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By the Numbers

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2 By the Numbers

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The current endangered species list has its administrative beginnings in 1964 when the Department of the Interior's Committee on Rare and Endangered Wildlife Species published a preliminary list of 62 species at risk of extinction (Goble, forthcoming). Following the enactment of the Endangered Species Preservation Act of 1966 (ESPA), the secretary of the interior in 1967 published the first official list of 78 "native fish and wildlife threatened with extinction" (ESPA sec. 1(c); U.S. Department of the Interior 1967; Wilcove and McMillan, this volume). By the time the Endangered Species Act (ESA) was adopted in 1973, there were 392 species on the list (Yaffee 1982). These first lists included only vertebrate species. On the thirtieth anniversary of the ESA, the number stood at 1,260 domestic species and 558 foreign species (USFWS 2003a), with plant and invertebrate species outnumbering vertebrates.

This chapter presents a graphical summary encapsulating thirty years of species protection and restoration under the ESA. The summary reveals both gains and losses. For some species, such as the Aleutian Canada goose (*Branta canadensis leucopareia*), the process worked as it was meant to, reversing decline and restoring populations to healthy levels (USFWS 2001a); for others, such as the dusky seaside sparrow (*Ammodramus maritimus nigrescens*), the process failed, and despite being listed the species continued to spiral toward eventual extinction (USFWS 1983; Walters 1992).

What follows is an assessment of the state of species protection as it has evolved under the ESA. This includes the taxonomic and demographic distribution of listed species, and the number of critical habitat designations. We also examine newer legal tools for conserving habitat on private land (such as habitat conservation plans), various measures of the act's success, and funding levels for species protection.

The Endangered Species List

The first step in recovery of a threatened and endangered species is listing it under the Endangered Species Act. The growth of the endangered species list from 78 species in 1967 to 1,260 at the end of 2003 is in part the result of expansion of the range of taxa that could be included on the list and in part the result of nonbiological factors such as litigation (Greenwald et al., this volume). An additional point should be noted: the number of listed species (1,260) is misleading. For example, the list groups together separate populations of a species listed as both endangered and threatened, infers that several species represent entire genera or families, and leaves out distinct population segments of some species. These assumptions about taxonomic diversity and species categorization, definition, and distribution are explained below.

Taxonomic Diversity

The most significant reason for the increase in the number of species listed has been an increase in the species eligible for listing (figs. 2.1 and 2.2). The 1967 list was compiled under the Endangered Species Preservation Act, which covered only "native fish and wildlife" (ESPA sec. 1(c)). In 1969, Congress expanded

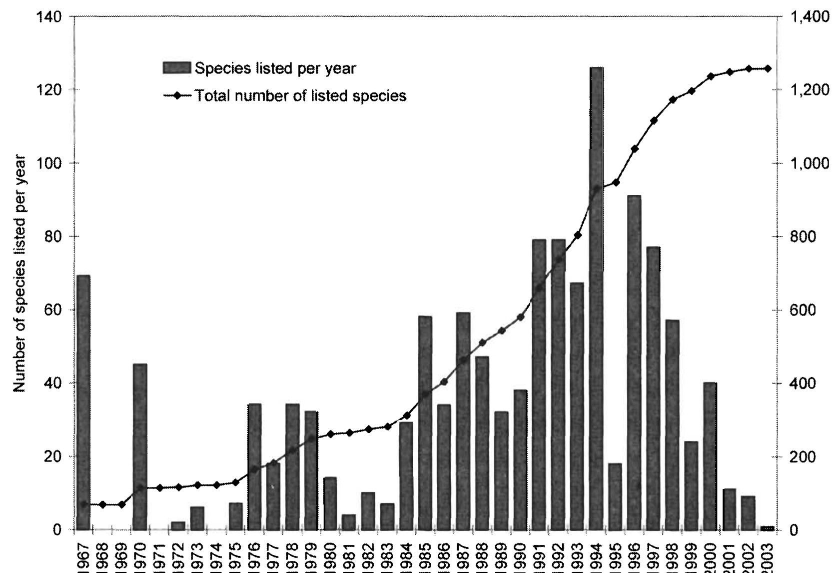

Figure 2.1. Listings of threatened and endangered species since 1967. (Data from USFWS 2004a.)

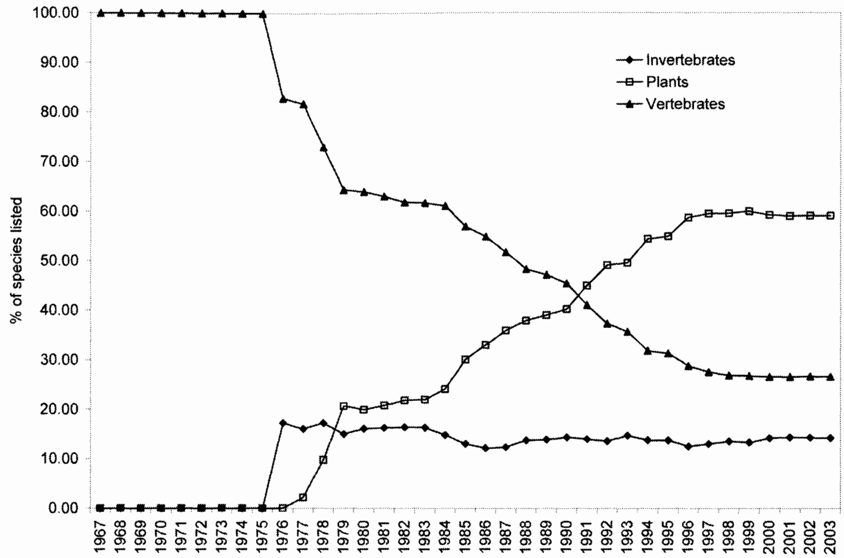

Figure 2.2. Taxonomic breakdown of listed species over time. (Data from USFWS 2004a.)

coverage in the Endangered Species Conservation Act (ESCA) to include mollusks, crustaceans, foreign species, and subspecies (ESCA secs. 3(a), 12(a)). Finally, in 1973, Congress expanded the definition of "species" to include plants, insects, "or smaller taxa." The ESA also created a new category of risk, "threatened" (ESA secs. 3(5), (11), (15), (4)(a)). At the end of 2003, there were 923 species of plants and invertebrates listed (73.3 percent); plants alone accounted for 59 percent of listed species.

Species Categorization

At the end of 2003, 78.2 percent of listed species were categorized as endangered. The ratio of endangered to threatened species has varied over time (fig. 2.3) and also varies among major taxa (table 2.1). Because species are threatened before they are endangered, the fact that most species are listed as endangered suggests that we are failing to get ahead of the risk curve.

Species Definition

As originally enacted, the ESA defined "species" as "any subspecies or smaller taxa." In 1978, the act was amended to include "any distinct population segment of any species of vertebrate." This allows the listing of three taxonomic categories only for vertebrates: species, subspecies, and *distinct population seg-*

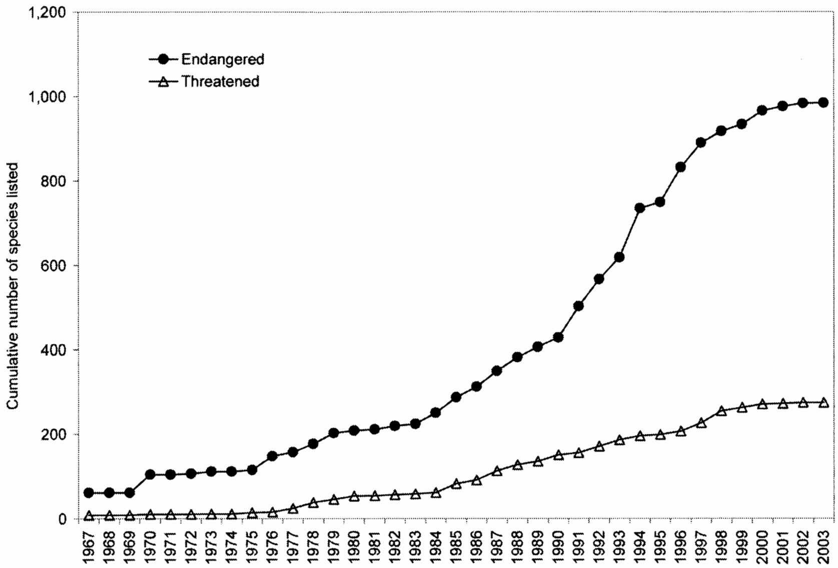

Figure 2.3. Proportion of threatened and endangered species over time in the United States. (Data from USFWS 2004a.)

TABLE 2.1. Number and percentage of threatened and endangered listings by taxonomic groups

Group	*Threatened*	*Endangered*
Vertebrates	94 (27.65)	246 (72.35)
Invertebrates	31 (17.32)	148 (82.68)
Plants	147 (19.76)	597 (80.24)

Note: Percentages given in parentheses.

ments. Species comprise 75.5 percent of the list, subspecies 21.1 percent, and distinct population segments 5.6 percent (table 2.2).

The listing of subspecies and distinct population segments is not consistent with their occurrence within taxa. Wilcove and his colleagues (1993) found that approximately 80 percent of taxa added to the list were full species. They also found, however, that more subspecies and populations than full species were listed for birds and mammals.

Logic suggests that the lower-ranking taxonomic units would be at risk earlier than higher-ranking units. Thus, individuals are lost from populations and populations from subspecies, and subspecies are extirpated prior to the loss of a species (Lomolino and Channell 1995; Hughes et al. 1997; Channell and Lomolino 2000; Cebellos and Ehrlich 2002). This process is well documented

TABLE 2.2. Number and percentage of threatened and endangered species, subspecies and distinct population segments (DPS) among different taxonomic groups

Taxonomic group	*Number listed*	*Number DPS*	*Number species*	*Number subspecies*	*% dps*	*% species*	*% subspecies*
PLANTS							
Conifers and cycads	3	N/A	2	1	N/A	66.7	33.3
Ferns and allies	26	N/A	23	3	N/A	88.5	11.5
Flowering plants	713	N/A	593	120	N/A	83.2	16.8
Lichens	2	N/A	2	0	N/A	100.0	0.0
Subtotal	744	N/A	620	124	N/A	83.3	16.7
INVERTEBRATES							
Arachnids	12	N/A	12	0	N/A	100.0	0.0
Clams	70	N/A	61	9	N/A	87.1	12.9
Crustaceans	21	N/A	21	0	N/A	100.0	0.0
Insects	44	N/A	20	24	N/A	45.5	54.6
Snails	32	N/A	30	2	N/A	93.8	6.3
Subtotal	179	N/A	144	35	N/A	80.5	19.6
VERTEBRATES							
Amphibians	21	5	15	2	23.8	71.4	9.5
Birds	91	16	44	35	17.6	48.4	38.5
Fishes	114	30	83	21	26.3	72.8	18.4
Mammals	78	13	28	40	16.7	35.9	51.3
Reptiles	36	7	20	10	19.4	55.6	27.8
Subtotal	340	71	190	108	20.9	55.9	31.8
Total	1,263	71	954	267	5.6	75.5	21.1

for the passenger pigeon (*Ectopistes migratorius*) (Schorger 1955) and is likely occurring with other species (e.g., greater prairie chicken [*Tympanuchus cupido*]). Although listing a species protects all biological units beneath it, most species are not listable until they have lost a substantial portion of their population, and thus it is likely that some lower taxa have already been lost. To the extent that the act's objective is to conserve the genetic potential of the species, such losses are evolutionarily significant.

Species Distribution

Geographically, listed species are not distributed uniformly across the United States. Instead, some 72 percent occur in just six states: California, Hawaii, Florida, Alabama, Tennessee, and Texas (fig. 2.4).

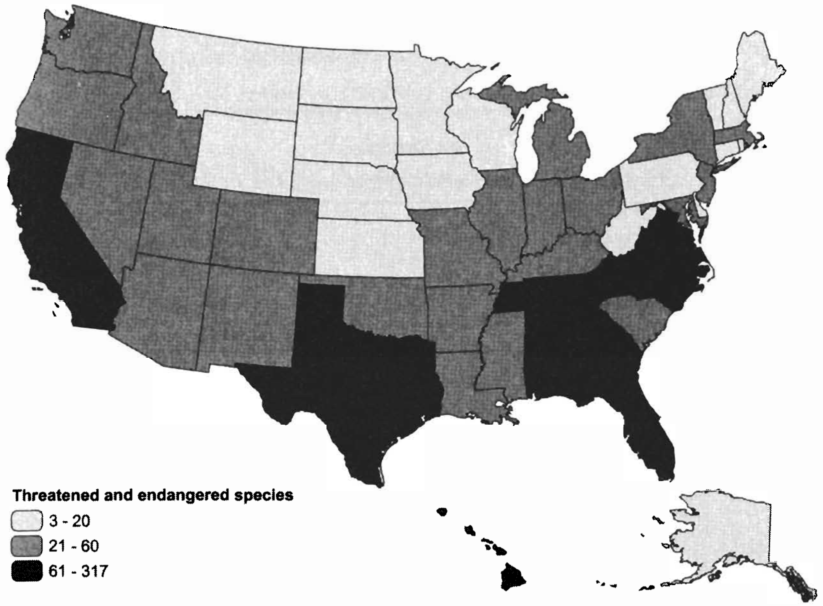

Figure 2.4. Geographic distribution of threatened and endangered species in the United States as of April 1, 2004. (Data from USFWS 2004a.)

Demographics

The Endangered Species Act specifies that a species is "endangered" when it is "in danger of extinction throughout all or a significant portion of its range"; a species is "threatened" when it "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." These definitions do not specify demographic guidelines; thus, the act lacks explicit criteria for determining population thresholds (individuals and populations), risk of extinction, and demographic trends. This is reflected in the published listing decisions. Wilcove and colleagues (1993) found that the median population size at the time of listing was fewer than 1,075 individuals for vertebrates, 999 for invertebrates, and fewer than 120 for plants. Population sizes at the time of listing varied by more than two orders of magnitude, even for species in the same taxonomic group (Wilcove et al. 1993).

Other groups identify species at risk of extinction with more quantitative thresholds. The World Conservation Union maintains a global "red list" that is based on population size, number of populations, trends, and threats (Mace and Lande 1991; IUCN 2003). NatureServe uses similar standards with emphasis on species in the United States (Master et al. 2000). Using the data of Master et al. (2000), we found that 3,122 species were identified in 1999 as either "criti-

TABLE 2.3. Comparison of threatened and endangered listings with NatureServe G1 and G2 species

Group	*Threatened and endangered*	*G1 or G2*
Vertebrates	324	324
Invertebrates	159	387
All animals	483	711
Plants	721	2,411

Source: Data for G1 and G2 species are taken from Master et al. (2000); those from the endangered species list are from the December 31, 1999, boxscore (USFWS 1999b).

cally imperiled" (G1) or "imperiled" (G2) within the United States. This is nearly three times more than the 1,204 species listed by the federal government as endangered or threatened species that year. More plants and invertebrates categorized as G1 or G2 were listed than were vertebrates in the same categories (table 2.3) (Stein et al. 2000). Although the same number of vertebrates were listed as were characterized as imperiled (324), mammals, birds, and reptiles were more likely to be listed than characterized as imperiled (table 2.4).

Assuming all G1 and G2 species in the United States are endangered or threatened, the backlog of unlisted species is a minimum of 6,029 (the number of unlisted G1 and G2 species as of November 2003). The number, however, is likely even larger since 35 percent of listed species (as of November 2003) were not ranked as G1 and G2 by NatureServe. Thus, an additional 2,552 species may be at risk. This would bring the number of potentially listed species to more than 9,000—a daunting number and one that suggests the workload for endangered species biologists will not lighten in the near future.

There is concern that species are listed unnecessarily or that species which should be listed are ignored because nonbiological factors are introduced into listing decisions (GAO 1993, 2003; Scott et al. 1995; National Wilderness Institute 1994). But the small numbers of individuals and populations at the time of listing suggest not that we list species without biological justification but rather that we face a backlog of unlisted at-risk species. That 78 percent of species are characterized as endangered at the time of listing supports this conclusion. Bluntly stated: we are not getting ahead of the extinction curve.

TABLE 2.4. Comparison of threatened and endangered listings with NatureServe G1 and G2 listings of vertebrate groups

Group	*Threatened and endangered*	*G1 or G2*
Mammals	69	29
Birds	89	47
Reptiles	36	21
Amphibians	17	49
Total	324	324

Source: Data for G1 and G2 species are taken from Master et al. (2000); those from the endangered species list are from the December 31, 1999, boxscore (USFWS 1999b).

Critical Habitat Designations

Although the Endangered Species Act requires that critical habitat be designated concurrent with the decision to list a species (ESA sec. 4(b)(6)(c)), often, this does not happen (Suckling and Taylor, this volume). The number of designations per year since 1973 varies from 0 to 25, except for a single large increase (278) that occurred in 2003. As of April 2004, critical habitat has been designated for 450 species (35.6 percent of all listed species), but these designations are taxonomically (table 2.5) and geographically (fig. 2.5) uneven. For instance, critical habitat has been designated for nearly half of all fish species but for only 0.2 percent of insect species, and most designations are in Hawaii and California. These patterns are explained elsewhere in this volume (Suckling and Taylor).

Despite the statutory requirement for designation at the time of listing, there have been significant delays in designating critical habitat for species (Greenwald et al., this volume). The time between listing and critical habitat designation was greatest for plants and least for reptiles and invertebrates (fig. 2.6).

Critical habitat designations have been controversial (USFWS 2003b; Williams 2001). Suckling and Taylor (this volume) found a positive relationship between critical habitat designation and recovery status. The reasons for this positive relationship are uncertain and the data suggest that critical habitat designation is but one of many possible factors accounting for a species' improved population status. Hoekstra et al. (2002b) concluded that critical habitat provided no positive effects in the recovery planning process. They did

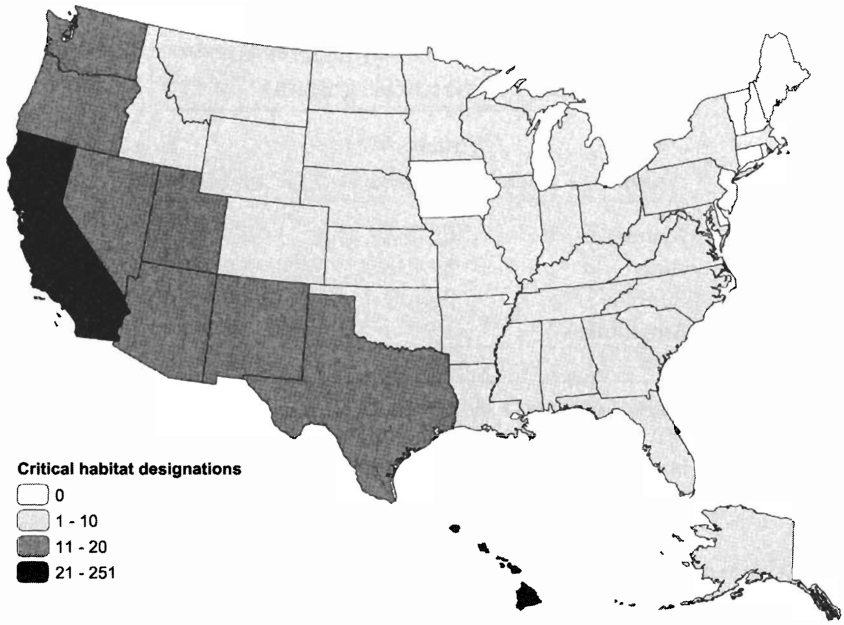

Figure 2.5. Geographic distribution of critical habitat designations in the United States as of April 1, 2004. (Data from USFWS 2004a.)

TABLE 2.5. Critical habitat designations for major taxonomic groups

Taxonomic group	*Species with critical habitat*	*Percentage of listed species*
Mammals	14	17.9
Birds	19	20.6
Amphibians	5	16.1
Reptiles	14	38.9
Fish	56	48.7
Crustaceans	4	19.0
Clams	2	2.9
Snails	2	6.3
Insects	1	0.2
Arachnids	6	8.3
Flowering plants	273	33.6
Ferns and allies	11	39.3

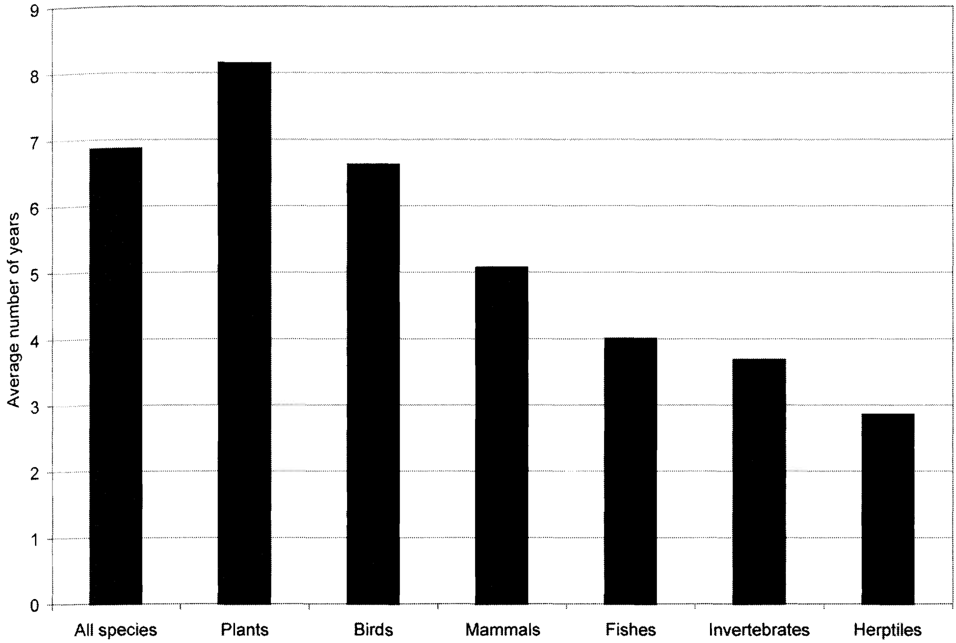

Figure 2.6. Average number of years between listing and designation of critical habitat. (Data from USFWS 2004a.)

not address the question of its influence in species recovery. Thus, in-depth species-by-species assessments may be required.

Conservation Tools for Nonfederal Lands

The U.S. Fish and Wildlife Service (USFWS) has developed three instruments intended to facilitate the conservation of species while providing greater certainty for nonfederal landowners. The statutory authority for these instruments is found in 10(a) of the Endangered Species Act, which authorizes the secretary to issue permits for the incidental taking of listed species (ESA sec. 10(a)(1)(B)) when the secretary has approved a "conservation plan" that meets enumerated criteria (ESA sec. 10(a)(2)). The USFWS has embroidered on the "conservation plan" provisions to create three categories: (1) candidate conservation agreements (*Code of Federal Regulations* 50:17.22(d)); (2) habitat conservation plans (*Code of Federal Regulations* 50:17.22(b)); and (3) safe harbor agreements (*Code of Federal Regulations* 50:17.22(c)).

Candidate Conservation Agreements

A *candidate conservation agreement* (CCA) is a voluntary agreement between the USFWS and a landowner under which the landowner agrees to specified actions to conserve "[p]roposed or candidate species [or] other unlisted species that are likely to become a candidate or proposed species" (USFWS 1999a). CCAs reflect the idea that implementing conservation measures before a species is listed may provide sufficient conservation to make it unnecessary to list the species. CCAs may be issued "with assurances," that is, with a promise that a nonfederal landowner will not be subjected to future regulatory obligations in excess of those agreed to at the time the landowner enters into the agreement.

As of April 1, 2004, there were 104 CCAs nationwide; only 7 CCAs included assurances. CCAs were distributed unevenly geographically (fig. 2.7) and taxonomically. The most commonly included taxa was vertebrates (71), followed by plants (66) and invertebrates (13); 14 CCAs were proposed with no candidate species specified. Of the 104 approved agreements, one addressed more than 25 species and one addressed 117 of the 133 species covered by CCAs, but most (97 plans, or 93 percent) addressed only a single species.

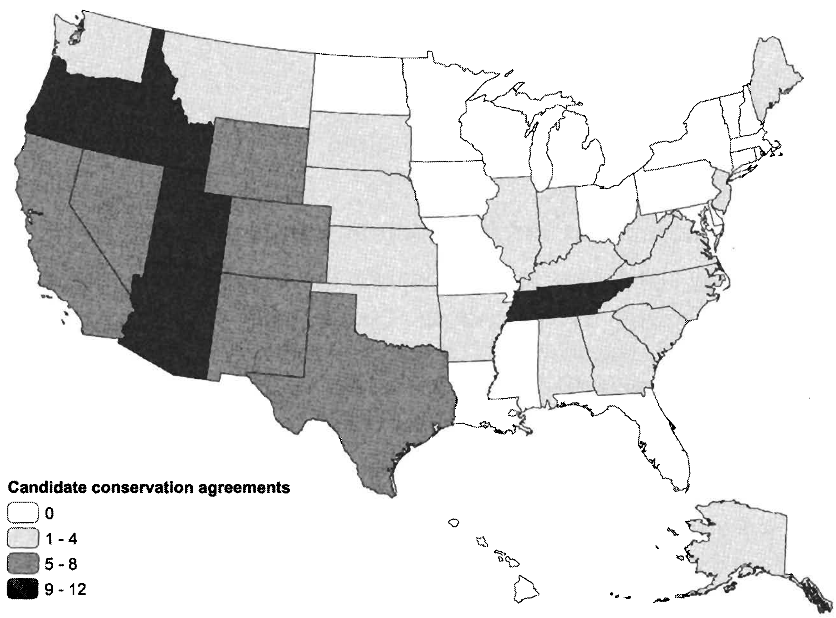

Figure 2.7. Geographic distribution of candidate conservation agreements (CCAs) in the United States as of April 1, 2004. (Data from USFWS 2004a.)

Habitat Conservation Plans

A *habitat conservation plan* (HCP) is a mitigation plan for activities that take listed species; an HCP is required for the issuance of an incidental take permit. Although Congress authorized HCPs in 1982, they remained little used until the Clinton administration: only fourteen HCPs were approved from 1983 to 1992, but by April 1, 2004, there were more than four hundred approved HCPs covering more than 38 million acres (USFWS 2004b). HCPs vary widely in size, ranging from less than 2.5 acres to more than a million acres (fig. 2.8). They also vary widely in the coverage of both the number of species and their taxa. Reptiles as a group have the highest percentage of species addressed by HCPs (44 percent); plants are least represented (5 percent). Of the 356 HCPs in the USFWS ECOS database, 273 (77 percent) addressed a single species; 10 addressed twenty or more species. Geographically, HCPs are unevenly distributed (fig. 2.9).

HCPs have been the focus of a number of studies. Kareiva and colleagues (1998) called for increased efforts to use explicit scientific standards and summaries of available data on the ecology of a species in plans as well as to create centralized databases that are generally accessible and include monitoring data.

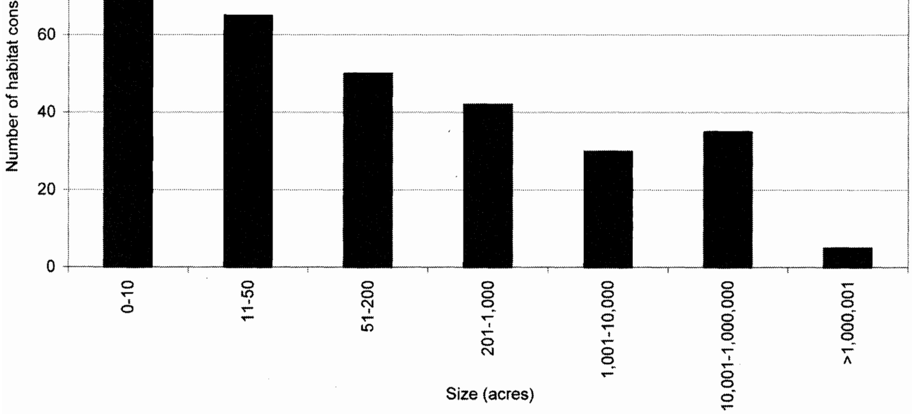

Figure 2.8. Size of habitat conservation plans. (Data from USFWS 2004a.)

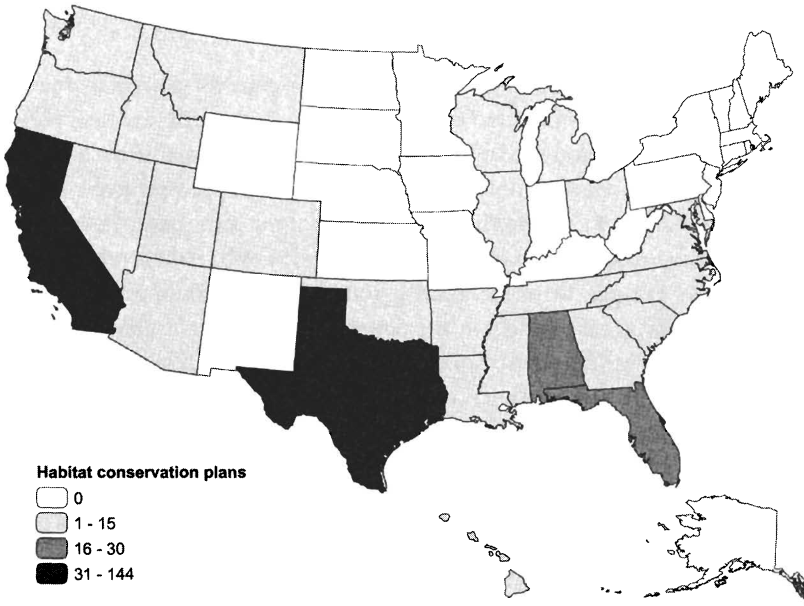

Figure 2.9. Geographic distribution of habitat conservation plans (HCPs) in the United States as of April 1, 2004. (Data from USFWS 2004a.)

Watchman et al. (2001) characterized HCPs as tools of compromise whose benefits to endangered species are yet untested. For a detailed examination of HCPs, see Thompson (this volume).

Safe Harbor Agreements

Safe harbor agreements (SHAs) are based on the principle that people who do good deeds on behalf of endangered species should not be penalized. To that end, a SHA may be issued when it "will provide a net conservation benefit to the affected listed species by contributing to the recovery of the listed species" (*Code of Federal Regulations* 50:17.22(c)(2)). The example most frequently cited activity is "restoring and enhancing habitat for endangered species."

As with CCAs and HCPs, these agreements are unevenly distributed both geographically and taxonomically. Twenty-three SHAs have been approved as of April 1, 2004, that cover twenty-six listed species and range in size from 0.2 to 161,173,776 acres. The number of species covered in SHAs range from one to five; of the twenty-three agreements, fourteen address a single species.

TABLE 2.6. Status of species with experimental populations

Status	*Percentage of all listed species*	*Percentage of experimental species*
Stable	30	8.9
Increasing	9	23.0
Unknown	24	8.9
Declining	34	47.0
Captive	<1	2.9
Presumed extinct	2	8.9

Experimental Populations

Experimental populations are a tool to reestablish threatened or endangered species in their former range (Goble 2002). An experimental population is a population released into an area that is "wholly separate geographically" from all other populations of the same species (ESA sec. 10(c)(j)). Members of an experimental population are treated as threatened even though nonexperimental populations of the same species may be endangered. This allows the USFWS to write less-restrictive rules under section 4(d) of the act. For example, gray wolves (*Canis lupus*) in Yellowstone are classified as an experimental population and depredating animals may be killed—something that would be illegal but for their classification.

Thirty-five experimental populations have been established for thirty-one species of animals. Only the gray wolf, the whooping crane (*Grus americana*), and the yellowfin madtom (*Noturus flavipinnis*) have multiple experimental populations. The statistical data on experimental populations is mixed. Species with experimental populations had higher percentages of both increasing and declining populations than did listed species in general (table 2.6).

Measures of Success

A consistent criticism of the Endangered Species Act is that it has not accomplished its purpose of recovering populations of listed species.

One correlate of recovery is the type of risk facing a species. Recovering species had easily identifiable threats and/or occupied major parts of their historic range (Abbitt and Scott 2001); none of the recovered species were primarily threatened by habitat loss. This suggests that we are recovering species with specific, easily remediable threats but are less successful when confronted with

TABLE 2.7. Changes in percentage of U.S. species by status over time

Status	*Species listed 5 years or less* As of 09/30/98	As of 09/30/00	*Species listed 6–10 years* As of 09/30/98	As of 09/30/00	*Species listed 11 years or more* As of 09/30/98	As of 09/30/00
Stable	15	17	32	27	36	40
Improving	2	3	6	7	15	14
Declining	41	48	23	32	32	27
Uncertain	41	31	39	30	13	15
Captivity	<1	<1	0	<1	<1	<1
Presumed extinct	<1	<1	<1	3	4	3

Source: USFWS 2003c.

habitat loss. Habitat loss, however, is the major cause of endangerment (Wilcove et al. 1998). Abbitt and Scott (2001) found a positive correlation between percentage of historical range occupied at time of listing and achieving recovery. This suggests that targeting habitat for conservation may be a cost-effective way to reduce future listings while also protecting currently listed species (Shaffer et al., this volume). Similarly, targeting at-risk ecosystems (Noss et al. 1995) for conservation efforts before they deteriorate to the point where associated species are at risk is another proactive approach to the endangered species problem.

Beginning in 1990, the secretaries of the interior and commerce have provided biennial status reports to Congress for species under their jurisdiction. The most recent USFWS report covers the period October 1, 2000, to September 30, 2002 (USFWS 2004c); it states that 30 percent of listed species had stable populations, 6 percent were characterized as improving, 21 percent were declining, and 39 percent were characterized as uncertain (USFWS 2004c). Generally, the longer a species was listed the better its status (table 2.7).

The most recent National Marine Fisheries Service (NMFS) report covers the period from October 1, 2000, to September 30, 2002 (NMFS 2002). At the end of that period, NMFS had sole (forty-three species) or joint (seven species) responsibility for fifty species (NMFS 2002). Of these species, 30 percent are increasing, 4 percent have stable populations, 10 percent are "mixed," 34 percent are declining, and 22 percent have an uncertain status (NMFS 2002).

In addition to status trends in biennial reports, there are several other potential measures of the success of the ESA. These include extinctions, prevention of extinctions, reclassifications, and delistings.

Species Presumed Extinct

By the end of 2003, the USFWS (2004a) had delisted nine species presumed extinct. In addition, the agency reported that twenty-eight species (2 percent) were considered extinct as of September 30, 2000. This number was subsequently reduced to twenty-six species after two Hawaiian plants were rediscovered. These numbers are consistent with two other independent estimates of extinction for the same time period (B. Czech, pers. comm. [estimated twenty-seven species]; K. Suckling, pers. comm. [estimated thirty-one species]).

Prevented Species Extinctions

Based on the risk of extinction, Schwartz (1999) found that 192 U.S. species could have been expected to go extinct between passage of the act in 1973 and 1999. Using his logic that 67 percent of species characterized as threatened or endangered would be expected to go extinct in one hundred years, 262 currently listed species could be expected to have gone extinct in the thirty years since passage of the act. Subtracting the 9 species declared to be extinct and 26 assumed to be extinct by the USFWS, we are left with 227 species that the ESA arguably prevented from going extinct.

TABLE 2.8. Downlisted species

		Status change	
Common name	*Date downlisted*	*From*	*To*
American alligator	1/10/1977	E	T
Virginia round-leaf birch	11/16/1994	E	T
Missouri bladderpod	10/15/2003	E	T
Siler pincushion cactus	12/27/1993	E	T
Maguire daisy	06/19/1996	E	T
Snail darter	07/05/1984	E	T
Bald eagle (lower 48 states)	07/12/1995	E	T
Arctic peregrine falcon	3/20/1984	E	T
MacFarlane's four-o'clock	03/15/1996	E	T
Alentian Canada goose	12/12/1990	E	T
Tinian monarch	04/06/1987	E	T
Louisiana pearlshell	09/24/1993	E	T
Small whorled pogonia	10/06/1994	E	T

(*continues*)

Table 2.8. *Continued*

Common name	*Date downlisted*	*Status change* *From*	*To*
Utah prairie dog	05/29/1984	E	T
Large-flowered skullcap	01/14/2002	E	T
Apache trout	07/16/1975	E	T
Greenback cutthroat troat	04/18/1978	E	T
Lahontan cutthroat trout	07/16/1975	E	T
Paiute cutthroat trout	07/16/1975	E	T
Gray wolf (western DPS*)	04/01/2003	E	T
Gray wolf (eastern DPS)	03/09/1978, 04/01/2003	E	T

*Distinct population segment.

Downlisted Species

A species is downlisted when its status changes from endangered to threatened. Twenty-two species had been downlisted (table 2.8) by the thirtieth anniversary of the Endangered Species Act. The USFWS has identified twenty-seven species it considers to be on the brink of recovery. Five species are identified as nearly ready to downlist and twenty-two to delist (D. Crouse, pers. comm.).

Delisted Species

A species is delisted when it meets recovery goals and is no longer threatened, that is, no longer "likely to become an endangered species in the foreseeable future" (ESA sec. 3(20)). At the thirtieth anniversary of the ESA, thirty-seven species had been delisted, thirteen due to recovery (fig. 2.10). In addition, the USFWS recently proposed delisting of eastern populations of gray wolves (*New York Times* 2004).

Abbitt and Scott (2001) examined factors associated with delisted species that had been recovered and found a positive relationship between population status and percentage of historical range occupied at the time of listing, as well as with percentage of recovery goals achieved. This suggests that the management actions set out in recovery plans are biologically relevant and, when implemented, can improve the status of the species.

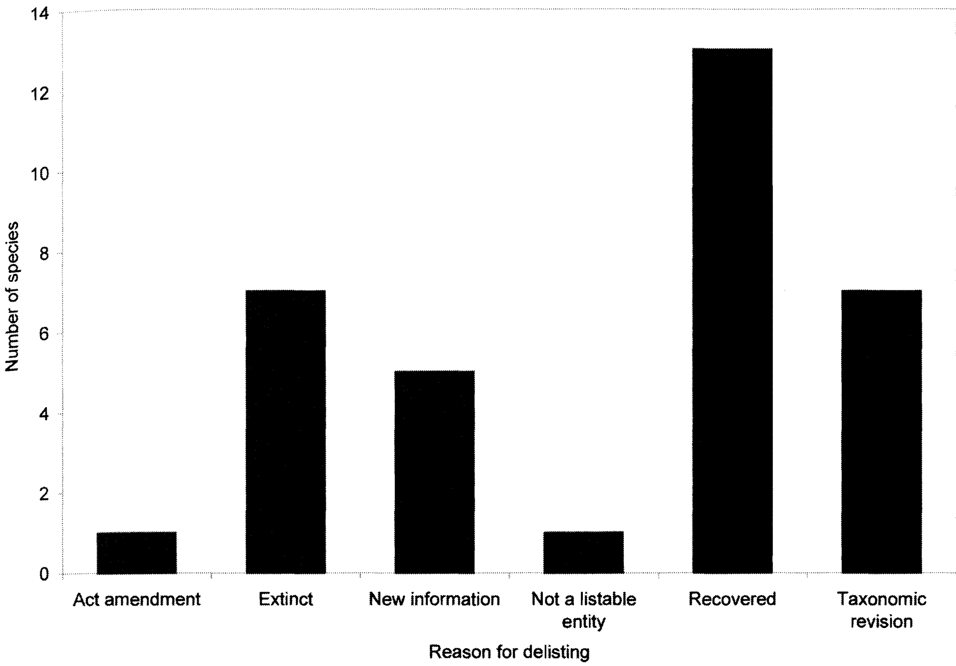

Figure 2.10. Delisted species in the United States and reasons for delisting as of December 31, 2003. The reason for delisting Rydberg milk-vetch (*Astragalus perianus*) has subsequently been changed to "original data in error (new information discovered)." (Data from USFWS 2004a,b.)

Funding

Funding for the endangered species program has varied dramatically since 1973 (fig. 2.11). The expenditure per listed species for all activities—administration, law enforcement, recovery, and others—was greatest four to six years after the act was passed, when it reached $241,000 per species. Figure 2.11 understates total funds because it does not include expenditures by the private sector; such funding often substitutes for direct federal funding (Kareiva et al., this volume). Nonetheless, this funding history suggests a diminished commitment to meeting the act's objectives.

Another measure of the adequacy of funding is to evaluate the percentage of the funds identified in recovery plans as needed to recover a species. Miller and colleagues (2002) found a positive relationship between funding and species recovery. Their findings suggest that recovery plans are identifying tasks that, when implemented, make a difference in the population status of the species. Thus, it would seem that large gains in the number of recovered species

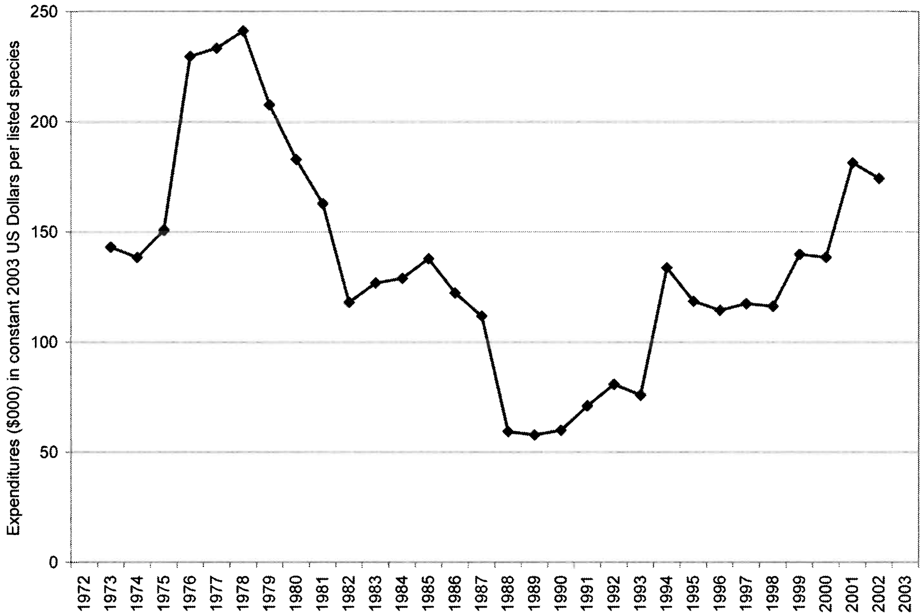

Figure 2.11. Expenditures per listed species in constant 2003 U.S. dollars. (Data from USFWS 2004a.)

could be obtained by increasing recovery expenditures for plants, a group of which only two species have been delisted due to recovery. Restani and Marzluff (2002) also suggested that improving the correlation between USFWS spending and species ranks would increase the number of recovered species.

Conclusion

A review of the numbers generated by thirty years of implementing the Endangered Species Act reveals a checkerboard pattern. Increasing numbers of listed species, with endangered species far outnumbering threatened species in 1973 and in 2003, suggest that listing and recovery planning are implemented when extinction risks have already reached critical levels. This message is reinforced by the number of species that have gone extinct while listed and by the existence of six thousand or more unlisted but apparently imperiled species. Our biggest challenge may lie not in the recovery of endangered species but in preventing imperiled species from becoming endangered.

Reinforcing these conclusions is the fact that, although full species are most often listed, subspecies and populations are likely at risk earlier. These conclusions are also supported by the fact that only a small number of populations and individuals are present at the time of listing (Wilcove et al. 1993).

A recurring question is, how are we to measure success? Our findings suggest that success is a continuum (J. M. Scott et al., forthcoming) but that delisting or downlisting are widely accepted measures. Our view is that success is incremental: an increase, however small, in the number of individuals, in the number of populations, or in the distribution of a listed species indicates success, as does any reduction in the number or intensity of threats to a listed species. Although each increase by itself may not signal full ecological recovery for a species or restore it to an ecological and evolutionarily viable level, combined they nonetheless are signs that progress is being made. That there is a demonstrated correlation between number of years since a species is listed and improvement in its status (USFWS 2004c) also gives reason for optimism. But it also suggests that it may be several more decades before we can fully assess the success of the Endangered Species Act in preventing the loss of species on this planet.