Endangered Species Act of 1973:Explicit and Implicit Trends in the Designation of Critical Habitat and the Effects of Critical Habitat on Chances for Recovery

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Abstract Nearly eighty-nine percent of all species listed under the Endangered Species Act (ESA) do not have critical habitat (National Research Council 1995). This is a great source of concern, considering evidence from previous studies suggesting that critical habitat aids in the process of species recovery (Houck 1993). The purpose of this investigation is twofold: 1.) Determine which factors may affect critical habitat designation, and 2.) Determine how critical habitat affects species' chances for recovery. Six factors, (a-f) were investigated for the first part of the purpose: a.) Plant or animal taxa; b.) Vertebrate or invertebrate status (among animals only); c.) Endangered or threatened status; d.) Recovery plan status; e.) Recovery priority; and f.) Economic conflicts. The single parameter for the second part of the purpose was percent recovery achieved. Data for all nine hundred and forty-nine U.S. species on the Endangered Species List were compiled and analyzed for the seven parameters under study. Each of the seven parameters was tested for association with critical habitat designation by using the Chi-Square test for association, or the G-test. Results revealed significant associations between each of the seven parameters and critical habitat designation with a G-square p-value of at least 0.05 or less in all cases. It was concluded that explicit and implicit trends in the way critical habitat is determined do likely exist. Furthermore critical habitat is significantly associated with species recovery. With the reaffirmation of the importance of critical habitat towards species recovery provided by this study, suggestions for increasing the number of species listed with critical habitat include various alterations to specific provisions of the ESA.

Introduction

Plants and animals are a natural component of the environment humans inhabit. In addition to the aesthetic, spiritual, and utilitarian values of wildlife, plants and animals also serve as useful biotic indicators of the overall health of ecosystems. A healthy ecosystem is one in which the number and variety of species present in an area are in balance with the resources available in that area. Non-human environmental forces such as temperature variation can cause natural fluctuations in species' populations (The California Nature Conservancy 1987). It is important to consider the potential negative effects that the loss of members of an ecosystem may have on the normal functioning of that ecosystem. If humans wish to maintain the health and biodiversity of natural ecosystems, we must provide a safeguard against human disturbances to wildlife.

Numerous factors contribute to the extinction of plants and animals, but the major causes are habitat destruction, degradation, and fragmentation. These factors are in turn influenced by pollution, introduction of exotic species, and commercial exploitation. According to a study included in book written by Reed F. Noss, eighty-eight percent of endangered species are affected by habitat destruction and degradation, forty-six percent by the introduction of exotic species, twenty percent by pollution, fourteen percent by over-harvest (hunting), and two percent by disease (Noss 1997). Environmental scientist Joel Cohen goes a step further in describing the decline of listed and unlisted species in economic terms: "Ninety-eight percent of all the animal extinctions since 1600 are a result of human economic activities. Thirty-six percent are the result of habitat conversions. Twenty-three percent are a result of hunting for food and for sale, and about thirty-nine percent are a result of introducing other species for human purposes." (Cohen, 1999) Of course many species are endangered by multiple causes, thus there is an overlap in the causes of endangerment cited here. Although absolute solutions to these problems may not exist or be entirely feasible due to conflicting human interests, some methods of alleviating the current high rate of species loss have been devised and implemented in recent years (USFWS 1998).

Since its enactment in 1973, the Endangered Species Act (ESA) has served as the key legal document designed to protect species or subspecies that are threatened worldwide with extinction (Houck, 1993). The act protects species by prohibiting the "taking" of listed species, defined as killing, harming, or harassing the species. It also requires federal agencies to conduct their activities in ways that will not compromise the continued existence of listed species (USFWS 1998).

There are three main stages in the application of the ESA. First, a species is identified and listed as threatened or endangered in all or part of its habitat. Second, the US Fish and Wildlife Service (USFWS) devises a Recovery Plan for the species or declares the species to be exempt from a recovery plan. That decision is based on current knowledge of the species' status and habitat. Lastly, if a recovery plan is applicable the plan is implemented and the species' population(s) is/are monitored by the USFWS and/or the National Marine Fisheries Service (NMFS) until a proposal is made to delist the species based on its successful recovery. The primary goals of the ESA are to protect the ecosystems upon which endangered/ threatened species depend and to recover listed species to the point where they can be delisted (USFWS 1988).

Listing a species as endangered or threatened is only the first step toward protecting that species from suffering further declines in population. Perhaps the most crucial factor affecting a species' chance for recovery and long-term survival is habitat. Although a species' ecological niche is rarely restricted to physical area, the ability of a species to survive and reproduce does depend on the availability of at least a minimal amount of space and resources as would exist within the confines of a given area. This is the main idea behind critical habitat, defined by the USFWS as "a specific geographic area(s) that is essential for the conservation of a threatened or endangered species and that may require special management and protection." (USFWS 2000)

Although the Department of the Interior has altered the original legal definition of critical habitat in an attempt to equate its protection capabilities with that of jeopardy, critical habitat provides significantly better protection in court than jeopardy. To jeopardize a species means "to reduce appreciably the likelihood of both the survival and recovery of a listed species." (USFWS 1988) When a species' existence is challenged in the courtroom by economic development the importance of critical habitat cannot be overestimated. In numerous cases such as *Tennessee Valley Authority v. Hill*, which concerned the previously unknown Snail Darter, the Supreme Court has relied explicitly on the designation of critical habitat for the species to halt federal projects that would alter critical habitat, an act forbidden by the ESA. In similar cases where no critical habitat has been designated, the court is forced to rely on jeopardy alone, which is viewed as discretionary and flexible. The decisions in these cases are most often in favor of development since jeopardy is a difficult condition to prove in court. In fact, between 1990 and 19995, of the 100,000 consultations USFWS conducted with federal agencies over actions that could

jeopardize listed species, only 0.054 percent resulted in jeopardy opinions. The rest were dismissed on the basis of insufficient evidence to support the theory of jeopardy (Houck 1995). One such example is *Sierra Club v. Froehlke*, in which a dam was authorized even though it would eliminate the dwellings of an endangered Indiana Bat, simply because the court said the Interior had failed to designate critical habitat. (Houck 1993).

Section 3, provision 5 of the ESA outlines several aspects of critical habitat: Critical habitat of a species must be designated by the Secretary of the Interior at the time of listing or in special cases within a two-year period from the date of listing. The proposed geographical area may include areas not currently occupied by the species, but which are essential to that species' recovery (USFWS 1988). Although all listed species are protected within their occupied habitat, only species with critical habitat designations benefit from the added protection of areas outside this range, providing a buffer zone between endangered or threatened species and potentially harmful human development. The modification of critical habitat is strictly prohibited by the ESA (USFWS 1982). Critical habitat is presumably determined by the best scientific data available. This, however, does not imply that all species that require critical habitat for their conservation actually receive the benefit of a critical habitat designation (USFWS 1999).

It is a great source of concern to many conservationists that nearly eighty-nine percent of all species listed in the U.S. do not have critical habitat. This statistic, provided by the National Research Council (1995), motivated me to conduct a policy study of endangered species and critical habitat designations. The purpose of this investigation is to determine which factors may affect critical habitat designation and, alternatively, how critical habitat affects a species' chance for recovery.

The results of this study should enable me to generate a hypothesis as to why nearly eighty-nine percent of all U.S. species listed under the ESA do not have critical habitat designations. Based on research, it will then be decided whether or not the problem is resolvable within current interpretations of the ESA. I will also assess the apparent benefit of critical habitat towards species recovery. If the benefit is found to be significant, suggestions will be made to improve the process of listing species with regard to critical habitat. This would mean that a larger percentage of species listed would have critical habitat designations, and thus may have a better chance at recovery.

Methods

Preliminary research revealed a significant lack of detailed information on endangered and threatened species in foreign countries. Therefore it was more practical to focus only on U.S. listed species, of which there are currently 949. (From this point on, any reference made to endangered and threatened species will apply solely to U.S. listed species.)

Materials were of a literary content and consisted primarily of the Endangered Species Act of 1973 (USFWS, 1988) and the U.S. Endangered Species List (USFWS, 1999). In addition to legal documents, numerous other scientific works were consulted regarding the ESA, critical habitat, species recovery, and individual listed species information.

In order to determine which factors may affect critical habitat designation and how critical habitat affects a species' chance for recovery, I structured my investigation around specific questions. The main questions to be addressed by this study are written below as numbers 1 and 2. Question 1 is followed by seven parameters to be investigated individually (a-f).

1.) Are there explicit or implicit trends in the way critical habitat has been determined over the past twenty-eight years? Is there an association between critical habitat status and the following seven parameters?

a.) Plant or animal status

b.) Vertebrate or invertebrate status (among animals only)

c.) Endangered or threatened status

d.) Recovery plan status

e.) Recovery priority

f.) Economic conflicts

2) Do species with critical habitat have a greater recovery rate? If yes, is the higher rate attributable to critical habitat designation or is it more likely due to extraneous factors?

An explanation for the selection of parameters (a-f) follows:

a. & b.) Although the Department of Interior is required by the ESA to give equal and fair consideration towards all critical habitat designations, it is suspected that charisma plays a major role in this designation process (Houck). As the general public appears through their conservation efforts to be more concerned with animals than plants, a greater effort to designate critical habitat for animals than for plants seems highly probable. Similarly, among animals, it seems clear that vertebrates would have proportionately more critical habitat designations than

invertebrates based on their more charismatic status. By charisma, it is implied that the species has greater value to the general public than non-charismatic species. Value, in this sense, can depend on any combination of the following factors: utilitarian, moral/religious, aesthetic, humanitarian, etc. (Errington 1987).

c.) Since the endangered status is indicative of a more dire state of existence than the threatened status, it is expected that more emphasis would be placed on designating critical habitat for endangered species in a desperate effort to bring them back from the brink of extinction.

d.) Recovery plan status is expected to be significantly associated with critical habitat status. It is presumed that if assignment of a recovery plan was based on current knowledge of the species and its habitat, and if there was significant knowledge to assign a recovery plan, then that knowledge should suffice for critical habitat designation as well.

e. & f.) Recovery priority and economic conflict are related to each other in such a way that recovery priority depends upon economic development conflicts, among other factors. (USFWS 2000). Hence, common sense would suggest that species with a higher recovery priority would be likely candidates for critical habitat designation since there is evidence to support the claim that critical habitat increases the likelihood of recovery (Houck 1993).

Step 1: Obtain the following documents:

- The Endangered Species Act of 1973 (updated version)
- List of Endangered and Threatened wildlife and plants
- Individual species recovery plan information from the USFWS website: Http://www.fws.gov

Step 2: Gather pertinent data:

- Create an appendix listing all 949 US species. Use the List and Recovery Plan information mentioned in step 1 to include in the appendix the data for the parameters as it appears at the top of Data Table 1: taxonomic group, total number, etc.
- Organize the data from Table 1 into the first two columns of Table.
- Divide data for the seven parameters into two categories: 1.) Critical habitat or 2.) No critical habitat.

Step 3: Analyze data for associations between parameters and critical habitat status using the chi-square test.

- Apply the chi-square test to each parameter data set, which consists of four numbers.
- Record the G squared value as well as the p-value for each parameter in the last two columns of Table 2.

Step 4: Interpret Results

- Check the p-values in the final column of Table 2 for significance. If the p-value is less than 0.05 the difference between the data is significant. Thus there is an association between the given parameter and critical habitat designation.
- The discussion will include explanations for any associations found.

DATA TABLE 1

TAXONOMIC GROUP	TOTAL #	LISTING STATUS		CRITICAL HABITAT	RECOVERY PLAN	ECONOMIC CONFLICT	RECOVERY PRIORITY		RECOVERY ACHIEVED	
		T	E	#	#	#	HI	LO	0-50%	51-100%
ANIMALS	420	112	312	84	319	143	282	137	379	41
VERTEBRATES	*290*	*87*	*207*	*79*	*229*	*108*	*182*	*107*	*252*	*38*
INVERTEBRATES	*130*	*25*	*105*	*5*	*90*	*35*	*100*	*30*	*127*	*3*
PLANTS	529	96	433	23	380	79	333	196	501	28
TOTAL	949	208	745	107	699	222	615	333	880	69

***** Data compiled from information provided by the USFWS: http://www.fws.gov

** Recovery priority is determined individually by the Interior on a number scale of 1-18, one being high priority. Economic conflict elevates the priority of recovery a species (USFWS 2001).

*** Percent recovery achieved is also determined on an individual basis, according to the recovery plan of the species.

Results

The following table includes the results of the chi-squared tests as applied to each of the seven parameters under study.

TABLE 2: RESULTS

VARIABLE	CRITICAL HABITAT		CHI-SQUARED TEST	
	YES	NO	G - value	G - P value
TAXONOMIC GROUP				
Animals	84	336	58.971	<0.0001
Plants	23	506		
TYPE				
Vertebrates	79	211	38.278	<0.0001
Invertebrates	5	125		
LISTED STATUS				
Endangered	66	679	18.431	<0.0001
Threatened	42	166		
RECOVERY PLAN				
Recovery Plan	88	611	4.93	0.0264
No Recovery Plan	19	231		
ECONOMIC CONFLICT				
Conflict	44	178	18.916	<0.0001
No Conflict	63	664		
RECOVERY PRIORITY				
High	98	517	46.071	<0.0001
Low	9	324		
RECOVERY ACHIEVED				
0-50%	94	786	3.681	0.055
51-100%	13	56		

The chi-square tests revealed a significant difference in the designation of critical habitat for all seven of the parameters: taxonomic group, type, listed status, recovery plan, recovery priority, economic conflict, and percent recovery achieved. Thus critical habitat designation would appear to favor:

a.) Animals over plants

b.) Vertebrates over invertebrates

c.) Threatened over endangered species

d.) Species with a recovery plan over those without one

e.) High-priority species over low-priority species

f.) Economic conflict over none

g.) Species with 51-100% of their recovery achieved over species with only 0-50% of their recovery achieved.

Discussion

All of the results were as expected with the one exception of species type. It was a surprise that critical habitat would be more strongly associated with threatened status than endangered status. Explanations for the results are as follows:

Critical habitat was significantly associated with animal taxa (G 58.971; p-value <0.0001) and vertebrates (G 38.278; p-value <0.0001). From these results I would draw the conclusion that charisma does play a role in the designation of critical habitat; thus the more charismatic species are more likely to have critical habitat.

Critical habitat was significantly associated with threatened status (G 18.431; p-value <0.0001). This result was surprising, as I expected there to be a greater concern for recovering endangered species. One possible explanation for this result comes from a study conducted by Oliver Houck (1993) regarding instances in which species were suddenly downlisted from an endangered status to a threatened status. Houck's theory about the change is that FWS downlisted the ten species for the purpose of loosening the hunting restrictions on the ten species, which happened to be considered game species. In seven of the ten cases, the species' populations were actually declining! Obviously the downlisting should have been investigated at some point for legitimacy, but was not. I expect that more threatened species receive critical habitat because they are more likely to recover than endangered species which have already suffered possibly irreversible declines in population. This would make sense if one of the major motives for delisting certain species is to make them more accessible as game species.

Critical habitat was significantly associated with recovery plan status (G 4.93; p-value 0.0264). This result seems likely since there was sufficient knowledge about the species to assign a recovery plan, thus there must also be sufficient knowledge to designate critical habitat.

Critical habitat was significantly associated with economic conflict status (G 18.916; p-value <0.0001) and high recovery priority (G 46.071; p-value <0.0001). Explanations for these expected results were discussed in methods and will not be repeated here.

Critical habitat was significantly associated with percent recovery achieved (G 3.681; p-value 0.055). This result answers question #2 which asked if critical habitat contributed to a species' chances for recovery. The association would suggest that species with critical habitat do benefit more in terms of recovery than species without critical habitat. The reason is most likely do to the power of critical habitat status in court when a species' survival is threatened by economic development (Houck 1993).

These associations, however significant, do not establish causation. Thus the conclusions of this study can only provide hypotheses on which factors affect critical habitat designation. Priorities, unless found explicitly stated in USFWS records, may only be assumed. And although the trend may be observed that species with critical habitat have higher recovery rates, this does not imply that critical habitat improves a species' chance for recovery.

Suggestions for increasing the number of listed species with critical habitat include the following: 1.) Include in the ESA a provision requiring a high minimum percentage or number of species to have critical habitat. 2.) Provide for a revision process of decisions made by the Interior regarding designation of critical habitat and downlisting of species' status. 3.) Change the legal definition of critical habitat back to its original form so that Interior cannot claim that critical habitat provides no further protection than jeopardy. In this way, Interior will not have the excuse of claiming that there would be no added benefit if critical habitat were designated.

In the future, maybe the results of this study can be taken a step further and be applied to all listed species, foreign and domestic. A more comprehensive analysis of the species' relationship with critical habitat would provide more powerful clues to determine where the Act went wrong and how to improve it. It is also important to keep in mind, the Act is evolving over time and changing in the numbers and taxonomic makeup, etc, which affects the types and degrees of problems that challenge the ESA.

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