PROGRESS WITH CONSERVATION STRATEGIES OF SELECTED THREATENED ANIMALS

Klaus Henle
UFZ Helmholtz Center for Environmental Research, Leipzig, Germany

Luca Luiselli
Institute of Environmental Studies Demetra, Rome, Italy; and Technip, Snamprogetti, Kellogg Brown & Root, Japan Gas Company Corporation, Nigeria Limited, Rivers State University, Nigeria

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Summary

Human activities have greatly impacted biodiversity. To make progress in the conservation of threatened species, threatening processes have to be removed or at least mitigated if they cannot be neutralized. The development of successful conservation strategies for selected threatened species requires several steps. We briefly describe these steps. In the first step, focal species have to be selected for setting management priorities. In the second step, we need to understand the cause(s) of decline for our focal species. We show how knowledge about threatening processes can be used to develop efficient conservation strategies and to help avoid failures. We outline progress in the development of action plans to remove threatening processes or to mitigate their effects. Frequently, this involves changing human land use practices. To achieve such changes, there must be enough incentives for the protection of the threatened species and its

habitat to outweigh alternative human land-use interests. Sustainable use of wild animals and plants may provide such incentives. We outline progress and problems with conserving threatened species through sustainable use. Even when the causes of decline have been well diagnosed, it is not always clear which of several potential conservation strategies to follow because of inherent ecological uncertainty and because of goal conflicts with other human interests or the needs of other threatened species. We present progress that has been made in choosing between alternative management options in the face of uncertainty of the risks and promises involved in different conservation strategies.

1. Introduction

Human activities have greatly impacted biodiversity. One of the most noticeable effects is the loss of species across a wide range of their former habitat and the global extinction of many species at an unprecedented rate. In spite of increasing efforts to protect threatened species and their habitats, the decline still continues and we face the risk that further species will fall over the brink of extinction.

To make progress in the conservation of biodiversity in general and of selected threatened species in particular, threatening processes have to be removed or at least mitigated if they cannot be neutralized easily. In addition, an active and innovative management may need to be developed and implemented to save selected species and their habitats. Furthermore, resources for conservation are limited. Therefore, we have to carefully set priorities both to select focal species for conservation actions and to select an optimal conservation strategy for threatened species.

Our responsibility for the protection of biodiversity is a major challenge to humanity, as was recognized in the world summit in Rio in 1992 and in many other international and national conventions and laws. Accepting this responsibility, we have to ask ourselves: What progress have we made with conservation strategies of selected threatened species? Which species should we select and how can we improve our approaches and efficiency in their conservation in order to stop or reverse current trends of decline?

The development of successful conservation strategies for selected threatened species requires several steps. First, we have to select species for our conservation strategies. In the first chapter, we briefly outline approaches that have been used in the selection of focal species. As a next step in the development of any conservation strategy, not only for species but particularly when we are concerned with the conservation of endangered species, we need to understand the cause(s) of an observed decline. Without such an understanding, our efforts are bound to be ineffective and sometimes even counterproductive. In the second chapter we summarize our knowledge about threatening factors and what we have learned in conservation biology about identifying these as agents of decline. We will show how this knowledge can be used to develop efficient conservation strategies and to help avoid failures.

Once we have understood the reasons for decline of a selected threatened species, we need to attempt to reverse the decline by removing or neutralizing the threatening process(es). Usually, an action plan is developed for this purpose. In the third section, we outline progress in the development of action plans to treat the decline. Frequently, removal of the threatening processes requires that human land-use practices will be changed. To achieve such changes, there must be enough incentives for the protection of the threatened species and its habitat to outweigh alternative human land-use interests. Sustainable use of wild animals and plants may provide such incentives. In the fourth section we outline our progress and problems with conserving threatened species through sustainable use.

Even when the causes of decline have been well diagnosed, it is not always clear cut which of several potential conservation strategies to follow. For example, it is sometimes heatedly debated whether off-site management (transfer of the endangered species to captivity) or on-site management should get priority in the conservation of a critically endangered species. Also, active management of one species may have detrimental effects on another threatened species. Such conflicts arose for example in re-introduction programs for peregrine falcons (*Falco peregrinus*) and owls (*Bubo bubo*) in Germany. In the last section, we will present progress that has been made in choosing between alternative management options in the face of uncertainty of the risks and promises involved in different conservation strategies.

2. Selecting Species for Conservation Strategies

Many different criteria have been used for selecting focal species for conservation strategies; these criteria depend on the conservation goals. For example, the criteria differ whether one is interested in selecting species as indicators of a healthy human environment, as representatives of biodiversity in general, or whether one wants to select among threatened species those that should receive highest priority in conservation practice.

The development of conservation strategies is usually based on the selection of indicator, focal, or target species. The definitions of “indicator,” “focal,” and “target” species vary in the conservation literature but broadly overlap. In the context of biodiversity conservation their use normally implies that the development of the strategy is based on the selection of a set of species representing “appropriate” conservation goals.

What is “appropriate” tends to vary with the conservation and ecological context and one’s *Weltanschauung* or worldview, including such factors as level of education, cultural background, economic status, political affiliation, gender, and so on. Selection criteria are guidelines that one creatively applies to establish a preference for the “best” indicators that fit the needs and circumstances of a given region or institution, and at the same time enhance adaptive planning capacities for sustainable development. At a time of increasing globalization these criteria should help create a minimum level of comparability, coherence, and consistency between measures and, perhaps more importantly, between the ways these measures are applied in real-life situations. The criteria listed in Table 1 have been selected based on extensive knowledge of the indicator literature and practical experience with performance measurements. Although the list contains some of the most obvious and most frequently quoted criteria, it is incomplete. But, then, is it possible to compile a complete list of loosely defined guidelines that deal with the endless complexity of decisions that emerge in the context of sustainable development?

Policy relevance	Can the indicators be associated with one or several issues around which key policies are formulated? Sustainability indicators are intended for audiences to improve the outcome of decision-making on levels ranging from individuals to the entire biosphere. Unless stakeholders can link the indicators to critical decisions and policies, it is unlikely to motivate action.
Simplicity	Can the information be presented in an easily understandable, appealing way to the target audience? Even complex issues and calculations should eventually yield clearly presentable information that the public understands.
Validity	Is the indicator a true reflection of the facts? Were the data collected using scientifically defensible measurement techniques? Are the indicators verifiable and reproducible? Methodological rigor is needed to make the data credible for both experts and laypeople.
Time-series data	Are time-series data available, reflecting the trend of the indicators over time? If based on only one or two data points, it is not possible to visualise the direction the species or the community may be going in the near future.
Availability of affordable data	Are good quality data available at a reasonable cost or is it feasible to initiate a monitoring process that will make them available in the future? Information tends to cost money, or at least time and effort from many volunteers.
Ability to aggregate information	Are the indicators about a very narrow or broader sustainability issue? The list of potential sustainability indicators is endless. For practical reasons, indicators that aggregate information on broader issues should be preferred. For example, forest canopy temperature is a useful indicator of forest health and is preferable to measuring many other potential indicators to come to the same conclusion.
Sensitivity	Can the indicators detect a small change in the system? We need to determine beforehand if small or large changes are relevant for monitoring.
Reliability	Will you arrive at the same results if you make two or more measurements of the same indicators? Would two different researchers arrive at the same conclusions?

Table 1. Criteria for the selection of indicator species for the conservation of biodiversity

In contrast, in the case of setting priorities in the selection of threatened species for conservation action plans the selection criteria are fairly restricted. The need of protection is reflected in the listing of a species in Red Data Books. In Red Data Books species are placed into different categories according to their degree of endangerment. Though roughly in agreement, the exact definitions of the categories differ among countries. In Table 2 we present the categories adopted by the IUCN (International Union for the Conservation of Nature. The colloquial terms “endangered” or “threatened” do not directly refer to any of these categories; however, the term "threatened" is more inclusive, applying to any threatened species, whereas "endangered" applies to species for which the threats are particularly serious. Unless otherwise specified we use these two terms in their colloquial sense.

Category	Criteria
EX Extinct	There is no reasonable doubt that the last individual of the taxon has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
EW Extinct in the wild	The taxon is known only to survive in cultivation, in captivity, or as naturalised population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual) throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
CR Critical endangered	The taxon is facing extremely high risk of extinction in the wild in the immediate future.
EN Endangered	The taxon is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.
VU Vulnerable	The taxon is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.
LC Least concern	The taxon is not Critically Endangered, Endangered or Vulnerable and does not qualify for Conservation Dependent or Near Threatened. Widespread and abundant taxa are included in this category.
NT Near threatened	The taxon is not Critically Endangered, Endangered, Vulnerable, or Conservation Dependant but is close to qualifying for Vulnerable.
DD Data deficient	There is inadequate information to make a direct, or indirect, assessment of the risk of extinction based on the distribution and/or population status of the taxon. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Listing in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate.
NE Not evaluated	The taxon has not yet been assessed against the criteria.

Table 2. International Union for the Conservation of Nature (IUCN) current categories of endangerment used in the International Red Data Book. More detailed evaluation criteria are published by IUCN (2001; www.iucnredlist.org).

The IUCN categories of endangerment are the most frequently used criteria for the selection of priority species for conservation efforts but have several short-comings. For example, they do not always reflect conservation needs. Recently a scheme has been suggested for identifying national responsibilities for the conservation of species that can help setting priorities in the selection of threatened species for action plans. This scheme requires comparably few data, is simple to apply, and removes some of shorting-comings of previous methods. Figure 1 shows the categories and the decision tree for identifying national responsibility. We believe that a combination of national responsibility and Red Data Book status is the best strategy for setting priorities in the selection of threatened species for action plans.

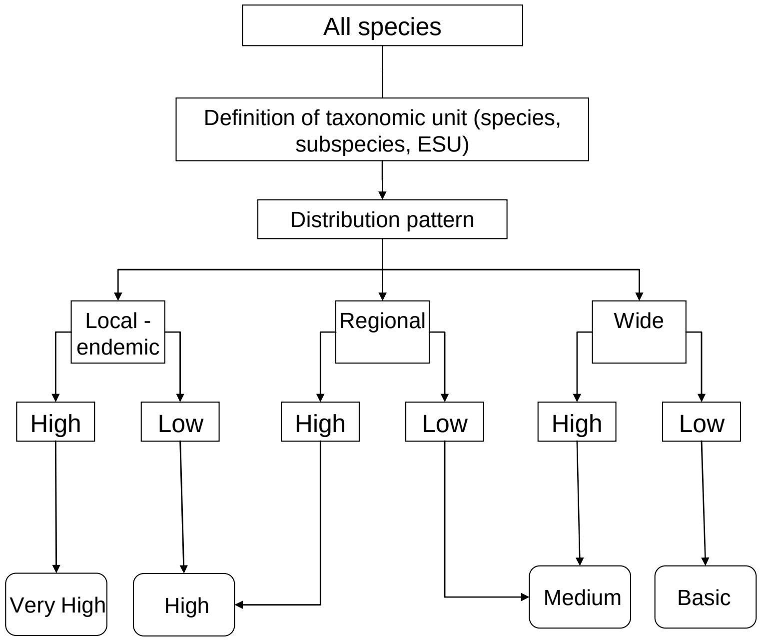

Figure 1. Decision tree of the newly developed method for the determination of national responsibilities in species conservation in Europe; ESU: Evolutionary Significant Unit. Figure from: Schmeller D.S., Gruber B., Bauch B., Lanno K., Budrys E., Babij V., Juskaitis R., Sammul M., Varga Z. and Henle K. (2008). Determination of national conservation responsibilities in regions with multiple political jurisdictions. *Biodiversity and Conservation* DOI: 10.1007/s10531-008-9446-9

3. Diagnosing the Decline

Many different causes of decline have been invoked for threatened species and it is easy to get lost in an indiscriminate battle against a multitude of potential factors. The classification of agents into main causes of decline has not yet seen much attention. Nonetheless, from an extensive knowledge of the conservation literature some important processes emerge repeatedly: habitat modification and loss, environmental contamination, overharvesting by people (hunting and collecting), introduction of alien species (predators and competitors), and nonanthropogenic processes. More recently, diseases have been implicated or diagnosed as an additional class of factors for the decline of species such as in the worldwide decline of amphibians or canine distemper virus and rabies for African wild dogs (*Lycaon pictus*) in the Serengeti. Furthermore, there may be chains of extinction such that the loss of one key species will result in the extinction of additional species that depend on this key species. A circumstantial case can be made to explain the disappearance of the huge New Zealand forest eagle

Harpagornis moorei that preyed on moas, large ground birds, of which New Zealand had many. The eagle died out at roughly the same time as the moas became extinct. Additionally, there may be interactions of several factors such as in the case of major highways that can lead to habitat modification and increased "harvest" (road-killed individuals) of threatened species.

Figure 2. The Large Blue butterfly (*Maculinea arion*)

Nonanthropogenic processes may also cause the extinction of a threatened species. Once a population of an endangered species is small, its susceptibility to random fluctuations and the vagaries of the environment strongly increases even when the threatening processes have been removed. Two bad years in a row, or a natural catastrophe such as a hurricane or a wildfire, may wipe out the entire remaining population as almost happened to the Puerto Rican Parrot (*Amazona vittata*) during hurricane Hugo. Natural succession likewise may drive to extinction a species that depends on a particular type of land use. This happened for example with the Large Blue butterfly (*Maculinea arion*) in England when its reserve was fenced off because it was assumed that collectors drove the decline. Unfortunately, cattle were also fenced out, the area became overgrown and the butterfly disappeared. Pesticides, weather, and inbreeding depression were all advanced as causes but none tested or substantiated. Intensive long-term research on the last butterfly colony in England showed that the caterpillars' survival depended on the presence of the right species of ant that adopt and raise the caterpillars. With a slight increase in turf height the ant species *Myrmica sabuleti* is replaced by *Myrmica scabrinodes* and caterpillar survival dropped from 15% to less than 2%. Until then, changes in the ants had not been noticed when the grassland had changed even slightly with less grazing.

How to determine which agent or agents push a species toward extinction is pivotal to conserving it. Despite it being self-evident, too often the crisis of the moment obscures such fundamental logic as evidenced for example by the case of the large blue butterfly in England. Our plea is to adhere to a scientific approach and to shun untested assumptions as far as possible. Logically arriving at a diagnosis stated as a hypothesis to be tested by a designed experiment and leading to adaptive management helps us avoid preconceived ideas that may misguide our conservation strategies. It is immensely easy to confuse observation with explanation. We can easily fall into the trap that, because an agent such as an introduced competing species is present, it is the problem. Diagnosing the cause of decline is not only pertinent to endangered species that have already declined to low numbers but also to species that still seem to be relatively common.

Most diagnoses start and end with observing an effect (poor survival or fecundity or rapid range contraction) coinciding in time and space with an assumed agent. However, this is not enough. Coincidences alone are insufficient validation, even though they may seem overwhelming. The evidence to accept or reject a hypothesis must be weighed systematically. A successful diagnosis depends on a logical series of steps as follows.

- Compile available information and study the species' natural history for knowledge of and a feel for its ecology and status.
- When confident that this background knowledge is adequate to avoid silly mistakes, list all conceivable agents of decline.
- For each agent, measure its level where the species now is and where the species used to be in space and time. For example, has the habitat changed? Does the species overlap with an introduced predator? Test one set against the other. Any contrast in the right direction identifies a putative agent of decline and thus a hypothesis to be tested. Do not assume that the answer is already provided by lay or scientific folk wisdom.
- Test the hypothesis by experiment to confirm that the putative agent is causally linked to the decline, not simply associated with it. Management treatments can often be used for this.

Few recovery plans for threatened species have carefully gone through all of these steps. As a consequence, many recovery plans had to go through a process of trial and error often with limited success until adequate management actions were found by coincidence. This is a dangerous approach since its risk of failure can be high and the consequence the final demise of a species. Example 1 illustrates the required steps for diagnosing the decline for the development of successful recovery plans.

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Biographical Sketches

Klaus Henle was born on January 5, 1955. He studied biology at the University of Stuttgart-Hohenheim, Germany. In 1988, he obtained his doctoral degree at the Department of Zoology, Australian National University, Canberra, with a thesis on "Population ecology and life history of a lizard community in arid Australia". He started his scientific career at the Institute for Landscape Planning and Ecology, University of Stuttgart, Germany, developing the conceptual basis for a national research initiative of the German Ministry of Science and Technology on nature conservation. With the foundation of the Centre for Environmental Research UFZ-Leipzig-Halle, he was appointed head of the Department of Conservation Biology and Natural Resources. His duties are the development, coordination, and synthesis of large interdisciplinary research projects in conservation biology. Major on-going research projects are as follows:

(a) species survival in fragmented landscapes;

(b) development of a robust indicator system for ecological changes in flood plain systems;

(c) conservation priorities and networks of protected areas;

(d) biodiversity monitoring and assessment;

(e) reconciliation of human-wildlife conflicts, and

(f) conceptual and theoretical basis of conservation biology.

These projects include co-operations with research institutes from most European countries as ewll as from Australia and Brazil.

Dr. Luca Luiselli obtained the degree of Doctor in Natural Sciences at the University of Rome, "La Sapienza," with a thesis on the comparative eco-ethology of some populations of Italian vipers. Since 1996 he has been a research associate with several industry organizations of the ENI group in Nigeria, as well as with conservation organizations in both Africa and Italy. He also has worked for the environmental departments of several oil companies, conservation organizations (e.g., Cercopan), and for the Rivers State University in Nigeria. He is also a researcher associated with the National Park of Gran Sasso-Laga, the National Park of Majella, and the Duchessa Mountains Natural Park. He is chairman for Nigeria of the IUCN/SSC Declining Amphibian Populations Task Force, and has won three international scientific research prizes (two from Chelonian Research Foundation, and one from IUCN/SSC Declining Amphibian Populations Task Force). He is also co-editor of *Amphibia–Reptilia*, and on the advisory editorial board of *Herpetozoa*. In the last 10 years, he has published over 70 papers in peer-reviewed journals, including high impact periodicals (e.g., *Nature*, *Oikos*, the *Canadian Journal of Zoology*, and others). His main research interests are the ecology of snakes in tropical and temperate regions and the modeling of forest reptile communities in areas under high environmental stress.