REINTRODUCTION SCHEMES FOR CAPTIVE-BRED ANIMALS

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Summary

The loss of biodiversity is considered a global phenomenon, and the final decades of the twentieth century have brought an increasing interest in conservation biology. Many strategies were attempted to restore endangered animal populations, including habitat management and captive breeding.

The main aim of a reintroduction project is the reestablishment of natural populations of a taxon that became extinct in the wild. The translocation of captive-bred animals should follow a precise four-step protocol: feasibility study, preparation phase, release phase, and monitoring phase.

An ecological study is necessary to understand the relationships between the species and its natural habitat. The declining or extinction factors should be highlighted and removed before release into the wild. All the environmental requirements for the species must be fulfilled, and researchers must know the species' population dynamics very well. The genetically and geographically closest populations should be chosen for breeding and translocation. Founders stocks can be bred either near the translocation areas or in large breeding centers in different countries. It is highly recommended that the release sites be prepared using habitat management techniques to maximize the survival probabilities.

The release must be preceded by accurate veterinary control. Sometimes captive-bred animals are subject to domestication and need a reeducation plan. The follow-up phase is important in order to ensure that the projects are successful or to identify the reasons leading to a failure. A reintroduction plan can be considered successful only when the following points are satisfied: the offspring of the founders start to breed, a minimum viable population (MVP) is reached and maintained, and the recruitment rate is higher than the adult death rate for three years.

The monitoring phase can be useful to verify the need of further releases to increase the number of founders or to modify the plans when some problem occurs. Some examples are presented.

1. Introduction

The conservation status of animal species is of concern throughout the world (e.g., approximately 8000 species of fish have become extinct or are severely endangered; a recent estimate suggests that about 30 000 species of animals and plants become extinct every year). The loss of biodiversity is considered a global phenomenon, and two of the main problems for endangered species are habitat fragmentation (see Section 3.2) and declining size of populations (see Section 3.3).

The final decades of the twentieth century have brought an increasing interest in conservation biology. Many strategies were attempted to restore endangered animal populations, including habitat management protection and restoration, nesting sites protection, alien species eradication, and—as a last resort—captive breeding. This final strategy is often used together with translocation projects, such as reintroduction and population reinforcement, but it must be stressed that these kinds of measures need to be carefully projected, because they could have many unexpected negative effects and should be always subordinated to habitat conservation. At the moment, over 3000 vertebrate species are being bred in zoos and other captive facilities.

2. Planning a Reintroduction Action

2.1. Aims and Objectives of Reintroduction

The main aim of a reintroduction project is the reestablishment of natural populations of a taxon that became locally or globally extinct in the wild, in order to restore original biodiversity. The first question to be asked is whether reintroduction is necessary, or if better results could be achieved with other less risky conservation measures. In fact, many factors should be taken into account when planning a program for captive breeding and the successive reintroduction, because the success of this kind of project is quite low. Some estimates made for translocation plans reported a success rate of 44% for birds and mammals, but another estimate for captive-bred animals was much lower (11%).

The International Union for Conservation of Nature and Natural Resources Species Survival Commission (IUCN/SSC) suggests that captive breeding for translocation should be done when the crisis is enormous and extinction is very likely. This measure should be adopted early, when the wild populations are still in the thousands. When a wild population is critically endangered, a close cooperation between field conservationists and captive-breeding specialists should be carried out, to make their efforts complementary and minimize the likelihood of extinction.

The captive-breeding programs for endangered populations should be conducted for the benefit of the species and without commercial transactions.

2.2. Scheme for Reintroduction Programs

The translocation of captive-bred animals should follow a precise four-step protocol:

- feasibility study
- preparation phase
- release phase
- monitoring phase

Each of these steps is described in detail below.

2.2.1. Feasibility Study

First of all, an ecological study is necessary to understand the relationships between the species and its natural habitat. The influence of environmental modifications, alien species, and anthropic factors should be taken in account. An evaluation of the animal's ability to re-adapt to the modified habitats must be carried out. Moreover, the declining or extinction factors should be highlighted and removed before the translocations are put in practice. The latter point should be considered as a key factor for a successful reintroduction (see Sections 3.1, 3.6, and 3.7).

The projects should involve the preparation and education of local people, in particular when reintroduction programs deal with dangerous species, such as large predators or venomous animals. The educational programs should stress the importance of wildlife conservation and natural habitats in an effort to avoid illegal collection, poaching, and local prejudices (see Section 3.1).

2.2.2. Preparation Phase

For all of the environmental requirements for the species involved in the projects to be fulfilled, an introductory study must be done in the chosen areas and the ecological needs of the species should be known. Particular attention should be addressed to the knowledge of population dynamics and structure of the species, so that the release stocks are adequate to create a self-sustaining wild population. Great care should be taken regarding the sex ratio and age structure of new populations; these data should be based on the knowledge of species biology. The use of juvenile individuals is usually preferable, as they are able to adapt more quickly to new habitats; furthermore, some species are highly philopatric, and the use of hatchlings often guarantee a lower dispersion of the founders (see Section 3.6). The adults are preferable for social species, or when greater experience is needed (see Section 3.2).

The reintroduction plan should include a prevision about population dynamics, spreading, and increasing of the released stock, as well as its interactions with other wild populations, so that any problem could be identified and confronted.

The genetically and geographically closest populations should be chosen for breeding and translocation, to preserve genetic identity and homogeneity.

The founders stocks can be bred either near the translocation areas or in large breeding centers in different countries. Each of these two options have advantages and disadvantages. A large breeding center in a distant area usually offers many favorable logistic opportunities, such as specialized personnel, veterinary care, organized structures, and controlled conditions. On the other hand, the animals could be affected by exotic diseases or accustomed to different food and climatic conditions, resulting in modified reproductive biology and altered behavior (see Section 3.8).

Breeding centers close to the release sites offer similar climatic conditions and food, scarce exposition to alien pathogen agents, and low stress due to long distance transport. Local centers sometimes suffer from lack of specialized personnel, organization, and security, and may also possess inadequate structures or suffer from political problems.

Furthermore, large enclosures guarantee conditions more similar to natural ones, whereas those that are small can induce stress due to high population densities.

It is highly recommended that the preparation of release sites include all the available techniques of habitat management to increase the suitability for the species and to maximize survival probabilities (see Sections 3.6 and 3.7).

2.2.3. Release Phase

The release must be preceded by accurate veterinary control to avoid the transmission of any kind of disease, including internal and external parasites. Moreover, it could be advisable to vaccinate the founders to limit the mortality due to local diseases. For some species, it is useful to create an enclosure in the release area where the animals can learn more about the natural habitat and get accustomed to the landscape and food resources.

The latter point also is quite important to re-create the natural gut flora to deal with new forage before the release.

Sometimes captive-bred animals are subject to domestication, and the modified patterns of behavior (in particular feeding and breeding, but also social behaviors) do not allow survival in the wild; in these cases, a re-education program is necessary.

The structure of the populations can be re-created for repeated introductions; this strategy could be useful to have different age classes and to reduce the effect of mortality in the first stock. To increase the survival probability of the founders, it is important to accurately choose the release seasons in accordance with species biology.

A metapopulation structure should be achieved to guarantee the maximum dispersion and minimize stochastic extinctions. In fact, one of the most debated problems is the "single large or several small" (SLOSS) concept: the question of whether it is better to have a unique large population or many that are small. The two options have both advantages and disadvantages: the former case increases the probability of meeting a suitable partner, and it is more resistant to unpredictable events. The latter option is more similar to natural populations, it guarantees a continued gene flow thus maximizing genetic diversity, and it is more resistant to habitat modifications; but each subpopulation is exposed to stochastic events that could lead it to extinction.

Last but not least, the choice of release sites is of primary importance for the project's success. In fact, the areas must be easily accessible by researchers and park staff for future monitoring and protection from poaching. Furthermore, in some cases it could be advisable to choose a place where an excessive dispersion is not possible, in particular during the first phases of the project.

2.2.4. Monitoring Phase

The follow-up phase is particularly important to make sure that the projects are successful or to identify the reasons leading to a failure. In fact, researchers should monitor the survival, the adaptation, and the dispersal of the released animals using a precise protocol. A reintroduction plan can be considered successful only when the following points are satisfied:

- the sons of the founders start to breed;
- a minimum viable population (MVP) is reached and maintained; and
- the recruitment rate is higher than the adult death rate for three years.

The length of the monitoring phase is variable and depends on the biology of the released species; it can last merely a few years for species that reach sexual maturity in a short time (e.g., some frogs, fish, etc.) or several decades for turtles, large mammals, or parrots.

This phase can be useful to verify the need of further releases to increase the number of founders, or to modify the plans when some problem occurs. In particular, it could be necessary to remove the founders when survival problems intervene, or to manage habitats to increase the success probability of the projects.

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Biographical Sketches

Edoardo Razzetti was born in 1968. He graduated in biological sciences at the University of Pavia in 1993 with a thesis about artificial passages for fish. Since 2002 he has been curator in the Natural History Museum of the University of Pavia. He devoted most of his time to the study of zoology, including distribution, habitat preferences, and taxonomy of many species of amphibians and reptiles; population biology, growth, and conservation of freshwater crayfish; distribution and management of autochthonous and alien species of freshwater fish. He is subsequently working on a European Union project (Life) about conservation of the white-clawed crayfish and has been commissioned by Institute Oikos (ONG–ONLUS member of the IUCN) to investigate the herpetofauna of Arusha National Park within the EU-financed project "Biological Conservation and Sustainable Management of Mount Meru System, Tanzania." He has published many scientific papers in national and international journals and is a member of various scientific associations including the Herpetological Association of Africa (HAA), Societas Herpetologica Italica (SHI).

Stefano Scali was born in Milan, Italy, on August 12, 1966. He graduated in biological sciences at the University of Milan in 1990 with a thesis about the ecology of a reptile community in a suburban habitat. He started a collaboration with the Natural History Museum of Milan in 1991, working with the vertebrate zoology department. He is interested in many fields of zoology, museology, and scientific education. He conducts many herpetological studies dealing with ecology, systematics, and conservation of Italian amphibians and reptiles, in particular of anurans and snakes. He directed the main Italian plan for the conservation the breeding and reintroduction of amphibian endangered species in Italy, in cooperation with the University of Pavia and some natural parks. He is interested in the study and production of statistical models of environmental factors affecting the presence and distribution of amphibians and reptiles at the community level. He has published many papers about the results of his research in some national and international journals and participated in many international herpetological meetings. He has also contributed to the knowledge of amphibians and reptiles with many public conferences and lessons in universities and schools. He is conducting a project for the creation of a database of the zoological collections of the Natural History Museum of Milan and contributed to the databases of some other Italian museums. He has made a systematic revision and published a catalog of Italian snakes in the collection of the Natural History Museum of Milan. He has also conducted some historical research about the collections in the museums of Milan and Como. He furthermore collaborated with the Forensic Medicine Institute of the University of Milan for statistical data analysis.