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Best Practice Guidelines for the Re-introduction of Great Apes

Edited by Benjamin Beck, Kristina Walkup, Michelle Rodrigues, Steve Unwin, Dominic Travis et Tara Stoinski

Series Editor: E.A. Williamson

Occasional Paper of the IUCN Species Survival Commission No. 35

SSC
Species Survival Commission

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Section I
Executive Summary

Re-introduction is one tool for conserving great apes and their natural habitats. These guidelines adapt other IUCN documents to pertain specifically to the re-introduction of great apes. The adaptation is justified by alarming declines in great ape populations and the destruction of their habitats, and because great apes are biologically and cognitively specialized and advanced, and generate particular animal welfare concerns.

The re-introduction process should begin by the appointment of a multidisciplinary specialist advisory team. The project manager should write a detailed proposal stating the project's background, objectives, methodology, schedule and budget addressing each of the subsequent steps listed below. The proposal should include quantifiable measures by which the project's success can be assessed. The proposal should be reviewed by the advisory team and by external reviewers.

Re-introduction should be guided by the Precautionary Principle: re-introduction should not endanger resident wild ape populations and their ecosystems. There must also be concern for the health, welfare and security of individual apes. Likewise there must be concern for the health and security of staff working with the apes and for people living near the release site.

There should be a complete review of the ecological, behavioural, developmental and cognitive biology of the taxon, as well as a medical risk assessment specifically tailored to the proposed move.

The release site should be within the historic range of the taxon to be re-introduced, and include sufficient suitable habitat to support a self-sustaining population. (There is provision for introduction outside of historic range and/or into marginal habitat under specific conditions.)

The original causes of decline of the taxon in the area should have been addressed and resolved.

There should be secure long-term financial support for the project, and approval from all relevant governmental and regulatory agencies. The re-introduction should be endorsed by local governments and people living near the release site. Local residents should be given preferential access to employment opportunities created by the project.

The individuals to be re-introduced should be assessed behaviourally, physically and genetically to ensure that they are suitable, and likely to survive re-introduction. Individual apes with significant deficits in survival-critical knowledge and skills should not be re-introduced without sufficient rehabilitation and post-release support to compensate.

Orphan infants may need physical and emotional support, including clinging and being carried, while they are learning how to live in the forest. Photo ©Purwo Kuncoro.

The individuals to be re-introduced must be medically screened and examined, quarantined, treated, vaccinated (where appropriate), and cleared for release, under the supervision of or in full consultation with a qualified veterinarian with great ape experience.

Each ape should be permanently identified and have secured individual medical and behavioural records.

There must be an occupational health programme for staff working with great apes before and after release. The programme should include training on zoonotic disease, and sound, hygienic husbandry practices.

There should be a detailed transport and release plan and thorough preparation of the release area prior to moving any apes into the area. The plans should be completely understood by all parties involved.

There should be a securely funded programme for post-release monitoring that includes behavioural and ecological observations and veterinary surveillance. Monitoring of all or at least a representative sample should continue for at least one year.

There should be a clearly understood plan for intervening in post-release outcomes, for example, treating an injured ape, and for responding to post-release human-great ape conflict.

There should be a plan to document and disseminate the outcomes and cost-effectiveness of the re-introduction project, using quantifiable measures of success as stated in the original proposal. The documentation of outcomes should be used to evaluate, and change if necessary, the project's methodology. There should be periodic external evaluation of the project's outcomes.

Section II
Context of Guidelines

The IUCN/SSC Primate Specialist Group *Best Practice Guidelines for Great Ape Re-introduction* is intended as a guide to assist great ape re-introduction programmes. Great apes include bonobos (*Pan paniscus*), chimpanzees (*Pan troglodytes*), gorillas (*Gorilla gorilla* and *G. beringei*), and orangutans (*Pongo pygmaeus* and *P. abelii*). The priority has been to develop standards that are of direct, practical assistance to those planning, approving, funding, or implementing re-introductions. But the guidelines are mainly lists of "what to do" rather than detailed explanations of "how to do it". The primary audience of these guidelines is the re-introduction practitioner.

The Section on Great Apes of the IUCN/SSC Primate Specialist Group was established in 2004 in response to alarming decreases in great ape populations. Although the IUCN *Guidelines for Re-introductions* (1998), the IUCN *Guidelines for the Placement of Confiscated Animals* (2002), and the IUCN *Guidelines for Nonhuman Primate Re-introductions* (2002) cover key issues regarding re-introductions, these are more general documents, the first applying to both plants and animals (see Key References, pp. 31–32).

Thus the Section on Great Apes determined that the more general *Guidelines for Re-introduction of Nonhuman Primates* (see p. 31) should be adapted specifically for great apes. Great apes have relatively large brains and highly specialized cognitive abilities, which are related to long gestation, lengthy periods of immaturity and behavioural development, dependence on learning for acquisition of survival-critical behaviours, and a long lifespan. They live in complicated social systems, and social learning is common. For a mammal, great apes mature sexually quite late in life, and have long interbirth intervals. These life history traits slow post-re-introduction population growth, thus making survival of every re-introduced individual especially valuable. The special cultural and conservation uniqueness of great apes is evidenced by current efforts to list them as World Heritage Species. In part this is due to great apes being the living forms most closely related genetically to humans, and most similar in terms of cognition, morphology, reproduction, and many aspects of social behaviour. All of this contributes to a heightened awareness of animal welfare issues involving great apes. Some favour extending human rights and personhood to great apes, which introduces a unique sensitivity for re-introduction.

While *Guidelines for Re-introduction of Nonhuman Primates* is the basis for this document, we have changed content and organization based on the suggestions of reviewers. The great ape guidelines were additionally based on current IUCN policy documents, a review of case histories, and consultation across a range of disciplines. The draft was reviewed by re-introduction practitioners, primatologists specializing in development, behaviour and ecology, and veterinarians with ape experience. Comments were received from 32 reviewers, and each comment was evaluated. Changes were made accordingly. Where there was no consensus on an issue, the final document provides no firm guideline on the issue, and the spectrum of viewpoints is described.

Great ape re-introduction projects should be conducted in accordance with the following IUCN policy documents: *IUCN Guidelines for Re-introductions* (1998), IUCN *Guidelines for Nonhuman Primate Re-introductions* (2002), *IUCN Guidelines for the Placement of Confiscated Animals* (2002), *IUCN Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species* (2000), *Translocation of Living Organisms* (IUCN Position Statement 1987), as well as the CITES Resolution for the disposal of confiscated live animals (CITES 1997).

It is important that these guidelines are implemented in the context of IUCN's broader policies pertaining to biodiversity conservation and sustainable management of natural resources. The philosophy for environmental conservation and management of IUCN and other conservation bodies is stated in key documents such as *Caring for the Earth* and *Global Biodiversity Strategy*. Other valuable resources are the IUCN/SSC Primate Specialist Group's Action Plans for Africa and Asia. A principle source for this document has been the *World Atlas of Great Apes and their Conservation* (Caldecott and Miles 2005) and an exhaustive review of the literature on ape re-introduction. Other useful companion sources are *Orangutan Reintroduction and Protection Workshop: Final Report* (Rosen, Russon and Byers 2001), *Orangutan Conservation and Reintroduction Workshop: Final Report* (Rosen and Byers 2002) and *African Primate Reintroduction Workshop: Final Report* (Carlsen, Cress, Rosen and Byers 2006).

The *Best Practice Guidelines for Great Ape Re-introduction* covers the main steps of a re-introduction effort. The steps are listed in a suggested order of execution in the Executive Summary. Managers of projects that have already begun should attempt to integrate the guidelines as soon as possible into their current operating procedures and protocol.

Because re-introduction projects are often restricted by such factors as location, resources, and government regulations, this document is meant as a "best-practice" model, or an ideal code of conduct. Re-introduction managers are strongly encouraged to use this document as their principal guide to ape re-introductions.

It is important for planners to recognize that, for all taxa, most re-introductions cannot be categorized as successes (Griffith, Scott, Carpenter and Reed 1989; Beck, Rapaport, Stanley Price and Wilson 1994). This confers extra responsibility for the careful planning and conduct of ape re-introduction projects, which are apt to be particularly difficult.

These guidelines assume that the apes in question are being held legally in their country of origin. Great apes being held illegally outside of their country of origin should be repatriated to their country of origin if the authorities wish to have them returned and there is a suitable facility available to receive them. Once repatriated, they can be considered for re-introduction using the procedures described below.

Because there are considerable differences between ape taxa and individuals, even a set of guidelines for great apes might be too broad. Where the guidelines include quantitative data such as age landmarks and home range sizes, programme managers and other stakeholders are expected to customize the quantitative values for the ape taxon and individuals with which they are working.

Inclusion of references for every conclusion and recommendation would make the document too long and difficult to read. Specific references are included only where reviewers suggested they would be especially appropriate. An extensive bibliography is included.

The latest release of the *IUCN Red List of Threatened Species* lists 12 subspecies of great apes, of which nine are endangered, and three are critically endangered. Because primate taxonomy is rapidly changing, the IUCN/ SSC Primate Specialist Group recommends that the primate "unit of conservation action" should be the lowest-named taxon, which includes a population or subspecies

Chimpanzee at Ngamba Island Sanctuary. Photo ©Serge Wich.

and not just currently recognised species. Re-introduction managers and others involved in ape conservation should thus recognise and work toward the conservation of all named taxa of great apes.

Because most great ape taxa are facing extinction in the wild, conservation measures such as habitat protection, ecosystem restoration, and law enforcement are underway, with varying degrees of success. Re-introduction is an additional measure. Several facilities in Africa and Asia have conducted or are planning great ape re-introductions or translocations, with some projects already well established.

Note that details regarding the care of great apes held in captivity prior to release, such as enclosure enrichment, are not covered in detail in these guidelines, except as they pertain directly to re-introduction. However, where appropriate, important points regarding these topics are noted, and references for the Husbandry Manuals of the North American Association of Zoos and Aquariums, the IPS *International Guidelines for the Acquisition, Care and Breeding of Nonhuman Primates* (2007) and other key references are provided. Additional references on husbandry can be found in the bibliography.

Some great ape re-introduction projects have been criticised for not adhering to proper standards for veterinary clearance, tourism management, and prevention of ecological risks to wild conspecifics. Although the issues involved with re-introduction can vary greatly depending on the taxon and region, general guidelines do apply. Developed in response to the increasing occurrence of and interest in great ape re-introduction projects, and thus the growing need for specific policy guidelines, this document will help ensure that such re-introduction efforts achieve their intended conservation and welfare benefit without causing adverse side effects of greater impact.

Section III
Definition of Terms

Re-introduction and Related Approaches

Re-introduction: An attempt to establish a species in an area which was once part of its historic range, but from which it has been extirpated or become extinct. “Re-establishment” is used to indicate that the re-introduction has been successful, i.e., a self-sustaining population has been established. “Re-introduction” is considered synonymous with the Americanized “reintroduction.”

Note: *For the purpose of this document, unless stated otherwise, “re-introduction” is also used to refer to any of the following related approaches:*

a. ***Translocation:*** the deliberate movement of wild great apes from one natural habitat to another for the purpose of conservation or management.

b. ***Reinforcement/Supplementation:*** the addition of individuals to an existing population of conspecifics (“re-stocking” is a synonym).

c. ***Conservation Introductions:*** the introduction of an ape taxon, for the purpose of conservation, outside its recorded known distribution, but within an appropriate habitat and eco-geographical area. This is an acceptable tool only when there is no suitable habitat remaining within an ape’s

historic range. Because of the risks associated with introducing a non-native species into an area, this approach should be considered a last resort.

d. ***Substitution:*** the introduction of a subspecies closely related to another subspecies that has become extinct in the wild and in captivity. The introduction occurs in suitable habitat within the extinct subspecies' historic range.

e. ***Rescue:*** the movement of wild great apes from one area to another to rescue them from a hazardous situation or to resolve conflicts with humans.

f. ***Welfare Re-introduction/Introduction:*** the release of captive great apes, either within (Re-introduction) or outside (Introduction) their historic range where there is evidence to indicate that their welfare would be improved.

Re-introduction Strategies

Soft Release Strategy: Great apes are held in enclosures at or near the re-introduction site prior to release, to assist them in adjusting to their new environment. Post-release support, such as supplemental feeding and protection from predators, is usually provided.

Hard Release Strategy: Great apes are not held in enclosures prior to release, except during transport. Apes are immediately released at the re-introduction site, and generally there is no post-release support.

In reality, hard and soft are not strictly dichotomous but represent extremes of a continuum.

Source Populations

Captive-born: Great apes born in captivity. Currently there is little scientific justification for re-introducing captive-born great apes, except those born in range country sanctuaries to parents awaiting re-introduction (see p. 13).

Wild-born: Great apes born in the wild (natural habitat) to free living parents.

Captive: Great apes held in captivity, such as in enclosures, private homes, or semi-wild environments, for a prolonged period. Captive stock can be wild-born or captive-born.

Mixed Wild/Captive: Captive social groups comprising both wild-born and captive-born great apes. The aim is usually to promote survival of the captive-born apes after re-introduction by exposing them to wild-borns that presumably have learned some survival-critical skills and can socially transmit them to the captive-borns.

Related Terms

Rehabilitation: the process by which captive great apes are treated for medical and physical disabilities until they regain health, are helped to acquire natural social and ecological skills, and are weaned from human contact and dependence, such that they can survive independently (or with greater independence) in the wild.

Sanctuary: A facility whose primary purpose is to provide security and humane care for captive great apes, for as long as is necessary. Most sanctuaries for great apes are within the range country of the taxa they hold. Some sanctuaries have programmes to rehabilitate and re-introduce at least some of their apes. Some sanctuaries have visitation and public education programmes, and some have non-invasive research programmes.

Section IV
The Precautionary Principle

Precautionary Principle: Protection of Wild Populations is Always the Priority

With the re-introduction of great apes, there is always a level of risk to the released individuals, indigenous wild populations if they exist, and their habitats. Consequently, this "precautionary principle" should guide all re-introduction efforts. "Re-introduction should not endanger resident

wild great ape populations by threat of communicable disease, unintended hybridization, extreme social disruption, crowding, or exaggerated resource competition. Re-introduction should not endanger populations of other interacting native taxa, or the ecological integrity of the area in which they live. The conservation of the taxon as a whole, and of other great apes already living free, must take precedence over the welfare of individual apes in captivity."

Section V
Planning and Preparing for Re-introduction

Identify the Need for Re-Introduction: Define Project Objectives, Prepare Proposal, and Establish a Multidisciplinary Team

Before initiating any re-introduction project, managers must clearly define its purpose(s). **The main objective of any re-introduction effort should be to establish self-sustaining populations of great apes in the wild by re-establishing an extinct wild population or supplementing a wild population that is under carrying capacity or not viable.** This may include re-establishing a flagship species in an ecosystem, maintaining or restoring natural biodiversity and key ecological relationships, and enhancing genetic variation of a taxon. Secondary objectives can include promoting conservation awareness, enhancing psychological or physical well-being for individual apes, enhancing protection and law enforcement efforts, and/or, when the following guidelines can be followed, freeing up sanctuary space. If secondary objectives conflict with the primary objective, they should never take priority over it.

Conservation introductions (see definition, p. 4) or rescue/welfare releases (see definitions, p. 5), may have a different primary objective. However they should adhere to these guidelines as closely as possible. Projects that address the welfare of individual apes must also consider the conservation of the species as a whole.

When done correctly, great ape re-introduction is usually very complex and expensive. Each re-introduction proposal (see below) should be rigorously reviewed on its individual merits. In the planning stages, it should be considered whether available funds might be better used to finance protection efforts of current wild populations and their habitats, to intensify law enforcement, and/or to expand sanctuary capacity in the country of origin. At the very least, re-introduction managers should seek funding that would not otherwise be available for such protection efforts. The benefits of a re-introduction project should outweigh the benefits of alternative conservation and protection measures for current wild populations (where those measures have a high likelihood of implementation and success), as well as outweighing the risks involved. In all cases, re-introduction must aim to be an effective component of an overall conservation scheme or an alternative to other ineffectual conservation efforts. However a rescue may be necessary, and be the only option, in an environmental emergency.

Great ape re-introductions should have approval from all relevant governmental and regulatory agencies. For example, by current governmental decree, Indonesian orangutans should not be re-introduced into areas with an existing wild orangutan population or connected to other forests that contain orangutan populations.

While tourism involving re-introduced great apes might raise needed revenue and promote conservation awareness, it has also been associated with introduction of communicable diseases, interference with adjustment to life in the wild, habituation to humans, and physical risks to both human and nonhuman apes. For these reasons, tourism involving re-introduced great apes or great apes eligible for re-introduction is at a minimum discouraged for orangutans and bonobos and strongly counter-indicated for chimpanzees and gorillas because of the possible aggressive nature of these two species. At the very least, tourism should be deferred until the re-introduced apes are well adapted to life in the wild, and should be carefully planned and monitored. If a great ape(s) is re-introduced to a group already being used for tourism, then tourism should be suspended until the re-introduced individual(s) are well adapted to life in the wild.

Re-introduction should be undertaken only if the original causes of decline of the taxon in the re-introduction area have been addressed and are not likely to recur.

Re-introduction requires a multidisciplinary approach involving a team of specialists from various backgrounds and areas of expertise. The team should include primatologists (particularly primate behaviourists and ecologists), animal care experts, veterinarians with ape experience, and representatives from governmental natural resource agencies, nongovernmental organizations, local communities, and funding bodies. Project leaders should be responsible for coordinating among the various bodies and ensuring full host country support. Re-introduction practitioners are strongly encouraged to contact the IUCN/SSC Re-introduction Specialist Group (RSG, see Key Contacts, pp. 43–44) to present and discuss their re-introduction proposals (see below) and results. In this way, a network of contacts can be developed and information from various projects shared.

Every re-introduction project should have a comprehensive, written proposal addressing every one of these guidelines that apply to the work. The proposal should include detailed accounts of objectives, methodologies, schedule, and budget. Outcomes of the re-introduction project should be stated as *a priori* hypotheses, data should be collected and analyzed, and outcomes published or otherwise widely disseminated. Any of the above objectives that is stated as a goal of a particular re-introduction project should be viewed as an opportunity and a responsibility for scientific documentation and validation. There are many intuitive opinions about re-introduction, but these should be systematically tested rather than uncritically accepted. Project proposals should be completed and peer-reviewed well before the releases are conducted. Proposals can be used to secure funding and government approvals, used as a blueprint to guide daily programme activities, and can be reviewed by peers to strengthen the plan and increase the probability of success. The proposal can be sent to the Re-introduction Specialist Group for review and endorsement. Annual progress reports should likewise be prepared and distributed widely.

Each re-introduction project should develop written protocols that apply specifically to its taxon, region, regulatory and legal structure, and other opportunities and constraints. These customized documents should be updated over time and eventually result in a re-introduction manual for the taxon of interest. These documents would directly relate to these guidelines ("what to do"), but would also include detailed explanations of "how to do it". Cumulatively, these customized documents would constitute a manual of great ape re-introduction biology.

Previous re-introductions of the same or similar taxa should be thoroughly researched. Contact should be made with people and organizations having relevant expertise, particularly the IUCN/SSC Re-introduction Specialist Group or the Pan African Sanctuary Alliance (PASA), prior to and while developing the re-introduction protocol. Short and long-term success indicators and predictions of project duration should be identified, in the context of the agreed-upon aims and objectives. Possible outcomes, favourable and unfavourable, should be anticipated, and responses formulated for each unfavourable outcome, which should be included as part of the proposal.

Determine if the Proposed Release Site is Within Range and Has Suitable Habitat

Re-introduction (within historic range)

The release site should ideally be within the taxon's historic, documented range. Because situations vary among ape taxa, interpretation of historic range should be made on a case-by-case basis with the help of experts in primate distributions and systematics. There are spatial and temporal aspects to historic range determination. Documented observations of occurrence of living individuals of the taxon, and recovered remains, are the bases for the spatial determination. In some cases, for example, orangutans in mainland Asia, historic range is not the same as recent distribution. Wild orangutans have been absent from mainland Asia for at least 500 years (Rijksen and Meijaard 1999). There are no guidelines about the maximum time a taxon has been absent from its historic spatial range in order to conclude that the area can no longer be considered historic range for purposes of re-introduction.

When suitable habitat within historic range is available, previous causes of a taxon's decline in the proposed re-introduction area must be identified and eliminated, or reduced to a level that no longer threatens the taxon. Such causes may include disease, hunting pressure, human-ape

conflict, pollution, poisoning, competition with or predation by other species, habitat loss, adverse effects of earlier research or management programmes, or a combination of these.

The vulnerability of the habitat and regulations governing the release site must be known and evaluated. For example, some release areas are in well-protected national parks, while others are on private land. The release area and the wildlife within should have reasonable assurances of long-term protection, which, given the longevity and generation time of great apes must be measured in decades.

Re-introduction sites should in part be selected based on maximum distance from human habitation and minimal human activity and use, in order to minimize ape-human conflict.

When the taxon of interest has been extirpated from the potential release site, the possibility of a habitat change having occurred since extirpation must be considered. The introduction of non-native species that may have altered the habitat to such a degree as to affect released apes must be evaluated. Likewise, any change in the legal/political or cultural environment needs to be identified and evaluated.

If any native species has filled the void created by the loss of the great ape taxon concerned, the effect the re-introduced taxon might have on the ecosystem must be investigated. Although a re-introduction is likely to disrupt established species to some degree, the re-introduction should not cause extinction of the replacement species.

Where a release site has undergone substantial degradation caused by human activity, a habitat restoration programme that provides at least all critical resources should be initiated before re-introduction. If such a restoration effort is not possible, and a site with suitable habitat is not available elsewhere, the re-introduction should be cancelled or a decision should be made to re-introduce in marginal habitat. If the latter is chosen, indefinite provisioning with food and water, and active population management of the re-introduced apes is likely to be necessary until such time as the habitat has recovered or returned to its former state. Provisioning has been dangerous to staff and could limit ranging of the re-introduced apes.

Timing of the release may be as important as selection of the release site itself. To assist managers in determining the ideal time of year for release, studies of seasonality of climate and vegetation of the proposed release site, including seasonal availability of water and foods (phenology studies) preferred by the great ape taxon of interest, are recommended.

Islands in rivers or freshwater lakes are considered to be within historic range if one of the adjacent river banks is within the known historic range, even if great apes were never documented on the island itself. Islands in an ocean are considered to be within historic range if the shoreline is within known historic range and the island is within 1 km of the shoreline (arbitrarily chosen as the maximum distance that great apes might cross naturally by rafting or walking during extreme low tides). The ecosystem of an island is certain to be impacted by re-introduced great apes; habitat restoration and ecosystem management may be required. Indefinite provisioning with food and water, and active population management is likely to be necessary on islands smaller than 500 ha and/or with densities of more than 0.1 individual per ha (based on experiences with chimpanzees in Africa; density might vary with ape taxon and age/sex distribution). This would not be a self-sustaining population, and the “re-introduction” might better be characterized as a semi-naturalistic sanctuary. An island would probably have to be at least 50,000 ha to support a self-sustaining population. Islands smaller than 5 ha are not likely to support a great ape population of any size, even given intense provisioning. In some cases environmental impact might dictate that a particular island is not appropriate for ape re-introduction.

Re-introductions should take place only when the taxon’s habitat requirements are satisfied and likely to be sustained for the foreseeable future. Bornean orangutans and chimpanzees are known to be able to survive in partially cleared forests, at least for short periods. Some individual great apes have been able to survive in marginal habitats with intensive support. Re-introduction managers should consider such data on the taxon of interest when evaluating release sites.

Carrying capacity must be determined, or at least scientifically estimated. The release site should be sufficient to sustain growth of the re-introduced population and support a self-sustaining population in the long run, particularly if there could be a major population expansion. Adequate ranging

space for solitary, dispersing individuals (such as solitary male gorillas and sexually mature male orangutans) must also be taken into account. Habitat restoration/improvement programmes can be implemented to increase carrying capacity, and habitat corridors can be established to connect the release site with other patches of suitable habitat.

Growth of the released population should be modelled under various sets of conditions to specify the optimal number and composition of individuals to be released, in total and per year, and the number of years necessary to promote establishment of a viable population. The optimal number of apes to be released per year may have to be modified in light of the number of apes ready for release and the social behaviour of animals already present on site (wild or previously released). When data are available, a Population and Habitat Viability Analysis (PHVA) may aid in identifying environmental and population variables and assessing their potential interactions, which would guide long-term population management. Reversible or irreversible contraception should be used in some circumstances. (For information on PHVA, contact the IUCN/SSC Conservation Breeding Specialist Group (see Key Contacts, pp. 43–44).

With a reinforcement project, the resident great ape population's size relative to carrying capacity and density, habitat use, and social structures must be determined to assess the potential for crowding, social disruption, and resource depletion.

Reinforcement should be undertaken only if the resident population is unlikely to be self-sustaining, because reinforcement presents a risk of disease transmission, social disruption, and introduction of alien genes to wild populations. An exception would be to return a infant or juvenile who has been through medical screening to its natal group.

Chimpanzees, gorillas, and orangutans are known to attack unfamiliar conspecifics. Chimpanzee and gorilla re-introductions in particular are less likely to be successful if there is a resident population. Thus, surveys to confirm or disprove extirpation should be conducted prior to release. Given their social structures, males are more likely to be attacked than females. Natural barriers may be utilized to prevent unwanted contact between released individuals and wild populations.

An analysis of available food resources and seasonal variations in food availability in the release site should be made to confirm the presence and availability of foods consumed by wild populations of the taxon of interest. Much of this information is already summarized in published catalogues. Certain species are more adaptable than others to changes in diet, so each taxon's dietary requirements must be considered. Re-introduction managers should be mindful of inter-population differences in food preferences and food processing techniques, which have been demonstrated for chimpanzees and orangutans. Re-introduction managers should also provide captive apes

Three female sub-adult western gorillas approaching the end of their 4-year rehabilitation before re-introduction to the Lefini Reserve, Congo. Photo ©Tony King/John Aspinall Foundation.

foods similar to those they will encounter in the release site, as well as limit or avoid feeding crop foods grown by communities adjacent to the release area (to help deter possible crop-raiding).

Introductions (outside of the taxon's historic range)

There are two types of introductions: conservation introductions and welfare introductions.

Conservation introductions of great apes would be conducted only as a last resort to save a genus, species or subspecies. Conservation introductions might have to be conducted under emergency circumstances, such as a natural disaster or epidemic.

When great apes are introduced outside of their historic range for conservation purposes, there should be clear agreement among all parties that the introduced population would be repatriated to within its historic range as soon as habitat is available and threats have been addressed. There should be a clear commitment by the range country government(s) to maintain/restore suitable habitat and to attempt to address and remove threats; the temporary absence of the apes should not be used as a rationale for relaxed habitat protection. Repatriation could be politically and logistically difficult, but is an essential goal in restoring ecosystems in both the historic range and the introduction site. Detrimental effects on the ecosystem of the release area should be anticipated, and there should be clear commitment to restoration after the apes are repatriated. The introduced population should be selected and managed intensively to maintain sufficient numbers, genetic diversity, and demographic stability to be sustainable, but population growth should be controlled to avoid exceeding carrying capacity. Reversible contraception might be required. Provisioning might also be necessary, although not so much as to allow excessive population growth. The apes' behaviour and adaptation to the new environment should be studied intensively to document the process and guide management of the ultimate repatriation. Other re-introduction guidelines would apply to such introductions. The costs and risks of such an introduction might prompt a decision to support a necessary expansion of range country sanctuary space to accommodate the imperilled taxon.

Introducing a species within the known historic range of its genus, for example, *Pan paniscus* introduced into Liberia, or introducing a subspecies within the known historic range of its species, would be regarded as a conservation introduction if it were the only option to save the species/subspecies. In other words, the introduction site could be within the range of closely related ape forms. In such cases, the release site should not allow contact with another species or subspecies of the same genus, unless the continued existence of the genus is otherwise unlikely.

Welfare introductions should be considered only when it is no longer possible to provide humane care in a sanctuary, or when there is strong reason to believe that there would be substantial increases in well-being by being moved from a sanctuary or zoo to a free-ranging habitat. Many sanctuaries already have such habitats, for example Ngamba Island sanctuary, and welfare introductions might be said to have already occurred in some cases. Note that welfare introductions are not to be conducted solely to dispose of surplus animals or to relieve overcrowding.

Welfare introductions should be conducted when there is no realistic prospect of re-introduction to suitable habitat within the historic range. The costs and risks of the introduction might prompt a decision to support a necessary expansion of range country sanctuary space, and/or to improve sanctuary management. Currently there is no conclusive evidence that introduction into a large free-ranging habitat inevitably increases well-being of all of the individuals involved. If enhancement of well-being is the rationale, there must be a funded plan to conduct pre- and post-release research to test whether enhancement of well-being has occurred. Contraception should be employed, and the population should be allowed to decrease to free up resources and to allow ecosystem restoration of the introduction site. Reproductive potential might be maintained in the introduced population if its founders carry rare genes and/or if there are no other viable populations of the taxon in the wild or in captivity. As reproduction ceases, the absence of immatures might to some degree compromise welfare, and the small aging population existing at the end of the exercise will be to some degree socially deprived. Provisioning will probably be required when introducing great apes into minimally suitable areas outside of historic range. Non-invasive behavioural research could be conducted. It should be made clear at every opportunity that the introduction is not a substitute for efforts to restore suitable habitat and address threats in the range countries. Detrimental effects on the ecosystem of the release area should be anticipated, and there should

be clear commitment to restoration after the population dies out. Other re-introduction guidelines would apply to such introductions. Before a welfare introduction is considered, consult the *IUCN Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species* (2000). Note that the use of contraception and planned extinction of the introduced population has no implications for zoos, because introduced great apes would disrupt the ecosystem of the release area and are thus technically an alien or invasive species. This is not the case for zoo apes, and scientifically managed reproduction to maintain genetically and demographically stable zoo populations is not inconsistent with these guidelines.

In conjunction with habitat assessment, review or gather socioecological and behavioural data on the taxon of concern

To determine the critical needs of the taxon of concern, the status, ecology, and behaviour of wild populations must be considered. For great apes, such data might include habitat preferences, adaptations to local ecological conditions, adaptations to disturbance, carrying capacity, density, home range, locomotor patterns and substrate preferences, foraging and feeding behaviour, sheltering and nest-building requirements, social behaviour and social system, emigration/immigration patterns, group composition, predators, and diseases. Inter-population differences and culturally acquired patterns are known to exist in at least chimpanzees and orangutans, so species- and genus-wide generalizations must be taken with caution. Studies of life history parameters such as rate of population increase, interbirth intervals, age structure and sex ratio may provide baseline data against which to measure project success. Overall, a good knowledge of the natural history of the taxon is important to the entire re-introduction scheme. In the case of great apes, most of this information exists and needs only to be compiled and surveyed carefully.

Where crucial socioecological and behavioural data for a great ape population or subspecies is lacking, studies to obtain this information should be carried out prior to re-introduction.

If a population of conspecifics already exists in the area of the release site, the total number of individuals, the number of groups, and group structure should be determined by pre-release surveys, in part to determine a baseline against which to assess the effects of the re-introduction and as part of estimating carrying capacity for the area.

When reinforcing a particular group by re-introducing one or a few individuals, the history of the group, its structure and size, and the personalities of key members should be considered. Ideally, the group would be the group of origin of the released individuals. It is desirable that the group be at least partially habituated to facilitate post-release monitoring; otherwise radio telemetry might be employed.

A complete repertoire of survival-critical behaviours of free-ranging great apes of the target taxon should be assembled. Again, most of these data already exist and need only to be compiled and surveyed carefully. Survival-critical behaviours include knowledge of appropriate foods and foraging techniques (perhaps including taxon- and population-specific tool use and manufacture), predator recognition and avoidance, nest-building, a full locomotor repertoire in three dimensions, appropriate intra-specific social behaviour with conspecifics of all ages and both sexes, displays, reproductive competence, and safe water-contact. Great apes born or held in captivity may be deficient in some or all of these behaviours and knowledge. They should be trained before release until competent in minimally functional survival skills appropriate for their age at release. Pre-release training can be done by human or ape surrogates or both. Trial-and-error learning and observational learning can be used. Great apes, especially chimpanzees, bonobos and orangutans, learn quickly by social learning. Thus demonstration of survival-critical behaviours by human and competent ape surrogates should be used whenever possible, especially with infants and juveniles that have not lived with their mothers in the wild for at least 18 months and have thus lacked sufficient opportunities to observe their mothers' perform such behaviours. The tendency to learn by observation can also result in great apes learning inappropriate behaviours, such as breaking into food storage lockers and using boats. These behaviours are inappropriate because they are not normally part of an independent ape's repertoire, and can lead to ape-human conflict. Thus care must be taken to ensure that apes do not inadvertently learn such behaviours and to discourage such behaviours if they already exist.

Pre-release training should include exposure to as many natural foods as possible, opportunities to locomote on natural vegetation, opportunities to build and sleep in nests, exposure to natural sounds and smells of the forest, controlled exposure to climatic extremes, controlled exposure to potential competitors and ectoparasites, protected exposure to unfamiliar conspecifics, and protected exposure to some predators.

Re-introduction projects must consider the humane treatment of great apes. There should be a documented assessment of the survival prospects of the apes to be released to justify the risks and stress (physical and psychological) involved. Ideally, survival prospects for released apes should approach those of wild apes of the same age and sex; experience has shown this rarely to be the case unless there is intense pre-release training and post-release monitoring and support. Thus appropriate pre-release training as well as post-release monitoring and support should be an essential component of re-introduction plans. In almost all cases with great apes, a soft release is appropriate.

Determine if the project can meet socioeconomic, financial and legal requirements

Great ape re-introductions are invariably long-term efforts that require continual public, political, and financial support. An assessment of cost-per-surviving-animal is important to fully understand the expenses involved and to help measure success. Consultation with other re-introduction practitioners and a review of the costs of previous projects are advised so that the actual monetary investment, time commitment, and similar requirements are fully understood before a re-introduction is initiated. It may be the case that providing lifetime care for great apes in captive colonies or sanctuaries is less expensive than re-introduction. Such decisions should include consideration of conservation, education, legal, and welfare benefits as well as monetary costs.

Re-introduction must take place with the full permission and involvement of all relevant government agencies. This is particularly important for re-introductions in border areas; for those involving more than one state or province; or when a re-introduced population can expand into neighbouring states, provinces, or territories.

Governmental policy toward re-introductions and the taxon concerned must be assessed. This may include checking existing provincial, national, and international legislation and regulations, and working toward the provision of new measures and acquisition of required permits.

Socioeconomic studies should be carried out to assess the impact, costs, and benefits of the re-introduction to local human populations.

A thorough assessment of project-related attitudes, concerns and behaviours of local communities is necessary to ensure long-term protection of the re-introduced population and its habitat, especially if the original cause of the taxon's decline was human factors. There should be ongoing monitoring of attitudes and behaviours to assess any changes.

The re-introduction project should be understood, accepted, and supported by local communities prior to initiation. Opportunities for project-related employment should be offered preferentially to members of the local communities, and training should be provided to disseminate requisite knowledge and skills.

If there is a risk of post-release human-ape conflict or interaction, a plan of action for managing and solving such situations should be agreed upon and fully understood by all project staff and relevant authorities. This is especially true for ex-captive male gorillas, chimpanzees and orangutans, which are known to range widely and can be aggressive toward humans. Options for dealing with aggressive males have included recapture and euthanasia. Members of local communities must be made aware of the unique risks posed by chimpanzees to unattended human infants, and by orangutans to human males. Human-ape conflict is especially likely when provisioning is intensive and dispersal is constrained. Special structures to protect caretakers might be required.

Assess the suitability of the great apes to be re-introduced

If great apes have been confiscated, the IUCN Guidelines for the Placement of Confiscated Animals (2002) *should initially be consulted. These guidelines offer three options for disposition of confiscated, rescued or repatriated apes: maintain in captivity for the remainder of the apes' lives (within the country of origin or in a foreign country), return to the wild, or euthanasia. If these guidelines*

have been reviewed, and release to the wild is the preferred option, then continue assessment of release-stock suitability.

Behavioural Assessment and Rehabilitation

Currently there is little scientific justification for re-introducing captive-born or artificially propagated great apes (except in range country sanctuaries planning re-introduction, where managers have concluded that the presence of infants is important to re-introduction success). There are usually enough great apes in sanctuaries and rescue, care, or rehabilitation within the country of origin that can be re-introduced, as well as threatened wild apes that need to be relocated. However, some re-introduction managers disagree with this guideline and argue that re-introduction of captive-born great apes may be justified if there are clear benefits from increasing public awareness or if sufficient number of individuals of an endangered taxon are unavailable in sanctuaries.

Great apes younger than two years should not be re-introduced, unless they can be returned to their natal group within three weeks of removal, their mother or another lactating female is present, they are showing normal age-specific behaviour, and they are physically healthy. Three weeks is chosen because lactation can resume within three weeks of not nursing.

Normally, great apes less than six years old (i.e., pre-juvenile) or lacking functional behavioural repertoires should be re-introduced only in groups that can be closely-monitored, and where there is intensive post-release monitoring, support and provision for rescue if necessary. It may be possible to re-introduce individual, socially-stable gorillas and chimpanzees (especially females) between two and six years of age into established groups. In such cases, intensive post-release support might not be desirable, but the same provisions for monitoring and rescue would apply. It is recognised that these age-based landmarks are general, and must be adjusted for taxon differences and the behavioural, emotional and cognitive development of individuals.

Ideally, adult and subadult gorillas, chimpanzees and bonobos should be re-introduced in intact age-graded social groups. Re-introduction of individual adults to established groups is riskier, especially for adult males, but can be considered under specific circumstances when the group and the individual are well acquainted and there is a high probability of success. A group of mixed age/sex orangutans can be re-introduced if the group has been established in captivity.

A young great ape awaiting re-introduction requires replacement of psychological support and affection that he/she lost when separated from the mother. This replacement is necessary for normal social, emotional, and behavioural development. Older apes have been reported to adopt orphans, and surrogacy by an adult ape is preferred. However, human surrogacy will be required in most cases. Human surrogacy is intense and must ensure that each infant is held, carried, fed, groomed, cleaned, protected, disciplined, exercised, and tutored for at least the first 18 months of life. Some “imprinting” on the surrogate and humans in general is to be expected and is potentially a serious handicap. Thus, as soon as they are stabilized, great apes under 18 months should be introduced to young conspecifics as well, as a first step in the infant’s identification with conspecifics. Generally, between 18 months and six years of age, interactions with humans should be gradually decreased, while at the same time opportunities for interactions with conspecifics should be intensified. Some stress on the ape and the human surrogate can be anticipated during the transition, but the transition is essential to foster the independence and competence that the ape will need to be re-introduced. A hand-reared great ape of six years or older should no longer require emotional support or protection from humans if there are opportunities for interaction with conspecifics.

There must be careful assessment of individual histories and behavioural competence before re-introduction. This will require advice from a group of experts with different specializations (for example, cognition, social interaction, temperament) who are not already emotionally bonded with the individual apes. At least for chimpanzees and orangutans, individuals that lived in the wild with their mother for at least one year before capture, and are healthy, are more likely to acquire a feral orientation and survival-critical behaviours with acclimatization and pre-release rehabilitation training. This effect seems to persist even after many years in captivity, under suboptimal captive conditions, and with considerable contact with people. Thus great apes with such histories are good re-introduction candidates. Apes captured before they are one year old, apes that were intensively

hand-reared and socialized with people, apes that remained in captivity beyond puberty, and apes that developed stereotypic behaviour or hyper-aggressiveness in captivity, are less suitable candidates and are less likely to survive even with considerable acclimatization, pre-release training, and post-release support. There are exceptions to both of these general conclusions, however, and their applicability to gorillas and bonobos has not been adequately tested. But, again, there should be pre-release psychological and behavioural assessment of individual apes by at least two independent experts (can be on site or receive behavioural profiles and information via videos, behavioural data) and the ape's caretakers, and these should be considered carefully by re-introduction managers. Preferably, there should be a series of such assessments during the pre-release rehabilitation period to determine progress and allow revision of rehabilitation care to induce normal development. In some cases, it might be more humane to retain an individual in lifetime captivity.

At least for chimpanzees and gorillas, females are more likely than males to survive re-introduction where a resident population is present. In some cases, it might be more humane to retain a male in lifetime captivity.

In some cases, such as confiscated individuals, their exact origin, including source country or population may be difficult to determine, even with genetic testing. Great apes whose subspecies cannot be confirmed should not be considered for re-introduction, except under exceptional circumstances as determined by the project's team of specialists, (see p. 5) and they should never be considered for a reinforcement programme.

Genetic Assessment

To avoid mixing of distinct genetic lineages or introducing genetically-based behavioural or other abnormalities, re-introduced great apes should be of the same species or subspecies as those currently residing in the release area or of those that were extirpated, and should be free of any atypical phenotypes that are likely to have a genetic basis.

With reinforcement projects, genetic assessment (for example, karyotyping, calculation of genetic variation, pedigrees) of individuals to be released and of wild populations of the taxon concerned is recommended. Non-invasive collection of samples, such as hair or faeces, is highly advised.

Caution should be taken to ensure that interspecific hybridization (offspring produced by different species, subspecies, or populations) in the wild is avoided, and that no species hybrids are present in the release stock. Hybrids are often not easily determined by morphology alone. Genetic testing is generally considered the best form of assessment.

When a new population is established by re-introduction, the number of founders (those that reproduce successfully) should be sufficient to ensure that the population would survive stochastic events (such as a severe storm, or a fire) and maintain adequate genetic heterozygosity. Based on experiences with zoo populations, and on modelling with wild orangutans, a new ape population with an initial size of 100 individuals would virtually ensure survival and retention of more than 95% of original genetic diversity for at least 100 years (Singleton *et al.* 2004). Note that it is assumed that the number of individuals that reproduce (founders) is apt to be smaller than total population size, and not all founders will have equal reproductive success. Thus a new population should have as a target size at least 100 individuals, although this could be accomplished with successive re-introduction cohorts.

Population Assessment

For social behaviour and foraging, inter-population differences and behaviours acquired by social transmission are known to exist in the great apes. Ideally, to ensure that inter-population differences are not distorted or hybridized, apes from one population should not be re-introduced into another population. However, it is often difficult to establish population provenance and it may be necessary to re-introduce individuals from different populations to establish a self-sustaining population or to translocate a rescued individual.

Re-introduction of an individual from one wild population to another, solely to investigate the dissemination of novel behaviours, cannot be justified. To repeat, the main goal of the re-introduction effort should be to re-establish self-sustaining populations of great apes in the wild and to maintain

the viability of those populations. However, when a re-introduced ape brings a natural, novel behavioural variant to the target population (and it is likely that great apes held in captivity will acquire unnatural novel behaviours), its dissemination (or lack thereof) during all stages of the re-introduction process should be documented.

Although not currently recommended, genetic and/or cultural hybridization might someday be considered necessary to save a higher taxonomic unit. For example, if two or more genetically or culturally (behaviourally) distinct populations are so depleted in numbers or diversity that they will surely become extinct, they might be combined in an effort to save a subspecies. The rationale could even be extended to an effort to save a genus, as a last resort to preserve an ape type. Other re-introduction guidelines would apply to such re-introductions.

Section VI
Disease Risk and Veterinary Requirements

Every re-introduction project should be accompanied by a health risk analysis aimed at summarizing the risks, either qualitatively or quantitatively, to the humans and animals involved. Major aspects of any health risk assessment include proper preventive medicine and pre-release screening delivered during an adequate quarantine period. Qualified veterinarians with appropriate expertise in great ape veterinary care should, therefore, be part of the management team throughout re-introduction planning, implementation, and follow-up activities.

The potential for transmission of many diseases is increased during the re-introduction process as animals and humans are in repeated contact under increasingly stressful conditions. Apes held in captivity or transported, even for a short period of time, may be exposed to a variety of pathogens for which they have no immunological experience. Releasing diseased apes to the wild may put at risk conspecifics or even unrelated taxa.

Daszak *et al.* (2000) review the effects of infectious diseases on wildlife in general, and Wolfe *et al.* (1998) and Leendertz *et al.* (2006) discuss primates in particular. We know very little about diseases in wild primate populations. Primates can act as reservoirs for human pathogens and vice versa (tuberculosis, for example). They can also act as the originator of disease in the human population. The current HIV pandemic, for example, originated from Simian Immunodeficiency Virus, in African nonhuman primates.

There are many established protocols for moving nonhuman primates between captive facilities around the world. In these cases, veterinary protocols are relatively tried and tested, there is a clear understanding of the conditions in which they were kept and in which they need to be kept in their new home, the veterinary history of the animals is, to a greater or lesser extent, fully documented, and quarantine and monitoring are merely questions of time and personnel. By contrast, there are no standard protocols for movement of nonhuman primates for the purpose of re-introduction, supplementation or translocation. In these cases, there is considerably more uncertainty and many more variables that need to be taken into account. Common questions include: How does one decide which diseases to test for? Are there diagnostic tests available for important diseases of concern? Are these tests valid? Are they performed in country? If not, can samples be collected, preserved, properly permitted, shipped and tested elsewhere in a timely fashion? How are results interpreted and what will managers do with animals that test positive? The risk analysis framework in the next section helps answer these questions in a logical sequence.

Disease risk analysis is a process that seeks to combine science and policy in areas with limited information to address questions of health. The main questions are 1) what is the likelihood of an animal or group of animals' survival in the new habitat? And 2) how can the likelihood that the animal movement will cause harm in the new environment be minimized? This process starts with a couple of basic assumptions. First, there is no such thing as zero risk — the goal is to identify and mitigate as many risks as possible, but all risk will never be eliminated. Second, real-world financial restraints force prioritization of mitigation strategies. Thus, all pertinent stakeholders must play a roll in this process. Finally, since health/disease information is constantly changing, assessments

should be conducted specifically for each situation and animal movement. It is important to remember to assess risks to both re-introduced and recipient populations (where relevant). Ideally, the first iteration of this process will assist managers to design and conduct a standard disease surveillance and monitoring programme (quarantine and pre-shipment examinations) that will, in turn, derive data necessary to conduct better assessments for subsequent movements. This document seeks to assist the user in progressing through a logical flow to identify and prioritize the most relevant health issues. Specific protocols for specific diseases are covered in many other documents available for review by veterinary "team members".

Risk Analysis and the Formulation of a Health Management Plan

The risk analysis process is a logical framework focused on answering basic questions:

- What adverse health events (usually disease) are important and how would such events be introduced/spread? (hazard identification)
- How likely is it that the event (disease introduction and/or spread, death, illness, etc.) will occur? (risk assessment)
    - The explanatory and supporting documentation of the risk analysis should be completely transparent (methodology and assumptions are clear to all relevant parties), and include a discussion of the uncertainty surrounding the conclusions.
- What can be done to decrease the likelihood of an adverse outcome? What can be done to reduce the consequences if it happens anyway? (risk management)

Many health-related organizations have published risk analysis frameworks; most follow the generic risk analysis process covered by the World Organization for Animal Health (OIE) [http://www.oie.int/eng/en_index.htm]. Since 1992, the Conservation Breeding Specialist Group (CBSG) of the World Conservation Union (IUCN) has conducted a series of workshops, gathering input from experts around the world, aimed at developing a series of easy-to-use risk assessment tools for both captive and free-range wildlife settings (Wolff *et al.* 1993; Armstrong *et al.* 2003).

Hazard identification and risk assessment: Define and prioritize your diseases of concern

First, an exhaustive list of potential diseases of concern (based on a comprehensive literature search) should be made. Second, the list should be prioritized using a set of criteria specific to the situation. The following points should be considered by all projects in light of the specific situation; the level of uncertainty surrounding each answer should be stated.

- Susceptibility of population(s) of concern (do not forget to consider other relevant populations such as humans and monkeys)

An immobilised silverback gorilla at PPG-Congo undergoes a final veterinary examination before transport and release, with protective clothing provided to all involved to reduce the risk of disease transmission. Photo ©Christelle Chamberlan / John Aspinall Foundation.

- Route(s) of transmission
- Severity of the agent if animal is infected (for example, morbidity, fecundity, mortality)
- Likelihood of spread to conspecifics
- Likelihood of spread to others
- Other environmental concerns

Screening for "normal diseases" would ideally be done in both introduced animals and the recipient population (if there is one). Those diseases present in both populations, or those that are not pathogenic, may be of lower concern in this case. This is sometimes difficult to interpret because common diseases in one population may be emerging diseases to another. At a minimum, apes to be introduced should be screened for infectious agents not found naturally in wild populations of the taxon of concern (such as pathogens acquired from people or other ape species). They should also be screened for agents, such as parasites, that may result in the introduction or spread of potentially dangerous diseases. Non-invasive methods that pose no or very little risk to the animals are strongly recommended, but they may fail to detect some pathogens that would be detected by more invasive methods.

In the following example, a qualitative ranking of potential diseases of concern resulted in a "stoplight protocol" where those highlighted in red were thought to be of highest risk and therefore must be screened for and/or prevented. This rough assessment is adapted from risk analysis material in the CBSG Disease Risk Assessment Manual (Armstrong *et al.* 2003). The reliability and certainty of the information behind the quantitative figures as shown for each category in the guide needs to be highlighted for each disease of concern. For definitions of categories, refer to the worked example below the rough assessment.

At this stage the precautionary principle is critical — that is, diseases of concern will rank higher (implying greater potential risk and therefore accompanied by more drastic mitigation strategies to allow the candidate to be released from quarantine) if there is certainty that a disease is detrimental to the species, or if there is a high level of uncertainty about the known effects, both to the individual, and to the population.

Rough assessment of the diseases of concern

The risk assessment disease spreadsheet on the next page is one example conducted for one specific site at a single point in time. The disease list is based on susceptibility and historical findings in chimpanzees, as well as field data collected from a specific potential release site. As the name suggests, this is a rough guide only for policy decisions on what disease surveillance will be most appropriate. It is a living document, and will be updated regularly as new information becomes available.

Where a disease is on the list for potential academic interest only (that is, the effect is not yet known), this disease may be considered to have lower relevance than one known to cause a major effect. By using this process, it will be obvious that the ranking will invariably change, as new data become available, or depending on particular local historical factors in any given area.

This ranking of disease is meant only as a rough guide. For the next step in the risk assessment, questions need to be answered for a particular situation, to help better qualify that risk. Using the Stoplight Hazard Analysis example on the following page, at least every pathogen in the red (high risk) category should be carefully analyzed in terms of the risk; the precautionary principle would require that all of the pathogens highlighted in amber (medium risk) be assessed as well. The questions in the working example on page 19 can be posed in numerous ways to be effective in the risk assessment. First, they can be posed as questions where qualitative rank or quantitative probabilities are assigned—this format results in a 'grade' for the specific disease. Second, they can be posed so that answers are provided in free form. In these cases, it is more difficult to 'rank' diseases but explanations of uncertainty may be easier to include. Whichever method is chosen should be implemented in a consistent and standardized way so that some form of comparison may be made.

Case Study – chimpanzee release. Disease rough assessment guide – Stoplight Hazard Analysis

Disease	Likelihood of susceptibility	Likelihood of exposure	Likelihood of becoming infected	Likelihood of transmitting to others	Severity to the individual if clinical	Severity for the population	Estimated significance to the programme	P of transmission from humans to apes	P of transmission between humans	P of transmission between apes	P of transmission from apes to humans	Updated significance to the programme	Sample required	Test
Ebola/ Marburg	5	1	5	3	5	5	24	3	3	3	3	36	Serum	RESEARCH INTEREST ONLY
Shigellosis	5	5	4	4	3	3	24	3	3	3	3	36	Faeces	culture
Salmonellosis (typed)	5	5	4	4	3	3	24	3	3	3	3	36	Faecal series	culture
Campylobacter spp.	5	4	4	4	3	3	23	3	3	3	3	35	Faecal Series	culture
Enteropathogenic *E. coli*	5	3	4	4	3	3	22	3	3	3	3	34	Faecal series	culture
Strongyloidiasis	4	5	5	4	3	3	24	2	3	2	2	33	Faeces	LM and culture
Hookworm	4	5	5	4	3	3	24	2	3	2	2	33	Faeces	LM
Entamoeba hystolytica	4	5	4	4	3	3	23	2	3	2	2	32	Faeces	LM
Streptococcus pneumoniae	4	3	4	4	4	4	23	2	3	2	1	31	Respiratory secretions	LM and culture
Yersinia spp.	4	4	4	4	3	3	22	2	3	2	2	31	Faeces	culture
Oesophagostomum	4	4	5	4	3	3	23	2	2	2	1	30	Faeces	LM
Balantidium coli	3	4	4	4	3	3	21	2	3	2	2	30	Faeces	LM
Whipworm	4	3	3	3	3	2	18	3	3	3	3	30	Faeces	LM
Tuberculosis	3	4	2	3	5	5	22	2	2	2	1	29	Respiratory secretions	TB test and culture
Dermatophylosis	4	4	4	4	3	3	22	1	2	3	1	29	Skin Scrape	LM
Giardia intestinalis	3	4	3	4	3	3	20	2	3	2	2	29	Faeces	LM
Pinworm	4	3	3	3	2	2	17	3	3	3	3	29	Faeces	LM
Cryptosporidium	4	3	3	3	3	3	19	2	2	2	2	27	Faeces	LM
Klebsiella spp.	4	2	3	3	3	3	18	2	2	2	2	26	Faeces	culture
Anthrax (*Bacillus anthracis*)	5	2	4	2	5	3	21	1	1	1	1	25	N/A	Clinical Signs
Rabies	4	3	3	3	5	3	21	1	1	1	1	25	Serum	serology
Sarcoptes spp.	2	3	2	3	3	2	15	1	3	3	1	23	Skin Scrape	LM
Malaria	3	5	3	2	3	2	18	1	1	1	1	22	Blood smear	LM
EMCV	5	2	4	1	5	3	20	0	0	1	0	21	N/A	Histopathology
Measles	3	1	3	3	3	3	16	1	1	1	1	20	Serum	serology
Hepatitis B	2	4	2	2	3	3	16	1	1	1	1	20	Serum	serology
Herpes simplex	2	4	3	2	1	1	13	2	2	2	1	20	Serum	serology
RSV	3	3	2	3	3	3	17	0	0	2	0	19	Serum	serology
Filariasis	3	3	3	2	2	2	15	1	1	1	1	19		
SIV/ HIV	3	1	2	3	2	2	13	1	1	1	1	19	Serum	serology
Polio	2	3	2	3	3	2	15	1	1	1	1	19	Serum	serology
Hepatitis A	2	4	2	1	2	2	13	1	3	1	1	19	Serum	serology
Influenza orthomyxovirus	2	2	3	2	2	2	13	1	3	1	1	19	Serum	serology
Candidiasis	3	3	2	2	2	2	14	1	1	1	1	18	Faeces	LM
STLV	3	3	2	3	1	2	14	1	1	1	1	18	Serum	serology
Amoebic meningioencephalitis	3	1	3	1	4	2	14	1	1	1	1	18		
Hydatids/ *Taenia*	2	3	2	2	3	1	13	1	2	1	1	18	Faeces	LM
Yellow Fever	1	2	2	2	3	3	13	1	2	1	1	18	Serum	serology
Pneumonyssus (mite)	3	2	3	2	3	2	15	0	0	2	0	17		
Adenovirus	3	2	2	2	2	2	13	1	1	1	1	17	Serum	serology
Parainfluenza III	1	2	2	3	2	2	12	1	1	1	1	16	Serum	serology
Pneumocyctis carnii	3	2	2	2	3	1	13	0	1	1	0	15		
Helicobacter	3	2	2	1	2	2	12	1	1	1	0	15		
Papilloma virus	3	3	2	2	1	1	12	0	1	1	1	15	Serum	serology
Tetanus	4	2	2	1	4	1	14	0	0	0	0	14		
Varicella virus	3	2	2	2	1	1	11	0	0	1	0	12		
Cyclosporiasis	3	1	2	1	2	1	10	0	0	1	0	11		
Hymenolepis nana	3	1	2	1	2	1	10	0	0	1	0	11		
Hepatitis C	1	1	2	1	1	1	7	1	2	0	0	10	Serum	serology
SFV														
Troglodytella														

Disease	Likelihood of susceptibility	Likelihood of exposure	Likelihood of becoming infected	Likelihood of transmitting to others	Severity to the individual if clinical	Severity for the population	Estimated significance to the programme	Probability of transmission from humans to apes	Probability of transmission between humans	Probability of transmission between apes	Probability of transmission from apes to humans	Updated significance to the programme	Sample required	Test
Ebola/ Marburg	5	1	5	3	5	5	24	3	3	3	3	36	N/A	Research interest only
	Scale of 1(low) to 5 (high). What is the likelihood that an individual animal to be released will be susceptible to this disease?	What is the likelihood that the animal to be released will be or has been exposed to this disease?	If an animal has been exposed, what is the likelihood that the animal will actually become infected and capable of transmitting the disease?	Is the disease causing organism likely to be transmitted to other individuals?	If an individual in the wild population does become clinically ill with the disease, how severe is it?	If a disease is likely to spread quickly through a population and kill many animals in that population, it would be considered severe for that population	Sum the numerical values assigned to each category. Diseases which have the highest ranking will be the most significant diseases to address	Scale of 0 (not transmissible) to 3 (highly transmissible)	Scale of 0 (not transmissible) to 3 (highly transmissible)	Scale of 0 (not transmissible) to 3 (highly transmissible)	Scale of 0 (not transmissible) to 3 (highly transmissible)		Faecal series = at least 3 samples required if disease is shed intermittently. Faeces = fresh sample required for culture + placed in formalin. Serum - blood collected in red top tubes and serum separated, OR follow protocol from GAHMU	LM = light microscopy
	Red — disease most likely to affect re-introduction. Every effort should be made to investigate these													
	Amber — disease could affect re-introduction. Investigate as much as possible													
	Green — disease less likely to affect re-introduction - investigate if possible													

Ape species X that has Disease Y is being released into Area A — Should Disease Y be considered a risk?

What is the likelihood of introducing Disease Y to other individuals and species in Area A because of this release? That is, do we know how this disease is transmitted, and what the consequences may be?

What is the likelihood of causing clinical disease in ape species X and other species, if chronic carriers are introduced? In other words, can chronic carriers of this disease pass it to other animals, resulting in clinical disease, and how easily can they do this?

What is the likelihood of causing a chronic carrier state in any offspring the adult carriers may have? If this particular disease is known to cause a chronic carrier status, do we think that this will happen in this situation and why (or why not)?

What is the significance to the health of animals if they are chronic carriers? Do we know if chronic carrier status will have disease consequences into the future?

What is the likelihood of people obtaining Disease Y from infected apes? Is this disease a zoonosis, and how easily can it be spread to people? Is this disease important for people? People have acquired SIV infection, for example, but to date no adverse health effects have been recorded.

By attempting to answer such questions as these, at this stage the level of uncertainty about our information for each disease will become obvious. Highlighting these areas of uncertainty is, we believe, the most important part of the assessment, because it reveals the data gaps that can be filled as necessary, and if the evidence suggests this is a major disease of concern. The chart on page 19 summarises these considerations of health risk analysis.

Highlighting Areas of Uncertainty For Disease Y

High Uncertainty

There are limited data to confirm the statement, even though the logic is sound.

Low Uncertainty

We are relatively sure that the statement is accurate.

- Long-term effects on the health of chronic carriers, and their effects on the population, remain unknown. However, as cross species infection is a possibility, and the human literature notes an increase in major health issues related to Disease Y infection later in life, it can be hypothesised that this is not a disease we wish to perpetuate within the population.
- If the imported apes are found to be Disease Y chronic carriers, and while, based on previous reports, it is most likely to be the ape species X specific strain of the virus, we are unable to ascertain this with certainty with our current testing (the surface antigen testing is highly sensitive, but not very specific). The laboratory we use for primate serology has never tried differentiating Disease Y strains, but it would be possible.
- Quantitative evidence of the zoonotic potential of Disease Y does not yet exist. Under normal husbandry protocols, and based on serological surveys of in-contact workers with positive non human primates we can be relatively certain that the quantified risk of obtaining Disease Y from apes is negligible.
- Potential for cross species transmission remains a possibility. This has been indicated in a number of studies (including a probable spread between gibbons and gorillas at a zoo), and has been scientifically proven experimentally.
- Based on quantitative evidence, high infectivity chronic carriers are likely to spread infection to their offspring.
- Vaccination using published protocols is protective.
- Disease Y is endemic in Species Z (and various other species) in the release area.
- Species A, B and C in the release area are free of Disease Y, based on widespread testing.

Risk management recommendations based on the risk assessment

Now that the hazard identification and risk assessment phases have established the level of risk (qualitatively or quantitatively) associated with each potential hazard, risk mitigation strategies, and associated costs, should be described for each. Three examples are listed on the following page — specific recommendations should be included in the overall veterinary recommendations for the importation of ape X into release site A.

Example 1: ***Husbandry practices if importing chronic carriers of Disease Y to a sanctuary, or if discovered in quarantine***

- Define risk of transmission to animal care staff. Educate regarding the risk of carriers shedding pathogen, and routes of transmission; reinforce rules to protect people in potential contact.
- Recommend vaccination of primate staff for important zoonotic diseases when available or appropriate. If this becomes protocol, it would be helpful to obtain Disease Y titres from staff before vaccination. Pre vaccination titre checks are often recommended with this vaccine.
- Vaccinate species X offspring as they arrive following approved protocol.
- Vaccinate *in-contact* naïve apes. As minimal information currently exists on the long-term efficacy of the vaccine in species X, further investigation is required into this before we can recommend release of these animals.
- As Disease Y is spread in bodily secretions only, make sure areas that are heavily contaminated with secretions (especially blood) are disinfected with the appropriate disinfectant.
- Change footwear or provide disinfectant footbath for staff entering the enclosure area where the chronic carrier is located.

Example 2: ***Disease Y presents a risk to conspecifics or closely related species. Therefore species X is not to be housed in a multispecies enclosure—either spatially or temporally—while in quarantine***

Example 3: ***Recommend testing for Disease Y*** *before* ***transporting to pre-release area***

- Recheck serology on all selected animals for Disease Y prior to shipment to pre-release site. If the animals are already known to be chronic carriers, it is still recommended that serology is checked, as clearing of infection has been known to occur.
- If found to be chronic carrier(s), recommend instigation of vaccination protocol and take steps to reduce the chance of cross contamination between the chronic carrier and *all* other apes in contact. As minimal information currently exists on the long-term efficacy of the vaccine in species X, further investigation is required into this before release of those animals identified as chronic carriers of disease Y can be recommended.

Risk communication

All stakeholders must be made aware of the most up-to-date findings of the assessment. This is part of an overall communication network that should be in place for the release programme.

Practical Considerations: Implementing the Health Management Plan

Once a risk analysis has been performed, a clearly defined veterinary protocol should be established, reviewed by the project's advisory team, and strictly followed. Many resources exist for disease-specific details which are not covered here. Disease screening is a costly and timely venture, especially in developing countries where many re-introduction candidates are housed. Re-introduction managers should ensure that adequate funding is available to screen for at least the highest risk agents recommended by a qualified veterinary team. There may be taxon- or region-specific disease issues which have specific testing needs at specific laboratories — many require invasive procedures for sampling, as well as complex sample storage and preservation needs. Some disease issues have important political implications. For example, polio, which can clinically affect chimpanzees, gorillas, and orangutans, and has been presumptively diagnosed in some wild apes, is currently undergoing a worldwide eradication campaign by public health authorities and the United Nations. As such, there are few reference laboratories in the world that test for this agent, and even fewer that will accept nonhuman primate samples. Since a positive test result may affect a country or region's polio status as defined by the World Health Organization, collaboration with the range country public health authority is strongly recommended in this case.

Some viruses, such as both old and emerging retroviruses (Simian Immunodeficiency Virus [SIV] and foamy viruses), are endemic in many African ape taxa and may play a role in natural population dynamics. Thus the presence of such viruses in certain apes would not necessarily preclude

the release of these apes, but positive results might present a highly political scenario. Similarly, contrary to popular sentiment, the release of parasite-free apes is not recommended since this may lead to acute parasitism and accompanying clinical disease upon re-introduction. On the other hand, re-introduction managers need to discuss the types of parasites that are "normal" in re-introduction candidates, as well as the likelihood that animals would shed pathogenic organisms into the environment. When screening wild populations, parasite richness and abundance is often dependent on individual and seasonal variation, so quantitative screening may be of limited value.

Note: It is important to remember to include non-infectious diseases, such as nutritional or behavioural issues, in the risk analysis process. For example, a nutrition report (both what the ape should be eating in that area, and what is being provided while in captivity, highlighting potential areas of concern), should be part of the overall health inspection.

Husbandry

It is not the intent of this manual to discuss in-depth husbandry practices, as many suitable documents exist, and experts are located all over the world. Apes in good general health are less likely to carry or suffer from infectious diseases than those living on inadequate diets or in sub-optimal physical or social conditions. Captivity alone may cause stress. Severe or chronic stress may cause immunosuppression, which can result in increased susceptibility to new diseases, and symptomatic expression of latent diseases.

Record keeping

Managers of re-introduction projects should ensure that all apes are readily, reliably, and permanently identifiable, for example by the use of transponders, tattoos, portrait and profile photographs, dental records (also including photographs), and records of permanent disfigurements such as missing digits and old scars.

Each ape should have an individual medical record. Medical records should always be kept current, backup copies made, and safely stored. Apes may have been given various names and record numbers during their lifetimes; all previous identifiers should be recorded, but a permanent name or other identifier should be issued and used consistently for all pre- and post-release activities.

Quarantine

Quarantine is the separation of apes upon entry or before release from any facility in the re-introduction process. The purpose of such isolation is for 1) basic health assessment; 2) acclimatization to the new environment with minimal stress; and 3) prevention of the spread of infectious diseases.

An initial seven-day stabilization period prior to the first examination is recommended to allow a great ape to adjust to its new environment, except in cases where emergency treatment is necessary. During the stabilization period, apes should not be exposed to other apes that have begun or have cleared quarantine. However, basic, non-invasive health assessments can be done during this time (such as faecal parasite screening and urinalysis).

Although there is disagreement between protocols at the international level regarding the time required to accurately investigate diseases of concern (30-, 60- or 90-day periods), a quarantine period of at least 90 days should be undertaken. Quarantine might be even longer for great apes with no medical history, individuals with known exposure to infectious disease, or individuals with questionable test results or showing possible disease symptoms. The project manager, attending veterinarian, and animal care staff must determine the appropriate quarantine period and procedures in each case, but it is best to be conservative. Great apes, especially infants, may have difficulty making a transition into a new facility with novel routines, new foods, and new people. The need for social contact, exercise and mental stimulation must be balanced with the need for disease control. Although great apes should not be deprived of social contact with conspecifics and/or humans for longer than 24 hrs during stabilization or quarantine, this need must be balanced with medical concerns at times when infectious disease isolation is necessary.

Quarantine cage for orangutans in Indonesia. Photo ©Ian Singleton.

In these cases, great apes living together or in close proximity can be quarantined together if deemed necessary to help diminish stress brought on by social isolation. If any individual in a quarantine group contracts or shows clinical signs of an infectious disease, however, *all* apes in the group must remain in quarantine, depending on the disease and the judgment of the attending veterinarian. When apes are quarantined together, an "all in-all out" rule should apply: if apes are added to a current quarantine group, then the quarantine start date should be reset for all quarantined apes to the arrival date of the newest individuals.

Quarantine facilities, including outside areas, should be physically isolated from other great apes, particularly breeding groups or individuals intended for release. Quarantine facilities should also be placed downwind (where wind direction is predictable) and downstream of other apes (where water flow is predictable). Small isolated islands might be appropriate. Ideally, at least 20m (four times the distance of dispersal of airborne disease agents) should separate newly-arrived apes from resident apes that have already passed their quarantine period, or a solid physical barrier should be placed between them. Appropriate barriers and pest-control measures should be used to prevent insects, birds, rodents, and other animals from easily entering the quarantine area. Apes should never be allowed out of the quarantine facility during the quarantine period.

Personnel working with quarantined apes (or handling their food, water, bedding and wastes) must observe established procedures to prevent cross-contamination to other resident apes. Such procedures should include strict personal hygiene, frequent hand-washing, use of separate equipment (such as cleaning materials), use of separate personal protective equipment such as footwear and clothing, thorough disinfection of all such items after use, and proper disposal of animal waste. Particular attention should be paid to avoiding the transmission of infective material via clothing, footwear, and equipment. Staff should never eat, drink or smoke in a quarantine facility. Ideally, a separate staff would care only for apes undergoing quarantine. If this is not possible, then contact with apes in quarantine should always follow contact with resident apes and never vice versa. If an animal in the resident group becomes ill and requires treatment, caretakers should change their daily routine to make sure healthy groups are seen to first, to prevent disease spread. Direct handling, with no intervening physical barrier, of conscious great apes in quarantine should be avoided because of the high probability of being bitten or scratched. Exceptions would be neonates that must be handled, held and bottle-fed, young apes that require social contact, and apes requiring contact for medical treatment.

A full clinical examination of every ape should be conducted, including complete blood count and serum chemistry where possible, under a general anaesthetic. Immobilization is also an opportunity to collect some basic biometric measurements, such as canine length, crown-rump length, hand and foot lengths. All of this should be part of the basic medical record described above. The

disease screening protocol designed as a result of the risk assessment should be implemented during this time as well. Specifics of disease testing should be included as part of the protocol.

Ideally, a serum bank should be established to store samples from all apes received. To this end, serum should be collected and stored at or below –20°C in a refrigerator/freezer that does not self-defrost and has reliable primary and back-up power sources (with failure alarms). For long-term banking (more than six months), a –70°C freezer or liquid nitrogen storage is advised. Because technology is rapidly changing, project veterinarians or geneticists should be consulted to determine the best storage method available. Additional serum samples should be taken and banked opportunistically, both within the quarantine period and afterward. A serum sample from each animal should be taken and banked immediately prior to transfer to the release site. While ideal, a serum bank may not be practicable for some ape sanctuaries.

Screening for endoparasites should be done at least three times during quarantine by testing faecal samples via both direct microscopy and flotation/concentration techniques. Faecal samples can be submitted for microbiological culture to test for the presence of potentially pathogenic bacteria, such as those of the genera *Salmonella, Shigella, Campylobacter* and *Yersinia*. Biological samples, including blood and hair, should be taken for genetic analysis. Samples may be frozen, dried, or preserved in alcohol or other solutions used for preserving genetic material. To determine which method to use, consult project veterinarians or a geneticist.

Vaccination should be given, as appropriate, during quarantine as determined by project veterinarians and the risk analysis process. Type, batch number and source of the vaccine should be recorded in an animal's medical records, as well as the site of vaccination in the case of injectable products. Serum samples from vaccinated apes should be tested opportunistically to establish the effectiveness of the vaccine schedules — usually this is most effective at least 30 days post vaccination.

All apes which die while in captivity must be necropsied, and tissue and body fluid samples collected for analysis. The necropsy should be performed as soon after death as possible to minimize the adverse effects of tissue degeneration and bacterial decomposition. Necropsies should be done with special consideration for human health and safety, as the potential to contract or spread diseases via careless post mortem techniques is high. When possible, all wild and re-introduced apes that die should also be necropsied and samples collected for further analysis. This information will be vital to help reduce uncertainty in the disease risk analysis.

Staff screening and health

Local human health authorities and consulting physicians should be involved in creating an occupational health programme for the project. The programme should include staff education regarding occupational health issues.

All staff should be in good general health. Staff members who are ill should not work with great apes or prepare their food. Staff members should promptly report onset of illness to the project manager or staff veterinarian. People who are ill are far more likely to contract other infectious diseases than are healthy individuals. Also, colds, influenza, measles, viral hepatitis, herpes viruses, enteric diseases such as salmonellosis, and many other infections can be passed to great apes and may cause serious disease. High standards of personal hygiene and facility cleanliness are required of animal care staff to avoid the transmission of infectious disease.

Protective clothing, such as disposable gloves and facemasks, should be worn whenever handling apes, including anaesthetised apes. Masks, gloves, and dedicated or disposable boots should also be worn when cleaning ape enclosures and when handling food and objects that will be given to the apes. This requirement applies to volunteers and visitors as well as to staff. Even if they are not handling apes or food, visitors approaching within 10m of great apes should wear masks.

Members of animal care staff, other project personnel, and anyone who may come in contact with the apes should undergo regular health checks for the safety of both the staff and the apes. Ideally conducted pre-employment, medical checks have advantages for staff and employer and ***should be developed in co-operation with a medical advisor.*** Characteristics of some existing programmes include: faecal bacteriology and parasitology; Hepatitis A, B, and C; tuberculosis; and

HIV. Because HIV-infected people can become severely immunosuppressed and would thus be at high risk of contracting disease from great apes, it is recommended that they not work directly with apes. However, laws of some nations prohibit denial of employment to HIV-infected people so this issue should be reviewed on case-by-case basis in light of the local culture. On a schedule determined by a consulting physician, there should be testing for tuberculosis via skin test or, for staff previously vaccinated with the BCG vaccine, acid-fast sputum test and/or chest X-ray. Other zoonotic risks should be included as determined by risk analysis.

New staff members, or current staff members who have been absent for an extended period, should not have any contact with apes for at least the first two weeks of employment/return. This allows sufficient time for development of most infectious diseases that the employee may be incubating when hired or returning, and for completion of medical tests if necessary. Pregnant staff members should be extremely careful when working with great apes and should seek a medical expert's advice on health risk. In general, staff members should not be employed at other primate-holding facilities or be exposed to apes outside of their work with the re-introduction project. Project managers should record all staff accidents, injuries, and illnesses.

Other people who have access to great apes awaiting re-introduction may pose a threat to the apes and may themselves be at risk of infection. The project manager and consulting veterinarian should decide which of the above health protocols for staff would also apply to volunteers, students, temporary staff, visiting zoo personnel, contractors and visitors.

Section VII
Transport and Release Strategy

*A detailed **transport and release strategy,** and a backup strategy should be developed and understood by all parties involved **prior** to any planned re-introductions.*

Development of transport plans for delivery of great apes to the country or site of re-introduction should place special emphasis on ways to minimize stress and avoid injury or illness. Apes should be transported in secure containment, large enough for them to stand quadrupedally, lie down comfortably, and turn around. Except for mothers with dependent offspring, great apes should be transported in individual compartments. However, sensory access between compartments is recommended. Apes can be habituated to transport crates by giving them access to the crates before shipment. Young, easily handled great apes might be carried by familiar caregivers during transport.

In some cases, where transport duration is less than a few hours, it may be preferable to transport great apes when they are anaesthetized. Shipping containers would not be required, at least for young apes. However, anaesthesia may increase the risk of transport, and deprives the ape of knowledge of the move. Where apes are anaesthetized only for crating purposes, departure should be delayed until they are fully conscious inside the crate, and recovery closely monitored throughout.

At all times during transport, frequent access to the apes for monitoring and the provision of sufficient food and water must be possible (with the probable exception of air transport).

Qualified personnel should accompany the release stock during transport and be trained and fully equipped to deal with emergencies such as acute health crises or escapes. A veterinarian must accompany anaesthetized apes at all times.

Project managers should consider transporting apes at night due to the cooler temperatures and apes' lower activity levels. Moves that occur in the morning or evening also avoid higher midday temperatures. Seasonal differences in temperature and rain should also be considered.

There must be a specific plan for removing apes from transport containment to holding cages, or directly to the wild if that is the intent. Shifting an ape from transport container to holding cage without anaesthesia is preferred, but requires structural compatibility between container and cage to prevent escape or injury.

The release strategy should address such details as acclimatization of the apes to the re-introduction area, behavioural training at the site, group composition, number of apes released, release patterns and techniques, and timing. The strategy should also provide for "site fidelity," such as short-term food provisioning and the presence of familiar caregivers, to ensure the released apes do not immediately disperse.

With soft-release strategies, all parties involved should fully understand the procedure. Some soft releases keep apes in transport cages at the release site, while others require the construction of enclosures or other temporary holding facilities. Such enclosures should provide a natural, commodious pre-release environment to help minimize stress to the apes and minimize risk of injury for any wild apes living in the area. They should be strong enough to contain panicked great apes and sufficient to accommodate the apes during unforeseen delays. Supplementary feeding stations, such as suspended platforms, should also be constructed. Apes should be released from holding as soon as it appears that they can respond normally.

Upon arrival at the final release site, apes should be closely observed. Individuals that have developed serious physical ailments or behavioural abnormalities during transport should not be released immediately. Observation should continue and any appropriate treatment administered. If the animal recovers, it may be released only with approval by project managers, consulting veterinarians, and behaviourists. Individuals that recover slowly and are not released with the main group may no longer be releasable.

With reinforcement projects, released apes should be distant enough from resident populations to minimize the chance of an encounter soon after release (see exception, below). The distance chosen should be based on the terrain and natural ranging behaviour of the great ape taxon involved, but should be at or beyond an edge of the home range of the nearest resident group or individuals likely to make eventual contact. Interaction with resident groups or individuals will promote genetic variability and can assist once-captive individuals to learn survival methods in their new wild environment.

An exception to the above is the release of one or a few individuals to a specific group, in which case the release should occur as close to the target group as possible, and as far away from other groups as normal ranging patterns allow.

The exact release site should be far enough from human dwellings, farms, roadways, or similar locales, to minimize the chance of apes dispersing to areas where humans are present. Natural boundaries, the taxon's home range and daily travel distance should be considered.

The release site should be mapped and demarcated. It may be necessary to cut trails and mark trees or other key points to facilitate post-release monitoring exercises, such as recording distance of dispersal after release.

Detailed planning should reduce risks during release implementation, such as for this silverback gorilla at PPG-Congo. Photo © Tony King / John Aspinall Foundation.

If radio telemetry is to be used, all tracking equipment should be checked to ensure it is in good working condition. Prior to release, tracking equipment should be tested in the release site to identify locations where reception is strong or poor, and where signals bounce. Apes should be habituated to radio collars and receivers well before release and the safety of the collars to the apes clearly demonstrated. A strategy for later removal and recovery of the collars is also necessary.

Thorough documentation of the release implementation, including behaviour of the apes before, during, and after release, is vital for future planning and to share with other re-introduction practitioners.

A clear decision-making chain and process should be determined in advance of the release, and all project personnel should know how decisions will be made and who will be making them. To the degree possible, potential outcomes should be anticipated and responses formulated in advance.

Facilities should be available to temporarily house individuals that react adversely to the re-introduction and must be rescued or recaptured.

The project director should decide whether dignitaries, media personnel or other interested parties are allowed to be present for the release, determine the code of conduct that they must follow, and provide a system to ensure compliance. If outside parties are present stringent measures should be taken to ensure that the apes are not affected by their presence.

Section VIII
Post-Release Monitoring

Post-release monitoring *should be conducted during and after the release, at least until rates of survival and reproduction can be estimated confidently.*

Long-term post-release monitoring is one of the most important components of a re-introduction or translocation project, so all (or a representative sample of) released individuals and an existing resident population should be monitored for an extended period, preferably for at least one year (i.e., one complete seasonal cycle). Post-release monitoring can be difficult and expensive, but it allows precise documentation of outcomes, which in turn allows refinement of procedures. Monitoring also allows quick human intervention if an individual needs to be rescued or if there is a need to intervene in great ape-human conflict. Monitoring allows accountability to funding and regulatory agencies and to the conservation community. It is strongly recommended that data gathered from monitoring projects are published, preferably in peer-reviewed journals but white papers available on web sites are another potential publication outlet.

Post-release monitoring of re-introduced great apes should include behavioural, demographic, ecological, and veterinary studies, measuring and mapping such variables as ranging patterns, intergroup and intragroup social interactions, group formation and structure, immigration and emigration, reproductive behaviour, feeding and food availability (for example, phenology studies), seasonal effects on behaviour, parentage, illness and injury, dates and causes of loss, and impact on ecosystem. A study of the processes of long-term adaptation by the released population as compared to wild populations is also important. Personnel conducting initial post-release monitoring should be familiar to the re-introduced apes. Radio telemetry should be considered for post-release monitoring.

Public relations activities, particularly conservation education and awareness, must be continued in the surrounding areas and their impact assessed. An evaluation of attitudes of local communities to the project over time should be included.

Socioeconomic studies should be made over time to determine the impact, costs, and benefits of the re-introduction project to local human populations.

Habitat protection should be ongoing and its effectiveness monitored.

Juveniles leaving their night cages and going to forest school for the day, accompanied by reseachers. Photo © Anne Russon.

Non-invasive techniques to monitor changes in released great apes' physical condition, such as estimating body weights, and urine and faecal sampling, should be developed without a need for recapture. Urinalysis, particularly for the presence of ketones, can be a useful indicator that the animal is obtaining adequate food intake. Protocols for recording food intake and observational assessment of released apes' physical condition and health status should be developed.

Genetic monitoring of released and wild populations is strongly advised. For reinforcement projects, such monitoring can help determine the genetic impact (increase in or loss of genetic diversity), if any, of the released apes on existing wild conspecifics. Genetic monitoring of re-introduced populations is also important to establish paternity and ascertain changes in genetic composition over time. Genealogies should be maintained as long as possible. Non-invasive techniques, such as collection of hair or faeces for DNA analysis, are advised.

Re-introduction managers should consult with veterinary and medical experts to develop strict human health, sanitation and waste removal standards for any field site used as a base from which to monitor released populations.

Field research staff should be subject to medical testing in the same manner as staff working at the quarantine facility, as required in "Staff Screening and Health" (pp. 24–25). Field staff should not work if they are ill.

Researchers and others should try to maintain a distance of 10m (two times the distance of dispersal of airborne disease agents) from released and wild apes, and they should not smoke, drink, or eat within sight of wild or re-introduced apes.

Humans have been injured or threatened by semi-tame and/or aggressive re-introduced great apes. Some cases have involved members of the re-introduction team, and some have involved residents of and around the release area. Apes whose histories (pp. 13–14) suggest that they will be aggressive toward humans should not be re-introduced. If such an individual was very likely to survive, it could be released in an area uninhabited by people and monitored only remotely. The possibility of ape-human contact underscores the importance of the guideline stipulating early and continued contact between the re-introduction project and local human residents about the purposes and procedures of the re-introduction. Local residents should be confident that unplanned ape-human contact will be addressed quickly by the managers of the re-introduction, and that they will be taught how to respond when confronted with an ape and how to report the incident. Staff members should be selected and trained in how to avoid provoking aggression, and should be taught how to respond in a confrontation. Particular attention should be given to safeguarding human infants. A re-introduced great ape that behaves aggressively towards people more than once should be translocated to a very remote area, returned to captivity, or euthanized if the lifetime captivity option is unavailable. Species patrol units might be employed specifically to monitor ape-human contact.

Intervention may be necessary if a post-release situation proves unfavourable. A documented plan for intervention or rescue, such as the removal of "problem" individuals, should be developed, with decision-makers clearly identified. This plan should be developed prior to release, reflect a wide variety of possible circumstances in which intervention may be necessary, identify appropriate personnel to conduct the action, and stipulate the period (post release) after which interventions would no longer be conducted. The plan should be understood by all parties involved. The plan should include provision for compensation for loss and damage. In general, intervention/rescue/compensation is warranted when the problems are caused by re-introduced apes, but not when the "problems" are those that would be caused naturally by normal wild apes.

For an ape that requires medical or other attention after release, capture and any subsequent treatment done under anaesthesia requires that all participating staff wear protective clothing and minimize stress to the animal.

All apes that die in the release area should be collected and investigated whenever possible. Every effort should be made to correctly identify the individual and determine probable time and possible cause of death at the site and then to perform a complete necropsy, and to collect, preserve and forward biological samples to a qualified diagnostic service such as the Great Ape Health Monitoring Unit (see Other Resources, p. 44).

On a regular basis, the overall success of the re-introduction project should be internally and externally evaluated according to the success criteria determined in the project proposal written at the project outset. This information should be distributed to the re-introduction, conservation and scientific community, local communities, and appropriate governmental bodies, so that other re-introduction practitioners may benefit from the results. When necessary, decisions should be made for revision (adaptive management), rescheduling, or discontinuation of the project.

Section IX
Considerations for Translocation

The following issues apply specifically to translocations—the deliberate capture and movement of wild apes from one natural habitat to another. Translocations should adhere to the guidelines listed previously in this document, but must also adequately justify the capture and removal of wild apes.

General Considerations

Translocation could be considered to establish or augment a population in suitable habitat within the historic range of the taxon, or to rescue an individual or population that is otherwise unlikely to survive. In the first case, removal of individuals for translocation must not endanger the wild source population.

A thorough capture strategy, including detailed capture techniques, and identification of appropriate personnel to conduct the action, must be developed, practiced, and fully understood by all parties involved. The capture of wild great apes is very difficult and carries its own inherent risks of injury and death for the apes. These risks should be clearly outweighed by the risks of remaining *in situ* such that injury or loss of individuals is avoided as much as possible. A veterinarian with great ape experience should be involved. Rehearsal of capture procedures should be conducted.

Groups to be moved should be studied in advance to assist in assessment of their behaviour and adaptability in the new environment. For example, data on known or assumed relationships among individuals, such as parent-offspring relationships, should be recorded.

Smaller groups should generally be targeted for translocation, for example, groups that are too small to form independent social units or are isolated from other groups and thus unable to form a viable population. However, groups that are significantly smaller than the average size for wild populations of the species of concern may be incapable of stabilizing or adapting after translocation. Management plans should take into account any individuals of a group that could not be captured in the projected time frame.

Extra care should be taken when targeting groups with recently weaned juveniles or individuals that are too small to be safely darted.

Rescued wild apes should be released as quickly as possible to minimize any alteration in their skills, behaviours, social relationships, and knowledge. However, all guidelines should still be followed, especially those on disease control. If necessary, some stages in planning and preparation, such as review and approval of written proposal, could be accelerated.

If more than one group is moved simultaneously, each group's holding cage(s) at the release site should be widely separated to minimize the chance that groups will encounter one another

soon after release. The distance chosen should be based on the natural ranging behaviour of the ape taxon involved, with groups being separated by at least one home-range area typical of that taxon.

Veterinary Considerations

Diseases can also be transported when moving wild great apes from one area to another. Some of these diseases may compromise the apes' ability to cope with the move, or they may infect resident apes living in the release area. Sample collection and testing for such diseases is important to increase the probability of success, and to provide a picture of what infectious agents occur naturally in a population. However, the additional stress that wild apes often experience due to unnecessary veterinary procedures should be avoided.

Since the Precautionary Principle applies to both the source and destination populations in great ape translocations, an external multidisciplinary group should review proposed veterinary plans to ensure that proper precautions for the health and welfare of the apes to be moved, as well as other apes living in the release area, are taken.

Protective clothing and good hygiene, as described above, are as critical when working with wild great apes as they are with captive apes, and must be practiced whenever handling wild apes.

Invasive veterinary screening of great apes involved in wild-to-wild translocation should be minimized. During the capture procedure, rapid physical examinations should be conducted on all individuals by experienced handlers who themselves are free of infectious disease. When possible, blood, hair, sputum, and faecal samples should be collected for genetic and veterinary analysis; a permanent identifier should be applied; facial and dental photographs taken and any other identifying features noted. In general, an anaesthetic should be used to minimize stress to the apes. Serum samples can help determine which infectious agents are present in the population. Findings may yield clues to the success or failure of the translocated apes and may provide valuable information for future translocations. A resource facility such as The Great Ape Health Monitoring Unit should be consulted concerning examination and sampling protocols, storage of samples, and record-keeping.

If great apes are to be translocated from areas where serious infectious diseases occur, more intensive screening and even quarantine should be considered. Quarantine should be at least 30 days, or more in cases where certain infectious diseases with longer incubation periods (such as tuberculosis or rabies) are suspected.

Every effort should be made to minimize stress during veterinary procedures, quarantine, and transport. Stress such as that caused by frequent anaesthesia and handling, overcrowding, social separation, loud noises, temperature extremes, rough transport and unnecessary onlookers can increase susceptibility to disease and disrupts cognitive functioning, and thus can interfere with translocation success. Release sites should be selected in part by the possibility for quick and direct movement from the capture site to the release site.

Section X
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Section XI
Bibliography

Some references in this bibliography may describe procedures that are not consistent with these guidelines.

For a version of this bibliography in End Note©, PDF copies of the references (re-introduction managers and sanctuary managers only; not all references are available), and to make corrections or additions to the bibliography, contact bbeck@greatapetrust.org or kwalkup@greatapetrust.org.

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Sodaro, C. (ed.) 2006. Orangutan Species Survival Plan Husbandry Manual. Orangutan SSP, Chicago Zoological Society, Brookfield Zoo, Brookfield, IL.

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Great Ape Survival Project (GRASP)
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Conservation Information Service http://pin.primate.wisc.edu/infoserv/cis/projects.html

PrimateLit Database:
http://primatelit.library.wisc.edu

Primate Info Net
http://pin.primate.wisc.edu/

Annex I. Decision Tree

Section A: General

A1) Is there a need for re-introduction, i.e., could re-introduction re-establish or supplement a viable, self-sustaining wild population to enhance the long term survival of a taxon?
- No → If no, continue to step **C1 (p 48)**.
- Yes ↓

A2) Is re-introduction the most cost-effective conservation action, i.e., would habitat restoration or habitat protection or law enforcement be more cost-effective for enhancing the long-term survival of a taxon?
- No → If no, discontinue re-introduction planning and proceed with other actions.
- Yes ↓

A3) Is an expert, multi-disciplinary team in place to plan and guide the re-introduction?
- No → If no, establish team and continue to step **A4**, or discontinue re-introduction planning.
- Yes ↓

A4) Is there a written proposal detailing the project's background, objectives, methodology, schedule and budget?
- No → If no, write proposal and continue to step **A5**, or discontinue re -introduction.
- Yes ↓

A5) Can the Precautionary Principle be upheld?
- No → If no, discontinue re-introduction planning.
- Yes ↓

A6) Is there a compilation of the socioecological, behavioural, and biomedical knowledge of the taxon?
- No → If no, compile literature review and continue to step **A7**, or discontinue re-introduction planning.
- Yes ↓

A7) Is there a source population that can supply apes suitable for re-introduction without jeopardizing the viability of the source population?
- No → If no, establish suitable source population and continue to step **A8**, or discontinue re-introduction planning.
- Yes ↓

A8) Is there a release site with suitable habitat within the historic range of the taxon? Have adequate surveys been carried out to check food availability?
- No → Conduct surveys to assess in detail planning. If an adequate release site is not available, go to step **B1 (p. 47)**, or restore habitat to make it suitable and then return to step **A9,** or discontinue re-introduction.
- Yes ↓

A9) Is the taxon absent from the proposed release site or, if present, is it sufficiently below carrying capacity to make detrimental competition and conflict with the re-introduced apes unlikely?
- No → If no select another site and return to step **A4**, or discontinue re-introduction planning.
- Yes ↓

A10) Have the original causes of decline or extinction of the taxon been addressed?
- No → If no, continue to step **B1 (p. 47)**, or address original causes of decline and then return to step **A11**, or discontinue re-introduction planning.
- Yes ↓

Continued on next page

Annex 1

Section A: General, *continued*

A11) Is there a reasonable likelihood of secure, long-term funding for the re-introduction project, including adequate preparation of the apes to be released, and long-term post-release monitoring?

No → If no, secure adequate funding and continue to step **A12**, or discontinue re-introduction planning.

Yes

A12) Can all local, national and international laws and regulations be met?

No → If no, revise plans to meet laws and regulations and continue to step **A13**, or discontinue re-introduction planning.

Yes

A13) Do the governments of the nation and district in which the release site is located support the re-introduction, and is there support by local communities?

No → If no, establish diplomatic, public relations, education and economic benefit programmes sufficient to gain support and continue to step **A14**, or discontinue re-introduction planning.

Yes

A14) Have the apes to be re-introduced been behaviourally and developmentally assessed; and have they acquired natural social and ecological skills, and been weaned from human contact and dependence, such that they can survive independently (or with greater independence) in the wild?

No → If no, conduct assessment, training and development of independence and continue to step **A15**, or discontinue re-introduction planning.

Yes

A15) Have the apes to be released been genetically characterized so as to ensure that they are of the same taxon as the population that previously existed or still exists at the release site?

No → If no, conduct genetic assessment to ensure taxon equivalency and continue to step **A16**, or if not the same taxon continue to step **B1 (p. 47)**, or discontinue re-introduction planning.

Yes

A16) Have the apes to be re-introduced been medically screened and examined, quarantined, treated, vaccinated and cleared for release?

No → If no, quarantine and treat apes and continue to step **A17**, or discontinue re-introduction planning.

Yes

A17) Is there a plan in place to safely transport apes to the release point, and to actually release them?

No → If no, formulate plan and continue to step **A18**, or discontinue re-introduction planning.

Yes

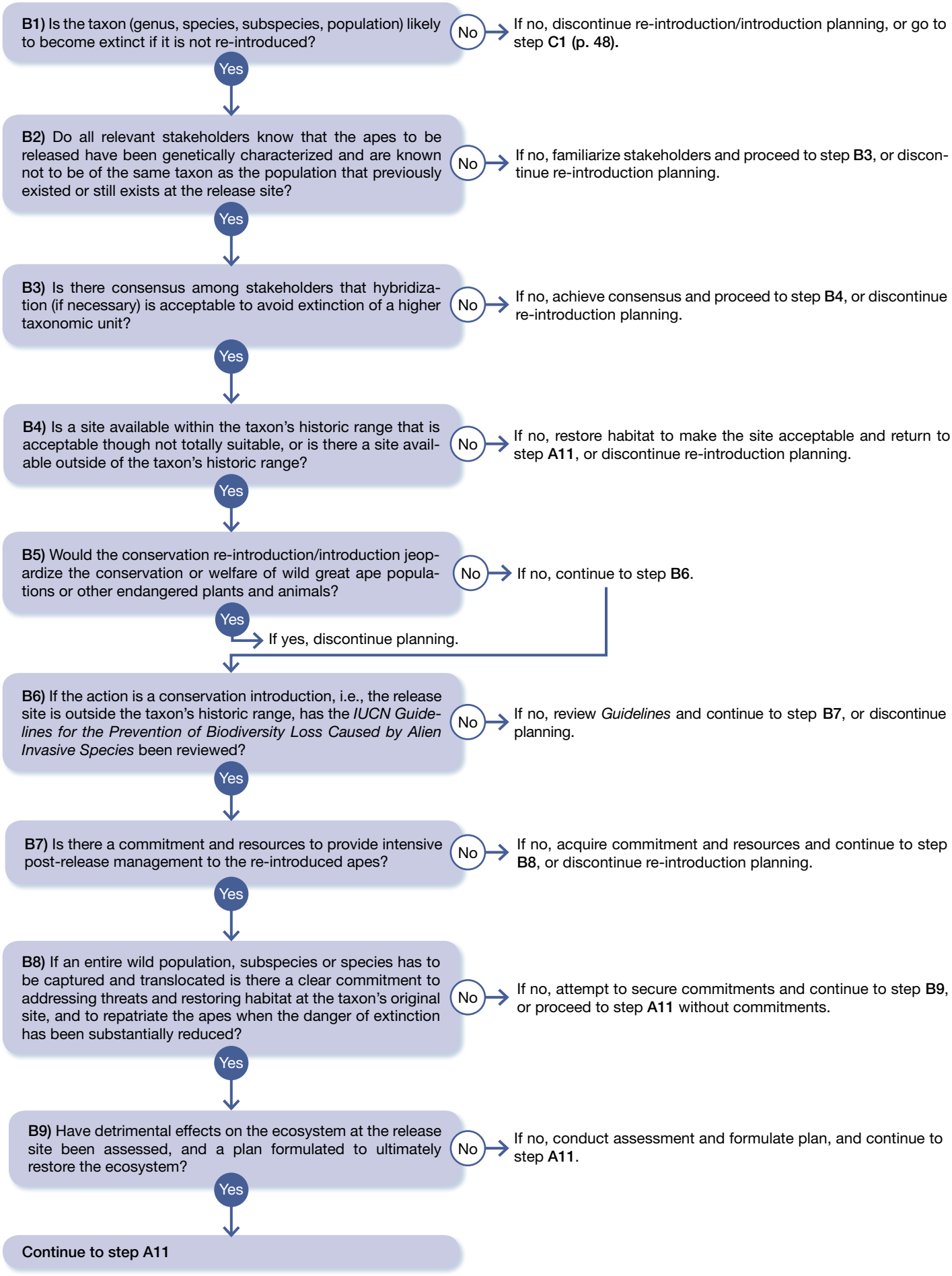
A18) Release apes, begin post-release monitoring and management. Continue to step A19.

Yes

A19) Document and publish post-release outcomes.

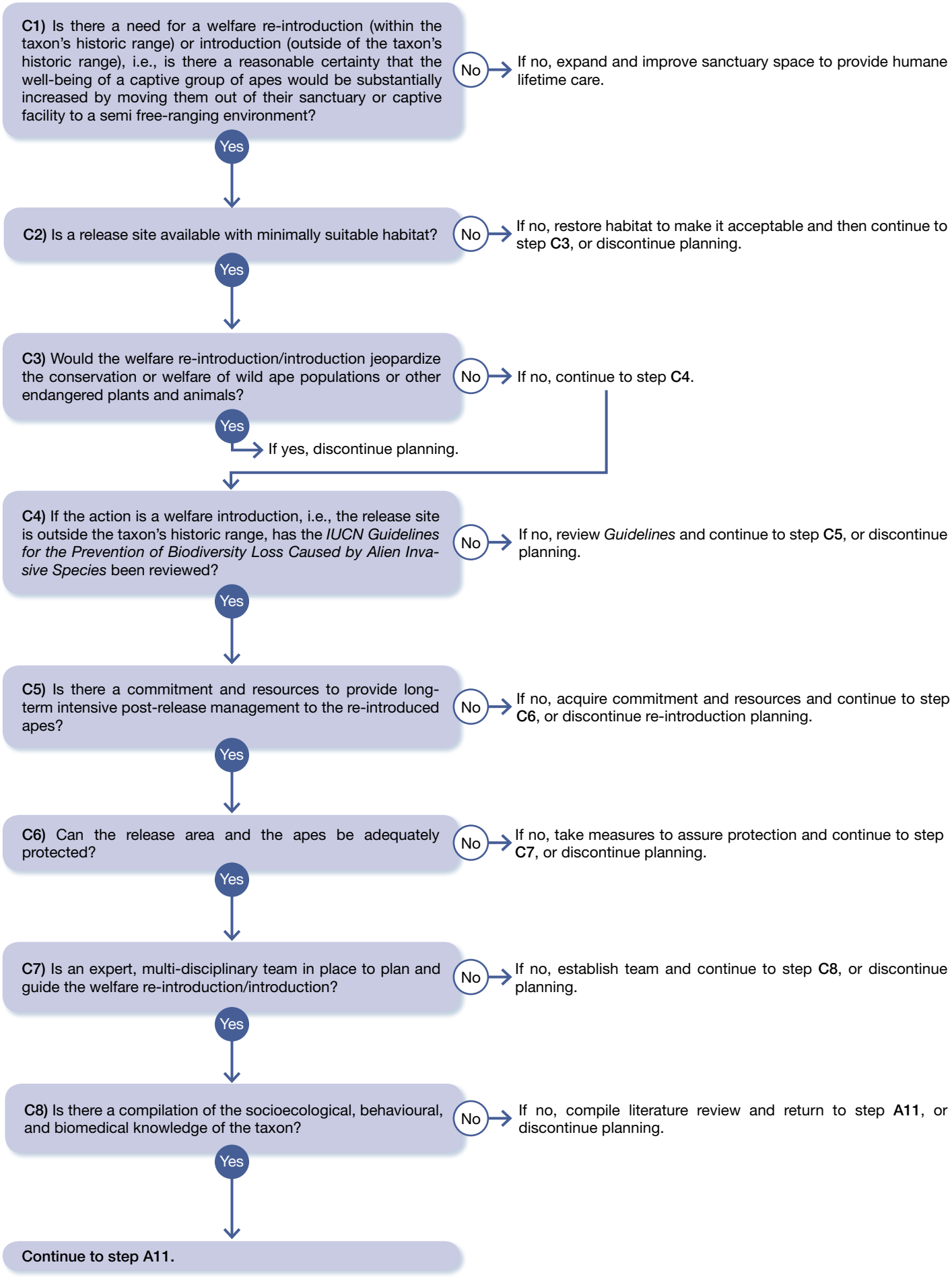
Annex 1

Section B: Conservation Re-introduction (within historic range) or Conservation Introduction (outside historic range)



Annex 1

Section C: Welfare Re-introduction/Introduction



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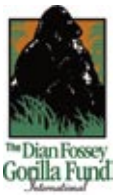

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