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12 Hybrids and Policy

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Hybridization (the interbreeding of individuals from genetically distinct populations, regardless of their taxonomic status) is the double-edged sword of conservation biology. On one hand, increased rates of hybridization because of human activities have led to the extinction of populations and species in plant and animal taxa throughout the world (Rhymer and Simberloff 1996; Allendorf et al. 2001). On the other, hybridization is an important and natural part of the evolutionary process. Thus, hybridization between isolated populations can be an important tool for recovery (Mansfield and Land 2002). However, it has been difficult to develop conservation policies that treat the problems caused by increasing anthropogenic hybridization and at the same time recognize the important evolutionary role of natural hybridization.

How the Endangered Species Act (ESA) should treat hybrids has been a topic of intense debate since its passage in 1973 (see box 12.1). The word "hybrid" does not occur in the definition of "species" in the ESA (sec. 3) nor are hybrids considered anywhere in the act. In fact, hybrids are not considered in endangered species legislation of any other nation (Haig, unpublished data) with the exception of the Biodiversity Act recently adopted by the Republic of South Africa (Republic of South Africa Act No. 8, 2004). In this chapter, we review the history of discussions related to listing hybrids under the Endangered Species Act, outline current legislation that may particularly address this issue, and explore new approaches to resolving this debate.

History of Hybrid Issues Related to the Endangered Species Act

A brief perspective on the terms and concepts related to hybrids may be useful prior to a discussion of policy (box 12.2 and fig. 12.1). The term "hybridize" has been used to mean very different types of matings, hence clarifying definitions is also critical for clear and informed consideration. Understanding and addressing conservation needs and management of hybrids has also become

BOX 12.1 Time line for events related to hybrid issues in the federal Endangered Species Act

1973	Passage of the Endangered Species Act: no mention of hybrids
1977	U.S. Department of the Interior defines "wildlife" to include hybrids in the Endangered Species Act
1977, 1983	U.S. Solicitor states that hybrids are not protected under the Endangered Species Act
Pre-1990	U.S. Fish and Wildlife Service discourages conservation efforts for hybrids because it felt doing so "might not help and could hinder recovery of endangered taxon"
1990	U.S. Fish and Wildlife Service states that "rigid standards should be revisited because the issue of hybrids is more properly a biological issue than a legal one"
1996	U.S. Fish and Wildlife Service and National Marine Fisheries Service propose an intercross policy for protection of hybrids under the Endangered Species Act
2000	U.S. Fish and Wildlife Service and National Marine Fisheries Service render policy on controlled propagation of captive populations
Present	Proposed intercross policy has not been approved or disapproved

more important as rates of hybridization increase due to increasing human encroachment on habitats and translocations of taxa (Allendorf et al. 2001).

Hybrid Policy

Four years after passage of the Endangered Species Act, hybrids became a controversial topic that has continued to this day (box 12.1). In May 1977, the U.S. Department of the Interior's Office of the Solicitor issued the statement that "because it defines 'fish or wildlife' to include any offspring without limitation, the act's plain meaning dictates coverage of hybrids of listed animal species. The legislative history buttresses this conclusion for animals and also makes clear its applicability to plants" (U.S. Department of the Interior 1977a). However, response from the U.S. Fish and Wildlife Service (USFWS 1977b) indicated that "since the Act was clearly passed to benefit endangered species, . . . it must have meant the offspring of two listed species and was not meant to protect a hybrid where that protection would in fact cause jeopardy to the continued existence of a species." The solicitor responded in August 1977 (U.S. Department of the Interior 1977c; reaffirmed in 1983; U.S. Department of the Interior 1983), stating that "Congress did not intend the Endangered Species

BOX 12.2 Definitions of hybrids and hybrid events

Admixture.	The production of new genetic combinations in hybrid populations through recombination.
Genetic mixing.	The loss of a formerly distinct population through hybridization.
Hybridization.	Interbreeding of individuals from genetically distinct populations, regardless of the taxonomic status of the populations.
Hybrid swarm.	A population of individuals that all are hybrids by varying numbers of generations of backcrossing with parental types and mating among hybrids.
Hybrid taxon.	An independently evolving, historically stable population or group of populations possessing a unique combination of heritable characteristics derived from two or more discrete parental taxa.
Hybrid zone.	An area of contact between two genetically distinct populations where hybridization occurs.
Intercross.	All crosses between individuals of different "species" as defined under the Endangered Species Act (i.e. taxonomic species, subspecies, and distinct population segments of vertebrates).
Introgression.	Gene flow between populations whose individuals hybridize.
Proportion of admixture.	The proportion of alleles in a hybrid swarm that come from each of the hybridizing taxa.
Pure population.	A population in which there has been no hybridization and therefore contains only individuals from the parental species.

Act of 1973 to cover hybrids of listed species" because he had learned that there was the potential for a listed species to be harmed by hybridization. Overall, the USFWS's early position was to "discourage conservation efforts for hybrids between taxonomic species or subspecies and their progeny because they do not help and could hinder recovery of endangered taxon." In 1990, the USFWS issued a statement that "rigid standards should be revisited because the issue of hybrids is more properly a biological issue than a legal one" (U.S. Department of the Interior 1990).

There was critical response from the scientific community regarding this approach to hybrids. In a 1991 paper, O'Brien and Mayr pointed out that invaluable biological diversity would be lost if the Endangered Species Act did not

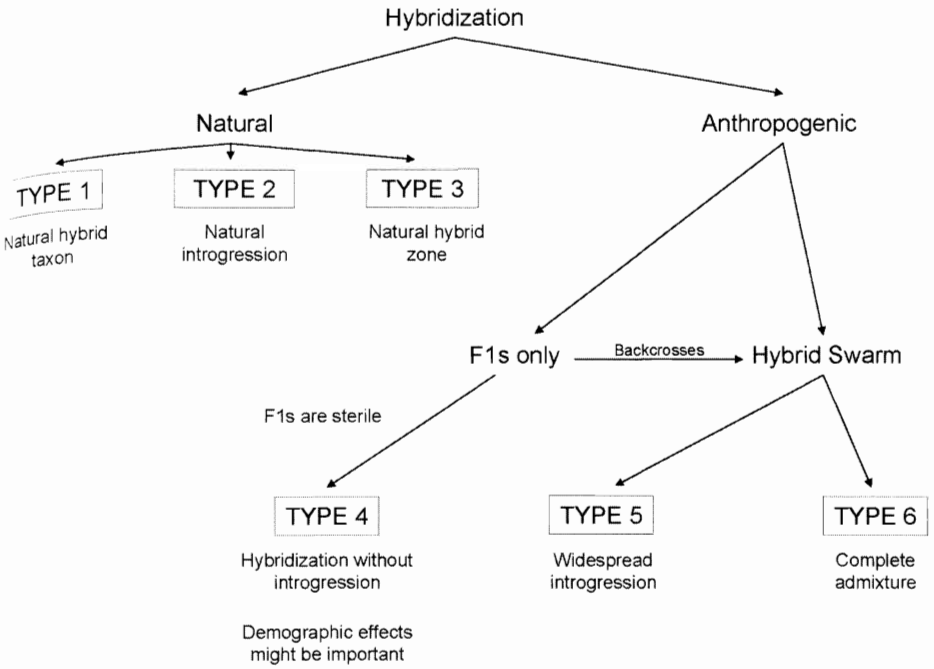

Figure 12.1. Categories of hybridization (from Allendorf et al. 2001).

protect some subspecies or populations that interbreed (e.g., Florida panther, *Puma concolor coryi*), or taxa derived from hybridization (e.g., the red wolf, *Canis rufus*). Further, Grant and Grant (1992) pointed out that few species would be protected by eliminating protection for any species interbreeding since so many plant and animal species interbreed to some extent.

Intercross Policy

In 1996, the U.S. Fish and Wildlife Service and the National Marine Fisheries Service (NMFS) drafted an intercross policy (USFWS and NMFS 1996f) that would have set guidelines for the possible protection of hybrids in response to the need for an updated policy. They used the word "intercross" instead of "hybrid" to try to avoid concerns that had accumulated with the term "hybrid." The policy would have included within the listing of a taxon

> "hybrid" individuals that more closely resemble a parent belonging to a listed species than they resemble individuals intermediate between their listed and unlisted parents. The Services propose to add to their joint regulations the terms "intercross" and "intercross progeny" and indicate

> the inclusion of intercross individuals within the original listing action for the parent entity.
>
> The proposed policy is intended to allow the Services to aid in the recovery of listed species by protecting and conserving intercross progeny, eliminating intercross progeny if their presence interferes with conservation efforts for a listed species, and fostering intercrossing when this would preserve remaining genetic material of a listed species. The proposed policy would only sanction these actions where recommended in an approved recovery plan, supported in an approved genetics management plan (which may or may not be part of an approved recovery plan), implemented in a scientifically controlled and approved manner, and undertaken to compensate for a loss of genetic viability in listed taxa that have been genetically isolated in the wild as a result of human activity. (USFWS and NMFS 1996f, 2)

Flexibility, adaptability, and guidelines in different situations were the key benefits of this policy. Thus, the two agencies could eliminate intercross progeny if their presence interfered with conservation efforts for a listed species as well as foster intercrossing where required for conservation. However, there was concern that the policy was worded in terms of individuals and not populations and that it did not address the issue of natural hybridization (Don Campton, USFWS, pers. comm.). This policy has never been formally adopted. However, it was also never formally withdrawn, and thus its adoption may be possible.

Controlled Propagation Policy

In 2000, the USFWS and NMFS adopted a new policy regarding controlled propagation of species listed under the Endangered Species Act (USFWS and NMFS 2000c). Overall, this policy provides clear authorization and latitude for cautiously tackling difficult situations related to genetic rescue. The policy specifically addresses the issue of hybrids in the following way:

> Based on sound scientific principles to conserve genetic variation and species integrity. Intercrossing will not be considered for use in *controlled propagation* programs unless recommended in an approved recovery plan; supported in an approved genetic management plan (if information is available to develop such a plan, and which may or may not be part of an approved recovery plan); implemented in a scientifically *controlled* and approved manner; and undertaken to compensate for a loss of genetic viability in listed taxa that have been genetically isolated in the wild as a result of human activity. Use of intercross individuals for species conservation will require the approval of the FWS Director or that of the NMFS Assistant Administrator, in accordance with all applicable policies. (USFWS and NMFS 2000c, 56921)

This policy was principally initiated to protect aquatic organisms from disease when being transferred among captive facilities but was also to prevent, unless specifically necessary, situations such as that of captive propagation and release of the peregrine falcon (*Falco peregrinus*) in the 1970s and 1980s (Cade and Burnham 2003). When eastern peregrine falcons had declined to only a very few individuals, plans were implemented such that birds released from captivity were combinations of seven subspecies originating from the western United States, boreal Canada and Alaska, Aleutian and Queen Charlotte Islands, Scotland, Chile, Australia, and Spain. While these releases did represent a highly diverse gene pool and the birds were successful (Barclay and Cade 1983; Cade and Burnham 2003), it might not be the best approach in other situations.

Another example stems from a headwater population of topminnow (*Poeciliopsis monacha*) (Vrijenhoek 1996). The species had lost all detectable heterozygosity because of a population bottleneck caused by drought and was being outcompeted by a sympatric asexual hybrid taxon from the same genus. Experimental replacement of thirty females with females from a downstream population that had high heterozygosity restored the original heterozygosity and the competitive ability of the sexual population. Sadly, the same did not occur for the now extinct dusky seaside sparrow (*Ammodramus maritimus nigrescens*). This subspecies was down to its last few males and the U.S. Fish and Wildlife Service failed to support crossing of these males with individuals from other closely related subspecies, arguing pure dusky seaside sparrows could never be created (James 1980). Its extinction occurred shortly thereafter.

Similar issues must be sorted out for an upcoming decision on the fate of the Micronesian kingfisher from Guam (*Todiramphus cinnamomina cinnamomina*). These birds were extirpated from Guam as a result of the brown tree snake (*Boiga irregularis*) introduction in World War II (reviewed in Haig and Ballou 1995) and are now in captive-rearing facilities on the U.S. mainland and Guam. Captive breeding has not been as successful as hoped, and thus current considerations include crossbreeding the Guam birds with birds from the Micronesian island of Pohnpei (*T. c. reichenbachii*). These hybrids may be interspecific or intraspecific depending on genetic work underway (Haig, unpublished data), but in either case, they could be protected if approved under the controlled propagation policy.

Potential Solutions in Existing Legislation

There are a variety of legislative means by which hybrids can receive protection under the Endangered Species Act.

Listing Hybrid Species of Natural Origin

Currently, the U.S. Fish and Wildlife Service considers stable, self-sustaining species of *natural hybrid origin* eligible for full protection under the Endangered Species Act (A. Hecht, USFWS, pers. comm.). However, it can be difficult to distinguish between natural and anthropogenic hybridization. The alternative is either to not allow protection of natural hybrids or to protect anthropogenic hybrids that could contribute to extinction of parental species and waste limited resources available for conservation.

One example where hybrid taxa could be listed is the case of hybrids between blue-winged warblers (*Vermivora pinus*) and golden-winged warblers (*V. chrysoptera*). The two species cross and produce viable offspring (e.g., Brewster's or Lawrence's warblers; Gill 1980) however, the golden-winged warbler is declining throughout its range (Confer and Knapp 1992). Given that it is not possible to detect the genetic makeup of the hybrids, it is important to protect these closely related taxa lest we lose all genetic material from the golden-winged warbler. Similarly, the Pecos sunflower (*Helianthus paradoxus*) was listed as threatened only after greenhouse experiments and molecular analyses showed that it was a true species but with hybrid origin (USFWS 1999a). Conversely, recent evidence indicating that the endangered Lloyd's hedgehog cactus (*Echinocereus lloydii*) was a hybrid not evolving independently of its parental species resulted in a delisting (USFWS 1999d).

Similarity of Appearance

An infrequently used provision in the Endangered Species Act may be useful in resolving some situations regarding hybrids. Section 4(e), the "similarity of appearance" clause, can be used when two taxa are so similar that the listed taxon could face further decline or loss of viability without protection of the nonlisted taxon:

> The Secretary may, by regulation of commerce or taking, and to the extent he deems advisable, treat any species as an endangered species or threatened species even though it is not listed pursuant to section 4 of this Act if he finds that (A) such species so closely resembles in appearance, at the point in question, a species which has been listed pursuant to such section that enforcement personnel would have substantial difficulty in attempting to differentiate between the listed and unlisted species; (B) the effect of this substantial difficulty is an additional threat to an endangered or threatened species; and (C) such treatment of an unlisted species will substantially facilitate the enforcement and further the policy of this Act.

Thus, it is a device to prevent listed species from being taken or traded under the guise of similarly appearing unlisted species. It can be looked upon as a way of shifting the burden of proof from USFWS law enforcement agents having to prove that a particular individual is protected to a suspect having to prove that it is not.

The U.S. Fish and Wildlife Service has only used section 4(e) seven times (USFWS 1983c, 1987, 1990a, 1991b, 1992, 1996c, 1997b). The National Marine Fisheries Service has never used it (M. Nammack, NMFS, pers. comm.). However, when used, it is invoked in cases where the listed species closely resembled a nonlisted species, making the listed taxa more vulnerable to "take." For example, all *Puma concolor* are protected in Florida so that no one would kill a Florida panther and claim it had escaped from a roadside zoo where other *P. concolor* subspecies are held in captivity (USFWS 1991b). All desert tortoises (*Gopherus agassizii*) are protected in the Mojave desert to avoid people picking up individuals from the listed Mojave population and claiming they were from the nonlisted Arizona population (USFWS 1990a). And American alligators (*Alligator mississippiensis*) are now protected (USFWS 1987). Take is prohibited, except by state permit, so there is regulated trade. Additional examples include the bog turtle (*Clemmys muhlenbergii*; USFWS 1997b), American black bear (*Ursus americanus*; USFWS 1992), and peregrine falcon (USFWS 1983c).

Implementing similarity of appearance protection under section 4(e) requires a formal rule-making procedure: listing in the *Federal Register*, public comment period, and final rule in the *Federal Register*. Similarity-of-appearance species are included on the list of threatened and endangered species as similarity-of-appearance-threatened or similarity-of-appearance-endangered. Under section 4(e), species are prohibited from intentional "take" as well as protected by trade restrictions. They do not, however, receive protection under other sections of the act that address habitat protection.

Sections 4(e) may be an effective tool in many circumstances with hybrids. For example, six species or subspecies of western trout in the genus *Oncorhynchus* are listed under the ESA. All of the listed taxa are threatened by hybridization with introduced rainbow trout (*O. mykiss*). Morphological identification of these hybrids is extremely difficult and sometimes impossible (Allendorf et al. 2004). Protecting hybrids between the listed taxa and rainbow trout could be a helpful management tool under some circumstances.

A similar situation has recently arisen in the case of hybridization between the threatened Canada lynx (*Lynx canadensis*) and unlisted bobcats (*L. rufus*; Schwartz et al. 2004). Taxa can be difficult to identify in the field and because hunters use traps that are left unattended (e.g., snare traps), animals can be

killed before they are identified. Thus trapping bobcats in areas where lynx and lynx-bobcat hybrids occur might result in unnecessary "take" of lynx. Therefore, implementation of section 4(e) for bobcats and the hybrids could provide a cushion for the lynx population to recover.

Finally, capturing hybrid trout in a similarity-of-appearance listing might be useful in some situations. This would be analogous to the similarity-of-appearance listing for all black bears in the range of the Louisiana subspecies.

Migratory Bird Treaty Act

An alternative to invoking the Endangered Species Act in hybrid cases involving birds is the Migratory Bird Treaty Act of 1918 (MBTA; Act of July 3, 1918), which, with a few exceptions, protects 99 percent of all North American bird species. The benefit of using the MBTA is that hybrids are included in the definition of species and are protected automatically and the ESA's extensive listing process can be bypassed. However, protection under the MBTA does not carry the stiff penalties exacted by the ESA. Thus, depending on the situation, the MBTA may be a more desirable route to pursue for prosecutors.

An example is the case of hybridization between northern spotted owls (*Strix occidentalis caurina*) and barred owls (*S. varia*) (Haig et al. 2004). Here, the issue was how to prosecute individuals who "take" hybrids when the hybrids can be difficult to differentiate in the field from ESA-listed northern spotted owls. Haig et al. suggested prosecuting under the Migratory Bird Treaty Act because they felt it was better to avoid going through the ESA listing process for similarity of appearance, especially when the number of violators would probably be minimal. And because the hybrids are deleterious to the recovery of spotted owls, there was no reason to afford them the special protection they would be given under section 4(e).

Convention on International Trade of Endangered Species of Wild Fauna and Flora

Parties (i.e., countries from around the world) to the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES) have long struggled with the issue of hybrid protection in international trade. Overall, hybrids are considered protected under this agreement. However, there are important caveats regarding treatment of plants and animals (boxes 12.3 and 12.4). For animals, the concern is mostly that hybrids might prove detrimental to survival of the listed species. For example, trade and subsequent release of hybrid parrots (family: Psittacidae) and falcons (family: Falconidae) has been particu-

BOX 12.3 Treatment of animal hybrids by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

THE CONFERENCE OF THE PARTIES TO THE CONVENTION CONCERNED that trade in hybrids of species included in the Appendices should be controlled in order to support the controls on trade in the species included in Appendices I and II determined that:

a) Hybrids may be specifically included in the Appendices but only if they form distinct and stable populations in the wild;

b) Hybrid animals that have in their recent lineage one or more specimens of species included in Appendix I or II shall be subject to the provisions of the Convention just as if they were full species, even if the hybrid concerned is not specifically included in the Appendices;

c) If at least one of the animals in the recent lineage is of a species included in Appendix I, the hybrids shall be treated as specimens of species included in Appendix I (and shall be eligible for the exemptions of Article VII when applicable);

d) If at least one of the animals in the recent lineage is of a species included in Appendix II, and there are no specimens of an Appendix-I species in such lineage, the hybrids shall be treated as specimens of species included in Appendix II; and

e) As a guideline, the words "recent lineage", as used in this Resolution, shall generally be interpreted to refer to the previous four generations of the lineage;

RECOMMENDS that, when Parties are considering the making of non-detriment findings, in accordance with Article III, paragraph 2 (a), or Article IV, paragraph 2 (a), for specimens of hybrids that are subject to the provisions of the Convention, they take into account any potential detriment to the survival of the listed species.

larly problematic (CITES Secretariat 1996, 14). Conversely, issues are more complex in plants where hybrid issues have been particularly focused on orchids and cacti (box 12.4). The potential for artificial propagation and hybridization in plants makes enforcing CITES very difficult because taxa identification may only be possible via molecular methods. In summary, CITES may provide protection for some hybridizing taxa for which international trade is a major threat but is not the answer to having an ESA hybrid policy.

BOX 12.4 Treatment of plant hybrids by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

THE CONFERENCE OF THE PARTIES TO THE CONVENTION determines that

a) Hybrids shall be subject to the provisions of the Convention even though not specifically included in the Appendices if one or both of their parents are of taxa included in the Appendices, unless the hybrids are excluded from CITES controls by a specific annotation in Appendix II or III (see annotation °608 in the Interpretation of Appendices I and II); and

b) Regarding artificially propagated hybrids:

i) plant species or other taxa listed in Appendix I shall be annotated (in accordance with Article XV) if the provisions relevant to the most restrictive Appendix are to apply;

ii) if a plant species or other taxon listed in Appendix I is annotated, an export permit or re-export certificate shall be required for trade in specimens of all artificially propagated hybrids derived from it; but

iii) artificially propagated hybrids derived from one or more unannotated Appendix-I species or other taxa shall be regarded as being included in Appendix II and entitled therefore to all exemptions applicable to artificially propagated specimens of species listed in Appendix II.

Issues to Consider

The challenge in developing an effective hybrid policy is to identify consistency in solutions to issues while recognizing that the first step to a good solution for any particular hybrid situation is identification of the specific underlying issue. Resolving the following issues may simplify crafting an effective hybrid policy: (1) Should hybridized populations be included as part of the unit considered for listing? (2) Should hybrids be protected that are not part of the listing unit? (3) How much protection is needed or warranted?

Considering Hybridized Populations for Listing

Should hybrid populations be listed? is an important and difficult question because the issues raised range from cases with natural and limited introgression, natural hybrid zones, and situations where hybridization is not a substantial

threat to the persistence of the candidate taxon, to cases where anthropogenic forces are causing or significantly accelerating introgression. In general, hybrids should be excluded if introgression can be stopped or limited. However, there are situations where we risk losing all remaining genetic material from a swamped taxon. The problem is that by the time this has happened, the swamped entity may be largely subsumed into something that does not itself meet the definition of threatened or endangered such as in the Mexican duck (*Anas "diazi"*). It was delisted because there was so much introgression with mallards (*A. platyrhynchos*) that it was not a distinguishable species (USFWS 1978a). It can be difficult to distinguish between natural and anthropogenic hybridization; nevertheless, this distinction is of primary importance. Without it, the alternatives for hybrid policy are either to not allow protection of natural hybrids or to protect anthropogenic hybrids that could contribute to extinction of parental species and waste limited resources available for conservation.

Treatment of hybridized populations has been especially problematic for westslope cutthroat trout (WCT, *O. clarki lewisi*). The U.S. Fish and Wildlife Service received a formal petition in 1997 to list westslope cutthroat trout as threatened throughout its range (USFWS 2002b). The agency concluded that listing the species as threatened was not warranted because of its widespread distribution and current status of its overall population (USFWS 1999h). However, a subsequent legal suit argued that this finding was incorrect because it included populations hybridized with rainbow trout in the WCT population considered for listing. The court ruled that the listing determination for westslope cutthroat trout was not based on the best available science and ordered the USFWS to reconsider whether to list the species as threatened after taking into account the prevalence of hybridization (USFWS 2002b).

How hybrids are treated in this case has important implications for whether the species should be listed. If hybrids between westslope cutthroat trout and rainbow trout (*O. mykiss*) are considered to be part of the WCT listing unit, then the listing unit almost certainly does not warrant protection under the Endangered Species Act because of its widespread distribution. However, if only WCT populations without introgression from rainbow trout are considered to be westslope cutthroat trout, then the listing unit would more likely warrant protection under the ESA because of its limited distribution and rapid continued decline. Hitt et al. (2003) found that introgression with rainbow trout is spreading rapidly in WCT populations.

Morphological detection of hybrids between westslope cutthroat trout and other trout has not been found reliable (Allendorf et al. 2004). Nevertheless, the Reconsidered Finding for an amended petition to list the westslope cutthroat trout as threatened throughout its range relied upon morphological criteria to identify it (USFWS 2003f). The finding also concluded that populations

containing 20 percent or less admixture with rainbow trout determined by molecular techniques would be considered westslope cutthroat trout. Thus the petition to list was denied (USFWS 2003f).

This finding is inconsistent with earlier USFWS findings. For example, the comparable finding with the Rio Grande cutthroat trout considered populations to be part of the listing unit only if they contained less than 1 percent introgression with either rainbow or another subspecies of cutthroat trout (USFWS 2002a). Protection of populations that appear to be westslope cutthroat trout morphologically but contain up to 20 percent admixture from rainbow trout also protect sources of spreading hybridization and will likely lead to the continued rapid decline of westslope cutthroat trout.

Protection of Nonlisted Hybrids

Often, information is obtained following the listing of a taxon that reveals hybridization of a listed taxa with another. Several factors need to be considered when assessing the potential value of a hybridized population. One is how many pure populations of the taxon remain. The smaller the number of pure populations, the greater the conservation and restoration value of any hybridized population. In addition, the greater the phenotypic (behavioral, morphological, etc.) differentiation between the hybridized population and remaining pure populations, the greater the conservation value of the hybridized population, because it may represent greater evolutionary potential. Another factor to consider is whether the continued existence of hybridized populations poses a threat to remaining pure populations. The greater the perceived threat, the lower the value of the hybridized population.

Determining Adequate Protection Levels

The degree of protection needed for hybrids clearly depends on the situation. Currently, taxa listed under section 4(e) are primarily protected from take but are not provided habitat protection under ESA section 7. Further, ESA violations carry heavy fines and potential incarceration—not insignificant punishment. Thus, as is often the case for enforcement of the ESA, decisions must be made on a case-by-case basis. However, the full complement of protections afforded by ESA should be available, if necessary, in hybrid situations.

Conclusion

In this chapter, we outlined the history of efforts to include protection of hybrids in the Endangered Species Act, potential current solutions, and issues to

consider in future amendments to the act. Clearly, establishing an effective policy regarding hybrids will not be simple given the variability of situations. Thus, developing a flexible policy will be key to its appropriateness and effectiveness in resolving key conservation dilemmas. Perhaps the most important feature of an effective policy would be a requirement that biological justification for the treatment of hybrids be included in any recovery or management plan involving hybrids.

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