Endangered Species UPDATE

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THE UNIVERSITY OF MICHIGAN
School of Natural Resources

In this Issue

A Critical Evaluation of the Species Approach to Biological Conservation

by

Richard L. Hutto, Susan Reel, Peter B. Landres

Editor's Note: *As the newly designed Update develops, we hope it will become an outlet for ideas and thoughts on a range of species conservation issues. In keeping with this image, we are printing the following article which expresses a view of the limitations of the species focus in biological conservation. We hope that it will act as the beginning of an ongoing discussion rather than an end in itself. We welcome letters and comments on this article as well as those that will appear in future issues. The success of the Update depends upon the participation of its subscribers.*

In its recent report, *Technologies to Maintain Biological Diversity*, The Office of Technology Assessment (OTA) suggests that the conservation of biological diversity entails the maintenance of not only a diversity of species, but also a diversity of patterns and processes at all levels of organization (OTA 1987). Yet of the possible methods that might be used to achieve the type of biological conservation goals outlined in the OTA report, a single one predominates in both public and private agencies. This method, which we refer to as the species approach, involves the maintenance of viable populations of select species (Holbrook 1974, Gould 1977). In general, population levels of select "management indicator species" are used to indicate the health of the environment, the welfare of other species, the value of a parcel of land, or the impacts of habitat alteration. Public agencies rely heavily (if not exclusively) on the species approach to meet their legislative mandates to maintain biological diversity (Flood et al. 1977, Patton 1978, U.S. Fish & Wildlife Service 1980a, Schamberger and Krohn 1982, Thomas 1982). We believe, however, that the species approach is too narrow to be used alone as a conservation tool, and that additional approaches should be implemented to balance the inherent limitations of the species approach. The arguments raised here are not meant to indict the species approach. Indeed it has been of great value in raising issues and protecting species as well as habitats. Rather, it is meant to take a step back from species focused conservation in an attempt to understand its limitations. Some of these limitations are discussed below with the intent of illustrating the need for a broader approach to biological conservation.

The Niche Concept and Species Conservation

First, there is the maxim that no two species occupy the same niche; every species is unique in its needs. No biologist would argue that a single species can be chosen to speak for the welfare of all others, yet many apparently believe that a well-chosen few should be able to do so (Graul et al. 1976). U.S. Forest Service regulations specify that management indicator species can and should be used to facilitate efforts to monitor and maintain viable populations of all species (36 C.F.R. sec.219.19). Unfortunately, the regulations do not specify how many indicator species are needed to monitor the health of wildlife populations or to assess the effects of habitat alteration. Yet the question remains, how many species are needed?

To answer this, we need to understand that the National Forest Management Act requires nothing less than the maintenance of viable populations of all wildlife species in all parts of their geographic ranges (Salwasser et al. 1984, Norse et al 1986). Next we must realize that the only species whose welfare will be assured by that of an indicator species will be those whose niches are entirely subsumed by, or included within, that of an indicator species. Moreover, the narrower the niche of an indicator species, the less likely it is that another species will occur entirely within the geographic and ecological limits of that indicator. If we choose the most stenotopic species as indicators (as recommended by Graul et al. 1976 and Graul and Miller 1984), then how can the maintenance of viable populations of a more broadly distributed species be assured throughout all parts of its geographic range ? If used to the exclusion of other approaches, the species approach often falls short of legislative mandates to protect all fish, wildlife, and plant species.

Competition for Public Attention

Given that conservation decisions are based on a small subset of all species, and given that no two species have identical needs, a necessary consequence is that species compete with one another for representation as management indicators. Time that might be better spent in the consideration of alternative approaches becomes funnelled toward determining which species to choose for the implementation of conservation and management programs (Thibodeau 1983). Although Fish and Wildlife Service biologists try to select indicators on the basis of objective sampling schemes (Roberts and O'Neil 1985, Fry et al. 1987), and forest

service biologists are directed to draw indicators equitably from each of several categories of species (36 C.F.R. sec, 219.19), the majority of indicator species used by both agencies are those that are taken for food, sport, or hides, and those that are threatened or endangered (Thomas 1982). Considerable change is needed before we progress from our historic orientation toward game production to an orientation more consistent with the goals of broad-based biological conservation. The species approach may be hindering that transition because agencies can maintain their traditional emphasis on game production through indicator species management.

Minimum Viable Populations

Even if we could somehow monitor the populations of all species, there would remain the perplexing problem of how to determine the viable population size of any one of them (see, for example, Shaffer 1981, Salwasser et al. 1984, Gilpin and Soule 1986, Harris et al. 1987). No matter what the criteria, however, populations at higher levels of abundance are more "viable" (able to persist for a period of years) than those at lower levels; viability is therefore, a continuous variable. The species approach converts this continuum into a categorical dichotomy of "viable" and not "viable." This is not only misleading, but dangerous because it allows us to believe that we can work toward some minimum population size and still retain the values associated with the presence of that species at higher population levels.

Incomplete Data

Most species have vastly different needs at different points in space and time. For example, the needs of a warbler in one part of its breeding range will differ from its needs in another part of the same range, just as its requirements in summer differ from those in winter. It simply is too difficult to monitor and conduct habitat analysis for a single species in numerous locations, in all seasons and in different (climatologically normal and non-normal) years. We are, therefore, too narrow in our focus when it comes to defining the requirements of any one species.

In spite of the fact that the "needs" of an indicator species are often based on narrowly focused and incomplete data, those data are beginning to be used in models to determine the value of a parcel of land to the maintenance of an indicator species' population. Other models will then be used to convert this perceived importance to a dollar value so that the value of preservation can be weighed against the economic value of development (USFWS 1980b). Although managers recognize that there are problems with the data base for such modeling, they recommend its use in the face of pressing decisions (Thomas 1979a). While we recognize that decisions must be made, we question whether the use of incomplete data from the species approach alone is the best way to make decisions about the value to wildlife of a parcel of land.

Public Support

While public support may be strong for the protection of endangered species, the public shows little support for species that tend not to be featured (Kellert 1986). In addition, with the ever-increasing number of threatened and endangered species, public support for any one is bound to decline. Under the species approach, the conservation movement will become more scattered, rather than increasingly focused, as more and more species compete for the public's attention.

Disproportionate Focus on Rare & Endangered Species

The species approach invariably draws attention to organisms on the verge of extinction. This may hinder an overall effort to conserve biological diversity for several reasons. First, a focus on the needs of the rarest species means that population size is the all-important criterion in our judgement of value. For example, most of us would find efforts to preserve 200 kirtland's warblers more valuable than efforts to

Endangered Species UPDATE

A forum for information exchange on endangered species issues

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Instructions for Authors:

The Endangered Species UPDATE welcomes articles related to species protection in a wide range of areas including but not limited to: research and management activities for endangered species, theoretical approaches to species conservation, and habitat protection and preserve design. Book reviews, editorial comments, and announcements of current events and publications are also welcome.

Readers include a broad range of professionals in both scientific and policy fields. Articles should be written in an easily understandable style for a knowledgeable audience. Manuscripts should be 7-10 double-spaced typed pages. For further information please contact Kathryn Kohm at the number listed below.

Subscription Information:

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Cover:

White pine and hemlock in McCormick Experimental Forest in Michigan's upper peninsula

Photo by Maria Pregitzer

maintain a million American redstarts. This is, in part, because we do not recognize the unique value of a million birds. We have difficulty relating to the value of the variety of higher-level patterns and processes represented by those million. Once a minimum viable population is reached, we tend to feel that all else is redundant. There is unique value to the million redstarts, however, we are simply untrained to recognize that value.

Consider that scrub jays are communal nesters in one part of their range and not so in another; that creosote bush grows alone in one part of its range and as part of a diverse desert plant community in another; or that fires burn frequently in some parts of the boreal forest and infrequently in others. It is just this variety of context within which a species occurs that provides us the opportunity to understand the world in which we live.

Second, rare and endangered species currently exert a disproportionate influence on the development of strategies for reserve design and placement because decisions are based largely on the locations of such species (Miller and Bratton 1987). Even The Nature Conservancy, a private organization dedicated to preserving the diversity of higher-order biological systems through land acquisition, bases its identification of key areas primarily on locations of rare species (Hoose 1983). Can the conservation of biological systems be assured through the preservation of a network of locations of rare species ?

Third, an approach that focuses on rare species raises questions about costs. Sampling low density populations to determine population trends is very expensive. The inevitable trend toward the use of zoos, captive breeding programs, and other activities associated with saving near-extinct species are so expensive that, even now, we cannot save them all. Still worse, the number of threatened and endangered species is increasing at an ever increasing rate which will exacerbate this problem (Nisbet 1978). While a broader approach may also be expensive, it would not necessarily require an exponential increase in cost to be successful.

Finally, with a focus on rare species, our conservation effort resembles a brinkmanship game as we rush to save one near-extinct species after another.

The Integrity of Ecological Patterns and Processes

The species approach does not meet the conservation goal of preserving diversity at all levels of biological organization because it does not explicitly recognize as valuable, anything other than, or above the level of species. It makes the conservation of species *per se* the goal. If there are viable populations of the chosen indicator species present, then we assume that we are conserving all levels of biological diversity. To use the Ehrlich's (1981) analogy of species as rivets in the Spaceship Earth, if we concentrate so much on individual rivets (species), we will be unaware if the spaceship itself remains in good shape. Thus, it is theoretically possible to preserve all of the earth's species but lose the integrity of higher order patterns and processes (Fritz 1983). The whole is greater than the sum of its parts (Noss and Harris 1986); but the species approach is based on the unlikely assumption that "...the entire ecosystem will be preserved if the indicator species are preserved" (Graul et al. 1976).

The species approach has also led to an increasing focus on gene banks and captive breeding programs as means toward the larger end of biological conservation. Although these efforts are to be praised, the integrity of patterns and processes above the species level cannot be assured through an approach that is slanted toward endangered species preservation. Efforts to conserve nature out of context are, for the most part, efforts toward the treatment of symptoms, rather than toward the development of a cure (Conway 1980).

Just as dangerous is the notion that if the species of concern is absent, then there is no conservation value in a parcel of land. This is well illustrated by the current controversy surrounding planned development in Glacier National Park (Anon. 1987). The only thing standing in the way of further development on McDonald Lake is a pair of bald eagles, which are protected by the Endangered Species Act. Forcing a single species such as the spotted owl or the bald eagle to stand not only for itself, but also to represent the value of entire ecosystems, puts undue responsibility on that species (Heinrichs 1983). Any single item, no matter how exotic, will pale in the face of fancy development plans. As beneficial as the Endangered Species Act is for the eagles, it is not effective as a general conservation act. Without that one pair of eagles, development would continue unchallenged because the presence of a listed species in the management area is required before the Act can be used to signal a potential conflict. Any conservation act that is species oriented would suffer the same limitation.

Human Population Growth

It is possible to maintain populations of select indicator species in the face of continued human population and resource exploitation. Therefore, the species approach may mislead us into thinking that we humans can continue to increase in population size while maintaining the integrity of nature. This is because we can grow and still maintain the presence of selected indicator species. Shaffer, (1981) for example, suggested that the adage, "the bigger the reserve, the better" must be replaced with "precise prescriptions for how much land is enough to achieve our conservation objectives". Such a statement implies that there is some minimum acceptable standard of biological diversity, above which all else is redundant. In reality, there is no way we can alter the land even a bit and retain its previous biological value. The reality of this continuous trade-off is not appreciated by the public; it is, in fact masked by the species approach, which suggests that we can avoid the negative impacts of growth and development through proper management. We need to supplement the species approach with an approach that reflects the trade-off reality that we cannot both preserve everything we have and continue to

(Continued on UPDATE page 4)

grow; further human population growth will necessitate a loss of biological diversity.

Conclusion

We believe the disadvantages outlined above warrant serious consideration of the species approach as a sole means to conserve diversity at all levels of biological organization. One solution would be to supplement the species approach with a land-based approach. The use of landscape patterns as a tool to maintain ecosystem-level patterns and processes (Ricklefs et al. 1984, Noss and Harris 1986, Noss 1987) stands as a promising supplement to the species approach, as do habitat based (Norton 1986b) and biogeographical (Diamond 1986, Scott et al. 1987) strategies. We hope this paper might stimulate further development along these lines and encourage further discussion of how to avoid the shortcomings of a species oriented conservation policy.

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Publication Schedule for the UPDATE :

Because the Update follows the publication schedule of the *Endangered Species Technical Bulletin*, irregularity of our monthly distribution is at times unavoidable. One of our goals is to provide the most current information on the federal Endangered Species Program. Hence, we publish and distribute the Update as soon as possible after reprint materials are received.

Book Review

Viable Populations For Conservation

Edited by Michael E. Soulé

Following is an excerpt from Viable Populations for Conservation, a new book edited by Michael Soulé. The book, which grew out of a workshop held at the The University of Michigan in October 1984, explores the definition and implications of the minimum viable population concept.

Chapters cover the roles of demographic and environmental variability, the effects of latitude, body size, patchiness and metapopulation structure; the implications of catastrophes; and the relevance of effective population size on inbreeding and natural selection. Additionally, decision theory and interagency cooperation relating to the management of endangered species and ecosystems are discussed in the final chapters. The conclusion draws lessons from each of the essays and provides a summary of future research needs and applications to conservation.

In the introduction (the opening of which is reprinted below), Soule lays the groundwork for the rest of the book and sets its thought-provoking tone. Here, he introduces the fundamental question : How much is enough ?

Given biblical precedence, it is not surprising that for millennia, a pair (male and female) has been deemed sufficient to initiate, if not perpetuate, a population. In fact, there is more than scriptural authority behind this myth. With luck, two can indeed be a sufficient number of founders.

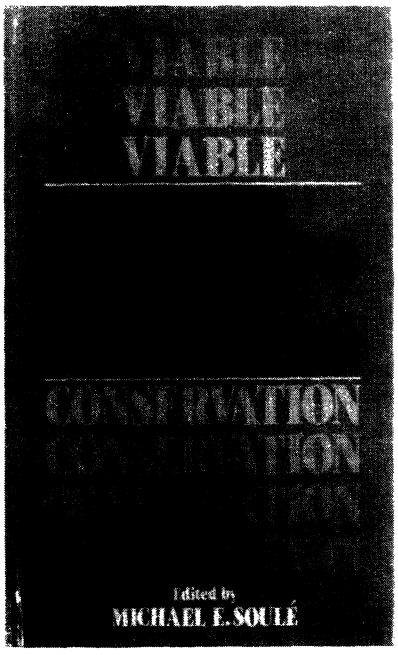
What is luck ? Without going into theories of randomness and probability, luck implies a fortunate or unusual circumstance leading to a good result. The result of interest in this book is the survival of a population in a state that maintains its vigor and its potential for evolutionary adaptation. Such a population is a viable population. Legend does not question Noah's success with each of his multitudinous experiments. He must have been very lucky indeed. He also had some advantages over us, not the least of which was a fresh, well-watered planet.

The problem that we address in this book is 'How much is enough ?'. Put more concretely, it is: What are the minimum conditions for the long-term persistence and adaptation of a species or population in a given place ? This is one of the most difficult and challenging intellectual problems in conservation biology. Arguably, it is the quintessential issue in population biology, because it requires a prediction based on a synthesis of all the biotic and abiotic factors in the spatial-temporal continuum.

Returning to the definition, we must define 'long term persistence,' and 'adaptation.' The former phrase means the capacity of the group to maintain itself without significant demographic or genetic manipulation for the foreseeable ecological future (usually centuries) with a certain, agreed on, degree of certitude, say 95%. The probabilistic qualifications is necessary (Shaffer, Chapter 5), because it would be impossible to guarantee absolutely the survival of a group. The qualifying phrase 'without significant demographic or genetic manipulation' is meant to imply that we are concerned with the ability of populations to maintain themselves in nature, given sufficient habitat and other elements of benign neglect, including freedom from excessive harvesting.

The term 'adaptation' implies that the group maintains a normal level of immediate fitness (individual vigor, fertility, fecundity) and has sufficient genetic variation to adapt by natural selection to changing environmental conditions within the predicted range of frequency and amplitude of disturbance and change.

If the entire history of our planet were condensed into one hour, it is only in the last few fractions of a second that mankind and its technology has spread across the globe-with devastating results for other species. For this reason, viability is now a *cause celébrè*. The last time a similar degree of disturbance occurred (during Pleistocene glaciations), the pace of change was slow enough for vegetation belts to be compressed towards the equator or to shift in accordance with the changing distribution of rainfall. Such shifts are now impossible because of the geographic distribution of anthropogenic habitat destruction, and because the rate of change and destruction today is measured in years and decades rather than in



centuries and millennia. Therefore, termination rates are now expected to be much greater.

Major extinctions have occurred before, and many species did go extinct in the Pleistocene. The difference is that now it is our species that is responsible, and countermeasures are therefore feasible. Presumably, glacial and interglacial humans could have prevented the Pleistocene extinctions if they had had our values, our knowledge of genetics, ecology, biogeography, and our level of technology.

Foundations of Inventory & Monitoring *an editorial by Kathy Freas*

Many agencies, conservation organizations, and academic institutions have recently focused attention on issues surrounding conservation of biodiversity. In the United States, our parks, refuges, and preserves include a wealth of genetic, species, and ecosystem diversity which they have been created to protect. However, we are largely ignorant of the capacity of our parks and preserves to meet that protection mandate. The sufficiency of our system to ensure the continued existence of large, conspicuous, relatively well-understood mammals is unknown. Equally obscure is the ability of the system to protect less glamorous species of vertebrates, invertebrates, and plants and the processes by which they are integrated.

Reasons for our ignorance are twofold. First, some of our largest national parks were created without consideration for ecological reality. Many species purportedly protected by the park system range outside park boundaries and are often dependent on resources external to parks. Second, no effective system exists for evaluating and monitoring the performance of parks and preserves in their role of protecting biodiversity.

Fundamental to both of these shortcomings is our inability to reach concensus on the functional meaning of such terms as "conservation," "preservation," and "protection of biodiversity." Part of our inability to create and maintain a useful inventory and monitoring system, by which we may evaluate the success of our parks and preserves, is the lack of criteria by which that success can be evaluated. What constitutes protection ? Is it stable or stationary age distributions for all species ? Maintenance of rates of various processes driving the system ? Lack of successional change ? "Normal" successional change (and with it changing species composition) ? Evolutionary change, or lack of it ? How and what do we measure? Energy flow, biomass, species diversity, absolute numbers? What kind of data will tell us whether the system we have set aside to protect biodiversity is doing its job ? Will these data be of the same types for every park?

The constraints imposed by the initial delineation of park boundaries continue to affect our perspectives in developing an inventory and monitoring program. An initial step in the development of such a system is the evaluation of existing parks according to criteria by which we would ideally create new ones. Miller (1984) has delineated several principles which integrate biological and socio-political considerations for the selection of habitats for conservation. Some combination of these may serve, for consideration and discussion, as the initial step in the process of determining a direction for development of an inventory and monitoring program.

1) On a macrobiogeographic scale, consider a general framework for an ideal network of protected areas representative of a geographic region. Keystone and indicator species should be identified along with life history patterns and interaction with other species and with processes in the ecosystem.
2) Evaluate genetic variability, initially for keystone species. Range density, breeding systems, existence of subpopulations and demographic viability are all important in these considerations.
3) Movement of water, energy, and nutrients should be delineated as well as general patterns of community change over time.
4) Shape, size, and number of preserves in a province must be considered. With several areas set aside, some may be left undisturbed while others are manipulated to achieve the appropriate condition for a specific suite of species.

Of course, resource managers are familiar with these kinds of considerations. When viewed together, these basic inventories offer a means by which to evaluate the potential of parks and preserves for the protection of biological diversity.

Probably none of our parks will measure up to what we might design. Yet, if we evaluate our existing parks and preserves according to the criteria we would establish for creation of new (or ideal) parks and preserves, we would have the ability to determine the "jobs" for which each park is best suited, and those which may not realistically be accomplished by each park. This kind of evaluation puts us in a position to make knowledgeable management decisions based on what a particular park is most suited to accomplish. Do we maximize efficiency by allowing a given park to function as a refuge for those species to which it is best suited to protect; or are our priorities such that boundaries should be changed, or environments manipulated to protect other species that will not survive without such changes ? Economic and political criteria will influence these kinds of trade-offs, but the process will be based in biological criteria for measuring park performance as protectors of biodiversity.

Once this dynamic inventory system is established, the nature of the monitoring system necessary to sustain it will become apparent. An attempt to create a monitoring system without philosophical and functional direction provided by an inventory/evaluation of this sort is equivalent to collecting data without benefit of the direction of an explicit hypotheses, and just as meaningless.

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Bulletin Board

Seabird Conservation Bulletin

The ICBP Seabird Specialist Group has recently published its latest bulletin. This bulletin is the main vehicle for keeping all those interest in seabird conservation informed. It includes information on publications, meetings, and activities relevant to seabirds and their conservation. The editors welcome information for the bulletin. To receive the ICBP Seabird Specialist Group Bulletin and become a member (free of charge), contact David & Maria Duffy, Progama de Vida Silvestre, Escuela de Ciencias Ambientales, Universidad National Heredia, Costa Rica or Malcom Coulter, Savannah River Ecology Lab., Drawer E, Aiken, South Carolina 29801 USA.

Tropical Forest Action Plan

The Tropical Forest Action Plan is a new publication prepared by FAO in cooperation with the World Resources Institute, the World Bank, and the United Nations Development Program. It describes the basic elements of the Tropical Forestry Action Plan and shows how it can be made to work to conserve and develop tropical forest resources on a long-term , sustainable basis. The Plan builds on past experience to identify what can be done now to begin solving the problem of deforestation in a systematic way. Toward this end,the Plan provides a basis for determining investment priorities and funding needs over the next five years. Additionally, it offers an opportunity to improve aid coordination and stimulate institutional reforms and new initiatives for a concerted global effort.

The Plan has five components: forestry in land use; forest-based industrial development; fuelwood and energy; conservation; tropical forest ecosystems; and institutions. It can be obtained through FAO, 1001 22nd Street, N.W., Washington D.C. 20437.

Zoo Design: The Reality of Wild Illusion

Zoo Design, The Reality of Wild Illusion, is a new book written by Kenneth J. Polakowski and published by the School of Natural Resources at The University of Michigan. The design and planning ideas in this publication recognize and build upon the multiple development goals currently embraced by accredited zoological parks. Education, recreation, conservation, and research goals are applied directly to specific physical conditions and the needs of visitors, animals, curators, keepers, and managers of zoological exhibits. To receive this book, send $25 along with a mailing address to School of Natural Resources, Zoo Design, The University of Michigan, 1548 Dana Building, 430 E. University, Ann Arbor, MI 48109-1115.

Educational Film Available on Deforestation

A film called " Trees of Hope", produced by the International Development Research Center (IRDC) of Canada documents the rapid deforestation occurring in some African countries and analyzes several solutions for dealing with the problem. The 18 minute film was shot on location Niger, Senegal, and Nigeria. To obtain the film in a 16mm print or videocassette (in French or English), contact IDRC, Communications Division, P.O. Box 8500, Ottawa, Ontario, K1G 3HG, Canada.

Bulletin board information provided by Jane Villa-Lobos, Smithsonian Institution

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