Chapter 9
Metapopulation Conservation: Captive Breeding, Reintroduction, Translocation and Population Management

Introduction

In the previous chapter we considered those intensive management options available to the Ethiopian Wolf Recovery Programme. Wildlife management measures used by species' recovery programmes include captive breeding, or a combination of *ex situ* and *in situ* metapopulation management.

A few conclusions emerge from previous chapters. The Ethiopian wolf embodies the two paradigms of conservation biology (Caughley 1994): the small-population and the declining-population. The first only raises the question of how long a population will persist, and concerns the consequences of smallness and rareness. The second deals with the cause of smallness and its cure, and involves research effort to determine why a population is declining and what might be done about it. We now know that the species is rarer than it ever was, and that those populations which remain are fewer and smaller than before (Chapter 2). These remaining populations are being increasingly exposed to detrimental extrinsic factors, such as increased contact with humans resulting in persecution and road kills (Chapter 3), and contact with domestic dogs with ensuing disease epizootics and hybridization (Chapters 4 and 5). Regardless of the causes of their decline, these populations are also vulnerable due to their smallness, they are more exposed to demographic and environmental stochasticity, genetic drift and inbreeding, resulting in loss of heterozygocity and fitness, inbreeding depression and eventual local extinction. Furthermore, dramatic declines in numbers in short intervals of time – catastrophes (either physical or biological) – have an important effect in populations' persistence. Recent theoretical work suggests that local extinctions are likely to be more common than short-term studies would lead us to believe (Mangel and Tier 1994). Since extinctions are likely events, we should expect extinctions even of protected and larger populations.

Against this background we conclude that in order to halt the decline and enable the eventual recovery of the Ethiopian wolf, vigorous conservation is required. We need to assure the continuation of afroalpine habitat conservation within protected areas, monitoring the demography of the different wolf populations, and through education, reduce the impact of human activities and livestock on their survival.

In order to conserve this species in the long-term we need to address the small-population concern as well. Chapter 8 concluded that captive breeding was not a sufficient answer to this problem, although it is potentially a stepping stone in efforts to assure the survival of the Ethiopian wolf. We emphasized the need to treat the remaining populations as a metapopulation for management purposes.

Metapopulations

A metapopulation is a population of populations. It refers to the range of a species composed of geographically isolated patches, interconnected through patterns of gene flow, extinction and recolonization (Lande and Barrowclough 1987). Several smaller populations occurring in separate ranges may be more viable than a single larger one, provided that the environmental variation influencing each different segment is at least partially independent. It is also important that there is at least some recolonization, natural or managed, of ranges that experience local extinction (Soulé 1987). Captive populations should be encompassed by conservation strategies and action plans as an integral part of metapopulations.

With the aid of suitable techniques we can associate all wolf populations into a single one, and manage it as such. We have now concluded that while captive breeding is imperative to establish a nucleus of 'pure' wolves as a last defence against extinction, a full-scale reintroduction will not be feasible in the foreseeable future. This fails to fulfil the main objective of modern captive breeding, that is to produce animals for reintroduction (IUCN 1987a), but on the other hand such a programme would allow the preservation of a sample of the existing genetic variability. In addition to the captive breeding of endangered species for their eventual reintroduction to the wild, translocation of a limited number of surplus animals, either captive-bred or wild-born, between populations emerges as a potentially important metapopulation management option available to future Ethiopian wolf conservation (see below).

There usually is great urgency to address the issues posed by conservation crises, but rarely enough time to assess a situation exhaustively before one must act. Our suggestions, in the Action Plan, may be superseded as more information on the species and on suitable management techniques becomes available. However, our intention has been to establish a clear framework for the conservation of the Ethiopian wolf that at least enables a start to be made. In this section we examine how the complementary approaches of captive breeding, reintroduction, translocation and metapopulation management may be applied in an Ethiopian Wolf Recovery Programme.

Management of Ethiopian Wolf Populations

The following captive breeding and metapopulation management programme is proposed for the Ethiopian wolf:

- establishment of a captive breeding facility in Ethiopia, preferably in or close to wolf habitat;
- captive breeding at international captive breeding facilities with experienced curatorial and veterinary staff;
- provide protection for afroalpine habitat and the wolves and progress towards metapopulation management.

Captive Breeding

The Ethiopian wolf is one of only two canid species which have never been kept or bred in zoos, and therefore the species lacks that last "insurance policy" against extinction. Thus, in addition to reversing the decline of wild wolf populations there is a strong argument for establishing a captive population as a hedge against further cataclysmic population declines. However, without reintroduction as the subsequent outcome of captive breeding, captive animals will be in danger of becoming decreasingly suitable for reintroduction, should it eventually occur. Captive conditions over generations may increase the animals' degree of domestication, decrease their natural ability to deal with stress, and their natural behaviour may become suppressed or inhibited.

Both captive breeding approaches, *ex situ* and *in situ*, provide different advantages and are mutually supporting. Indispensable to the whole programme is the continued maintenance of the species' natural habitat and linking population management into a single metapopulation. The latter may be achieved through reintroduction of captive-bred animals and/or translocation of wild-bred animals. This includes restocking of existing populations and/or reintroduction in areas where the species was extirpated. Figure 9.1 shows a diagram of the proposed metapopulation management programme, including *ex situ* and *in situ* captive breeding and eventual reintroductions and restocking.

The goals of this programme will be:

- to develop captive programmes for Ethiopian wolf conservation with the primary purpose of contributing to the survival and recovery of the species in the wild;
- to provide animals to re-establish or restock wild populations when the need and opportunity arises;
- to conduct problem-oriented research that will contribute to manage wolves both in the wild and in captivity;
- to channel financial and technical support from the zoological institutions responsible for captive breeding towards *in situ* conservation, possibly through Adopt-A-Park programmes;
- to use the Ethiopian wolf as a *flagship* species for conservation education and public relations for all Ethiopian wildlife.

Ex Situ Captive Breeding

A pilot captive population could be immediately established in an existing facility (*ex situ* option), with a nucleus of animals on '*breeding loan*' from the Ethiopian Government. Similarly, expertise from existing facilities around the world could be brought in to help establish a pilot captive population within a specifically constructed Ethiopian facility. Captive breeding is a highly sophisticated procedure and there are several advanced institutions around the world willing to become involved in such a programme. Hitherto, progress in establishing a captive population has been slow due to the difficulty of obtaining permission to capture and breed individuals from the wild and other prerequisites for exporting wolves to

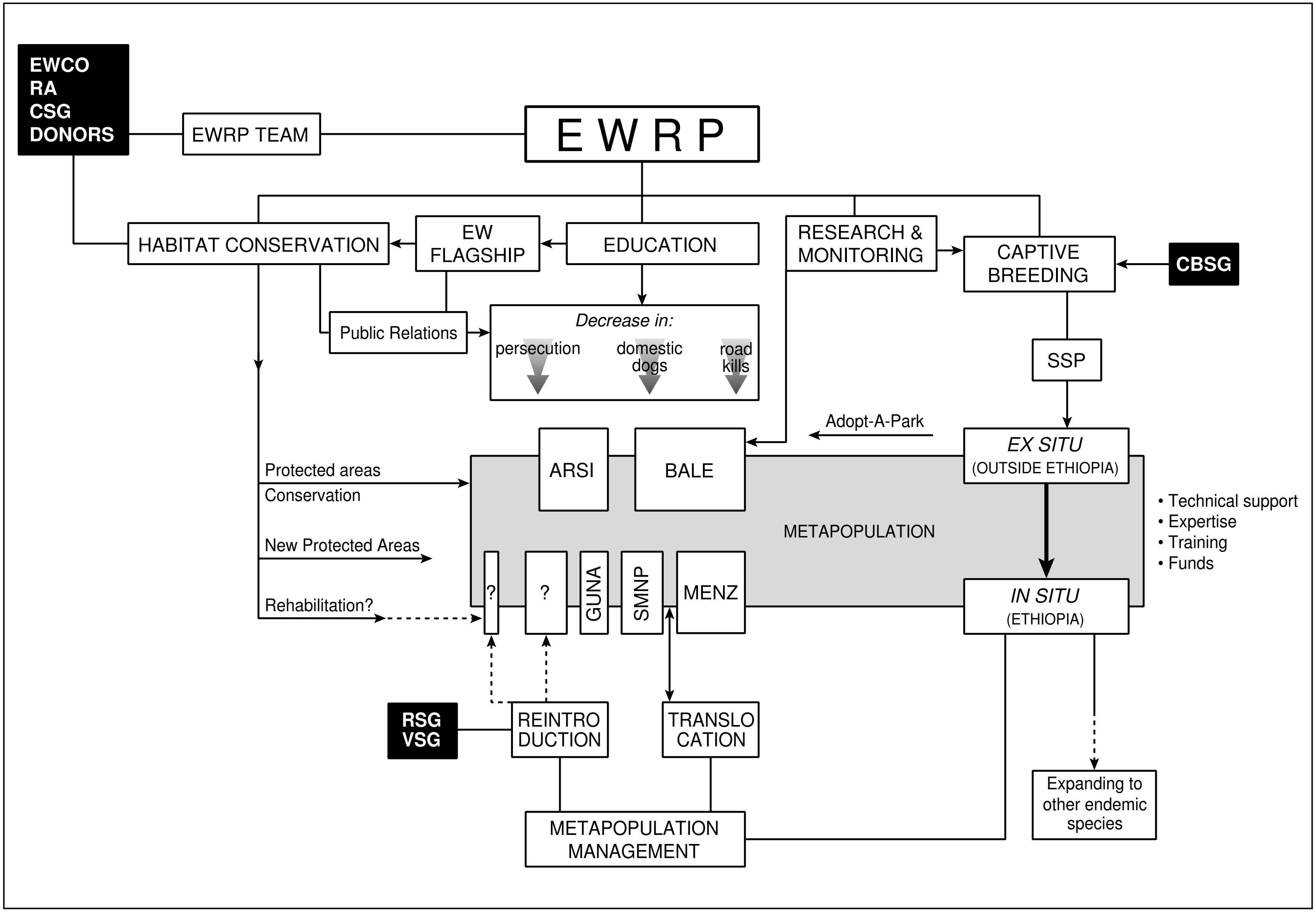

Figure 9.1. Flow chart summarizing the various components of the Ethiopian Wolf Recovery Programme, indicating relationships between them and the different agencies involved. Agencies are shown as white text on black backgrounds, and the acronyms used are listed in Chapter 10.

breeding facilities outside the country.

The main advantages of an *ex situ* breeding programme for the Ethiopian wolf are:

- availability of extensive experience on keeping and breeding of closely-related species;
- minimal start-up and running costs;
- the ready availability of advanced technology (such as genetic screening, embryo-transplants, hormonal monitoring);
- advanced veterinary medical care;
- potential to breed more animals faster with lower mortality;
- potential for fund raising, including the exhibition of this rare and unfamiliar species.

The disadvantages include:

- unfamiliar conditions in terms of habitat, prey types and climate;
- exposure to unfamiliar diseases;
- costs of transport and possible quarantine.

Funds raised by the different zoological institutions involved should be channelled to the *in situ* Ethiopian Wolf Recovery Programme and for the conservation of the afroalpine ecosystem, possibly through an Adopt-A-Park system similar to that in practice with the tiger (*Panthera tigris*) in India and Malaysia.

Captive breeding at existing international facilities outside Ethiopia should be governed by a strict international loan agreement. Animals for breeding outside Ethiopia would be supplied on breeding loan; and thus would never be out of Ethiopia's possession and control. Ownership of all the wolves, including potential founders and all successive generations, and participation in management by Ethiopia should be part of such an agreement.

In Situ Captive Breeding

The main aims of *in situ* captive breeding are to create a new population safe from the threats faced by wild populations, and to produce a founder population for release into the wild in reintroduction programmes. It should be possible to breed the species in large semi-natural enclosures in a suitable afroalpine location, and to develop a large captive population intended to supply stock for restocking or reintroduction to areas from which the species has been extirpated but which are again suitable.

The obvious advantages of breeding Ethiopian wolves within their range in Ethiopia are:

- the establishment of semi-natural enclosures in terms of habitat type;
- the availability of natural food;
- exposure to natural climatic conditions;
- the reduction of exposure to unfamiliar diseases;
- development of local wildlife management expertise;
- practical demonstration of national concern;
- local publicity.

Disadvantages of a captive breeding in Ethiopia may include:

- no captive facility currently exists;
- the high expense of initiating and running a new breeding facility;
- lack of assured financial support for a long-term programme, given Ethiopia's many other pressing priorities;
- no experienced curatorial and veterinary staff available to deal with the onset of critical health, reproductive and management situations;
- lack of sophisticated support infrastructure;
- exposure to local diseases.

A modest captive breeding facility could be built in a suitable location in Ethiopia. The local breeding facility should consist of suitable wolf enclosures, a simple clinic and food preparation room and staff accommodation at an appropriate site. The original facility may eventually be enlarged. Experience acquired by programme staff in captive breeding techniques could be transferred in the future to an education facility and to accommodate the breeding of other endangered highland wildlife, for example walia (*Capra walie*), mountain nyala (*Tragelaphus buxtoni*), Prince Ruspoli's turaco (*Tauraco ruspolii*) and wattled crane (*Bugeranus carunculatus*).

Guidelines for a Captive Breeding Programme

Based on proposals submitted in 1992 (Sillero-Zubiri *et al.* 1992), the main tasks involved in the design, coordination and funding of the programme are presented in loose chronological order:

First Phase

- Establishment of an international captive breeding programme;
- Coordination of captive breeding effort;
- Signature of ownership agreement between breeding institutions and government agencies;

- Selection, capture and transport of potential founder animals;
- Establishment of a breeding nucleus: the preferred option is to begin with a facility in Ethiopia if funding can be made available quickly;
- Develop husbandry research;
- Investigate potential for the use of electro-ejaculation and cryo-preservation of semen;
- Secure funding for Ethiopian facility;
- Development of educational programme in Ethiopia.

Second Phase

- Establish and consolidate an Ethiopian captive breeding programme (plans are already being drawn up);
- Select suitable location(s);
- Determine facilities required;
- Build facility;
- Establishment of breeding nucleus;
- Organize management of the facility;
- Develop technical and scientific cooperation;
- Training of Ethiopian nationals;
- Implementation of educational programme.

Based on the above considerations a captive breeding programme in Ethiopia must be considered a long-term operation, with resources and planning available for at least 10 years. The institution(s) responsible for the project must provide their continued support until, at least, conditions for reintroduction in the wild are suitable.

Coordination of Captive Breeding Programmes

The proposed breeding programme would be biologically safe through drawing on the wealth of existing practical knowledge collated by CSG, the Conservation Breeding Specialist Group (CBSG) and programmes on captive breeding of other related species, and our recent knowledge of the species' ecology, demography and mating system in the wild. Details of the proposed programme have to be agreed by all participating GOs and NGOs and are dependant upon developments in funding, possible locations, government approval and other factors.

It is vital to establish a managerial structure to coordinate and oversee the future captive breeding programme. Participating zoos should cooperate to manage individual animals within the different breeding facilities involved as a single population. The overall programme should be coordinated between the CSG, CBSG, experts from captive breeding centres involved and relevant Ethiopian agencies.

A master plan should include demographic and genetic analysis of the captive population, including which animals should breed and with whom, which ones should not breed, which ones should be removed from the population, and which ones should be used for research, reintroduction or genome banking. The master plan should follow the format adopted by the American Zoo and Aquarium Association (AZA) for its Species Survival Plans (SSP).

Studbooks are indispensable to track the degree of relatedness between individuals (Dathe 1990). Detailed information on the location, whether from different populations or subspecies, and genetic relatedness of potential founder animals should be compiled in a studbook and used to manage the captive population and optimize outbreeding.

Genetic Considerations

Chapter 5 outlined several genetic questions important to the establishment and genetic maintenance of captive populations of Ethiopian wolves. These also apply to their eventual reintroduction or the genetic supplementation of populations in the wild through restocking. In naturally occurring populations there are great inequalities in reproductive success among individuals and sexes such that the effective population size is reduced. Furthermore, a high degree of philopatry risks potential inbreeding. This risk, however, seems to be circumvented through extra-pack mating (Sillero-Zubiri *et al.* 1996b).

Several genetic considerations would need to be assessed:

Number of potential founder individuals. In theory, a large stock of 50 or more individual potential founders would be recommended to start a captive nucleus, in order to represent and preserve the diversity of the wild population. However, captive populations have been founded with fewer individuals and succeeded although some inbreeding depression may occur (Chapter 5). In practice, and view of the small number of wolves surviving, it may be possible to start a captive nucleus with as few as 10–15 animals. Rapid expansion of the initial population and careful genetic management would keep inbreeding to a minimum.

Selection of potential founders. Having secured permission to capture 10–15 individuals for captive breeding, they should be selected to represent the genetic diversity of wild populations before the introduction of domestic dogs into the afroalpine range. This requires first the choice of source population(s) for the potential founders. We recommend BMNP as the preferred source for the majority of the potential founders, this being the larger wolf population as well as the one with the largest carrying capacity (and therefore least likely to be altered by the temporary population reduction caused by the potential founders' removal). Additional animals may be drawn from Arsi and perhaps Menz populations, to optimize the captive population's initial genetic diversity. Molecular genetic techniques can effectively be used to deduce population-specific polymorphisms and determine whether it is advisable to interbreed individuals from different populations (Avise 1994, but see Chapter 5).

The potential founder animals should be chosen such that they are unrelated and best represent the genetic diversity within the source population. Established molecular genetic protocols should be used to detect the genetic relatedness between potential founders and the selection of closely related individuals should be avoided (Gottelli *et al.* 1994). Animals of hybrid ancestry should be excluded. This may be achieved by the selection of individuals from different packs that appear phenotypically normal, such as those in Sanetti Plateau and Tullu Deemtu in BMNP. Captured animals should be tested for genetic evidence of dog ancestry (Gottelli *et al.* 1994, Chapter 5).

In order to reduce the impact the capture of potential founder animals might have on the source population, subadult animals, which have not yet been recruited into the breeding population, should be targeted. Young males may be removed from the larger packs in the source population (preferably those packs with at least 4−5 males), ideally from packs that have breed successfully the previous year. Young females that have left their natal packs and became floaters (Sillero-Zubiri *et al.* 1996b) constitute ideal candidates, since their removal would not affect breeding dynamics in established packs. Alternatively, subadult females from packs with at least three females may be chosen. On no account should either adult females that have bred or dominant adult males be removed. An alternative strategy would be to target animals in the fringes of a wolf population, since they would probably be dispersing animals, with lower survival expectancy. This would be a suitable strategy when collecting a few potential founders from smaller, less well known populations.

Husbandry. Husbandry. Once in captivity, the founder population should be managed to reduce inbreeding and the loss of variability and should be expanded rapidly. In addition to the preservation of genetic variability, husbandry practices need to address the preservation of wild-adapted behaviour (Tudge 1991, Badridze *et al.* 1992). This may be achieved in large semi-natural enclosures, with wolves kept in stable groups (*e.g.* breeding pair with offspring of the previous year). It will be necessary to consider a feeding regime that insures that captive bred individuals destined for release have appropriate survival skills; in due course this will necessitate evaluation of topics such as the feeding of live rodent prey (perhaps established in naturalistic colonies with escape terrain). We acknowledge that this is an ethically complicated issue, and flag it as one that may have to be addressed.

To reduce the loss of genetic variability in a small, captive population, the genetic relationships of individuals need to be understood and the breeding structure manipulated so that the number of breeders and their genetic dissimilarity is maximized. Multiple mating and paternity occurs in Ethiopian wolves (Gottelli *et al.* 1994). In order to mimic the pattern that occurs in the wild, husbandry practices may include multiple insemination of females by different males to maximise the chance that they may become pregnant and at the same time allow genetic contributions from an increased number of males to be included in the next generation. This might be achieved by placing the oestrous female in a separate enclosure and allowing males other than her partner access to her cage in succession.

Reproduction technology. The establishment of a captive population will permit species-specific husbandry research, in order to optimize future metapopulation management. An obvious path is the development of specific protocols for the collection of viable sperm and eggs from wild wolves that could be frozen for future use in captive breeding (Chapter 5). Sperm from wild males may be collected through electro-ejaculation. The sperm may be used later for artificial insemination or to fertilize harvested eggs *in vitro*. Similarly, eggs could potentially be flushed from wild caught females, viably frozen and matured at a later date for fertilization and implantation in captive wolves. Such fertilized eggs could potentially be brought to term in surrogate mothers from a related species, such as domestic dogs. A genetic bank of eggs and sperm from wild caught wolves could be used to enrich the genetic diversity of captive wolves once the breeding program is started and, in the meantime,

Table 9.1
Reintroduction of Ethiopian wolves. Is it supported by the reintroduction criteria proposed by Kleiman *et al.* (1994). Scale 5 = best.

Condition of species	
1. Need to augment wild population	Yes
2. Available stock	No
3. No jeopardy to wild population	?
Environmental conditions	
4. Causes of decline removed	No
5. Sufficient protected habitat	No
6. Unsaturated habitat	No
Biopolitical conditions	
7. Negative impact for locals	No
8. Community support exists	2
9. GOs/NGOs supportive/involved	Yes?
10. Conformity with all laws/regulations	?
Biological and other resources	
11. Reintroduction technology known/in development	3
12. Knowledge of species' biology	4
13. Sufficient resources exists for programme	No
Recommended reintroduction/translocation	**No**

would provide a hedge against the very real possibility of dramatic population declines and even extinction in the wild.

Reintroduction and Translocation

There have been a few attempts at reintroducing canid species in the past, and these were reviewed in Chapter 8. With the increased sophistication of captive breeding in the last decade, reintroduction may become a more frequent recovery technique in the future. However, with regard to the Ethiopian wolf, no reintroduction programmes should be considered until human influences are controlled and the threat from domestic dogs is totally removed from potential release sites, or until new natural reserves are created to conserve more habitat suitable for the species.

The benefits of intervention should be carefully weighed against its possible negative effects (such as disturbance and accidental disease introduction) before deciding whether or not such an intervention can be justified. Because of the conservation significance of animal translocations, the implementation and interpretation of risk assessment should be evaluated by regular reviews by outside specialists.

Kleiman *et al.* (1994) presented 13 criteria that should be considered prior to implementing a reintroduction. These criteria can be used in decision making, especially regarding proposals to use captive-bred animals for a reintroduction, and are grouped into four discrete categories: condition of the species; environmental conditions; biopolitical conditions; and biological and other resources. We applied these criteria to the Ethiopian wolf. Table 9.1 presents the criteria and indicates where the species lies with respect to the recommendation to initiate or carry out a reintroduction programme. In some cases we have insufficient data to determine whether a criterion is met.

Overall, consideration of the proposed criteria lead us to the conclusion that it would be premature to recommend a reintroduction of Ethiopian wolves into a new area at this stage. However, conditions may change in the near future and reintroduction may become a feasible management option.

Translocation as a means of restocking small populations and boosting genetic variability remains an option more likely to be of use for the management of Ethiopian wolf populations. This method is less expensive than captive breeding and reintroduction, but will require a high degree of planning and implementation. Wayne and Gottelli (Chapter 5) showed that the BMNP wolf population exhibited significantly less genetic variation than expected. Supplementing a population with as little as one or two individuals per generation may be enough for genetic variability to be maintained. Behavioural and demographic arguments need to be considered in the selection of individuals for wild-to-wild translocations. The age and sex category of those animals targeted is important for two reasons. First, as suggested above, removal of individuals from the wild should not affect the reproductive dynamics of the source population. Second, Ethiopian wolves show a high degree of philopatry, and only females would disperse under normal conditions. Similarly, only relatively young (1.5–4 year old) females were seen to immigrate into an established wolf pack and breed (Sillero-Zubiri *et al.* 1996b). Both findings point at young females as the best choice for translocation purposes. However, while it has been shown that wild-born individuals perform better than captive-born ones in translocation operations (Chapter 8), the potential impact of removing animals from a relatively small wild population should not be overlooked, and careful consideration should be given to the use of captive-born individuals in spite of their potentially lower success rate, bearing in mind that they would be more 'expendable' that wild ones. An additional precaution when moving individuals between wild or captive populations is the risk of transmitting disease.

Translocation Guidelines

In order to minimize disease risks due to the transfer of animals between different wild and/or captive populations Cunningham (1996) suggested the following guidelines:

- Before a translocation assess disease risks and take precautions to minimize these risks.
- Maintain the animals in captivity as near to the site of capture/release as possible (preferably in the region of origin).
- Maintain the animals in captivity for as short a time as possible.
- Prevent contact between the animals in question and those from a different source or of a different species.
- Keep and handle the animals under hygienic conditions to minimize the risk of parasites being passed from the keepers to the animals.
- Avoid the transfer of parasites from foodstuff to the animals.
- Clinically healthy animals should not be regarded as parasite free and therefore should be treated with caution.
- Translocation to areas devoid of related species helps decrease the risk of interspecific transmission of disease.

Metapopulation Management

Gottelli *et al.* (1994) showed that the genetic variability of wild populations of Ethiopian wolves in BMNP was low in comparison to that of other related canids, suggesting long-term effective population sizes of less than a few hundred individuals. The role of genetics in the future management of wild and captive Ethiopian wolf populations is discussed earlier in this volume (Chapter 5).

Metapopulation management will be required to avoid further loss of genetic variability. In order to keep isolated and small populations genetically viable, captive born animals may have to be released into established wild groups, and some wild-born animals may have to be caught for use in captive breeding. Additionally direct wild-to-wild translocations may be used. Such exchanges must be accompanied by intensive medical checks to avoid the possibility that disease might be exchanged between populations.

The whole programme should be dynamic, making use of genetic records of the captive animals as well as information from wild populations. Metapopulation management should integrate the management of wild and captive populations, population genetic management, conservation and management of habitat and eventual reintroductions to areas where the species has been extirpated. Information from both wild and captive populations and their habitat should be used to elaborate a Population and Habitat Viability Assessment (PHVA) in order to coordinate all aspects of the programme, and to optimize the management of all remaining Ethiopian wolf populations. This recovery programme needs careful design and supervision by a steering group of experts.

Conclusions

Ethiopia experiences unique environmental conditions, which have resulted in the evolution of a plethora of endemic animal and plant species. The future of several of these larger Ethiopian wildlife species is in question due to continuing and insidious pressures on the habitats and the species themselves. To insure the continuity of these species until more benign conditions prevail in their environment, captive breeding and population management are crucial for some of the species. Arguably the most endangered of these, due to persecution, critical genetic circumstances and habitat modification, is the Ethiopian wolf.

The Ethiopian wolf population in the Bale Mountains apparently increased since the BMNP was established in the 1970s and into the 1980s, illustrating the importance of conservation areas to ensure the survival of this species. However, the dramatic decline that the Bale population has suffered since 1990, together with the small numbers remaining elsewhere and the fragmentation of its population, highlight the vulnerability of these wolves. Reduced levels of genetic variability are further compounded by the dilution of the species' gene pool from cross-species breeding (Gottelli *et al.* 1994). The Ethiopian wolf is now more endangered than ever. Ethiopia and the world stand in extreme likelihood of losing the species if action is not taken soon. In view of the persisting human impact on its overall distribution and its vulnerability to extinction, the establishment of a captive breeding and population management programme must be undertaken.

A captive breeding programme has already been proposed for Ethiopia, with the Ethiopian wolf as a flagship species, but one view expressed in Ethiopia was the concern about removing any of the world's remaining Ethiopian wolves from the wild. However, information from the wild and recent events involving hybridization and disease epizootics have made captive breeding a priority to enhance the survival of the species. Establishing a captive population could forestall the possibility of a natural disaster wiping out a whole wild wolf population, or of genetic extinction through hybridization.

In summary, the Ethiopian wolf would benefit from a captive breeding operation in order to halt the loss of genetic variability sustained by its remaining small populations, and protect some stock from introgression with domestic dog genes. *In situ* captive breeding is the preferred technique and there are already proposals and funding pledged for the establishment of such a facility in the near future. The surplus wolves from the captive nucleus and some wild caught animals could be used for restocking. Reintroduction may become an option in the future if the species becomes extirpated from a protected area with sufficient habitat available to make such an operation viable. Reintroduction to small islands of afroalpine habitat where the species has been extirpated is another attractive possibility, although a technical problem with this exercise is the limited scope for expansion of the reintroduced population, so that even at carrying capacity, population sizes may not strictly be viable.

We know that a successful reintroduction project will have to be extended over many years and may necessitate the release of a large number of animals. To succeed, the project will have to invest heavily in the involvement of local people through employment opportunities and community education. This calls for long-term commitment, a large recovery team, clear protocols and guidelines for population management and most importantly, institutional support. All of these characteristics are resource-intensive, suggesting that prospects for adequate, long-term funding must be good if captive breeding and/or reintroduction are to be undertaken responsibly. Captive breeding, both *in situ* and *ex situ*, must be carried out in collaboration with field research into the wild-living populations. The captive breeding facilities will greatly benefit from new information about Ethiopian wolf ecology and behaviour.

This programme should be coordinated between the Canid Specialist Group (CSG), the Conservation Breeding Specialist Group (CBSG), the Veterinary Specialist Group (VSG), the Re-introduction Specialist Group (RSG), experts from existing captive breeding centres and the most up-to-date information from the wild in Ethiopia. Such a programme would be biologically safe through drawing on the wealth of existing practical knowledge collated by CSG, CBSG and programmes on captive breeding of other related species, and our extensive recent knowledge of the species' ecology, demography and mating system in the wild. Details of the proposed programme have to be agreed by all participating GOs and NGOs and are dependant upon developments in funding, possible locations, Government approval and other factors.