POLICY PERSPECTIVE

Connectivity conservation and endangered species recovery: a study in the challenges of defining conservation-reliant species

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Abstract

Many species listed under the US Endangered Species Act (ESA) face continuing threats and will require intervention to address those threats for decades. These species, which have been termed conservation-reliant, pose a challenge to the ESA's mandate for recovery of self-sustaining populations. Most references to conservation-reliant species by federal agencies involve the restoration of population connectivity. However, the diverse threats to connectivity faced by different species have contrasting implications in the context of the ESA's mandate. For species facing long-term threats from invasive species or climate change, restoration of natural dispersal may not be technically feasible in the foreseeable future. For other species, restoration of natural dispersal is feasible, but carries economic and political cost. Federal agencies have used a broad definition of conservation reliance to justify delisting of species in the latter group even if they remain dependent on artificial translocation. Distinguishing the two groups better informs policy by distinguishing the technical challenges posed by novel ecological stressors from normative questions such as the price society is willing to pay to protect biodiversity, and the degree to which we should grow accustomed to direct human intervention in species' life cycles as a component of conservation in the Anthropocene Epoch.

Introduction

The US Endangered Species Act (ESA) is among the world's most far-reaching and influential biodiversity protection statutes (Taylor *et al*. 2005). Listing of species as threatened or endangered under the ESA is designed to trigger an array of federal regulatory provisions that protect both the species and its habitat. Congress intended that these legal tools would reduce threats and allow a species' status to improve "to the point at which the measures provided pursuant to this Act are no longer necessary" (16 U.S.C. §1532 [3]). The species would then be removed from the ESA's list of threatened and endangered species (delisted) and primary management responsibility returned to the states.

Many of the first species to be delisted, such as the peregrine falcon (*Falco peregrinus*) and brown pelican (*Pelecanus occidentalis*), fit this pattern. These species were primarily threatened by pesticide pollutants that could be comprehensively addressed by new federal regulations. In contrast, many currently listed species face ecologically complex threats that are less amenable to regulatory remedy (Doremus & Pagel 2001). For example, as human landuse fragments natural habitats, many species have experienced a reduction in population connectivity (Soulé & Terborgh 1999). Connectivity is important to recovery because it may enhance demographic and genetic flows that support persistence of peripheral populations and long-term maintenance of a species' evolutionary potential (Lowe & Allendorf 2010).

Recovery efforts often seek to restore connectivity between core habitat areas by means of habitat restoration or restrictions on overexploitation in areas used for dispersal. This approach, because it can result in long-term amelioration in threats, is analogous to the falcon and pelican examples in fitting within the delisting framework envisioned under the ESA. Alternately, translocation (capture, transport, and release of individuals) offers an option for avoiding the socioeconomic costs of restoring connectivity in the landscape matrix where wildlife must coexist with human landuses. Such a translocation-based strategy does not create self-sustaining populations but rather relies on long-term intensive management to counteract the effect of connectivity loss on species viability. Such intensive management is a common approach for species, while they are listed as endangered or threatened (USFWS 2003, 2010). The question of whether a species can be delisted, while still dependent on such intensive management has proved more controversial.

Recent reviews have posited that most listed taxa are "conservation-reliant species" (CRS) because "preventing delisted species from again being at risk of extinction may require continuing, species-specific management" into the future (Scott *et al*. 2005, see also Scott *et al*. 2010 and Goble *et al*. 2012). The U.S. Fish and Wildlife Service (FWS) has employed the concept of CRS to justify delisting of species that still require direct manipulation of their populations to maintain a biologically secure status. This issue has most often arisen in the context of population connectivity; four of the five references to CRS in recovery planning and delisting documents have invoked CRS to justify delisting species that still require artificial translocation to maintain connectivity (Supplementary Information S3).

The question of whether delisting such species is appropriate as a legal and policy matter has received little scrutiny. In aggregate, decisions on when to delist species have far-reaching implications for the ultimate status of biodiversity. Such decisions also touch on the broader issue of whether society should grow accustomed to direct human intervention in ecosystems and species' life cycles as a necessary component of conservation in what has been termed the Anthropocene Epoch (Kareiva *et al*. 2012). The relevance of this broader question is not limited to the U.S. context. For example, Australia's endangered species listing framework follows that of the International Union for Conservation of Nature (IUCN) in defining a "conservation dependent species" as one which is the focus of a species-specific conservation measures, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years (IUCN 2013).

In this article, we first review the limited guidance provided by the ESA and subsequent case law on the question of what level of connectivity restoration is appropriate before a species is delisted. We then consider examples from a range of listed species to discover commonalities that can clarify key policy questions regarding connectivity restoration for endangered species.

The legal context of conservation reliance and connectivity

The language of the ESA and much subsequent agency practice emphasize an overarching goal of recovery of species and ecosystems in the wild (16 U.S.C. §1531 [a][3], see Supporting Information S1 for references to a goal of self-sustaining populations in recovery plans). In the 2009 case *Trout Unlimited v. Lohn* (559 F.3d 946, 9th Cir. 2009), the court cited both the ESA's preamble and the act's legislative history in concluding that "the ESA's primary goal is to preserve the ability of natural populations to survive in the wild." However, the relatively few court cases that have addressed this issue have not established clear precedent as to if and when exceptions can be made so that species can be delisted while still dependent on translocation. The most relevant case involves a 2007 U.S. FWS proposal to delist the Yellowstone grizzly bear (*Ursus arctos*), a carnivore with relatively limited dispersal range (Proctor *et al*. 2004; see Supporting Information S2 for additional information on species referenced in the text). FWS asserted that the Yellowstone grizzly bear is a conservation-reliant species because it requires active management (72 FR [Federal Register] 14987; see also Supporting Information S3 for a list of uses of "conservation-reliant species" in agency documents). FWS then relied on the CRS label to justify translocation of bears if efforts to reestablish natural connectivity between Yellowstone and more northerly bear populations were unsuccessful (72 FR 14896). The delisting rule was challenged in part over its potential future dependence on translocation. Although the rule was vacated on other grounds, the Montana District Court noted that "the concerns about long-term genetic diversity" (i.e., the need for translocation) did not warrant continued listing. It is unclear whether the court reached this conclusion because genetic concerns could be satisfactorily resolved by translocation following delisting, or simply because genetic concerns would not manifest within the "foreseeable future." The Services' (FWS and National Marine Fisheries Service) currently define the "foreseeable future" as extending as far into the future as predictions based on best available data can provide a reasonable degree of confidence (USDI 2009).

This definition, although not excluding consideration of long-term genetic threats, in practice allows wide latitude to the Services on whether to address such issues.

Unlike the grizzly bear, the gray wolf (*Canis lupus*) can disperse long distances (>800 km; Boyd *et al.* 1995). Although successful reintroductions in the mid-1990s led by 2005 to abundant wolf populations in the northern Rocky Mountains, delisting of the species was delayed in Wyoming, in part because the state's wolf management plan provided the species protection from overexploitation in only a small portion of the state. To ensure adequate dispersal between Yellowstone and other wolf populations, Wyoming subsequently agreed that wolves would receive more protection during peak dispersal season in limited areas. However, environmental groups sued to block the wolf delisting rule, in part because the state could resort to translocation if sufficient natural dispersal does not occur (77 FR 55530).

FWS referenced conservation reliance several times in rulemaking processes regarding wolves (Supplementary Information S3). Initially, the proposed delisting rule for wolves in the northern Rocky Mountains asserted that "[h]uman intervention in maintaining recovered populations is necessary for many conservation-reliant species and a well-accepted practice in dealing with population concerns (Scott *et al*. 2005)" (74 FR 15178, 76 FR 61816). In response to critical public comments, the FWS qualified and seemingly contradicted its earlier assertion by stating that the northern Rocky Mountain wolf population is "not expected to need or rely on human-assisted migration often, if ever, and these populations will not become "conservation-reliant" as defined by Scott *et al.* (2005, entire)" (77 FR 55565).

FWS's treatment of connectivity requirements in wolf populations contrasts with its consideration of connectivity for the wolverine (*Gulo gulo*), a carnivore species inhabiting the northern Rocky Mountains with dispersal abilities similar to the wolf (>500 km, Flagstad *et al.* 2004). In a recent draft proposal to list the wolverine as a threatened species, FWS found loss of natural connectivity a primary reason the species merited listing (78 FR 7886). Whereas for wolves, translocation was judged as consistent with delisted status, FWS found the need for such action warrants listing of wolverines as threatened.

The influence of ecological factors on a species' connectivity requirements

Ecological factors such a species' mating system, magnitude of population fluctuations, and migratory behavior (Table 1) affect the level of connectivity required for recovery. The most commonly proposed rule of thumb for connectivity suggests that at least one genetically effective migrant (but in some cases >10 migrants; Vucetich & Waite 2000) per generation into a population is necessary to minimize loss of polymorphism and heterozygosity (Allendorf 1983; Table 1, column 1). If the species' mating system causes individuals to have widely varying reproductive contributions, many individual "census migrants" are required to ensure that one migrant is genetically effective (produces at least one offspring in the recipient population) (Table 1, column 2). For example, among gray wolves, only a single pair of dominant individuals typically breeds within each pack.

The magnitude of population fluctuations experienced by a population also affects the role of connectivity in ensuring persistence. Invertebrates, such as the Karner blue (*Lycaeides melissa samuelis*) and Fender's blue butterfly (*Icaricia icaroides fenderi*), typically have short generation times and highly variable population sizes (USFWS 2003, 2010). This causes population connectivity in the form of demographic rescue (Brown & Kodric-Brown 1977) to be critical if the overall metapopulation is to persist in a dynamic natural environment (Table 1, column 3). Lastly, a species' migratory behavior may imply that a large proportion of population must successfully move between areas on an annual or generational basis (Table 1, column 4). For example, Pacific salmon from the Columbia River spend 3–4 years in the ocean, so up to a third of the adult cohort must return to the natal river each year.

We classified species (Table 1) by these three ecological factors and by whether connectivity restoration could be achieved by one-time measures (e.g., dam removal or operational changes) or necessitated continued intervention (e.g., invasive species control). Species affected by more than one factor (e.g., species with varying reproductive contributions inhabiting fluctuating environments) are categorized based on the factor imposing the highest connectivity requirements.

Lack of connectivity is an immediate demographic threat to migratory species such as Columbia River Pacific salmon. Recovery plans for species in this group (cell with horizontal line background; Table 1) propose translocation as necessary both before and after delisting, and do not include recovery actions that would restore natural migration. Although it is technically feasible to remove or mitigate barriers to migration such as hydroelectric dams, there are often enormous economic and legal impediments to doing so. Proposals to delist such species as dependent on translocation in perpetuity are in effect proposals to reconsider the ESA's normative assumption concerning the value society places on recovery of wild, self-sustaining populations.

Table 1 Categorization of species discussed in text in terms of degree of population connectivity (i.e., dispersal rate) required for recovery and socioeconomic cost required to restore connectivity. Species affected by more than one ecological factor are categorized based on the factor imposing the highest connectivity requirements

	Degree of connectivity required for recovery, due to life history or ecological factors			
Type of intervention necessary to restore connectivity	1. Lowest—One to several genetically effective migrants per generation	2. Low—Genetically effective migration where individuals have highly varying reproductive contribution	3. Medium—Demographic rescue due to variable population size	4. High—Migratory populations
One-time intervention (dam removal, habitat restoration, and regulatory remedy)	**Grizzly bear** **Concho water snake**	**Gray wolf** **Red-cockaded woodpecker**	**Fender's blue butterfly** **Karner blue butterfly**	**Columbia river salmon**
Continuing intervention (augmentation, translocation, control of invasive species)	**Wolverine** **Many species due to climate change**	**Southern Idaho ground squirrel** **Greater sage grouse**	**Black-footed ferret**	**Peary caribou**

A second group of species (cells with vertical line background; Table 1) may be nonmigratory, but nonetheless face long-term genetic threats from loss of connectivity. With the exception of reintroductions needed to restore extirpated populations, recovery plans for these species typically do not specify translocation prior to delisting but acknowledge that translocation may be necessary in the future if adequate genetic diversity is not present. Recovery plans may choose not to include recovery actions designed to reestablish natural dispersal because of significant societal opposition to the species' presence in dispersal zones (wolves and grizzly bears) or because of the economic costs of removing barriers to natural dispersal (Concho water snake [*Nerodia paucimaculata*]; USFWS 1993).

In the examples discussed above, connectivity restoration can be achieved via controversial or costly—but technically feasible—actions such as dam modification or removal, or via restrictions on overexploitation in habitat important for natural migration. For a final category of species (cells with gray background; Table 1), loss of historic levels of population connectivity is due to threats (e.g., invasive species, altered disturbance regimes, or climate change) that are extraordinarily challenging or impossible to fully remedy given current technical knowledge. For example, invasive species may operate synergistically with altered disturbance regimes to degrade an ecosystem to the point where restoration to the previous state may become difficult or impossible (Suding *et al*. 2004). In large portions of the western United States, sagebrush (*Artemisia* spp.) has been replaced by cheat grass (*Bromus tectorum*), an exotic annual bunchgrass. This trend, in turn, may trigger a shift toward more frequent fires that inhibit sagebrush recovery and limit dispersal of sagebrush-associated species such as the southern Idaho ground squirrel (*Spermophilus brunneus endemicus*) and greater sage grouse (*Centrocercus urophasianus*) (Knick *et al*. 2003). Climate change is projected to cause contraction or shifts in suitable habitat for a large proportion of the world's species (Thomas *et al*. 2004). For example, wolverines are threatened by loss of natural connectivity as climate change causes loss of their habitat, which is associated with snow-covered areas (78 FR 7886).

Discussion

Based on a review of recovery plans for a range of species (Table 1 and Table S2), we conclude that three contrasting types of challenges confront efforts to restore connectivity between populations of listed species: 1) threats that society avoids addressing because of the socioeconomic costs of doing so, 2) threats that society avoids addressing because they are not immediate, and 3) threats for which there is no permanent resolution at any cost given current technical knowledge. Distinguishing species affected by these three classes of threats is important because it allows us to distinguish normative questions from the technical obstacles to maintaining a self-sufficient population of a species that arise from the ecological attributes of a species and its stressors. These normative questions include both economic elements (what price society is willing to pay to protect biodiversity and how future risks are weighed against current costs), and ethical elements such as whether humans have an obligation to prevent species extinction (Callicott 2009).

As the Services attempt recovery of controversial and formerly widely distributed species such as gray wolves (Bruskotter *et al.* 2013), the agencies have gradually decreased their focus on recovering self-sustaining populations, a shift justified in some instances by reference to a broad definition of conservation-reliant species (74 FR 15178). This is consistent with reviews that found that most (Scott *et al.* 2010) or all (Goble *et al.* 2012) listed species fit the definition of conservation-reliant. Scott *et al.* (2010) classified most listed species as conservation-reliant in part because they included species requiring any of several types of ongoing conservation action, including efforts to 1) control other species, 2) control pollutants, 3) manage habitat, 4) control exploitation or human access, or 5) augment populations. However, these five types of actions have contrasting implications as to whether a species' status is self-sustaining in light of the ESA's mandate. The ESA anticipated that new regulations would be necessary to remedy threats such as overexploitation and pollutants, even for otherwise self-sustaining populations (Rohlf *et al.* in press). Similarly, because the continued persistence of almost all species requires regulatory limitations on human actions that destroy their habitat, the need for such protections should not preclude considering a population as self-sustaining. In contrast, a species that requires repeated population augmentation or intensive control of invasive competitor or predator species or disease does conflict with the paradigm of listing as a temporary stage followed by recovery of self-sustaining populations.

We agree with Scott *et al.* (2010) that conservation reliance is "a continuum encompassing different degrees of management," and acknowledge that some examples straddle the border between species that are or are not potentially self-sustaining in the wild. For example, although delisted populations of Karner blue and Fender's blue butterfly may not be dependent on translocation, they will require continued prescribed fire or fire surrogates to maintain suitable habitat. Because prescribed burning might not be necessary if conservation areas were sufficiently large to accommodate natural disturbance regimes (Pickett & Thompson 1978), such populations could become self-sustaining in the absence of humans. In most landscapes, however, disruption of natural disturbance processes can be remedied only by continued intervention to maintain fire-dependent ecosystems. Because prescribed fire is typically not a "species-specific" intervention (as specified in Scott *et al.* 2005's definition of CRS), but rather an ecosystem restoration tool, it is consistent with the ESA's mandate for conserving the ecosystems upon which listed species depend.

When the Services interpret the ESA's mandate using a definition of conservation-reliant species that include most or all listed species, they presuppose that costly or politically difficult obstacles to a species' self-sufficiency need not be fully addressed to delist species if these species could be secure given continued intensive management. Removing self-sufficiency from the threshold for considering a species recovered has several undesirable consequences. If natural dispersal is achievable (e.g., for highly vagile species such as the gray wolf or wolverine), delisting of populations still dependent on translocation rather than natural dispersal lowers the likelihood that delisted populations will meet other common recovery standards such as resiliency, redundancy, and representation (Shaffer & Stein 2000). Populations that require intensive management actions such as translocation by definition have lower resilience than those that are self-sustaining without such measures (Redford *et al.* 2011). Conversely, broad-scale connectivity is likely to increase the resilience of species to climate change by increasing adaptive potential (Lowe & Allendorf 2010).

The ESA of 1973 went beyond previous versions of the act in extending legal protections to vertebrate species facing extinction in only a portion of their range (Carroll *et al.* 2010). This had the overall effect of raising the threshold for recovery away from the earlier focus on preserving relict populations toward a more ambitious goal of geographically widespread recovery of self-sustaining populations and the ecosystems on which species depend. Species that are well-distributed outside of core habitat (e.g., in dispersal corridors) are more likely to achieve the representation goals suggested by the ESA's protection for species imperiled in a "significant portion of [their] range" (Carroll *et al.* 2010).

We advocate use of a narrower and more explicit definition of conservation reliant species, which would be limited to those species that lack the ability to persist in the wild in the absence of direct and ongoing human manipulation of individuals or their environment (Rohlf *et al.* in press). This definition distinguishes those species which would persist and even thrive if humans were to vanish from the landscape (e.g., gray wolf) from those whose only hope of persistence lies in human intervention (e.g., black-footed ferret threatened by introduced plague).

The complex question of whether species permanently threatened by invasives, altered disturbance regimes, and climate change should be eventually delisted or remain under long-term federal management involves both normative and technical issues. Ultimately, resolution of the normative issues hinges on resolving contrasting visions of the meaning of ecological recovery in the Anthropocene Epoch. A definition of conservation-reliant species that clearly distinguishes technical from values-based judgments will allow society to better address the normative debate over what cost should be borne to protect biodiversity, while separately addressing the urgent biological challenges that novel stressors such as climate change and invasive species pose for ecosystem and species restoration.

Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web site:

S1. Examples of references to the goal of self-sustaining populations in recovery planning documents.

S2. Table of attributes of species mentioned in text that provide examples of consideration of connectivity in recovery planning.

S3. Use of the term "conservation-reliant species" by the US Fish and Wildlife Service in recovery and delisting documents.

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Supplementary Information S1. Examples of references to the goal of self-sustaining populations in case law and recovery planning documents.

Trout Unlimited v. Lohn (W.D.Wash. June 13, 2007, and 559 F.3d 946, 9th Cir. 2009)

This case (first (2007) in district court and subsequently (2009) on appeal to the 9th Circuit Court) considered the role of augmentation and translocation in recovery, specifically the legality of a NMFS policy setting forth how the Service will consider hatchery-spawned salmon and steelhead (*Oncorhynchus mykiss*) in ESA listing and recovery decisions. The district court decision stated "If the ESA did not require that species be returned to a state in which they were naturally self-sustaining, preservation of the habitat of the species would be unnecessary." Subsequently the circuit court stated

> [T]he ESA's primary goal is to preserve the ability of natural populations to survive in the wild. As the district court put it, "[t]hat the purpose of the ESA is to promote populations that are self-sustaining without human interference can be deduced from the statute's emphasis on the protection and preservation of the habitats of endangered and threatened species." *See, e.g.,* 16 U.S.C. § 1531(b) ("The purposes of this [Act] are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, [and] to provide a program for the conservation of such endangered species and threatened species....")… The ESA's legislative history also confirms that the ESA is primarily focused on natural populations. *See* H.R.Rep. No. 95-1625, at 5, *reprinted in* 1978 U.S.C.C.A.N. at 9455.

The circuit court noted that because the NMFS policy instructs the agency to consider both the positive and the negative effects of hatchery fish on the viability of natural populations, the policy is "consistent with the ESA's overall focus on preserving natural populations."

Services' joint Section 7 Handbook, 1998 (p. 4-36)

Recovery is "the process by which species' ecosystems are restored and/or threats to the species are removed so self-sustaining and self-regulating populations of listed species can be supported as persistent members of native biotic communities."

Florida panther (*Puma concolor coryi*), finding of no significant impact regarding genetic restoration and management, 1995 (60 FR 478):

"Restoring endangered or threatened animals or plants to the point where they are again secure, self-sustaining members of their ecosystems is a primary goal of the Service's endangered species program".

Peregrine Falcon (*Falco peregrinus*) delisting rule, 1998 (63 FR 45446):

“Recovery is the process by which the decline of an endangered or threatened species is arrested or reversed and threats to its survival are neutralized so that long-term survival in nature can be ensured. The goal of this process is the maintenance of secure, self-sustaining wild populations of species with the minimum investment of resources”.

Whooping Crane (*Grus americana*), establishment of a nonessential experimental population, 2001 (66 FR 33903):

“the purpose of the Act goes beyond restoring the number of individuals but is to conserve populations in the wild and the ecosystems upon which they depend”.

Rio Grande silvery minnow (*Hybognathus amarus*), designation of critical habitat, 2003 (68 FR 8088):

“The purpose of the Act is to conserve listed species and the ecosystems on which they depend. Relegating a species to captivity does not conserve the ecosystem on which they depend. Controlled propagation is not a substitute for addressing factors responsible for an endangered or threatened species' decline. Therefore, our first priority is to recover wild populations in their natural habitat wherever possible, without resorting to the use of controlled propagation”.

Supplementary Information S2. Attributes of species used as examples of consideration of connectivity in recovery planning. Post-delisting translocation is listed if suggested in recovery plans for the species. Approximate average dispersal distance is shown in kilometers.

Species	ESA Status	Dispersal	Barriers to connectivity	Translocation suggested		Other recovery actions
				Before	After delisting	
Columbia River Pacific salmon *Oncorhynchus spp.*	Threatened	100-1000	Hydroelectric dams	Y	Y	Improve passage survival at dams, restore flows, riparian habitat
Concho water snake *Nerodia paucimaculata*	Recovered	10-20	Dam	N	Y	Restore flows, riparian habitat
Fender's Blue Butterfly *Icaricia icaroides fenderi*	Endangered	0.5	Habitat loss, altered fire regime	Y	N	Habitat restoration, prescribed fire
Gray wolf (Northern Rocky Mountains) *Canis lupus*	Recovered	100	Overexploitation	Y	Y	Seasonal hunting closure
Greater sage grouse *Centrocercus urophasianus*	Candidate	100	Habitat loss, invasive species	Y	n/a	Habitat restoration
Grizzly bear (Yellowstone) *Ursus arctos horribilis*	Threatened	15	Overexploitation, habitat loss	N	Y	Habitat restoration
Karner Blue Butterfly *Lycaeides melissa samuelis*	Endangered	0.5	Habitat loss, altered fire regime	Y	N	Habitat restoration, prescribed fire
Red-cockaded woodpecker *Picoides borealis*	Endangered	5-10	Habitat loss, altered fire regime	Y	Unknown	Habitat restoration, prescribed fire
Southern Idaho ground squirrel *Spermophilus brunneus endemicus*	Candidate	1.2	Overexploitation, invasive species	Y	n/a	Habitat conservation, shooting ban
Wolverine *Gulo gulo*	Candidate	60	Overexploitation, habitat loss	Y	N	Trapping ban
Black-footed ferret *Mustela nigripes*	Endangered	4	Habitat loss, disease	Y	Y	Habitat conservation

Supplementary Information S3. Use of the term "conservation-reliant species" by the US Fish and Wildlife Service in recovery and delisting documents.

Gray wolf, Northern Rocky Mountains DPS delisting rule (77 FR 55565):

"Issue 36: Many comments objected to human-assisted migration as a strategy to address potential genetic threats associated with reduced or lost connectivity when feasible methods for ensuring natural dispersal and population connectivity exist (e.g., reducing human-caused mortality). Others thought human-assisted migration should be a last resort and that it was an inappropriate tool to overcome anthropogenic barriers to dispersal (primarily human-caused mortality). Others noted that this management approach risks unnecessarily creating a **conservation-reliant species**. Some suggested allowance for human-assisted migration meant the population was not recovered, because the Act requires self-sustaining wild populations to achieve recovery. Other comments argued any species that requires translocation is not recovered because section 3 of the Act defines "recovery" (technically "conservation") as "the point at which the measures provided pursuant to this Act are no longer necessary" and the list of measures includes relocation. Some comments expressed the view that we had no real assurance Wyoming would use translocation only as an option of last resort, and more likely, it would become "standard procedure."

A few comments viewed our allowance for human-assisted migration as removing State incentive to achieve the criterion via natural dispersal. Others requested clarification on when it would be used, what it would look like, and how it would be financed. These comments concluded it was counter to the Act for us to rely on the unenforceable intentions of Wyoming as grounds to dismiss this potential threat. One comment suggested the proposed rule oversimplified the feasibility of artificial translocation noting few transplanted wolves would become breeders, that artificial insemination would be technically difficult, and that such a program would be costly to the States. Still other comments suggested relocating problem wolves instead of killing them, noting the ancillary benefit of providing gene flow. Other comments insisted delisting should not occur until the population can be shown to be genetically viable under State management without translocation.

Response 36: Montana, Idaho, and Wyoming all agree that natural connectivity is the preferred approach to maintaining genetic diversity, and have indicated an intention to jointly collaborate to provide continued opportunities for natural connectivity between all three recovery areas (Groen et al. 2008, p. 2; WGFC 2012, pp. 6-7). Given the dispersal capabilities of wolves and the proximity of suitable habitat, we conclude that the States can, and will, achieve adequate levels of genetic exchange. Such levels likely occurred when the population was between 101 and 846 wolves and have likely been exceeded at higher population levels (as discussed in more detail in Factor E below). Although future dispersal will differ from past levels, the available data support a conclusion that human-assisted migration is unlikely to be a regular activity. Instead, translocation of wolves or other management techniques to move genes between subpopulations would only be used as a stop-gap measure, if necessary to increase genetic interchange (WGFC

2012, p. 7). In short, NRM wolves and wolves in the GYA are not expected to need or rely on human-assisted migration often, if ever, and these populations will not become "**conservation reliant**" as defined by Scott et al. (2005, entire). That said, should it ever become necessary, human-assisted migration is an acceptable management technique (especially when relied upon only as a measure of last resort). This conclusion is consistent with the position we took in our 1994 Environmental Impact Statement, which noted that other wildlife management programs rely upon such agency-managed genetic exchange and concluded that the approach should not be viewed negatively (Service 1994, pp. 6-75)."

<u>Gray wolf, Northern Rocky Mountains DPS delisting rule (76 FR 61816):</u>
"Human-assisted migration will be used, as necessary, to maintain levels of genetic exchange and connectivity for both the GYA (including Wyoming) and the larger NRM metapopulation (Groan et al. 2008, p. 2; WGFC 2011, pp. 26-29). Human intervention in maintaining recovered populations is necessary for many **conservation-reliant species** and a well-accepted practice in dealing with population concerns (Scott et al. 2005). The 1994 wolf reintroduction EIS indicated that intensive genetic management might become necessary if any of the subpopulations developed genetic or demographic problems (Service 1994, pp. 6-74). The 1994 EIS stated that other wildlife management programs rely upon such agency-managed genetic exchange, and that the approach should not be viewed negatively (Service 1994, pp. 6-75). Human-assisted genetic exchange is a proven technique that has created effective migrants in the NRM DPS. An example of successful managed genetic exchange in the NRM population was the release of 10 wolf pups and yearlings translocated from northwestern Montana to YNP in the spring of 1997. Two of those wolves became breeders and their genetic signature is common throughout YNP and the GYA (vonHoldt et al. 2010, p. 4422). Wolves could easily be moved again in the highly unlikely event that inbreeding or other problems ever threatened wolves in the GYA or any other area. Agency-managed genetic exchange could focus on such proven established methods, or use other novel means of introducing genes into a recovery area (e.g., artificial insemination of wolves). At this time, such approaches remain unnecessary."

<u>Gray wolf, Northern Rocky Mountains DPS delisting rule (74 FR 15178):</u>
"As explained in the recovery section above, wolf recovery in the NRM never depended solely on natural dispersal. Should genetic issues ever materialize, an outcome we believe is extremely unlikely, the MOU provides a failsafe in that it ensures States will implement techniques to facilitate agency-managed genetic exchange (moving individual wolves or their genes into the affected population segment) (Groen et al. 2008). Human intervention in maintaining recovered populations is necessary for many **conservation-reliant species** and a well-accepted practice in dealing with population concerns (Scott et al. 2005). The 1994 wolf reintroduction EIS indicated that intensive genetic management might become necessary if any of the sub-populations developed genetic demographic problems (Service 1994, p. 6-74). The 1994 EIS stated that other wildlife management programs rely upon such agency-managed genetic exchange and that the

approach should not be viewed negatively (Service 1994, p. 6-75). Human-assisted genetic exchange is a proven technique that has created effective migrants in the NRM DPS. An example of successful managed genetic exchange in the NRM population was the release of 10 wolf pups and yearlings translocated from northwestern Montana to YNP in the spring of 1997. Two of those wolves become breeders and their genetic signature is common throughout YNP and the GYA (vonHoldt 2008). Wolves could easily be moved again in the highly unlikely event that inbreeding or other problems ever threaten any segment of the NRM wolf population. Other future agency-managed genetic exchange could include other means of introducing novel wolves or their genes into a recovery area if it were ever to be needed. At this time, such approaches remain unnecessary and are highly likely to remain unneeded in the future."

Grizzly bear, Yellowstone DPS delisting rule (72 FR 14897):
"Issue 10—Several commenters objected to relocating bears from the NCDE to the GYA to address genetic concerns because it would violate the Act's vision of "self-sustaining populations," "recovery of populations in the wild," and "natural recovery." They cited the need for augmentation as evidence that the Yellowstone DPS is not truly recovered.
Response—The Act does not require a "hands off" approach as a prerequisite for delisting. In fact, the presence of adequate regulatory mechanisms to ensure that appropriate management and monitoring activities continue is required before delisting can occur. For the Yellowstone grizzly bear DPS to remain unthreatened in all or a significant portion of its range in the foreseeable future, active management is necessary to limit mortality, provide adequate habitat, respond to grizzly bear/human conflicts, and maintain genetic diversity either through natural connectivity or through translocation. In this way, the Yellowstone grizzly bear DPS is a "**conservation-reliant species**" (Scott et al. 2005, p. 383). Augmentation is proposed as a precautionary measure based on the recommendations of Miller and Waits (2003, p. 4338) to maintain current levels of genetic diversity, should grizzly bear movement into the GYA not occur over the next 20 years."

Kirtland's Warbler, 2012 Kirtland's Warbler Fact Sheet (Available at
http://www.fws.gov/midwest/endangered/birds/Kirtland/kiwafctsht.html).
"Due to many dedicated people, the Kirtland's warbler has met the recovery population goal. However, as a **conservation-reliant species**, the continued success of Kirtland's warbler is dependent on annual habitat management and cowbird control. It is hoped that soon, provisions can be made to ensure that these management activities are continued into the future, allowing Kirtland's warblers to be removed from the list of threatened and endangered species."