Guidelines for Reintroductions and Other Conservation Translocations

ANNEXES TO GUIDELINES

Annex 1: Background

Humans have moved organisms between sites for their own purposes for millennia. This has yielded benefits for human kind, but in some cases has led to disastrous impacts. IUCN stated its perspective on such moves with its 1987 Position Statement on the Translocation of Living Organisms. Subsequently, the Species Survival Commission's Reintroduction Specialist Group developed policy guidelines that were approved by IUCN's Council in 1995 and published in 1998 as the IUCN Guidelines for Reintroduction[1]. The Guidelines were short and practical in focus and have been used by other SSC Specialist Groups to derive more detailed Guidelines for their own taxa and purposes[2].

In 2010 Guidelines were deemed to need review and revision, because:

1/ The last 20 years have seen a huge increase in the numbers of rigorously designed and assessed, carefully implemented and monitored plant and animal reintroductions, with an associated increase in the understanding of the scientific principles, ethics and practical issues associated with successful reintroductions.

2/ The perspective of a reintroduction as a single species being returned to its indigenous range is now restrictive: while many such examples remain, translocation is being used with many and multiple motivations and under a huge range of circumstances. Hence, reintroductions occupy a place within a spectrum of translocations that are both for conservation benefit and for other purposes, and many with aspects of each. Hence, compared to the 1998 Guidelines, the scope of this revision has been widened to include all translocations with conservation benefit (as defined in the Guidelines, Section 1) their primary purpose.

3/ It is increasingly recognised that, while species conservation remains a priority for conserving biodiversity, reintroduction needs to be undertaken in the context of the conservation and restoration of habitats and ecosystem services.

4/ The increasing rate and complexity of global change, including habitat loss, species declines, biological invasions and climate change suggest entry into an age of "ecological surprises" where management solutions based on historical precedent may not always be adequate for future biodiversity conservation needs.

5/ Reintroductions or restoration efforts with the direct participation of community groups of interested people have increased.

The wider scope of the revised Guidelines reflects the fact that conservation is becoming increasingly interventionist, actively managing biodiversity. A major factor influencing this is climate change, set against a backdrop of massive habitat destruction and fragmentation.

The palaeo-ecological record and contemporary observations show that climate change has profound influence on the distribution and abundance of species. An increasing number of species will be susceptible to extinction if they are unable to adapt to new conditions within their current ranges or are unable to shift their distributions.

If climate change (or other major threat) predictably dooms a species to extinction in its current location, one option is to move it deliberately to sites where conditions are judged to be more suitable, or are likely to become so in the future. Such sites will often be outside the species' known

[1] http://www.iucnsscrsg.org/download/English.pdf
[2] http://www.iucnsscrsg.org/policy_guidelines.html

or inferred indigenous range. The 1998 Guidelines included "Conservation / Benign Introductions: an attempt to establish a species, for the purpose of conservation, outside its recorded distribution but within appropriate habitat and eco-geographical area." Thus, assisted colonisation has been used successfully to counter imminent extinction threats to endangered species long before the current concern over climate change impacts. The revised Guidelines include assisted colonisation as one option within the overall spectrum of translocations (**Figure 1**).

One of the most debated aspects of translocating species outside their indigenous range, albeit with conservation intentions, is that this action could harm local biological diversity, human livelihoods, health and economy. It is therefore important to assess carefully the risks related to these translocations, making best use of advances in invasion biology. Hence, the revised Guidelines are a product of both the Reintroduction and Invasive Species Specialist Groups.

The Guidelines strive to cover situations of conservation intervention that may today seem challenging to current conservation convention; however, it is hoped the Guidelines will have a long effective lifespan. They are not an advocacy document for conservation translocations; indeed they are designed to ensure that proposals for any such activity are rigorously designed and scrutinised, whatever the taxon or scale of operation. Accordingly, the need for risk assessment and sound decision-making processes in all translocations is emphasised, but with the level of effort in proportion to the scale, risk and uncertainties around any translocation.

The scope of the Guidelines is deliberately restricted to issues around the translocation of single species or, at most, small numbers of species and their critically co-dependent species. Many of the tools and elements of other translocations are shared with conservation translocations, as delimited here. This would include, for example, the rehabilitation and release of small numbers of individuals, or the promotion of conservation benefit through ecotourism. Further, aspects of conservation translocations merge with many other disciplines in contemporary conservation, which also have their own guidelines or policies. Within IUCN, these Guidelines should be seen as complementary to, and consistent with, the following key works:

- IUCN Guidelines for the Placement of Confiscated Animals (2000)[3]
- IUCN Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species. (2000)[4]
- IUCN Technical Guidelines on the Management of Ex-situ populations for Conservation (2012 in preparation)[5]
- IUCN World Commission on Protected Areas (2012 in draft), Ecological Restoration for Protected Areas: Principles, guidelines and best practice[6].
- IUCN (2012 in draft). Guide to Wildlife Disease Risk Assessment[7].

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[3] http://data.iucn.org/dbtw-wpd/edocs/2002-004.pdf

[4] http://intranet.iucn.org/webfiles/doc/SSC/SSCwebsite/Policy_statements/IUCN_Guidelines_for_the_Prevention_of_Biodiversity_Loss_caused_by_Alien_Invasive_Species.pdf .

[5] [Website to follow]

[6] [website to follow]

[7] [website to follow]

- IUCN Red List[8]
- IUCN (2000). The IUCN Policy Statement on sustainable Use of Wild Living Resources[9].

And, it should be noted that many other organisations have developed their own Guidelines for activities in the spectrum from species reintroduction to ecosystem restoration.

These Guidelines are consistent with the guiding spirit of the Convention on Biological Diversity and its Strategic Plan for Biodiversity (the Aichi Biodiversity Targets).

Annex 2. Definitions and classification

Conservation benefit as a primary objective

The requirement that a conservation translocation must benefit either a population or its species, or the ecosystem it occupies, is consistent with the requirement of the 1998 Guidelines, namely that the purpose of a reintroduction is the establishment of a viable population.

The present Guidelines acknowledge that conservation benefit may be broader than establishing a demographically viable population (for example, through ensuring the persistence of traits essential for survival), but that primary benefit should still be at a higher level of organisation than the individual.

Where conservation benefit is not obvious

There are several situations in which conservation benefit

- is not the primary aim, or
- may be hard to discern, or
- is commingled with other benefits, or
- is deferred to some future period, or
- cannot be confirmed until some future period.

These situations occur singly or in combination in the following:

1. Releases for rehabilitation

The present Guidelines consider the release of individuals for the sake of their welfare, or for rehabilitation from captivity, as primarily for the benefit of the released individuals; hence, such releases are outside the scope of these Guidelines.

Such releases may yield some conservation benefit, but equally they may cause harm. The risks are well-known to practitioners, and some are covered in other IUCN Guidelines[10]. It is to be hoped that the precautionary tone and treatment of risk in these Guidelines will help shape strategies for the release of rehabilitated animals, even though they are not the focus of these Guidelines.

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[8] http://www.iucn.org/about/work/programmes/species/our_work/the_iucn_red_list/.

[9] http://intranet.iucn.org/webfiles/doc/SSC/SSCwebsite/Policy_statements/The_IUCN_Policy_Statement_on_Sustainable_Use_of_Wild_Living_Resources.pdf

[10] For example, B.Beck et al. (2007). Best practice guidelines for the re-introduction of Great Apes. Gland, Switzerland, SSC Primate Specialist Group of the World Conservation Union; 48 pp. http://www.primate-sg.org/PDF/BP.reintro.V2.pdf

2. Population reinforcement for recreational or commercial offtake

Comparable situations arise where populations are augmented for purposes of recreational or commercial offtake. Again, the hierarchy of motivation should be considered, and often conservation benefit at the level of the population or ecosystem will either be non-existent or be secondary to other interests. But, the risks in translocation and release in such cases may also be precisely those covered in these Guidelines.

3. Mitigation translocations

'Mitigation translocation' is increasingly common, and may concern very large numbers of individuals; it involves the removal of organisms from habitat due to be lost through anthropogenic land use change and release at an alternative site. Permission for these development operations is often conditional on an obligation to mitigate or offset the impacts of the development. This is then claimed to be met by the translocation of individuals of key species from the site to be developed for release into further 'wild' sites.

Rigorous analysis and great caution should be applied when assessing potential future conservation benefits and using them to mitigate or offset current development impacts, in view of the inherent uncertainty regarding translocation success. Further, any mitigation proposal should follow the process of design and feasibility, implementation, monitoring and adaptive management of these Guidelines.

Under the translocation spectrum of Figure 1, circumstances will dictate the nature of the mitigation measure amongst these options:

1 If the translocated individuals are released into existing populations of conspecifics, then it is a reinforcement provided there is a conservation benefit for the receiving population; evidence shows that individuals released into established populations may experience very high mortality.

2. If they are released into empty habitat in indigenous range, then it is a reintroduction,

3. If released into empty habitat that could not qualify as within indigenous range, then it is a conservation introduction,

4. If released into an area that is definitively not habitat, it is an irresponsible release with no conservation benefit.

The first three options are covered under these Guidelines. The fourth option should not be allowed.

4. Removal for intensive protection

Organisms may be removed from their natural environment into conditions of intensive protection, as provided by zoological and botanic gardens and other dedicated facilities. Where conservation is a claimed motivation, this is usually a response either to progressive reduction in numbers with an increased risk of local or total extinction, or as emergency action in the face of sudden catastrophic threat or reduction in numbers.

Where the stated purpose is to protect and/or propagate such species until individuals can be returned to the wild, conservation benefit is clearly intended. But, entry into intensive protection is not regarded as a release, and the conditions usually experienced (such as limited space, controlled environmental conditions, breeding programmes) are beyond the scope of these Guidelines. Many relevant aspects are considered in other IUCN resources[11].

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[11] IUCN Technical Guidelines on the Management of Ex-situ populations for Conservation (2012 in preparation)

In contrast, any return of individuals from intensive protection back into natural conditions is a release and translocation; it should have conservation benefit, and will be covered by these Guidelines.

Least risk, least regret translocations

Much reintroduction experience has been with species that are naturally scarce or threatened, and/or are already declining, or are extinct locally or globally.

The wider range of conservation translocations is less focused on rare species. Assisted colonisation is most often viewed as a solution for species facing extreme threat from climate change, irrespective of their current conservation status.

Translocations of species that are neither naturally scarce or declining, nor with high probabilities of extinction are increasing, often as partnerships between local communities and conservation professionals, in which the principle motivation is the restoration of a component of local cultural heritage.

While such small-scale, community-driven restorations should be subject to all relevant formal regulations and legislation, like any translocation, they are likely to be relatively low-risk in terms of the cost of failure or the likelihood of extreme, adverse ecological impacts. These may be characterised as 'low cost, low risk, least regret' translocations. The Guidelines are equally applicable but, as they state, many of the recommended considerations around planning, feasibility and risk should have levels of effort proportional to the scale and nature of the intended translocation.

Annex 3: Deciding when translocation is an acceptable option

3.1 Introduction

1. Any proposed species translocation should be justified by identifying a conservation benefit and weighing any benefits against risks, while considering alternative actions that could be taken. Motivations such as experimenting solely for academic interest, releasing surplus captive stock, rehabilitation for welfare purposes, attracting funding or public profile, or moving organisms to facilitate economic development are not regarded here as conservation purposes.

2. Species or populations that have small or declining populations or ranges, and/or high probabilities of extinction, will often be prime candidates. The metrics used by the IUCN Red List status can be used to assess the potential need for conservation intervention.

3. While the ultimate aim of any conservation translocation is to secure a conservation benefit, this benefit may need long-term or permanent management support to persist. Such obligations and their cost implications should be included in any assessment of alternative conservation solutions (below).

4. Conservation priorities exist at the levels of species, biological communities and ecosystems for different purposes. Candidate species for conservation translocation might be accorded priority based on biological criteria such as their ecological role, their evolutionary distinctiveness or uniqueness, their role as flagship species, their degree of endangerment, or their potential as

ecological replacements. Translocations may be promoted on grounds of cultural heritage and its restoration but this alone is not conservation benefit. The pivotal criteria for justifying any conservation translocation will be situation- and species-specific.

5. Where species are extinct, consequent changes in the ecosystem can indicate a need to restore the ecological function provided by the lost species; this would constitute justification for exploring an ecological replacement.

3.2 Assessing extinction causes and threats

1. Any proposed conservation translocation should be justified by first considering past causes of severe population decline or extinction. There should be confidence that these past causes would not again be threats to any prospective translocated populations.

2. Threats need to be identified through all seasons and at appropriate geographic scale for the species, taking account of the species' biological attributes and life history.

3. During a species' absence, potential new threats to any restored population may have arisen.

4. All threats, direct and indirect, that might jeopardise attainment of the stated conservation benefit of the translocation should be identified and measures specified by which these threats would be mitigated or avoided.

5. The spatial extent of a threat should be considered. Threats causing local extinctions are often acute but controllable, but threats that operate over all or a large part of the species' range (such as pathogens, introduced predators or competitors, widespread land-use change, atmospheric pollutants and climate change) are more difficult to manage.

6. The severity of impact or sensitivity to a threat may vary with demography or life stage. Threat assessments need to consider the adaptive capacity of the focal species; this capacity will tend to be higher in populations with high genetic diversity, long-range dispersal and/or effective colonisation ability, short lifespans/high reproductive rates, phenotypic plasticity, and rapid evolutionary rates.

7. Threats can be biological, physical (such as extreme climate events), or social, political or economic, or a combination of these.

8. Threats may be inferred from anecdotal observations of conditions around the time of extinction, with subsequent rigorous testing of the anecdotes.

9. It is useful to consider multiple hypotheses for causes of extinction or decline and to test these based on the available evidence; where significant uncertainty exists, an experimental approach within the translocation programme can provide guidance for implementation.

10. A trial release may answer uncertainties such as the identity of past threats , but should only be contemplated where all formal requirements have been met, where consequences will be suitably monitored and will be used to refine further release design, and any unacceptable impacts can be mitigated or reversed.

3.3 Considering Alternatives

Many conservation translocations will yield conservation benefit only at high cost and with considerable risks. Therefore, irrespective of any conservation priority assigned to the species, any proposed translocation should be justified through comparison with alternative solutions, which might include:

1. Increasing habitat availability through restoration, connectivity, corridor establishment, or habitat protection (area-based solutions),
2. Improving the viability of extant populations through management interventions such as pathogen, predator or invasive alien species control, food provision, assisted reproduction, or protective fencing (species-based solutions),
3. A variety of tools including establishment of protected areas, changes in legislation or regulations, public education, community-based conservation, financial incentives or compensation to promote the viability of the wild populations can be valuable either on their own or in combination with area- or species-based solutions (s*ocial/indirect solutions),*

4. Doing nothing*:* inaction on behalf of a rare and declining species may carry lower risks of extinction compared to those of alternative solutions, and the focal species might adapt naturally where it is or adjust its range without human intervention *(no action*).

5. A conservation translocation may be used as one solution amongst these other approaches.

Annex 4: Planning a translocation

1. The goals, objectives and actions should take into account the commonly observed phases of development of successfully translocated populations:

- The Establishment phase starts with the first release and ends when post-release effects are no longer operating; these effects can include the effects of the translocation process, chance events in small populations, or a delay before reproduction occurs, all of which may slow initial growth.
- The Growth phase is often characterised by high rates of increase and/or expansion of range, continuing until the population approaches carrying capacity.
- The Regulation phase starts with the reduction in survival and/or recruitment due to increased population density.

2. The rates and duration of the Establishment and Growth phases will vary widely and be species-specific; they will influence the translocation flowchart (**Figure 2**).

Annex 5: Feasibility and Design

5.1 Background biological and ecological knowledge

1. Information on the biology and ecology of wild populations (if they exist) should be collected or collated from available publications, reports, species action plans and consultations with relevant species experts including both professional and amateur naturalists.

2. Background biological knowledge should cover aspects such as: reproduction, mating systems, social structure and behaviour, physical adaptations, individual growth and development, parental care, population dynamics in indigenous range.

3. Background ecological knowledge should include biotic and abiotic habitat requirements, intraspecific variation, adaptations to local ecological conditions, seasonality and phenology, dispersal, and interspecific relationships including feeding, predation, disease, commensalism, symbioses and mutualisms.

5.2 Models, precedents for same/similar species

1. Some type of modelling should be used to predict the outcome of a translocation under various scenarios, as a valuable insight for selecting the optimal strategy.

2. It is always useful to construct a basic conceptual model (for example, verbal or diagrammatic), and then to convert this to a quantitative model if possible.

3. Modelling and planning should be informed by data from previous species management activities including translocations of the same or similar species.

4. If data are not available for the species, inferences can be made from closely related sub-species and/or ecologically similar species.

5.3 Habitat

1. As habitats vary over space and time, species' ranges are dynamic. Environmental conditions will continue to change after species extinction. It is invalid to assume that former range will invariably provide suitable habitat.

2. It is insufficient to address only the causes of the original population decline as other threats may have emerged during any period of extinction.

3. It is essential to evaluate the current suitability of habitat in any proposed destination area.

4. Although the habitat requirements of large, generalist animal species may be easy to infer, this will not usually be the case with many taxa, for instance those with complex life cycles such as migratory species or invertebrates with larval stages.

5. A habitat assessment should include assurance of essential seasonal or episodic environmental variation.

6. The occurrence and severity of episodic or unpredictable events that are extreme and adverse for the species should be assessed.

7. The release area should be large enough to support the stated population targets. The effective habitat area will depend on the size and isolation of individual patches if the habitat is fragmented.

8. Given the prevalence of habitat fragmentation, conservation translocation designs may include increasing connectivity between habitat fragments to establish a metapopulation (a set of populations with some dispersal between them).

9. For some taxa, habitat quality and proximity to other sites may be more important determinants of habitat suitability than habitat patch size.

10. Achieving suitable habitat may require its restoration or even creation, or removal of alien or non-indigenous animals or plants that were a threat in the past to the focal species or would be a threat again for translocated individuals; any such removal should be done as humanely as possible and in a manner that causes minimum disruption to habitats or other species.

11. While no organisms should be released without assessment of habitat quality in the destination area, the level of effort expended on assessment should be proportional to:

- the scale of area likely to be affected by the translocation and subsequent establishment,
- the degree of certainty on the expected performance of the released organisms,
- the level of risk of undesired and/or harmful outcomes,
- the ability to reverse unacceptable outcomes.

12. Assessing habitat requirements will involve surveys of extant populations of the focal species if they remain in the wild. However, current range can be an unreliable indicator of habitat requirements if remnant populations have been forced into refuges of sub-optimal habitat.

13. The possible ecological roles of the focal species in the new environment should be carefully evaluated, with the particular concern that the conservation interests of other species and habitats will not be jeopardised by the translocation (**Section 6**).

14. Plants, fungi and invertebrates that are immobile for at least part of their life cycle, require microsite assessment potentially at the scale of centimetres; in contrast, large animal species living in extreme or unpredictable conditions will require areas that will vary unpredictably in size and location between seasons and years.

15. As even the most detailed habitat assessments may not capture the full range of environmental variation during the lifespan of individuals of the focal species, the loss through death or dispersal of translocated individuals in some sites or in particular years should be expected.

16. A candidate species may be linked with other species either through a shared ecological dependence or as providers of critical functions such as being a sole pollinator, a symbiont or host. Any destination area should be surveyed for the presence of any essential co-dependents of the focal species. It may then be necessary to translocate these essential species with the focal species; alternatively, species indigenous to the destination area may be able to assume these roles.

17. The release area and essential habitat for the translocated organisms should be secure from incompatible land-use change before the conservation goal is reached, and, ideally, in perpetuity.

5.4 Climate requirements

1. The climate requirements for the focal species should be understood and matched to current and/or future climate at the destination site.

2. The climate requirements of any candidate species for a conservation translocation can be assessed through measurement of key climate parameters in the species' current range; this should include the extent of climate variation tolerated by the species based on its distribution; the resulting bio-climate envelope can be used in models of predicted climate change to assess how the focal species might respond to scenarios of future climate; the results can be used to identify potentially suitable destination locations. However, the utility of this approach depends on many factors such as the availability and quality of data, spatial resolution and the climate change scenarios used[12]; in addition, the bio-climate model for a species with a small, remaining range will under-estimate the breadth of potentially suitable climatic conditions.

3. A climate envelope model should be supplemented by a study of other factors that might determine habitat suitability and distribution, such as the presence of essential or co-dependent species, the effects of predators, competitors, disease etc.

4. Any determination that an area is habitat for a conservation translocation should include reassurance that its climate is predicted to remain suitable for the reintroduced species for long enough to achieve the desired conservation benefit, acknowledging the uncertainties inherent in climate projections.

5.5 Founders

Genetic considerations

1. Any source population should be able to sustain removal of individuals/propagules, and removal should not jeopardise any critical ecological function, except in the case of an emergency or rescue removal.

2. If there is little genetic variation in source material used for translocations, there are two potential risks: the first is that reproduction between related individuals can lead to reduced vigour,

[12] http://www.iucnredlist.org/documents/RedListGuidelines.pdf

reproductive output and survival (inbreeding depression); the second is a lack of adequate genetic variation to enable survival and adaptation in the face of environmental change.

3. Such genetic problems can occur due to sampling a source population with low genetic diversity (typically small/ isolated populations), biased sampling of a single source population, genetic bottlenecks in the translocation process, and unequal survival, establishment and reproductive output in the destination area.

4. If founders originate from environments markedly different to the destination area, there is a risk of failure due to their being poorly adapted to the destination area.

5. If a translocation programme involves mixing populations, there is the potential for fitness costs associated with genetic incompatibilities between different lineages (genetic outbreeding depression). Predicting the situations in which genetic incompatibilities may occur is not simple, and the fact that problems may not become apparent for 2-3 generations makes pilot testing difficult. However, recent meta-analyses[13] provide useful working principles.

6. Taking individuals from multiple populations can increase the genetic diversity and decrease the risk of inbreeding depression in the translocated population. This is appropriate if outbreeding depression and/or (for animals) behavioural differences between the populations are considered unlikely.

7. More radical strategies involve greater geographical or ecological distances between source and destination sites, and/or greater mixture of source material from multiple populations.

8. Multiple sourcing aims to provide a balance between using primarily local/ecologically similar source material, and introducing decreasing proportions of genotypes with increasing geographical/ecological distance from any population at the destination site. This is designed to mimic the beneficial influx of 'useful' genetic variants from occasional long distance gene flow, without swamping out locally adapted variants. This approach is recommended for fragmented habitats in which either the fragments contain inbred individuals or their populations are considered unlikely to possess adequate genetic variation to respond to environmental change.

9. Predictive sourcing aims to introduce genetic diversity that will be adapted to the predicted direction of environmental change. The challenge is to introduce material adapted to future environmental conditions, without being so maladapted to current conditions that it suffers immediate fitness consequences.

10. A combination of multiple and predictive sourcing is a logical, but largely untested strategy for translocations in fragmented systems which are likely to suffer detrimental effects of climate change; it may be especially considered for conservation introductions.

11. The relative risks and benefits associated with the choice of source population(s) will vary depending on the goals and type of translocation and source population availability A species' life history traits are also relevant as they are major determinants of the amount and spatial distribution of a species' genetic variation. As the 'mixture approaches' to translocations essentially involve providing variable source populations upon which natural selection can act, such sourcing may result in increased mortality, with possible consideration for animal welfare.

5.6 Disease and parasite considerations

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[13] Frankham R et al. (2011). Predicting the probability of outbreeding depression. Conservation Biology: 25:465-475

1. Surveillance of source populations can establish the potential pathogen community present; individuals can then be selected for purposes of reintroduction or translocation, based on a risk assessment.

2. All aspects of the translocation process can cause stress-induced disease: the conditions and duration of any quarantine, inappropriate disease prevention protocols, poorly designed transport containers and methods of transport, extended time in transport, and lack of adaptation prior to transport can contribute to the occurrence of disease and mortality during the translocation process.

3. The possibility of infection through interaction with human, domestic animal or inanimate elements during the translocation process is always present and in practice unpredictable; effective biosecurity is, therefore, a requirement throughout.

4. Tools for management after release, such as feeding stations that concentrate or mix released and wild conspecifics, may promote the exchange of pathogens.

5. Pathogen risk assessment of translocated plants should include the possibility of infection through interaction with wild and domestic plants, disease vectors or inanimate components during the translocation process.

6. If an extinct host had parasites that also became extinct, then it is desirable from a restoration perspective to re-establish those parasites with the translocated host; but, this should be subject to especially rigorous assessment of the risks to the same or other species in the destination area; an apparently benign mutual relationship between host and parasite at source may change adversely for the host in the destination environment.

7. Translocations within geographical/administrative areas sharing diseases may not need extensive disease screening, but attention to managing infection threat should increase with the distance between source and destination sites.

Annex 6: Risk assessment

6.1 Assessing the risk landscape

1. Any translocation may fail to deliver desired results or have unintended consequences. The probability of achieving desired results is favoured by early identification of the risk factors that might be encountered across all aspects of the translocation. Risk is assessed as the likelihood of any risk factor occurring, combined with the severity of its impact. The range of possible risks comprises the 'risk landscape'.

2. A risk assessment should carefully consider all information on the species' biology, history of invasiveness in other geographical contexts (including closely-related species in the same genus), known pathogens or parasites, probability of potential impacts - including economic impacts, and available options for reversing those impacts. The risk assessment should take into account all sources of uncertainty and apply them at an appropriate spatial scale. In the case of translocations outside indigenous range, the risk assessment should include predictions of range expansion over various time periods.

3. A risk analysis should include assessment of the availability of necessary resources to cope with problems that emerge during the translocation, and the subsequent likelihood of meeting all regulatory requirements.

4. The uncertainty in risk assessment should be carefully considered, especially for translocations outside of indigenous ranges.

5. It should be stressed that current risk assessment protocols focus at the single species level, and require in-depth information on a species' ecology. Thus, these protocols are not fully applicable to assemblages of species, or to taxonomic groups for which information is limited.

Translocations with transboundary risk

1. Common duty and international law aim to prevent, reduce and control environmental harm to neighbouring countries, and to promote cooperation to manage transboundary environmental risks. States should carefully consider risks to neighbouring territories.

Decision making

1. The decision to proceed or not with a translocation requires weighing the potential risks against the expected benefits. This means assessing the probabilities that different outcomes may occur (either quantitatively or qualitatively), and placing values on those outcomes.

2. For example, if a proposed conservation introduction is deemed to have a high probability of success and have a low probability of undesirable impact on the destination ecosystem, it might still be the wrong option if the current functioning of that ecosystem is highly valued. If impact on the ecosystem cannot be predicted confidently, risks cannot be assessed adequately, and translocation should not be the preferred option in these circumstances.

3. The use of structured decision-making frameworks is recommended, so the logic, value judgements and knowledge gaps behind such decisions are clear to everyone involved.

Managing undesirable outcomes

1. Risk analysis should include an evaluation of options to reduce the risk of undesirable outcomes. The most obvious option is to remove the translocated population. However, this may be possible only at very early stages after establishment when undesirable effects may not yet be evident.

6.2 Risks to the source population

1. Where a translocation involves removal of individuals or propagules from existing wild populations, any potential negative impacts on the source population should be assessed.

2. If removal of individuals or propagules from a source population causes a reduction in its viability in the short-term, the translocation objectives should include balancing this with the expected gain in viability of the destination population, so that the species has a greater overall viability than without the translocation within a stated time period.

3. Translocations can affect not only the source populations of the focal species but may also have negative effects on associated/dependent species in the communities from which those individuals are removed.

4. It may be beneficial to use non-viable populations as sources of stock.

6.3 The ecological consequences of translocation

1. The ecological consequences of a translocation include those affecting both the translocated species and other species or ecological processes in the destination community.

2. The biological traits of a species in a source area may indicate its expected performance in a destination area; but species' responses may be different under the ecological conditions of the destination area due, for example, to a change of predators or parasites or a different level of competition, or to interactions with other species already present.

3. Translocated organisms will engage in any or many of the following ecological processes, irrespective of whether they are deemed desirable or undesirable, intended or unintended:

at the level of species/populations or ecosystem structure, these may include:

inter-specific competition and predation, hybridisation (intra- and inter-specific), disease transmission (pathogenic or vector/reservoir), parasitism, bio-fouling, grazing/herbivory/ browsing, rooting/digging, trampling, interaction with invasive species , and introduction of pathogens to the same species, other species, or humans.

at the level of ecosystem functioning, these may include modifications to:

hydrology, nutrient regimes, food webs, natural benthic communities, complete replacement/loss of habitat, physical disturbance, fire regime, successional patterns and soil attributes including erosion, accretion and structure.

4. The risks of undesirable effects increase greatly when a species is translocated outside its known range.

5. The complex and interacting negative effects of introduced species on biodiversity, human health, cultural values and ecosystem services may only become evident decades after introduction.

6.4 Disease risk

1. As it is not possible, despite all appropriate precautions, to ensure that translocated individuals of any species are completely free of all disease / pathogen risk, risk assessment should therefore focus on known pathogens in the translocation stock that are likely to have undesirable impacts on other organisms at the destination. Generalist pathogens with no known history at the destination are a particularly high risk.

6.5 Associated invasion risk

Where inadequate biosecurity protocols have resulted in further species being introduced with the translocated organisms, there is a risk of the former becoming invasive in the release area. If this happens, the benefits of the translocation may be insignificant compared to the damage done by the invasive species.

6.6 Gene escape

Intraspecific hybridisation

1. Where translocations involve reinforcement, or reintroductions close to existing populations, there is a risk of genetic swamping of the resident population(s) by the translocated individuals. This can potentially cause a reduction in vigour or reproductive success in a small, stable, resident population if a large proportion of the subsequent reproductive output is derived from the less well-adapted translocated stock.

Interspecific hybridisation

1. Translocation of a population into the close vicinity of a closely related species may result in inter-specific hybridisation which would not have occurred naturally. This is particularly likely in cases where a conservation introduction moves a species out of its extant range and overcomes natural geographical barriers to hybridisation with related species. In these situations, hybridisation can potentially threaten the genetic integrity / distinctiveness of the resident species, and in extreme cases extinction-by-hybridisation is possible.

6.7 Socio-economic risks

1. The risk assessment should cover the potential direct and indirect negative impacts on human interests:

- Direct effects on people and livelihoods such as potential or perceived dangers from released plants, animals and fungi, and the adverse public relations arising from any incidents,
- Indirect ecological effects that could threaten food supplies or ecosystem services such as clean water, erosion control, pollination, or nutrient cycling.

2. Any risk that the public in a source area might not accept the responsible removal of individuals as a necessary part of conservation benefit for the focal species should be addressed.

6.8 Financial risks

1. Where a translocated species causes significant, unacceptable consequences, such as its increase to damaging, pest status, the likely outcomes are:

- remedial costs may be very high,
- remedial costs cannot be met from project funds,
- funding for future conservation translocations is less likely.

Annex 7: Release and implementation

Many essential aspects of founder selection are covered under 'Biological feasibility – Founders' (**Guidelines Section 5.1 and Annex 5.5**). This section covers the specific and proximate factors that will shape founder demographics for maximum chance of successful release and establishment, and the variety of possible supportive management actions.

1. The most appropriate life stage for translocation should be identified.

2. The optimum number of individuals to translocate will vary from species to species and with the objectives of each translocation. The optimum number will be a trade-off between impact on the source population and reducing the risk of the founder population failing to establish because of random effects on a small population, and lack of genetic diversity.

3. Mortality in the translocated population may mean that the number of effective founders is considerably less than the number translocated.

4. While successful establishment of translocated populations often depends on the release of individuals in natural sex ratios and age classes (and social groupings in animals), it may be enhanced by deliberate bias in founder selection, for example either by increasing the proportion of individuals of breeding age or by favouring the proportion of juveniles; any such strategy will be specific to the species and circumstances.

5. Plant founder selection will be influenced by the age class most amenable to successful transplanting; plants have scope for releasing individuals as seeds, which have advantages and disadvantages: they can be easy to transport and can be obtained in large numbers. The use of seeds can facilitate experimental approaches to translocation by testing different management options. However, as seeds may have mortality rates of >90%, a mixture of seeds, juvenile and adult plants is often an optimal release strategy.

6. Population models can assist in determining the optimal strategy in terms of trade-offs between source and founding populations, and in the optimal selection of numbers and composition of founders. After initial release, information from ongoing monitoring can define the optimum number and size of further releases through adaptive management (**Annex 8.2**).

7. Where individuals are sourced from small and declining populations, their number, age and sex composition may be determined only by what is available.

8. The life history, ecology and behaviour of the focal species, together with any seasonality in essential resource availability, should guide scheduling of releases; species may have periods of development during which they are more predisposed to disperse, establish home ranges, have higher mortality, or breed.

9. Releasing individuals over several years may help to overcome inter-annual variation in climate and the occurrence of natural disturbances that occur infrequently but with severe results.

10. Releases at multiple sites will increase the chance of selecting favourable habitat, avoiding localised disturbance events, and may encourage development of local sub-populations.

11. Repeat releases at one site may allow newly released animals to learn survival skills from those released earlier, but the social or territorial behaviour of some species may discourage such repeat releases.

12. Low survival in released organisms can be due to a wide range of health, behavioural, or other ecological factors; diverse management options can contribute to higher post-release success.

13. Released animals should exhibit behaviours essential for survival and reproduction, and for compatibility with any conspecifics in the release area; it may sometimes be desirable to move groups of animals with their social relationships intact.

14. Animals can be behaviourally conditioned before release to avoid predators, or to develop predatory skills that may have been lost either over short periods or successive generations in captivity; this may be particularly valuable for socially complex species; where possible, practitioners should design experiments to determine the efficacy of conditioning techniques and/or to determine correlates between pre-release behaviour and post-release survival.

15. Pre-release treatment or medication can help to protect animals and plants from pathogens encountered after release.

16. Animals may be held for some period at the release site to allow them to accustom to local conditions or enhance social group cohesion; such procedures are most likely to be useful with captive-bred animals, but should never be assumed to be useful without evidence.

17. Rapid dispersal of animals from release sites is common, and may be linked to stress before or during the release process; such movements are also often associated with immediate post-release mortality and occasionally low reproductive rates; in contrast, a period of confinement at the release site can discourage translocated animals from returning to their source area.

18. Horticultural management can prepare plants for local conditions through modifying conditions such as irrigation, light levels and available nutrients.

19. During or following release, the provision of artificial caging, shelters or residences, or supplementary food and water can increase survival of plants and animals, but may also promote disease transmission through artificially concentrating individuals.

20. For some species such as invertebrates, amphibians or reptiles, 'head-starting' avoids the heavy mortality of young age classes in the wild; wild hatchlings are reared in protective enclosures before release at less susceptible size/age.

21. In various species, 'fostering' integrates captive-bred or orphaned eggs/wild young with offspring that are already being raised by wild-born parents; this may allow the translocated young to be fed by wild conspecifics and to learn behaviours and traditions that may be critical for survival.

Annex 8: Outcome assessment and continuing management

8.1 Survey / monitoring before release

It is desirable to collect baseline information on any area before releases into it. Without it, it is difficult to ascribe observed changes after release to the impacts of the released organisms.

The resources for pre-release survey are likely to be less than for post-release monitoring; hence, pre-release effort should focus on the species and ecological functions most likely to be affected by the translocation.

While the emphases of pre- and post-release monitoring may differ slightly, their methods and resulting data should allow direct comparison.

8.2 Monitoring after release

While post-release monitoring is an essential part of a responsible conservation translocation, the intensity and duration of monitoring should be proportional to the scale of the translocation (in terms, for example, of the numbers of organisms released, their ecological roles, the size of area affected) and the levels of uncertainty and of risk around the translocation results.

Demographic monitoring

1. Translocation objectives are often stated in terms of desired population sizes or probabilities of extinction within defined time frames (**Guidelines Section 4**). Assessing whether populations are likely to meet these objectives requires demographic models of populations, so the information from monitoring should be designed to allow choice between alternative models and model parameters. Monitoring can just involve estimating (or indexing) abundance, but predictions will be much more precise if data are collected on vital rates, such as survival, reproduction and dispersal.

2. Methods of estimating abundance include sample plots, with methods to account for incomplete detectability; indices of relative abundance or presence/absence surveys may be adequate, but only if objectives focus solely on the growth or spread of populations.

3. Estimating survival rates involves monitoring a sample of marked (or otherwise identifiable) individuals; incomplete detectability should be accounted for to avoid biased survival estimates, and it may also be important to avoid confounding death and dispersal; where it is difficult to mark or directly observe individuals, photo identification using natural markings or genetic monitoring (see below) may be appropriate.

4. Estimating reproductive success involves quantifying numbers of offspring or propagules produced, along with establishment rates of offspring in the translocated population; this requires field surveys to identify reproductive individuals, their breeding locations, and the fate of their offspring, especially their survival to reproductive age; alternatively, it may be adequate to estimate recruitment, for example through the number of new individuals entering the population per individual currently present.

5. Monitoring detail will be determined by the species' longevity and specific attributes such as age of first reproduction.

6. Monitoring should cover the entire area occupied by the translocated population.

Behavioural monitoring

Behaviours which can yield insights into the adjustment of translocated animals to the destination area include activity and movement patterns, foraging behaviour and diet selection, social organisation, breeding season and success.

Ecological monitoring

1. Ecological monitoring should be undertaken to record the ecological changes associated with the translocation, and to contribute towards the general knowledge basis for translocation feasibility and design. It is most unlikely that any translocated organism can attain its intended demographic targets without evident ecological impacts.

2. Ecological monitoring is also necessary to link changes in habitat, for whatever reason, to the translocated population's demography.

3. Unexpected consequences of a translocation should be detected and monitored to see whether their longer-term impacts will be neutral, negative or positive.

4. The appearance of unintended and undesirable adverse impacts following translocation may prompt radical changes of management or even reversal of the translocation (**Annex 8.3**).

5. Where a translocation purpose is to restore an ecological function, monitoring should include a focus on detecting and measuring the return of this function.

Genetic monitoring

1. Genetic markers can establish the proportion of genetic diversity that is captured from the source populations and whether this diversity is maintained in the transition to the established population at the release site(s). Tissues taken and stored in the early stages of a translocation programme can be a cost-effective resource for future evaluation of genetic change.

2. In well-resourced projects, genetic monitoring may also be used to make demographic inferences, such as insights into the number of adults contributing to subsequent generations, the extent to which translocated individuals in reinforcement are contributing genes to the resident population, and for gaining general insights into behavioural ecology or population size.

Health and mortality monitoring

1. Monitoring can assess whether there are unacceptably high levels of disease/adverse welfare/mortality which will impact on the success of the translocated population, or which may present a threat to any neighbouring populations; however, if recapture is needed for this purpose, it may only exacerbate underlying problems.

2. Identifying the causes of death accurately and precisely can be critical in assessing translocation progress and indicating the challenges facing the establishing population.

Socio-economic and financial monitoring

1. The socio-economic and financial impacts of any translocation should be monitored, especially in a conservation introduction.

2. Where such impacts are undesirable and unacceptable, monitoring results can prompt changes in management or an exit strategy (**Annex 8.3**).

8.3 Continuing management

1. Monitoring information enables managers to assess whether objectives are being met according to schedule. This information can then be used both to adjust any ongoing management of the current population and, more generally, to contribute to the design of other translocations.

2. Adjustments may involve increasing or decreasing the intensity of management or changing the type of management. For example, if a translocated population failed to grow despite ongoing management, it might make sense to increase the intensity of that management. Alternatively, it might be better to try a different management option or even discontinue management and relocate the remaining individuals elsewhere. If monitoring indicated the translocated population was having undesirable impacts, this could potentially lead to a decision to control or remove the population or conduct other management actions to lessen these impacts. The decision process should be transparent, and reflect current understanding of the population's dynamics and impacts, the values placed on different outcomes by all people involved, and the cost of management options.

3. Although decisions need to be made, it is essential to acknowledge the uncertainty in population predictions. There are two sources of uncertainty in these predictions. First, populations

are subject to random variation due to chance fates for individuals (demographic stochasticity) or to environmental fluctuations (environmental stochasticity). Second, understanding of populations is always limited, and decisions should be supported by inclusion of the assumptions behind them and the extent of uncertainty in biological knowledge of them.

4. A key benefit of monitoring is that it allows practitioners to progressively improve understanding and therefore develop more accurate models for further predictions and objective setting. This is especially useful when original objectives cannot be met due to factors beyond management control. This process of learning from management results is called "adaptive management". However, adaptive management does not mean merely adjusting management following monitoring; it means having clear models in place in advance that are then evaluated against monitoring results. It is sometimes appropriate to manipulate management actions deliberately to gain knowledge, a process known as "active adaptive management". For example, if a translocated population is growing at the target rate under a management regime, it may make sense to temporarily discontinue the regime to ensure it is necessary.

Annex 9: Dissemination of information

1. Dissemination aims to ensure that maximum information around a conservation translocation is available in timely and suitable fashion to target audiences. Hence, communication should start at the planning stage, followed by reporting on progress at key stages of the project, and with this information disseminated to all parties involved.

2. Effective communication of information through the course of a conservation translocation serves the following purposes:

- It prevents conflict with interested parties in both source and destination areas, and generates trust that any translocation is undertaken with integrity and without hidden motives (the corollary is that retrospective management of negative interactions can be costly and damaging to the translocation),
- It allows the evaluation of success whilst translocation is actively implemented, and should provide a lasting record of methods, monitoring and results that contribute to retrospective evaluation and comparison with other translocation attempts,
- Dissemination of results is often part of statutory or contractual requirements,
- It contributes to assessments of species' status by providing data on survival and range,
- It provides a lasting record of the origins of any population of the translocated species.

3. Mechanisms for communication should be relevant to the intended audience, but should include several of the following platforms; use of these may be combined with consultative processes:

- Internet resources, social media, presentations at venues around the release area,
- Publication mechanisms of statutory bodies which should be publicly accessible unless good cause is given for maintaining confidentiality.
- Publication mechanisms of non-governmental organisations where these are made publicly available.
- Databases of translocations kept by statutory bodies or non-governmental organisations.
- Meta-analyses of conservation translocation success across major taxa.

- Publication in peer-reviewed media confers an assurance of quality, and permanent, formal citation; this allows publications to be sourced and become a resource for any subsequent evidence-based, systematic reviews.

4. Information should be disseminated in languages and formats best suited to serve essential and interested parties and organisations.

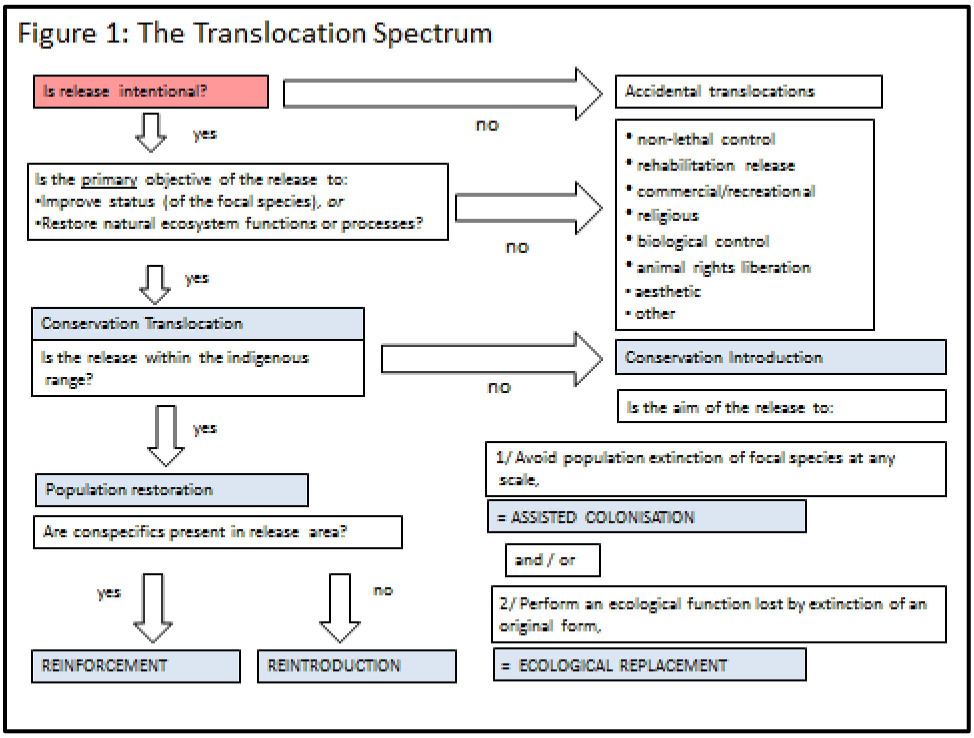

Figure 1: The Translocation Spectrum

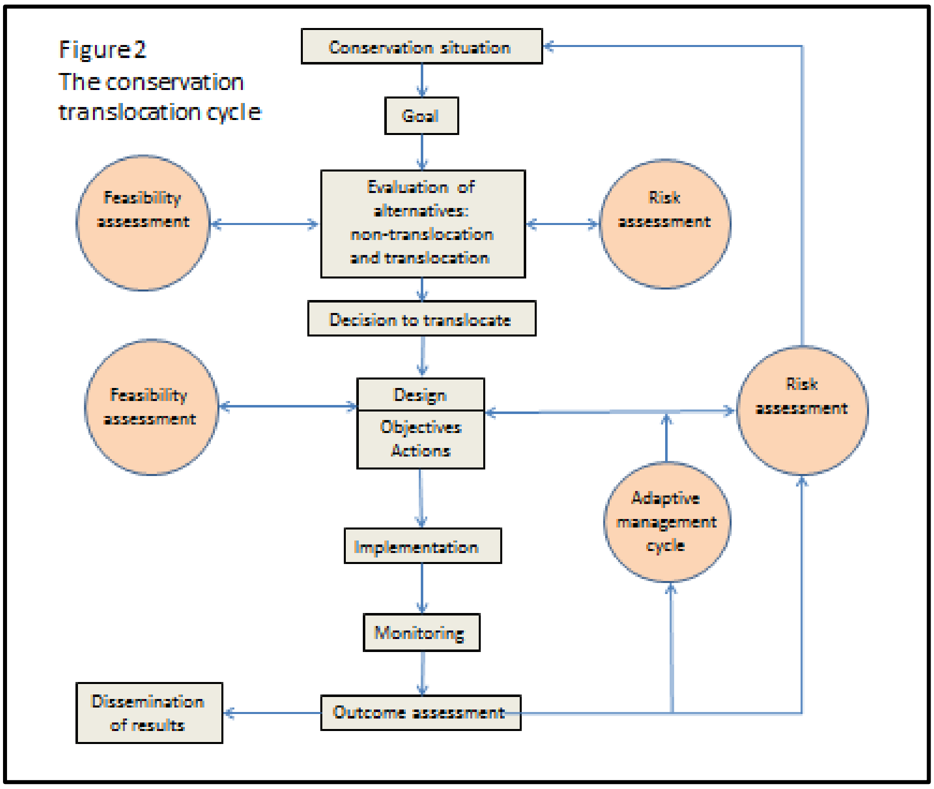

Figure 2
The conservation translocation cycle