Petition for a Red Wolf (*Canis rufus*) Recovery Plan

December 8, 2016

Animal Welfare Institute
Center for Biological Diversity
Defenders of Wildlife
Endangered Species Coalition
South Florida Wildlands Association
WildEarth Guardians
Wolf Conservation Center

December 8, 2016

The Honorable Sally Jewell
Secretary
Department of the Interior
1849 C Street, NW
Washington, D.C. 20240

The Honorable Dan Ashe
Director
U.S. Fish and Wildlife Service
1849 C Street, NW
Washington, D.C. 20240

Re: Petition to the U.S. Department of Interior and U.S. Fish and Wildlife Service for Development of an Updated Recovery Plan for the Red Wolf (*Canis rufus*)

Dear Secretary Jewell and Director Ashe:

Pursuant to Section 4(f) of the Endangered Species Act ("ESA") and Section 553(e) of the Administrative Procedure Act ("APA"), the Animal Welfare Institute, Center for Biological Diversity, Defenders of Wildlife, Endangered Species Coalition, South Florida Wildlands Association, WildEarth Guardians, Wolf Conservation (collectively, "Petitioners") hereby petition the U.S. Department of the Interior ("DOI"), by and through the U.S. Fish and Wildlife Service ("USFWS" or "Service"), to meet its mandatory duty to develop a recovery plan for the red wolf by revising and updating its 1990 recovery plan so that it utilizes the best available science and meets the ESA's criteria.[1] 16 U.S.C. § 1533(f); 5 U.S.C. § 553(e).

The Animal Welfare Institute ("AWI") is a nonprofit charitable organization founded in 1951 and dedicated to reducing animal suffering caused by people. AWI engages policymakers, scientists, industry, and the public to achieve better treatment of animals everywhere—in the laboratory, on the farm, in commerce, at home, and in the wild.

The Center for Biological Diversity ("Center") is a nonprofit conservation organization dedicated to the protection of native species and their habitats through science, policy and environmental law. The Center has more than 1.1 million members and online activists dedicated to the protection and restoration of endangered species and wild places. The Center has worked for many years to protect imperiled plants and wildlife, including red wolves.

For all the reasons set forth in this petition and as a matter of law, the Service should respond to this petition by updating the 1990 Red Wolf Recovery/Species Survival Plan to incorporate new recovery strategies throughout the red wolf's historic range. *See* 16 U.S.C. § 1533(f). Should the

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[1] Petitioners and their members are "interested persons" within the meaning of the APA, and they petition the Service for a comprehensive recovery strategy for the red wolf pursuant to the APA and in accordance with the ESA. *See* 5 U.S.C. § 553(e) (granting any "interested person the right to petition for the issuance, amendment, or repeal of a rule"); *id*. § 551(4) (a "rule" is "the whole or a part of an agency statement of general or particular applicability and future effect designed to implement, interpret, or prescribe law or policy").

Service fail to comply with these mandatory obligations, Petitioners may pursue relief from a federal district court.[2]

Accordingly, we ask you to respond to this petition expeditiously to inform us that you have begun work on an updated plan for the red wolf. Moreover, we ask that you include a timeline by which you will complete the recovery planning process and begin implementation of recovery strategies necessary for the red wolf.

Sincerely,

Noah Greenwald, Endangered Species Program Director
Collette Adkins, Senior Attorney
Center for Biological Diversity

Tara Zuardo, Wildlife Attorney
Animal Welfare Institute

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[2] 5 U.S.C. § 702 ("A person suffering legal wrong because of agency action, or adversely affected or aggrieved by agency action within the meaning of a relevant statute, is entitled to judicial review thereof."); *id.* § 551(13) ("agency action" includes "the whole or a part of an agency rule, … or the equivalent or denial thereof, or failure to act"); *id.* § 706(1) and (2)(A) (granting a reviewing court the authority to "compel agency action unlawfully withheld or unreasonably delayed" and/or to "hold unlawful and set aside agency action … found to be … arbitrary, capricious, an abuse of discretion"); *see also* 16 U.S.C. § 1540(g)(1)(C) ("any person may commence a civil suit on his own behalf" "against the Secretary where there is alleged a failure of the Secretary to perform any act or duty under section 4 which is not discretionary with the Secretary").

EXECUTIVE SUMMARY

While some of the analysis and many of the identified conservation actions in the red wolf's recovery plan from 1990 remain relevant, much has also changed and been learned about the red wolf in the last two decades. Petitioners submit this document to assist the Service in updating the red wolf recovery plan by providing scientific information about threats to the red wolf and strategies to address those threats and promote recovery.

History of Red Wolf Decline and the Recovery Program. The red wolf was once abundant throughout the southeastern United States, but human persecution—including government-sponsored eradication programs—and hybridization with coyotes led to its near-extinction by the 1960s. Animals from a remnant red wolf population from Louisiana and Texas were removed from the wild for a captive-breeding program, and the wolf was declared extinct in the wild in 1980. That captive breeding program supplied a reintroduction effort in 1987 in the Alligator River National Wildlife Refuge in North Carolina. That is the only extant wild red wolf population, which peaked at about 150 wild red wolves in 2005.

Thereafter the red wolf population began to decline, primarily due to shootings, and in 2014, the Service began dismantling the Red Wolf Recovery Program. In September 2016, the agency recommended drastic changes to the Red Wolf Recovery Program, including restricting the red wolf population to federal lands in Dare County, North Carolina.

Description and Taxonomy of Red Wolves. This medium-sized pack animal has a slender build and a cinnamon-colored coat interspersed with gray and black. Most evidence long has indicated that the red wolf is a distinct species, and, while some authorities have suggested it may be a subspecies or admixture, consensus exists that the red wolf should be protected under the ESA because its unique lineage is worthy of conservation.

Diet, Home Range, and Habitat Use. Red wolves feed on a variety of prey, including deer, rabbits, and rodents. They show flexibility in foraging behavior that appears to depend on demographic (e.g., age, pack size, breeder weight) and environmental (e.g., season, prey distribution) factors. A red wolf's home range size averages about 70 km^2 and is influenced by habitat type and body weight. The red wolf is a habitat generalist. Agricultural fields are widely used in the summer, while forested habitats with increased cover are primarily used in the winter.

Population Status. The red wolf is the world's most critically endangered canid with a total wild population estimated at 45 individuals widely distributed across a five-county area in North Carolina.

Threats. The primary threat to the red wolf is shootings, which caused an estimated 30 out of 65 red wolf deaths from 2012 to 2015. Illegal shooting deaths occur when wolves are mistaken for coyotes, but wolves are also legally shot and killed under the current 10(j) rule, which allows for killings under numerous circumstances. By reducing population size, gunshot mortality potentially increases red wolf inbreeding and red wolf hybridization with coyotes, which are other key threats to the wolf. Another threat is disease, which has the capacity to wipe out the single extant red wolf population, especially given that coyotes expose red wolves to a wide variety of wildlife pathogens found in the Southeast. Most people support red wolf recovery, but negative attitudes of vocal opponents have led to increased poaching as well as pressure on the Service to dismantle the red wolf program, which also constitutes a threat to the species' survival and recovery.

Recovery Goals. The 1990 recovery plan called for the establishment of 220 red wolves in three wild populations. In preparing a revised recovery plan the Service must apply current science on red wolf population viability to determine whether that goal will ensure red wolf conservation. Achieving the recovery goal requires reducing and removing threats, as well as growing the red wolf population and its current range through reintroductions.

Needed Recovery Actions. A variety of recovery actions are needed to address the numerous threats to the wild red wolf population. To address gunshot mortality, the Service needs to work with the state government to restrict coyote hunting in the wolf's range and educate landowners and hunters to avoid deaths due to mistaken identity. A revised 10(j) rule needs to be promulgated that reduces the number of wolves that can be legally shot or removed.

The threat of hybridization will lessen as shootings decline and the red wolf population grows. Until that time, use of sterile coyotes as placeholders is a proven tactic for addressing this threat. Although the risk of inbreeding depression will also decline as the wolf population grows, genetic diversity can be maintained through pup cross-fostering and other releases of captive-raised wolves into the wild. Disease monitoring and prevention plans are needed to address the threat of disease.

Reintroduction of red wolves to additional sites within their historic range is of critical importance to red wolf recovery. Additional individuals would not only grow the population and expand its range, but they would also help reduce other risks associated with small and isolated populations, such as inbreeding depression and disease.

The success of reintroduced populations depends in large part on maintaining positive public attitudes towards red wolves. Financial incentives for impacted landowners and public education campaigns are needed components of the Red Wolf Recovery Program.

BACKGROUND

Currently the world's most endangered wild canid, the red wolf was once abundant throughout the southeastern United States. Human persecution—including government-sponsored wolf eradication programs—along with widespread extirpation of the red wolf's primary prey, white-tailed deer (VerCauteren 2003), and hybridization with coyotes led to near-extinction of the red wolf by the 1960s (USFWS 1990; Hinton et al. 2013).

The coyote hybridized with some remnant wolf populations, and the resulting hybrids gave the impression that the red wolf survived, and even thrived, in much of its range west of the Mississippi (Goldman 1944; Nowak 1967, 1979, 1999; Sealander 1956; Young 1944, 1946). As late as 1964, the U.S. Fish and Wildlife Service considered the species common over a large region, with such information being cited by the American Society of Mammalogists (1965) and Cahalane (1964).

Perhaps the earliest published indication of the red wolf's plight came from the Arkansas Game and Fish Commission (1951) and the Louisiana Wildlife and Fisheries Commission (1952–1953, 1954–1955). Both agencies noted that the original populations of large wolves in their states were vanishing and being replaced by a smaller kind of wolf. McCarley (1959) subsequently reported that the red wolf was either extirpated or extremely rare in Texas, and Sampson (1961) showed that its absence from Missouri had been known by the early 1940s. The first authoritative recognition that the entire species was in far more serious trouble than generally acknowledged came from Young (1960, p.131): "Subject to the same persecution as its two close relatives, it is now fast disappearing, and is found only in a small area west of the Mississippi."

By the mid-1960s the critical status of the red wolf was understood (American Society of Mammalogists 1966; Cahalane 1965; Nowak 1967; Pimlott and Joslin 1968). Under a precursor to the Endangered Species Act ("ESA"), the red wolf gained protection as an endangered species in 1967. 32 Fed. Reg. 4001 (March 11, 1967). Thereafter efforts began to locate and capture as many wild red wolves as possible. A residual population of red wolves was located along the Gulf coast of Texas and Louisiana (Nowak 1979) and identified for conservation efforts. Most of the canids captured were believed to be red wolf/coyote hybrids. In the end, 17 individuals captured were considered red wolves by wildlife biologists, 14 of which became the founders of the captive-breeding program. The Service declared red wolves to be extinct in the wild in 1980 (Gilbreath and Henry 1998).

In 1986-87, the Service established a "nonessential experimental population" of red wolves at the Alligator River National Wildlife Refuge in northeastern North Carolina, returning the species to the wild after a 10-year absence. 51 Fed. Reg. 26564, 26569 (July 24, 1986). The red wolf recovery area was later expanded to include three national wildlife refuges, a Department of Defense bombing range, state-owned lands, and private property, spanning a total of 1.7 million acres.

For its first 25 years, the reintroduction effort showed considerable success, growing the population to more than 120 wolves by 2001 and maintaining this population level for over a decade (Faust et al. 2016; Hinton et al. 2016a, *in press*). But beginning in the mid-2000s, the state of North Carolina loosened regulations on coyote hunting, which dramatically increased incidental take of red wolves (Hinton et al. 2015a, 2015b, 2016a, *in press*). This increased mortality in turn has led to increased breeding pair disbandment, hybridization with coyotes, and ultimately a declining red wolf population, with the most recent estimates showing as few as 45 wolves live in the wild today (Hinton et al. 2015a, 2015b, 2016a, *in press*; Faust et al. 2016).

Rather than respond to this decline with aggressive actions to save the red wolf, the Service began backing away from recovery. In August 2014, the agency dismissed and did not replace the Red Wolf Recovery Program coordinator. The Service eventually created a new recovery team that included landowners who opposed the program, as well as a representative from the state wildlife commission, but failed to include a number of scientists that had spent years conducting research on red wolves and assisting the recovery program.

In early 2015, the Service stopped supporting the use of "placeholder" sterilized coyotes, despite evidence that it reduced production of hybrid litters and thereby limited genetic introgression (Bohling and Waits 2015; Bohling et al. 2016; Hinton and Chamberlain 2014; Gese and Terletzky 2015; Gese et al. 2015). The Service also began removing red wolves from private lands at the request of landowners, issuing take permits that allow landowners to shoot red wolves.

The Service has also curtailed investigations and prosecutions of suspected illegal red wolf mortalities. In fact, the Service did not issue any timely law enforcement press releases seeking information on illegally killed red wolves between 2014 and April 2016, even though numerous wolves were killed by suspected or confirmed gunshots or other illegal take during this time period.

Then, citing no legal authority to do so, the Service announced in June 2015 that it was halting all red wolf releases to do a "feasibility study." In all likelihood, this abandonment came in response to opposition to red wolf recovery from a small number of vocal landowners and the North Carolina Wildlife Resources Commission. The Service commissioned the Wildlife Management Institute (WMI) to conduct an independent review of the Red Wolf Recovery Program.

The WMI evaluation supported recovery of a wild population in North Carolina, concluding that the "experimental release of captive red wolves to the wild in 1987 proved red wolves could survive and successfully reproduce in the wild" (WMI 2014). The WMI evaluation also concluded that although the red wolf reintroduction program was successful, further recovery depends on the establishment of at least two additional populations and the Service spending more resources to build local stakeholder support for the program (WMI 2014).

Despite the conclusions of the WMI evaluation, the Service recently issued a recommended decision, based on input from the politically-compromised recovery team, that calls for substantially scaling back the North Carolina recovery effort. Specifically, the Service intends to limit the wild population to federal lands in Dare County, which is less than 10 percent of the approximately 6,000 km^2 designated Red Wolf Recovery Area currently occupied by the species, and to do this by removing wolves at the request of private landowners, among other measures (USFWS 2016a). This decision is inconsistent with the recovery of red wolves and the broad conservation purpose of the ESA.

In this document, we demonstrate that further red wolf recovery is possible and urge the agency to develop and implement a new recovery and species survival plan.

DESCRIPTION AND TAXONOMY OF RED WOLVES

The red wolf (*Canis rufus*) is a medium-sized member of the dog family (Canidae), formerly found across much of the southeastern United States (Nowak 1979, 2002). Adult red wolves average about 4.5 feet (137 cm) in length from nose to tail tip and approximately 2.3 feet (70 cm) in height at the shoulder, and weigh from 50 to 85 pounds (23 to 39 kg), with males typically heavier than females (Hinton and Chamberlain 2014).

Red wolves have a slender build, a narrow muzzle, relatively long legs, large ears, and a rather short coat. While a reddish element in the fur sometimes is pronounced, coloration generally is cinnamon or tawny interspersed with gray and black. Melanism (black pelage) existed in historic red wolf populations, but the phenotype is extinct today (Nowak 1979). Individuals commonly live in packs, which serve as the family unit and facilitate hunting of deer and other prey (Hinton and Chamberlain 2010; Dellinger et al. 2011).

The renowned naturalist, John James Audubon, and his colleague, John Bachman (1851), were the first authorities to distinguish the red wolf and apply its present specific epithet *rufus*. They treated it as a subspecies of the gray wolf (*Canis lupus*) and considered its range to be centered in Texas but to extend into Arkansas and Mexico. They also recognized, as had earlier writers, that another kind of wolf, a darker variety, occurred to the east as far as Kentucky and Florida. Later, Vernon Bailey (1905), who was chief field naturalist of the precursor agency to the USFWS, designated these wolves as a full species, *Canis rufus*, with a range restricted to Texas. He thought the darker wolf farther east was also a full species, *Canis ater*. Shortly thereafter, Miller (1912a, 1912b) concluded that the correct name for the more easterly wolf was *C. floridanus*, and he also indicated that another distinct species, *C. lycaon*, occurred to the north in eastern Canada. Thereafter Goldman (1937, 1944) concluded there were just two North American wolf species, *C. lupus*, which included *lycaon* as a subspecies, in most of the continent, and *C. rufus*, which included *floridanus* as a subspecies, in the Southeast. All authorities regarded the smaller coyote (*C. latrans*), historically found primarily in the western U.S., as a species separate from the wolves.

The northern limits of the red wolf's range have not been well understood, although Nowak (2002, 2003) assigned 19th century specimens from Maine and Pennsylvania to *C. rufus* and suggested that it once occupied the entire region south of the Prairie Peninsula, Lakes Erie and Ontario, and the Saint Lawrence River. He also proposed that the gray wolf (*C. lupus*) had undergone natural introgressive hybridization from the red wolf in prehistoric time, thereby creating the subspecies *C. lupus lycaon*, currently found in southeastern Ontario and southern Quebec. That subspecies shows some morphological similarity to *C. rufus*.

Nowak also determined the red wolf and gray wolf to be sharply distinct where their ranges met in Texas and Oklahoma. He reported no gray wolf specimens within the historical range of the red wolf other than in Texas and Oklahoma. Nowak (1979, 2002, 2003) found the coyote (*C. latrans*) to be specifically distinct from *C. rufus* and, until about 1900, not to have occurred within the historical range of the latter, except for a narrow zone of sympatry along the western and northwestern edges of the red wolf's distribution.

The distinction of the red wolf as a full species (distinct from both *C. lupus* and *C. latrans*) has been supported by most assessments of modern and fossil material, including some molecular studies (Atkins and Dillon 1971; Bertorelle and Excoffier 1998; Cronin 1993; Dowling et al. 1992a, 1992b; Elder and Hayden 1977; Freeman 1976; Gipson et al. 1974; Hall 1981; Hedrick et al. 2002; Jackson 1951; Kurten and Anderson 1980; Mech and Federoff 2002; Nowak 1992, 1995; Nowak and Federoff 1996, 1998; Nowak et al. 1995; Paradiso 1968; Phillips and Henry 1992). However, based on a multivariate analysis of skulls, Lawrence and Bossert (1967, 1975) concluded that the original wolf populations of the Southeast were not more than subspecifically distinct from *C. lupus.* Wozencraft (2005) also treated *rufus* as a subspecies of *C. lupus*.

Some have argued that the red wolf is simply a hybrid of *C. lupus* and *C. latrans*. Indeed, there have been unsuccessful formal petitions to remove ESA protections based on the claim that it is a hybrid. *See* 62 Fed. Reg. 64799 (Dec. 9, 1997). The idea of hybrid origin stems primarily from the molecular work of a team centered at the University of California, Los Angeles, which suggests the red wolf was created, starting about 265 to 430 years ago, when environmental disruption from European settlers led to hybridization between the gray wolf and coyote in southeastern North America (Jenks and Wayne 1992; Reich et al. 1999; Roy et al. 1994a, 1994b, 1996; vonHoldt et al. 2011; Wayne 1992; Wayne and Gittleman 1995; Wayne and Jenks 1991; Wayne et al. 1995, 1998).

A second team of molecular authorities from Trent University in Ontario (Kyle et al. 2006; Wilson et al. 2000) found the red wolf represents part of a separate lineage that originated in the Pleistocene. These scientists conclude that *rufus* was closely related to *lycaon* and that those two taxa had a common origin with *C. latrans* rather than with *C. lupus*. Such affinities were generally supported by still another assessment of DNA, primarily as derived from pre-Columbian remains (Brzeski et al. 2016). However, that study also suggested the possibility that the red wolf originated as a natural hybrid of *C. lupus* and *C. latrans* long before European colonization.

Beyond the molecular studies, all available historical and paleontological information gives <u>no</u> indication that either the coyote or gray wolf were present in the Southeast, or that there was any hybridization there between 10,000 and 100 years ago (Nowak 2002). Nowak (1979, 2002) observed no difference between modern and prehistoric red wolves. In addition, recent field work in eastern North Carolina shows the red wolf population there has maintained its unique phenotype and relatively larger external size (when compared to coyotes) (Hinton and Chamberlain 2014). A new genetic assessment of wild *Canis* in that area has shown that substantial numbers of both *C. rufus* and *C. latrans* occur sympatrically there, occupying the same geographic habitat at the same time, but they have maintained their specific distinction, with only a very small proportion of individuals undergoing hybridization (Bohling et al. 2016). In addition, Chambers et al. (2012) reviewed the taxonomy of North American wolves and concluded that the red wolf is a full species, with the name *Canis rufus*, that arose in prehistoric times and is distinct from *Canis lupus* and *lycaon*.

Finally, as the Service noted in its September 2016 proposed decision on the future of red wolf recovery, a recent meeting of "leading canid geneticists, as well as taxonomists and legal scholars … could not agree on the historic genetic lineage of the red wolf, but most the group concluded that the red wolf is a listable entity under the ESA" (USFWS 2016a, p. 2). Although the scientists differed on whether red wolves should be considered a distinct species, a subspecies, an admixture, or a distinct population segment, they all agreed red wolves represent a unique lineage that is worthy of conservation (USFWS 2016a, p. 2-3).

DIET, HOME RANGE AND HABITAT USE

Successful recovery of red wolves (*Canis rufus*) will require understanding how wolves use the landscape for critical resources. Red wolf diet and habitat use has been documented since the 1970s (Riley and McBride 1972; Shaw 1975), but only in the last decade have these aspects of red wolf biology been quantitatively examined for the reintroduced population (Phillips et al. 2003; Dellinger et al. 2011; Dellinger et al. 2013; Hinton and Chamberlain 2010; Hinton 2014).

<u>Diet</u>

Riley and McBride (1972) and Shaw (1975) reported red wolves in Texas subsisted primarily on small and large rodents such as nutria (*Myocastor coypus*), rabbits (*Sylvilagus* spp.), and cotton rats (*Sigmodon hispidus*). Conversely, Phillips et al. (2003) reported that larger prey—such as white-tailed deer (*Odocoileus virginianus*), raccoons (*Procyon lotor*), and marsh rabbits (*Sylvilagus palustris*) —constituted 86 percent of the red wolf's diet on the Albemarle Peninsula in North Carolina. Additionally, Dellinger et al. (2011) reported that during pup-rearing (spring and summer) adult white-tailed deer and fawns constituted 66 percent of the red wolf's diet in North Carolina, with high variability in diet composition between packs. For example, some packs subsisted largely on rodents while still other packs consumed a significant amount of anthropogenic-related food scraps and offal (Dellinger et al. 2011).

High variability in prey use is likely due in part to variability in the spatial distribution and abundance of prey. Consumption of white-tailed deer likely increases with higher white-tailed deer densities (Hinton 2014; Hinton et al. 2016, *in review*). Variability in prey has also been attributed to the demographic make-up of packs in which juvenile red wolves consumed more rodents than adults (Phillips et al. 2003). This is likely because juveniles have less hunting experience than adults and adults may restrict their access to carcasses of larger prey when pups are present (Gese et al. 1996). Additionally, as individual wolf weight increased, consumption of larger prey—such as white-tailed deer—increased (Hinton 2014; Hinton et al. 2016, *in review*). Increased body weight likely increases the ability of red wolves to successfully attack larger animals (Hinton 2014; MacNulty et al. 2009).

Lastly, red wolf diets were more diverse in summer compared to winter, primarily due to increased consumption of raccoon, nutria, and muskrat (Hinton 2014). Overall, red wolves are highly carnivorous but, like other *Canis* species, show flexibility in foraging behavior, whether induced by demographic (e.g., age, pack size, breeder weight, etc.) or environmental (e.g., season, prey distribution, etc.) parameters. It should be emphasized that the above findings primarily pertain to the lone wild population of red wolves in North Carolina. It is likely that some or all of the findings above might not translate to a wild population of red wolves established elsewhere within their historic range due to various environmental parameters.

<u>Home Range Sizes</u>

Spatial use patterns of red wolves were first reported on wolves in southeastern Texas and southwestern Louisiana (Riley and McBride 1972; Shaw 1975). Prior to their extirpation, red wolves in Texas and Louisiana exhibited home ranges between 25 and 130 km^2 (Riley and

McBride 1972; Shaw 1975). The reintroduced population in North Carolina generally has larger home ranges, with sizes averaging 68.4 ± 7.5 km^2 for residents and 319.2 ± 57.3 km^2 for transients (Hinton et al. 2016b, *in press*).

Red wolf home ranges are thus generally intermediate in size to those of coyotes (4-70 km^2; Bekoff and Gese 2003) and gray wolves (69-2,600 km^2; see Mech and Boitani 2003). As explained below, variation in home range size for red wolves is influenced by several factors such as habitat type and body weight (Hinton et al. 2016b, *in press*).

Red wolves occupying areas composed primarily of agricultural fields were observed to have smaller home ranges than red wolves occupying areas with more forested habitat (Dellinger, J. A., *unpublished data*; Phillips et al. 2003; Hinton et al. 2016b, *in press*). This is likely due to differences in habitat productivity, again with agricultural fields providing more habitat and forage for prey species compared to forested areas.

Lastly, body weight of individual red wolves was also shown to influence home range size. Given similar habitat, home range size scaled positively with body size (Hinton et al. 2016b, *in press*). This is likely due to larger individuals having larger metabolic requirements, which require larger home ranges with more prey compared to smaller individuals.

Habitat Use

The earliest documentation of red wolf habitat use occurred during the 1970s. Shaw (1975) surmised that intensive logging in the late 1800s and early-to-mid 1900s drastically reduced the available habitat for red wolves and contributed in large part to their drastic population decline. However, given the historic range of the red wolf (Nowak 2002, 2003) and the extant population's selection for open agricultural habitats, it is likely they inhabited grasslands, savannas, and open woodlands of eastern North America even prior to European colonization (Hinton 2014).

Assessments of the reintroduced population in North Carolina report the red wolf's strong selection of agricultural fields over coastal bottomland forests and wetlands (Hinton and Chamberlain 2010; Dellinger et al. 2013; Hinton et al. 2016b, *in press*; Dellinger, J. A., *unpublished data*). Yet it appears red wolves will use more natural habitat types over agricultural fields if natural habitat types of sufficient size exist (Dellinger, J. A., *unpublished data*).

Red wolves were more likely to use less preferred habitat (e.g., wetland or lowland forest) if it was bisected by an unpaved (secondary) road, probably because roads facilitated travel and searching for prey by cursorial predators such as red wolves. Although red wolves were shown to use areas near unpaved roads, wolves avoided areas close to paved (primary) roads and with higher human densities (Dellinger et al. 2013). As human density increased, red wolves were more likely to use habitat types with increased cover, such as pine plantations and lowland forests (compared to more open habitat like agricultural fields) (Dellinger et al. 2013).

As expected, habitat use analyses depicted the red wolf as a generalist that is capable of adapting habitat use patterns to changes in human activity and distribution. During summer red wolves intensively used agricultural fields over the other aforementioned habitat types. However, during winter, red wolves used more forested habitats with increased cover (Chadwick et al. 2010; Dellinger, J. A., *unpublished data*). These shifts were likely primarily driven by human agricultural activity, which influences available forage and habitat for the red wolf's important prey species.

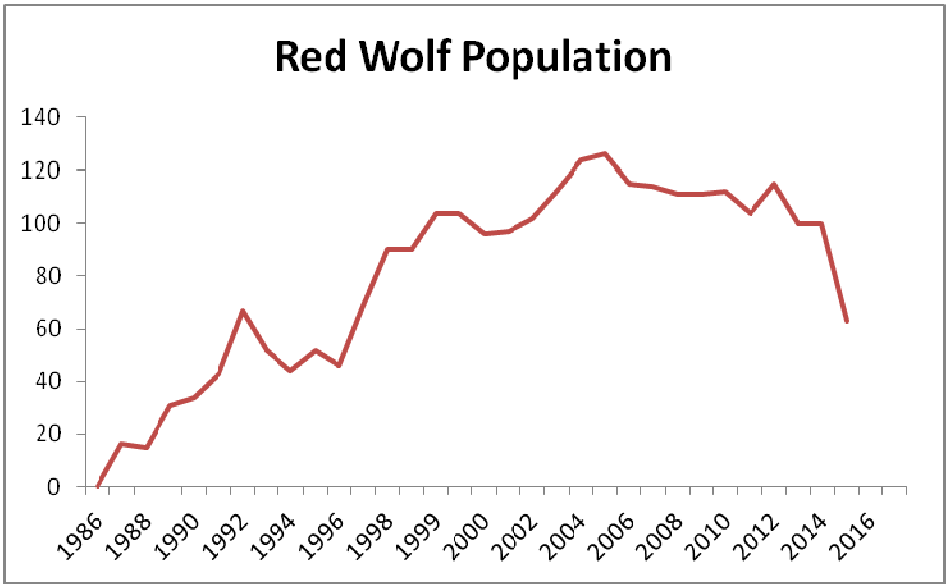
Given recent insight into foraging and habitat use patterns of red wolves, it is possible to suggest current management practices that could be used to benefit red wolves. For example, because red wolves readily utilize open contiguous tracts of land with adequate forage (e.g., agricultural and successional fields), wildlife managers could utilize prescribed burning techniques to create large patches of natural early successional habitat (Hinton 2014). This would also buffer impacts of agricultural activity on seasonal space use patterns of red wolves by providing similar habitat to utilize during and after harvest of agricultural crops. Current science on foraging and habitat use patterns of red wolves should also be used to evaluate whether suitable habitat exists on federal lands within Dare County, where USFWS has proposed to limit the recovery area (USFWS 2016a).

POPULATION STATUS

The red wolf is formally classified as "critically endangered" by the International Union for Conservation of Nature (IUCN) and as "endangered" by the Service. Extant populations now are recognized to exist only in captivity and, through reintroduction, in eastern North Carolina (Nowak 1979, 1999; Nowak et al. 1995; Phillips et al. 2003). They are the remnant of a species that once played a major role in the ecology of a vast part of North America.

After reintroduction, red wolf population estimates peaked in 2005–06 and then decreased (Hinton et al. 2016a, *in press*). Overall, annual growth rates (λ) ranged between 0.78 and 2.07. From 1998 to 2005, the red wolf population increased from an estimated 90 to 151 wolves with an average annual growth rate (λ) of 1.12 (Hinton et al. 2016a, *in press*). By 2006 approximately 130 wolves in 20 packs inhabited about 2,600 square miles of the reintroduction area (Phillips et al. 2003; Hinton et al. 2013). However, from 2005 to 2013 the red wolf population decreased from an estimated 151 to 103 wolves with an average annual growth rate (λ) of 0.96 (Hinton et al. 2016a, *in press*).

The wild population had 74 individuals as of January 2015 (Faust et al. 2016). Then, in September 2016, the Service explained that the wild red wolf population consisted of 28 monitored individuals in five packs with only three known breeding pairs (USFWS 2016a, p. 6). The total population is estimated at 45 individuals widely distributed across a five-county area in North Carolina (USFWS 2016a, p. 6).



The most recent population viability analysis of the red wolf (Faust et al. 2016) concluded that under current conditions, without releases from the captive program or improvements to the wild population's vital rates, the only remaining wild population of red wolves is likely to go extinct within 37 years but maybe as soon as eight years. However, the authors concluded that the wild population can avoid extinction and remain viable with assistance (Faust et al. 2016). The most realistic scenarios for preventing extinction involve a combination of reductions in mortality rates, increases in breeding rates (hypothesized to be achievable by reducing the disruptive effects of breeding-season mortality), and receiving releases from the captive program for a short, intense period (15 years) followed by intermittent releases to maintain genetic health (Faust et al. 2016).

THREATS TO THE RED WOLF

A. Shootings and Non-Lethal Wolf Removals

Shootings

Anthropogenic mortality, primarily shooting, was a driving factor in the historic decline of the red wolf and remains the primary threat today (Bartel and Rabon 2013; Bohling and Waits 2015; Hinton et al. 2015a; Murray et al. 2015; Hinton et al. 2016a, *in press*).

The North Carolina Wildlife Resources Commission intensified this threat when, in the early 2000s, it greatly relaxed regulations on coyote hunting. These changes included no closed season, no bag limits, and allowance of artificial lighting for nighttime coyote hunting (Hinton et al. 2015b).

Following relaxation of the rules on coyote hunting, Bartel and Rabon (2013) documented a roughly 375 percent increase in mortality of red wolves from gunshots (2004-2012 compared to 1988-2003). From 2012 to 2015, shootings caused an estimated 30 out of 65 red wolf deaths (USFWS 2016b).

The Service has found that gunshot mortality is a "serious threat" to red wolves that is "hampering the ability of the red wolf" to recover (USFWS 2007, p. 28). Gunshot mortality has "reduced the number of breeding pairs and pups," and "the population consequences of such mortality is highly limiting" (USFWS 2007, p. 29). Supporting this observation, Hinton et al. (2016a, *in press*) used 26 years of red wolf population data to examine trends in causes of mortality and found that anthropogenic mortality during the fall hunting season has increased significantly and is now the leading cause of death for red wolves.

By lowering the number of red wolves in the recovery area, gunshot mortality also potentially increases red wolf inbreeding and promotes red wolf hybridization with coyotes (Kelly and Phillips 2000, p. 249-51; Hinton et al. 2015a; Way 2014). Bohling and Waits (2015) found that more than half of the observed wolf-coyote hybridization events followed the disruption of a stable breeding pair of red wolves due to mortality of one or both breeders, and that humans caused 69 percent of these deaths, primarily through gunshot mortality prior to the red wolf breeding season. The scientists concluded that disruption of stable breeding pairs of red wolves facilitates hybridization, jeopardizing future recovery of the red wolf (see also Bartel and Rabon 2013, Hinton et al. 2015a).

After the Service failed to take action to reduce shooting mortalities, conservation groups took the state to court and eventually reached a settlement under which nighttime hunting of coyotes using artificial lights was prohibited (because that is when red wolves are most likely to be mistaken for coyotes). In addition, permits for and reporting of coyote hunting was required in the red wolf recovery area (Hinton et al. 2015b). Further analysis is required to determine if these changes have reduced red wolf mortality due to shooting.

The Section 10(j) rule that governs the reintroduced red wolf population has driven much of the legal gunshot mortality. The current rule is the product of 1995 amendments that liberalized the legal shooting of wolves. 60 Fed. Reg. 18940 (April 13, 1995). Indeed, it is one of the most liberal rules for killing endangered species ever promulgated. For this reason, the 1995 amendments have been the target of criticism by scientists—even from within the Service—who conclude that too many wolves can be killed under them (Phillips et al. 2003; USFWS 1999).

The 10(j) rule provides that private landowners may kill red wolves if federal attempts to "capture such animals have been abandoned." 50 C.F.R. 17.84(c)(4)(v). This exception has led to private landowners killing even non-offending wolves that disperse onto private land if the Service refuses to take action to capture them.[3]

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[3] In response to litigation brought by conservation groups, in September 2016, a federal district court restricted the federal government's ability to remove red wolves from private property in North Carolina. The order stops wildlife officials from removing red wolves from private property unless they can show the animals are threatening humans, pets, or livestock. *Red Wolf Coalition v. USFWS*, No. 2:15-CV-42-BO (E.D.N.C. Sept. 28, 2016).

A particularly troubling example of the implementation of this rule occurred in 2015, when the Service issued a permit for a landowner to kill a red wolf that had not exhibited any problem behaviors. The private landowner shot and killed the wolf, a denning mother wolf who had previously mothered a total of 16 pups through four separate litters. No effort was made to locate her pups, and their fate is unknown.

Non-Lethal Removals

Non-lethal removals have been and continue to be a serious threat to the recovery of the red wolf in the wild. This threat could get much worse under a decision the Service recommended. In a memorandum dated September 12, 2016, the Service recommended revising the 10(j) rule to "reduc[e] the focus of the [non-essential experimental population] project to federal lands within Dare County" (USFWS 2016a). Under the Service's plan, all wolves outside of federal lands within Dare County would be removed from the landscape and incorporated into the captive program.

In a letter dated October 11, 2016, numerous scientists from the scientific team conducting the red wolf Population Viability Analysis objected to the Service's recommended removal of these wild wolves (Faust et al. 2016). They explain that the captive program "does not 'need' wild red wolves from North Carolina for its security" and that any benefits of adding these wild wolves to the captive program "could just as easily be gained via transfer of genetic material between the wild population and the [captive] population" (Faust et al. 2016). The scientists further warn that "singular focus on the [captive] population will no doubt result in extinction of red wolves in the wild" with a "a median time to extinction of 14 years" (Faust et al. 2016).

In its recommended decision, the Service explains that wolf removals could not occur until after a public comment process on a revised 10(j) rule, as well as environmental reviews, including NEPA compliance and ESA consultation. Moreover, the Service's ability to continue non-lethally removing wolves has been temporarily blocked by a court order. *Red Wolf Coalition v. USFWS*, No. 2:15-CV-42-BO (E.D.N.C. Sept. 28, 2016).

If the Service moves forward with its recommended decision, non-lethal wolf removals would likely become a primary threat to recovery of the wild red wolf population.

B. Hybridization

The threat of hybridization with coyotes was a major cause of the red wolf's decline and remains a threat to the long-term viability of any red wolf population—whether in North Carolina or elsewhere in the species' historic range. Recovery of the red wolf necessitates utilizing proven strategies to address this threat, as well as adaptive management to address new aspects of the problem (e.g. Miller et a. 2003). But as more than a decade of work shows, it is possible to control hybridization, especially if gunshot mortality is controlled (Gese et al. 2015).

Hybridization with the expanding coyote population accelerated the red wolf's decline after the 1930s (McCarley 1962; Nowak 1979, 2002). Goldman (1944) and Jackson (1951) recognized that this process was occurring locally, but McCarley (1962) was the first to point out that hybridization was a widespread threat to the existence of the red wolf. Subsequent assessment of specimens from different areas confirmed introgression from *C. latrans* to *C. rufus* almost throughout the remaining range of the latter (Elder and Hayden 1977; Freeman 1976; Gipson et al. 1974; Goertz et al. 1975; Lawrence and Bossert 1967; Paradiso 1968). In a comprehensive study of all available material, Nowak (1979) found the red wolf to persist in unmodified form only in extreme southeastern Texas and southern Louisiana. As explained above, these wolves were captured to use for the reintroduction program.

The Albemarle Peninsula in eastern North Carolina was selected as the first red wolf reintroduction site in the 1980s in part because it was believed that coyotes had not yet reached this area. However, coyotes had likely already reached at least Washington County prior to reintroduction (DeBow et al. 1998). In 1993, the first known hybridization event between a reintroduced red wolf and a coyote was documented. By the late 1990s, genetic and morphological analysis suggested that introgressed individuals were present in the wild population.

Using population and genetic modeling, a 1998 Population and Habitat Viability Analysis (sponsored by the IUCN Captive Breeding Specialist Group) predicted that the red wolf population would soon become extinct without intervention (Kelly et al. 1999). This prompted the Service to form the Red Wolf Recovery Implementation Team, which comprised eight scientists with expertise in red wolves and red wolf management. That team subsequently developed the "Red Wolf Adaptive Management Plan" to address the threat of hybridization (Kelly 2000; Stoskopf et al. 2005; Gese et al. 2015).

Under that adaptive management plan, the recovery area was divided into three zones (Gese et al. 2015). In zone 1, which is farthest east and forms the core of the recovery area, the goals were to radio-collar all red wolves and remove all coyotes or hybrids. In zone 2, farther west, the goal was to capture and either remove coyotes and hybrids or sterilize them to serve as placeholders that would maintain territories against further encroachment of coyotes without genetic risk to red wolves (Gese et al. 2015). These same strategies were carried out in zone 3, the farthest west, resources permitting. A number of measures were also taken in addition to this strategy, including release of additional red wolves from captivity and fostering of captive born pups in wild litters to increase genetic diversity and overall abundance (Gese et al. 2015).

Several peer-reviewed studies have found that the efforts to implement the adaptive management plan were successful at both increasing the population and limiting introgression with coyotes (Stoskopf et al. 2005; Bohling and Waits 2011; Gese et al. 2015; Bohling et al. 2016). Based on the observation that the "genetic composition of the wild red wolf population" contained less than four percent coyote ancestry, Gese et al. (2015) concluded that "the adaptive management plan was effective at reducing the introgression of coyote genes into the red wolf population," but that implementation of the adaptive management plan or similar strategies would need to continue into the "foreseeable future." Their evaluation led the "WMI [to] believe[ ] that the FWS placeholder strategy is a valid conceptual technique to reduce the introgression of coyote genes into the red wolf population" (WMI 2014).

Clearly, reintroduction of red wolves in the face of coyote hybridization is possible, but it will require ongoing management. One consistently overlooked factor is the role of anthropogenic mortality in facilitating hybridization. Hinton et al. (2015a) used 22 years (1991–2013) of trapping data to assess the impacts of anthropogenic mortality on red wolf breeding units and found that increased mortality due to gunshots has corresponded to a 34 percent decline in annual preservation of red wolf breeding pairs and a 30 percent decline in replacement of *Canis* breeders by red wolves, leading the authors to conclude that "human-caused mortality, specifically gunshots, had a strong, negative effect on the longevity of red wolf pairs, which may indirectly benefit coyotes by removing their primary competitor." These findings further highlight the importance of limiting anthropogenic mortality as part of any recovery strategy, both for its negative impact on red wolf demography as well as its impact on the threat of hybridization from coyotes.

In sum, the threat of hybridization is minimized by fostering an environment that bolsters red wolf populations and supports encounters between red wolves (Hinton et al. 2015a, 2015b). The red wolf adaptive management program has demonstrated how policies and management tools provide a means for managers to further reduce the threat of hybridization. Establishing sterile placeholder individuals in the landscape and other tools to reduce hybridization can work, and they need to be part of any revised recovery strategy, as discussed in the "Recovery Actions" below.

C. Inbreeding

The wild red wolf population is isolated, with no nearby wild populations to allow immigration and gene flow. The lack of gene flow—combined with an extreme demographic bottleneck and small population size—makes red wolves vulnerable to inbreeding and loss of genetic variation.

Genetic variability and inbreeding depression, which can be defined as the detrimental fitness cost associated with inbreeding, can affect red wolf recovery directly by reducing survival and reproductive success, or indirectly by affecting traits such as morphology (Keller and Waller 2002). For instance, clear associations exist between inbreeding and blindness, reduced reproductive success, reduced sperm quality, and congenital bone deformities in other wild canid populations (Liberg et al. 2005, Asa et al. 2007, Hedrick and Fredrickson 2008, Räikkönen et al. 2009).

Today, nearly every wild born red wolf is inbred to some degree. Fortunately, the wild red wolf population does not appear to be suffering from negative effects of inbreeding at this time (Brzeski et al. 2014). The only measured trait that exhibited a correlation with inbreeding was adult body size, where more inbred red wolves tended to be smaller. This could indirectly affect fitness by reducing a red wolf's ability to secure a territory, a pre-requisite for breeding (Brzeski et al. 2014).

Disease susceptibility could also be exacerbated by inbreeding and low genetic variation, especially when considering that red wolves will likely be exposed to new pathogens through time. However, recent research has indicated that red wolves have maintained functional genetic variation at immune genes and display evidence of natural selection at these genes (Brzeski et al. 2014).

Recognizing the threat inbreeding poses to red wolves, the Red Wolf Recovery Program previously augmented the wild population with captive born individuals that have lower mean kinship than wild born wolves. However, in June 2015 the Service stopped all further releases of captive wolves into the wild population, which has reduced gene flow and increased the threat of inbreeding depression. Due to the smaller population size, the threat of inbreeding depression will be greatly intensified if the Service proceeds with its plan to remove wild wolves outside of federal lands in Dare County.

D. Disease

Despite the adaptive potential of red wolves to respond to novel pathogens, inbreeding depression could lower disease resistance and immune capabilities in the contemporary population (Spielman et al. 2004). Disease has already affected red wolf viability in the remnant Louisiana-Texas population (Phillips and Parker 1988) and the now-abandoned Smoky Mountain recovery site. *See* 63 Fed. Reg. 54152–54153 (Oct. 8, 1998).

A recent review of past red wolf disease occurrence, regional disease threats, and contemporary baseline parasite data was conducted to inform a monitoring plan aimed at preventing disease-mediated population declines in red wolves (Brzeski et al. 2015). The study found several possible pathogen threats to contemporary wild red wolves. Common viral pathogens that are prevalent in the southeast region that threaten red wolves include canine distemper and canine parvovirus, as well as widespread endoparasites (Brzeski et al. 2015). The most prevalent parasites in red wolves and sympatric coyotes were heartworm (*Dirofilaria immitis*), hookworm (*Ancylostoma caninum*), and *Ehrlichia* spp. Several red wolves have also tested positive for bacteria causing Lyme disease (*Borrelia burgdorferi*) (Brzeski et al. 2015). Coyotes may act as a source or reservoir for disease.

E. Public Attitudes Towards Red Wolf Recovery

Since the term "human dimensions" of wildlife management was coined in 1973, the value of human dimensions research has slowly gained recognition in the wildlife management field (Bath 1998; Manfredo et al. 1998). Specific to the Red Wolf Recovery Program, a 2013 memorandum between the Service and North Carolina Wildlife Resources Commission highlighted the need for collaborative research on the "attitudes and opinions of N.C. private landowners and other citizens concerning canids on North Carolina's Albemarle Peninsula (AP)" (Dohner and Myers 2013). However, this memorandum comes 26 years after the first red wolves were released into the wild in 1987. Even today little information exists on the human dimensions of the Red Wolf Recovery Program.

It was clear at the onset that social factors would play a significant role in red wolf recovery efforts. The first attempt to secure a reintroduction site for red wolves, which was at Land Between the Lakes located on the border of Tennessee and Kentucky, was unsuccessful due to a lack of public support (USFWS 1990). However, this experience provided valuable insight into the importance of factors outside the biological and ecological realms that would need to be addressed for future reintroduction attempts. In particular, the experience demonstrated the need to create positive relationships with the public early on, especially those in the immediate vicinity of recovery efforts, and conduct public outreach and education efforts. Program officials would go on to use this knowledge to garner local support for the first reintroduction of red wolves into eastern North Carolina in 1987, demonstrating the importance of social factors in red wolf recovery.

Social factors continue to influence red wolf recovery. While gunshot mortality and hybridization with coyotes have been identified as the most pressing threats to red wolf recovery (Hinton et al. 2013; Hinton et al. 2015a; Hinton et al. 2016a, *in press*), the current sociopolitical atmosphere surrounding the Red Wolf Recovery Program may have reached a point at which such atmosphere is just as threatening.

For example, landowner concerns led the North Carolina State Legislature to pass a 1992 law that permitted the killing of red wolves under certain situations (Mangun et al. 1997). And complaints from two private landowners opposed to red wolf recovery led the Office of Inspector General of the U.S. Department of the Interior to investigate the recovery program. In addition, the North Carolina Wildlife Resources Commission ("NRWRC") issued a 2015 resolution requesting the USFWS to terminate the Red Wolf Reintroduction Program in North Carolina (NCWRC 2015).

Moreover, a 2014 review of the Program that the Wildlife Management Institute ("WMI") conducted found that a lack of attention has been given to both the research and application of human dimension efforts such as public outreach. The WMI Report explained that a lack of effort to increase and maintain public support led to "an atmosphere of distrust within some segments of the community" (WMI 2014).

Largely relying on dissent from outspoken opponents of the recovery program, the Service has taken steps to dismantle the Red Wolf Recovery Program. The Service explains that "growing concerns from private landowners" led it to assess the feasibility of the red wolf program and to contract the WMI report (USFWS 2016a, p. 1). In its September 2016 recommended decision to restrict red wolves to federal lands in Dare County, the Service states: "without private landowner support we will not be able to recover the red wolf" and that "fundamental change is needed in the way stakeholders are engaged" (USFWS 2016a, p.4).

Quintal (1995) found opponents of red wolf recovery were generally older, less educated, less knowledgeable of red wolves, and more likely to reside in Hyde County. Mangun et al. (1997) found a positive correlation between education level and how important red wolf preservation was to an individual; specifically, individuals who were older and less educated were less willing to pay for red wolf recovery. Kramer and Jenkins (2009) found only 13 percent of farm operators in the five-county recovery area would participate in a red wolf conservation program (i.e., payment for ecosystem services). Eastern North Carolina is primarily a rural landscape with a human population characterized by low to moderate incomes and low educational attainment levels, suggesting that such opposition to the recovery program might remain without intensive public outreach, incentives, and education efforts (Kramer and Jenkins 2009).

While some opposition exists, the few studies on public attitudes towards red wolves have found wide-ranging support for the recovery program, including within the five-county recovery area

(Quintal 1995; Rosen 1997; Mangun et al. 1997; WMI 2014). In randomized surveys of individuals who resided in or around the five-county recovery area, Rosen (1997) found roughly 70-75 percent of individuals favored red wolf recovery in northeastern North Carolina and another unspecified location. Eighty-six percent of individuals believed in principle that red wolves should exist in the wild, not just in zoos (Rosen 1997). Mangun et al. (1997) found 80 percent of respondents felt the recovery program was either somewhat or very important, and Quintal (1995) reported more than half (51.7 percent) of respondents supported red wolf recovery.

Studies also found that individuals are willing to visit the recovery region or contribute financially to red wolf conservation. Mangun et al. (1997) found a majority of respondents would likely (50 percent), definitely (12 percent) or probably (38 percent) visit the Alligator River National Wildlife Refuge. Rosen (1997) found approximately 71 percent of respondents were interested in visiting a recovery region, which at the time included both northeastern North Carolina and the Great Smoky Mountains National Park. When asked if individuals would visit if the red wolf was removed from the wild, the probability of an individual visiting northeastern North Carolina declined by roughly 30 percent. Visitation to recovery regions has the potential to support local and regional economies. Indeed, Mangun et al. (1997) estimated a willingness-to-pay totaling $1.43 million in economic benefits to 11 counties in eastern North Carolina. Thus, the Red Wolf Recovery Program has economic benefits locally and surrounding the red wolf recovery area.

To demonstrate support for continuing red wolf recovery, in January 2016 conservation organizations submitted to the Service a petition signed by nearly 100 private landowners in North Carolina's five-county red wolf recovery area expressing their support for keeping endangered red wolves on their land, as well as another 1,538 North Carolina residents.[4] In addition, more than 110,000 comments were submitted to the Service from national supporters of the Red Wolf Recovery Program in 2014.[5]

Although the majority of U.S. citizens appear to support the Red Wolf Recovery Program, powerful opposition also exists, and that opposition appears to be driving current management decisions that are threatening the wolf.

POPULATION TARGETS

For the foreseeable future, downlisting or delisting of red wolves is not feasible, and the goal of a revised Red Wolf Recovery Program is to create stable, self-sustaining wild populations of red wolves.

Achieving this goal requires reducing and removing threats that have the potential to bring about extinction of the species, as well as increasing the red wolf numbers through reintroductions so that it has the potential for allowing natural evolutionary processes to work within the species (USFWS 1990, p. 26-27).

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[4] https://www.biologicaldiversity.org/news/press_releases/2016/red-wolf-01-26-2016.html
[5] http://thetruthaboutredwolves.com/doc/ResponsetoOct7PRnumbers.pdf

The current recovery plan states a goal of 220 wild red wolves in three populations (USFWS 1990, p. 79). In developing the revised recovery plan, the Service should apply the best available science on population viability to reexamine these goals to ensure that they are sufficient to ensure long-term red wolf conservation.

RECOVERY COORDINATOR AND TEAM

Personnel are needed to effectively coordinate and manage the red wolf program. In August 2014 the agency dismissed and did not replace the red wolf recovery coordinator. A full-time program coordinator is essential to provide leadership and assure continuity of various objectives, establish annual objectives and goals, develop budgetary needs, and serve as a spokesperson for the program (USFWS 1990, p. 80).

Similarly, a properly-credentialed recovery team is needed to review progress and address special needs of the species (USFWS 1990, p. 80). The Service recently created a new recovery team that includes landowners who oppose the program as well as a representative from the state wildlife commission, but it does not include a number of the scientists who have spent years conducting research on red wolves and assisting the recovery program. A successful recovery team must include scientific experts on the red wolf who can ensure application of the best available science.

NEEDED RECOVERY ACTIONS TO ADDRESS THREATS TO THE RED WOLF

A. Address Shootings and Non-Lethal Red Wolf Removals

<u>Preventing Shootings of Red Wolves Misidentified as Coyotes</u>

Following a settlement reached in litigation that conservation groups brought against the North Carolina Wildlife Resources Commission, nighttime hunting of coyotes and coyote hunting on federal lands was prohibited, and permits were required for coyote hunting on private lands. These measures have helped prevent accidental shootings of red wolves, but more measures are needed.

When revising the Red Wolf Recovery Plan, we recommend that the Service consider the following additional measures to prevent accidental shooting of red wolves:

1. Prohibit coyote hunting in the core red wolf recovery area;
2. Require coyote hunters to pass a test in red wolf identification before receiving a coyote hunting permit;
3. Require reporting and inspection of all coyotes taken; and
4. Close the coyote season when three red wolves have been taken in any year.

These measures have a high likelihood of substantially reducing red wolf mortality, as well as reducing incursion of coyotes into core habitat for red wolves.

Promulgate a New 10(j) Rule Protective of Red Wolves

Conservation groups, including the Center for Biological Diversity and the Animal Welfare Institute, petitioned the Service in May 2016 to amend the red wolf 10(j) rule because the structure of the current 10(j) rule allows people to shoot wolves in too many situations.[6] A revised recovery plan should recognize that a new 10(j) rule is needed to reduce the threat of anthropogenic mortality posed by the current regulatory framework.

One of the most problematic aspects of the current 10(j) rule is that "[a]ny person may take red wolves found on private land" if "such taking is not intentional or willful." 50 C.F.R. § 17.84(c)(4)(i); *see also* 50 C.F.R. 17.84(c)(4)(ii) (dealing with unintentional take on public lands). As explained immediately above, claims of mistaken identity are commonplace. Anyone who kills a red wolf can claim that they believed it was a coyote—thereby falling within this exception. This permissive allowance of lethal take gives a wink-and-a-nod to anyone that wants to kill a red wolf (Newsome et al. 2015).

A revised 10(j) rule, as proposed in the May 2016 petition, should remove this exception for unintentional take, which will lead to fewer deaths by encouraging people to make a positive identification before shooting. Even so, prosecutorial discretion would likely lead to very few prosecutions of people who claim they did not intend to kill a protected wolf.[7] Moreover, North Carolina could receive take coverage for red wolves killed during its coyote hunting season by working with the Service to draft an incidental take permit. That incidental take permit would require that take of red wolves be minimized and mitigated to the extent practicable. 16 U.S.C. § 1539(a).

The current 10(j) rule also allows private landowners or their agents to kill wolves "in the act of killing livestock or pets." 50 C.F.R. § 17.84(c)(4)(iii). While the Service has stated that providing "tools" for private landowners to defend domestic animals may help build landowners' tolerance for wolves on their property, allowing landowners to kill such offending wolves is too severe given the dire status of the wild population of red wolves (Chapron and Treves 2016). Instead, the Center has proposed a revised 10(j) rule that modifies this exception to allow private landowners or their agents to harass—but not injure or kill—red wolves on their property.

The current 10(j) rule also provides that private landowners may kill wolves if federal attempts to "capture such animals have been abandoned." 50 C.F.R. 17.84(c)(4)(v). This exception has led to private landowners killing even non-offending wolves that disperse onto private land if the Service refuses to take action to capture them. A revised 10(j) rule would reduce shooting deaths by removing this exception for private landowners. Harassing wolves on private property to discourage them from entering property could be allowed under a revised 10(j) rule, but killing

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[6]http://biologicaldiversity.org/species/mammals/red_wolf/pdfs/Emergency_Petition_to_Protect_the_Red_Wolf_5_19_2016.pdf

[7] Under the "McKittrick Policy," the U.S. Department of Justice will not prosecute individuals for violating the ESA unless it has proof that a person knew that he or she was killing an endangered species. As such, even outside of the exceptions provided in the 10(j) rule, people can shoot red wolves supposedly mistaken as coyotes without fear of prosecution.

non-offending wolves cannot be tolerated when the wild wolf population teeters on the brink of extinction. Moreover, harassment is likely more effective than live capture and removal of wolves from private lands because experience has shown that removed wolves will likely return to that same area upon release unless the animal is biologically driven to disperse (USFWS 2011; USFWS 2013, p. 22-23).

B. Address Hybridization

As discussed above, hybridization with coyotes presents one of the greatest challenges to the recovery of red wolves and likely necessitates some level of management in perpetuity. Despite the challenges presented by hybridization, the Red Wolf Adaptive Management Plan—including targeted control of coyotes and hybrids and release of sterilized coyotes as placeholders that hold territories until red wolves move into the territory or are reintroduced—was effective at limiting introgression of coyote genes into the red wolf population (Gese et al. 2015; Murray et al. 2015). As such, the Service should reinstate the adaptive management plan implemented by the red wolf implementation team and stick to proven techniques for recovering the red wolf (USFWS 2007, WMI 2014).

Indeed, the Service itself concluded in its last five-year review of the red wolf that: "We have effectively reduced interbreeding and coyote gene introgression using the adaptive plan and associated non-invasive techniques, all with assistance from scientists on the Red Wolf Recovery Implementation Team (Adams 2006, Beck 2005, Stoskopf et al. 2005)" (USFWS 2007).

The placeholder strategy was effective in large part because of red wolves themselves. Between 1993 and 2007, 32 instances of red wolves displacing or killing coyotes and no instances of the reverse were observed (USFWS 2007). Adams (2006) observed that all of the observed introgression of coyote genes into the red wolf population resulted from one hybridization event, meaning that despite considerable overlap between coyotes and red wolves, not much cross-breeding was occurring and efforts to limit hybridization were working in most cases. Modeling by Hedrick et al. (2002) determined that if the adaptive management program was maintained for 60 years, introgression of coyote genes could be reduced to below one percent (USFWS 2007).

These facts indicate that hybridization is a manageable problem but requires the Service's long-term commitment. For these reasons, a plan for carrying out such management should be developed in a revised recovery plan.

C. Address Inbreeding Through Captive Red Wolf Releases

While inbreeding depression currently appears to be minimal in wild red wolves, true effects of inbreeding are generally greater than those observed (Hedrick and Kalinowski 2000). Because the red wolf's small population size puts it at great risk of inbreeding depression, releases from the captive red wolf population, including pup cross-fostering, should be part of the strategy taken to avoid that risk and help ensure the health of the wild red wolf population.

Red wolf captive breeding procedures deliberately pair mates to reduce inbreeding (Waddell and Long 2013), resulting in lower mean kinship relative to the wild red wolf population. Releases from the captive population into the wild population results in augmentation of the wild red wolf gene pool with underrepresented genes from the captive wolf population (USFWS 2007, p. 20).

Pup cross-fostering involves placing captive-born pups less than two weeks old into litters of wild red wolves estimated to be the same age as the captive pups. Wild red wolves adopt and raise the fostered pups. Cross-pup fostering is essential to the growth of the endangered red wolf population because it augments (Hinton et al. 2016a, *in press*) and increases genetic diversity in the wild population.

The USFWS's Five-Year Status Review for the red wolf stated that "pup fostering has developed as a significant and useful population management tool in red wolf recovery" (Waddell et al. 2002; Kitchen and Knowlton 2006). The Red Wolf Recovery Program has cross-fostered 21 captive pups into wild litters since 2002; in each instance, the captive born cross-fostered pups were less inbred and had lower mean kinship values than the wild born averages.

Anecdotal evidence shows that fostered red wolves contribute positively to the growth and stability of the wild population. Hinton and Chamberlain (2010) radio-marked and monitored four of nine pups in the Beechridge Pack. The breeding male (11199M) of the Beechridge pack was a captive born individual who was fostered into a wild litter during 2002 (J. Hinton, personal communication). From 2004 to 2008, 11199M sired 36 pups in the wild. Additionally, another fostered wolf (11577F) dispersed and eventually paired with a mate, and from 2011 to 2013, she produced 17 pups in the wild until her mate was shot (J. Hinton, personal communication).

Prior to fiscal year 2013, the Service's red wolf quarterly reports routinely included information about cross-fostered individuals. For example, the First Quarter Report for fiscal year 2010 noted "three pups were born to the previous breeding pair in 2009, and two zoo-born pups were fostered into the wild litter" (USFWS 2009, p. 4). The Service stopped publishing information on pup cross-fostering in 2013, and in June 2015, the Service announced that it was halting all red wolf releases.

Under the guidance of a revised recovery plan, the Service should resume pup cross-fostering. It should also release captive born juveniles or family groups with the aim of reducing overall inbreeding and mean kinship in the wild population. Additional reintroductions are also a necessary piece to address inbreeding depression, as addressed below.

D. Reduce Risk of Disease in the Wild Red Wolf Population

Disease remains a management concern for red wolves because of the prevalence of numerous pathogens in wildlife in the Southeast and because coyotes can spread these diseases to wolves. In critically endangered species such as red wolves, pathogens that reduce fitness, result in occasional deaths, or even moderately affect population growth could contribute to extinction (Woodroffe 1999).

To mitigate disease-driven declines, disease monitoring and prevention plans should be implemented to ensure long-term recovery. These plans could include periodic health checks for wild wolves and sympatric coyotes to evaluate disease prevalence and determine region-wide epizootics. If new and virulent pathogens are detected, management intervention or treatment can be assessed on a disease-by-disease basis. Part of disease management could also include evaluations of vaccine efficacy, an area of research where captive red wolves have been utilized in the past (Harrenstien et al. 1997, Acton 2008, Anderson et al. 2014).

E. Provide For Additional Red Wolf Reintroductions

Reintroduction into additional sites is necessary for red wolf survival and recovery. Most importantly, reintroduction sites are important places to help increase the population of red wolves and restore wolves to additional areas within its historic range. Additionally, increased genetic diversity from additional reintroductions will further act to mitigate inbreeding depression associated with small isolated populations (Brzeski et al. 2014; USFWS 2007, p. 10), especially upon the establishment of metapopulations with interactions between populations to achieve the necessary exchange of genetic material.

Reintroductions are also of critical importance to the management of disease (Brzeski et al. 2015). With only a single wild red wolf population, disease has the potential to spread and wipe out that population. The establishment of at least two more reintroduction sites within red wolf historic range could partly alleviate disease risk (Bartel and Rabon 2013). Furthermore, expanding recovery efforts across the red wolf's historic range will facilitate evolutionary processes, such as natural selection, that are needed to promote adaptation and population persistence in anthropogenic landscapes (Bartel and Rabon 2013).

The 1990 Red Wolf Recovery Plan provides a history of red wolf reintroduction efforts (USFWS 1990, p. 12-15) and calls for the reintroduction of wolves into at least three areas within the wolf's historic range (USFWS 1990). The recent Wildlife Management Institute report reaffirmed the need for additional reintroduction (WMI 2014). The report found that "[s]uccessful accomplishment of the current recovery plan objectives will require identification of suitable areas and reintroduction of red wolves to 2 other distinct locations within historic red wolf range" (WMI 2014, p.3).

Scientists have developed criteria for assessing potential reintroduction sites (Kelly et al. 1999, p. 49-52; Shaffer 2007; van Manen et al. 2000). Considerations include (1) reproductive isolation from coyotes; (2) adequate prey base (i.e., white-tailed deer); (3) minimum space requirements; (4) human and road densities; and (5) tolerant landowners and supportive institutions. Experience has shown that red wolves will use human-associated landscapes and can thrive if protected from shooting and trapping. They prefer lowland forests and wetlands as naturally occurring habitats and agricultural fields and pine plantations as human-altered habitats (Dellinger et al. 2013; Hinton 2016b). Red wolves prefer areas with secondary, unpaved roads for their hunting and visibility needs as long as human density remains low (Dellinger et al. 2013). When evaluating suitable habitat in reintroduction sites, the Service should also consider the impacts of climate change.

Red wolf hybridization with coyotes has been one of the greatest concerns associated with reintroduction efforts. Yet in larger populations, red wolves will likely have less incidence of hybridization with other species of canids, as red wolves will have a larger pool of available mates (Sparkman et al. 2011; Hinton et al. 2015a; Bohling and Waits 2015).

Scientists have identified numerous potential areas for red wolf reintroduction.[8] Possibilities include the following:

- Central Coastal North Carolina, including Croatan National Forest (Shaffer 2007);
- Daniel Boone National Forest in eastern Kentucky (Jacobs 2009);
- Central Panhandle in Florida, including Apalachicola National Forest and St. Marks National Wildlife Refuge (van Manen et al. 2000);
- Okefenokee ecosystem in Georgia, including Okefenokee National Wildlife Refuge and Banks Lake National Wildlife Refuge (van Manen et al. 2000);
- Northwestern Alabama (van Manen et al. 2000; Paradiso and Nowak 1972); and
- Everglades National Park and Big Cypress National Preserve (USFWS 1990, p. 13).

This petition does not analyze the various potential reintroduction areas, but Petitioners ask that the Service's revised recovery plan call for establishment of at least two additional reintroduction sites, consistent with the 1990 Recovery Plan and the guidance provided by the 2014 Wildlife Management Institute report. Additional land acquisitions may be necessary to meet this objective (USFWS 1990, p. 89).

F. Increase Public Support for the Red Wolf Program

Public support for red wolf recovery is necessary to allow access to private property for wolf management; reduce illegal shootings and landowner requests for nonlethal removals; and ensure continued funding of the recovery program. As such, the revised red wolf recovery plan should consider how to influence the sociopolitical atmosphere surrounding the red wolf recovery.

One mechanism for engaging stakeholders and improving support of endangered species programs is through financial incentives (Smith and Shogren 2001, 2002; Defenders of Wildlife 1994; Stone 1995; Kennedy et al. 1996; Bourland and Stroup 1996). Program documents illustrate that private landowners have been willing to assist in recovery efforts by allowing red wolves and program officials to access their property. Gilbreath and Henry (1998) identified agreements in place as of December 31, 1997, including a memorandum of understanding (1), lease (1), partner's (6) and verbal (14) agreements, totaling $9,500 in payouts with 22 properties

[8] When assessing potential reintroduction sites, the Service should consider anecdotal reports suggesting that large, wolf-like individuals still are present in throughout the eastern half of Texas, as well as in southern Arkansas and Louisiana. There may still be populations with substantive or even predominant characteristics of red wolves, and such populations may be worthy of conservation attention or at least further investigation. For example, Giordano and Pace (2000) observed that coyote-like canids on Sabine National Wildlife Refuge were different from all other Louisiana populations. And Mech and Nowak (2010) reported a few specimens with red wolf-like characters in one area of northern Texas.

encompassing 196,000 acres. Another 13 or more documents detail such agreements from 1998 to 2003 (USFWS 2016a). For example, a September 30, 2003, document details a partner's agreement in which the USFWS paid $1,500 a year for both red wolves and program officials to access 7,033 acres of farmland (reduced to 4,433 at some point during the agreement).

Renewed and more substantive financial incentives could facilitate better cooperation with landowners whose land is currently occupied by red wolves in North Carolina. Additionally, financial incentives will likely need to be a component for future red wolf reintroduction sites.

Managers also need to address public concerns about red wolves. Quintal (1995) suggested that fear motivated those who opposed red wolf recovery, citing human safety as the primary concern followed by the threat to livestock, pets, and game animals. However, such concerns have rarely materialized. Indeed, there are no reports of a red wolf attacking a human, and livestock and pet losses have been extremely rare.

In addition, concerns about coyotes must be addressed since they will likely continue to play a significant role in red wolf recovery; for example, much of the recent vocal opposition to the recovery program has revolved around the limitations red wolf recovery puts on individuals' ability to manage coyotes on private property (WMI 2014). Indeed, Kellert (1985) reported that wolves and coyotes were among the most disliked animals. As such, program officials must be knowledgeable of both human-wolf and human-coyote conflict.

Managers and researchers should identify what constitutes conflict, what influences it, how individuals respond, and ultimately, how conflict affects red wolf conservation efforts. For example, a common concern among hunters is the impact coyotes and red wolves are having on game populations (e.g., deer). Managers and researchers must relate such perceptions with scientific data and focus on informing stakeholders of actual impacts.

For red wolf recovery to achieve long-term success, managers must understand if, how, and why attitudes change over time (Williams et al. 2002; Bright and Manfredo 1996). The few studies addressing public attitudes towards red wolves (Quintal 1995; Mangun et al. 1997; Rosen et al. 1997) are decades old and may not reflect current attitudes; perhaps most important, opposition towards red wolf recovery may have evolved. An updated human dimensions study would provide managers the information needed to develop efficient and effective strategies that target the most pressing social issues facing red wolf recovery.

Improving the current sociopolitical atmosphere surrounding the Program will require a multi-faceted approach involving partnerships, education, and outreach. Understanding why individuals have negative attitudes towards a species, such as the red wolf, is necessary to provide a foundation from which biologists and educators can strive to improve human-wolf relations (Bath and Buchanan 1989; Kellert 1987).

CAPTIVE PROGRAM

A captive breeding program needs to remain an important component of a revised recovery plan. The advantages of captive propagation include protection from poaching; more genetic management and enhanced preservation of the gene pool; accelerated expansion of the population to provide animals for reintroduction into new areas; and increased total numbers of animals maintained (USFWS 1990, p. 25). As explained in the 1990 Recovery Plan, "the purpose of captive propagation is to reinforce, not replace, wild populations." Zoos are reservoirs of genetic and demographic material that should be periodically infused into natural habitats to reestablish species that have been extirpated or to revitalize populations that have been debilitated by genetic and demographic factors ((USFWS 1990, p. 25).

While this Petition focuses on recovery of the wild population, Petitioners urge the Service to consider what updates are needed to the Species Survival Plan to ensure that the captive program continues to reflect the best available science. Cryogenic preservation of red wolf sperm and embryo banking should also remain a feature of the recovery program (USFWS 1990, p. 89).

CONCLUSION

An amended recovery plan is necessary to allow red wolves to survive in the wild and make progress toward recovery. Key elements of a revised plan include (1) revisions to the regulatory framework to reduce lethal and nonlethal removals of wolves from the wild; (2) resuming the use of the placeholder program to diminish coyote-wolf gene introgression; (3) resuming the use of the cross-pup fostering program as a way to increase the genetic diversity of the species; (4) utilizing additional reintroduction sites to increase the number and sizes of wild red wolf populations and expand wolf range; and (5) using outreach and education to garner support for wolves and end killings of red wolves.

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