Department of Defense

Legacy Resource Management Program

06-330

Establishing New Pathways to the Recovery of Species Under the Endangered Species Act

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Introduction

In the last century the United States population increased nearly fourfold from 76 to 291 million. In this same period the Gross Domestic Product increased at an even greater rate. The larger human population combined with their increased consumption of natural resources placed increased demands on this country's wildlife habitats. Prairies and diverse bottom land hardwoods were converted to agricultural lands, century-old forests were harvested, urban areas expanded into surrounding rural landscapes. We became the world's greatest economy. To facilitate transportation of people, goods and services to all Americans, America built a system of transportation corridors that crisscrossed the country in passages one to twelve lanes wide, linking the nation together from coast to coast and Mexico to Canada. The attendant loss and fragmentation of habitat left very few unaltered landscapes. Those few remaining "native" habitats were largely in parks, reserves, wildlife refuges and large public and private holdings. These areas became hotspots for wildlife. The thirty million acres of Department of Defense lands are among the best of these safe havens for wildlife particularly threatened and endangered species. Nearly four hundred military installations have "significant natural resources" and more than two thirds of those provide habitat for one or more threatened or endangered species (Boice 2006). Additional loss and fragmentation of wildlife habitat is expected in the next 100 years. The population of the United States is projected to be half a billion people by 2100 and the Gross Domestic Product will multiply several times over its value in 2000. Our ability to save natural areas will be exceeded by the losses of what few natural areas remain, leaving less space for wildlife.

The value of military reservations to federally listed threatened and endangered (T&E) species has increased as a consequence of the increased human populations and resulting urban, suburban, and rural development. Military managers are thus increasingly faced with challenges of balancing endangered species conservation with military missions and the need for training readiness. This challenge is complicated by incomplete or inconsistent directives for recovery of listed species (Boice 1997, 2000). Ambiguous recovery goals for species found on Department of Defense (DoD) lands can lead to resource management programs that fail to identify the most successful recovery actions, yet compromise the military's mission to provide realistic training opportunities.

For all the above and more reasons, the 30 million acres of Department of Defense land, a substantial portion of which belongs to the Army, provides some of the best and most important T&E species habitat in the nation (Groves et al. 2000; Stein et al. 2008). As of 2004, DoD lands provided habitat for more than 300 T&E species and have greater density of endangered species than any other public land holding (Current list of Threatened and Endangered Species, DENIX 2004). Military installations have been aggressive in promoting recovery of these species (Boice 2006) and DoD managers have been successful managing species such as red cockaded woodpecker, black-capped vireo, least tern, desert tortoise, and others. Nationally, however, the Endangered Species Act (ESA) has been criticized for failing to improve or recover the population status of most species listed as threatened or endangered. Under the ESA, recovery is envisioned as a state or condition, resulting from various conservation measures, in which a given species no longer requires the statutory protection of the ESA (Scott et al. 2005). While there are no standard criteria that define when a species has been recovered, the qualitative definition of a recovered species is one for which the risk of extinction has been reduced to the point that the species' survival in the wild is ensured (USFWS 1994). Decisions on a species' recovery goals vary widely (Stanish 2005) and recovery goals are often more political than biological (Tear et al. 1993; Scott et al. 1995). In practice, the number of individuals specified in recovery goals often varies by orders of magnitude even within a class of organisms (Wilcove et al. 1993).

The primary objectives of this research were to 1) assess the recovery status of T&E species on Department of Defense installation lands, 2) identify success stories, 3) compare the status of T&E species on military lands with those not found on military lands, 4) identify those T&E species that could be future success stories in relatively short time periods, 5) develop realistic time frames for evaluating the recovery status of a listed species, and 6) identify management practices on DoD lands that could prove effective in general species recovery.

Objective 1: Assess the Recovery Status of Threatened and Endangered Species on Department of Defense Lands

We assessed the recovery status of T&E species on Department of Defense lands in two ways: population status and recovery achieved. Based on United States Fish and Wildlife Service's Congress Report 2006 data, thirty-one percent of the T&E species occurring on DoD lands were stable or increasing in population status (USFWS 2006, Fig. 1). These numbers varied among taxonomic groups (USFWS 2006, Fig. 2). Those species with 75% or more of occurrences on DoD installations were nearly twice as likely to be increasing or stable than other species occurring on DoD lands (USFWS 2006, Table 1 and Fig. 3).

Table 1. Species with 75% or more occurrences on Department of Defense lands, their population status, and recovery objectives achieved (USFWS 2006).

Species	Branch	Recovery Objective	Population Status
San Clemente loggerhead shrike	Navy	2	I
San Clemente sage sparrow	Navy	2	S
San Clemente Island broom	Navy	2	I
San Clemente Island bush-mallow	Navy	2	S
Honohono	Army	1	U
San Clemente Island Indian paintbrush	Navy	1	S
San Clemente Island larkspur	Navy	2	S
San Clemente Island woodland-star	Navy	1	S
Saint Francis' satyr butterfly	Army	1	S
Rhadine infernalis	Army	1	U
Oahu tree snail (Achatinella dimorpha)	Army	1	U
Oahu tree snail (Achatinella livada)	Army	1	U
Oahu tree snail (Achatinella pulcherrima)	Army	1	U
Oahu tree snail (Achatinella rosea)	Army	1	U
Oahu tree snail (Achatinella valida)	Army	1	U
Tern, California least	Navy	3	D
Vireo, least Bell's	Navy	3	I

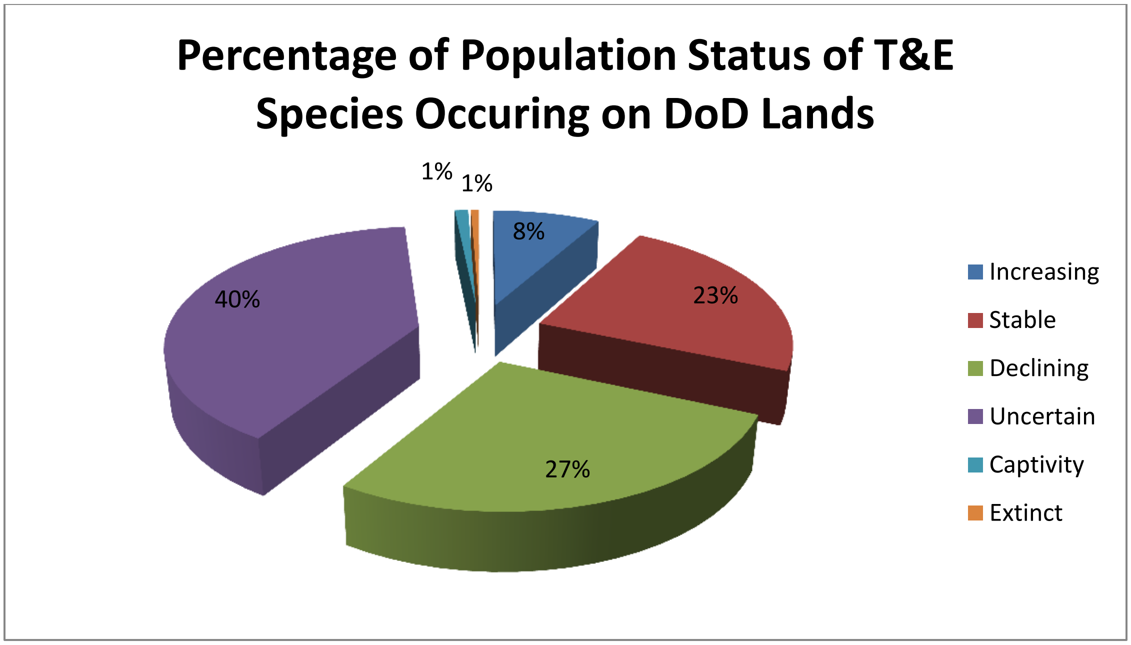

Figure 1. Population status of threatened and endangered (T&E) species occurring on Department of Defense (DoD) lands (USFWS 2006).

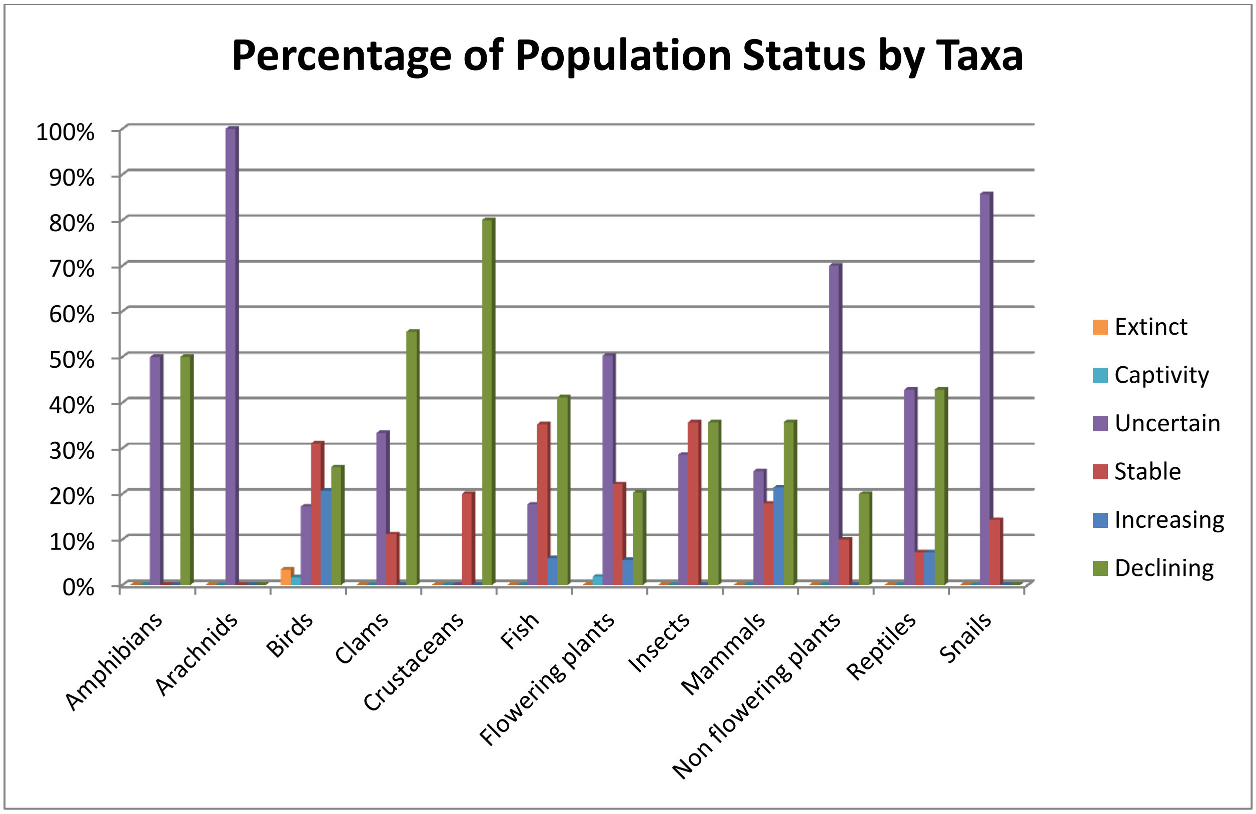

Figure 2. Population status by taxonomic group (USFWS 2006).

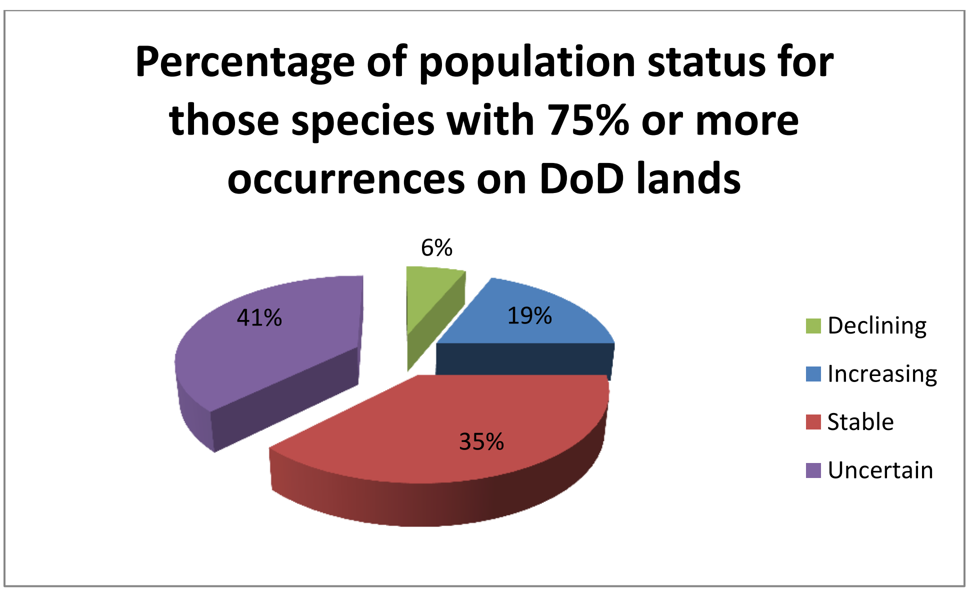

Figure 3. Population status of T&E species with 75% or more occurrences on Department of Defense (DoD) lands (USFWS 2006).

A second measure of conservation success is recovery objectives achieved. Seven percent of T&E species on DoD properties had 50% or more of recovery objectives achieved (USFWS 2006, Fig. 4). As with population status, the percent of recovery objectives achieved varied among taxonomic groups (USFWS 2006, Fig. 5). Species with 75% or more of their occurrences on DoD lands had more recovery objectives achieved than did other T&E species on DoD lands USFWS 2006, (Fig. 6).

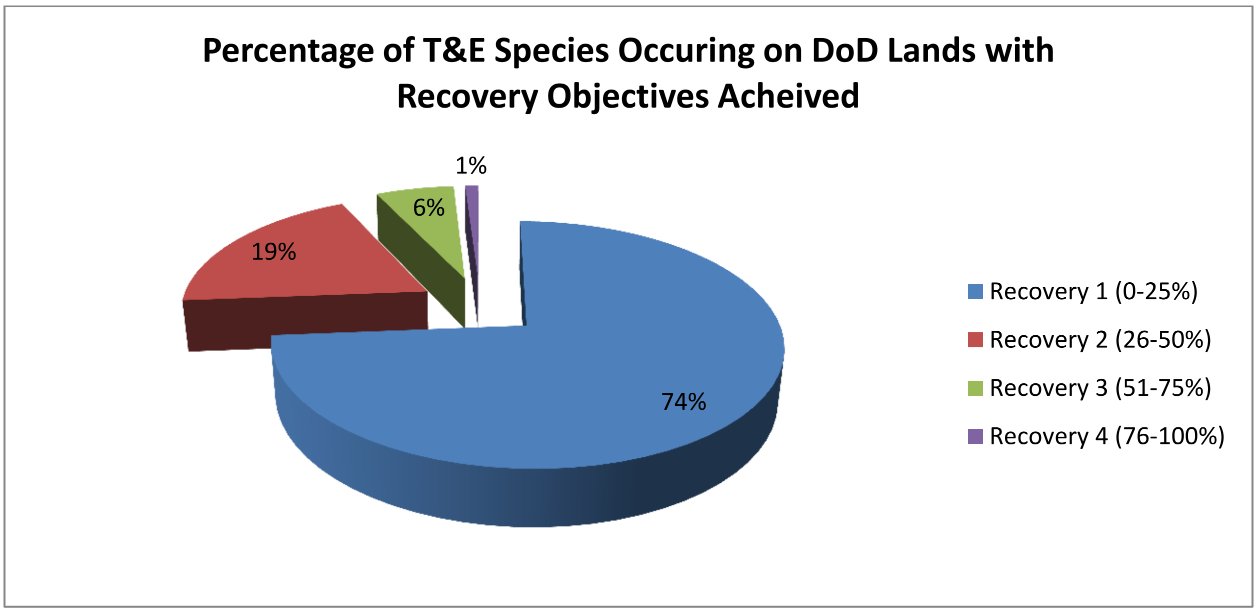

Figure 4. Recovery objectives achieved for threatened and endangered species occurring on Department of Defense lands (USFWS 2006).

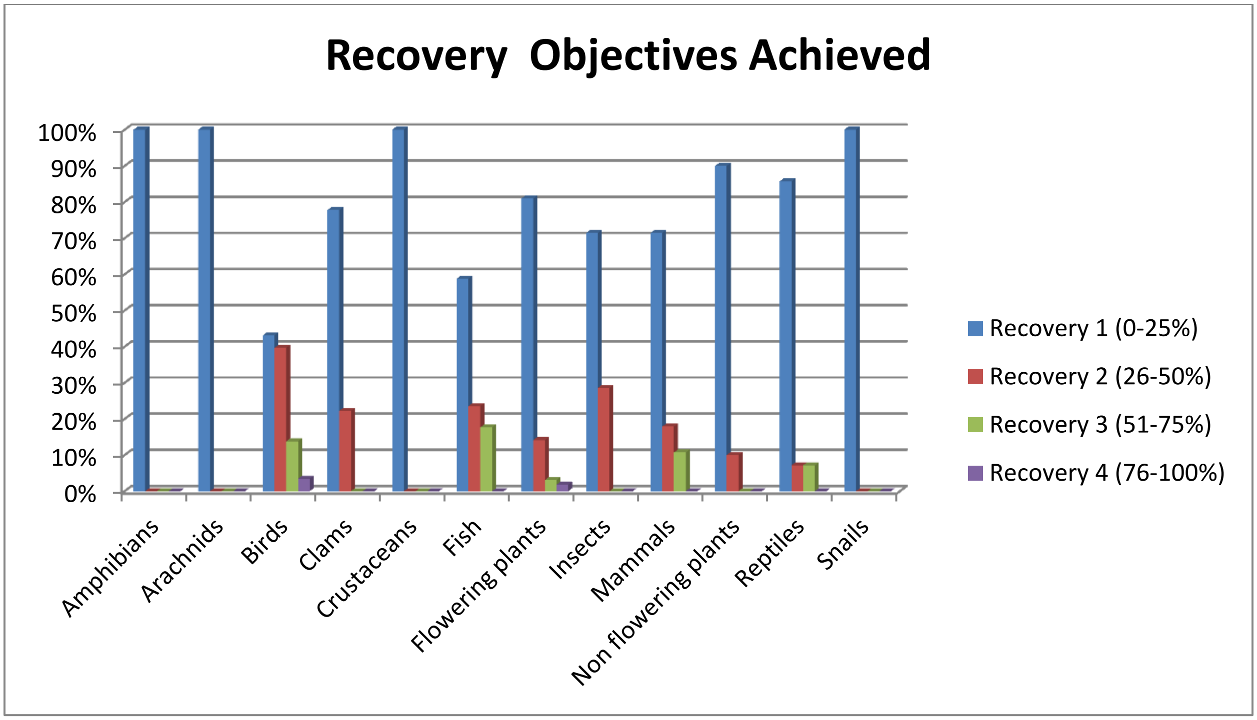

Figure 5. Recovery objectives achieved by taxonomic group for threatened and endangered species occurring on Department of Defense lands (USFWS 2006).

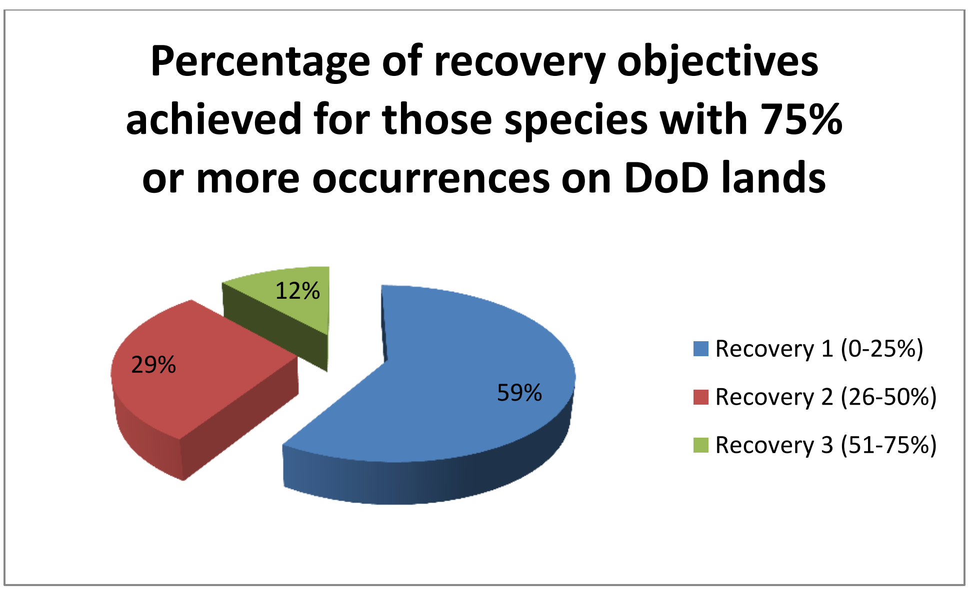

Figure 6. Percent of recovery objectives for species with 75% or more occurrences on Department of Defense lands (USFWS 2006). None of these species had greater than 75% of recovery objectives achieved.

Objective 2: Identify Success Stories

What constitutes 'success' under the Endangered Species Act has been the focus of a great deal of attention. Success, as with recovery, is a process not an event in the conservation of endangered species. Below we present the DoD record for five steps in the recovery process: prevention of extinction, stabilized population, improving population, downlisted, and delisted.

In the most recent US Fish and Wildlife Service Report to Congress (USFWS 2006), 28 species were reported as presumed extinct. Only two of these species, Oahu creeper and Bachman's warbler, were known from DoD lands and both were also found elsewhere. None of the four species that have been delisted because of extinction were reported from DoD installations (USFWS 2006). For the 3.6% of species reported as presumed extinct in the USFWS 2004 report to Congress (USFWS 2006), species found on DoD lands were five times less likely to have become extinct than those found elsewhere (USFWS 2006, Fig. 7). As previously discussed in the section on species status, 23% of species on DoD lands had stable populations and 8% of species occurring on DoD lands were improving in population status (USFWS 2006, Fig. 1). Eight of 19 downlisted species and 10 of 17 delisted species occurred on DoD lands (USFWS 2006,Table 2). Several of the delisted species (e.g., American alligator, Arctic peregrine falcon, Aleutian Canada goose) were also downlisted prior to delisting but are only reported here as delisted.

Table 2. Species known to occur on Department of Defense lands that have been downlisted, delisted, or proposed for reclassification because of recovery (USFWS 2008).

Species	Status
Alligator, American	Delisted
Eagle, bald	Delisted
Falcon, American peregrine	Delisted
Falcon, Arctic peregrine	Delisted
Goose, Aleutian Canada	Delisted
Monarch, Tinian	Delisted
Pelican, Brown (Atlantic coast)	Delisted
Sunflower, Eggert's	Delisted

Wolf, gray (MN)	Delisted
Wolf, gray (Western Great Lakes)	Delisted
Crocodile, American (Fl. Pop)	Downlisted
Pogonia, small whorled	Downlisted
Prairie dog, Utah	Downlisted
Salamander, California tiger (Sonoma county)	Downlisted
Skullcap, large-flowered	Downlisted
Trout, greenback cutthroat	Downlisted
Trout, Lahontan cutthroat	Downlisted
Wolf, gray (lower 48 States)	Downlisted
Hawk, Hawaiian	Proposed for downlisting
Mouse, Preble's meadow jumping	Proposed for delisting
Pelican, Brown (entire, except Atlantic Coast pops)	Proposed for delisting

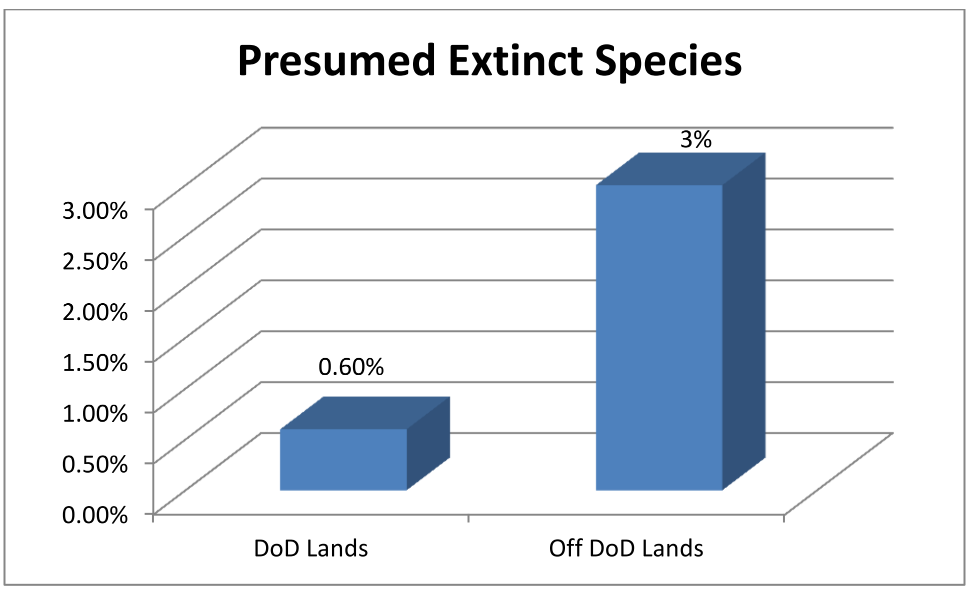

Figure 7. Percent of threatened and endangered species reported as presumed extinct by the U.S. Fish and Wildlife Service (USFWS 2006).

Objective 3: Compare The Status Of Threatened And Endangered Species On Department Of Defense Lands With Those Not Found On Military Lands.

Department of Defense lands have habitat for 25.6% percent of threatened and endangered species. Here we report on the comparative conservation status of species found on DoD lands, and the conservation expenditures on their behalf, with those for T&E species found elsewhere.

As indicated previously, species on DoD lands were far less likely to have become extinct (USFWS 2006, Fig. 7). However there were no significant differences in population status between those T&E species on DoD lands and those found elsewhere (USFWS 2006, Fig. 8). Those species with 75% or more of their occurrences on DoD lands were more than twice as likely to have stable or increasing populations (Fig. 9). However, we found no significant differences in recovery objectives achieved between species occurring on DoD lands and those found elsewhere (USFWS 2006, Fig. 10). Those T&E species with 75% or more of their occurrences on DoD lands were 42% more likely to have achieved >50% of recovery objectives (Fig. 11).

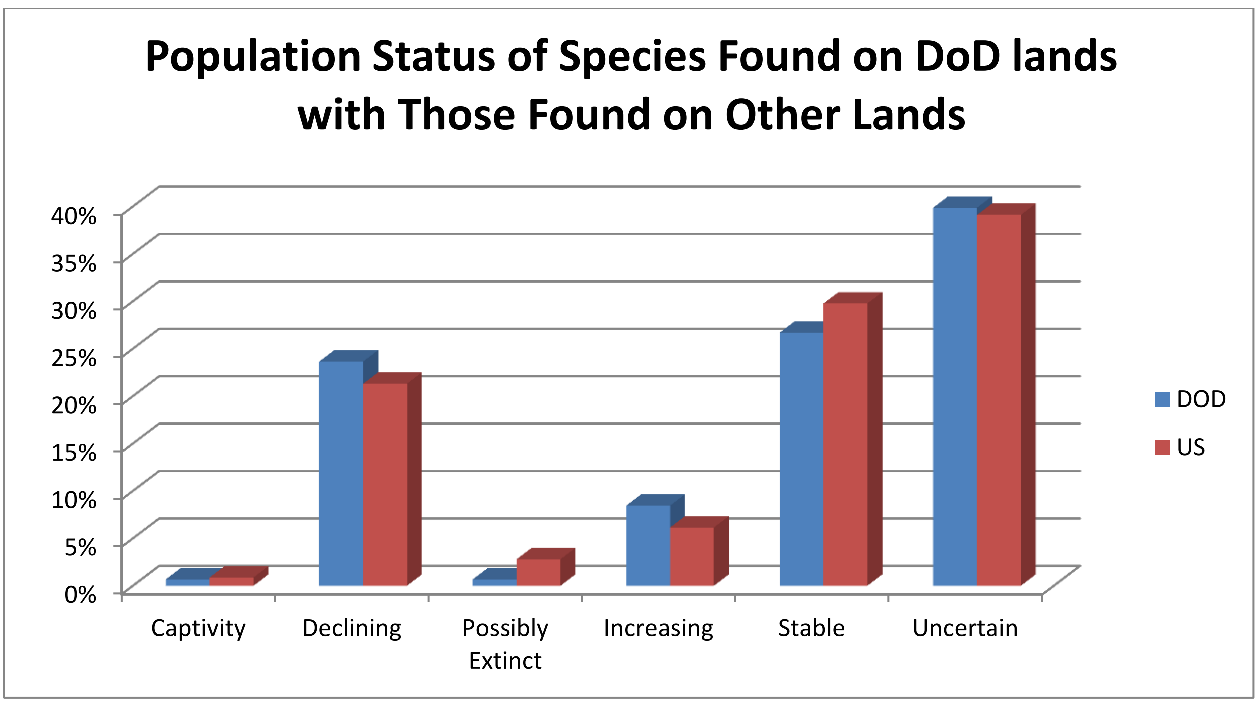

Figure 8. Population status for threatened and endangered species found on Department of Defense (DoD) lands compared with those found on other lands (USFWS 2006).

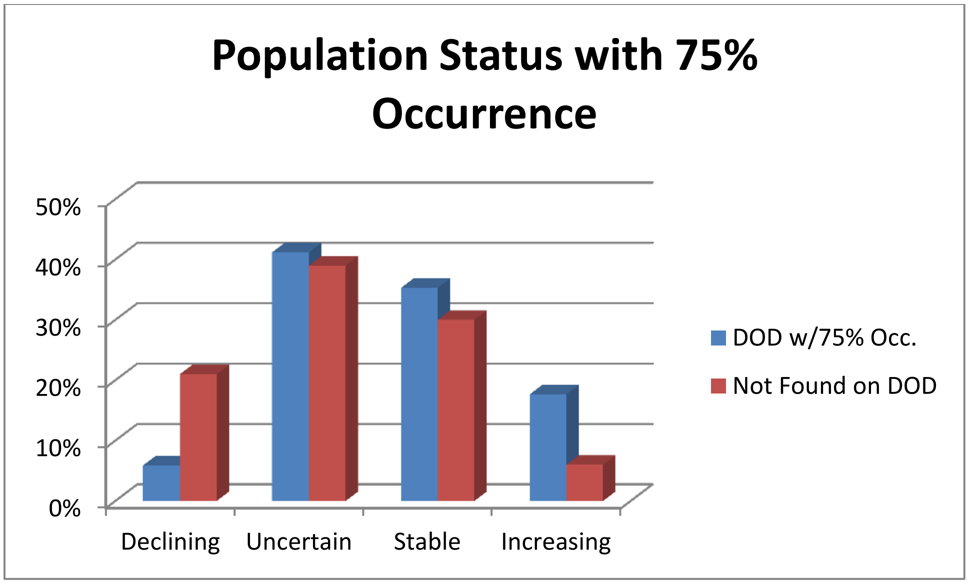

Figure 9. Population status of species with 75% or more occurrences on Department of Defense (DoD) lands with those found on other lands.

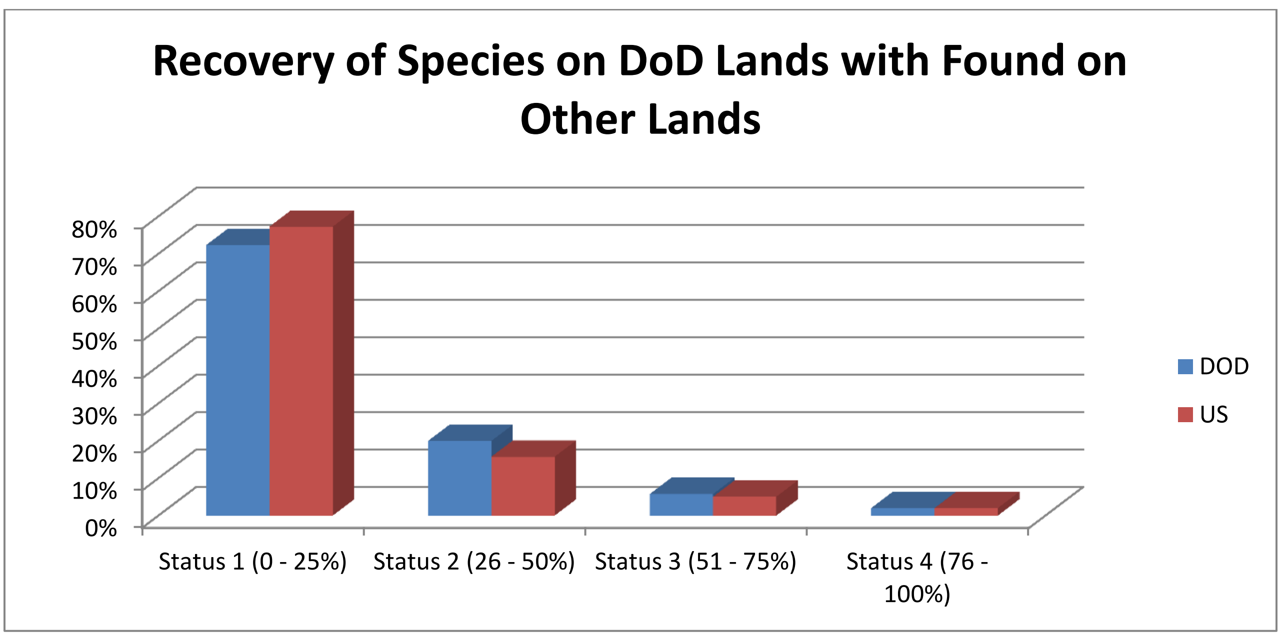

Figure 10. Recovery objectives achieved for threatened and endangered species found on Department of Defense (DoD) lands compared with those found on other lands (USFWS 2006).

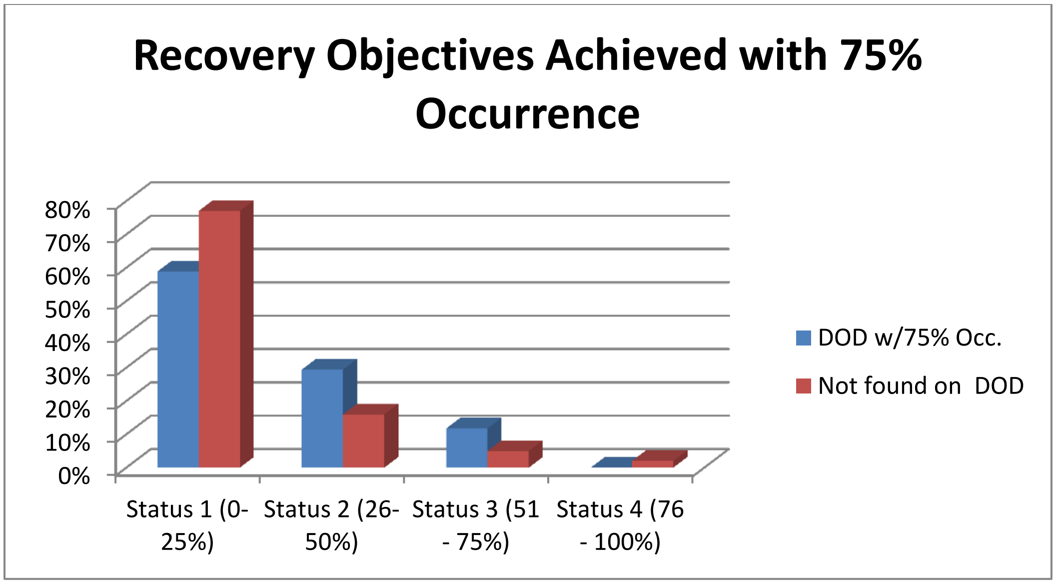

Figure 11. Recovery objectives achieved for species with 75% occurrences on Department of Defense lands with those found on other lands.

With responsibility for 25.6% of T&E species in 2004, Department of Defense expenditures were 47.8% of those of the US Fish and Wildlife Service (Fig. 12) and they spent more dollars for each species under their authority than did the Service (Fig. 14). Expenditures varied among taxonomic groups with mammals (Fig. 13), birds (Fig. 14), and reptiles (Fig.15) receiving the greatest funds and DoD expenditures exceeding USFWS expenditures for snails (Fig. 18), flowering plants (Fig. 22), and non-flowering plants (Fig. 22).

Expenditures also varied among the military service groups with US Department of Army spending the greatest amount (Fig. 29, Appendix B).

Expenditures: see additional graphs and tables in Appendices A and B.

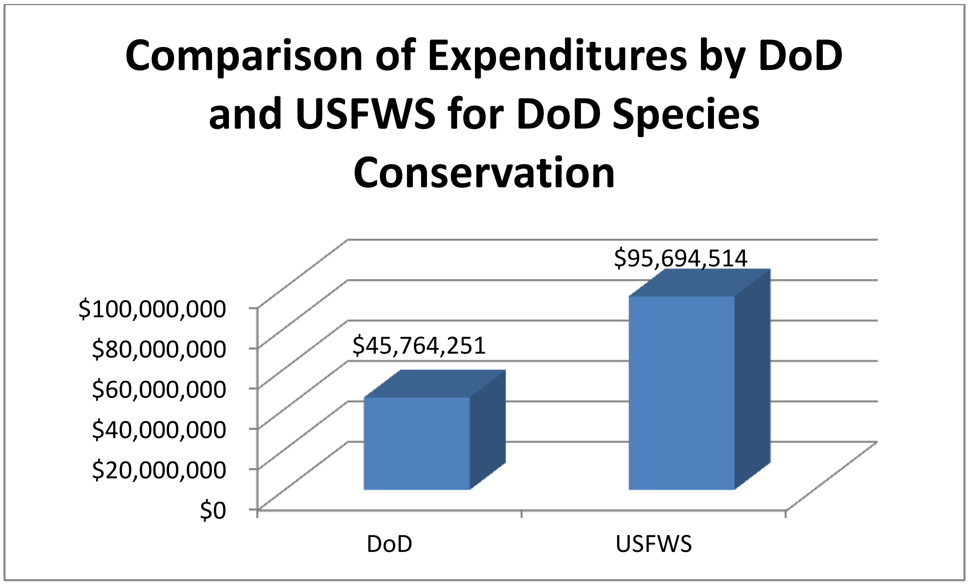

Figure 12. Comparison of expenditures by Department of Defense and US Fish and Wildlife Service for DoD species conservation (USFWS Expenditures 2004).

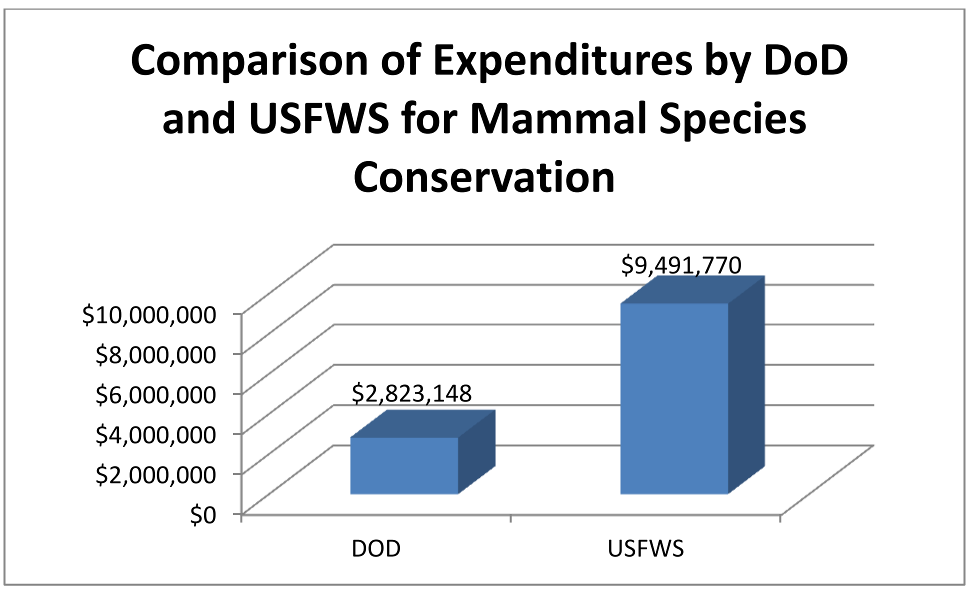

Figure 13. Comparison of expenditures by Department of Defense (DoD) and US Fish and Wildlife Service for mammal species (USFWS Expenditures 2004).

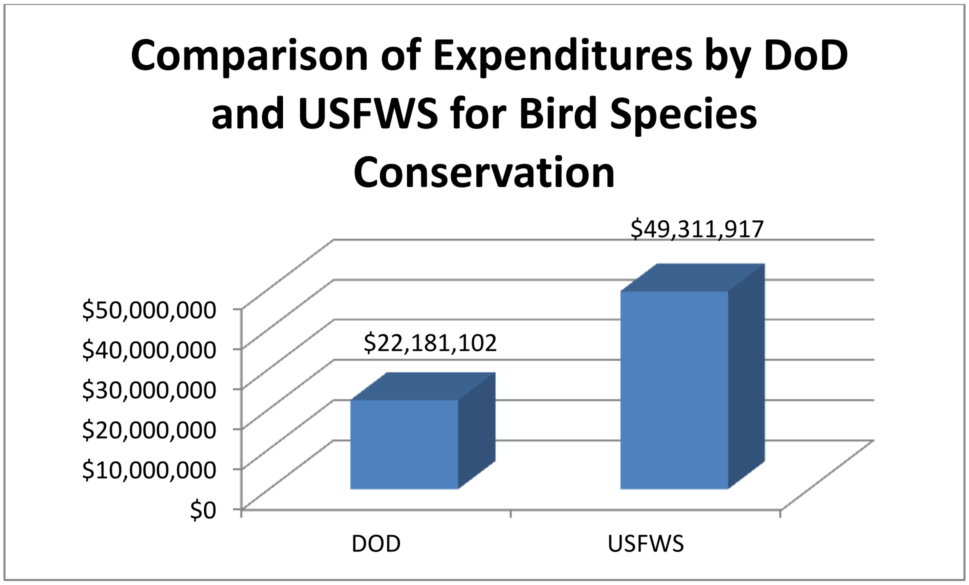

Figure14. Comparison of expenditures by Department of Defense (DoD) and US Fish and Wildlife Service for bird species (USFWS Expenditures 2004).

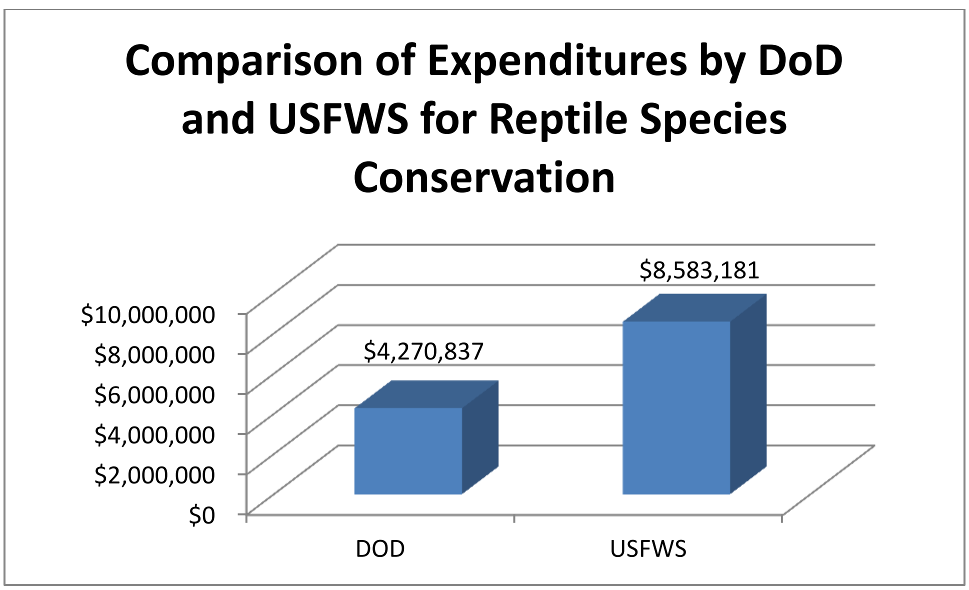

Figure 15. Comparison of expenditures by Department of Defense (DoD) and US Fish and Wildlife Service for reptile species (USFWS Expenditures 2004).

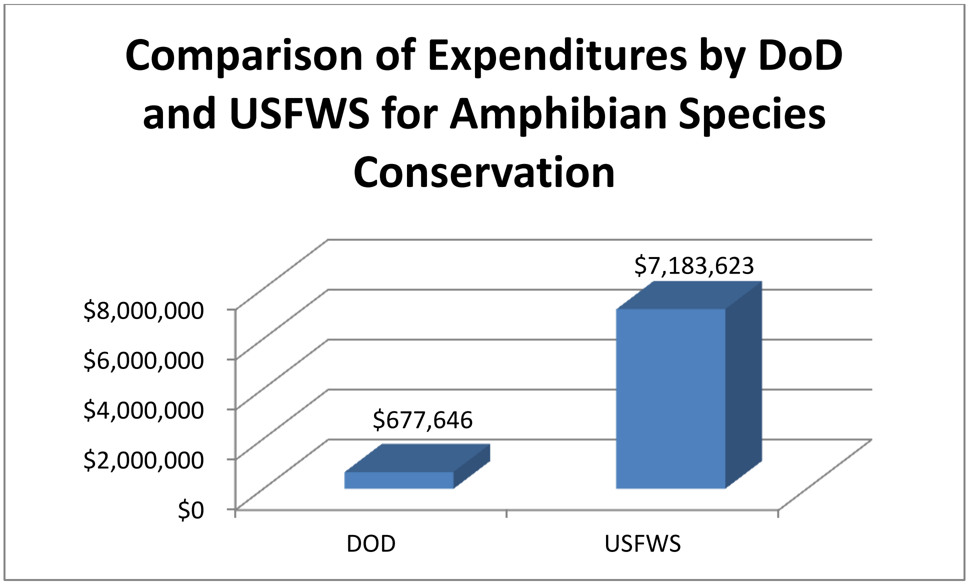

Figure 16. Comparison of expenditures by Department of Defense (DoD) and US Fish and Wildlife Service for amphibian species (USFWS Expenditures 2004).

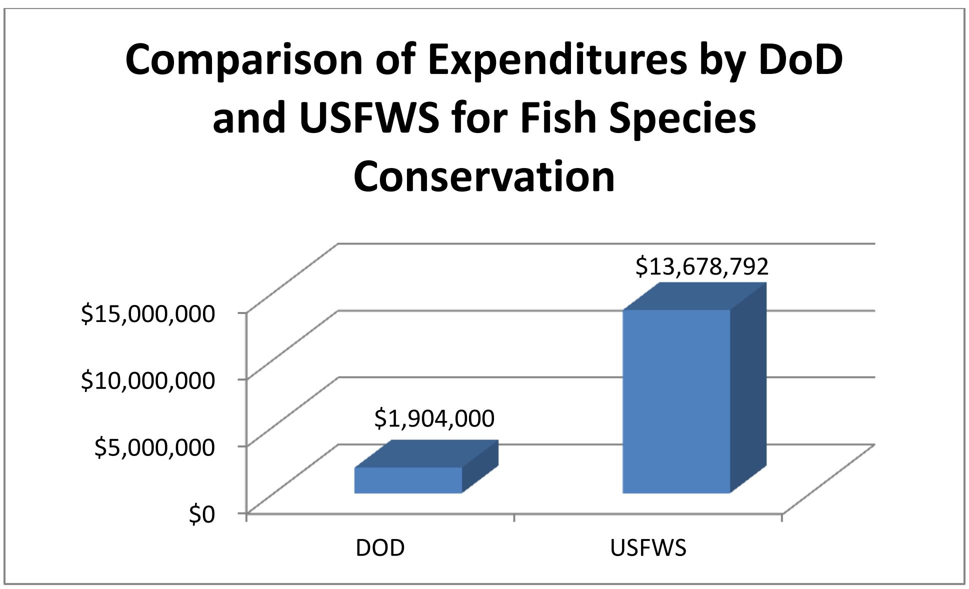

Figure 17. Comparison of expenditures by Department of Defense (DoD) and US Fish and Wildlife Service for fish species (USFWS Expenditures 2004).

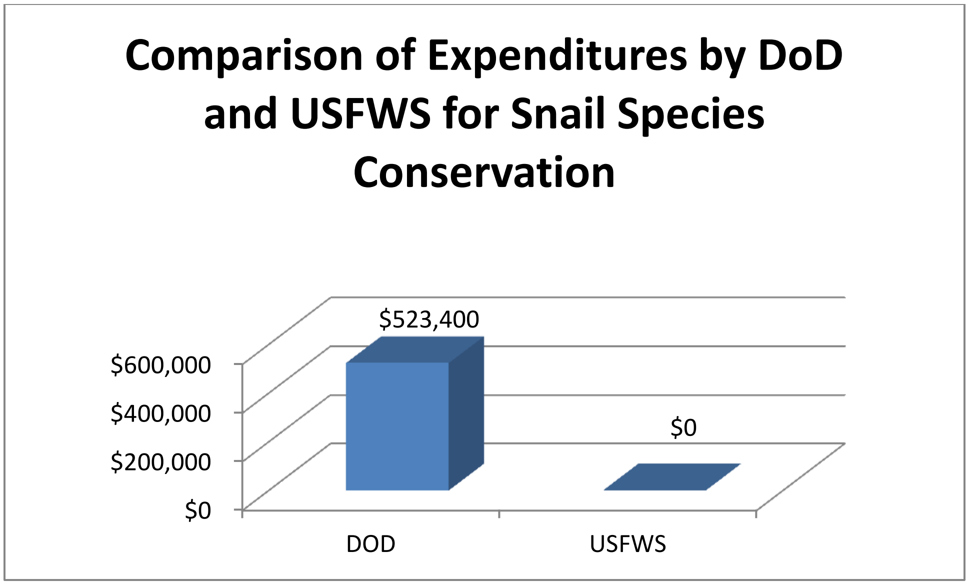

Figure 18. Comparison of expenditures by Department of Defense (DoD) and US Fish and Wildlife Service for snail species (USFWS Expenditures 2004).

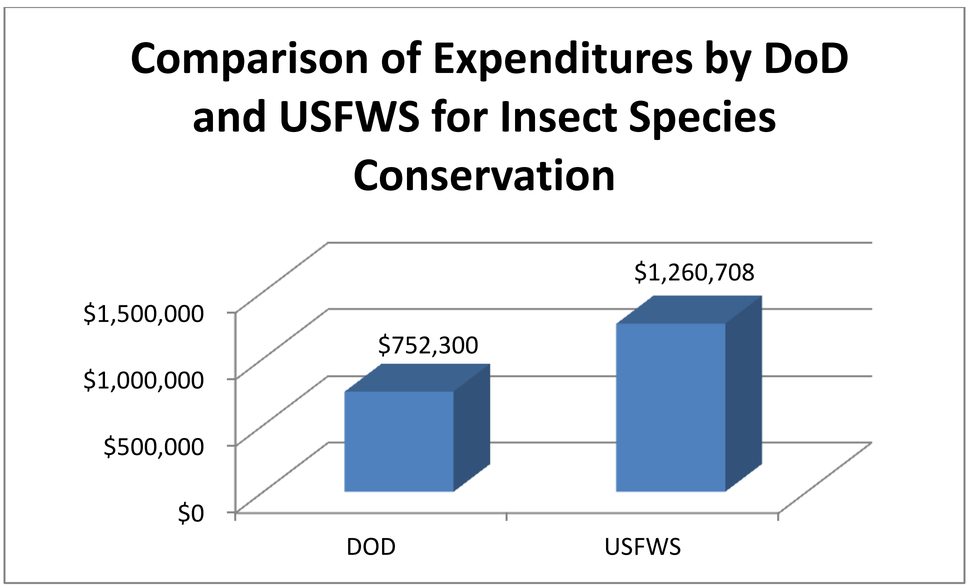

Figure 19. Comparison of expenditures by Department of Defense (DoD) and US Fish and Wildlife Service for insect species (USFWS Expenditures 2004).

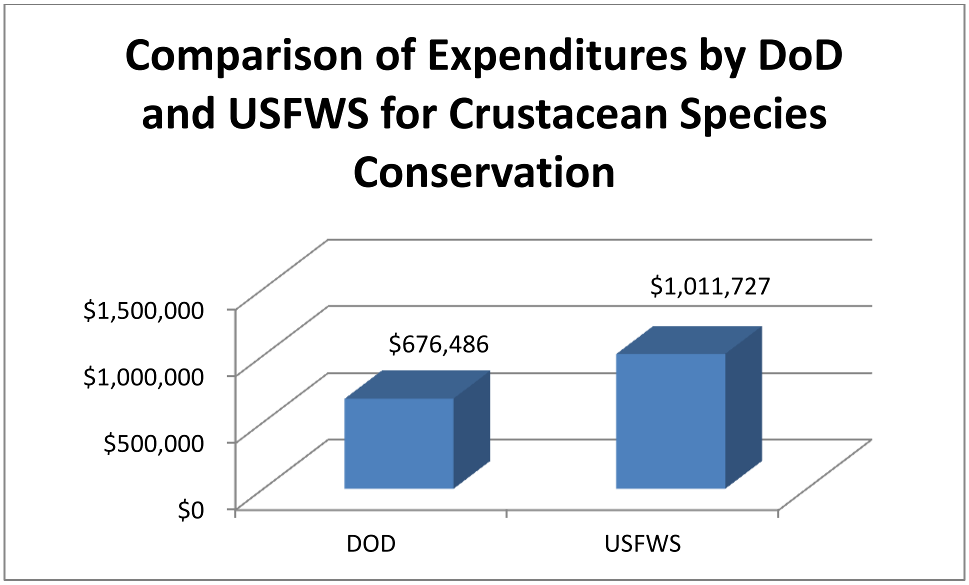

Figure 20. Comparison of expenditures by Department of Defense (DoD) and US Fish and Wildlife Service for crustacean species (USFWS Expenditures 2004).

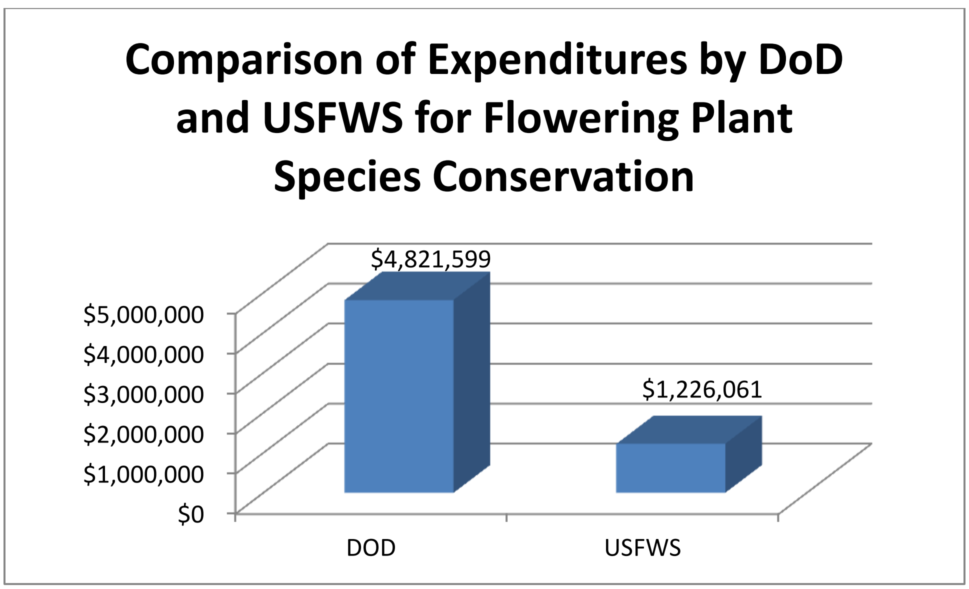

Figure 21. Comparison of expenditures by Department of Defense (DoD) and US Fish and Wildlife Service for flowering plant species (USFWS Expenditures 2004).

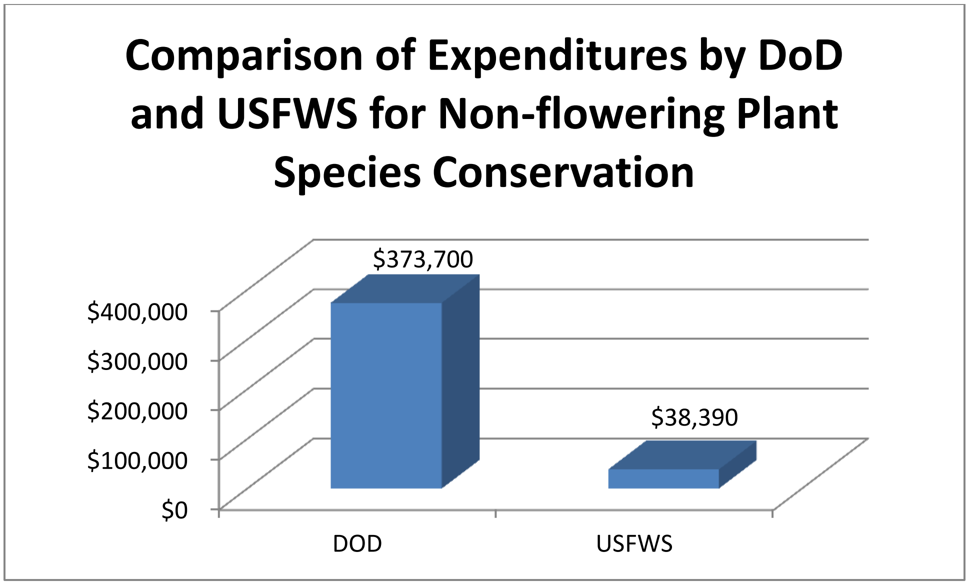

Figure 22. Comparison of expenditures by Department of Defense (DoD) and US Fish and Wildlife Service for non-flowering plant species (USFWS Expenditures 2004).

Objective 4: Identify Those Species That Could Be Future Success Stories In Relatively Short Time Periods.

We identified 32 species considered to be possible future success stories (Table 3). These are species with > 50% of recovery objectives achieved, stable or increasing populations, and /or identified as possible success stories by one or more groups (USFWS 2006; Babbitt 1998; Boice 1996). These species are considered by many to be potential speedy success stories. The potential for these species to be future success stories is supported by the delisting of three of them (Eggert's sunflower, gray wolf, bald eagle), the proposed delisting of two (brown pelican, Preble's jumping mouse), and proposed down listing of yet another (the Hawaiian hawk) during our study. To this list we would add the 11 species that have 75% or more of their occurrences on Department of Defense lands (Table 1). We include these species because those are the species over which Department of Defense can effect recovery actions over all or a significant portion of the species range by actions taken on DoD lands and through collaborative conservation partnerships with adjacent landowners using programs like the Army Compatible Use Buffer Program (ACUB) or any of the many USFWS conservation tools (e.g., Safe Harbor Agreements, Conservation Credits System, Conservation Easements, Conservation Bank, etc.). Six of these species were among the top 100 species funded by the U.S. Fish and Wildlife Service in 2004 and five were among the top 10 species funded by Department of Defense since 1991 (Table 4).

Table 3. Potential speedy success stories of threatened and endangered species (FWS 2006; Boice 1996; Babbitt 1998; Center for Biological Diversity 2008).

Species	Type	Recovery Achieved	Population Status	Conservation Reliant	Top/Bottom 100 of Expenditures 2004	Success Story Identified By	% Occurrence on DoD Lands	Downlisted/ Delisted
Bat, gray	Mammal	51%-75%	Improving	Yes	top	FWS Report 2006	50-75%	-
Clover, running buffalo	Flowering plant	51%-75%	Stable	No	-	FWS Report 2006	n/a	-
Coot, Hawaiian	Bird	51%-75%	Stable	Yes	-	FWS Report 2006	0-25%	-
Crocodile, American*	Reptile	76%-100%	Improving	No	-	FWS Report 2006	50-75%	Downlisted
Darter, Okaloosa	Fish	51%-75%	Stable	Yes	-	FWS Report 2006	50-75%	-
Eagle, bald	Bird	76%-100%	Improving	No	-	FWS Report 2006	50-75%	Delisted
Goby, tidewater*	Fish	51%-75%	Stable	Yes	-	FWS Report 2006	50-75%	-
Hawk, Hawaiian	Bird	76%-100%	Improving	Yes	-	FWS Report 2006	0-25%	-
Howellia, water	Flowering plant	76%-100%	Stable	No	-	FWS Report 2006	n/a	-
Monkshood, northern wild	Flowering plant	51%-75%	Stable	Yes	-	FWS Report 2006	n/a	-
Mouse, Choctahwatchee beach	Mammal	51%-75%	Uncertain	Yes	-	FWS Report 2006	0-25%	-
Otter, southern sea	Mammal	51%-75%	Improving	Yes	bottom	FWS Report 2006	n/a	-
Pagonia, small-worled	Flowering plant	51%-75%	Stable	No	-	FWS Report 2006	n/a	Downlisted
Palila	Bird	51%-75%	Stable	Yes	top	FWS Report 2006	0-25%	-
Sea turtle, Hawksbill	Reptile	51%-75%	Uncertain	Yes	top	FWS Report 2006	0-25%	-
Skullcap, large flowered	Flowering Plant	51%-75%	Stable	Yes	-	FWS Report 2006	n/a	Downlisted
Stilt, Hawaiian	Bird	51%-75%	Stable	Yes	-	FWS Report 2006	50-75%	-
Stork, wood	Bird	51%-75%	Stable	Yes	top	FWS Report 2006	50-75%	-
Sunflower, Eggert's	Flowering Plant	76%-100%	Stable	No	-	FWS Report 2006	n/a	Delisted
Tern, California least	Bird	51%-75%	Declining	Yes	top	FWS Report 2006	75-100%	-
Trout, greenback cutthroat	Fish	51%-75%	Improving	Yes	-	FWS Report 2006	25-50%	Downlisted
Vireo, least Bell's	Bird	51%-75%	Improving	No	-	FWS Report 2006	75-100%	-
Warbler, Kirtland's	Bird	51%-75%	Improving	Yes	-	FWS Report 2006	50-75%	-
Whitlow-wort, papery	Flowering plant	76%-100%	Uncertain	Yes	-	FWS Report 2006	n/a	-
Wireweed	Flowering plant	51%-75%	Uncertain	Yes	-	FWS Report 2006	n/a	-

Wolf, gray	Mammal	76%-100%	Stable	No	-	Babbitt	0-25%	Delisted
Frog, California redlegged	Amphibian	0-25%	Uncertain	Yes	top	Babbitt	50-75%	-
Shrike, San Clemente loggerhead	Bird	26%-50%	Improving	Yes	-	Ctr. for Biodiversity	75-100%	-
Snail, Oahu tree	Snail	0-25%	Uncertain	Yes	-	Babbitt	75-100%	-
Sparrow, San Clemente sage	Bird	26%-50%	Stable	Yes	-	Ctr. for Biodiversity	75-100%	-
Paintbrush, San Clemente Island	Flowering plant	0-25%	Stable	Yes	bottom	Ctr. for Biodiversity	75-100%	-
Woodpecker, red cockaded	Bird	0-25%	Improving	Yes	top	Boice	50-75%	-

*based on observed occurrences

Table 4. Species from Table 3 that have been the top ten funded species since 1991 for Department of Defense.

Common Name	Scientific Name	Group	Total Expenditures since 1991 ($ 1000's)
Woodpecker, Red Cockaded	Picoides borealis	birds	67352.2
Shrike, San Clemente loggerhead	Lanius ludovicianus mearnsi	birds	17282.9
Darter, Okaloosa	Etheostoma okaloosae	fishes	8438
Eagle, Bald	Haliaeetus leucocephalus	birds	8427.5
Tern, California Least	Sterna antillarum browni	birds	8352

Objective 5: Develop Realistic Time Frames For Evaluating The Recovery Status Of A Listed Species.

How long does it take to recover a species from the brink of extinction? The record of species delisted since passage of the Endangered Species Act provides one answer to that question. Nineteen species have been downlisted because of recovery. The median time to downlist a species was 11 years 4 months, the longest was 39 years 4 months. For the 19 species that have been delisted, median time to delisting was 24 years (range 7-40 years). Five of the 78 species first listed (Wilcove and McMillan 2006) have been delisted, one has been downlisted. Thus 92% of the first group of species listed have yet to be down or delisted. These findings are consistent with the four to five decades and longer that we found for the 20 species of vertebrates for which we modeled projected time to recovery. Thus, our findings suggest that realistic estimates of time to full recovery for species will generally be measured in decades, not years. This will likely be affected by life history characteristics of species and the level of risk one is willing to assume (Noon et al. this report; Goble this report). In the next section we present the details of our analysis of time to recovery for 20 vertebrate species.

Estimating Recovery Times for Threatened and Endangered Species

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Introduction

Some members of the United States Congress have sought to change the Endangered Species Act (ESA) because, they argue, the Act has resulted in the "recovery" of only a very small number of listed species. Since the Act has as its primary goal the 'recovery' of threatened and endangered species some have claimed that it is in need of amendment. One of the key problems is that "recovery" is not defined in the Act. In practice, recovery has been loosely and ambiguously interpreted to mean improvement in the status of a listed species so that it will no longer require the protections of the Act. In practice, this generally means the existence of one or more populations that have finite rates of increase greater than 1 and which are sufficiently large to be buffered from normal environmental variation. One of the main reasons that recovery remains vague is because recovery cannot be defined except in probability terms.

It is not at all clear that the number of species recovered since the Act was passed in 1973 is the best metric for evaluating the success of the Act. For example, if the Act were evaluated in terms of the number of listed species that would otherwise have gone extinct if not listed, the Act appears to be very successful. In addition, it seems inappropriate to criticize the Act in terms of number of species recovered without first having some idea of expected time to achieve recovery. Recovery times for threatened and endangered species will vary across species according to the severity of threats to its persistence and the status of the species' population(s) at the time of listing. The multiple factors influencing recovery times can be partitioned into those that are inherent to the species life history and ecology (intrinsic factors; Table 5) and those that have to do with the human-induced threats and natural environmental variation (extrinsic factors; Table 6).

Table 5. Intrinsic factors affecting recovery times.

1) Initial population size(s) at the time of listing.
2) Age and sex distributions at the time of listing.
3) Age at first reproduction.
4) Reproductive potential of the species
5) Maximum attainable survival rates
6) Variance in parameters 1 -5.
7) Density-dependent factors affecting birth and/or survival rates.
8) The species longevity and whether it experiences reproductive senescence.
9) Spatial distribution of the species across the landscape (for those species with multiple, distinct populations).

Table 6. Extrinsic factors affecting recovery times.

1) The degree to which threats that originally put the species at risk have been addressed and mitigated.
2) Emerging, novel threats.
3) Shifts in environmental conditions that change the expected value of birth and survival rates (e.g., global climate change).
4) Slow rates of recovery for factors limiting population growth (e.g., habitat such as old-growth forest that takes decades or centuries to return to suitable conditions forest).
5) Catastrophic events (e.g., floods, fire, storms).

In practice, we believe that decisions as to whether or not a species is recovered will most often be based on its attaining some threshold population size. Such thresholds will have to be set high enough so that the decision point is sufficiently precautionary to address most future threats to persistence. Setting threshold population sizes, and stipulating a statement of acceptable risk, are policy, not scientific decisions. However, those decisions can be greatly informed by science by evaluating the relationship between future population size and variation in one or more intrinsic population factors (Table 1). The research results we present below focus primarily on the intrinsic factors affecting recovery times, with an ultimate goal of estimating how time to recovery varies. This will be accomplished by using stochastic demographic projection matrices based on discrete-time representation of population dynamics (Caswell 2001).

The question of times to recovery and how recovery times are expected to vary across species has been addressed in a preliminary way by Calder (2000). Calder's approach was to estimate the time required for initial population size (N_0) to double ($N_T = 2N_0$ = recovery goal) based on allometrically derived estimates of intrinsic growth rate ($r = \ln\lambda$) and assuming a model of exponential growth ($N_t = N_0 e^{rt}$). At a particular annual growth rate, r, the time its takes a population to double in size is: $t_{2N} = 0.69/r$. Published estimates of the relationships between r and body mass (M) are available for mammals (e.g., Hennemann 1983, Caughley and Krebs 1983, Thompson 1987). However, these published relationships vary extensively. As a compromise solution, Calder (2000) combined all eutherian mammal estimates to derive the following relationship in (kg): $r = 0.99M^{-0.33}$ and the reciprocal function $t_{2N} = 0.69M^{0.33}$.

In a similar fashion, Calder (2000) estimated the r-M relationship for birds to be approximately 1/3 of mammal r because of inherent differences in reproductive output. Calder used an alternative approach developed by May and Rubenstein (1984) to estimate r based on average life time reproduction of females (R_0 = annual fecundity X life expectancy) and age at first reproduction (t_{mat}): $r = \ln(R_0)/t_{mat}$. When this equation was combined with fecundity allometry (Allaine et al. 1987) and estimates of t_{mat} (Calder 1996), the resulting relationship for birds was: $r = 1.12M^{-0.17}$. This equation gives a population doubling time estimate for birds based exclusively on body mass of: $t_{2N} = 7.1M^{0.17}$.

The allometric approach of Calder (2000) is a useful first approximation of the relationship between doubling times and body mass. Allometrically based, deterministic analyses that do not directly incorporate information on birth and survival rates or their annual variation will generally yield too optimistic estimates of recovery times. Year-to-year variation in vital rates will generally increase the time it takes to double initial population sizes and introduces the possibility that small populations may going extinct before attaining a target size. As a consequence, the allometrically-based estimates of r used by Calder (2000) yield optimistic and probably unrealistically short population doubling times.

We take a different approach from Calder in estimating the time it takes to recover a population to a target size. Instead of having maximum growth rate determined by a species mean body mass, we set growth rate at various levels and estimate time to recovery for different initial conditions and degrees of environmental variance. By evaluating all species over the same set of growth rates we essentially remove any among species variance that can arise from differences in λ. Any observed differences among species will not be attributable to differences in λ but are a consequence of a species' life history structure (its birth and survival schedule) and different degrees of environmental variation.

Ultimately, we believe that an evaluation of the success of a recovery program, such as one based on future population sizes, need to be based on a realistic assessment of a species' demographic potential. To illustrate one approach, we compute estimates of expected times to recovery for a subset of avian species currently listed as threatened or endangered under the ESA. The subset was restricted to those species for which there were estimates in the published literature of their age- or stage-specific vital rates. When listed, most species have vital rates that do not provide for a growing population ($\lambda < 1.0$). In this case, the underlying causes of endangerment have not been addressed and such species will not recover over any time period. So, to estimate recovery times we had to first assume positive growth rates which required several simplifying assumptions. First, the threats that originally put the species at risk have been addressed. Second, the initial population sizes (N_0) are sufficiently large so that demographic stochasticity is not an issue. Third, no new threats to persistence have arisen in the interim. Fourth, population growth is exponential and independent of density. We accomplish this using an age-structured or stage-structured projection matrix model with stochastically varying birth and survival rates over a range of initial population sizes and growth rates.

Methods

We searched the USFWS Endangered Species web site for a list of bird species listed as threatened or endangered under the ESA. We then searched the published literature for each of these species to determine the availability of estimates of age- or stage-specific birth and death rates. All species with vital rate estimates were entered into a data base for subsequent analysis. For these species, we represented their life history structure with an age- or stage-based projection matrix whose dimension was based on the number of ages (stages) reported in the literature. For all simulations, we set the lower right entry in the projection matrix (element $\theta_{n,n}$) to the adult survival rate. This had the effect of ignoring life span (usually unknown) and assumed no senescence decline in survival or reproduction, both optimistic assumptions. We assumed an all-female exponential growth model where the dynamics were described via a stochastic projection matrix.

We found that most published birth and survival rate estimates were not accompanied by reliable estimates of their standard errors. If standard errors were reported, most estimates confounded sampling error with true process variance. Our approach assumed that vital rate variance increased with the mean value of the rate. Therefore, we simulated variation in the vital rates by assigning a specific coefficient of variation (cv) to each survival and birth rate. The lower and upper bounds on the cv set the lower and upper bounds on a uniform distribution centered on the mean value of the vital rate. At each time step, for each vital rate, a parameter value was selected from the corresponding uniform distribution. This amounts to an assumption of independence among the vital rates. Even though this may seldom be true, and our model was able to incorporate vital rate correlations, none of the literature we examined provided these estimates.

We used a target population size of 500 as our recovery goal. Estimates of effective population sizes for long-term persistence vary widely across studies and across taxa (Franklin et al. 2002:339). For example, Thomas (1990) suggested that 100 is probably inadequate, 1000 adequate for species with modest annual variability in population size and as large as 10000 for highly variable species. Any target population size is inherently arbitrary but we chose a value of 500 because we believe it is a realistic target for individual local populations for recovering species and is sufficiently large to be relatively unaffected by demographic stochasticity.

For each combination of parameter values, the dynamics of each species was stochastically simulated 1000 times over a 100 year time frame for each initial population size. Simulations were run for each combination of growth rate (λ) varying from 1.10 to 1.20 in steps of 0.2 and for each combination of initial population size (N_0) from 50 to 200 in steps of 25 individuals. For each simulated growth trajectory we first recorded whether the species survived or had fallen below the quasi-extinction threshold of 20. If it survived, we recorded the final population size at the end of 100 years, and recorded whether the population size reached ≥ 500 individuals.

We evaluated the probability of reaching a population ≥ 500 individuals within 100 years for multiple values of λ. Since the vital rate estimates for most listed species did not yield a λ > 1.0, we had to raise (occasionally lower) the birth and survival rates to attain the target λ-value for each simulation. This was done by increasing the values of the rates in the combined parameter space so as to obtain the target λ-value. The direction and extent of movement in parameter species was weighted by a rate's elasticity value.

The estimation of mean time to recovery is explored under three combinations of parameter values: 1) a range of λ-values > 1.0 to an upper limit of 1.20; 2) annual variation in vital rates at a cv = 10% and 20%; and 3) a range of N_0 values from 25 to 200. All simulations were initialized at a stable stage distribution and a random matrix generated at each time step.

Our simulation program, written in MatLab, and is available from the authors. In developing our programs we benefited substantially from computer code in Morris and Doak (2000).

Results

There are many possible combinations of parameters in our models and each combination of parameter values will yield a different mean recovery time. We partition our discussion of the results according to the effects of 1) variation in λ; 2) variation in initial population size, and 3) variation in the coefficient of variation of the birth and survival rates. In our graphs, we primarily evaluate how the probability of recovery (dependent variable) varies over time (independent variable). Since the same set of λ-values were evaluated for all species, among species differences in demography-recovery times relationship are small. Thus, we report results for just the Least Bell's Vireo (*Vireo belli pusilius*) but these results are largely representative for all species examined.

<u>Variation in λ:</u> We use Bells' Vireo to illustrate the effects of varying mean λ on the probability of recovery (Fig. 23). Given a coefficient of variation of 10% and an N_0 = 200, the time it takes for all simulated populations to recover (to reach N_T = 500) ranges from 30 years for λ = 1.10 to >80 years for λ = 1.04. When λ is = 1.02, only about 20% of all simulated populations recover and those that do recovery are taking over 90 years.

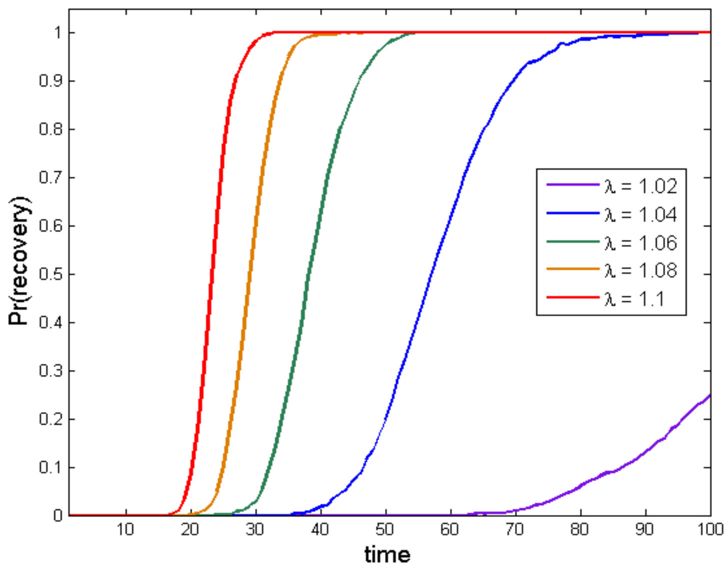

Figure 23. Probability of recovery ($N_T \geq 500$) over a 100-year time period for 5 different values of population growth rate (λ).

<u>Variation in initial population size</u>. We again use the Bell's Vireo to illustrate the effects of varying initial population size on the mean time to recovery (Fig. 24). Given a coefficient of variation of 10% and a λ = 1.04, the time it takes for all simulated populations to be recovered varies from about 30 years for N_0 = 200 to >80 years for N_0 = 50.

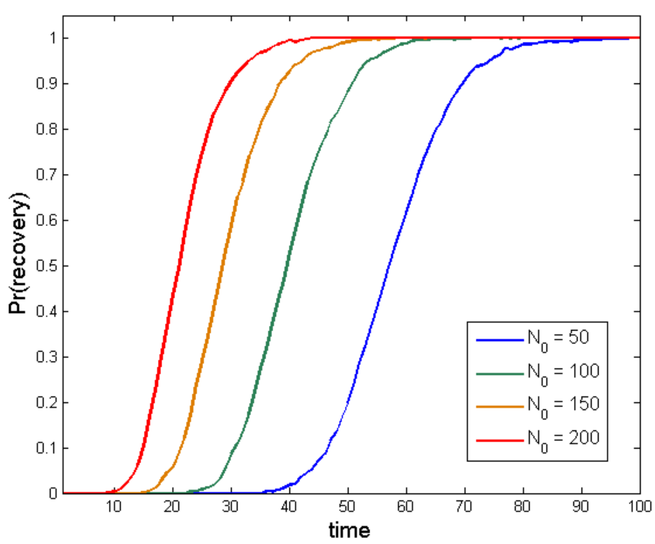

Figure 24. Probability of recovery (NT ≥ 500) over a 100-year time period for 4 different values of initial population size (N0).

Variation in vital rate variance. The effects of a change in the coefficient of variation of the vital rates from 10 to 20% is illustrated with the Bell's Vireo (Fig. 25). Assuming N_0 = 200 and λ = 1.04, 100% of all simulations recovered within 35 years when cv = 10%, but it took > 80 years when the cv = 20%.

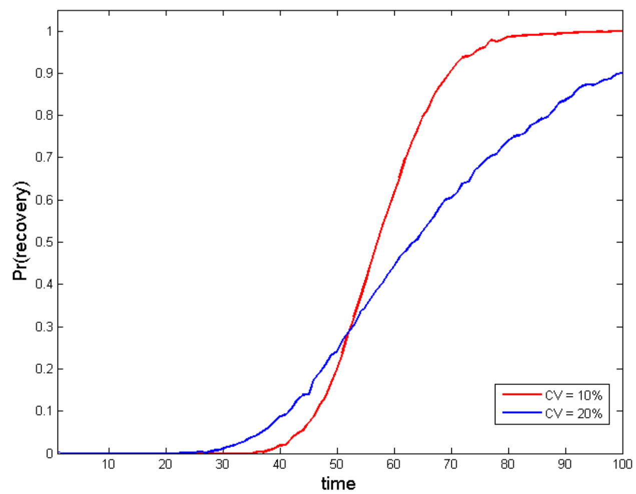

Figure 25. Probability of recovery ($N_T \geq 500$) over a 100-year time period for 2 different values of variation in the vital rates.

Covariation in demographic rates. The factors affecting a species population dynamics are likely to covary. For example, we explored the effect of varying N_0 and the CV of the vital rates together for the Least Bell's Vireo (Fig. 26). When N_0 = 200 and cv = 10 it took over 50 years for all simulations to reach recovery. When the cv was raised to 20%, 100% recovery was not reached until > 90 years. Changes in the probability of recovery became more pronounced when we lowered N_0 = 50. When cv = 10% population with an initial size of 50 took ~ 100 years to reach full recovery. When the cv = 20%, initial populations of size 50 never reached full recovery -- < 80% of the populations recovered over 100 years.

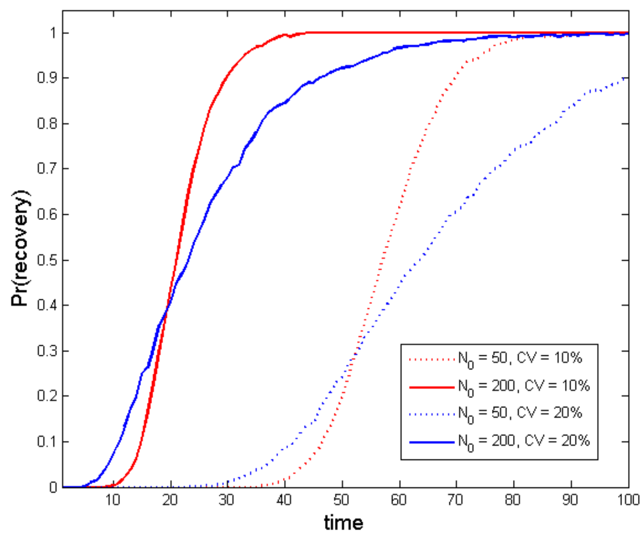

Figure 26. Probability of recovery (NT ≥ 500) over a 100-year time period for 2 different Initial population sizes (N0) and 2 values of population growth rate (λ).

Discussion

Allometrically based estimates of population doubling times are generally < 10 years for all bird species (Calder 2000). Our estimates, based on a target population size of 500, generally reported recovery times > 30 years and often in excess of 50 years when highly variable, small population conditions were simulated. Our results suggest that realistic estimates of time to recovery for avian species will generally be measured in decades, not years.

The ESA was passed in 1973, approximately 37 years ago. It is insightful to estimate the probability of recovery to some target population size over this time period. We evaluated the probability of recovery within 35 years for the Least Bell's Vireo as a function of varying growth rate (λ) and initial population size (N_0; Fig. 27). We find that only at initial population sizes > 150 and at sustained λ > 1.08 do we observed 100% of the simulated populations recover (i.e., $N_T \geq 500$). Under conditions of low growth rate, small initial population sizes, and high environmental variance recovery is an unlikely outcome over the short-term (< 30 years).

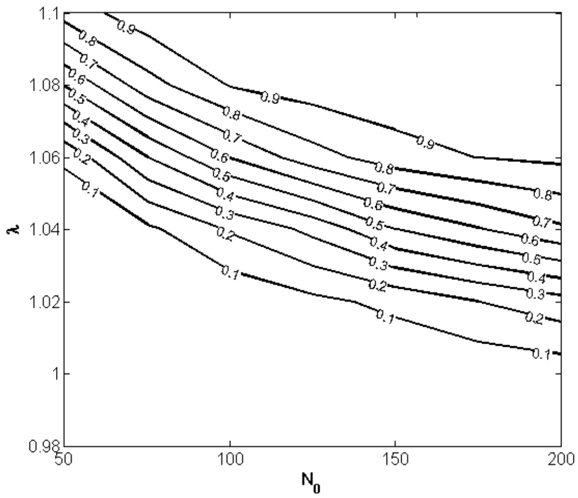

Figure 27. Isolines for the Probability of recovery ($N_T \geq 500$) over a 35-year time period for various values of population growth rate (λ) and initial population size (N_0).

It is important to recall the many optimistic assumptions we made for our analyses. Most importantly, we assumed mean birth and death rates that provided for a growing population. For most listed species, this will only occur when the threats that led to their listing have been mitigated and no new threats have arisen. It is also important to understand that our target for recovery – 500 females—was in reference to individual local populations. We envision that global targets for population size, which include the species geographic range, will be at least an order of magnitude larger.

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Objective 6: Identify Management Practices On Department Of Defense Lands That Could Prove Effective In General Species Recovery On Other Land Holdings.

Management practices and strategies are known to vary among species. To assess differences in management actions between T&E species occurring on DoD lands and those found on other Federal, State, and private lands, we examined all available recovery plans and documented the management actions identified as necessary for the recovery of a species. Management actions with shared objectives were grouped into a single strategy. We identified five conservation strategies and 35 management actions that were employed in support of listed species. The strategies for species used to conserve species on DoD lands were similar to those used on species occurring elsewhere (Table 7).

Table 7. Percent of conservation management strategies for conservation reliant species found on, and those not known to occur on, Department of Defense (DoD) lands.

	Within DOD Lands	Outside DOD Lands
Control of Other Species (invasives)	38%	32%
Active Habitat Management	27%	21%
Control of Direct Human Impacts	17%	19%
Artificial Recruitment (translocation, etc.)	14%	24%
Pollution Control	3%	3%

Control of other species was the most commonly invoked strategy for species regardless of where they occurred. However it was identified as a conservation strategy more frequently 38% vs 32% for species occurring on DoD lands. Artificial recruitment was invoked more frequently for species not occurring on DoD lands. The rank importance of conservation strategies employed was the same for DoD and non DoD species with the exception of control of direct human impacts ranked number 3 for DoD species and number 4 for non DoD species and artificial recruitment was number four for DoD species and number three for non DoD species.

The management actions identified for species occurring on DoD lands were very similar to those stipulated for species not occurring on DoD lands (Table 8). The major difference being that captive propagation was employed twice as frequently for non DoD species.

Table 8. Percent of conservation management actions for conservation reliant species within and outside Department of Defense (DoD) lands. We did not specify conservation management actions <2%.

Within DOD Lands		Outside DOD Lands	
Control exotic fauna	20%	Control exotic fauna	20%
Control exotic flora	17%	Captive propagation	16%
Fire management and control	10%	Control exotic flora	13%
Captive propagation	8%	Control human access	7%
Control human access	6%	Fire management and control	8%
Control native fauna	6%	Control water systems	5%
Control water systems	5%	Control native fauna	4%
Mechanical Control of Vegetation	4%	Control parasites and disease	3%
Control grazing	3%	Control grazing	3%
Control ORV use	3%	Control ORV use	3%
Control parasites and disease	2%	Mechanical Control of Vegetation	2%
Control poaching	2%		
Captive breeding	2%		

Seventy-one percent of species on DoD lands identified management practices that were species specific and would have to be continued for the foreseeable future even if recovery goals were achieved. We characterized these species as conservation reliant (Scott et al. 2005).

There were significant differences among taxonomic groups regarding percentage of species that were conservation reliant (Table 9) with 45% being flowering plants (Fig. 28).

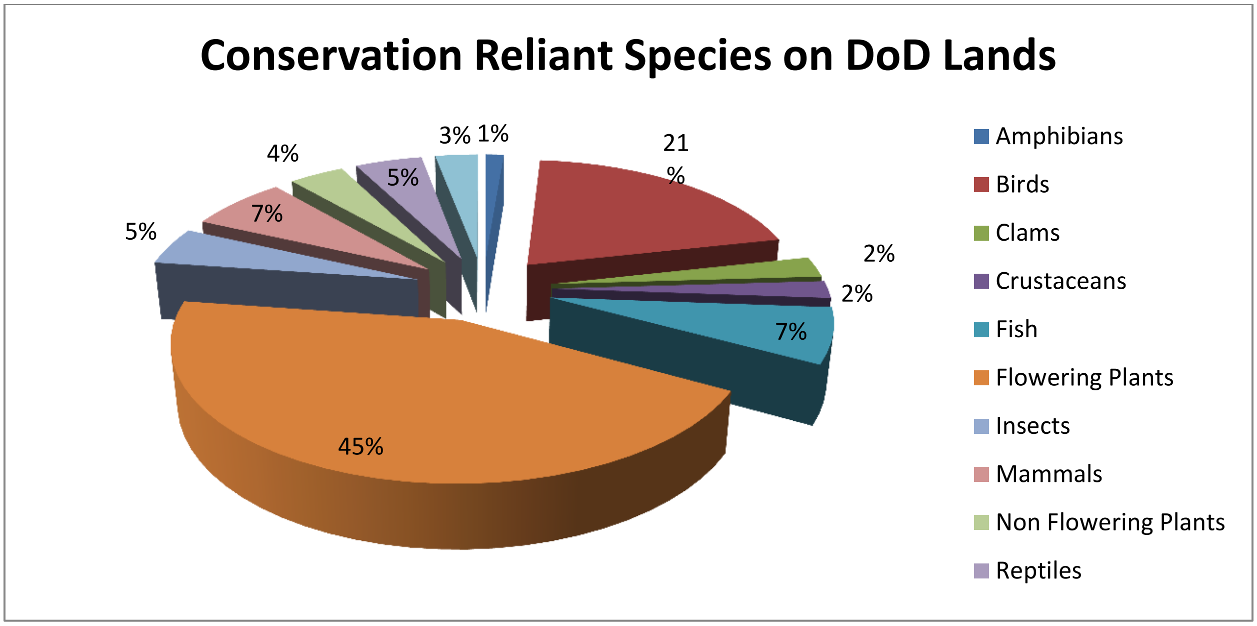

Figure 28. Conservation reliant species by taxonomic group occurring on Department of Defense (DoD) lands.

Table 9. The percent of taxa for conservation reliant species residing within Department of Defense (DoD) lands and outside DoD lands.

	Within DOD Lands	Outside DOD Lands
Amphibians	1%	1%
Birds	20%	5%
Fish	6%	10%
Mammals	7%	3%
Reptiles	5%	2%
Clams	3%	6%
Crustaceans	2%	2%
Insects/Arachnids	5%	4%
Snails	3%	7%
Plants	49%	60%

The large percentage of conservation reliant species occurring on DoD lands suggest that post recovery management actions will be needed when species reach recovery goals if these species are to be delisted. Recovery Management Agreements have been identified as a biologically and legally defensible tool that if implemented in the recovery process and well before proposed delisting can be successfully used to delist a species.

Below we document the elements of a Recovery Management Agreement and suggest where and how they may be used to benefit threatened and endangered species on DoD lands in ways that are compatible with training activities.

Recovery Management Agreements

Under the Endangered Species Act, a species can be delisted as recovered when the threats that it faces are mitigated or managed to the point that the species is no longer at risk of extinction in the foreseeable future. One promising but infrequently method to delist species as recovered is the recovery management agreement (RMA) -- an agreement between a landowner or a land-managing agency and the Fish and Wildlife Service (USFWS) under which the landowner or manager agrees to assume responsibility for managing the threats facing a listed species. This is likely to be particularly attractive when the landowner or manager controls the entire range of a narrow endemic species.

The problem that an RMA is designed to remedy is the increasing likelihood that a species requires ongoing conservation management once its population has achieved a specified viability target. The implicit model of endangered species recovery assumes that the threats facing a listed species will be eliminated, its population will rebound, it will be delisted and, after delisting, the species will thrive with little attention. The record indicates, however, that most species listed under the Endangered Species Act are subject to threats that will require recurrent management actions after delisting in order to maintain a biologically and legally sufficient population to keep that species from again being sufficiently at risk of extinction that it must be relisted.

The RMA concept is a step toward formalizing what has been a sporadic, ad hoc process. An example is Robbins' cinquefoil (*Potentilla robbinsiana*), a long-lived dwarf member of the rose family. Its historical range was restricted to three sites in the White Mountains of New Hampshire and Vermont. At the time of listing, however, the species had been reduced to a single site (Monroe Flats) in New Hampshire. The site unfortunately was bisected by the Appalachian Trail and the species' abundance had been substantially reduced due to trampling and habitat destruction by hikers.[1]

[1] Determination of Pontententilla [sic] robbinsiana to Be an Endangered Species, with Critical Habitat, 45 Fed. Reg. 61,944, 61,945 (1980).

As a result of management activities, the total number of individuals grew from less than 2,000 to more than 14,000 specimens in four populations.[2] The increased number of individuals and the physical separation of the populations met the species' viability target and the USFWS concluded that the species was biologically recovered.

Biological recovery, however, is in itself insufficient: there must also be sufficient regulatory or other conservation mechanisms in place to provide reasonable assurances that the species will not be again placed at risk as a result of removing the ESA's protection. This problem was addressed through an RMA. The USFWS, the land-managing agency (U.S. Forest Service [USFS]), and an NGO (the Appalachian Mountain Club) had taken several management actions to reduce the impact of hikers: the trail was re-routed away from the original population, a wall was constructed around the population's location and posted with "closed entry" signs. Finally, a series of conservation-management agreements provide for continuing risk-management after delisting: a Club naturalist is present during the summer at a hut near the population and, along with other staff at the hut, monitors human interaction with the population.[3] More importantly, the USFWS and the USFS entered into a memorandum of understanding for the conservation of the species under which the USFS agreed to continue management measures after delisting. The USFS promised to provide "long-term protection on the Forest irrespective of the species standing under the Endangered Species Act." The USFWS agreed to maintain the Monroe Flats habitat, "vigorously protect" the species from take through human disturbance, to train personnel, and to provide educational and interpretational information to visitors to the forest.[4]

Robbins' cinquefoil thus could be delisted because its population met the specified viability target and thus had recovered biologically and the threats requiring continuing conservation management -- trampling and habitat destruction by hikers -- had been reduced to a reasonable level (1) through an RMA with the land-managing agency that the habitat would be managed to maintain its biological value to the species and (2) through an agreement with a conservation organization to provide monitoring and ongoing educational activities.

An RMA should have both biological standards and legal requirements that the managing entity must satisfy. The biological standards are determined by the threats the species faces. These threats must be known and manageable and the conservation management

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2 Removal of *Potentilla robbinsiana* (Robbins cinquefoil) From the Federal List of Endangered and Threatened Plants, 67 Fed. Reg. 54,968 54,973 (2002).

3 *Id.* at 54,970, 54,972-73.

4 U.S. Forest Service and U.S. Fish & Wildlife Service, Memorandum of Understanding for the Conservation of Robbins' Cinquefoil (*Potentilla robbinsiana*) 1 (Dec. 2, 1994).

necessary to mitigate the threats must be able to be implemented over a biologically relevant area. The information in a species' recovery plan should provide guidance for the development of an RMA.

The legal requirements are formalized through an RMA, an enforceable contract between the USFWS and a federal land management agency with the power to take the necessary conservation management actions and the financial ability to do so for the foreseeable future. RMAs will transfer management authority from the USFWS to the land-management authority. This transfer would benefit recovery efforts because of the broader range of management authorities available to land managers (*e.g.,* the to exclude).[5] As a species nears its recovery goals or the point at which ongoing management is likely to be sufficient to maintain a specific abundance and distribution, an RMA would be negotiated and the land-management authority would assume responsibility for the ongoing management.

Discussions with agency staff indicate that at least the following components are necessary:

1. Biological goals tied to the recovery plan. This will include a monitoring program that is sufficient to track the population of the species. For example, the agreement might specify three increasingly restrictive levels of management based on the recovery plan's delisting population: for a population greater than 50% above the delisting population; for a population between the delisting population and a population 50% greater than that population; and for a population less than the delisting population.
2. Management actions that reflect the risks facing the species as identified in the listing package and the recovery plan.
3. Adaptive management strategies that ensure that the RMA is evaluated and revised regularly.
4. A defined duration.
5. Assurances by the land manager of its ability to implement the agreement.
6. Incidental-take authority may also be necessary for management actions undertaken before delisting of the species.[6]

The Endangered Species Act: What We Talk about When We Talk about Recovery

Dale D. Goble[*]

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5 *Cf.* Endangered and Threatened Wildlife and Plants; Notice of Availability of Draft Recovery Crediting Guidance, 72 Fed. Reg. 62,258, 62,260 (Nov. 2, 2007) ("The Service has neither the resources nor the authorities to implement many, if not most, recovery actions.").

6 *See* J. Michael Scott et al., Recovery of Imperiled Species under the Endangered Species Act: The Need for a New Approach, 3 Frontiers in Ecology and the Environment 383, 384 (2005).

The objective of the Endangered Species Act is to recover species that are at risk of extinction. The drafters of the Act shared a widely held assumption that recovery would follow from an orderly progression: species at risk of extinction would be identified, the factors placing them at risk would be determined, the methods needed to eliminate the threats would be determined and implemented, and the species would be recovered to a point at which they could be delisted as a self-sustaining wild population that would need only the protection of already existing regulatory mechanisms. The reality has proved far more complex.

Abstractly, recovery requires an assessment of the risk (the probability of extinction over some period of time) facing the species and an ethical / policy judgment that that risk is acceptable. The federal wildlife agencies have only recently begun to address these factors explicitly. As a result, the best information of what "recovery" means are the decisions delisting species as recovered. These decisions demonstrate that the agencies have focused on two distinguishable factors. The first is a demographic component that is met when a species has sufficient numbers and is sufficiently dispersed to reduce the risk from stochastic events to a reasonable level. The second factor focuses on risk management: are there sufficient conservation-management mechanisms to provide reasonable assurances that the removal of the ESA's protection will not jeopardize the species? Under both factors, the agency implicitly evaluates the acceptability of the risk under the reasonableness rubric.

This article evaluates five cases against the agency's operational definition.
Recovery is an elusive concept.

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* Margaret Wilson Schimke Distinguished Professor Law, University of Idaho.
Writing is seldom an entirely solitary endeavor -- this article perhaps less so than many. The genesis of the idea for conservation-reliant species and recovery-management agreements grew out of Endangered Species Act @ 30 Project, a multi-disciplinary, multi-interest evaluation of the Act that J. Michael Scott (University of Idaho, College of Natural Resources and U.S. Geological Survey) and I began in the winter of 2001. Frank Davis (University of California-Santa Barbara, Bren School of Environmental Science and Management) and Geoffrey Heal (Columbia University, Graduate School of Business) joined as organizers the following spring and fall. For additional information on the Endangered Species Act @ 30 Project, see Dale D. Goble et al., *Preface, in* THE ENDANGERED SPECIES ACT AT THIRTY: RENEWING THE CONSERVATION PROMISE xi-xiv (Dale D. Goble et al. eds. 2005). *See also* J. Michael Scott et al., *Recovery of Imperiled Species under the Endangered Species Act: The Need for a New Approach,* 3 FRONTIERS IN ECOLOGY & ENV'T 383 (2005). In addition, several people have assisted this iteration -- whether through discussions on the issues or by providing documents; thanks to Mike Scott, Erik Ryberg, Holly Doremus, Barbara Cosens, John Fay, Susan Kilgore, Maureen Laflin, Michael Nelson, and Kieran Suckling. The usual disclaimers apply with particular force. The funding for this paper was made possible by the Department of Defense Legacy Natural Resources Program Project 06-630.

Under the Endangered Species Act,[7] the terms that define the concept are inevitably imprecise and ambiguous. This linguistic ambiguity is compounded by the unavoidable uncertainty of the science underpinning the decision-making. The combination of linguistic and scientific uncertainty haunts both the fundamental ethical/policy choice and the daunting risk-management issues presented by the Act's mandate that the nation recover species at risk of extinction.

The drafters of the ESA specified that its purpose is the "conservation" of at-risk species and the ecosystems upon which these species depend.[8] This is an aggressive objective because the term "conservation" and its cognates are defined as the affirmative duty to "use ... all methods and procedures which are necessary to bring any [listed] species to the point at which the measures provided pursuant to this Act are no longer necessary."[9] Successful conservation thus is recovery -- an equivalence that the agencies responsible for implementing the Act (the Fish and Wildlife Service (USFWS) in the Department of the Interior and the National Oceanic and Atmospheric Administration-Fisheries (NOAA) in the Department of Commerce[10]) first made explicit in 1980.[11]

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[7] 16 U.S.C. •• 1533-1544 (2000).

[8] 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. *Id.* • 1531(b). *Cf. id.* • 1536(a)(1) ("All federal agencies shall ... utilize their authorities in furtherance of the purposes of this Act by carrying our programs for the conservation of [listed] species.").

[9] *Id.* • 1532(3). In 1988, Congress linked recovery to conservation in requiring Secretary to "implement a system ... to monitor ... the status of all species which have recovered to the point at which the measures provided pursuant to this Act are no longer necessary" and which have therefore been delisted. Endangered Species Amendments of 1988, Pub. L. No. 100-478, • 1004, 102 Stat. 2306, 2307 (1988) (currently codified at 16 U.S.C. • 1533(g)).

[10] As with most federal statutes, the ESA delegates power to a cabinet-level officer, in this case generally either the Secretary of the Interior or the Secretary of Commerce. 16 U.S.C. • 1532(15). The Secretary of the Interior has delegated his statutory authority to the USFWS; the Secretary of Commerce has delegated his authority the NOAA (formerly the Marine Fisheries Service (NMFS)). Note that NOAA is authorized to list a species and to reclassify a species from threatened to endangered, but is only authorized to "recommend" delisting a species or reclassifying a species from endangered to threatened. 16 U.S.C. • 1533(a)(2).

[11] Rules for Listing Endangered and Threatened Species, Designating Critical Habitat, and Maintaining the Lists, 45 Fed. Reg. 13,010, 13,023 (1980) (codified at 50 C.F.R. • 424.11(d)(2)) (a species can be delisted as recovered when "the evidence shows that it is no longer Endangered or Threatened"). The term was formally defined in joint USFWS and NOAA regulations in 1986 to mean the "improvement in the status of listed species to the point at which the listing is no longer appropriate under the criteria set out in section 4(a)(1) of the Act." Interagency Cooperation -- Endangered Species Act of 1973, as Amended; Final Rule, 51 Fed. Reg. 19,926, 19,958 (1986) (currently codified at 50 C.F.R. • 402.02). In 1990, the USFWS issued guidelines on recovery planning that amplified the then-existing regulatory definition:

> 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 its long-term survival in nature can be ensured. The goal of this process is the maintenance of secure, self-sustaining wild populations of species.

Fish & Wildlife Service, Policy and Guidelines for Planning and Coordinating Recovery of Endangered and Threatened

The drafters of the statute envisioned an orderly progression. The process of recovery begins with a *risk assessment*. If the responsible federal wildlife agency (either USFWS or NOAA) determines that the species is sufficiently at risk of extinction, it is listed as either "endangered"[12] or "threatened."[13] Once a species is listed, the Act's second type of actions -- *risk-management* -- come into play. These provisions fall into two general groups. The first are focused on preventing extinction: these actions protect the listed species from activities that threaten its continued existence.[14] The second group of actions are recovery actions: the federal wildlife agency prepares a recovery plan for the species specifying how the threats to its continued existence will be eliminated; the threats are eliminated, and the species recovers.[15] Once there is "substantial" evidence that the species status has

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Species 1 (May 25, 1990). NOAA's new, interim guidance on recovery planning includes a similar statement. *See* National Marine Fisheries Service, Interim Endangered and Threatened Species Recovery Planning Guidance 1.1-1 (July 2006).

[12] "The term 'endangered species' means any species which is in danger of extinction throughout all or a significant portion of its range." 16 U.S.C. • 1532(6).

[13] "The term 'threatened species' means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." *Id.* • 1532(20).

[14] The Act's primary extinction-prevention provisions include:

1. the consultation mandate of • 7(a)(2) which requires federal agencies that propose an action (including funding or permitting private action) to consult with the federal wildlife agency to "insure that [the] action ... is not likely to jeopardize the continued existence" of the species or "result in the destruction or adverse modification" of the species' critical habitat. *Id.* • 1536(a)(2). *See generally* Thomas v. Peterson, 753 F.2d 754 (9th Cir. 1985); *see also* Sierra Club v. U.S. Fish & Wildlife Service, 245 F.3d 434 (5th Cir. 2001); Defenders of Wildlife v. Babbitt, 130 F. Supp. 2d 121 (D.D.C. 2001).
2. the civil and criminal sanctions imposed by sections 9 and 11 on any person (broadly defined to include governmental and business entities, 16 U.S.C. • 1532(13)) who takes (broadly defined to include harassing or harming, *id.* • 1532(19)) or engages in commerce in endangered species. *Id.* • 1539(a)(1). Threatened species are protected by regulations adopted under • 4(d). *See id.* •• 1539(a)(1)(G), 1533(d). The USFWS regulations on threatened species specify that, in the absence of a special rule applicable to an individual species, all of the prohibitions applicable to endangered species are also applicable to threatened species. 50 C.F.R. • 1731(a) (2005). Section 11 contains civil and criminal penalties applicable to violations of the prohibitions. 16 U.S.C. • 1540. *See generally* United States v. McKittrick, 142 F.3d 1170 (9th Cir. 1998); Christy v. Hodel, 857 F.2d 1324 (9th Cir. 1988), *cert. denied sub nom.,* Christy v. Lujan, 490 U.S. 1114 (1989).
3. the habitat conservation planning requirements for obtaining an incidental take permit in • 10(a)(1)(B). These permits operate as a limit on the take prohibition by permitting take that is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity." 16 U.S.C. • 1539(a)(1)(B). Before issuing a permit, the wildlife agency must find that the permitted actions "will not appreciably reduce the likelihood of the survival and *recovery* of the species in the wild." *Id.* • 1539(a)(2)(B)(iv) (emphasis added). Similarly, the incidental take statement provision in • 7(b)(4) requires compliance with the standards in • 7(a)(2). *Id.* • 1536(b)(4)(B). *See generally* National Wildlife Federation v. Babbitt, 128 F. Supp. 2d 1274 (E.D. Cal. 2000).

[15] Recovery planning is required by • 4(f). 16 U.S.C. • 1533(f). *See generally* Defenders of Wildlife v. Babbitt, 130 F. Supp. 2d 121 (D.D.C. 2001); Federico Cheever, *The Road to Recovery: A New Way of Thinking About the Endangered Species Act,* 23 ECOLOGY L.Q. 1 (1996). Recovery actions also include:

1. all federal agencies have an (under-enforced) affirmative obligation under • 7(a)(1) to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of [listed] species." 16 U.S.C. • 1536(a)(1). *See generally* Pyramid Lake Paiute Tribe of Indians v. U.S. Department of Navy, 898 F.2d

changed,[16] the listing agency again assesses the extinction risk facing the species, applying the same substantive standards and the same procedural requirements as those used in the decision to list the species.[17] After delisting, the Act's drafters assumed that the species would thrive because the threats to its existence had been eliminated.

Implementing the Act has proved far more complex -- in part because of the impact of the Act itself on our understanding of species conservation[18] and in part because of the compounding impacts of the drivers of extinction.[19]

1210 (9th Cir. 1990); House v. U.S. Forest Service, 974 F. Supp. 1022 (E.D. Ky. 1997); J.B. Ruhl, *Section 7(a)(1) of the "New" Endangered Species Act: Rediscovering and Redefining the Untapped Power of Federal Agencies Duty to Conserve,* 25 ENVTL. L. 1107 (1995).

2. under • 10(a), the wildlife agencies are authorized to issue recovery permits "to enhance the ... survival of the affected species." 16 U.S.C. • 1539(a)(1)(A).
3. under • 10(j), the wildlife agencies are authorized to introduce experimental populations of listed species. *Id.* • 1539(j). *See generally* Wyoming Farm Bureau Federation v. Babbitt, 199 F.3d 1224 (10th Cir. 2000); Dale D. Goble, *Experimental Populations: Reintroducing the Missing Parts, in* THE ENDANGERED SPECIES ACT 379 (Donald C. Baur & Wm. Robert Irvin eds., 2002).
4. finally, Fred Cheever has made a convincing case -- one that appears to be supported by what little empirical data exists -- that the designation of critical habitat is a recovery action. The term is defined as "(i) the specific areas within the geographical area occupied by the species, at the time it is listed ... on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed ... upon a determination by the Secretary that such areas are essential for the conservation of the species." 16 U.S.C. • 1532(5). *See* Cheever, *supra* at 56-58; *see also* Kieran Suckling & Martin Taylor, *Critical Habitat and Recovery, in* THE ENDANGERED SPECIES ACT AT THIRTY: RENEWING THE CONSERVATION PROMISE 75 (Dale D. Goble et al. eds. 2006).

[16] 16 U.S.C. • 1533(b)(3)(B).

[17] The Act mandates an elaborate process for listing a species that includes a petition procedure, evidentiary findings, public notice, and opportunities for comment in addition to statutory deadlines for the various steps. Critical habitat is also to be designated at the time of listing. *See generally* 16 U.S.C. •• 1533(a)-(c); U.S. FISH & WILDLIFE SERVICE, DEPARTMENT OF THE INTERIOR, ENDANGERED SPECIES LISTING HANDBOOK (4th ed. 1994).

[18] In defining "conserve," the drafters of the Act conceived the statute to be an ambitious project in planned obsolescence: its goal, after all, is to bring at-risk species to the point "at which the measures provided pursuant to this Act are no longer necessary." 16 U.S.C. • 1532(3). Instead, the ESA has turned out to be a technology-forcing statute: the Act created powerful incentives that have helped to transform fundamentally our understanding of ecosystems -- a process that has have revealed the Act's naivete.

In 1973, ecosystems were conceived as static, equilibria systems: remove the disturbing cause and the system would return to a steady state. The ESA reflects this perspective; it is built upon the assumption that the threats at-risk species face are remediable in the sense that they can be eliminated. The list of threats that the agency is to consider in determining the status of a species, *id.* •• 1533(a)(1)(A)-(E), for example, embodies the equilibrium assumption: remove the disturbance -- establish reserves, prohibit take, remove predators, etc. -- and the species will recover. Beyond the possible need for ongoing law enforcement, the Act's measures will no longer be necessary.

Ecologists, however, have increasingly recognized that ecosystems are not equilibria systems, but rather are "complex systems that are dynamic and unpredictable across space and time." Tabatha J. Wallington et al., *Implications of Current Ecological Thinking for Biodiversity Conservation: A Review of the Salient Issues,* 10(1) ECOLOGY & SOC'Y 15, 15 (2005) (visited Sept. 15, 2005) <http://www.ecologyandsociety.org/vol10/iss1/art15>. In Daniel Botkin's metaphor, nature is a discordant harmony: "We see a landscape that is always in flux, changing over many scales of time and space,

The Coordinates of Recovery: Probability, Time, and Acceptability

The decision that a species has recovered requires an assessment of the risk of extinction the species faces. As first-year torts students soon discover, "risk" is the probability that something bad will happen.[20] Under the ESA, the bad possible event is the extinction of a species. Since extinction is nearly always a process rather than a calamitous event, the risk assessment also includes a temporal scale over which the risk is to be assessed. Thus, the risk of extinction has two components: probability and time.

In principle at least, these two components are determinable -- albeit with greater or lesser certainty. Conservation biologists currently employ population viability analysis (PVA) to provide information on the probability that a species will become extinct within a specified period of time.[21] A PVA is a demographic population model that, like other demographic

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changing with individual births and deaths, local disruptions and recoveries, larger scale responses to climate from one glacial age to another, and to the slower alterations of soils, and yet larger variations between glacial ages." DANIEL B. BOTKIN, DISCORDANT HARMONIES 62 (1990). As a result, the state of any ecosystem or population is most accurately described in probability distributions rather than determinate values. "[R]andom [*i.e.,* probabilistic] events play a major role in the life of species and in the functioning of ecosystems." Lawrence L. Master et al., *Vanishing Assets: Conservation Status of U.S. Species, in* PRECIOUS HERITAGE 93, 95 (Bruce A. Stein et al. eds., 2000). Ecology is an historical science because both species and ecosystems are historical artifacts that reflect the events that have occurred in and to them.

One result of our shifting understanding is that the Act is designed to address threats that do not reflect the predominant problems facing declining species. Removing a disturbance through take restrictions and refuge creation is insufficient to recover most species because most species have not been put at risk by discrete causes such as over-harvest or the effects of DDT. Instead, most species are imperiled by the incidental effects of habitat degradation and invasive species. One study, for example, found that 60% of the listed species in the United States are imperiled by either disruption of natural fire disturbance regimes or the spread of non-native species. David S. Wilcove & Linus Y. Chen, *Management Costs for Endangered Species,* 12 CONSERVATION BIOLOGY 1405 (1998); *see also* David S. Wilcove et al., *Leading Threats to Biodiversity: What's Imperiling U.S. Species, in* PRECIOUS HERITAGE 239 (Bruce A. Stein et al. eds., 2000) [hereinafter cited as Wilcove et al., *Leading Threats*]; David S. Wilcove et al., *Quantifying Threats to Imperiled Species in the United States: Assessing the Relative Importance of Habitat Destruction, Alien Species, Pollution, Overexploitation, and Disease,* 48 BIOSCI. 607 (1998) [hereinafter cited as Wilcove et al., *Quantifying Threats*].

[19] The population of the United States was about 212 million when Richard Nixon signed the ESA in the waning days of 1973 -- nearly 45 percent less than the current more than 303 million. *See generally* Holly Doremus, *Lessons Learned, in* THE ENDANGERED SPECIES ACT AT THIRTY, *supra* note 9, at 195, 195; U.S. Census Bureau, U.S. POPClock Projection (visited Jan. 1, 2008 ▪ so the number is greater today) <http://www.census.gov/population/www/popclockus.html>. Habitat loss has been even more dramatic: urbanized land increased 34 percent between 1982 and 1997 alone. Doremus, *supra* at 195. The nation's gross national product (GNP) has increased nearly 10 times, from $1464 billion to $14071.6 billion. U.S. Department of Commerce, Gross National Product (visited Jan. 1, 2008) <http://research.stlouisfed.org/fred2/data/GNP.txt>. These domestic transformations are compounded by the emerging drivers of global change such as economic globalization and climate change.

[20] *See, e.g.,* United States v. Carroll Towing Co., 159 F.2d 169, 173 (2d Cir. 1947) (Hand, J.).

[21] This description of population viability analysis is based upon Steven R. Beissinger & M. Ian Westphal, *On the Use of Demographic Models of Population Viability in Endangered Species Management,* 62 J. WILDLIFE MANAGEMENT 821 (1998); Mark S. Boyce, *Population Viability Analysis,* 23 ANN. REV. ECOLOGY & SYSTEMATICS 481 (1992); D. DeMaster et

population models, begins with a mathematical description of the species or population that is built upon data on mortality rates, recruitment rates, and the age distribution of the population. It differs from other demographic models by focusing on extinction and including those stochastic processes believed to significantly impact extinction: demographic stochasticity ("chance events in the survival and reproductive success of a finite number of individuals"), environmental stochasticity ("temporal variation of habitat parameters and the population of competitors, parasites, and diseases"), genetic stochasticity ("changes in gene frequencies due to founder effect, random fixation, or inbreeding"), and natural catastrophes ("floods, fires, droughts, etc., which may occur at random intervals through time").[22] The models allow the relative importance of different threats to be evaluated by varying the data and comparing the output (the probability of extinction of a species or population over a specified period).[23]

For example, in listing the orca population in Puget Sound (the Southern Resident killer whale DPS), NOAA evaluated a PVA that the biological review team had prepared.[24] Noting that, even under the most optimistic iteration of the model, the probabilities of extinction ("less than 0.1 to 3 percent in 100 years and 2 to 42 percent in 300 years") "were low, but not insignificant," the agency concluded that the species was "at risk of extinction" and listed it as endangered.[25]

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al., Recommendations to NOAA Fisheries: ESA listing criteria by the Quantitative Working Group, (June 10, 2004) (Tech. Memo. NMFS-F/SPO-67, National Oceanic & Atmospheric Administration, Seattle); Hugh P. Possingham et al., *Population Viability Analysis, in* ENCYCLOPEDIA OF BIODIVERSITY 831, 831 (Simon A. Levin ed., 2001). It is important to note that there is no single PVA model. Rather, the term refers to the approach employed. Beissinger & Westphal, *supra*, at 822-29.

[22] Mark L. Shaffer, *Minimum Population Sizes for Species Conservation,* 31 BIOSCIENCE 131, 132 (1981). These four type of risks are examined in more detail in Boyce *supra* note 15, at 483-95; COMMITTEE ON SCIENTIFIC ISSUES IN THE ENDANGERED SPECIES ACT, NATIONAL RESEARCH COUNCIL, SCIENCE AND THE ENDANGERED SPECIES ACT 124-43 (1995) [hereinafter cited as COMMITTEE ON SCIENTIFIC ISSUES]; Possingham, *supra* note 15, at 832-35.

[23] In the seminal paper, Shaffer calculated the risk of extinction of Yellowstone population of grizzly bears. Shaffer, *supra* note 16, at 133. For a more complete example, *see* David B. Lindenmayer & Hugh P. Possingham, *Ranking Conservation and Timber Management Options for Leadbetter's Possum in Southeastern Australia Using Population Viability Analysis,* 10 CONSERVATION BIOLOGY 235 (1996).

[24] *See* Endangered and Threatened Species; Endangered Status Southern Resident Killer Whales, 70 Fed. Reg. 69,903, 69,909 (2005).

[25] 70 Fed. Reg. at 69,909. In contrast, in a decision not to list slickspot peppergrass, the USFWS argued that a 64-82% chance of extinction within 100 years was not a "foreseeable" event; this assertion that prompted the federal district court to respond -- understandably --that the agency's decision "defies common sense." Western Watersheds Project v. Foss, 2005 WL 2002473, at 9, 11 (D. Idaho Aug. 19, 2005). In the *Federal Register* notice withdrawing the proposed rule to list the species (the decision prompting the judicial decision), the agency had not reported the numerical estimates, preferring to focus on the species' improved chance of survival (to 36%) with proposed conservation measures. Endangered and Threatened Wildlife and Plants; Withdrawal of Proposed Rule to List *Lepidium papilliferum* (Slickspot peppergrass) as Endangered, 69 Fed. Reg. 3094, 3100 (2004). The approach brings to mind the old joke about lies,

The most detailed discussion involves the USFWS's recent decision not to list the cerulean warbler.[26] In assessing the extinction risk, the agency concluded that the best available science indicated that (1) the estimated total population of the species was 390,000 individuals in 2006 (plus or minus 50 percent, *i.e.,* between 535,000 and 145,000) and (2) the population trend of the species was an annual decline of 3.2 percent (between 4.2 and 2.0 percent with a 90 percent certainty).[27] This suggested that the population would decline to 200,000 in 20 years, 80,000 in 50 years, and 15,000 in 100 years. But, as the agency noted,

> the farther into the future we attempt to predict, the less confident we can be that the historical trend will persist. Future population sizes will vary due to a variety of factors, both random events and progressive changes in causal environmental factors that we cannot foresee at this time.[28]

The agency therefore concluded that the species was not at risk of extinction in the foreseeable future.[29]

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damn lies, and statistics.

[26] Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to List the Cerulean Warbler (Dendroica cerluea) as Threatened with Critical Habitat, 71 Fed. Reg. 70,717, 70,718 (2006).

[27] *Id.* at 70,731, 70,723.

[28] *Id.* at 70,731.

[29] *Id.* at 70,731-32. Decisions specifying what is the foreseeable future (the term that directly implicates the time element of risk) appear similarly ad hoc. At one extreme is the recent delisting of the Greater Yellowstone DPS of grizzly bears, in which the USFWS adopted the definition from *Merriam-Webster's Dictionary of Law* of "foreseeable future" as "such as reasonably can or should be anticipated: Such that a person would expect it to occur or exist under the circumstances." This definition was chosen, "as opposed to an a priori time period (e.g., 100 years), to avoid placing an arbitrary limit on our time horizon." Endangered and Threatened Wildlife and Plants; Final Rule Designating the Greater Yellowstone Population of Grizzly Bears as a Distinct Population Segment; Removing the Yellowstone Distinct Population Segment of Grizzly Bears from the Federal List of Endangered and Threatened Wildlife; 90-Day Finding on Petition to List as Endangered the Yellowstone Distinct Population Segment of Grizzly Bears, 72 Fed. Reg. 14,866, 14,910 (2007). It does seem at least strange, however, to adopt such an fundamentally ambiguous standard to make what is supposed to be a scientific decision. *See* 16 U.S.C. • 1533(b)(1)(A)). In contrast, in the proposal to delist the Greater Yellowstone DPS the agency adopted "approximately 100 years" "based on 10 grizzly bear generations where a single female may take 10 years to replace herself in a population." Endangered and Threatened Wildlife and Plants; Designating the Greater Yellowstone Population of Grizzly Bears as a Distinct Population Segment; Removing the Yellowstone Distinct Population Segment of Grizzly Bears from the Federal List of Endangered and Threatened Wildlife; Proposed Rule, 70 Fed. Reg. 69,853, 69,866 (2005). The agency noted that "[t]his time period is also commonly used in population viability analyses of grizzly bear populations." *Id.* Although the numbers have varied, the common approach has been to employ a numerical standard often based on the species's generation time. *E.g.,* Endangered and Threatened Wildlife and Plants; 12-Month Petition Finding and Proposed Rule to List the Polar Bear (*Ursus maritimus*) as Threatened Throughout Its Range, 72 Fed. Reg. 1064, 1070-71 (2007) (foreseeable future is 45 years based on the International Union for the Conservation of Nature and Natural Resources (IUCN) Red List process which uses "10 years or three generations, whichever is the longer"); Endangered and Threatened Species; Final Listing Determinations for Elkhorn Coral and Staghorn Coral, 71 Fed. Reg. 26,852, 26,856-57 (2006) (30 years in assessing the risk to elkhorn coral and staghorn coral: "we established that the appropriate period of time corresponding to the foreseeable future is a function of threats, life-history characteristics, and the specific habitat requirements for the species"); Endangered and Threatened Wildlife and Plants;

The limitations of PVAs reflect the fundamental uncertainty of the underlying science: extinction is a complex, poorly understood *probabilistic* process. Its probabilistic nature means that it is an indeterminate process even if we had complete knowledge of all of the factors that affect the process -- and our knowledge is far from complete.[30] Thus, the risk of extinction that any species faces is uncertain to a greater or lesser degree. Acknowledging this inherent uncertainty is not an argument for rejecting PVAs out of hand -- they are, after all, part of "the best scientific ... data *available.*"[31] It is instead simply a recognition of the limitations of data.

12-Month Finding for a Petition to List the Yellowstone Cutthroat Trout as Threatened, 71 Fed. Reg. 8818, 8830 (2006) (20 to 30 years, which is 4 to 10 generations "depending on the productivity of the environment" -- a period which "is long enough to take into account multi-generational dynamics of life-history and ecological adaptation, yet short enough to incorporate social and political change that affects species management"); Endangered and Threatened Wildlife and Plants; Designating the Northern Rocky Mountain Population of Gray Wolf as a Distinct Population Segment; Removing the Northern Rocky Mountain Distinct Population Segment of Gray Wolf from the Federal List of Endangered and Threatened Wildlife, 71 Fed. Reg. 6634, 6643 (2006) (30 years -- 10 generations -- because "[i]t has taken 30 years for the causes of wolf endangerment to be alleviated and for ... wolf populations to recover") [hereinafter cited as NRM Wolf Proposed Delisting]; Endangered and Threatened Wildlife and Plants; 12-Month Finding for Petitions to List the Greater Sage-Grouse as Threatened or Endangered, 70 Fed. Reg. 2244, 2281 (2005) ("30 to 100 years, about 10 grater sage-grouse generations to 2 sagebrush habitat cycles"); Endangered and Threatened Wildlife and Plants; Reconsidered Finding for an Amended Petition to List the Westslope Cutthroat Trout as Threatened Throughout Its Range, 68 Fed. Reg. 46,989, 47,006 (2003) (20 to 30 years, "approximately 4 to 10 WCT generations").

30 Possingham et al., *supra* note 15, at 831; *see generally* Brian Dennis et al., *Estimation of Growth and Extinction Parameters for Endangered Species,* 61 ECOLOGICAL MONOGRAPHS 115, 115-16 (1991); Kathlee LoGiudice, *Toward a Synthetic View of Extinction: A History Lesson from a North American Rodent,* 56 BIOSCI. 687 (2006). For example, it remains uncertain why the passenger pigeon, once the most common terrestrial animal, became extinct. One theory is that the population collapsed because the killing focused on the species' colonial nestings where the density of the birds made the work much easier. In addition, there was a substantial market for squabs -- the unfledged nestlings. Hunters could simply shake the trees and picked up the squabs as they fell from the nests. In its dense nesting colonies, it was possible to kill almost every squab. Furthermore, shooting near colonies caused pigeons to abandon their nests and nestlings. The massive killing coupled with the low rate of reproduction (one egg per nesting), led to a failure to recruit new members into the aging population and doomed the species. David E. Blockstein & Harrison B. Tordoff, *A Contemporary Look at the Extinction of the Passenger Pigeon,* 39 AM. BIRDS 845, 850 (1985); Etta S. Wilson, *Personal Recollections of the Passenger Pigeon,* 51 AUK 157, 165-66 (1934). Alternatively, it has been argued that the species required high population densities to breed. Once the population fell below that threshold, most pigeons ceased to breed. I.L. Brisbin, *The Passenger Pigeon: A Study in the Ecology of Extinction,* MODERN GAME BREEDING, Oct. 1968, at 13, 19-20; T.R. Halliday, *The Extinction of the Passenger Pigeon,* Ectopistes migratorius, *and Its Relevance to Contemporary Conservation,* 17 BIOLOGICAL CONSERVATION 157 (1980); J. Michael Reed, *The Role of Behavior in Recent Avian Extinctions and Endangerment,* 13 CONSERVATION BIOLOGY 232 (1999). Others have suggested that habitat fragmentation and diseases were contributing causes. *E.g.,* Norman Myers, *The Extinction Spasm Impending: Synergisms at Work,* 1 CONSERVATION BIOLOGY 14, (1987); Katherine F. Smith *et al., Evidence for the Role of Infectious Disease in Species Extinctions and Endangerment,* 20 CONSERVATION BIOLOGY 1349 (2006).

31 16 U.S.C. • 1533(b)(1) (emphasis added); *see also id.* • (b)(2) (designation of critical habitat); *id.* • (b)(7) (emergency listing); *id.* • 1536(a)(2) (jeopardy determination); *id.* • (c)(1) (biological assessment); *id.* • (h)(2)(B)(i) (exemption determination); *id.* • 1539(j)(2)(B) (designation of experimental population as nonessential).

Ultimately, however, determining that a species is either endangered or threatened is not a scientific decision.[32] Beyond the question of risk (that is, the probability of extinction over some temporal scale), is the fundamental *ethical/policy* question: What risk is *acceptable*? Although science can inform this judgment (by shedding light on the probability and time elements of the risk), it cannot -- given the gap between the descriptive and the prescriptive -- make the actual decision.

Consider, for example, a thought experiment proposed by Daniel Goodman[33] (Fig. 29). Assume that 5,000 years ago, our species adopted a global policy of managing the environment to ensure an 85 percent probability that no species of mammal would go extinct within 100 years. The probability of any one of the approximately 4400 mammals then in existence surviving to the present would be 0.0003 per species. Assuming that the dynamics of all of the species were independent, the probability is 27 percent that no mammals would remain. The probability that more than 3 species of mammals would remain is only 4 percent. In contrast, consider the approach of Mark Shaffer who "arbitrarily propose[d]" a definition of acceptable risk as "a 99% chance of remaining extant for 1000 years despite the foreseeable effects of demographic, environmental, and genetic stochasticity, and natural catastrophes."[34] Using Shaffer's metric, the probability of any one of the 4400 mammals surviving to the present would be 95 percent per species -- 4184 species of mammals would probably survive. While the results obviously differ dramatically, neither Goodman's nor Shaffer's standard is more "scientific" than the other -- both turn on an ethical/policy decision on what is an *acceptable* risk.

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[32] Holly Doremus, *Listing Decisions under the Endangered Species Act: Why Better Science Isn't Always Better Policy,* 75 WASH. U.L.Q. 1029, 1088 (1997). *See also* DeMaster et al., *supra* note 15, at 2-3; Robin S. Waples et al., *A Biological Framework for Evaluating whether a Species Is Threatened or Endangered in a Significant Portion of Its Range,* 21 CONSERVATION BIOLOGY 964, 965 (2007).

[33] Daniel Goodman, *Predictive Bayesian Population Viability Analysis: A Logic for Listing Criteria, Delisting Criteria, and Recovery Plans, in* POPULATION VIABILITY ANALYSIS 447, 454 (Steven R. Beissinger & Dale R. McCullough eds., 2002). As a statistically-challenged law prof, my particular thanks to Oz Garton.

[34] Shaffer, *supra* note 16, at 132. Shaffer describes his choices as "arbitrary"; it is, however, more accurate to label them "ethical" or "policy" positions rather than "scientific" statements. *See also* Boyce, *supra* note 15, at 482 ("Definitions and criteria for viability, persistence, and extinction are arbitrary, *e.g.,* ensuring a 95% probability of surviving for at 100 years.").

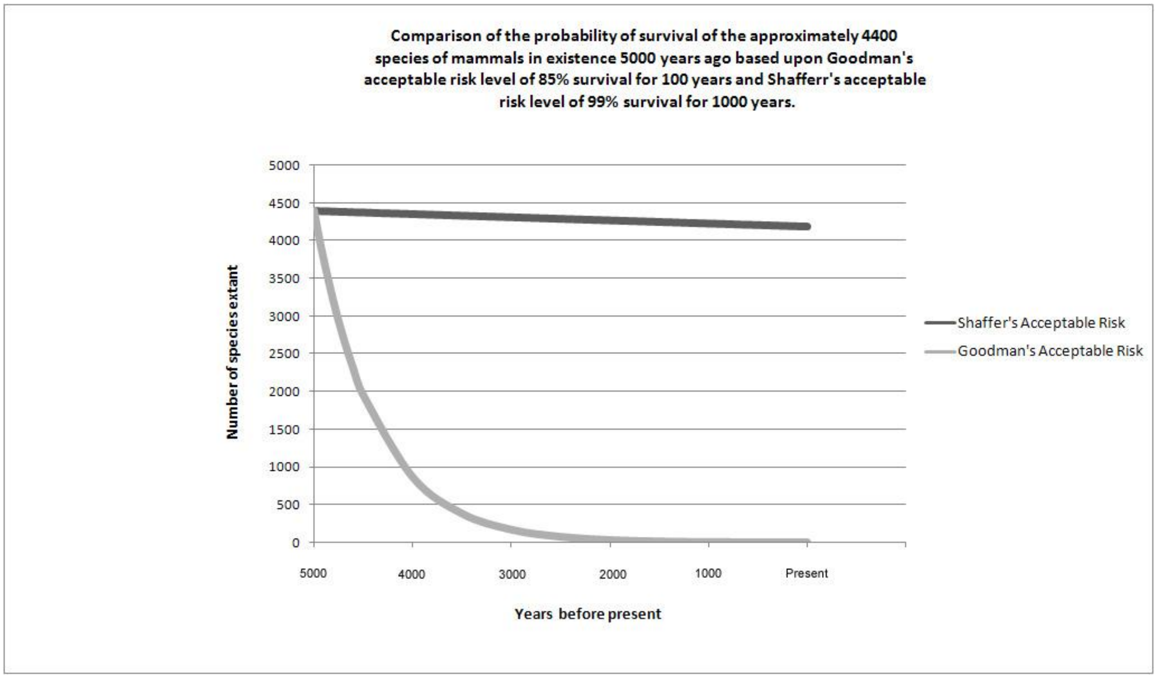

Figure 30. Comparison of the probability of survival of the approximately 4400 species of mammals in existence 5000 years ago based upon Goodman's acceptable risk level of 85% survival for 100 years and Shaffer's acceptable risk level of 99% survival for 1000 years.

The Act's decision-making standard for this risk assessment is its interlocking definitions of "endangered" -- "in danger of extinction throughout all or a significant portion of its range"[35] -- and "threatened" -- "likely to become ... endangered ... within the foreseeable future throughout all or a significant portion of its range."[36] For recovery, the crucial standard is whether the species is "threatened" since a species that is threatened is less at risk than a species that is endangered -- and a species is no longer threatened when it is no longer "likely to become [in danger of extinction] within the foreseeable future throughout all or a significant portion of its range."[37]

Although this language does provide some guidance on both how much probability (*i.e.,* "in danger" and "likely to become" in danger) over how long a time (*i.e.,* "foreseeable future"), the guidance is far from precise: How much "in danger" must a species be to be "endangered"? Beyond a vague "more," how does that degree of risk differ from the degree of risk that is "likely to become" in danger? Or, is the difference between "endangered" and "threatened" measured solely on a temporal scale? That is, is an endangered species "in danger" *now* while a threatened species is "in danger" *within the foreseeable future*? These

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35 16 U.S.C. • 1532(6).

36 *Id.* • 1532(20).

37 *Id.* •• 1532(20), (6).

questions reflect an intractable difficulty in determining when a species is recovered: the linguistic uncertainty that results from the inherent fuzziness of language.

Fundamentally, the decision that a species has recovered is an ethical/policy decision on the acceptability of risk the species faces. This judgment is haunted by the combination of scientific and linguistic uncertainty.

Decision-making under Uncertainty: Status Reviews

Despite some movement toward quantifying the uncertainty and time elements of the risk of extinction facing a species, these issues have largely been obscured in implementing the Act by the requirement that the assessment of risk of extinction and the determination of the acceptability of that risk be made through a status determination (*i.e.,* listing, reclassification, and delisting decisions) that focuses the decision on an evaluation of five factors that potentially affect the species:

- (A) the present or threatened destruction, modification, or curtailment of its habitat or range;
- (B) overutilization for commercial, recreational, scientific, or educational purposes;
- (C) disease or predation;
- (D) the inadequacy of existing regulatory mechanisms; or
- (E) other natural or manmade factors affecting its continued existence.[38]

The analysis of these five factors is the centerpiece of an increasingly detailed case-by-case risk assessment. The strength of this approach is that it permits an extended examination of the specific threats facing a species given what is known about its life history traits.[39] Indeed, the USFWS (which has the statutory responsibility for most species[40]) has argued that this focus is unavoidable because "the circumstances applying

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[38] 16 U.S.C. • 1533(a)(1). The first three of these factors -- habitat loss, overutilization, and predation or disease -- are the primary extrinsic drivers of extinction; the fourth factor focuses on the existing regulatory mechanisms available to control the three extinction factors; the final factor is a precautionary catch-all. The inclusion of "natural causes" emphasizes the congressional conclusion that at-risk species are to be protected regardless of the source of the immediate risk: the hall of mirrors of causation -- proximate or otherwise -- thus was ruled out of bounds. The fact that a potential *coup de grace* is a "natural" event does not require a parsing of the contribution of human actions. *See, e.g.,* Christopher Cokinos, Hope Is a Thing with Feathers 121-93 (2000).

[39] *E.g.,* Katherine Ralls et al., *Developing Criteria for Delisting the Southern Sea Otter under the U.S. Endangered Species Act,* 10 Conservation Biology 1528 (1996).

[40] In general, the Secretary of the Interior has responsibility for all species other than "commercial fisheries, whales, seals, and sea-lions, and related matters." The Fish & Wildlife Act of 1956, Pub. L. No. 1024, • 3(d)(1), 70 Stat. 1119, 1120. Responsibility for these species was transferred from the now-defunct Bureau of Commercial Fisheries of the Department of the Interior to the Department of Commerce under Reorganization Plan Number 4 of 1970. *See* Reorg. Plan No. 4 of 1970, • 1(a), 3 C.F.R. 202 (1970), *reprinted in* 15 U.S.C. • 1511, at 995 (1988).

to most species are individualistic enough as to be incapable of precise definition or quantification."[41] As a result, the agency adopted a more qualitative approach that emphasizes the magnitude (high to low) and immediacy (imminent and non-imminent) of the threats facing the species as the key determinants.[42]

The case-by-case approach does not, however, distinguish between the probability and time elements of risk, on the one hand, and the acceptability of the resulting risk, on the other. That is, the approach blends decisions on the likelihood of extinction over some duration with the judgment that some (generally unstated) degree of risk is acceptable. This reduces the transparency of the decision-making and -- as the examples suggest -- doubtless results in inconsistent decisions on the status of different species.

These statutory factors encourage a focus on specificity that has obscured the underlying questions of risk -- the probability of extinction over some time -- and its ethical dimension. Although the USFWS and NOAA have the authority to adopt a policy specifying the factors to be considered in determining the probability and time components of the risk assessment, they have not chosen to do so. In the absence of a more explicit quantification of these elements and a specification of the degree of risk that is ethically acceptable, agency decisions delisting species as recovered provide the best available information on what "recovery" means operationally.

Defining "Recovery" Operationally by Delisting Species

As noted, the decision to delist a species as recovered is made through a risk assessment that procedurally and substantively mirrors the decision to list the species: both require an evaluation of the species' status under the five statutory threat factors.[43] Contrary to Heraclitus famous admonition, however, the path up is not the same as the path down.[44]

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[41] Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 Fed. Reg. 43,098, 43,100 (1983).

[42] *Id.*

[43] "[T]he same five statutory factors must be addressed in delisting as in listing." Defenders of Wildlife v. Babbitt, 130 F. Supp. 2d 121, 133 (D.D.C. 2001) (quoting Fund for Animals v. Babbitt, 903 F. Supp. 96, 111 (D.D.C. 1995)). *See also* National Wildlife Federation v. Norton, 386 F. Supp. 2d 553, 558 (D. Vt. 2005).

[44] *See* G.S. KIRK ET AL., THE PRESOCRATIC PHILOSOPHERS 188 (2d ed. 1983) ("The path up and down is one and the same."). The USFWS and NOAA have acknowledged this difference in adopting the "Policy for Evaluation of Conservation Efforts when Making Listing Decisions" (PECE). Policy for Evaluation of Conservation Efforts when Making Listing Decisions, 68 Fed. Reg. 15,100 (2003). In response to the suggestion of several commenters on the draft Policy that it be applied to all decisions, the agencies stated that "a recovery plan is the appropriate vehicle to provide guidance on actions necessary to delist a species." *Id.* at 15,101. Similarly, the Quantitative Working Group also reported that it was divided on whether the standards for listing should also be applied to delisting and reclassification decisions and therefore recommended considering those criteria separately. Demaster et al., *supra* note 20, at 5.

Two differences between listing and delisting are worthy of note. The first is the amount information that is available. When a species is proposed for listing, generally relatively little is known about it. By the time it is proposed for delisting, on the other hand, there is a body of data on the management actions that have proven to be successful in recovering the species.

The second difference is that the decision to delist a species removes the risk management provided by the ESA. As a result, the risk-assessment required in a delisting decision necessarily must include an evaluation of the risk management that will be available if the species were delisted. That is, the agency must decide not only that the species is no longer threatened (that the probability of extinction over the foreseeable future is acceptable), but also that the removing the ESA's risk-management mechanisms will not render the species again at-risk.[45] Is the ESA all that is preventing the species' extinction?[46]

A review of the decisions delisting species as recovered demonstrates that recovery has two elements. The first is *demographic*: the species' population must have increased to (or at least stabilized at[47]) a point at which it is both sufficiently large and dispersed to reduce the risk that it will be extinguished by stochastic events to a reasonable level. The second requirement is *risk-management*: there must be sufficient regulatory or other conservation mechanisms in place to provide reasonable assurances that the species will not be again placed at risk by removing the ESA's protection. The "reasonable" qualification in both statements is, of course, the ethical judgment that the remaining risk of extinction is acceptable.

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[45] This requirement is included within the five-factor analysis. The fourth factor requires the agency to evaluate "the inadequacy of existing regulatory mechanisms." 16 U.S.C. • 1533(a)(1)(D).

[46] This second difference highlights the irony of the ESA: the Act is a powerful, focused statute that can bring species back from the brink of extinction, but this power can itself make the statute irreplaceable because neither federal nor state law provides significant, focused protection against threats such as habitat degradation and nonnative species. Wilcove et al., *Leading Threats,* note 12 *supra;* Wilcove et al., *Quantifying Threats*, note 12 *supra.* Although there are other, generally applicable statutes that protect habitat (*e.g.,* the Clean Water Act, 33 U.S.C. •• 1251-1387, and local zoning regulations), such statutes are unlikely to be sufficient to protect most listed species because such statutes only incidentally protect habitat in the process of advancing other objectives (such as obtaining clean water). As a result, these statutes do not provide assurances of ongoing, species-specific management. Existing statutes on nonnative species (*e.g.,* the Nonindigenous Aquatic Nuisance Prevention and Control Act, 16 U.S.C. •• 4701-4741, and state noxious weed control programs) are also insufficiently tailored to be of much assistance. The problem is that specific species face specific threats, threats that generally require continuing monitoring and risk management -- actions that are not available under statutes such as the Clean Water Act. Holly Doremus, *Delisting Endangered Species: An Aspirational Goal, Not a Realistic Expectation,* 30 Envtl. L. Rep. (Envtl. L. Inst.) 10,434 (2000); Holly Doremus & Joel E. Pagel, *Why Listing May Be Forever: Perspectives on Delisting under the U.S. Endangered Species Act,* 15 Conservation Biology 1258 (2001); Jack E. Williams et al., *Prospects for Recovering Endemic Fishes Pursuant to the U.S. Endangered Species Act,* 30:6 Fisheries 24, 24 (2005).

[47] If a species' population has stabilized, the species may have recovered if there is ongoing, effective risk management.

The Numerical Context

Currently, 1351 U.S. species are listed as either threatened or endangered;[48] 16 species have been delisted as recovered;[49] an additional 16 species have made sufficient progress toward recovery to be reclassified from endangered to threatened.[50] Until the most recent delistings,[51] at least, the recovered species shared similar demographic profiles and fell along a continuum defined by the type of risk management that was required to address

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[48] U.S. Fish & Wildlife Service, *Box Score* (visited Oct. 29, 2007) <http://ecos.fws.gov/tess_public/Boxscore.do>. Of these, 1046 are listed as endangered and 305 as threatened. *Id.* The total, worldwide list is 1921 species. *Id.*

These numbers are often cited by the Act's opponents as demonstrating that it is "not working." *E.g.,* House Committee on Resources, *Press Release: Pombo Releases Oversight Report on ESA Implementation* (May 17, 2005) (visited Sept. 3, 2005) <http://kwua.org./news/PRpomboESA051705.htm>. The assertion is either overly simplistic or actively disingenuous. For example, the Government Accountability Office subsequently concluded that Pombo's figures "are not a good gauge of the act's success or failure." Government Accountability Office, Endangered Species: Time and Costs Required to Recover Species Are Largely Unknown 1 (visited Apr. 6, 2006) <available at http://www.gao.gov/new.items/d06463r.pdf>. Given the complexity of risks faced by species, *e.g.,* Wilcove et al., *Leading Threats,* note 12 *supra*; Wilcove et al., *Quantifying Threats*, note 12 *supra*; the frequent lack of meaningful alternative legal protection; the fact that it took many species decades or centuries to reach a point of acute vulnerability and the extremely meager funding of recovery efforts, Julie K. Miller et al., *The Endangered Species Act: Dollars and Sense?,* 52 BIOSCI. 163 (2002); it is unrealistic to expect that many species would have recovered over the 30 years the Act has been in effect. *See generally* Timothy D. Male & Michael J. Bean, *Measuring Progress in US Endangered Species Conservation,* 8 ECOLOGY LETTERS 986 (2005); Martin F. Taylor, Kieran F. Suckling, & Jeffrey J. Rachlinski, *The Effectiveness of the Endangered Species Act: A Quantitative Analysis,* 55 BIOSCI. 360 (2005).

A better measure of the Act's success is its ability to prevent extinction. Based on the risk of extinction, it is probable that the Act has prevented 227 species from going extinct. J. Michael Scott et al., *By the Numbers, in* THE ENDANGERED SPECIES ACT AT THIRTY, *supra* note 9, at 16, 31-32; Mark W. Schwartz, *Choosing the Appropriate Scale of Reserves for Conservation,* 30 ANN. REV. ECOLOGY & SYSTEMATICS 83, 86-87 (1999).

[49] The 16 species are: American alligator, brown pelican, Palau fantail flycatcher, Palau ground dove, Palau owl, gray whale, arctic peregrine falcon, American peregrine falcon, Aleutian Canada goose, Robbins' cinquefoil, Columbia white-tailed Deer [Douglas County DPS], Hoover's woolly-star, Eggert's sunflower, gray wolf [Minnesota population = Western Great Lakes DPS], grizzly bear [Yellowstone Ecosystem DPS], and bald eagle.

[50] The 16 species that have been downlisted are: Apache Trout, Lahontan cutthroat trout, Paiute cutthroat trout, greenback cutthroat trout, Utah prairie dog, snail darter, Louisiana pearlshell, Siler pincushion cactus, small whorled pogonia, Virginia round-leaf birch, MacFarlane's four-o'clock, Maguire daisy, large-flowered skullcap, Missouri bladderpod, Gila trout, and American crocodile.

[51] Writing a law review article is at least partially an academic exercise -- even if one hopes to change a small bit of the world. Since my purpose is to demonstrate that recovery involves both biological/demographic and legal/risk management components, the following analysis assumes that the agency's statements about individual species' demographic and risk-management status are accurate descriptions of the science. I recognize that this is a counterfactual statement. *See* Office of Inspector General, Department of the Interior, Report of Investigation: Julie MacDonald, Deputy Assistant Secretary, Fish, Wildlife and Parks (available at <http://www.biologicaldiversity.org/swcbd/programs/esa/pdfs/DOI-IG-Report_JM.pdf> (visited Apr. 17, 2007); U.S. Fish & Wildlife Service, *News Release: U.S. Fish and Wildlife Service to Review 8 Endangered Species Decisions* (July 20, 2007) (available at <http://www/fws/gov/home/ESA.Review.NR.Final.pdf> (visited Aug. 17, 2007); *see also* Center for Biological Diversity v. U.S. Fish & Wildlife Service, 2005 WL 2000928, at 15 (N.D. Cal. Aug. 19, 2005); Erik Stokstad, *Appointee "Reshaped" Science, Says Report,* 316 SCI. 37 (2007); Jo Becker & Barton Gellman, *Leaving No Tracks,* WASH. POST., June 27, 2007, at A1. *See generally* Dale D. Goble, *Recovery in a Cynical Time -- With Apologies to Eric Arthur Blair,* 82 U. WASH. L. REV. 581 (2007).

the post-delisting threats the species faced. At one end are species such as the Aleutian Canada Goose, which can be adequately protected by previously existing state and federal regulatory and monitoring mechanisms. At the other end are species, typified by Robbins' cinquefoil and the Columbia white-tailed deer, which require the development of new species-specific risk-management programs.

Risk Management Through Existing Regulatory Mechanisms

The Aleutian Canada goose was listed as endangered in 1967 as a result of population declines largely caused by the introduction of a predator (foxes) onto its nesting grounds.[52] Removal of the foxes from these islands, reintroduction of the species onto the now-fox-free islands, and hunting closures on the species' wintering grounds in Oregon and California allowed the species' population to climb from 790 individuals in 1975 to 5,800 in 1989 (when it was reclassified as threatened[53]) to 36,978 in 2000 (just before the species was delisted in 2001[54]). At the same time, the breeding range increased from one to more than six islands.[55] This population increase and dispersal reduced the demographic threat to the species from a stochastic event to a acceptable level, thus meeting the threshold demographic requirement.

Increased population is a necessary condition for delisting, but it is not in itself sufficient. As noted, if the ESA's focused protection is all that is preventing the species from being foreseeably at risk of extinction, it cannot be delisted.[56] Thus, the second prong of the inquiry: are there sufficient risk-management mechanisms to provide reasonable assurances that the species will not again be unreasonably at risk of extinction?

The necessary, on-going risk management for the Aleutian Canada goose was stitched together from a number of existing regulatory mechanisms. The species' nesting grounds

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[52] The species was listed under the Endangered Species Preservation Act (ESPA), a predecessor of the ESA. Endangered Species Preservation Act, Pub. L. No. 89-669, 80 Stat. 926, *repealed by* Endangered Species Act of 1973, Pub. L. No. 93-205, • 14, 87 Stat. 884, 903 (1973). Native Fish and Wildlife: Endangered Species, 32 Fed. Reg. 4001 (1967). Under the ESPA, the Secretary was not required to discuss the risk factors affecting the species; that discussion can be found in the proposal to reclassify the species from endangered to threatened in 1989. *See* Proposed Reclassification of the Aleutian Canada Goose from Endangered to Threatened, 54 Fed. Reg. 40,142 (1989).

[53] 54 Fed. Reg. at 40,142.

[54] Final Rule to Remove the Aleutian Canada Goose from the Federal List of Endangered and Threatened Wildlife, 66 Fed. Reg. 15,643, 15,645 (2001) [hereinafter cited as Aleutian Canada Goose Delisting].

[55] *Id.*

[56] 16 U.S.C. • 1533(a)(1) (delisting must consider "the inadequacy of existing regulatory mechanisms"); *see also id.* • 1536(a)(2) ("Each Federal agency shall ... insure that any action ... carried out by such agency ... is not likely to jeopardize the continued existence of any [listed] species.").

are on the Alaska Maritime National Wildlife Refuge;[57] the USFWS thus has the authority to take management actions that might be necessary to maintain the species' numbers and distribution, including removing foxes from additional islands.[58] On the species' wintering grounds, feeding and roosting habitat was acquired, either as fee interests or through conservation easements.[59] More significantly, the species' status is monitored and take is managed by the federal and state governments through the Pacific Flyway Council,[60] a regulatory entity established under the Migratory Bird Treaty Act (MBTA).[61]

The Aleutian Canada goose thus could be delisted because (1) its numbers had increased and its population had dispersed sufficiently to reduce the risk of stochastic events to an acceptable level and (2) a conservation-management system was created that had sufficient regulatory power to prevent the species from slipping back into an at-risk status.

Several delisted species share two characteristics with the Aleutian Canada goose: their decline was the result primarily of a specific, remediable, threat and the risk management necessary to delist the species after its population recovered could be provided through existing regulatory mechanisms. For example, the gray whale and the American alligator

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[57] *See* U.S. Fish & Wildlife Service - Alaska, *Alaska Maritime National Wildlife Refuge* (visited Jan. 24, 2006) <http://alaska.fws.gov/nwr/akmar/index.htm>.

[58] *See* 16 U.S.C. §§ 668dd-668ee. *See also* U.S. Fish & Wildlife Service - Alaska, *Wildlife: Alien / Invasive Species* (visited Jan. 24, 2006) <http://alaska.fws.gov/nwr/akmar/wildlife-wildlands/nonnative/alien.htm>.

[59] Aleutian Canada Goose Delisting, *supra* note 48, at 15,651-52.

[60] The Council is a one of the regional bodies established under the Migratory Bird Treaty Act that represent federal, state, and provincial fish and game agencies. The Pacific Flyway council is composed of the western states and provinces. *See* Pacific Flyway Council, *Coordinated Management* (visited Sept. 9, 2005) <http://pacificflyway.gov/Index.asp>. The Council has prepared a management plan for the Aleutian Canada goose. *See* Pacific Flyway Council, Pacific Flyway Management Plan for the Aleutian Canada Goose (July 30, 1999) (unpublished report available at <http://pacificflyway.gov/Abstracts.asp#acg>).

[61] 16 U.S.C. §§ 703-711. The MBTA federalized the conservation of migratory birds: i. The Act begins, for example, with a broad declaration that "it shall be unlawful to ... take, ... kill, ... possess, ... sell, ... ship, [or] export ... any migratory bird." *Id.* § 703. Federal protection extends to "any product ... which ... is composed in whole or part, of any such bird or any part, nest or egg thereof." *Id.* Finally, the species is also listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and thus is protected against international commerce. Convention on International Trade in Endangered Species of Wild Fauna and Flora, Mar. 3, 1973, 27 U.S.T. 1087, 993 U.N.T.S. 243. The Convention embodies a system of import and export permits that provide the basis for a control structure to regulate international commerce in species designated for protection in one of the Convention's three appendices. *Id.* arts. II, §§ 1-3, III, §§ 2-4, IV, § 2. Appendix I includes "all species threatened with extinction, which are, or may be affected by trade," *id.* art. II, § 1; species listed in Appendix may not be traded for commercial purposes. Appendix II species are those that may become threatened with extinction "unless trade in specimens of such species is subject to strict regulation" or species that closely resemble other Appendix II species, *id.* art. II, § 2; these species may be traded subject to restrictions. Appendix III includes all species that have been identified by a party to Convention as subject to regulation within its jurisdiction, *id.* art. II, § 3.

were listed primarily due to over-harvesting.[62] Following listing and implementation of take prohibitions, the species's populations increased. The necessary risk management to guard against recurrence of the demographic threat posed by overharvest has, in both cases, been provided by a number of existing regulatory mechanisms, including the International Whaling Commission,[63] the Marine Mammal Protection Act (MMPA),[64] and the Lacey Act.[65] Similarly, the American peregrine falcon, the arctic peregrine falcon, and the brown pelican were at risk of extinction primarily from exposure to organochlorine pesticides (*e.g.,* dicholoro-diphenyl-trichloroethane [DDT]).[66] Banning DDT (and an intensive reintroduction program for peregrines) led to population recovery. Although the Federal Insecticide,

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[62] The gray whale was listed because of severe depletion as a result of harvest, particularly shore-based whaling operations. Gray Whale, 58 Fed. Reg. 3121, 3125 (1993). The alligator was listed "due to concern over poorly regulated or unregulated harvests." Reclassification of American Alligator as Threatened Due to Similarity of Appearance Throughout the Remainder of its Range, 52 Fed. Reg. 21,059, 21,059 (1987) [hereinafter cited as Alligator Reclassification].

[63] The International Whaling Commission was created under the International Convention for the Regulation of Whaling, Dec. 2, 1946, 10 U.S.T. 952, 161 U.N.T.S. 72. In addition to the Commission, the gray whale remains subject to an extensive array of regulatory mechanisms. At the international level, the species is also covered by CITES. *See* note 55 *supra.*

[64] The species is also protected under federal law when it is within U.S. territorial waters, including most significantly the take prohibitions of the MMPA. 16 U.S.C. §§ 1361-1407 (2000). Additional federal laws are also applicable and offer additional protection: the National Environmental Policy Act, 42 U.S.C. §§ 4321, 4331-4335 (2000); the Clean Water Act, 33 U.S.C. §§ 1251-1387 (2000); the Act to Prevent Pollution from Ships, 33 U.S.C. §§ 1901-1909 (2000); the Marine Protection, Research, and Sanctuaries Act, 33 U.S.C. §§ 1401-1447f, 2801-2805 (2000); the Oil Pollution Act of 1990, 33 U.S.C. §§ 2701-2719, 2731-2738, 2751-2761 (2000); and the Outer Continental Shelf Lands Act Amendments, 43 U.S.C. §§ 1344-1355, 1801-1802, 1841-1845, 1862-1866 (2000).

[65] 16 U.S.C. §§ 701, 3371-3378 (2000). The Lacey Act prohibits interstate shipment of wildlife taken contrary to state or federal law. The alligator continues to be managed pursuant two additional federal regulatory mechanisms: a special rule promulgated under the ESA's similarity of appearance provisions (since the alligator is similar to other crocodilians which still are listed), 50 C.F.R. § 17.42 (2004); and listing under Appendix I of CITES, which prohibits international commerce in the species. The USFWS concluded that these "federally enforced laws and regulations ... require that any harvest options by States meet certain minimum conditions to insure against a recurrence of the original problems which prompted listing, *i.e.,* excessive take." Alligator Reclassification, *supra* note 56, at 21,062.

[66] Exposure to DDT caused egg-shell thinning and precluded successful nesting. Final Rule to Remove the American Peregrine Falcon from the Federal List of Endangered and Threatened Wildlife, and To Remove the Similarity of Appearance Provision for Free-flying Peregrines in the Conterminous United States, 64 Fed. Reg. 46,542, 46,452 (1999); Removal of Arctic Peregrine Falcon from the List of Endangered and Threatened Wildlife, 59 Fed. Reg. 50,796 (1994); Removal of the Brown Pelican in the Southeastern United States from the List of Endangered and Threatened Wildlife, 50 Fed. Reg. 4938, 4938 (1985) (organochlorine pesticides were also directly toxic to pelicans). Organochlorine pesticides such as DDT were put into widespread use World War II. This class of chemicals did not break down readily in the environment and thus were concentrated as one moved up the food chain (bioaccumulation). This produced concentrations of the primary metabolite of DDT (dichlorophenyl-dicholorophenylene [DDE]) in the fatty tissues of female birds, which impaired calcium release for egg shell formation. Although the use of DDT was banned in the United States on December 31, 1972, organochlorines remained a problem due to the chemicals persistence in the environment. Endangered and Threatened Wildlife and Plants; Final Rule to Reclassify the Bald Eagle from Endangered to Threatened in All of the Lower 48 States, 60 Fed. Reg. 35,999, 36,000 (1995).

Fungicide, and Rodenticide Act (FIFRA)[67] delegates the Environmental Protection Agency sufficient authority to screen chemicals to prevent the re-introduction of organochlorines, additional risks had emerged since the species listings -- and other regulatory mechanisms were available to address these potential limiting factors. In delisting the species, the USFWS cited the MBTA[68] and CITES,[69] which provide protection against take and commerce; various federal land management statutes which gave the land-managing agencies sufficient authority to protect the species' habitat;[70] as well as state regulatory mechanisms.[71] The combination of these mechanisms provided sufficient assurance of ongoing risk management to satisfy the agency that the species was no longer threatened.

This is the basic pattern: recovery has both demographic and risk-management requirements. That is, the species must not only have recovered biologically, it must also be protected into the future against a recurrence of the risks that threatened its existence. For this group of species, the requisite risk management was provided through existing conservation and regulatory mechanisms such as the MBTA or the International Convention for the Regulation of Whaling. These mechanisms were sufficient because the species faced threat that was remediable through traditional wildlife management tools such as take restrictions or common regulatory approaches such as banning a toxic substance. In addition, there was another factor at work that may have trumped the rest: geese and whales and falcons and pelicans are habitat generalists that can flourish in human-impacted environments -- the last peregrine that I have seen was in Washington, D.C.

Most species, however, are not like peregrine falcons: they cannot be delisted because they cannot maintain recovered populations given the lack of existing and effective risk management mechanisms to address the threats they face. This reflects the fact that most species are at risk of threats -- primarily habitat loss and invasive competitors or predators -- that cannot be eliminated but only managed. Such continuing conservation management requires species-specific risk-management schemes. These species demonstrate the irony of the ESA.

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67 7 U.S.C. •• 136-136y.

68 64 Fed. Reg. at 46,554-55; 59 Fed. Reg. at 50,800; 50 Fed. Reg. at 4941-42.

69 64 Fed. Reg. at 46,554-55; 59 Fed. Reg. at 50,801.

70 For the peregrine falcon, the agency cited the National Forest Management Act, 16 U.S.C. •• 1600-1616; Federal Land Policy and Management Act, 43 U.S.C. •• 1701-1784; and the various management requirements applicable to the National Wildlife Refuge System, *see* Dale D. Goble & Eric T. Freyfogle, Wildlife Law 219-37 (2002). For the brown pelican, the statutes are the Estuary Protection Act, 16 U.S.C. 1221-1226 (2000), and the refuge system statutes.

71 64 Fed. Reg. at 46,555; 50 Fed. Reg. at 4941-42.

Risk Management Through Individualized Regulatory Mechanisms

Five delisted species -- Robbins' cinquefoil, Columbian white-tailed deer, bald eagle, Hoover's woolly-star, and the Great Lakes distinct population segment (DPS)[72] of gray wolf -- are examples of species that lacked sufficient protection under existing regulatory or other conservation mechanisms. Like most species, four of these species require protection against habitat degradation and nonnative species;[73] they require on-going risk management beyond the monitoring and take restrictions required by the goose. The fifth species -- the gray wolf -- is a special (though not unique) case: although it is a habitat generalist that can thrive in a wide variety of habitats, the species requires additional management because it troubles and, therefore, is killed by humans.[74] Delisting these species has required a different approach to risk management and thus offers a more nuanced and broadly applicable understanding of recovery.

Robbins' Cinquefoil

Robbins' cinquefoil is a long-lived, dwarf member of the rose family that was historically restricted to three sites in the White Mountains of New Hampshire and Vermont. At the time of listing, the species had been reduced to a single population (Monroe Flats) in New Hampshire. The site was bisected by the Appalachian Trail and the species' abundance had been substantially reduced due to trampling and habitat destruction caused by hikers.[75] It is this threat that differs from those faced by the goose or the whale: while removing foxes from an island or prohibiting the killing of whales removes the threat that led to near extinction, hikers require continuing, carefully structured management.

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[72] The Act's definition of "species" defines the term to include "any distinct population segment of any species of vertebrate fish or wildlife." 16 U.S.C. • 1532(16). In 1996, the USFWS and NOAA adopted a policy that described a process for denominating DPS. Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the Endangered Species Act, 61 Fed. Reg. 4722 (1996). The policy on DPS specifies three elements to be considered in designating a DPS: "[1] Discreteness of the population segment in relation to the remainder of the species to which it belongs; [2] The significance of the population segment to the species to which it belongs; and [3] The population segment's conservation status in relation to the Act's standards for listing." *Id.* at 4725.

[73] Wilcove et al., *Leading Threats,* note 12 *supra;* Wilcove et al., *Quantifying Threats*, note 12 *supra.* All five species fit this pattern if Euro-Americans are included in the list of invasive species.

[74] *See* Dale D. Goble, *Of Wolves and Welfare Ranching,* 16 HARV. ENVTL. L. REV. 101 (1992).

[75] Determination of Pontententilla [sic] robbinsiana to Be an Endangered Species, with Critical Habitat, 45 Fed. Reg. 61,944, 61,945 (1980). In addition, the species had been the object of intense collection activities: a detailed study found "over 850 plants in herbaria collections worldwide, which represents one of the most extensive collections known for a single species." Removal of *Potentilla robbinsiana* (Robbins' cinquefoil) from the Federal List of Endangered and Threatened Plants, 67 Fed. Reg. 54,968, 54,973 (2002) [hereinafter cited as Cinquefoil Delisting]. Commercial collecting activities ended in the early 1900s and scientific collection has also decreased as scientists have become more aware of the impacts of their activities. *Id.*

Following listing of the species in 1980, three additional populations of the species were established; the total number of individuals grew from less than 2,000 to more than 14,000 specimens in the four separate populations.[76] The increased number of individuals and the physical separation of the populations made the species less susceptible to a random, catastrophic events and thus met the threshold demographic requirement.[77]

The risk-management component was satisfied through a series of actions that secured the species' habitat and assured ongoing management of that habitat to meet the species's biological needs. The USFWS, the landowner -- U.S. Forest Service (USFS) -- and a conservation organization -- the Appalachian Mountain Club -- took several steps to reduce the impact of hikers: the trail was re-routed away from the original population and a wall was constructed around that population and posted with "closed entry" signs. In addition, a series of conservation-management agreements provided for ongoing monitoring and risk-management for this population.[78] A Club naturalist is present during the summer at a hut near the population and, along with other staff at the hut, monitors human interaction with the population and provides education on its status and requirements.[79] The USFWS and the USFS also entered into a memorandum of understanding (MOU) for the conservation of the species under which the USFS agreed to continue to monitor and management the populations after delisting.[80]

Robbins' cinquefoil thus was delisted because (1) translocation and habitat restoration had increased the number of individuals and populations sufficiently to provide *reasonable* assurance against stochastic risk and (2) the threats requiring continuing risk management -- trampling and habitat destruction by hikers -- had also been reduced to a reasonable level (a) through an agreement with a conservation organization to provide monitoring and ongoing educational activities and (b) through an MOU with the land-managing agency that the habitat would be managed to maintain its biological value to the species.

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[76] 67 Fed. Reg. at 54,973.

[77] In addition, seed is collected annually for storage in a seed bank. *Id.* at 54,970.

[78] The location of the three other populations has not been disclosed so as not to call attention to them. *Id.* at 54,973.

[79] *Id.* at 54,970, 54,972-73.

[80] The USFS agreed to provide "long-term protection on the Forest irrespective of the species standing under the Endangered Species Act." U.S. Forest Service and U.S. Fish & Wildlife Service, Memorandum of Understanding for the Conservation of Robbins' Cinquefoil (*Potentilla robbinsiana*) 1 (Dec. 2, 1994). The USFWS agreed to maintain the Monroe Flats habitat, "vigorously protect[]" the species from take through human disturbance, to train personnel, and to provide educational and interpretational information to visitors to the forest. *Id.* at 3.

Columbian White-tailed Deer

The Columbian white-tailed deer further illustrates the range of conservation-management activities that may be required following delisting. The species was once common in the bottomlands and prairie woodlands of the lower Columbia, Willamette, and Umpqua River basins in western Oregon and southwestern Washington. It declined rapidly following Euro-American settlement as a result of habitat loss, uncontrolled sport and commercial hunting, and "perhaps other factors."[81] By the early 1900s, the species had been reduced to two, disjunct populations: one along the lower Columbia River and the other in the Umpqua Valley of Douglas County in southern Oregon. Following its listing under a predecessor of the ESA in 1967,[82] the Douglas County deer population increased from an estimated 400-500 animals in 1970[83] to about 6,070 animals in 2002 as a result of the recovery activities initiated pursuant to the ESA.[84] Since the Columbia River population had not increased significantly, the USFWS designated the two populations as DPS and delisted the Douglas County DPS as recovered.[85] Although there was only a single population in each DPS,[86] the increased number of individuals and the concomitant range expansion of the species in Douglas County led the agency to conclude that the DPS faced a substantially reduced -- and acceptable -- risk from a stochastic event such as a forest fire.

The species' risk-management requirements were met through a variety of regulatory and other conservation mechanisms that the agency concluded were sufficient to manage both the recurrence of the threat factors that had led to listing and new threats that had emerged. Threat factors such as overutilization from hunting were addressed through traditional game management tools (as was the case with both the goose and the whale). The threat of habitat loss through land conversion to agriculture and residential homesites, however, differs from traditional wildlife management in at least two relevant ways. First, given human demographic trends, the threat is unlikely to abate in the foreseeable future. Second, it is not a question of removing the predator or the poison. Even if land were set

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81 Final Rule to Remove the Douglas County Distinct Population Segment of Columbian White-tailed Deer from the Federal List of Endangered and Threatened Wildlife, 68 Fed. Reg. 43,647, 43,647 (2003) [hereinafter cited as Deer Delisting].

82 Native Fish and Wildlife; Endangered Species, 32 Fed. Reg. 4001 (1967).

83 Endangered and Threatened Wildlife and Plants; Proposed Rule to Delist the Douglas County Population of Columbian White-Tailed Deer, 64 Fed. Reg. 25,623, 25,264 (1999).

84 Deer delisting, *supra* note 77, at 43,648.

85 *Id.*

86 The USFWS summarily rejected public comments contending that a third population should be established prior to delisting. *Id.* at 43,652-53.

aside permanently, habitat loss requires ongoing monitoring and management because nature is not static -- particularly in an age of global climate change.[87] Management thus was all the more crucial. Unfortunately, there were no existing risk-management mechanisms (such as the MBTA) that could monitor and manage the range of risks facing the species from the modification of its habitat. Something more was required.

The USFWS addressed this need for additional risk management by requiring at least 5,000 acres of "secure habitat" as a recovery goal. The agency defined "secure" as "areas that are protected from adverse human activities ... in the foreseeable future, and that are relatively safe from natural phenomena that would destroy their value to the subspecies."[88] This definition, it should be noted, has both a legal and a biological component: the habitat must be legally protected against adverse human actions and it must be managed to continue to meet the biological requirements of the species.

The legal component could be satisfied, the agency concluded, through "zoning ordinances, land-use planning, parks and greenbelts, agreements, memoranda of understanding, and other mechanisms available to local jurisdictions,"[89] as well as through public ownership of the land or protection of habitat by private conservation organizations through "easements, leases, acquisitions, donations, or trusts."[90] In response, public entities (primarily the Bureau of Land Management (BLM) and the county) acquired over 7,000 acres of habitat.[91] The county also adopted a Columbian White-tailed Deer Habitat Protection Program that imposed land-use controls, including minimum lot sizes and set-back requirements in deer habitat.[92]

Simply setting aside habitat is insufficient, however, because there must also be legal assurances that that habitat will be managed to continue to meet the biological needs of the species. Risk management, in other words, requires *management*. For the Columbian

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87 Habitat changes ripple across space and time because ecosystems respond slowly and often in nonlinear ways; the effect of a change may not be immediately apparent. *See generally* Dale D. Goble, *What* are *slugs good for? Ecosystem Services and the Conservation of Biodiversity,* 22 J. LAND USE & ENVTL. L. 411 (2007).

88 Deer Delisting, *supra* note 75, at 43,651.

89 *Id.*

90 *Id.* The security of these various tools is likely to vary widely. Federal acquisition of land is probably the most secure; acquisition by private conservation organizations is also likely to be relatively secure (depending upon funding); local politics, on the other hand, may be hostile to the conservation needs of the species or prove unwilling to expend the necessary funds.

91 *Id.* at 43,653-54.

92 *Id.* at 43,654-55.

white-tailed deer, the largest publicly owned parcel of habitat is the BLM-managed North Bank Habitat Management Area, a 7,000-acre former cattle ranch that BLM acquired to provide habitat for the species.[93] The BLM management plan for the area includes controlled burns, grazing modifications, and restoration activities to increase the quality of habitat to the deer.[94] In addition, the Douglas County Parks Department manages a 1,100-acre park as a wildlife refuge and a working ranch to provide habitat for the species.[95]

These actions led the USFWS to conclude that the Douglas County population of Columbian white-tailed deer could be delisted because (1) its population and distribution had increased to the point that the risk of a stochastic event was reduced to a reasonable level, thus satisfying the threshold demographic requirement; (2) the threat facing the species that required continuing risk management -- maintenance of sufficient suitable habitat -- was also reduced to a reasonable level through (a) legal protection of the habitat and (b) agreements with the landowners or managers of that habitat to ensure that it would be managed to maintain its biological value to the species.[96]

Bald Eagle

The recent delisting of the bald eagle[97] demonstrates the importance of the risk-management element of recovery. The species eagle is a striking example of the success of the ESA. Eagle populations have increased dramatically since it was listed in 1967: the

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[93] *Id.* at 43,653.

[94] *Id.* at 43,653-54.

[95] *Id.* at 43,654. The Nature Conservancy also manages a 35-acre site in part to provide deer habitat. *Id.*

[96] Hoover's woolly-star offers another variation on this basic pattern. The species is an annual herb in the phlox family that grows in the San Joaquin and Cuyama Valleys in California. Land conversion (oil, gas, and agricultural development, and urbanization) had extirpated several populations and left the remaining populations at-risk. Determination of Endangered or Threatened Status for Five Plants from the Southern San Joaquin Valley, 55 Fed. Reg. 29,361, 29,368, 29,363-64 (1990). In addition, the species was threatened by the federal land-managing agencies' practices such as introducing nonnative grasses to stabilize soil. *Id.* at 29,365.

The threats requiring continuing conservation management -- oil and gas development, urbanization, grazing, agricultural conversion -- were reduced to a reasonable level through (1) an extensive reserve network of secure habitats under federal, state, and private management (2) coupled with commitment by the primary land-managing agency to "ensure that actions they authorize, fund, or carry out do not contribute to the need to re-list the species." Removing Eriastrum hooveri (Hoover's woolly-star) from the Federal List of Endangered and Threatened Species, 68 Fed. Reg. 57,829, 57,832 (2003); *see also id.* at 57,835-36. The USFWS noted that such "specific commitments [are] needed to protect the populations from incompatible uses such as heavy oilfield development, flooding or rising groundwater levels, and dense vegetation due to proliferation of nonnative plants or suppression of fires." *Id.* at 57,830. The combination of risk management provisions led the USFWS to conclude that the "management commitments by BLM will protect *Eriastrum hooveri* from [other risks] far into the future." *Id.* at 57,836.

[97] Endangered and Threatened Wildlife and Plants; Removing the Bald Eagle in the Lower 48 States From the List of Endangered and Threatened Wildlife, 72 Fed. Reg. 37,346 (2007) [hereinafter cited as Eagle Delisting].

number of breeding pairs increased from 791 (in 1974) to 5748 (in 1998) and 9789 (in 2007).[98] In proposing to delist the species in 1999, the USFWS noted that "[t]he bald eagle population has essentially doubled every 7 to 8 years during the past 30 years."[99] Furthermore, the population increases were broadly distributed across 4 of the 5 recovery regions.[100] This increased population and distribution satisfied the demographic element of recovery. Indeed, most recovery region's met their population goals in the early 1990s.

The problem that delayed delisting the species was securing the necessary risk management. Delisting the bald eagle -- a species with continent-wide distribution -- raises difficulties that were not present with such narrowly distributed species as Robbins' cinquefoil and the Columbian white-tailed deer. It is possible to provide specific, place-based risk management for all of the existing populations of the cinquefoil and the deer; to do the same for the existing populations of eagles is a far more complex task. But -- like the deer -- the dominant threat facing the eagle is habitat loss, a threat that is not remediable but only manageable. This is the classic example of a threat caused by diffuse, local decisions -- the "Tragedy of Fragmentation":[101] jurisdictional boundaries produce myopic decisions that can aggregate into a large decision that is never directly made. Although the Tragedy of the Commons is far better known,[102] it is the Tragedy of Fragmentation that poses a far greater risk to biodiversity. Consider, for example, coastal wetlands. Between 1950 and 1970, nearly 50 percent of the wetlands along the coasts of Connecticut and Massachusetts were destroyed, not as a result of a conscious decision, but through the

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98 *Id.* at 37,347.

99 Endangered and Threatened Wildlife and Plants; Proposed Rule to Remove the Bald Eagle from the List of Endangered and Threatened Wildlife, 64 Fed. Reg. 36,454, 36,457 (1999) [hereinafter cited as Proposed Eagle Delisting].

100 The Chesapeake Recovery Region had over 800 breeding pairs in 2003; the recovery goal (300 nesting pairs) was met in 1992. Endangered and Threatened Wildlife and Plants; Removing the Bald eagle in the Lower 48 states From the List of Endangered and Threatened Wildlife, 71 Fed. Reg. 8238, 8241-42 (2006). The Northern States Recovery Region had 2559 occupied breeding areas in 2000; the recovery goal of 1200 occupied areas was met in 1991. *Id.* at 8242. The Pacific Recovery Region had 1627 breeding pairs in 2001; the recovery goal of 800 pairs was met in 1990. *Id.* The Southeastern Recovery Region had 1500 occupied breeding areas in 2000; the recovery goal (1500 occupied areas) was met in 1997-2000. *Id.* The Southwestern Recovery Region had 46 occupied breeding areas in 2003; the report states that the recovery goal had been met in 2003, but is short on detail. *Id.* at 8242-43. The Southwestern Region has been problematic, perhaps because it is at the climatic edge of the species' tolerance. The decision to delist the Southwestern Recovery Region population has been challenged by the Center for Biological Diversity and the Maricopa Audubon Society. *See* Center for Biological Diversity, Bush Administration Suppressed Scientific Panel Recommendation to Keep Arizona Bald Eagle on Endangered Species List (Jan. 5. 2007) <http://www.biologicaldiversity.org/swcbd/press/desert-bald-eagle-01-05-2007.html> (visited Aug. 18, 2007).

101 Alfred E. Kahn, *The Tyranny of Small Decisions: Market Failures, Imperfections, and the Limits of Economics*, 19 KYKLOS 23 (1966); GOBLE & FREYFOGLE, *supra* note 65, at 1363-65; Dale D. Goble, *The Property Clause -- as if Biodiversity Mattered,* 75 U. COLO. L. REV. 1196 (2004).

102 Garret Hardin, *The Tragedy of the Commons*, 162 SCI. 1243 (1968).

conversion of hundreds of small tracts[103] The fragmentation of ownership, with its resulting focus on individual decisions to develop individual tracts, obscured the overall impact of those decisions. This is the problem facing the eagle: the species' habitat preferences parallel our species' and decisions to permit the construction of a home are made in a setting that is unlikely to value eagles equally with increased tax revenue and the multiple advantages of "development." The importance of the decision to delist the eagle is the agency's response to the problems of continental distribution and local decision-making.

In re-listing the species in 1978,[104] the USFWS concluded that it was at risk of extinction based upon three of the five threat factors. First, breeding habitat "has been considerably reduced" due to "[h]uman activities, such as logging, housing developments, and recreation."[105] Second, the species continued to be killed illegally.[106] Third, organochlorine pesticides continue to contribute to reproductive failure because of their persistence in the environment, particularly in the Northeast.[107] When the agency reexamined these threats in re-proposing to delist the species in 2006, it noted that eagles were still being poached and that some populations continued to experience depressed breeding success due to organochlorines.[108] Nonetheless, the agency concluded that neither was a serious threat to the species, in part because existing regulatory mechanisms were sufficient to manage these threats.[109] Once again, however, habitat loss presented a more complicated problem. Since the species depends upon large trees within 2 miles of water for nesting and will abandon nest when disturbed by human activity, the species is vulnerable to water-associated development and to human disturbances associated with water-based

[103] William E. Odum, *Environmental Degradation and the Tyranny of Small Decisions*, 32 BioSci. 728, 728 (1982).

[104] The "southern bald eagle" was listed as endangered on March 11, 1967. Native Fish and Wildlife: Endangered Species, 32 Fed. Reg. 4001, 4001 (1967). Following enactment of the ESA, USFWS listed the entire species as endangered throughout the conterminous 48 states except in Washington, Oregon, Minnesota, Wisconsin, and Michigan where it was listed as threatened. Determination of Certain Bald Eagle Populations as Endangered or Threatened, 43 Fed. Reg. 6230 (1978).

[105] 43 Fed. Reg. at 6232.

[106] *Id.* at 6232 ("Shooting continues to be the leading cause of direct mortality in adult and immature bald eagles, accounting for 40 to 50 percent of the birds picked up by field personnel.").

[107] *Id.*

[108] Endangered and Threatened Wildlife and Plants; Removing the Bald Eagle in the Lower 48 States from the List of Endangered and Threatened Wildlife, 71 Fed. Reg. 8238, 8246, 8249 (2006) [hereinafter cited as Reopening Comment on Eagle Delisting].

[109] The agency noted that, although a low level of illegal shooting and trade in eagle feathers continues, these activities can be controlled under the Bald and Golden Eagle Protection Act (BGEPA), 16 U.S.C. •• 668-668d, and the MBTA. 71 Fed. Reg. at 8246.

recreation.[110] Although concluding that habitat loss was not currently a limiting factor, the agency acknowledged that eagle habitat is often subject to development pressures and, therefore, that habitat loss may limit future growth of some populations. Nonetheless, the agency was optimistic: "Despite these potential limitations, however, numerous factors ensure the bald eagle is not likely to become endangered *in the foreseeable future* by loss of suitable habitat."[111] The most important of these factors was the substantial amount of habitat on protected lands (*e.g.,* National Wildlife Refuges, National Parks, National Forests, state and private conservation lands) and the federal laws that "will remain in place after delisting to ensure the continued recovery of the bald eagle."[112]

Although the *Federal Register* notices cite a remarkably long list of federal statutes that continue to apply to the species after delisting,[113] there are two unacknowledged but significant issues. First, the most powerful and specifically applicable of the statutes -- the MBTA (enacted in 1918) and the Bald and Golden Eagle Protection Act (BGEPA) (enacted in 1940)[114] -- were in place before the listing of the bald eagle under the ESA and thus demonstrably had failed to prevent the species' slide toward extinction. Given that track record, the agency's renewed faith in the statutes prompts at least some concern. Second, none of the statutes in the agency's lengthy list provides unambiguous authority to protect habitat. Since habitat loss is the most serious threat facing the species, the lack of legal authority to protect habitat is a significant impediment to delisting the species as recovered despite its demographic recovery.

To overcome this difficulty, the USFWS adopted a new, narrowly focused regulatory program.[115] Under the BGEPA, it is illegal to "take, possess, ... at any time or in any

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[110] Endangered and Threatened Wildlife and Plants; Reclassify the Bald Eagle from Endangered to Threatened in Most of the Lower 48 States, 59 Fed. Reg. 35,584, 35,589-90 (1994); Endangered and Threatened Wildlife and Plants; Final Rule to Reclassify the Bald Eagle from Endangered to Threatened in All of the Lower 48 States, 60 Fed. Reg. 35,999, 36,006 (1995).

[111] Reopening Comment on Eagle Delisting, *supra* note 102, at 8246 (emphasis added). The reach of "foreseeable future" remained unspecified.

[112] *Id.* at 8249; *see also* Proposed Eagle Delisting, *supra* note 94, at 36,458.

[113] *See generally* Proposed Eagle Delisting, *supra* note 93, at 36,459; Eagle Delisting, *supra* note 92, at 8247-48. The list includes: the BGEPA, which prohibits take, possession, and commercial activities, 16 U.S.C. §§ 668-668d; the MBTA, which also prohibits take, possession, and commercial activities, 16 U.S.C. §§ 703-711; the Lacey Act, which criminalizes interstate shipment of illegally acquired birds and (more commonly) bird parts, 16 U.S.C. § 3372, and 18 U.S.C. §§ 42-44; CITES, note 55 *supra*; FIFRA, note 61 *supra*; and the Fish and Wildlife Coordination Act, which requires consideration of wildlife in water resource development projects, 16 U.S.C. §§ 661-661c.

[114] Act of June 8, 1940, ch. 278, 54 Stat. 250 (codified as amended at 16 U.S.C. §§ 668-668d).

[115] Protection of Eagles; Definition of "Disturb," 72 Fed. Reg. 31,132 (2007); U.S. Fish & Wildlife Service, National Bald Eagle Management Guidelines (May 2007)

manner" a bald or golden eagle.[116] The Act subsequently defines the term "take" to "include ... pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, or molest or disturb."[117] The inclusion of the term "disturb" substantially broadens the concept,[118] arguably to include habitat-affecting activities.[119] In preparing to delist the species, the USFWS promulgated a regulation defining "disturb" as

> to agitate or bother a bald or golden eagle to the degree that causes, or is likely to cause, based on the best scientific evidence available, (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.[120]

The preamble to the *Federal Register* notice emphasized that the phrase "is likely to cause" was included so that actual injury, death, or nest abandonment did not have to be documented "since death or injury will almost always occur at a later date and sometimes a different location."[121] The agency also noted that "injury" need not include wounding of killing an eagle but extended to a "decrease in its productivity."[122]

Simultaneously with promulgating the regulatory definition of "disturb," the agency issued *National Bald Eagle Management Guidelines*[123] that are intended to "[a]dvise landowners,

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<http://www.fws.gov/migratorybirds/issues/BaldEagle/NationalBaldEagleManagementGuidelines.pdf> (visited Aug. 18, 2007) [hereinafter cited as Eagle Management Guidelines].

[116] 16 U.S.C. • 668.

[117] *Id.* • 668c.

[118] The expansiveness of "disturb" is tempered by the culpability standard, which requires the actor to act "knowingly, or with wanton disregard for the consequences of his act." *Id.* • 668.

[119] Inclusion of the term "disturb" also distinguishes the BGEPA from the MBTA. The courts have resisted extending the MBTA's prohibitions to habitat modification such as logging. *See, e.g.,* Newton County Wildlife Ass'n v. United States Forest Service, 113 F.3d 110 (8th Cir. 1997); Sierra Club v. Martin, 110 F.3d 1551 (11th Cir 1997); Seattle Audubon Soc'y v. Evans, 952 F.2d 297 (9th Cir. 1991); Mahler v. United States Forest Service, 927 F. Supp. 1559 (S.D. Ind. 1996).

[120] *Id.* at 31,140 (to be codified at 50 C.F.R. • 22.3). In its discussion of the regulation, the agency noted that the only court that had considered the relationship between the ESA and BGEPA had concluded that "[t]he plain meaning of the term 'disturb' is at least as broad as the term 'harm' and both terms are broad enough to include adverse habitat modification." *Id.* at 31,133 (quoting Contoski v. Scarlett, 2006 WL 2331180, at *3 (D. Minn. Aug. 10, 2006). *Cf.* 50 C.F.R. • 17.3 ("*Harm* in the definition of 'take' in the [Endangered Species] Act means an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering."); *see also* Babbitt v. Sweet Home Chapter, 515 U.S. 687 (1995) (upholding the regulatory definition of "harm" with potentially significant limitations).

[121] Eagle Delisting, *supra* note 91, at 31,132.

[122] *Id.* at 31,133.

[123] Eagle Management Guidelines, note 109 *supra.*

land managers, and the general public of the potential for various human activities to disturb bald eagles."[124] The Guidelines state,

> [i]n addition to immediate impacts, th[e new regulatory] definition also covers impacts that result from human-induced alterations initiated around a previously used nest site during the time when eagles are not present, if, upon the eagle's return, such alterations agitate or bother an eagle to a degree that injures an eagle or substantially interferes with normal breeding, feeding, or sheltering habits, and causes, or is likely to cause, a loss of productivity or nest abandonment.[125]

The new, formal definition of "disturb" and the *Guidelines* are an attempt to overcome the Tragedy of Fragmentation and to manage the threats to habitat for a species with a continent-wide range. The agency's position is that tying the habitat protection provisions of the proposed definition of "disturb" through the *Guidelines* to existing and alternate nest sites[126] overcomes the difficulties both in defining the specific habitat to be protected and in specifying how that habitat should be managed. The agency argues that this approach provides reasonable assurance of the necessary risk management. If it is successful in protecting sufficient individual nest and roosting sites, it will be because of the ESA: by protecting individual nest and roosting sites, the Act identified these sites so that they will continue to receive protection into the future. Unfortunately, however, local pressure to develop is insistent and the national perspective is easily distracted by newer goals.

Gray Wolf

The attempts to delist the gray wolf in the northern Rocky Mountains emphasize the importance of risk management to recovery. Wolves were initially listed in 1967 when the subspecies *Canis lupus lycaon* ("timber wolf") was determined to be endangered in Minnesota and Michigan.[127] Over the next nine years, the USFWS listed three additional subspecies, the "Northern Rocky Mountain wolf" (*Canis lupus irremotus*),[128] the "Mexican

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[124] *Id.* at 1. One of the ironies of the ESA in contrast to BGEPA is that the latter is a much less flexible statute since it does not contain incidental take provisions. As the agency stated, "Although it is not possible under BGEPA or the MBTA to absolve from liability individuals or entities who follow the Guidelines, the Service will prioritize its enforcement efforts to focus on those individual or entities who take bald eagles or their parts, eggs, or nests without undertaking the measures recommended by the Guidelines." *Id.*

[125] *Id.* at 2. The *Guidelines* also note that activities that impact migrating and winter roost cites fall within the definition of "disturb" because such activities may interfere with feeding. *Id.* at 8. The protection for such sites is less, however, because the interference must cause injury or death because, although the proposed definition includes "nest abandonment" as a prohibited result, it does not include roost abandonment.

[126] *Id.* at 7-8, 11.

[127] Native Fish and Wildlife; Endangered Species, 32 Fed. Reg. 4001, 4001 (1967).

[128] Conservation of Endangered Species and Other Fish or Wildlife; Amendments to Lists of Endangered Fish and Wildlife, 38 Fed. Reg. 14,678 (1973). Both subspecies were included on the list of endangered native wildlife when it was

wolf" (*Canis lupus baileyi*),[129] and the "gray wolf" (*Canis lupus monstrabilis*).[130] In 1978, the agency concluded that "the taxonomy of wolves is out of date" and abandoned the subspecific designations; the agency listed the entire species -- now denominated simply "gray wolf" (*Canis lupus*) -- as endangered throughout its range in the conterminous United States and Mexico except in Minnesota and Isle Royal National Park, Michigan, where it was listed as threatened.[131]

Although there may have been occasional dispersing individuals into the Northern Rocky Mountains, there were no established populations of wolves when *Canis lupus irremotus* was listed as endangered in 1973. In 1982, a wolf pack from Canada began to occupy Glacier National Park along the border. In 1986, the first litter of pups in over fifty years was discovered in the Park near the Canadian border. The same year a pack also denned east of the Park on the Blackfoot Indian Reservation.[132]

A recovery plan that had been prepared in 1980 was revised in 1987 since wolves were now breeding in the region.[133] The 1987 plan established a recovery goal that required three populations, one in northwestern Montana, one in central Idaho, and one in Yellowstone National Park.[134] Concluding that wolves were unlikely to recolonize Yellowstone National Park by themselves, the recovery planners proposed to reintroduce the species as an experimental population of the species. Following a lengthy and contentious process, the USFWS designated portions of Idaho, Montana, and Wyoming as two nonessential experimental populations in 1994.[135] In 1995 and 1996, as total of 66

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re-promulgated as part of a general restructuring of volume 50 of the *Code of Federal Regulations* in January 1974. *See* Subchapter B -- Taking, Possession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of Wildlife, 39 Fed. Reg. 1158, 1175 (1974). The timber wolf had been redesignated the "Eastern Timber wolf."

[129] Endangered and Threatened Wildlife and Plants; Determination That Two Species of Butterflies Are Threatened Species and Two Species of Mammals Are Endangered Species, 41 Fed. Reg. 17,736 (1976).

[130] Endangered and Threatened Wildlife and Plants; Endangered Status for 159 Taxa of Animals, 41 Fed. Reg. 24,062 (1976).

[131] Endangered and Threatened Wildlife and Plants; Reclassification of the Gray Wolf in the United States and Mexico, with Determination of Critical Habitat in Michigan and Minnesota, 43 Fed. Reg. 9607 (1978).

[132] NRM Wolf Proposed Delisting, *supra* note 23, at 6635.

[133] *Id.*

[134] *Id. See also* U.S. Fish & Wildlife Service & Northern Rocky Mountain Wolf Recovery Team, *Northern Rocky Mountain Wolf Recovery Plan* 13-14 (Aug. 3, 1987) (available at <http://ecos.fws.gov/docs/recovery_plans/1987/870803.pdf>).

[135] Endangered and Threatened Wildlife and Plants; Establishment of a Nonessential Experimental Population of Gray Wolves in Yellowstone National Park in Wyoming, Idaho, and Montana, 59 Fed. Reg. 60,252 (1994); Endangered

wolves were released into the two areas, 35 in central Idaho and 31 in Yellowstone.[136] The species achieved the numerical and distributional goals specified in the species' recovery plan in 2000; the durational component was satisfied in 2002.[137]

Beginning in July 2000, the USFWS began a concerted push to delist wolves. After several false starts,[138] the agency delisted the Western Great Lakes (WGL) DPS in February 2007.[139] It has not, however, been successful thus far in delisting the Northern Rocky Mountain (NRM) DPS despite the fact that the species achieved the demographic goals for delisting. On February 8, 2006, the USFWS issued an advanced notice of proposed rulemaking to designate a NRM DPS and to delist the DPS.[140] In August of that year, however, the agency issued a notice finding that delisting of the DPS was not warranted. As the agency noted,

> Because the primary threat to the wolf population (human predation and other take) still has the potential to significantly impact wolf populations if not adequately

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and Threatened Wildlife and Plants; Establishment of a Nonessential Experimental Population of Gray Wolves in Central Idaho and Southwestern Montana, 59 Fed. Reg. 60,266 (1994). *See generally* Goble, note 9 *supra.*

[136] Endangered and Threatened Wildlife and Plants; Regulation for Nonessential Experimental Population Segment of the Western Distinct Population Segment of the Gray Wolf; Final Rule, 70 Fed. Reg. 1286, 1287 (2005).

[137] NRM Wolf Proposed Delisting, *supra* note 23, at 6635-37.

[138] The agency initially proposed to establish four DPS covering all populations of the species within the conterminous United States. Endangered and Threatened Wildlife and Plants; Proposal to Reclassify and Remove the Gray Wolf From the List of Endangered and Threatened Wildlife in Portions of the Conterminous United States; Proposal to Establish Three Special Regulations for Threatened Gray Wolves, 65 Fed. Reg. 43,450 (2000). Three of the four DPS (Western Great Lakes, Western, and Northeastern) were to be reclassified from endangered to threatened -- except where parts of the DPS were listed as experimental populations; the fourth DPS (the Mexican wolf) was to remain listed as endangered. In the area outside the DPS, the species would be delisted. *Id.* With the change in administrations, the USFWS on April 1, 2003, reclassified and delisted the species across the conterminous United States. Endangered and Threatened Wildlife and Plants; Final Rule to Reclassify and Remove the Gray Wolf from the List of Endangered and Threatened Wildlife in Portions of the Conterminous United States; Establishment of Two Special Regulations for Threatened Gray Wolves, 68 Fed. Reg. 15,804 (2003). This proposal replaced the four previously proposed DPS with three -- Eastern, Western, and Southwestern -- reduced the geographic scope of each DPS because "a DPS cannot be designated for an area that is unoccupied by a populations of the species of concern." *Id.* at 15,807. The species was to be delisted outside the three new DPS. Also on April 1, the USFWS published an Advance Notice of Proposed Rulemaking to delist the Eastern DPS. Endangered and Threatened Wildlife and Plants; Removing the Eastern Distinct Population Segment of Gray Wolf from the List of Endangered and Threatened Wildlife, 68 Fed. Reg. 15,876 (2003). Federal district courts in Oregon and Vermont held the agency's action to be arbitrary, capricious, and a violation of the ESA. National Wildlife Federation v. Norton, 386 F. Supp. 2d 553 (D. Vt. 2005); Defenders of Wildlife v. Norton, 354 F. Supp. 2d 1156 (D. Or. 2005). The proposals and the resulting litigation are discussed in Goble, note 45 *supra.*

[139] Endangered and Threatened Wildlife and Plants; Final Rule Designating the Western Great Lakes Populations of Gray Wolves as a Distinct Population Segment; Removing the Western Great Lakes Distinct Population Segment of the Gray Wolf from the Federal List of Endangered and Threatened Wildlife, 72 Fed. Reg. 6052 (2007).

[140] NRM Wolf Proposed Delisting, *supra* note 23, at 6634.

> managed, the Service needs regulatory assurances that the States will manage for sustainable mortality levels before we can remove ESA protections."[141]

The USFWS concluded that it lacked the necessary assurances because "Wyoming State law and its wolf management plan do not provide the necessary regulatory mechanisms to assure that Wyoming's numerical and distributional share of a recovered NRM wolf population would be conserved if the protections of the ESA were removed."[142]

Like the bald eagle, the NRM wolf DPS demonstrates the crucial role that the risk-management structure plays in delisting species as recovered. Unlike the eagle, however, there is no federal statute that can provide the protection against the threat facing the species. The state wolf management plans thus are essential to maintaining the biologically recovered populations.

Recovery: A Preliminary Assessment

The decisions to delist species as recovered provide some substance to the otherwise elusive concept of recovery. Although the decisions do not provide much in the way of specifics for either the probability or time elements of the risk of extinction decision, they do demonstrate that recovery has two components: a demographic component (the species' population size and dispersal are sufficient to provide reasonable assurances that it will not be extinguished by stochastic events) and a risk-management component (existing risk-management mechanisms provide reasonable assurances that the species will not be again placed at risk by removing the ESA's protection).

The Demographic Component of Recovery

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141 Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to Establish the Northern Rocky Mountain Gray Wolf Population (*Canis lupus*) as a Distinct Population Segment To Remove the Northern Rocky Mountain Distinct Population Segment from the Federal List of Endangered and Threatened Wildlife, 71 Fed. Reg. 43,410, 43,426 (2006) [hereinafter cited as 12-Month Finding on Wolf]. *See generally id.* at 43,423-24. In January 2004, the USFWS determined that Wyoming's wolf management plan was inadequate. Wyoming's challenge to this decision was dismissed on procedural grounds by the district court, a decision that was affirmed by the Tenth Circuit Court of Appeals. Wyoming v. United States Department of the Interior, 360 F. Supp. 2d 1214 (D. Wyo. 2005), *aff'd per curiam,* 442 F.3d 1262 (10th Cir. 2006).

142 12-Month Finding on Wolf, *supra* note 135, at 43,430. The USFWS published a second proposed rule to delist the NRM DPS in February 2007. Endangered and Threatened Wildlife and Plants; Designating the Northern Rocky Mountain Population of Gray Wolf as a Distinct Population Segment and Removing This Distinct Population Segment From the Federal List of Endangered and Threatened Wildlife, 72 Fed. Reg. 6106 (2007). The agency proposed to delist the species in Idaho and Montana and offered to delist the species in Wyoming if that state "adopts a State management plan that is consistent with the requirements ... that have already been incorporated into Montana's and Idaho's regulatory framework." *Id.* at 6134.

The fewer the number of individuals and populations, and the more restricted the species' range, the greater the risk of extinction from a stochastic event in any given period of time. If the entire population of a species is located on a single atoll, one catastrophic event (such as a tsunami) might extinguish it.[143] The number of Puerto Rican parrots in the wild, for example, fell from 47 to 22 after hurricane Hugo devastated the Luquillo Experimental Forest.[144] Satisfying the demographic component of recovery therefore requires that there be a sufficient number of individuals and sufficiently dispersed population(s) to provide reasonable assurances that the species will not be extinguished by a foreseeable combination of stochastic events.[145]

The delisting packages have emphasized the number of both individuals and populations. The number of Robbins cinquefoil, for example, increased from less than 2,000 to more than 14,000 individuals and the number of populations increased from 1 to 4.[146] Similarly, the number of Aleutian Canada goose increased nearly fifty-fold (from 790 individuals in 1975 to 36,978) and the breeding range increased from one to more than six islands.[147] The USFWS's decision-making, however, has become increasingly conclusory. For example, in responding to comments suggesting that the Douglas County DPS of the Columbia white-tailed deer should not be delisted until at least one additional population had been established, the agency noted that, although translocation "is likely to be an important component of the management of the ... DPS after delisting,"[148] it was not necessary before delisting because "[a] review of the threats" facing the DPS "shows that it no longer requires protection of the Act."[149]

Decisions reclassifying species from endangered to threatened also focus on the increasing numbers of individuals and populations. The Virginia round-leaf birch offers an example. In 1975, a single population of 41 individuals of was rediscovered after being thought extinct. The species was listed as endangered in April 1978[150] and reclassified as

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143 *See, e.g.,* Mark Shaffer, *Minimal Viable Populations: Coping with Uncertainty, in* VIABLE POPULATIONS FOR CONSERVATION 69, 70 (Michael E. Soule ed., 1987).

144 *See* Puerto Rican Parrot (*Amazona vittata*), http://audubon2.org/watchlist/viewSpecies.jsp?id=168 (visited on Nov. 5, 2007).

145 Shaffer, *supra* note 16, at 131.

146 Cinquefoil Delisting, *supra* note 69, at 54,973.

147 Aleutian Canada Goose Delisting, *supra* note 48, at 15,645.

148 Deer Delisting, *supra* note 75, at 43,652.

149 *Id.* at 43,653.

150 Endangered and Threatened Wildlife and Plants: Determination that 11 Plant Taxa Are Endangered Species and

threatened in November 1994.[151] In its rationale for reclassifying the species, the USFWS noted that a breeding orchard had been established at the Reynolds Homestead Research Center and specimens from a program established at the U.S. National Arboretum had been widely distributed to arboreta, botanical gardens, nurseries, and private individuals.[152] In addition, 20 wild populations had been established and sufficient information about the species' life history and biological needs had been determined so that management to facilitate the species' reproduction was ongoing.[153] Finally, populations had been established on USFS land where the "habitats are protected from adverse modification."[154] The agency thus concluded that, although the species remained vulnerable due to its restricted range and relatively limited numbers, "the successful propagation and distribution of plants together with its current distribution and afforded protection" meant that the birch was not in imminent danger of extinction and thus was no longer endangered.[155]

The Risk-Management Component of Recovery

Recovery also requires reasonable assurances that the risks the species faces are sufficiently addressed through some form of ongoing risk management so that the species will not slip back into an at-risk status. There must be sufficient risk management addressing both the recurrence of the threat factors that prompted the listing and of any new risks that have emerged.

As the case studies demonstrate, crafting a species-specific risk-management structure is likely to be the most difficult and uncertain problem in recovering most species. This reflects two factors. First, most species are at risk because of threats that cannot be eliminated. The majority of species are threatened by habitat modification and nonnative competitors or predators.[156] One study, for example, found that 60% of the listed species in

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2 Plant Taxa Are Threatened Species, 43 Fed. Reg. 17,910, 17,914 (1978).

[151] Endangered and Threatened Wildlife and Plants; Reclassification of the Virginia Round-Leaf Birch (Betula uber) from Endangered to Threatened, 59 Fed. Reg. 59,173 (1994).

[152] *Id.* at 59,174-75.

[153] *Id.* at 59,174.

[154] *Id.* at 59,175.

[155] *Id.* at 59,176. The same concerns can be seen in decisions downlisting the Missouri bladderpod, Endangered and Threatened Wildlife and Plants; Reclassification of *Lesquerella filiformis* (Missouri Bladderpod) from Endangered to Threatened, 68 Fed. Reg. 59,337, 59,340 (2003); and the Louisiana pearlshell, Endangered and Threatened Wildlife and Plants; Determination to Reclassify the Louisiana Pearlshell (Margaritifera hembeli) from Endangered to Threatened, 58 Fed. Reg. 49,935 (1993).

[156] Wilcove et al., *Leading Threats*, *supra* note 12, at 95; Wilcove et al., *Quantifying Threats,* note 12 *supra.* These threats are frequently synergistic because nonnative species often thrive in disturbed habitats.

the United States are imperiled by either disruption of natural fire disturbance regimes or the spread of non-native species.[157] Such threats require ongoing conservation *management*.

For example, Kirtland's warbler requires controlled burning and selective logging to maintain the jack pine stand structure the species requires for nesting because a natural fire regime can no longer occur in the scattered jackpine stands of the Midwest.[158] Similarly, least Bell's vireo needs ongoing trapping of parasitic cowbirds to fledge offspring.[159] These and similar species face threats that require continuing management. Recovering such species becomes a question of securing both the necessary habitat and ongoing, biologically appropriate management of that habitat. These problems are likely to be dramatically exacerbated by global climate change.

The second factor making risk-management the more difficult problem for recovering listed species is the lack of sufficiently focused regulatory mechanisms to manage the threats. As the case studies demonstrate, for most listed species there is no specifically targeted legal protection other than the ESA.[160] As a result, conserving such species requires the creation of species-specific risk-management protocols.

Given the variety threats facing listed species, the types of regulatory mechanisms relied upon to provide the requisite conservation management has varied. For some species (such as the Aleutian Canada goose), this component involved eliminating a discrete threat (foxes on islands) and establishing a management structure to monitor take. Other species (such as Columbian white-tailed deer, bald eagle, and gray wolf) require a specifically tailored risk-management structure because there was no existing regulatory mechanisms

[157] Wilcove & Chen, note 12 *supra*.

[158] Kirtland's warbler (*Dendroica kirtlandii*) requires prescribed burns to maintain appropriate jack-pine habitat structure. The warbler has exacting habitat requirements: extensive, homogenous stands of young jack pines located on poor soils -- a habitat type that was more common when forest fires were more common. Fire suppression and habitat fragmentation reduced this habitat and led to the listing of the species. Conserving the species requires regular burning of habitat to produce the requisite stand structure. *See* U.S. FISH & WILDLIFE SERVICE, KIRTLAND'S WARBLER RECOVERY PLAN App. B (1985).

[159] The brown-headed cowbird has an unusual reproductive strategy: they lay their eggs in the nests of other species, leaving the host to raise the cowbird young. Cowbirds have evolved to have a quick hatch time and to develop rapidly which allows them to out-compete their fellow nestlings with the result that the host's own young seldom survive. Least Bell's vireo is particularly susceptible to such brood parasitism and controlling cowbirds is a significant recovery goal for the species. U.S. FISH & WILDLIFE SERVICE, DRAFT RECOVERY PLAN FOR THE LEAST BELL'S VIREO (*VIREO BELLII PUSILLUS*) 25-28 (1998).

[160] Doremus, note 40 *supra*; Williams et al., note 40 *supra.* This is particularly true for plants and invertebrates which are often entirely without legal protection.

that is sufficiently focused to provide the more intensive ongoing conservation management needed to address the threats facing the species. Although the goose, the deer, the cinquefoil, the eagle, and the wolf are points along a continuum, the distinction between them is significant because the particularized risk-management structure required by the deer, eagle, and wolf means that there is unlikely to be any existing management structure such as the flyway councils established under the MBTA that will provide the authority needed to manage the risks the species face.

This is the irony of the ESA: it is a powerful statute that can bring species back from the brink of extinction, but the strength of the Act in preventing extinction becomes a deterrent to delisting a species because to do so will frequently remove the protection needed to conserve it -- and thus lead to a downward spiral that would necessitate relisting.

Discussion

Department of Defense lands have long been recognized as hotspots for listed species (Groves et al. 2000, Stein et al. 2008). What has not been widely recognized is that there may be a conservation advantage for a species occurring on DoD lands. This conclusion is suggested by our finding that species occurring on DoD lands were less likely to have become extinct and much more likely to have been down or delisted than species not found on DoD lands. Our findings that there were no large differences in population status nor recovery achieved when all species occurring on DoD lands were compared with species not found on DoD lands seems to suggest otherwise. However, these seemingly counter-indicative findings may simply reflect that, for many DoD species, the DoD lands are but a fraction of all their occurrences. Thus, actions beneficial to these species on DoD lands are not at a scale that influences population status range wide. The significantly improved population status and recovery achieved for species that had 75% or more of their occurrences on DoD lands supports this conclusion.

The status reports in the biannual USFWS report to Congress are for a species entire range and may not accurately reflect the status of a species on DoD lands. The same is true for recovery goals accomplished. A report for these measures of conservation success for populations on DoD lands, installation by installation with summary for all DoD lands, would provide a more accurate indication of conservation accomplishments on DoD lands.

A conservation opportunity that emerges from these findings is that increased attention to those species that occur entirely or mostly on DoD lands would yield greatest conservation benefits when management actions are implemented at ecologically relevant scales consistent with recovery plan objectives. Currently none of those species have more than 50% of their recovery objectives achieved although 53% reported stable or improving population status in the last USFWS report to Congress (USFWS 2006). Additionally these and other species for which DoD has a significant portion of habitat or population occurrences are species for which large conservation advantage might be obtained through cooperative conservation partnerships with landowners adjacent DoD lands (Boice 2006)

Delisting and downlisting, the commonly referred to benchmarks of success for the Endangered Species Act (Scott et al. 2005; Goble et al. 2006), are but two steps in the process of recovering species. Our study suggests that the time required to achieve these policy benchmarks of recovery will be measured in decades, not years. This is consistent with the findings of others (Wilcove and McMillan 2006; GAO 2006). One of the take away messages of our study was that interruption of management efforts delays recovery and increases costs.

We identified 32 species, representing 10% of all threatened and endangered species occurring on DoD lands, that because of recovery achieved and population status could be possible “speedy success” stories. Twelve of these species occurred on San Clemente or San Nicolas Islands and are under the control of the US Navy. These islands are home to a number of other imperiled species, as well as other endemic species (Raven, 1963; USFWS 1984), and are among the top 20 military installations for species at risk (www:natureserve.org/images/dodsarlarge.gif). The combination of single agency management and high numbers of threatened and endangered species provides an opportunity for not only speedy success for the species occurring there but also the island ecosystem. If realized, the Department of Defense would be able to showcase their conservation accomplishments and demonstrate what can be achieved for conservation while maintaining mission readiness for an entire ecosystem. San Clemente and San Nicholas Islands could serve as models of what can be accomplished in both species and ecosystem management actions in a manner compatible with military readiness. Protecting not only groups of species but the ecosystems in which they reside and the ecological services associated with the system (Boice 2006).

The majority (71%) of species occurring on DoD lands are conservation reliant. Thus requiring continuing species-specific management actions even after recovery goals have been achieved. Recovery Management Agreements between DoD and US Fish and Wildlife Service or NOAA and facilitation of other conservation agreements (e.g., conservation credits, Safe Harbor agreements, Candidate Conservation Agreements) by property owners adjacent to and nearby DoD facilities is one new tool that DoD may use to mitigate impacts of training activities on and facilitate recovery of listed and candidate species on DoD lands. This would not only facilitate recovery but work to prevent species from becoming endangered. The recently signed management agreement between DoD and USFWS that facilitated the delisting of Eggert’s sunflower (USFWS 2005), those for Columbian white-tailed deer and Robbins cinquefoil, and the Recovery Management Agreement process discussed in this report provide new tools for facilitating recovery of threatened and endangered species, post-recovery management, and early intervention to prevent species from becoming threatened or endangered (Scott et al. 2005).

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Appendix A: Expenditures

Table 10. Air Force expenditures exceed FWS expenditures for recovery of species in 2004.

Common Name	Scientific Name	Air Force	FWS	Recovery Status	Popn Status
Kangaroo rat, San Bernardino Merriam's	Dipodomys merriami parvus	$12,500	$672	1	d
Mouse, southeastern beach	Peromyscus polionotus niveiventris	$150,000	$44,900	1	u
Pronghorn, Sonoran	Antilocapra americana sonoriensis	$231,540	$117,000	1	d
Falcon, northern aplomado	Falco femoralis septentrionalis	$142,439	$85,000	2	u
Jay, Florida scrub	Aphelocoma coerulescens	$649,400	$595,800	2	d
Owl, Mexican spotted	Strix occidentalis lucida	$2,801,357	$917,618	2	u
Petrel, Hawaiian dark-rumped	Pterodroma phaeopygia sandwichensis	$138,000	$81,707	1	u
Rail, Guam except Rota	Rallus owstoni	$106,000	$9,338	1	u
Sparrow, Florida grasshopper	Ammodramus savannarum floridanus	$98,000	$20,500	2	d
Tortoise, desert U.S.A., except in Sonoran Desert	Gopherus agassizii	$1,178,000	$1,040,749	1	d
Darter, Okaloosa	Etheostoma okaloosae	$749,000	$97,000	3	s
Steelhead southern CA coast	Oncorhynchus (=Salmo) mykiss	$2,000	$0	n/a	n/a
Beaked-rush, Knieskern's	Rhynchospora knieskernii	$18,500	$0	2	u
Pigeon wings	Clitoria fragrans	$15,000	$2,500	1	u
Sunflower, Eggert's	Helianthus eggertii	$68,700	$42,500	4	s
Tarplant, Gaviota	Deinandra increscens ssp. villosa	$23,500	$1,196	1	s
Wireweed	Polygonella basiramia	$15,000	$2,300	3	u
Woolly-star, Santa Ana River	Eriastrum densifolium ssp. sanctorum	$12,500	$0	4	u
Yerba santa, Lompoc	Eriodictyon capitatum	$2,000	$0	1	s

Table 11. Army expenditures that exceed FWS expenditures for recovery of species in 2004.

Common Name	Scientific Name	Army	FWS	Recovery Status	Popn Status
Bat, gray	Myotis grisescens	$764,900	$556,000	3	i
Bat, Hawaiian hoary	Lasiurus cinereus semotus	$73,400	$70,757	1	u
Elepaio, Oahu	Chasiempis sandwichensis ibidis	$131,200	$17,141	2	d
Hawk, Hawaiian (='lo)	Buteo solitarius	$45,000	$28,136	4	s
Warbler (=wood), golden-cheeked	Dendroica chrysoparia	$2,137,000	$222,100	3	i
Woodpecker, red-cockaded	Picoides borealis	$4,500,700	$2,096,000	1	i
Alligator, American	Alligator mississippiensis	$19,000	$18,478	delisted	delisted
Tortoise, desert U.S.A., except in Sonoran Desert	Gopherus agassizii	$1,083,100	$1,040,749	1	d
Tortoise, gopher W of of Mobile/Tombigbee Rs.	Gopherus polyphemus	$930,000	$109,500	1	d
Salamander, Sonora tiger	Ambystoma tigrinum stebbinsi	$85,000	$13,000	1	u
Logperch, Roanoke	Percina rex	$50,000	$0	1	u
Snails, Oahu tree	Achatinella spp.	$523,400	$88,739	1	u
Butterfly, Saint Francis' satyr	Neonympha mitchellii francisci	$400,000	$4,300	1	s
Ground beetle, [unnamed]	Rhadine exilis	$50,000	$10,000	1	u
Ground beetle, [unnamed]	Rhadine infernalis	$50,000	$10,000	1	u
Meshweaver, Madla's Cave	Cicurina madla	$50,000	$10,000	1	u
Shrimp, Alabama cave	Palaemonias alabamae	$29,700	$600	1	s
Alani	Melicope lydgatei	$33,400	$3,843	1	u
Amole, purple	Chlorogalum purpureum	$224,000	$5,520	1	u
Aupaka	Isodendrion longifolium	$25,000	$5,497	1	u
A`e	Zanthoxylum hawaiiense	$20,000	$8,931	1	u
Cactus, Sneed pincushion	Coryphantha sneedii var. sneedii	$27,400	$0	2	s
Gilia, Hoffmann's slender-flowered	Gilia tenuiflora ssp. hoffmannii	$2,300	$0	2	i
Haha	Cyanea acuminata	$58,400	$5,505	1	u
Haha	Cyanea humboldtiana	$33,400	$547	1	u
Haha	Cyanea koolauensis	$58,400	$547	1	u
Haha	Cyanea st-johnii	$33,400	$3,843	1	u
Haha	Cyanea superba	$72,800	$4,993	1	u
Ha`iwale	Cyrtandra dentata	$72,800	$5,396	1	u
Ha`iwale	Cyrtandra subumbellata	$25,000	$547	1	u
Ha`iwale	Cyrtandra viridiflora	$33,400	$560	1	u
Honohono	Haplostachys haplostachya	$20,000	$3,731	1	u
Kamakahala	Labordia cyrtandrae	$25,000	$8,801	1	u
Kamanomano	Cenchrus agrimonioides	$72,800	$5,193	1	u
Kio`ele	Hedyotis coriacea	$25,000	$3,735	1	u

Kolea	Myrsine juddii	$33,400	$559	1	u
Kuahiwi laukahi	Plantago princeps	$97,800	$6,392	1	u
Kulu`i	Nototrichium humile	$72,800	$5,085	1	d
Lau `ehu	Panicum niihauense	$12,000	$161	1	d
Loosestrife, rough-leaved	Lysimachia asperulaefolia	$50,500	$6,000	1	s
Lo`ulu	Pritchardia kaalae	$72,800	$245	1	d
Mahoe	Alectryon macrococcus	$97,800	$5,873	1	u
Ma`oli`oli	Schiedea kealiae	$54,300	$137	1	u
Mehamehame	Flueggea neowawraea	$97,800	$5,614	1	u
Nanu	Gardenia mannii	$58,400	$559	1	u
Na`ena`e	Dubautia herbstobatae	$72,800	$5,191	1	u
Nehe	Lipochaeta tenuifolia	$72,800	$4,986	1	d
Nioi	Eugenia koolauensis	$41,700	$547	1	u
No common name	Alsinidendron obovatum	$72,800	$8,487	1	c
No common name	Alsinidendron trinerve	$25,000	$5,505		
No common name	Bonamia menziesii	$72,800	$5,309	1	d
No common name	Cyanea (=Rollandia) crispa	$33,400	$3,854	1	u
No common name	Hedyotis degeneri	$72,800	$5,191	1	u
No common name	Hedyotis parvula	$72,800	$4,986	1	d
No common name	Hesperomannia arborescens	$58,400	$656	1	u
No common name	Lobelia gaudichaudii ssp. koolauensis	$25,000	$547	1	u
No common name	Lobelia niihauensis	$72,800	$137	1	u
No common name	Lobelia oahuensis	$25,000	$137	1	u
No common name	Neraudia angulata	$145,500	$5,193	1	u
No common name	Neraudia ovata	$20,000	$4,101	1	d
No common name	Phyllostegia hirsuta	$58,400	$5,505	1	u
No common name	Phyllostegia mollis	$25,000	$566	1	u
No common name	Sanicula mariversa	$72,800	$5,191	1	d
No common name	Sanicula purpurea	$58,400	$547	1	u
No common name	Schiedea hookeri	$72,800	$5,563	1	u
No common name	Schiedea nuttallii	$72,800	$8,508	1	d
No common name	Silene hawaiiensis	$20,000	$3,731	1	u
No common name	Silene lanceolata	$92,800	$3,814	1	u
No common name	Spermolepis hawaiiensis	$92,800	$8,751	1	u
No common name	Stenogyne angustifolia var. angustifolia	$20,000	$3,731	1	u
No common name	Tetramolopium arenarium	$20,000	$3,731	1	u
No common name	Tetramolopium filiforme	$72,800	$245	1	d
No common name	Viola oahuensis	$33,400	$547	1	u
Oha	Delissea subcordata	$72,800	$8,908	1	d

Opuhe	Urera kaalae	$25,000	$3,433	1	u
Pamakani	Viola chamissoniana ssp. chamissoniana	$97,800	$663	1	d
Pennyroyal, Todsen's	Hedeoma todsenii	$20,000	$0	2	d
Popolo ku mai	Solanum incompletum	$20,000	$3,767	1	u
Po`e	Portulaca sclerocarpa	$20,000	$3,821	1	u
Pu`uka`a	Cyperus trachysanthos	$13,000	$179	1	i
Schiedea, Diamond Head	Schiedea adamantis	$30,000	$3,476		
Sumac, Michaux's	Rhus michauxii	$80,000	$8,200	1	s
Thistle, Chorro Creek bog	Cirsium fontinale var. obispoense	$40,400	$5,520	2	s
Trillium, relict	Trillium reliquum	$20,000	$9,500	2	u
Water-umbel, Huachuca	Lilaeopsis schaffneriana var. recurva	$100,000	$28,000	1	i
`Akoko	Chamaesyce celastroides var. kaenana	$72,800	$5,688	1	u
`Akoko	Chamaesyce rockii	$33,400	$559	1	u
`Akoko	Euphorbia haeleeleana	$72,800	$5,153	1	u
`Anaunau	Lepidium arbuscula	$97,800	$619	1	u
`Ohe`ohe	Tetraplasandra gymnocarpa	$100,100	$547	1	u
No common name	Asplenium fragile var. insulare	$20,000	$3,821	1	u
No common name	Diellia falcata	$97,800	$5,573	1	u
No common name	Pteris lidgatei	$58,400	$559	1	d
Pauoa	Ctenitis squamigera	$72,800	$245	1	u
Quillwort, Louisiana	Isoetes louisianensis	$73,300	$24,200	2	s
Wawae`iole	Lycopodium (=Phlegmariurus) nutans	$33,400	$3,855	1	u

Table 12.FY 2004 Marine expenditures that exceed FWS expenditures for recovery of threatened and endangered species occurring on DoD lands (USFWS)

Common Name	Scientific Name	Marines	FWS	Recovery Status	Population Status
Pronghorn, Sonoran	Antilocapra americana sonoriensis	$30,000	$0	1	d
Seal, Hawaiian monk	Monachus schauinslandi	$500	$0	n/a	n/a
Ambrosia, San Diego	Ambrosia pumila	$5,376	$2,626	2	s
Brodiaea, thread-leaved	Brodiaea filifolia	$80,000	$31,724	1	d
Button-celery, San Diego	Eryngium aristulatum var. parishii	$42,261	$90	1	s
Flannelbush, Mexican	Fremontodendron mexicanum	$5,376	$0	n/a	n/a
Loosestrife, rough-leaved	Lysimachia asperulaefolia	$12,488	$6,000	1	s
Manzanita, Del Mar	Arctostaphylos glandulosa ssp. crassifolia	$5,376	$0	1	d
Mesa-mint, San Diego	Pogogyne abramsii	$42,261	$90	1	s
Navarretia, spreading	Navarretia fossalis	$67,261	$35,006	1	d
Orcutt grass, California	Orcuttia californica	$42,261	$90	1	d
Thornmint, San Diego	Acanthomintha ilicifolia	$5,376	$180	n/a	n/a

Table 13. Navy expenditures that exceed FWS expenditures for recovery of species in 2004.

Common Name	Scientific Name	Navy	FWS	Recovery Status	Population Status
Kangaroo rat, Fresno	Dipodomys nitratoides exilis	$40,000	$12,541	1	u
Seal, Hawaiian monk	Monachus schauinslandi	$15,300	$0	n/a	n/a
Elepaio, Oahu	Chasiempis sandwichensis ibidis	$49,036	$17,141	2	d
Megapode, Micronesian	Megapodius laperouse	$110,400	$1,583	n/a	n/a
Moorhen, Mariana common	Gallinula chloropus guami	$55,000	$4,002	1	s
Rail, light-footed clapper U.S.A. only	Rallus longirostris levipes	$144,500	$44,341	2	s
Sparrow, San Clemente sage	Amphispiza belli clementeae	$67,755	$90	2	s
Swiftlet, Mariana gray	Aerodramus vanikorensis bartschi	$111,776	$40,143	1	s
Tern, California least	Sterna antillarum browni	$899,352	$297,743	3	d
Towhee, Inyo California	Pipilo crissalis eremophilus	$15,000	$2,019	1	u
Boa, Puerto Rican	Epicrates inornatus	$39,073	$25,000	n/a	n/a
Chub, Mohave tui	Gila bicolor mohavensis	$65,000	$13,520	1	d
Beaked-rush, Knieskern's	Rhynchospora knieskernii	$700	$0	2	u
Bird's-beak, salt marsh	Cordylanthus maritimus ssp. maritimus	$78,500	$20,427	1	u
Gilia, Monterey	Gilia tenuiflora ssp. arenaria	$15,000	$13,062	2	u
No common name	Abutilon sandwicense	$3,264	$547	1	u
Rock-cress, shale barren	Arabis serotina	$5,000	$2,000	2	u
Rockcress, Santa Cruz Island	Sibara filifolia	$1,600	$0	1	i
Spineflower, Monterey	Chorizanthe pungens var. pungens	$15,000	$11,656	1	d
Ihi`ihi	Marsilea villosa	$18,000	$137	1	d

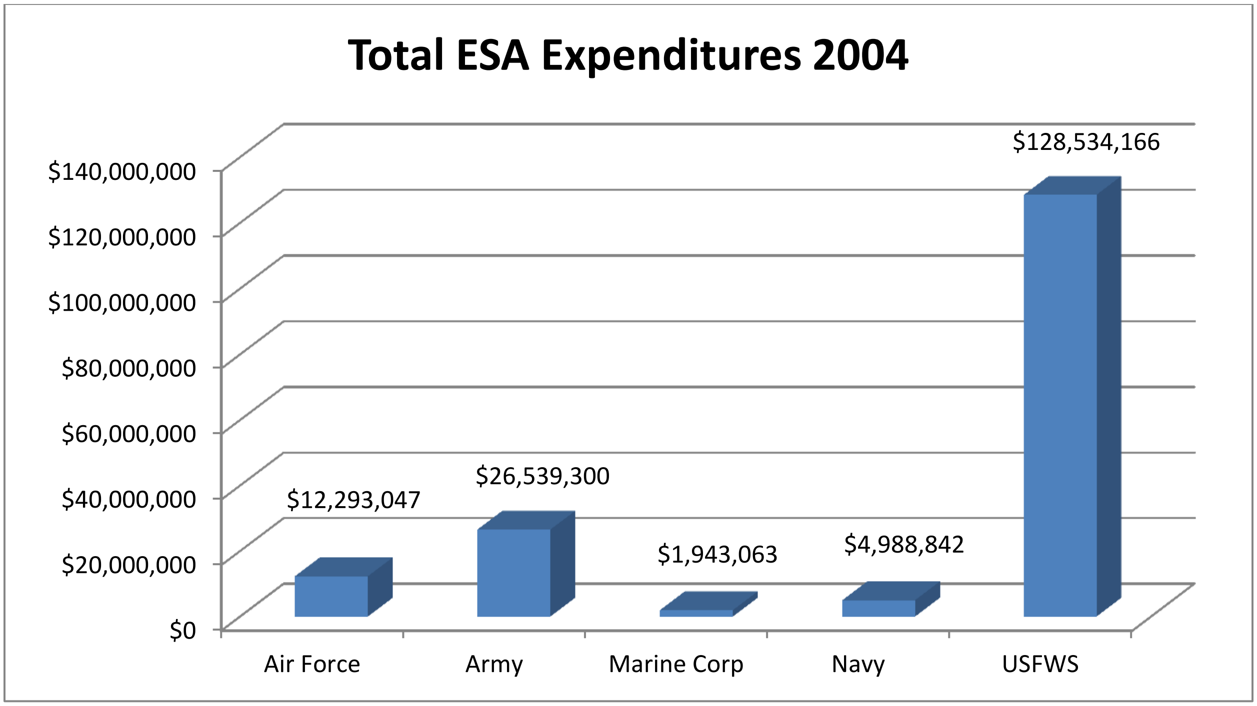

Figure 30. Total expenditures for threatened and endangered species for each Department of Defense branch and the US Fish and Wildlife Service.

Appendix B: Department of Defense species from the 1967 listing of threatened and endangered species.

Table 14. Department of Defense species from the first listing of threatened and endangered species.

Species	Status	Type	
Indiana Bat - *Myotis sodalis*	Endangered	Mammal	
San Joaquin Kit Fox - *Vulpes macrotis mutica*	Endangered	Mammal	
Grizzly Bear - *Ursus horribilis*	Delisted	Mammal	
Black-Footed Ferret - *Mustela nigripes*	Endangered	Mammal	
Florida Panther - *Felis concolor coryi*	Endangered	Mammal	
Florida Manatee or Florida Sea Cow - *Trichechus manatus latirostris*	Endangered	Mammal	
Sonoran Pronghorn - *Antilocapra americana sonoriensis*	Endangered	Mammal	
Hawaiian Dark-Rumped Petrel - *Pterodroma phaeopygia sandwichensis*	Endangered	Bird	
Hawaiian Goose (Nene) - *Branta sandvicensis*	Endangered	Bird	
Aleutian Canada Goose - *Branta canadensis leucopareia*	Delisted	Bird	
Hawaiian Duck (or Koloa) - *Anas wyvilliana*	Endangered	Bird	
California Condor - *Gymnogyps californianus*	Endangered	Bird	
Florida Everglade Kite (Florida Snail Kite) - *Rostrhamus sociabilis plumbeus*	Endangered	Bird	
Hawaiian Hawk (or Ii) - *Buteo solitarius*	Endangered (Proposed for downlisting)	Bird	
Southern Bald Eagle - *Haliaeetus t. leucocephalus*	Delisted	Bird	
Whooping Crane - *Grus americana*	Endangered	Bird	
Hawaiian Common Gallinule - *Gallinula chloropus sandvicensis*	Endangered	Bird	
Hawaiian Crow (or Alala) - *Corvus hawaiiensis*	Endangered	Bird	
Akiapolaau - *Hemignathus wilsoni*	Endangered	Bird	
Palila - *Psittirostra bailleui*	Endangered	Bird	
Bachman's Warbler - *Vermivora bachmanii*	Endangered (presumed extinct)	Bird	
Kirtland's Warbler - *Dendroica kirtlandii*	Endangered	Bird	
American Alligator - *Alligator mississippiensis*	Delisted	Reptiles	
Shortnose sturgeon - *Acipenser brevirostrum*	Endangered	Fish	*NMFS lead
Greenback Cuttthroat Trout - *Salmo clarki stomias*	Threatened	Fish	
Maryland Darter - *Etheostoma sellare*	Endangered	Fish	