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Wildlife is Not Crying Wolf: How Fish & Wildlife Service can Utilize the Endangered Species Act to Mitigate Hybridization Threats to Listed Species

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Abstract

As humans modify Earth's landscapes and climate change fundamentally alters ecosystems, separately evolving wildlife populations may once again meet and interbreed with one another. This hybridization process may ultimately drive the less prolific of the two populations into extinction. U.S. Fish & Wildlife Service ("FWS") has failed to fully utilize the tools within the Endangered Species Act ("ESA") to adequately address the unique problems of species hybridization. Although FWS has resisted attempts to delist species undergoing hybridization, their recovery plans and critical habitat designations fall short of maximizing the potential for species recovery. This paper first explores the current regulatory framework governing hybridized species under the ESA. Next, it demonstrates the shortcomings of FWS's management decisions on hybridized species conservation using red wolves as the prime example. Finally, it concludes with recommendations to issue guidance on FWS's approach to recovery plans and critical habitat designations for hybridizing species in the future.

Introduction

Biological diversity is vital to support complex ecosystem interactions which create habitable environments for creatures and provide resources humans can utilize.[1] Anthropogenic changes to the environment pose a threat to biodiversity when they create a catalyst for previously diverging populations of a wildlife to migrate to the same habitat and

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1. Johan Rockström, *What Kind of Earth Will Future Generations Inherit?*, WORLD ECON. FORUM (Oct. 1, 2015), https://perma.cc/3LF2-CWPF.

produce hybridized offspring.[2] Such offspring may not be as well-suited to the habitat and may drive the smaller of the hybridizing populations into extinction.[3] When the smaller population is a threatened or endangered species, the ESA offers mechanisms, such as designating critical habitat and creating a recovery plan, that have the potential to prevent a population's extinction.[4]

However, the unique threats that populations undergoing hybridization face are not always accounted for when FWS implements the ESA requirements. As exemplified by FWS's treatment of the red wolf in eastern North Carolina, FWS's designation of critical habitat and creation of recovery plans is insufficient to help hybridizing threatened and endangered species recover when neither implement specific strategies to reduce hybridization. First, critical habitat designations should take into account hybridization by covering areas that are further away from other populations with which they could hybridize. This will help minimize the overlap between the two populations and therefore reduce hybridization. Second, recovery plans must include proactive mechanisms to prevent continued hybridization. Namely, when the more populous hybridizing species is not endangered or threatened, FWS should sterilize, cull, or relocate individuals who occupy the same territory as the less populous species. This will give the less populous species time to reproduce until their numbers are large enough to withstand a hybridization threat. Then, even if another population interbreeds with them, the majority of their genetic make-up is not at risk of vanishing.

The broad requirements in the ESA are enough to allow the FWS to take these proposed actions. It is FWS issued guidance in the area of hybridization that is lacking. Additional guidance creating a framework to address hybridization problems is key to ensure threatened or endangered species susceptible to hybridization have their best shot at survival. Listing a hybrid species or a species that becomes hybridized is a futile exercise without either a designated critical habitat that seeks to minimize overlap between hybridizing species or a robust recovery plan that works to minimize interactions with a non-listed hybridizer.

2. *See generally* Marco Todesco et al., *Hybridization and Extinction*, Vol. 9, No. 7 EVOLUTIONARY APPLICATIONS 892 (2016).
3. Todesco et al., *supra* note 2, at 898.
4. Endangered Species Act § 4, 16 U.S.C. § 1533 (2019).

Biological Diversity and Hybridization

> The value of biodiversity is that it makes our ecosystems more resilient, which is a prerequisite for stable societies; its wanton destruction is akin to setting fire to our lifeboat.
>
> -Johan Rockström[5]

Biological diversity is defined in the Convention on Biological Diversity as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems."[6] The complex interactions between Earth's organisms create resilient ecosystems which produce resources humans need to survive.[7] According to Darwin's theory of evolution, natural selection leads to diverging species better suited to each of their habitats.[8] However, with a rapidly changing planet due to human influence,[9] some diverging species are reconnecting to create hybridized species.[10]

Hybridization occurs when two genetically distinguishable populations mate to produce offspring.[11] This can decrease biological diversity through genetic swamping, where the population with fewer numbers is eventually replaced by hybrids.[12] Anthropogenic hybridization can occur when habitat disturbances alter natural barriers between communities, allowing the migration of wildlife to different ecosystems.[13] Climate change can also exacerbate hybridization when ecosystems change

5. Rockström, *supra* note 1.

6. United Nations Convention on Biological Diversity, art. 2, June 5, 1992, 1760 U.N.T.S. 143.

7. *See* NAT'L RESEARCH COUNCIL, AN ECOSYSTEM SERVICES APPROACH TO ASSESSING THE IMPACTS OF THE DEEPWATER HORIZON OIL SPILL IN THE GULF OF MEXICO 55 (Nat'l Acads. Press 2013).

8. CHARLES DARWIN, ON THE ORIGIN OF SPECIES BY MEANS OF NATURAL SELECTION, OR THE PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE 111–14 (1st ed. 1859). NOTE: IS AUTHOR REALLY QUOTING FIRST EDITION? OR A SUBSEQUENT EDITION?

9. THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2014: SYNTHESIS REPORT 40–54 (Rajendra K. Pachauri et al. eds., 2015), https://perma.cc/QPV7-GNB2; Peter M. Vitousek et al., *Human Domination of Earth's Ecosystems*, 277 SCIENCE 494, 494–99 (1997).

10. *See generally* Todesco et al., *supra* note 2, at 892.

11. *Id.*

12. *Id.*

13. *Id.* at 901.

amid new climate conditions which can result in range shifts when wildlife migrate in search of an area with the conditions of their former ecosystem.[14]

In Canada, for example, southern flying squirrels shifted their range north in response to climate change, bringing them into contact with the northern flying squirrel.[15] These populations are now undergoing hybridization.[16] Additionally, in the arctic, climate-change induced melting ice is eliminating natural barriers between species and shifting their range to result in at least thirty-four hybridizations as of 2006, including a hybrid polar and grizzly bear.[17]

The key to preventing hybridization is reproductive isolation, which has become increasingly challenging as the Earth's landscape transforms due to human interference.[18] Furthermore, the more fertile the hybridized species, the higher the likelihood the less prolific parent species will be driven into extinction.[19]

Hybridization's negative impacts can arise when the hybrid creature is less fit than the parents and cannot replace their vital role in the ecosystem.[20] For example, polar-grizzly hybrids in a German zoo exhibited seal hunting behaviors but did not have the strong swimming ability of polar bears.[21] If a population undergoing hybridization is a keystone species, its decreased presence in the habitat can have cascading negative environmental impacts.[22]

On the other hand, hybridization can also be a tool to save a species from extinction.[23] Small, inbred populations can benefit from hybridization

14. *Id.*
15. Todesco et al., *supra* note 2, at 901
16. *Id.*
17. Brendan P. Kelly et al., *The Arctic Melting Pot*, 468 NATURE 891, 891 (2010).
18. Todesco et al., *supra* note 2, at 899–902.
19. *See id.* at 892, 898; *see also* Maurizio Serva, *A Stochastic Model for the Interbreeding of Two Populations Continuously Sharing the Same Habitat*, 77 BULL. OF MATHEMATICAL BIOLOGY 2354, 2364 (2015) (demonstrating through stochastic mathematical model that the average percent of the extinct populations genes in the surviving population hybrids is a function of the relative initial size of the populations and the mating rate).
20. Kelly et al., *supra* note 17.
21. *Id.*
22. CHARLES J. KREBS, ECOLOGY: THE EXPERIMENTAL ANALYSIS OF DISTRIBUTION AND ABUNDANCE 378 (6th ed. 2009) (defining keystone species as a "[r]elatively rare species in a community whose removal causes a large shift in the structure of the community and the extinction of some species"); *see also* Henry Eden W. Cottee-Jones & Robert J. Whittaker, *The Keystone Species Concept: A Critical Appraisal*, 4(3) FRONTIERS OF BIOGEOGRAPHY 117, 125 (2012) (surveying the history of the term "keystone species" and proposing a definition: "a keystone species is a species that is of demonstrable importance for ecosystem function").
23. Todesco et al., *supra* note 2, at 902.

when it increases the population's overall fitness without driving it into extinction.[24] For example, the Florida Panther was nearly hunted to extinction in the 1900s.[25] Their small population lacked enough genetic diversity for their offspring to thrive, and inbreeding resulted in heart problems and reproductive defects that would have resulted in the extinction of the species.[26] However, in 1995, FWS introduced Texas cougars into the same habitat as the Florida panthers to promote hybridization between the two closely related species.[27] The hybrid offspring were much fitter than the Florida panther population and filled the same niche in the ecosystem.[28]

While the recovery of the Florida panthers demonstrates how human-induced hybridization between populations can save a species from extinction, hybridization as a means of preserving an inbred population is a rare outcome in natural populations.[29] Although hybridization is a natural process that regularly occurs in the wild,[30] the rate at which landscapes are changing and separately evolving populations are reuniting to interbreed surpasses the normal pace in which these chance encounters occurred in the past. In the past, when two species interbred the encounters between them were likely slow at first, such as a single bird drifting off to a new island during a storm, or a population tentatively expanding its normal range. If the hybrid offspring was less fit, natural selection would take its course and neither the hybrid nor its offspring would predominate amongst either population. If the hybrid offspring was at least as fit as the parents, a phenomenon known as hybrid vigor or heterosis, the hybrid population may begin to predominate both populations or settle in a location between the populations.

Today, humans are rapidly changing landscapes which increases the frequency of encounters between populations than the course of nature would typically provide without human interference. While scientists could wait-and-see whether hybrid offspring are more fit than their parents and perhaps better suited to these rapidly changing environments, this approach could also result in the extinction of species which fulfill important ecosystem functions. The rapid rate of hybridization could result in a generation of hybrids which are less fit than their parents or do not fulfill

24. *Id.* at 903.
25. Christine Dell'Amore, *Hybrid Panthers Helping Rare Cat Rebound in Florida*, NAT'L GEOGRAPHIC (Sept. 24, 2010), https://perma.cc/V9G4-8NH2.
26. *Id.*
27. *Id.*
28. *Id.*
29. Todesco et al., *supra* note 2, at 904.
30. John M. Drake, *Heterosis, The Catapult Effect and Establishment Success of a Colonizing Bird*, 2 BIOLOGY LETTERS 304, 304–07 (2006).

the same essential roles in the ecosystem. If scientists wait-and-see, and the results are not beneficial to the wildlife or ecosystem, it may be too late to save the species without expensive and resource-intensive interventions.

While hybridization is a useful tool to save an inbred species from extinction, naturally occurring hybridization resulting from rapid changes in the climate and landscape may jeopardize the existence of important species. This paper focuses on hybridization as a threat to biodiversity through genetic swamping. Hybridization is a real threat to rare species who come into contact with genetic "cousins."[31] These contacts are likely to increase as anthropogenic forces continue modifying ecosystems. The ESA provides the federal government with a tool that has the potential to preserve threatened and endangered species at risk of extinction due to hybridization. With effective guidance on approaches to establishing critical habitat and developing recovery plans, species susceptible to hybridization have a better shot at surviving in this sixth era of extinction.[32]

Endangered Species Act

The ESA was enacted in 1973 to preserve endangered and threatened species at all costs.[33] It delegates authority to the Secretary of the Interior to list endangered and threatened species,[34] establish critical habitat,[35] and create a recovery plan.[36]

A. Listing Species

The Secretary determines whether a species is endangered or threated based on five factors enumerated under section 4(a)(1) of the ESA, which generally outlines any impacts to the species or its environment that affect its continued existence.[37] The Secretary may list a species on their own, or in response to a petition to list a species.[38] The factors for listing a species are the same factors the Secretary shall consider when delisting a species.[39]

31. *See generally* Donald A. Levin, *Hybridization and Extinction*, 90 AM. SCIENTIST 254 (2002).
32. John D. Sutter, *Sixth Mass Extinction: The Era of 'Biological Annihilation'*, CNN (July 11, 2017), https://perma.cc/Y5H6-EW96.
33. Tenn. Valley Auth. v. Hill, 437 U.S. 153, 184 (1978) ("The plain intent of Congress in enacting this statute was to halt and reverse the trend toward species extinction, whatever the cost."); *see also* 16 U.S.C. § 1531(b) (2019).
34. 16 U.S.C. § 1533(a)(1).
35. *Id.* at § 1533(a)(3)(A)(i).
36. *Id.* at § 1533(f)(1).
37. 16 U.S.C. § 1533(a)(1).
38. *Id.* at § 1533(b)(3)(A).
39. *Id.* at § 1533(a)(1).

i. What is a "species" under the ESA?

The ESA defines "species" as "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature."[40] Since the Secretary makes listing determinations based "solely on the basis of the best scientific and commercial data available,"[41] their conclusions on whether a fish, wildlife, or plant species, subspecies, or distinct population segment meets any of the factors enumerated under section 4(a)(1) of the ESA must be based on scientific data. Thus, the Secretary will look to scientific studies on organisms to determine their eligibility for listing under the ESA and defer to scientific studies when there is a question as to a group's status as a species.

Scientists have not settled on a uniform definition of "species."[42] While the textbook standard definition of a biological species is a group of individuals capable of interbreeding to produce fertile offspring,[43] there are many instances in which separately identified and named species have interbred to produce fertile offspring.[44] This can have significant consequences for wildlife under the ESA. For instance, when two separately identified species mate to produce offspring, does this mean that those two species are actually the same species along with their fertile hybrid? If one of the separately identified species was listed under the ESA and the other species was not, is this ground for delisting the species since it appears to be more numerous than originally thought? On the other hand, if the interbreeding species each retain their distinct status as separate species, what species is the hybrid offspring? Will the hybrid receive the same protections as the listed parent under the ESA?

The evolving field of taxonomy, the science of naming species,[45] gives us a first step in answering these complex questions. The more modern phylogenetic species concept does not factor the ability to interbreed into the determination of which individuals are members of the same species.[46] Rather, a species is a group of organisms that share

40. 16 U.S.C. § 1532(16).
41. *Id.* at § 1533(b)(1)(A).
42. Carl Zimmer, *What Is a Species?*, 298 SCI. AM. 72, 72–79 (2008).
43. *E.g.*, *Boundless Biology*, LUMEN (last visited Mar. 29, 2020), https://perma.cc/4G4M-6D9J; Zimmer, *supra* note 42, at 72–79.
44. *See, e.g.*, Y. Milián-Garcia et al., *Genetic Evidence of Hybridization Between the Critically Endangered Cuban Crocodile and the American Crocodile: Implications for Population History and In Situ/Ex Situ Conservation*, 114 HEREDITY 272–80 (2015).
45. Zimmer, *supra* note 42, at 72–79.
46. *Id.*

"clear-cut traits."[47] Other clues, such as evidence the individuals descended from a common ancestor and DNA testing, can help determine which organisms are members of the same species.[48] Thus, it is possible for two species to interbreed to produce fertile offspring and retain their status as separate species.

Two cases from the Ninth Circuit Court of Appeals, decided within one-and-a-half years of each other, demonstrate how little an animal's ability to interbreed with another factors into whether it can be listed under the ESA.[49] In *Gutierrez*, the court held the National Marine Fisheries Service ("NMFS") did not violate the ESA when it listed steelhead as a threatened species distinct from rainbow trout even though steelhead sometimes interbreed with rainbow trout.[50] The court confirmed NMFS is permitted to list portions of a scientific species because the ESA defines species to include "any subspecies of fish."[51] In *Alsea Valley*, the court held the inclusion of sixteen population segments of West Coast Salmon as a listed species was permissible even though the separate populations did not interbreed with regularity.[52] Although the ESA does include as part of the definition of a species that they interbreed when mature, it does not say how often this interbreeding must occur, and does not go so far as to require regular interbreeding.[53] These two cases taken together show the wide latitude FWS and NMFS have to list species: a listing can include only a portion of a species capable of interbreeding with others or it can include multiple populations that may only rarely interbreed with each other. This also demonstrates how species threatened by interbreeding can be listed separately from the populations they interbreed with, thus offering them additional protections against extinction from the dilution of their gene pool. Furthermore, if protections can be extended to species they may only occasionally interbreed with, it may be easier to prohibit hunters from killing the more vulnerable population due to mistaken identity.

The ESA, modern taxonomy, and case law have demonstrated when two separately identified species mate to produce fertile offspring they can still be identified as separate species. Furthermore, under the more modern phylogenetic species concept, the listed status of a hybridizing species is unlikely to change so long as the population retains distinct "clear-cut"

47. *Id.*
48. *Id.*
49. Modesto Irr. Dist. v. Gutierrez, 619 F.3d 1024 (9th Cir. 2010); Alsea Valley All. v. Lautenbacher, 319 Fed. App'x 588 (9th Cir. 2009).
50. *Gutierrez*, 619 F.3d at 1037.
51. *Id.* at 1032.
52. *Alsea Valley All.*, 319 Fed. App'x at 589.
53. *Id.*

traits.[54] However, what remains unanswered is what status a hybrid offspring of two separately identified species adopts.

ii. Is a hybrid with at least one listed parent protected under the ESA?

In 1996, FWS and NMFS proposed a policy that identified the status of hybrid species.[55] If a hybrid more closely resembled its listed parent compared to other hybrids of the two species, then that hybrid was protected under the same framework as the parent.[56] This policy also permitted FWS and NMFS to eliminate hybrid offspring that were dissimilar to the listed parent as a tool to preserve the traits of the listed species and prevent genetic swamping.[57] Furthermore, it proposed guidance on utilizing hybridization as a tool to help listed species recover, especially when the species had a small population trending towards genetic bottlenecking, or in other words, when the population did not have enough genetic diversity to give the species hope for future survival.[58] However, this proposal was neither passed nor withdrawn,[59] and merely offers insight into what FWS and NMFS could have implemented regarding their approach to hybrids.

In 2000, FWS and NMFS adopted a policy on hybrid, or intercross, species, however it only addresses guidance on hybridization as a tool to save a species from extinction.[60] The policy proposes that when in-situ (within the natural environment) conservation strategies fail, ex-situ (outside the natural environment) strategies can be employed to remove listed species from the environment and breed them with other species in captivity to prevent their extinction.[61] Here, hybridization is used as a tool to diversify the gene pool of a listed species while attempting to retain its distinctive phenotypical features that enable it to interact with its habitat in the same or similar manner.[62]

While FWS and NMFS proposed a reasonable solution for categorizing hybrid offspring in 1996, it was not enacted, and their

54. Zimmer, *supra* note 42, at 72–79.

55. Proposed Policy and Proposed Rule on the Treatment of Intercrosses and Intercross Progeny (the Issue of ''Hybridization''), 61 Fed. Reg. 4710 (proposed Feb. 7, 1996) (to be codified at 50 C.F.R. pt. 424).

56. *Id.*

57. *Id.*

58. *Id.*

59. *Id.*

60. Policy Regarding Controlled Propagation of Species Listed Under the Endangered Species Act, 65 Fed. Reg. 56916 (proposed Sept. 20, 2000).

61. Policy Regarding Controlled Propagation of Species Listed Under the Endangered Species Act, *supra* note 60.

62. *Id.*

subsequent Intercross Policy of 2000 neglected to account for hybridization as a threat to biodiversity. It is unclear what status hybrids have under the ESA. Furthermore, FWS and NMFS have no other guidance on strategies to aid listed species threatened by hybridization. As habitat modification and climate change continue to alter the landscape of our planet, hybridization is likely to occur more frequently. While listing species under the ESA offers strong protections against extinction, without clear guidance on how to classify hybrids and how to address threats from hybridization, FWS and NMFS may not fully capture the power of the ESA in aiding species survival.

B. Critical Habitat

The Secretary is required to establish critical habitat for an endangered or threatened species at the same time it is listed.[63] The designation of critical habitat is based on the "best scientific data available" just like the determination on whether to list a species.[64] If the critical habitat of the species is indeterminable, the Secretary may wait up to one-year to designate critical habitat so long as they actually made an effort to determine the critical habitat first.[65] Unless extraordinary circumstances apply, such as the designation of critical habitat is likely to result in the extinction of the species because it will lead collectors to their location, the designation of critical habitat must happen concurrently with the listing.[66]

The critical habitat must include the "geographic area essential to the conservation of the species."[67] This can include a portion of its current or historic range, up to the entire current and historic range.[68]

C. Recovery Plan

After a species is listed along with its designated critical habitat, the Secretary must develop a recovery plan incorporating site-specific management actions necessary to conserve the species.[69] The goal of a

63. 16 U.S.C. § 1533(a)(3)(A) (2019).

64. *Id.* at § 1533 (b)(2).

65. *Id.* at § 1533(b)(6)(C)(ii); N. Spotted Owl v. Lujan, 758 F. Supp. 621, 628 (W.D. Wash. 1991).

66. James Salzman, *Evolution and Application of Critical Habitat Under the Endangered Species Act,* 14 HARV. ENV. L. REV. 311, 334 (1990); *see also* Endangered Species Act Amendments of 1978, Pub. L. No. 95-632, 92 Stat. 3751 (1978) (codified as amended at 16 U.S.C. § 1533(a)(3)); H.R. REP. NO. 95-1625, at 17 (1978), as reprinted in 1978 U.S.C.C.A.N. 9453, 9467.

67. 16 U.S.C. § 1532(5)(A) (2019).

68. *Id.*

69. *Id.* at § 1533(f).

recovery plan should be the proliferation of the species to the point where delisting is warranted because its survival is no longer threatened.[70] Furthermore, several requirements accompanying recovery plans, such as public notice and comment periods, monitoring requirements, and reporting requirements, serve to give the public an avenue for input and a reason to be confident that the plans will be transparent and actually executed.[71]

FWS's Management of Red Wolves under the ESA

Red wolves, also known by the scientific name Canis rufus, once roamed the southeast United States.[72] They share a common ancestor with both gray wolves and coyotes.[73] Coyotes predominated in the western half of the United States and thrived in the open country.[74] However, in the twentieth century coyotes began moving east as humans transformed once natural barriers between habitats into agricultural fields and logged forests.[75] Coyotes quickly adapted to new eastern environments and their numbers swelled.[76] While gray wolves often kill coyotes, red wolves interbreed with them.[77] As the population of red wolves dwindled due to hunting, their continued hybridization with coyotes posed a risk to their survival as a species.[78] Since wolves are much larger than their coyote cousins, they consume more prey and have a different impact on the environment.[79] For example, when wolves were reintroduced into Yellowstone, the impact they had on elk behavior had cascading positive impacts on the environment and drastically increased biodiversity in the area.[80] Elks browsed trees less so they could be on the move to try to avoid predation by wolves.[81] As a result, willow trees prospered, beavers built more dams, the flow of the river changed, and the ecosystem grew to be far

70. *Id.* at § 1533(f)(B)(ii).
71. 16 U.S.C. § 1533(f).
72. *Red Wolf*, THE NAT'L WILDLIFE FED'N, https://perma.cc/PSV4-B4C6 (last visited Mar. 4, 2020).
73. *Id.*
74. Robert Winkler, *Coyotes Now at Home in Eastern U.S.*, NAT'L GEOGRAPHIC (Aug. 6, 2002), https://perma.cc/3XXN-5TLF.
75. *Id.*
76. *Id.*
77. *Id.*
78. *Red Wolf*, *supra* note 72.
79. *Id.*
80. Brodie Farquhar, *Wolf Reintroduction Changes Ecosystem in Yellowstone*, MY YELLOWSTONE (Jan. 15, 2019), https://perma.cc/UM4X-33E9.
81. *Id.*

more complex and diverse.[82] If coyotes replaced red wolves through genetic swamping, an ecosystem's potential for robust biodiversity may not be realized, as the reintroduction of wolves in Yellowstone demonstrates.

FWS's approach to red wolves and how it addressed the threat coyotes presented to the survival of the species gives us insight into what strategies are effective when designating critical habitat and developing a recovery plan for a species threatened with hybridization. Ultimately, FWS's wait-and-see approach to red wolf and coyote interactions and its hesitation to take any action to prevent hybridization initially, despite ample evidence that hybridization posed a threat, lead to a slow recovery for the species. Today, its reluctance to enforce take prohibitions has left the species with a small wild population, entirely dependent upon a captive breeding program for their survival as a species into the foreseeable future.

A. Delisting Efforts

FWS listed red wolves as an endangered species under the Endangered Species Preservation Act on March 11, 1967.[83] However, by the mid-1970s the wild population of red wolves dwindled drastically.[84] FWS decided to capture forty red wolves to begin a captive breeding program in an effort to save the species from extinction.[85] Captively bred red wolves were released in the Alligator River National Wildlife Refuge ("Refuge") in eastern North Carolina as a nonessential experimental population, meaning the population will be treated as threatened instead of endangered allowing FWS more leeway to permit some takings of the species.[86] Although there are about 200 red wolves currently in captive breeding programs,[87] the reintroduction of red wolves to the wild has largely been a failure. In 2010, 130 red wolves roamed in eastern North Carolina.[88] However, as of January 10, 2018, an estimated twenty to thirty wolves persist in the habitat.[89] Red wolf numbers have declined largely

82. *Id.*
83. Endangered Species, 32 Fed. Reg. 4001 (Mar. 11, 1967).
84. Proposed Determination of Experimental Population Status for Red Wolves in North Carolina, 51 Fed. Reg. 26564 (July 24, 1986).
85. *Id.*
86. Proposed Determination of Experimental Population Status for Red Wolves in North Carolina, 51 Fed. Reg. at 26564, *supra* note 84.
87. *Facts & Stats*, RED WOLF COALITION, https://perma.cc/T3NL-3NDD (last visited Mar. 30, 2020).
88. *Id.*
89. *Red Wolf*, IUCN RED LIST OF THREATENED SPECIES, https://perma.cc/7D6G-37R7 (last visited Mar. 30, 2020).

due to conflicts with ranchers who own land surrounding the Refuge.[90] North Carolina and local counties have also supported the ranchers in eradicating wolves from their private property when they wander beyond the geographical boundaries of the Refuge.[91]

Fortunately, FWS has resisted attempts to take the red wolf off the endangered species list.[92] In both 1992 and 1997 FWS rejected petitions to delist the red wolf.[93] Ranchers were largely behind these attempts to delist because they believed the wolves threaten their livelihood.[94] Their rationale in their petitions to delist was that the red wolf was not a distinct scientific species, but rather the hybrid offspring of gray wolves and coyotes.[95] After reviewing the delisting petitions, FWS concluded they did not present scientific evidence of current hybridization.[96] Furthermore, while there was evidence of hybridization between red wolves, gray wolves, and coyotes in the past, all three are still recognized as distinct species with unique morphological traits.[97] Even if the red wolf was a subspecies of the gray wolf, it would retain protection under the ESA because the ESA permits the listing of subspecies.[98] Finally, even if the red wolf was entirely a gray wolf/coyote hybrid it would likely still retain its status as an endangered species so long as it retained unique physiological traits that allow it to fill its niche as a top predator in the environment.[99] The crux of both delisting rejections was that red wolves exhibited unique phenotypic, morphological, and behavioral characteristics that were unique compared to other predators in the same habitat.[100]

While FWS characterized the efforts to delist the red wolf as a long shot in their rejections of the delisting petitions, that may not actually be the case. FWS has recognized instances where mixing of species warranted

90. Dan Dewitt, *This is a Death Sentence for Red Wolves*, BLUE RIDGE OUTDOORS (Aug. 30, 2018), https://perma.cc/Y4QJ-YNZK.

91. *Id.*

92. Finding on Petition to Delist the Red Wolf, 57 Fed. Reg. 1211, 1246 (Jan. 13, 1992); Finding on Petition to Delist the Red Wolf, 62 Fed. Reg. 64,799 (Dec. 9, 1997) (to be codified at 50 C.F.R. pt. 17).

93. Finding on Petition to Delist the Red Wolf, 57 Fed. Reg. at 1246; Finding on Petition to Delist the Red Wolf, 62 Fed Reg. at 64,799.

94. Finding on Petition to Delist the Red Wolf, 57 Fed. Reg. at 1246; Finding on Petition to Delist the Red Wolf, 62 Fed Reg. at 64,799 (petition submitted by the American Sheep Industry Association).

95. Finding on Petition to Delist the Red Wolf, 57 Fed. Reg. at 1246.

96. *Id.*

97. *Id.*

98. *Id.*

99. *Id.*

100. Finding on Petition to Delist the Red Wolf, 62 Fed. Reg. 64,799 (Dec. 9, 1997) (to be codified at 50 C.F.R. pt. 17).

delisting because the genetic material of the endangered species was "irretrievably mixed with that of another species."[101] For example, in 1987 FWS removed the Amistad gambusia, an endangered fish, from the endangered species list because it went extinct.[102] Its extinction was partially due to hybridization with the mosquitofish.[103]

Unlike the Amistad gambusia, there are many red wolves in captivity that maintain a purer stock of red wolf DNA than the hybridizing experimental population in eastern North Carolina.[104] While this appears to distinguish the plight of the red wolves from the now extinct Amistad gambusia, efforts continue to analyze red wolf ancestry to convince FWS that red wolves should be delisted. Local ranching interests in eastern North Carolina persistently push their agenda to eliminate the nonessential experimental population and seek to establish that the red wolf is not a taxonomically valid species in order to pressure FWS to delist it.[105] To this end, Congress funded a nine-member committee in March of 2018 to reexamine the taxonomic status of the red wolf.[106]

The final peer-reviewed report, published by The National Academies of Sciences, Engineering, and Medicine, concluded the red wolf was a valid taxonomic species.[107] While there was historically some hybridization between red wolves, gray wolves, and coyotes, each group retained unique morphological characteristics that justified identification as separate species.[108] Although there is no available ancient red wolf DNA to compare with modern red wolf DNA, an examination of ancient red wolf skeletal remains, particularly dental structures, compared to modern red wolves reveals enough similarities to conclude modern and ancient red wolves are the same species.[109]

This report grants more legitimacy to the red wolf's listing as an endangered species. However, the report cautions that if genomic data

101. Proposed Policy and Proposed Rule on the Treatment of Intercrosses and Intercross Progeny (the Issue of ''Hybridization''), 61 Fed. Reg. 4710 (proposed Feb. 7, 1996) (to be codified at 50 C.F.R. pt. 424).

102. Removal of Gambusia Amistadensis, the Amistad Gambusia From the List of Endangered Wildlife, 52 Fed. Reg. 46,083 (Dec. 4, 1987) (to be codified at 50 C.F.R. pt. 17).

103. *Id.*

104. Michael Doyle, *Wolf Debate Heats Up*, GREENWIRE (Mar. 20, 2019), https://perma.cc/5E8S-628X.

105. *Id.*

106. Doyle, *supra* note 104.

107. THE NAT'L ACADEMIES OF SCIS., ENG'G, AND MED., EVALUATING THE TAXONOMIC STATUS OF THE MEXICAN GRAY WOLF AND THE RED WOLF 1, 4 (Nat'l Academies Press 2019).

108. *Id. at* 7.

109. *Id. at* 63.

from ancient red wolf specimens becomes available, the report's conclusions could change.[110] Furthermore, if the experimental population continues to interbreed with coyotes despite efforts to reduce breeding opportunities between coyotes and red wolves, the experimental population may become extinct just like the Amistad gambusia. While there remains a robust captive red wolf population, FWS could choose to stop investing resources to maintain a captive population if there is no hope for providing a natural habitat for them where they will not be wiped out through interbreeding with coyotes. While the ESA demands conservation of endangered species at all costs,[111] ex-situ preservation in perpetuity defeats the purpose of the ESA. Preserving a species for its own sake ex-situ may be noble, however wolves serve an important niche in the environment which they cannot fulfill in a zoo.

While the recognition of red wolves as a valid taxonomic species and the existence of the captive population may thwart delisting efforts, establishing stable populations that can resist hybridization threats is essential to both the survival of wildlife threatened by hybridization and to increasing biodiversity. Certainly, there is not enough room in all the zoos in the U.S. to house the creatures that will be threatened by hybridization in the future as climate change progresses and humans continue to modify habitats. Ex-situ conservation methods are also likely to be more expensive and resource intensive than in-situ strategies. Collecting animals from the wild, developing methods of care and monitoring them daily, and giving them ample room to maintain their health and well-being are certainly not cheap or quick endeavors.

The solution may lie with in-situ conservation strategies tailored to hybridizing species and encapsulated within critical habitat designations and recovery plans.

B. Critical Habitat

There is no critical habitat designation for red wolves.[112] This is likely because red wolves were listed under the predecessor to the ESA, the Endangered Species Preservation Act, and the requirement to concurrently designate critical habitat at the same time as listing a species was not yet

110. *Id. at* 61.

111. Tenn. Valley Auth. v. Hill, 437 U.S. 153, 184 (1978) ("The plain intent of Congress in enacting this statute was to halt and reverse the trend toward species extinction, whatever the cost."); *see also* Endangered Species Act, 16 U.S.C. § 1531(b) (2019).

112. *See generally Red Wolf*, U.S. FISH & WILDLIFE SERV., https://perma.cc/9G4V-RSPR (last visited Mar. 30, 2020).

law.[113] Furthermore, by the time the ESA was passed, FWS determined the population of red wolves in the wild was too small to be sustainable and captured every wild red wolf they could locate.[114] Although the red wolf was biologically extinct in the wild by 1980, FWS maintained the status of the red wolf as endangered.[115] With no wild population, the exercise of designating a critical habitat may have been a meaningless endeavor. Furthermore, the ESA prohibits designating a critical habitat for nonessential experimental populations.[116]

The original range of the red wolf extended throughout the southeastern United states.[117] Red wolves were captured from Texas and Louisiana to begin the captive breeding program.[118] FWS selected the Alligator River National Wildlife Refuge ("the Refuge") in eastern North Carolina to release a nonessential experimental population of captively bred red wolves.[119] The Refuge was selected because it had abundant small mammals, such as rabbits and possums, which are the wolves' main food source.[120] FWS posited that the wolves would not pose a threat to any nearby livestock because there was plenty of natural prey for them to consume.[121] The Refuge also provided dense cover where the wolves could easily den and covered an expansive, isolated region where FWS calculated human interference would be low.[122]

While the Alligator River National Wildlife Refuge is geographically isolated, it is surrounded by ranch land in nearby Hyde and Dare counties.[123] This poses two threats to the red wolves. First, it creates opportunities for red wolf confrontations with livestock and ranchers when red wolves naturally explore nearby land. This is evidenced by many killings of red wolves on private ranch land, where ranchers either claim they or their livestock were threatened by red wolves.[124] At times, the county ordinances themselves defied the federal regulations in the ESA

113. Endangered Species Preservation Act of 1966, Pub. L. No. 89-669, 80 Stat. 926 (repealed 1973).

114. Proposed Determination of Experimental Population Status for Red Wolves in North Carolina, 51 Fed. Reg. 26,564 (July 24, 1986).

115. *See generally Red Wolf*, *supra* note 112.

116. Endangered Species Act § 10, 16 U.S.C. § 1539(j)(2)(C)(ii) (2019).

117. *Red Wolf*, *supra* note 112.

118. *Id.*

119. Proposed Determination of Experimental Population Status for Red Wolves in North Carolina, 51 Fed. Reg. at 26,564.

120. *Id.*

121. *Id.*

122. *Id.*

123. *Red Wolf*, *supra* note 112 (Red Wolf Current and Proposed NC Non-essential Experimental Population Map).

124. Dewitt, *supra* note 90.

prohibiting take.[125] Second, this invites coyotes into the Refuge. Coyotes once inhabited primarily the western United States and began migrating eastward when habitats across the United States were modified to create room for new agricultural lands, ranch lands, and development.[126] Coyotes prefer vast open spaces to traverse, and thus the open ranch space around the red wolves' refuge serves as a doorway to invite coyotes into a new habitat.[127]

While confrontations with livestock owners can be managed by enforcing federal prohibitions on take, threats from hybridization with coyotes demand a more nuanced approach. Nowhere in the regulations explaining why the Refuge was selected as the ideal place for the introduction of red wolves did FWS consider the presence or density of coyotes in the area. In the future, FWS must take into account the presence of potential hybridizers, the density of their population in the area, and the likelihood they will be enticed to travel to the area due to habitat modifications through agricultural land, ranch land, or climate change.

The Refuge may have been the best suited habitat for the red wolves, but it is also possible that there is a different location within their historical southeastern range which contained similar benefits of isolation from humans and a contiguous area for them to roam, yet fewer coyotes.

If FWS continues to ignore the presence of hybridizers in the future, the likelihood that newly hybridizing species will survive will certainly diminish. Hybridization is a unique threat that demands an analysis of the potential impacts of another population of interbreeding organisms' behaviors and territory be evaluated.

C. Recovery Plan

The original red wolf recovery plan extensively discusses the threat coyotes pose to the red wolves through hybridization.[128] In fact, hybridization was one of the leading causes behind the extinction of red wolves in the wild.[129] Nevertheless, the original recovery plan did not call for the implementation of any effective strategies to curtail the coyote population in the experimental population's habitat in eastern North Carolina.[130] Instead, it cites to previous efforts to kill coyotes in red wolf habitat with approval.[131]

125. *Id.*
126. Winkler, *supra* note 74.
127. *Id.*
128. U.S. FISH & WILDLIFE SERV., RED WOLF RECOVERY PLAN (1989), https://perma.cc/WH23-LR36.
129. *Id.* at 9–11.
130. *Id*. at 11.
131. *Id.*

Killing coyotes is an ineffective mechanism to prevent coyote and red wolf interbreeding.[132] Once a coyote is killed, other coyotes will simply migrate into the deceased coyote's territory.[133] This can exacerbate the problems for both hybridization and ranchers because now several coyotes may be competing for the territory of the deceased coyote, temporarily increasing the coyote population in the area.[134] Ironically, ranchers who think they are killing pests that threaten their livestock end up inadvertently inviting more coyotes onto their land.[135] The only proven method for preventing hybridization between coyote and red wolf populations, and avoiding a short-term spike in coyote population in the area, is to sterilize coyotes.[136]

Sterilized coyotes will continue to mate and occupy their territory, but are unable to produce offspring. The longer the coyote lives, the more time the red wolves in the area will have to produce offspring with one another without intermixing their genetics with coyotes. Sterilization of coyotes in red wolf habitat would need to occur at regular intervals until the red wolf population was robust enough to out-compete coyotes and to ensure occasional interbreeding would not threaten the genetic heritage of the red wolf population. This essentially translates to ensuring the population of red wolves in an area is much greater than the population of coyotes. Furthermore, coupling this sterilization strategy with other strategies to deter additional coyotes from migrating to the area, such as reducing nearby unnatural open fields (which serve as a land bridge for coyotes to migrate into new areas), will ensure the red wolf population has a chance to reach a sustainable level.

It was not until the 2000s that FWS finally adopted a sterilization plan for coyotes in red wolf habitat.[137] This strategy proved effective in practice for many years as the sterilized coyotes served as "placeholders" in the habitat until they were displaced by the growing red wolf population.[138] Modeling showed that if this adaptive management strategy continued for sixty years the red wolf population would contain 99% red wolf genes.[139]

However, in the 2018 Red Wolf Species Status Report, FWS describes how red wolf population numbers have plummeted in recent

132. Megan M Draheim, *Why Killing Coyotes Doesn't Make Livestock Safer*, SCI. AM. (May 31, 2017), https://perma.cc/7W8F-KP92.

133. *Id.*

134. *Id.*

135. Draheim, *supra* note 132.

136. U.S. FISH & WILDLIFE SERV., RED WOLF 5-YEAR STATUS REVIEW 11 (2007), https://perma.cc/2CDH-BFUW.

137. U.S. FISH & WILDLIFE SERV., *supra* note 136.

138. *Id.*

139. *Id.*

years, despite the successful coyote sterilization strategy.[140] When red wolves mate they form a breeding pair for life.[141] However, with the rise of gunshot deaths of red wolves in recent years, due to the failure of the federal, state, and local governments to enforce takings prohibitions, when one member of a red wolf breeding pair is killed it is difficult for the surviving member to find a nearby red wolf to form a new bonded pair.[142] Instead, red wolves are creating mating pairs with the more numerous coyotes in the region, which further exacerbates the issue.[143] If the coyote replacing the deceased member of the breeding pair is not sterilized, then the pair is likely to create hybridized offspring.[144] However, if the coyote is sterile, then that breeding pair will produce no hybridized offspring, yet this also eliminates that red wolf's capacity to contribute to the red wolf population because of its tendency to form long-term partnerships with its mate.[145] When red wolves are released from the captive breeding program into the Refuge, they are released as a breeding pair in order to avoid the potential for the wolf to partner with an available coyote.[146] Thus, even an effective sterilization strategy is not enough to help a species threatened with hybridization to recover when they continue to try to mate with other species due to dwindling population numbers from outside factors.

While the FWS did eventually implement an effective strategy for addressing the threat hybridization posed to red wolves, if they had formal guidance on addressing threats to hybridizing species, these strategies could have been implemented decades earlier. FWS's wait-and-see approach revealed in their initial recovery plan's objective to determine the extent of interbreeding before acting, was unwise given the evidence, delineated in the same report, of the long history of interbreeding between the two species. While it is true some naturally hybridizing species create a more robust population better adapted to their environment, hybridization between coyotes and red wolves is essentially a death sentence for the red wolf species because they are vastly outnumbered by coyotes. Eliminating wolves from an environment and replacing them with coyotes will not serve the ecosystem in the same manner because wolves consumer more prey than coyotes due to their larger size.[147]

140. U.S. FISH & WILDLIFE SERV., RED WOLF SPECIES STATUS ASSESSMENT (2018), https://perma.cc/2FDE-WGKV.

141. *Id.* at 19.

142. *Id.* at 36.

143. U.S. FISH & WILDLIFE SERV., *supra* note 140, at 37.

144. U.S. FISH & WILDLIFE SERV., *supra* note 140.

145. *Id.*

146. *Id.*

147. *See* Kyle Waggener, *What is the Difference Between Red Wolves and Coyotes*, TIMBER WOLF INFO. NETWORK, https://perma.cc/NZV8-K9SH. (last visited Mar. 30, 2020)

A strategy to curb hybridization is essential to the survival of an endangered species susceptible to hybridization, however it must be paired with other effective and enforceable strategies that prevent the unnecessary loss of species members. Even attempts to hybridize with sterilized members of another population can be detrimental to the population as a whole when it removes that creature from the mating pool.

Recommendations to Issue Guidance on Recovery Plans and Critical Habitat Designations for Species Threatened by Hybridization

Under ESA section 4(h), the Secretary must publish agency guidelines to ensure the purpose behind each element of the ESA is achieved.[148] This includes criteria for listing and a system for developing and implementing recovery plans.[149] Current published guidelines only address hybridization as a tool to save inbred populations from extinction.[150] There are no published guidelines on hybridization as a threat to a species existence and a catalyst for extinction. Listed species that are susceptible to hybridization face unique threats that must be strategically addressed to ensure not only the continuation of that species, but the continuation of a robust population capable of fulfilling an important role in its ecosystem.

Although, as attempts to delist the red wolf demonstrate, having a captive population can prevent a species from becoming delisted even if the wild population hybridizes to extinction, ex-situ conservation strategies are not sustainable options for every species. Furthermore, the number of hybridizing species is likely to drastically increase as climate change advances. Effective in-situ conservation strategies modeled on new FWS department guidance will help FWS to quickly and effectively address threats to endangered and threatened species from hybridization.

A. Critical Habitat Guidelines

When selecting critical habitat for a listed species FWS should carefully evaluate the presence of potential hybridizers in the environment. FWS should determine whether any genetic cousins are present and, if they are, measure the density of the population. These steps are essential to prevent genetic swamping of the listed species. When habitat for both

("Coyotes usually weigh between 25 and 35 pounds while Red Wolves usually weigh between 50 and 80 pounds.").

148. Endangered Species Act § 4, 16 U.S.C. § 1533(h) (2019).

149. *Id.*

150. Policy Regarding Controlled Propagation of Species Listed Under the Endangered Species Act, 65 Fed. Reg. 56,916 (proposed Sept. 20, 2000).

species is limited, the slight overlap of their habitats will not necessarily drive one into extinction if they do hybridize. If only a portion of each of their ranges overlaps, the overlapping population can create a stable hybrid group that does not impede the genetic purity of either species.[151]

When there are multiple options for where critical habitat can be designated, FWS should select an area where the two populations will not overlap or will overlap the least. At a bare minimum, an area with a lower density of hybridizers than other potential habitats should be selected.

While other factors are important to the selection of a listed species' critical habitat, including the availability of their food source, ability to find shelter, and isolation from human interference, selecting an area that will minimize interactions between potential hybridizers may be key to the survival of the species. If hybridizers are present and begin to interbreed with the less populous endangered or threatened species, it is only a matter of time before the listed species goes extinct without ex-situ conservation interventions. If the threat of hybridization is not addressed when selecting a critical habitat, a species may be on the path to extinction regardless of how suitable the habitat may otherwise be to their needs.

Unfortunately, FWS did not consider the density of the coyote population in the Refuge before it reintroduced red wolves into the area. While it may have been the area with the least dense coyote population, it is possible there was a more suitable habitat that would have given the wolves a better shot at creating a sustainable population because the threat posed by interbreeding was lessened.

B. Recovery Plan Guidelines

When FWS develops recovery plans, it should directly address the threat that hybridization poses to the listed species by ensuring an unlisted hybridizer is culled, sterilized, or relocated. The proper approach to containing the population of an unlisted hybridizer will vary depending on how the two populations interact with each other and the environment. FWS should retain the flexibility to implement the approach best suited to each situation, however it should take action to prevent hybridization and not adopt a wait-and-see approach as it initially did with the red wolves. By the time the FWS determines whether the hybrid offspring are better suited to the environment and ecosystem than their parents, it may be too late to undo the negative effects of hybridization on the listed species. Especially when the ultimate outcome is a hybrid offspring that does not fill the same necessary niche in the ecosystem as the listed parent.

Additionally, if FWS determines sterilization of the unlisted hybridizer is the best strategy, it should implement additional measures to

151. Todesco et al., *supra* note 2.

prevent prolonged mating between the listed species and sterilized individuals. While attempts to breed between the listed species and a sterilized hybridizer will not result in offspring, repeated mating between the two may prevent the listed species from introducing their genetic diversity into the listed species' population and could result in fewer listed species offspring. This could significantly prolong the effort to help the species recover.

FWS did release captive red wolves into the Refuge in breeding pairs to encourage them to create offspring to help the population recovery.[152] However, when one member of the pair died, often prematurely due to rancher's efforts to eradicate them from neighboring private land, there were many instances in which the remaining member of the breeding pair formed a new pair with a sterilized coyote.[153] Active management to prevent untimely deaths of the listed species and additional measures to intervene when a sterilized hybridizer forms a pair with the listed species are essential to ensuring the listed population continues to grow.

Conclusion

The ESA provides sufficient legal authority for FWS to protect hybridizing endangered and threatened species, however the FWS needs guidance on how to establish critical habitat and create recovery plans that will help these species recover. FWS should designate critical habitat that minimizes range overlap between endangered or threatened species and other populations with which they could hybridize. FWS should also ensure recovery plans include specific and tailored measures to minimize hybridization, including sterilization, culling, or relocation of the population that is not threatened. Climate change and continued human interference in natural ecosystems are likely to put additional endangered and threatened species at risk of hybridization by catalyzing species migration and removing natural ecological barriers that once separated distinctly evolving populations. Nevertheless, when two hybridizing populations are both listed species, or when the only remaining suitable habitat necessarily overlaps for both populations, the tools within the ESA may not be enough to ensure a population's survival.

152. U.S. FISH & WILDLIFE SERV., *supra* note 136.
153. U.S. FISH & WILDLIFE SERV., *supra* note 140.