain listed as endangered.

REVIEW ANALYSIS

Listed Entity

Taxonomy and nomenclature

The taxonomy of the Red Wolf was assessed by the Committee on Assessing the Taxonomic Status of the Red Wolf and the Mexican Gray Wolf; Board on Life Sciences; Board on Agriculture and Natural Resources; Division on Earth and Life Studies; National Academies of Sciences, Engineering, and Medicine in 2019 (National Academies of Sciences, Engineering, and Medicine 2019). The document had several findings and conclusions related to Red Wolf taxonomy related to gray wolf (*Canis lupus*) and coyotes (*Canis latrans*), which are directly quoted from the document below:

“Finding: Fossil evidence suggests that at least five subspecies of *Canis lupus* were present in North America after 1 million years ago. The earliest fossils attributed to *Canis rufus* were found in Florida and dated at 10,000 years ago” (page 53)

“Finding: Fossil evidence indicates that *Canis latrans* arose in North America and spread across the continent but that it disappeared from the eastern North America approximately 10,000 years ago and returned in the 1900s” (page 53)

“Finding: Based on the limited set of specimens available for analysis, prior to contact with modern coyotes, populations of *Canis rufus* could be morphologically distinguished from *Canis lupus* using canonical discriminant analysis. Although conclusions from studies based on skull morphology differ as to whether *Canis rufus* represented a subspecies of *Canis lupus* or a distinct species, an analysis of the anatomy of the cerebellum supports the recognition of *Canis rufus* as historically a distinct species” (page 55).

“Finding: North American canid species are genetically very similar to each other and have substantial amounts of shared genetic variation” (page 56).

“Finding: The mtDNA haplotypes from historical wolf-like canids (previous to the recent sympatry with coyotes) in the eastern United States cluster within the coyote clade” (page 56).

“Finding: The contemporary population of red wolves in North Carolina is morphologically distinguishable from sympatric coyotes and Red Wolf–coyote hybrids” (page 57).

“Finding: The red wolf population shows evidence of past genetic contributions from populations related to gray wolves, coyotes, or both” (page 58).

“Finding: The red wolf is genetically more closely related to coyotes than to western gray wolves” (page 59).

“Finding: The timing of the admixture between red wolves and other canids is still unresolved, but Red Wolves have divergent genetic ancestry that predates European colonization” (page 61).

“Finding: The red wolf has some degree of genetic ancestry not found in reference populations of western gray wolves or coyotes” (page 62).

“Finding: Red wolves have a social organization and reproductive behavior that is more similar to gray wolves than to coyotes, and when mates are available they exhibit assortative mating” (page 63).

“Finding: Morphological analyses suggest cohesiveness among red wolf specimens from the end of the Pleistocene to the early 1900s, but it remains unclear whether this continuity is shared with the extant captive and managed populations” (page 64).

“Finding: Genetic continuity between the managed red wolf population and the historical wolf in the eastern United States cannot be firmly established without genomic data from ancient specimens. However, the patterns of genetic variability are compatible with the hypothesis that the red wolf shares a fraction of its genetic history with a canid distinct from modern reference coyotes and gray wolves” (page 65).

“Finding: The reported social behaviors of the natural and restored populations are very similar” (page 66).

“Finding: The original distribution of red wolves seems to have been tied to the distribution of the eastern temperate forests. The red wolves require larger home ranges to obtain their prey than coyotes. This requirement of larger home ranges is consistent between the original natural population and the extant managed population in North Carolina” (page 67).

“Finding: The diet of the red wolves in the restored population includes a greater consumption of deer than the natural population. However, this may be a function of prey availability and body size. Both red wolves and coyotes in North Carolina consume a similar diet in terms of the types of prey, but they differ in the proportions of deer, rabbits, and other small mammals in their diets and in their seasonal consumption of these prey types” (page 68).

“Conclusions

1. Available evidence suggests that the historical red wolves constituted a taxonomically valid species.
2. Extant red wolves are distinct from the extant gray wolves and coyotes.
3. Available evidence is compatible with the hypothesis that extant red wolves trace some of their ancestry to the historical red wolves.
4. Although additional genomic evidence from historical specimens could change this assessment, evidence available at present supports species status (*Canis rufus*) for the extant red wolf” (page 69).

Distinct Population Segment (DPS) (61 FR 4722)

The Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This species was not listed as a DPS, and we have no new information that would indicate the species should be listed as a DPS under the Service's 1996 DPS Policy.

Recovery Criteria

Recovery Plan or Outline

Revised Recovery Plan for the Red Wolf (*Canis rufus*). Third Revision. September 2023 (Service 2023).

Recovery plans are not regulatory documents and intended to provide guidance to the Service, States, and other partners on methods of minimizing threats to listed species and on criteria that may be used to determine when recovery is achieved. If the recovery criteria defined in the plan are still valid, meeting recovery criteria can indicate that the species no longer requires protections under the Act. However, when recommending whether a listed species should be delisted, the Service must apply the factors in section 4(a) of the Act ([84 FR 45020](#)).

Delisting Criteria:

Criterion 1: Three viable wild populations occur within the Red Wolf historic range and are distributed to maximize species redundancy.

- Populations occur in suitable habitats of sufficient quantity and quality to support natural demographic processes (e.g., survival, reproduction, dispersal, and mortality) that lead to viable populations, as described in Criterion 2.

Criterion 2: Each Red Wolf population meets the following criteria for viability:

- One of the three populations consists of at least 180 individuals, the other 2 populations consists of a minimum of 280 individuals each, based on an estimate of the number of individuals 1 year and older;
- At least 80% of current and future founder gene diversity has been maintained;
- Once the population meets minimum abundance, the population is stable or growing for a period of 10 years without extensive human interventions (mean population growth rate for those 10 years is ≥ 1.0); and
- Each population has a 95% probability of persistence for 100 years.

Criterion 3: Adequate mechanisms or long-term commitments are in place that provide a high level of certainty that Criterion 2 for each population will be maintained into the foreseeable future without the protections of the Act.

At this time none of these criteria have been met.

Biology and Habitat Summary

For more information about life history, biology, mating systems and threats, the reader can refer to the Species Status Assessment Report (Service 2018b), the most recent population viability analysis (Miller et al. 2023), and discussions in the Third Revision of the Recovery Plan for Red Wolf (Service 2023). For up-to-date information about the Red Wolf recovery activities including the captive population and recent releases, reproductive successes, and coyote management work, please refer to the Red Wolf Recovery Program website:

<https://www.fws.gov/project/red-wolf-recovery-program>. More information about the Association of Zoos & Aquariums' Saving Animals From Extinction (SAFE) program (captive breeding program) for Red Wolf can be found on their website: <https://www.aza.org/connect-stories/stories/saving-the-endangered-american-red-wolf> and the Action Plan for 2019-2022 (Lasher 2019).

Populations

Eastern North Carolina. Currently, there is only one wild breeding population of Red Wolves, the Eastern North Carolina Red Wolf Population (ENC RWP), which encompasses five counties of the Albemarle Peninsula in eastern North Carolina (Beaufort, Dare, Hyde, Tyrrell, and Washington counties) (Figure 1).

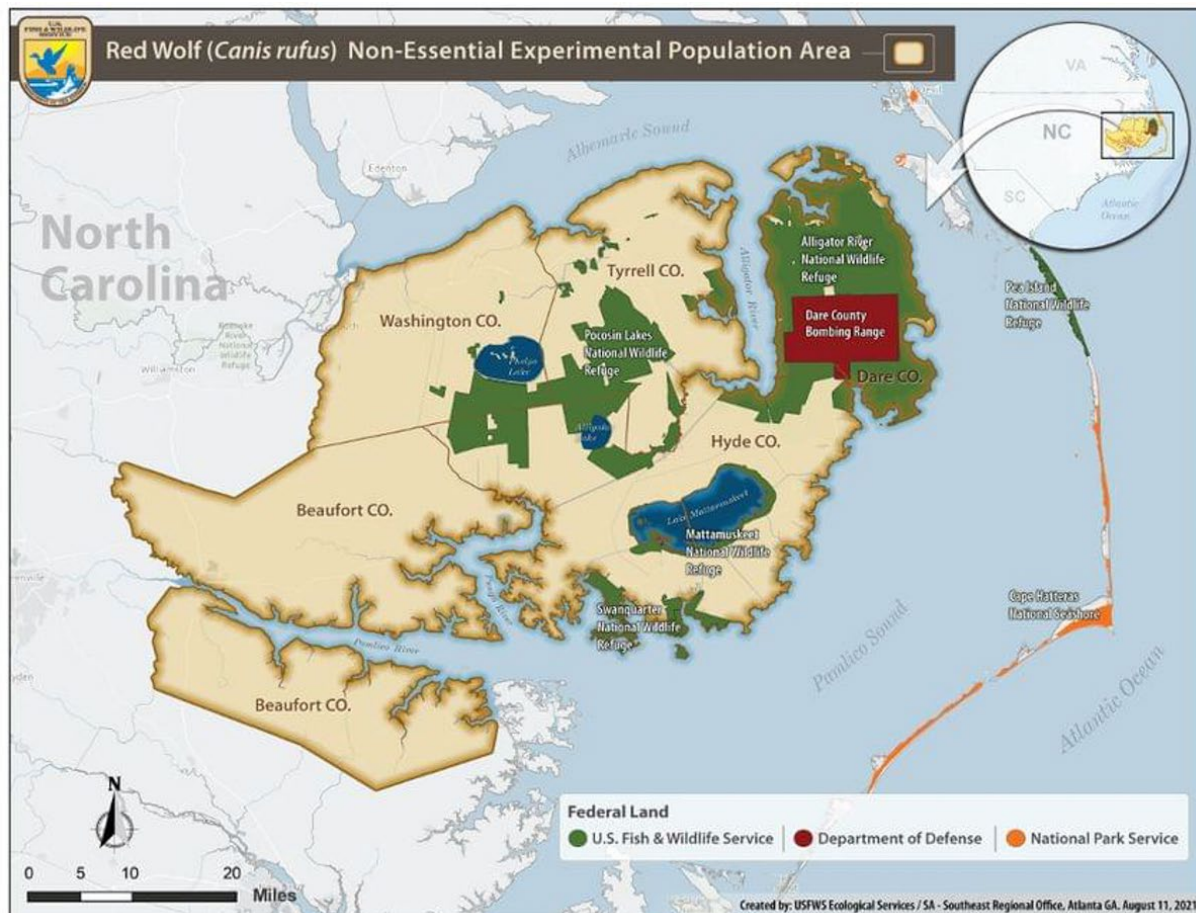


Figure 1. Map of the boundaries of the Non-essential Experimental Population of Red Wolf in eastern North Carolina.

Between 1987 and 1994, over 60 adult Red Wolves from what is now called the SAFE population were released into this population. By the mid-1990s, Red Wolves in the wild maintained territories, formed packs, and successfully bred. Between 1995 and 2014, 34 Red Wolves were released, and 39 Red Wolf pups were fostered into the ENC RWP (Service 2023). These management actions led to population growth and in 2012 an estimated population as high as 120 Red Wolves within the five-county ENC RWP area.

After peaking, the population declined dramatically. Human-caused mortality (e.g., gunshots, vehicle strikes) has been the leading cause of this decline. Hybridization with coyotes, which is exacerbated by human-caused mortality, particularly in breeding pairs, and low Red Wolf population numbers also played a key role in this decline. Additionally, the Service suspended management activities (e.g., pup fostering, releases, translocations, and coyote sterilization) while independent reviews of the Red Wolf Recovery Program were ongoing by the Wildlife Management Institute and others. Between 2015 and 2018, there were no Red Wolf releases, translocations, pup fostering, or coyote sterilizations.

In 2019, Service resumed management actions with the translocation of a male Red Wolf from St. Vincent National Wildlife Refuge (NWR) (See St. Vincent NWR section below) to the ENC RWP and coyote sterilizations under a permit from NCWRC. By 2020, the known (radio-collared) population reached its lowest at 7 known Red Wolves. Between 2020 and February 2024, 25 Red Wolves were released (includes releases from the SAFE population and translocation of wild Red Wolves from St. Vincent NWR) and 5 Red Wolf pups were fostered into the ENC RWP (Service 2023). Due to declining population size and the mortality of one or both Red Wolves in established breeding pairs, there were no known Red Wolf pups born in the wild in 2019, 2020 or 2021, which is the first time that has occurred in over 30 years. The Service is currently implementing actions, such as adaptive management (e.g., coyote sterilization/euthanasia), translocation of Red Wolves from an island propagation site on St. Vincent NWR, releases of Red Wolves from the SAFE population into the ENC RWP, and pairing wild Red Wolves in the ENC RWP to create new Red Wolf breeding pairs within the ENC RWP. Additionally, the Service is pursuing pup fostering to increase the population in the wild where the necessary prerequisites are present. As a result of management actions taken in 2020 and 2021, a wild Red Wolf litter of 6 pups (4 females, 2 males) was confirmed on April 19, 2022, born to the Milltail breeding pair on Alligator River National Wildlife Refuge (NWR) – the first wild Red Wolf litter born since 2018.

On approximately April 11, 2023, the breeding female of the Milltail family group on Alligator River NWR had a litter for the second year in a row. The litter consisted of 5 pups (3 females, 2 males). A pup from a SAFE-born litter was fostered into this litter. On June 7, 2023, during routine monitoring, members of this family group, including all 6 pups, were seen from a great distance by the Service, which indicates that the foster pup was successfully adopted by the wild Red Wolf mother. On September 26, 2023, the breeding male of the Milltail family group was found to be a mortality. Necropsy results indicate that the cause of death was a vehicle strike. On December 22, a Milltail female pup from this year, was found to be a mortality. Cause of death also appears to be a vehicle strike, though necropsy results are pending. As of January 2024, four of the five remaining pups have been captured, collared, and released within their family group's home range where they have remained. In late January 2024 a male red wolf from the SAFE population was released after 3 months in an acclimation pen within the territory of the Milltail

family group in an attempt to replace the previous breeding male; as of mid-February 2024, he has incorporated into the family group. All adult and juvenile SAFE-born Red Wolves released in the ENC RWP and all captured wild adult and juvenile Red Wolves are collared with orange radio (GPS and VHF) collars with orange reflective material. See additional discussion of orange collars in the Threats discussion below.

Also in 2023, two additional litters were born in the wild in acclimation pens within the ENC RWP to a family group from the SAFE population and a wild female paired with a male from the SAFE population. In late May 2023, the family group and their pups were released from the acclimation pen. In July 2023, a Red Wolf pup from this family group was reported injured on Pocosin Lakes NWR. That pup later died as a result of her injuries, despite efforts to save her. Later that same day a mortality notification was received for her father, the breeding male of the family group. Necropsy results are pending on both mortalities and are part of an ongoing law enforcement investigation. Shortly after these mortalities, the SAFE-born breeding female dispersed from the refuge for the first time and later became involved with the depredation of chickens on multiple occasions. She was captured in September 2023 by the Service and placed back into the SAFE population. Monitoring indicated that the remaining pups from this family group were likely abandoned after the mortalities and the breeding female's move off the refuge.

In May 2023, the newly formed pair (wild female paired with a male from the SAFE population) and their pups were released from the acclimation pen within the female's territory. On November 19 and 20, 2023, the two surviving pups were captured, collared, and released within their family group's home range where they have remained with the breeding pair.

Management actions implemented since 2020 have stemmed the decline and the population has experienced an increase. In June 2023, after releases were completed for the year, the total population was estimated to be between 32 and 34, with 16 known through active radio-collars. By December, this number decreased to between 21-23 individuals with 11 known through active radio collars due to the deaths of several older Red Wolves due to natural causes, other anthropogenic mortalities, and some mortalities that the cause could not be determined (see Red Wolf Recovery Program website for complete summary of management actions and mortalities from 2020 to present). As of February 2024, after the collaring of pups born in 2023, the total estimated population is between 20 and 22, with 18 known (collared) Red Wolves. The total population is an estimate based on known radio-collared Red Wolves, adult Red Wolves with radio collars that quit functioning relatively recently that are likely still on the landscape, pups of the years that are too small to be collared, and an additional few un-collared adult Red Wolves that are thought to potentially be on the landscape based on reported sightings and remote sensing cameras.

Population estimates as of February 2024:

- Known/collared (wild): 18
- Total estimate (wild): 20-22
- Red Wolf SAFE (captive population used for introductions): 263

St. Vincent NWR. In 1990, the Service established an island propagation site for the Red Wolf at St. Vincent NWR, an isolated island off the Gulf Coast of Florida (see Service 1990). The role of this site is to propagate Red Wolf pups in the wild in a somewhat controlled (an isolated island),

but natural environment (low visitation most of the year and Red Wolves roam free on the island) that will provide them with a wild experience as juveniles for the purpose of being strategically translocated into a wild population, such as the ENC RWP. In 2022, a male was released into this population and paired with one of the wild females. No breeding success has been confirmed between this pair. In 2023, a female Red Wolf was translocated from St. Vincent to the ENC RWP.

Additional Information. Although the only established known population occurs in North Carolina, a recent publication suggested evidence that a wolf consistent with Red Wolf in size and features may have occurred in east Texas between 2014 and 2017 (Ladine 2021). Unfortunately, genetic testing did not occur on the hair samples collected, so these potential sightings could not be verified.

Over the last several years, studies have found Red Wolf ancestry still persists in wild canids in the southeast Texas/southwest Louisiana area where what was thought to be the last of the wild Red Wolves were captured in the 1970s to begin the captive breeding program (now the SAFE program) for Red Wolves. This ancestry is known Red Wolf ancestry, meaning these canids share alleles with the 12 founder Red Wolves used to establish the program, their decedents that currently make up the SAFE breeding program, and the reintroduced population in Eastern North Carolina. Additionally, these studies found this Gulf Coast canid population may carry Red Wolf ghost alleles. These are alleles absent from any other North American canids (e.g., coyote, gray wolf, eastern wolf, and dog), including known Red Wolves, but are thought to be alleles lost, or not captured, when Red Wolves were removed from the wild to start the SAFE population. Currently, an ongoing study is conducting further trapping of canids in coastal Louisiana and Texas to collect genetic samples and phenotypic data for comprehensive genomic and morphological analyses. In collaboration with this study, research is also being conducted on historical museum specimens to more accurately define Red Wolf genetics and, thus, better quantify Red Wolf ancestry of wild canids, including those being studied along the Gulf Coast. At this time, it is unclear if these Gulf Coast canids constitute Red Wolves.

Threats (Five-Factor Analysis) Summary

The status of a species is determined from an assessment of factors specified in section 4 (a)(1) of the Act. These threats are detailed in the species' previous 5-year reviews (Service 2007 and 2018a), and SSA Report (Service 2018b). A summary of the current threats is detailed below.

Factor A: the present or threatened destruction, modification, or curtailment of its habitat or range

Habitat Availability. Habitat for the population of Red Wolves in North Carolina is expected to be impacted by potential future development and sea level rise (Service 2018b, Drobles 2022). The habitat loss from sea level rise is more thoroughly discussed below under Factor E. Sea Level Rise. Development potential in the future may become more relevant if habitat is limited by another factor like sea level rise, which could drive Red Wolves into areas more heavily used by humans or in areas where the “placeholder” strategy (e.g., removal/sterilization of coyote and Red Wolf/coyote hybrids) is not implemented to limit introgression with coyotes. We note, though, that some of the areas immediately west of the ENC RWP, where they could likely move initially if factors such as development or sea level rise precluded the eastern area, are private

lands that are currently less developed and, in some cases, have a comparable number of roads but with fewer highways.

North Carolina Wildlife Federation and the Service's Partners for Fish and Wildlife Program's "Prey for the Pack" habitat improvement program provides technical assistance and funding to private landowners to improve habitat in eastern North Carolina (<https://ncwf.org/blog/prey-for-the-pack/>) that benefit the landowner and wildlife. Service staff have continued to develop additional Prey for the Pack agreements throughout the ENC RWP and have completed some in key locations adjacent to Alligator River NWR. Programs like this certainly provides improved habitat for Red Wolves and other wildlife in the covered areas.

Factor B: overutilization for commercial, recreational, scientific, or educational purposes

Overutilization is not believed to be a threat to the species, however, see the discussion about illegal killing of Red Wolves below.

Factor C: disease or predation

Disease and parasites occur in the SAFE and wild population (Service 2018b and references therein). Although some diseases are common on the landscape and could potentially pose some level of a threat to the wild Red Wolf population including canine distemper, canine parvovirus, and rabies (Brzeski et al. 2015), they have not been a factor in the ENC RWP to date. Currently, wild Red Wolves, and coyotes to be re-released after capture, are vaccinated for a variety of diseases including canine distemper, parvovirus, coronavirus, parainfluenza, *Leptospirosis*, adenovirus, Lyme disease, and rabies whenever they are handled. This reduces the threats of disease in the wild population. Coyotes can be a reservoir for disease and parasites in areas where they interact with Red Wolves but is somewhat ameliorated by treating captured coyotes.

Factor D: the inadequacy of existing regulatory mechanisms

Illegal killing/poaching. Anthropogenic mortalities, including gunshots and vehicle strikes, has been the leading cause of decline in Red Wolves. Persecution of Red Wolves on the landscape is still a significant threat to the species, including mortalities from gunshot (intentional and unintentional), poisoning, and other suspected illegal activity. Anthropogenic causes of death have contributed to around 80% of marked animal deaths, with just over 50% estimated to be caused by poaching or cryptic poaching (suspected illegal activity where poachers conceal evidence) (Agan et al. 2021a). A study assessing human attitudes toward Red Wolves in the vicinity of the ENC RWP indicated that the majority liked Red Wolves, supported their restoration, dislike policy that would limit Red Wolf protections, trusted the agency, and would not kill a Red Wolf illegally (Agan et al. 2021b). However, 11% of self-identified male hunters would kill any wolves they encountered on the landscape (Agan et al. 2021b).

The "Prey for the Pack" program is designed to not only improve habitat for Red Wolves and other wildlife species, but also increase tolerance and support for Red Wolves on the landscape. Prey for the Pack agreements include a commitment by the landowner to allow Red Wolves to use their property without harassment.

Although the "Prey for the Pack" program may increase tolerance and support for Red Wolves, there are some that will continue to kill Red Wolves they encounter on the landscape despite any

incentives. There have been documented poaching cases for Red Wolves in the last two years including one in 2023 in Washington County, NC (notice published August 7, 2023; <https://www.fws.gov/press-release/2023-08/federal-officials-seek-assistance-investigation-red-wolf-death>) and another in Tyrrell County, NC in 2022 (notice published May 13, 2022; <https://www.fws.gov/press-release/2022-05/federal-officials-seek-assistance-investigation-red-wolf-death>). With the limited number of individuals in the population, any loss of individuals can have a significant impact on the population and pack dynamics, putting the population at risk. See the Species Status Assessment Report that discusses pack dynamics, mating requirements, and impacts of loss of individuals (Service 2018b).

The orange radio collars with orange reflective material put on all adult/juvenile Red Wolves in the ENC RWP are for tracking purposes and to identify them as a Red Wolf and illegal to shoot, potentially decreasing gunshot mortality due to misidentification as a coyote. All Red Wolves mentioned above that were shot were wearing orange collars, indicating that the collar may not be effective at preventing all poachers; however, we believe the collars are effective at preventing gunshot mortality due to misidentification. Additionally, the orange collars may be effective at increasing the likelihood of the successful prosecution of poachers since it is less likely to be able to claim misidentification, which could potentially reduce the poaching due to concern over being prosecuted.

A recently released population viability analysis by Miller et al. (2023) indicated that mitigation of anthropogenic mortality is needed to facilitate increased Red Wolf abundance. Although Red Wolves are protected under the Act, those protections and existing state laws appear to be inadequate to protect the species from anthropogenic mortality such as, gunshot, poisoning, and suspected illegal activity that have continued since the species' listing (Service 2018a, 2018b, and references therein).

Factor E: other natural or manmade factors affecting its continued existence.

Vehicle strikes. Vehicle strikes, along with other anthropogenic causes of mortality like gunshot, continue to be a leading cause of mortality in Red Wolves. According to Hinton et al. (2017), vehicle collisions resulted in 34% of all mortality resulting from an anthropogenic source between 1987 and 2013. Between 2019 and 2023, there were 11 mortalities due to vehicle strike. This mortality level would be expected to increase as habitat becomes more fragmented by roads and with increasing human traffic that would be expected with increased development. Additionally, this threat would also likely increase with increases in the population size of Red Wolf.

A recent report identified mitigation measures (e.g., wildlife fencing, wildlife crossing structures) were likely most needed along U.S. Highway 64, U.S. Highway 264, and Highway 94 to substantially reduce vehicle strike mortality (Huijser and Begley 2023). Three Red Wolves released from the SAFE population in 2021 and a wild Red Wolf in 2023 were killed along this stretch of the road.

To reduce vehicle mortality within the ENC RWP, orange reflective material is affixed to the bright orange radio collars on Red Wolves to increase their visibility along at night. We do not have any data on the effectiveness on the collars related to reduction of vehicle strikes at this time. Since early February 2022, mobile electronic message signs, purchased by the Service, the

North Carolina Wildlife Federation, and the Red Wolf Coalition have been placed along highways and roads in closest proximity to remote Red Wolf release sites. When needed, these signs are moved to areas where tracking/monitoring indicates Red Wolf are near roads. Areas where signs have been placed include multiple locations on Highway 64, Highway 264, Highway 94, and Shore Drive. We have no information to determine the effectiveness of these signs but believe they have increased public awareness of Red Wolves in the vicinity and hope they increase vigilance of drivers and reduce vehicle mortalities.

Hybridization (Coyote Introgression). In addition to anthropogenic sources of mortality, interbreeding with coyotes continues to be a significant threat to Red Wolves in the wild. Some early research indicates that management efforts “may have limited coyote densities in northeastern North Carolina” (Hinton and Chamberlain 2022). An additional study by Hinton et al. (2018) suggests that as Red Wolves become more abundant on the landscape, coyote hybridization will likely decrease, reducing this threat. Gese et al. (2015) further discusses addressing hybridization in Red Wolf.

The recent population viability analysis by Miller et al. (2023) supports this information. “Direct management of coyote reproductive output – primarily in the form of sterilization of intact coyotes over 25 years in a manner that allowed them to retain the ability to form pairs and occupy territories but fail to produce offspring – was shown overwhelmingly to foster reduction in the coyote breeding population, to open up the possibility of more frequent Red Wolf-Red Wolf pair formation and, consequently, to improve the chances of Red Wolf population growth and long-term viability” (Miller et al. 2023). A major component to management of the ENC RWP is minimizing interbreeding between Red Wolves and coyotes and limiting coyote gene introgression into the wild Red Wolf population while simultaneously building a restored Red Wolf population. The Service currently conducts coyote removal and sterilization on NWR lands and private lands, under a permit obtained from the North Carolina Wildlife Resources Commission (NCWRC) and with landowner permission (including “Prey for the Pack” agreements), within the ENC RWP. Currently, areas in close proximity to wild Red Wolves are targeted for coyote removal and sterilization. Sterilization does not affect the bond of a coyote pair which mate for life, nor does it impact the size of their territory or the vigor with which they defend it, meaning they will continue to limit the intrusion of “new” coyotes into their territory, thus limiting the overall population. Additionally, sterile coyotes are not capable of breeding with other canids, effectively limiting the growth of the coyote population and limiting hybridization events with wild Red Wolves. Ultimately, these “placeholder” canids are replaced by Red Wolves either naturally (e.g., displacement) or via management actions (e.g., removal followed by pairing wild or translocated Red Wolves into the territory). This management technique has been effective in managing the adverse effects of hybridization on the wild Red Wolf genome (Gese and Terletzky 2015, Gese et al. 2015).

Climate Change, Hurricanes, Extreme Weather, and Sea Level Rise. Extreme weather events, such as high winds or flooding from hurricanes could result in direct mortality of individuals. Hurricanes have caused deaths of at least two SAFE Red Wolves and could have contributed to the death of one Red Wolf in the wild (Service 2018b).

The Albemarle peninsula is expected to be impacted by sea level rise and climate change. Projections forecast an approximate 24% loss of land in the five-county area in eastern North

Carolina. These projections are discussed in the Species Status Assessment Report (Service 2018b). The loss of this habitat may result in westward dispersal which could be problematic as Red Wolves move into a more fragmented landscape that could be more favorable for coyotes. However, some of the areas immediately west of the ENC RWP, where they could likely move initially if factors such as development or sea level rise precluded the eastern area, are private lands that are currently less developed. A more recent study assessed the impacts of sea level rise and urbanization on suitable sites for Red Wolf into the future (Drobes 2022). This study emphasized the loss of habitats along the coast from sea level rise and the potential for more interior reintroduction locations that may provide appropriate habitat and resources.

Small Population Size and Founder Stock. Only 14 animals were used to found the SAFE propagation program for Red Wolves, though only 12 genetic lines are represented. Since the number of founders are limited, inbreeding depression is of concern for the species. Along with inbreeding depression there are other concerns relating to the relatively small population size, including reduced genetic variability, significant decline by stochastic events, potential Allee effects, which are discussed in more detail in the Species Status Assessment Report (Service 2018b). When considering the potential release of Red Wolves from the SAFE population for the purposes of attempting to create pairings with wild Red Wolves, their genetic relatedness is taken highly into account in order to maintain genetic variability as much as possible.

Other. Wildfires have been incidentally reported to result in mortality of individual Red Wolves, pups (Beck et al. 2009). Although this is a possibility, it is not currently a significant source of mortality in the population. Additionally, Red Wolves have been known to use carcasses, gut piles, and garbage dumps as food sources. This activity could put Red Wolves in closer proximity to roads in cases of roadkill, people, livestock, and coyotes which may also be attracted to these sources of food. This may increase conflict with humans and introgression with coyotes. Additionally, evidence of habituation to humans in SAFE-born Red Wolves released into the ENC RWP has impacted the success of some releases. Behaviorally appropriate SAFE-born Red Wolves are needed for reintroductions into the wild.

Synthesis

The Red Wolf is a species of wolf once common throughout the Eastern and South-Central United States. A nonessential experimental population located in eastern North Carolina has approximately 20-22 wild wolves. The SAFE (captive) population has 263 individuals. The species continues to be threatened by hybridization with coyotes, human-caused mortalities including poaching, poisoning, vehicle strikes, habitat modification from development and loss from future sea level rise. Only 12 animals were used to found the SAFE propagation program for Red Wolves and introductions. Since the number of founders are limited, inbreeding depression, reduced genetic variability, significant declines by stochastic events, and potential Allee effects are all of concern for the species. Considering the full analysis described in the Species Status Assessment report, the Red Wolf continues to have virtually no resiliency, no redundancy, and very low representation. Because of the threats facing the species and low viability in the wild, we believe the species continues to meet the definition of an endangered species.

RECOMMENDED FUTURE ACTIVITIES

A detailed discussion of recovery actions and criteria are presented in the Revised Recovery Plan (Service 2023).

REFERENCES

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RESULTS / SIGNATURES

U.S. Fish and Wildlife Service Status Review of Red Wolf

Status Recommendation:

On the basis of this review, we recommend the following status for this species. A 5-year review presents a recommendation of the species status. Any change to the status requires a separate rulemaking process that includes public review and comment, as defined in the Act.

Downlist to Threatened

Uplist to Endangered

Delist:

The species is extinct

The species does not meet the definition of an endangered or threatened species

The listed entity does not meet the statutory definition of a species

No change needed

LEAD REGIONAL OFFICE APPROVAL:

Assistant Regional Director – Ecological Services, Fish and Wildlife Service

Approve _____

APPENDIX A. SUMMARY OF PUBLIC COMMENTS

Summary of Public Comments

The majority of public comments (11,148) were received as a form letter with a variety of minor variations. This form letter was organized via The Public Interest Network. An additional email was also provided from the group indicating, they had 22,496 signatures. The letters provided the following as the main body of the email.

"Vehicle strikes, hybridization with coyotes and poaching are urgent and ongoing threats that, if left unchecked, could quickly lead to the extinction of the red wolf in the wild. Continued management and protection is vital if these wolves are going to be able to reestablish a growing, thriving population in their natural habitat.

A study entitled "Majority positive attitudes cannot protect red wolves (Canis rufus) from a minority willing to kill illegally," published in the October 2021 edition of Biological Conservation, revealed that a small portion of surveyed respondents -- residents of red wolf habitat -- would kill any wolf they encountered. Maintaining stringent protective measures for wolves is the only way to protect them from being decimated by poaching."

In addition to the form letter and its information, we received emails with information from three interested members of the public and from the Wildlands Network and the Southern Environmental Law Center (on behalf of the Red Wolf Coalition, Defenders of Wildlife, and Animal Welfare Institute). Most of these comments focused on concerns relating to the experimental population (10(j)) designation, coyote hybridization and management, illegal killing, vehicle strikes genetics and taxonomy, and recovery planning and implementation activities.

Response to Public Comments

A 5-year review is written to make sure all species listed as threatened or endangered under the Act continue to have the appropriate level of protection. A five-year review utilizes the best available scientific and commercial data on a species to determine whether its status has changed since the time of its listing or its last status review.

Addressing future actions and activities and finding avenues for funding are part of the recovery planning process (recovery planning and implementation). Enforcing or strengthening laws related to illegal killing or other activities that harm Red Wolves and interpretation of those laws are also not part of the 5-year review. We have incorporated all novel or new information where appropriate within the document if they pertained to the current status of the species or current and future threats.