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Conservation-Reliant Species and the Future of Conservation

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Abstract

Species threatened with extinction are the focus of mounting conservation concerns throughout the world. Thirty-seven years after passage of the U.S. Endangered Species Act in 1973, we conclude that the Act's underlying assumption—that once the recovery goals for a species are met it will no longer require continuing management—is false. Even when management actions succeed in achieving biological recovery goals, maintenance of viable populations of many species will require continuing, species-specific intervention. Such species are "conservation reliant." To assess the scope of this problem, we reviewed all recovery plans for species listed as endangered or threatened under the Act. Our analysis indicates that 84% of the species listed under the Act are conservation reliant. These species will require continuing, long-term management investments. If these listed species are representative of the larger number of species thought to be imperiled in the United States and elsewhere, the challenge facing conservation managers will be logistically, economically, and politically overwhelming. Conservation policies will need to be adapted to include ways of prioritizing actions, implementing innovative management approaches, and involving a broader spectrum of society.

Introduction

There is a broad consensus that humans have fundamentally altered the earth and placed many of its species at risk of extinction (e.g., Janzen 1998; McKibben 2006; Meyer 2006; Kareiva *et al.* 2007; Wiens 2007). Human impacts have increased over the past several decades as local has become global and the scale of human influences has multiplied (Millennium Ecosystem Assessment 2005; IPCC 2007). Not only are extinction rates increasing, but the geographic and taxonomic scope of threatened extinctions is broadening as well (Ricketts *et al.* 2005).

The growing recognition of the magnitude of human impacts on nature and of the current and looming wave of global extinctions has prompted both international and national programs to protect imperiled species (Balmford *et al.* 2005; Goble 2006). In the United States, the Endangered Species Act of 1973 established "a program for the conservation of ... endangered species and threatened species" and "the ecosystems upon which [these] species depend" (16 U.S.C. sec. 1531(b)). The Act was based on the assumption that preventing extinction is a straightforward process: identify species at risk of extinction, document the factors that imperil them, conduct research to determine the conservation measures necessary to eliminate those threats, implement those measures on a biologically relevant scale, and, when populations rebound to the point at which they are self-sustaining in the wild without the protection they are afforded under the Act, remove them from the list ("delist"), and declare them "recovered."

The expectation when the Act was drafted was that recovery would be commonplace once the appropriate actions were taken. To be sure, there have been notable successes, including the peregrine falcon

(*Falco peregrinus*), Aleutian cackling goose (*Branta hutchinsii leucopareia*), and gray whale (*Eschrichtius robustus*). But such species are the exception rather than the rule (Doremus & Pagel 2001; New & Sands 2003). On December 31, 2007, only 15 of the 1,136 listed species had met recovery goals and been removed from the list (USFWS 2009a).

In the United States, the Endangered Species Act requires that the decision to list or delist a species be based on findings on the risk the species faces from a statutory list of five threat categories: habitat loss, overutilization, disease or predation, inadequate regulatory mechanisms, and any other reason (ESA sec. 4(a)(1)(A)-(E)). The key to success under the Act, therefore, is eliminating the threat(s) that led to a species' imperilment. If these threats cannot be eliminated, continued management will be required and this management will require "existing regulatory mechanisms" to ensure that it continues for the foreseeable future. For example, although the population recovery goals for Kirtland's warbler (*Dendroica kirtlandii*) have been met since 2001, the species has not been delisted because its maintenance requires continuing and intensive management (timber stand management and control of brown-headed cowbirds, *Molothrus ater*) (Bocetti & Goble 2010). Without such management, the species would once again become imperiled.

We have previously labeled such species "conservation reliant" because they will require some form of conservation management for the foreseeable future (Scott *et al.* 2005). Conservation reliance is a continuum encompassing different degrees of management. It extends from species that occur only in captivity, through those that are maintained in the wild by releases from captive-breeding programs and those that require continuous control of predators or human disturbance, to species needing only periodic habitat management. Although the intensity and frequency of management actions required varies among species at different points on this continuum, the common characteristic is that some form of management will be required, even after the biological recovery goals for a species have been achieved or exceeded, to prevent it from sliding back toward extinction (Scott *et al.* 2005). For example, management of grizzly bears (*Ursus arctos horribilis*) in the greater Yellowstone area led to population increases and the delisting of the species as recovered under the provisions of the Endangered Species Act. When the decision was challenged, however, a federal district court held that the postdelisting management provided insufficient protection and ordered the species relisted (Federal District Court for the District of Montana 2009). In Australia, the woylie (brush-tailed bettong, *Bettongia penicillata*) was delisted in 1999 on the basis of a positive response to management, only to be relisted within a decade as populations declined, possibly in response to threats not considered in the initial listing (Australian Government Department of the Environment, Water, Heritage and the Arts 2009).

The U.S. Endangered Species Act does not recognize distinctions among species at different points on this conservation-reliance continuum; species are either listed (as threatened or endangered) or not. After a previously listed species is delisted, it receives no legal protection beyond that accorded to other species that are not (legally) imperiled. It is this lack of species-specific protection following delisting that is the source of the problem facing the Kirtland's warbler, the grizzly bear, and the other species that are conservation reliant.

If only a few of the species currently listed under the U.S. Act are conservation reliant, then the challenge is manageable. But if conservation reliance is widespread, the task for conservation managers would be overwhelming. Managing species at risk of extinction is expensive, logistically difficult, and often politically contentious (witness the controversy surrounding management of the spotted owl, *Strix occidentalis*, in the U.S. Pacific Northwest; Yaffee 1994), making it unlikely that all conservation-reliant species can receive the necessary management attention. Managers and policy makers will need to establish priorities and make hard decisions.

Methods

To evaluate the magnitude of the problem, we analyzed information from the recovery plans developed for species listed under the U.S. Endangered Species Act. We used these plans because they provide a rich and extensive body of data about the conservation-management requirements of a large number of species at risk of extinction. We reviewed the final recovery plans for 1,136 listed species (495 animals [196 invertebrates, 299 vertebrates] and 641 plants) available on December 31, 2007 (USFWS 2009b). Recovery plans synthesize the available biological information for a species and specify the actions necessary to reclassify it from endangered to threatened status ("downlist") or to remove it from the Act's protection altogether ("delist") (USFWS 1990). Our analysis follows the definition of "species" in the Act, which includes subspecies and distinct population segments of vertebrates (ESA sec. 3(14)).

We categorized a species as *conservation reliant* if the conservation-management actions identified in the narrative portion of the species' recovery plan addressed threats that will require ongoing management because they cannot be eliminated. In identifying management

actions that lead to conservation reliance, we included only actions that involved active management implementation; we did not include actions that were contingent upon additional research or evaluation. Thus, we included actions that included the terms "control," "implement," "manage," or "conduct," but did not include actions preceded by the terms "assess," "monitor," "identify," "investigate," "determine," "if needed," or "if warranted."

These terms are admittedly imprecise and do not take into account differences in the magnitude or frequency of the required actions. For example, control of disturbance to an endangered plant species might require only that an area be fenced to exclude people or herbivores. Once the initial management investment is made, subsequent management might entail little more than periodically maintaining the fencing. But it would still require ongoing monitoring and maintenance, even at a low level of investment. On the other hand, conservation of another endangered plant might entail onsite monitoring and educational activities to prevent people from entering a critical area as is required for Robbins' cinquefoil (*Potentilla robbinsiana*) (USFWS 2002). Exclusion of people and pets from nesting areas of federally endangered California least terns (*Sterna antillarum browni*) or federally threatened western snowy plovers (*Charadrius alexandrinus nivosus*) necessitates fencing or posting of areas and requires continuous maintenance.

Recovery plans do not contain sufficient information to distinguish among levels of management that may be required to maintain a species. In addition, the terms that we did not include in designating a species as conservation reliant (and which therefore may define a species as nonconservation reliant) often reflect a lack of knowledge about the threats that imperil a species, so some of these species may turn out to be conservation reliant once more is known. For example, the recovery plan for the Sonoran pronghorn (*Antilocapra americana sonoriensis*) lists several management strategies that need to be "investigated" (USFWS 1998), so we did not categorize the species as conservation reliant. Some of these strategies are now being implemented as management actions (i.e., forage enhancement, supplemental watering, and captive breeding; Krausman *et al.* 2005), and it is likely that such actions will need to continue to ensure the pronghorn's persistence. Our assessment of the extent of conservation reliance among listed species thus may underestimate the actual magnitude of the problem.

The management actions identified in recovery plans can take many forms. Efforts may be focused on managing other species that negatively affect the conservation target (e.g., control of predators, nest parasites, competitors, disease vectors), actively managing habitat and ecological processes (e.g., prescribed cuts, prescribed burns, controlled releases of water from dams), supplementing resources (e.g., providing contaminant-free food for California condors, *Gymnogyps californianus*), controlling direct human impacts (e.g., excluding people from a least tern colony), or artificial recruitment (e.g., supplementing populations through release of captive-reared individuals or translocation from another site to maintain genetic diversity or augment population numbers). We grouped management actions into five conservation-management strategies, each of which includes two or more similar types of management actions: (1) control of other species, (2) control of pollutants, (3) habitat management, (4) control of use of species and/or human access, and (5) population augmentation. Because species that require multiple management strategies may have a more difficult road to recovery, we also assessed the number of conservation-management strategies required for each species. We used chi-square goodness-of-fit tests to test for differences among groups (Mead *et al.* 1993).

Results

Conservation-reliant species

Of the 1,136 listed species we evaluated, 951 (84%) are conservation reliant by our measures. The percentage of conservation-reliant species did not differ significantly among major taxonomic groups (84%, 85%, and 81% for invertebrates, plants, and vertebrates, respectively; $P = 0.94$; $\chi^2 = 0.12$, df = 2). Similarly, there was no statistical evidence for differences in the percentage of conservation-reliant species among vertebrate groups (mammals, 67%; birds, 96%; reptiles, 72%; amphibians, 77%; fish, 80%; $P = 0.11$; $\chi^2 = 7.64$, df = 4) or among invertebrate groups (insects, 100%; crustaceans, 94%; snails, 83%; clams, 72%; $P = 0.11$ $\chi^2 = 5.96$, df = 3).

Required management strategies

The most common management strategies listed for conservation-reliant species were control of other species, active habitat management, and artificial recruitment. Management strategies varied among taxonomic groups (Table 1). For example, active habitat management was the most frequently identified management strategy for vertebrates and plants ($P < 0.01$; $\chi^2 = 9.47$, df = 2), whereas artificial recruitment and pollution control were most frequently cited for invertebrates ($P < 0.01$; $\chi^2 = 11.67$ & 31.12, df = 2) (Table 1). The recovery plans for most species (65%) listed multiple strategies that would be required for postrecovery management (Table 2).

Table 1 Percentage of species for each conservation-management strategy

	Vertebrates	Invertebrates	Plants	**All species**
Control of other species	64%	54%	71%	**66%**
Active habitat management	62%	32%	52%	**51%**
Control of direct human impacts	49%	23%	35%	**36%**
Artificial recruitment	33%	62%	39%	**42%**
Pollution control	12%	19%	<1%	**7%**
All strategies	**81%**	**84%**	**85%**	**84%**

Discussion

The challenge created by the conservation reliance of threatened and endangered species is formidable. Based on our analysis, 84% of the species listed under the U.S. Endangered Species Act will need continuing management actions, even after these species have met the population and distribution goals of their recovery plans. For example, delisting of the Columbian white-tailed deer (*Odocoileus virginianus leucurus*) was predicated upon the development of land-management policies to protect its habitat on a fragmented mosaic of public and private ownership and on the assurance that this habitat would continue to be managed to meet the species' requirements (Goble 2010). This required crafting a complex management approach that included zoning and land-use ordinances, set-asides (e.g., green belts, parks), conservation easements, and agreements with landowners and public-land managers to manage their land in specific ways.

The deer, like many species at risk of extinction, occurs on landscapes that are fragmented in quality and ownership. In other situations, the natural disturbance agents that historically maintained openings necessary to the survival of species are missing or altered (Menges & Hawkes 1998). Changes in grazing regimes and elimination of American bison (*Bison bison*) migrations, for example, may have caused declines of running buffalo clover (*Trifolium stoloniferum*); the recovery plan for this species calls for mimicking these historical disturbances through ongoing habitat management (USFWS 2007).

Often, threats emanate from an area larger than that occupied by the species of concern. The most common conservation-management strategy for the species we considered, for example, is control of other species (Table 1). When the threatening species occupy a wider range of habitats or larger areas than the species to be conserved, however, elimination of the threat may not be possible and control must be ongoing. The eradication of exotic foxes (*Vulpes* spp.) from the breeding islands used by the Aleutian cackling goose was instrumental to their recovery and delisting (USFWS 1990), but removal of introduced mongooses (*Herpestes* spp.), rats (*Rattus* spp.), and feral cats (*Felis catus*) from the much larger islands inhabited by the endangered Hawaiian stilt (*Himantopus mexicanus knudseni*) has proved impossible. Continuing control of nonnative predators and management of small marsh habitats throughout the islands are necessary to maintain the stilt in the wild (USFWS 2005).

The Australian experience suggests that conservation reliance is not restricted to imperiled species only in the United States. For example, control of nonnative species is a major tool in conservation management of many endemic mammals in Australia (Short & Smith 1994), and control of nonnative predators is an important element of conservation management of the woylie (Martin *et al.* 2006). Studies also suggest that postrecovery management will be required for many endangered insects (New & Sands 2003).

Nonetheless, because conservation reliance is determined in large part by the nature of the threats a species faces, it is likely to vary among countries to the extent that the types of threats vary. In China, overexploitation appears to be the primary threat to vertebrates; nonnative species were identified as a threat factor for only 3% of the listed species (Yiming & Wilcove 2005). Although the threat factors identified for endangered species in Canada are generally similar to those in the United States, overexploitation is considered a more significant threat than nonnative species (Venter *et al.* 2006).

In addition, the provisions in the U.S. Endangered Species Act requiring an explicit description of regulatory mechanisms as an element of the decision to delist a species may be a significant factor in calling attention to the problem. The statutes of other nations do not include an explicit list of threats that must be assessed in determining whether a species is imperiled. For example,

Table 2 Percentage of conservation-reliant species with one or more conservation-management strategy

Number of conservation-management strategies	Vertebrates	Invertebrates	Plants	**All species**
1 Strategy	33%	29%	38%	**35%**
2 Strategies	29%	56%	35%	**37%**
3 Strategies	24%	10%	18%	**18%**
4 Strategies	11%	4%	9%	**9%**
5 Strategies	2%	1%	0%	**1%**

neither Canada's Species at Risk Act (2002) nor Australia's Environment Protection and Biodiversity Conservation Act (1999) includes such a list of threats. Australia's Act recognizes a "conservation-dependent" category that includes species that are "the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered" (EPBCA sec. 179(6)). Thus, a species could remain on the threatened species list even though it no longer meets the eligibility criteria, if delisting would seriously reduce the beneficial effects of management.

Conservation reliance is likely to become even more pervasive in the future. Wilcove & Master (2005) estimated that 14,000–35,000 species may currently be imperiled in the United States. These trends are not limited to the United States. Expanding human populations, the resulting degradation and fragmentation of habitats and spread of nonnative species, and the consequences of climate change will push more species toward extinction (Ricketts *et al.* 2005; Sekercioglu *et al.* 2008), swelling the ranks of conservation-reliant species. Globally, the International Union for Conservation of Nature (IUCN) Red List of species threatened with extinction continues to grow, from 16,118 species in 2007 to 17,291 species in 2009. The Intergovernmental Panel on Climate Change has projected that perhaps 20–30% of the species assessed to date are likely to have an increased risk of extinction if increases in average global warming exceed 1.5–2.5 °C (IPCC 2007). Clearly, we have seen only the tip of the iceberg.

What can be done? Part of the solution is in funding. In the United States, current funding is inadequate even to meet the conservation-management needs of those species that are currently listed (Miller *et al.* 2002). In 2003, for example, the U.S. Fish & Wildlife Service estimated that it would cost $153 million just to process the 286 candidate species then awaiting a listing decision; the total budget for all listing activities that year was only $16 million (Stokstad 2005) Things have not improved: the 2009 listing budget was actually less than the 2003 budget when adjusted for inflation (FWS 2009; www.fws.gov/budget/2009/2009%20GB/05.2%20Listing.pdf). As the ranks of conservation-reliant species continue to grow, the budgetary shortfall will only become greater. Other solutions must be sought.

We must begin by recognizing the extent and importance of conservation reliance. Presently, the listing of species and drafting of plans for their recovery revolve around the identification of threats that have caused imperilment and that must be addressed by recovery actions. Too often, the approach is based on a short-term response to an emergency. For recovery to be lasting, recovery plans should also include an evaluation of the threats that are likely to continue when recovery goals have been met. The management actions necessary to ameliorate these long-term threats should be incorporated into recovery plans at the outset. As experience with individual species increases, the recovery plans and postlisting management structure should become increasingly specific. This will reduce the chances that the extinction risk for a delisted species will increase once the legal protections of an endangered species act are removed (as with the woylie in Australia) as well as reduce the level of reliance of the species. Delisting of a species is a legal or regulatory step, not necessarily the endpoint of management.

The conservation-management actions needed to assist conservation-reliant species will also require the participation of a broad community of individuals and entities. Governments and nongovernmental conservation organizations and land trusts have been instrumental in protecting and managing places for nature, but protected areas alone will be insufficient to meet conservation goals (Wiens 2009). Management practices must be expanded to include a mix of public and private lands, balancing the priorities of differing land uses, ownerships, and conservation objectives (Walter *et al.* 2007; Freyfogle 2009). Incorporating a broader array of land uses and ownerships into the conservation agenda will depend on strong public-private partnerships. Fashioning such partnerships will require that management options be expanded beyond those available under the Endangered Species Act. One approach is to develop partnerships among federal and state agencies and nongovernmental organizations through the use of conservation-management agreements, which formalize the legal responsibilities of the conservation managers to meet the biological requirements of a species (Scott *et al.* 2005; Bocetti & Goble 2010). Incorporation of such a mechanism into the framework of the Endangered Species Act would require changes in policies and regulations, but not the law. A creative mix of regulations and incentives and a greatly expanded group of individuals involved in postrecovery management will be needed to ensure that conservation-reliant species receive adequate conservation efforts if and when they are delisted (Wilcove 2004; Parkhurst & Shogren 2006; Freyfogle 2009).

Even if new conservation partnerships are forged, the range of policy and management options is expanded, and the private sector is empowered to do more, the sheer number of current and future conservation-reliant species compels us to recognize that not all species can receive the same level of conservation attention (nor do they now). Priorities must be established for which species and ecosystems should be managed

and which management practices should be employed. Prioritization approaches based on cost-effectiveness or return-on-investment (e.g., Murdoch *et al.* 2007; Briggs 2009) offer some possibilities, but other approaches should also be explored. We have not been able here to consider differences in the magnitude and duration of the conservation actions required by different conservation-reliant species, but such information should be part of a prioritization effort.

The U.S. Endangered Species Act and similar instruments in other nations have worked well. Recognizing the degree of conservation reliance among imperiled species should not be taken to mean that recovery and delisting are unattainable goals or that conservation-reliant species are beyond hope. To avoid extinction, we must recognize when and where conservation reliance is likely to occur and incorporate it into conservation planning. It is also essential to implement the targeted monitoring that will be needed to detect when management can be reduced or removed without further imperiling a species or how management actions should be adjusted in the face of unanticipated demographic responses of target species to rapid environmental change. Conservation-reliant species are yet another indication that we live in human-dominated landscapes in which maintenance of biodiversity will increasingly require increased investments of time, money, and dedication by all segments of society.

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