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To: U.S. Fish and Wildlife Service—redwolfreview@fws.gov

Comments on Eastern North Carolina Red Wolf Population Review

We, the undersigned, submit the following comments on the Eastern North Carolina Red Wolf Population Review, pursuant to the U.S. Fish and Wildlife Service (FWS) news release of August 29, 2014.

We encourage FWS to: (1) maintain the Recovery Program in eastern North Carolina, at least at current levels; (2) continue ongoing research and develop further methodology to control hybridization and other threats to the reintroduced population; and (3) work with the local public and government to facilitate cooperation without curtailment of the Program.

The eastern North Carolina red wolf (*Canis rufus*) population, and the supporting field operation, is the crowning achievement of a half century of research and conservation activity, largely by FWS and associated parties and agencies. Such effort began with collection of specimens in the early 1960s, which confirmed the precarious status of the species (Paradiso 1965, 1968) and led to its formal endangered classification in 1967. Intensification of field work followed, and establishment of a captive breeding population (Nowak 1979; Nowak et al. 1995). According to Ms. Cynthia K. Dohner, FWS Region 4 Director (letter of June 14, 2014, to Mr. Gordon Myers), "this action became a landmark in conservation and has saved this wolf from the brink of extinction."

However, captive breeding, while critically important, cannot replicate the evolutionary landscape needed to keep the red wolf a functional and robust predator. We thus believe its reintroduction to eastern North Carolina, which began in 1987 and has led to a functioning population of 90–110 animals (Phillips et al. 2003; Rabon et al. 2013), is an even more remarkable conservation achievement. It appears to have been the first successful return of an entire major population of a large and primarily predatory mammal, and was among the first instances of a species, considered extinct in the wild, being re-established therein from a captive population. It served as a model for subsequent canid reintroductions, particularly those of the gray wolf (*Canis lupus*) to the American Southwest and to the Yellowstone region (Carley 2000; Phillips et al. 2003). In 2007 the Red Wolf Recovery Program received the Association of Zoos and Aquariums North America Conservation Award. Bud Fazio, then team leader of the program said, "The award is a tribute to long-term conservation efforts . . . . We thank all those who have dedicated many years of hard work . . . ." (Hendry 2007).

Those were not empty words. The enduring commitment of red wolf field biologists and technicians is legendary, some having devoted many years, even decades to the Recovery Program (Beeland 2013). Moreover, the Program has served as a testing ground for remarkable techniques, some now used widely in wildlife conservation, including those involving acclimation of captive-born animals to the wild before release, genetic monitoring, cross fostering of captive-born pups into wild litters, and use of sterilized canids that serve as "place-holders" to preclude hybridization (Bartel and Rabon 2012; Fazio 2007). Such dedication and innovation by FWS personnel and their associates would be made worthless if the recovery operation in eastern North Carolina were to be abandoned or abridged.

Indeed further actions are needed in the area, such as those suggested by Fazio (2007) and Hinton et al. (2013), in order to lower human-induced mortality, restrict hybridization between red wolf and the invading coyote (*Canis latrans*), and improve cooperation with the local populace and state agencies. We would suggest still other measures, including: (1) routine preservation of cranial and molecular specimens; (2) establishment of additional small but wild populations, protected from interaction and hybridization with the coyote by canid-proof fences, such as have proved effective in keeping the dingo (*Canis familiaris dingo*) out of sheep-raising parts of Australia (Corbett 2008; Hayward and Kerley 2009); (3) investigation of potential population expansion beyond the designated five-county recovery area into mainland North Carolina (Bohling and Waits 2011); and (4) widespread searches, as initiated on a small scale by Mech and Nowak (2010), for morphological and molecular evidence of remnant red wolf influence in the canid populations now occupying its historical range. And we of course strongly support research and funding that would be applied to reintroduction of two additional wild populations within the historical range, the need for which has long been recognized by FWS (Fazio 2007).

We consider the red wolf a species that will require proactive conservation efforts for the foreseeable future, especially procedures to control and monitor hybridization with the coyote. When red wolf reintroduction began, the coyote had been identified in barely a dozen counties of North Carolina, evidently as a result of natural range expansion from the west and accidental or deliberate release (DeBow et al. 1998). Now it is found in all 100 counties, with thousands reportedly killed annually by hunters and trappers throughout the state (Myers 2012). The Recovery Program field personnel in eastern North Carolina stand like the Spartans at Thermopylae. Pull them out, even significantly curtail their work, and the red wolf population would be overwhelmed. A unique natural treasure, and a half century of dedicated FWS effort to save the species in the wild, would be lost. Notwithstanding the technical classification of the population, its demise and/or disruption of the field operation, would inflict severe harm on the species as a whole.

While it may sometimes appear heavy-handed, proactive human intervention in wildlife conservation has been acknowledged as a necessary modern reality (Scott et al. 2010). It is in fact the norm for most common game populations. For example, white-tailed deer (*Odocoileus virginianus*) and wild turkey (*Meleagris gallopavo*) populations were extirpated and later reintroduced (Leberg et al. 1994). Both species are currently managed intensively and require constant monitoring to ensure that harvest criteria and changes in habitat quality do not hinder population dynamics (Alpizar-Jara et al. 2001; Norman et al. 2004; Strickland et al. 2012). Of particular interest is the elk (*Cervus elaphus*), which, like the red wolf, was reintroduced to North Carolina, though in the western part of the state. The elk population there, almost identical in size to that of the red wolf, is carefully protected and monitored, with much attention paid to management options that will encourage population growth but consider the welfare of landowners (Linehan and Palmer 2014).

The necessity of proactive management may cast the image that the red wolf recovery effort is fruitless. However, notwithstanding the obstacles the program has faced, many positive achievements suggest recovery is possible. Despite increasing coyote presence in the recovery area, the number of red wolf litters has outpaced the number of hybrid litters almost every year since the program's inception (Bohling and Waits In Review). Also, contrary to popular belief,

the red wolf has not interbred indiscriminately with the coyote. Research using genetic pedigree techniques (Adams 2006; Bohling et al. 2013), non-invasive genetic sampling (Adams et al. 2003, 2007; Bohling 2011), and morphometric analysis (Hinton and Chamberlain 2014) have demonstrated that hybrids are a minor component of the total canid population. Such not only indicates that the efforts of FWS biologists have been successful, but also that natural pairings between wolf and coyote are infrequent. This finding is reinforced by a survey of documented hybridization events, revealing that hybrid litters frequently followed the disruption of stable breeding pairs by human-caused mortality, such as gunshot (Bohling and Waits In review). Modeling approaches suggest a red wolf population threatened by hybridization can persist and maintain its genetic integrity under certain conditions (Fredrickson and Hedrick 2006). Genetic studies of the reintroduced population, together with analysis of its reproductive history, also have assessed inbreeding and inbreeding depression (reduction in offspring fitness caused by mating among close relatives). Although the population had relatively few founders (14), inbreeding depression therein was found to be minimal, thus suggesting long-term persistence may not be significantly hampered by inbreeding (Brzeski et al. 2014).

Considering the above examples of resilience and viability in the red wolf population, it is imperative to maintain those conditions that foster potential success of the program. Unfortunately, during the last decade the population has declined modestly, partly because of killing by people, thereby potentially increasing coyote presence, destabilizing pack structure, lowering ability to hold territories, and augmenting conditions for hybridization (Hinton et al. 2013). We believe FWS should work to reverse that trend, and that there must be no tolerance for factors that might limit the size or disrupt the social dynamics of the red wolf population, no moderation in field activity, and no reduction of the recovery area.

FWS might look towards the recovery of the eastern wolf (sometimes regarded as the subspecies *Canis lupus lycaon* and sometimes as the species *Canis lycaon*) in southeastern Canada for the potential heights red wolf recovery could achieve. The eastern wolf was reduced to a small population in the area around Algonquin Provincial Park and was threatened by hybridization with the invading coyote. However, protection of the wolf both in and around the Park allowed re-expansion to the point at which the population naturally retains its genetic distinctiveness, without active human management (Wilson et al. 2009; Rutledge et al. 2010). There is no reason to assume the red wolf not capable of comparable recovery, if more stringent protection is provided for the population.

We recognize that there has been much argument as to whether the red wolf is indeed a distinct species, a constituent of another species, or simply a hybrid. The last opinion seems common in eastern North Carolina. Indeed, there have been at least two formal petitions to remove the red wolf from the U.S. List of Endangered and Threatened Wildlife, based on the claim that it is a hybrid; both were rejected by FWS (Henry 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 by European settlers led to hybridization between the gray wolf and coyote in southeastern North America (Reich et al. 1999; vonHoldt et al. 2011).

We reject the view that the red wolf is a hybrid and note that both molecular (Kyle et al. 2006; Wilson et al. 2000) and morphological (Nowak 1979) evidence shows the species to represent a separate lineage that originated well back in the Pleistocene. All available historical and

paleontological information gives no indication that the coyote and gray wolf were present in the Southeast, or that there was any hybridization there, between 10,000 and 100 years ago (Nowak 2002). Recent field work in eastern North Carolina shows that the red wolf population there has maintained its unique phenotype and large external size (Hinton and Chamberlain 2014). We acknowledge that some molecular studies (Wilson et al. 2000, 2003, 2009) suggest the close affinity, even conspecificity, of the red wolf and the eastern wolf (*lycaon*). However, as explained by Nowak (2009), there may be no trenchant disagreement between that view and our own. In any case, we would point out that an extensive recent review of the taxonomy of North American wolves, prepared by four FWS authorities and published by FWS, regards the red wolf as a full species, with the name *Canis rufus*, that arose in prehistoric times and that is distinct from *Canis lupus* and *lycaon* (Chambers et al. 2012). Finally, we note that *Canis rufus* is recognized as a valid species, and as "critically endangered," by the IUCN (Kelly et al. 2008).

In conclusion, we believe the red wolf is a distinct species that has been an integral component of the natural ecosystems of eastern North America since prehistoric times. It played a major role in the history and folklore of that region (North Carolina State University even uses the nickname "Wolfpack"). On the verge of extinction, the red wolf was saved in a heroic conservation undertaking by FWS and has since been maintained by the devoted workers of that agency. Continued support by the Recovery Program in eastern North Carolina is vital to the long-term prospects of the species. We urge that those efforts not be abandoned, and that they even be strengthened.

Signatures

Jennifer R. Adams, Ph.D.
University of Idaho
Department of Fish and Wildlife Sciences
875 Perimeter Drive MS1136
Moscow, ID 83844-1136
adamsj@uidaho.edu
208-885-4121

T. DeLene Beeland
Science Writer/Author of *The Secret World of Red Wolves: The Fight to Save North America's Other Wolf*
398 Webb Cove Road
Asheville, NC 28804
delene@nasw.org

Justin H. Bohling, Ph.D.
Postdoctoral Researcher
Institut des Sciences de l'Evolution
Universite Montpellier 2
34000 Montpellier
France

Justin.bohling@univ-montp2.fr

Kristin E. Brzeski, Ph.D. Candidate
Louisiana State University
School of Renewable Natural Resources
Baton Rouge, LA 70803
kbrzes1@lsu.edu

Justin A. Dellinger
Wildlife Biologist, Colville Tribes Fish and Wildlife Department, and
Ph.D. Student, University of Washington
Box 352100
Seattle, WA 98195
jad1nel2@gmail.com
509-846-3747

Philip W. Hedrick, Ph.D.
Ullman Professor of Conservation Biology
School of Life Sciences
Arizona State University
Tempe, AZ 85782
philip.hedrick@asu.edu

Joseph W. Hinton, Ph.D.
Postdoctoral Researcher
Warnell School of Forestry and Natural Resources
University of Georgia
Athens, GA 30602
jhinton@uga.edu

Melissa L. Karlin, Ph.D.
Assistant Professor of Environmental Sciences
St. Mary's University
One Camino Santa Maria
San Antonio, TX 78228
mkarlin@stmarytx.edu

Ronald M. Nowak, Ph.D.
2101 Greenwich Street
Falls Church, VA 22043
ron4nowak@cs.com
703-237-6676

Joe Poston, Ph.D.
Associate Professor of Biology
Catawba College

2300 W. Innes St
Salisbury, NC 28144
jpposton@catawba.edu
704-637-4443

Ronald Worth Sutherland, Ph.D.
Conservation Scientist, Wildlands Network
3705 C Erwin Rd
Durham, NC 27705
ron@wildlandsnetwork.org
919-401-7271 w 919-641-0060 c

Kitti L. Virts, Ph.D.
Volunteer Comment Coordinator & Supporter, Red Wolf Recovery Program
Psychologist & Health Service Provider in TN
614 Barlin Drive
Nashville, TN 37221
kitti.virts@comcast.net
615-848-8214

Jonathan G. Way, Ph.D.
Research Scientist
Marsh Institute, Clark University
89 Ebenezer Road
Osterville MA 02655
jw9802@yahoo.com
508-360-6879 c

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