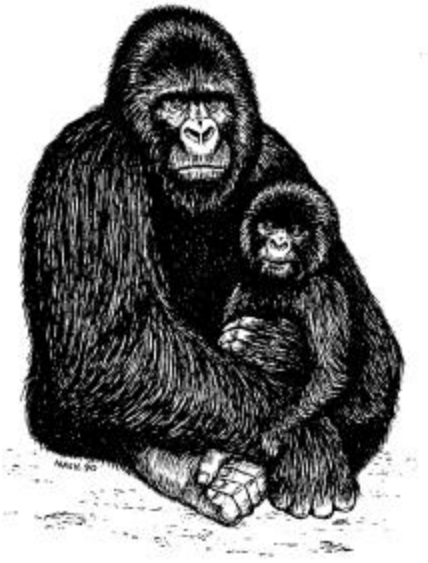
CAN THE MOUNTAIN GORILLA SURVIVE?

Population and Habitat Viability Assessment for *Gorilla gorilla beringei*

Kampala, Uganda
8 - 12 December, 1997



S. Werikhe, L. Macfie, N. Rosen, and P. Miller, editors

A Collaborative Workshop:

Uganda Wildlife Authority
Office Rwandais de Tourisme et Parcs Nationaux
Institut Congolais pour la Conservation de la Nature

The Primate Specialist Group (SSC/IUCN)

The Conservation Breeding Specialist Group (SSC/IUCN)

Sponsors:

Columbus Zoo
International Gorilla Conservation Programme
Dian Fossey Gorilla Fund International
Dian Fossey Gorilla Fund Europe
Wildlife Conservation Society
Jersey Wildlife Preservation Trust
Abercrombie & Kent

A contribution of the IUCN/SSC Conservation Breeding Specialist Group in conjunction with the Uganda WildlifeAuthority (UWA), Office Rwandais de Tourisme et Parcs Nationaux (ORTPN), Institut Congolais pour la Conservation de la Nature (ICCN), and the Primate Specialist Group.

Sponsors of this PHVA workshop were The Columbus Zoo, The International Gorilla Conservation Programme, The Dian Fossey Gorilla Fund International, The Dian Fossey Gorilla Fund Europe, The Wildlife Conservation Society, The Jersey Wildlife Preservation Trust, and Abercrombie & Kent.

Cover Photo: Maturing silverback male courtesy of Martha Robbins
Cover and Section Divider Illustration: Steven Nash

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DONORS

We spotted from our camp a group of black, large apes, which attempted to climb to the highest peak of the volcano. Of these apes we managed to shoot two, which fell with much noise into a canyon opening to the northeast of us. After five hours of hard work, we managed to haul up one of these animals with ropes. It was a large, man-like ape, a male, about 1½ m. high and weighing over 200 pounds. The chest without hair, the hands and feet of huge size. I could unfortunately not determine the genus of the ape. He was for a chimpanzee of a previously unknown size, and the presence of gorillas in the Lake region has as yet not been determined.

Report of Captain Oscar von Beringe
while climbing Mt. Sabinio in the
Virunga Volcanoes region,
October 17, 1902.

Reprinted from
The Mountain Gorilla:
Ecology and Behavior

Can The Mountain Gorilla Survive?

POPULATION AND HABITAT VIABILITY ASSESSMENT (PHVA) FOR *Gorilla gorilla beringei*

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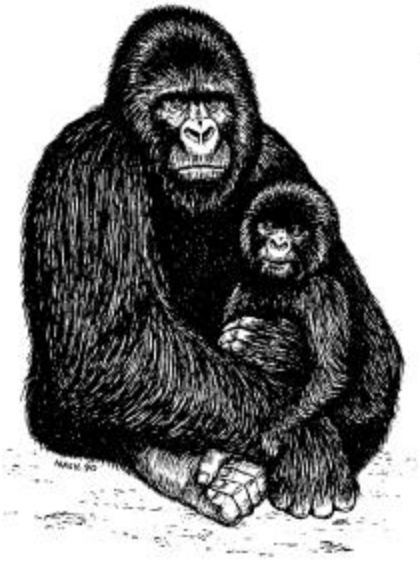


8 – 12 December 1997
Kampala, Uganda

Section

Executive Summary and Recommendations

1

Mountain Gorilla Population and Habitat Viability Assessment Executive Summary

Introduction

Gorillas are found in east central Africa and equatorial west Africa.One of the three gorilla subspecies, the mountain gorilla (*Gorilla gorilla beringei*), is restricted in its distribution to two small populations: one of about 300 individuals in the Bwindi Impenetrable National Park in Uganda, and the other of about 320 animals in the Virunga Volcanoes region. The Virungas region includes Mgahinga Gorilla National Park (Uganda), Parc National des Volcans (Rwanda), and Parc National des Virunga (Democratic Republic of Congo). There is currently some debate concerning the taxonomic continuity of these two populations; morphological and genetic analysis have not yet reached consensus. While the taxonomic debate continues, we recognize these two populations as distinct management units that may require individual attention unique to their ecological and geopolitical environments. Consequently, we will continue to refer to these populations as mountain gorillas throughout this text.

The distribution of the mountain gorilla is entirely within National Parks, but there are serious threats to these ecologically vital afromontane and medium altitude forest habitats. Historically, hunting and poaching resulted in a rapid decline of the Virungas population from which it has not yet recovered. The continuing civil unrest and outright armed conflict in Rwanda and the Democratic Republic of Congo (former Zaire) is producing many thousands of refugees who are encroaching into the Parc des Volcans and the Parc des Virunga areas. Current rates of deforestation for firewood collection and building materials are likely to cause permanent habitat damage in the very near future. Uganda's Mgahinga National Park also has suffered from these unsustainable land-use practices. Moreover, the dangerous situation in Rwanda has prevented any protection, conservation, or research efforts since August 1997, the longest period in recent history that the Virunga gorillas have been unmonitored and unprotected (i.e., no anti-poaching patrols). The potentially rapid rate of habitat destruction in the National Parks resulting from this crisis situation will result in a decline in mountain gorilla population size and a long-term reduction in the viability of the subspecies as a whole. There is a need for a systematic evaluation of mountain gorilla population viability and development of a regional management plan that incorporates the needs of all relevant governmental, non-governmental agencies, public and private stakeholders.

The Conservation Breeding Specialist Group, in collaboration with the Primate Specialist Group, was invited by the Director of Uganda Wildlife Authority, the Office Rwandais de Tourisme et Parcs Nationaux, and the Institut Congolais pour la Conservation de la Nature to conduct a PHVA for the mountain gorilla in December, 1997 in Kampala, Uganda. Participants included biologists, researchers, and wildlife managers from Uganda, Congo and Rwanda, and international experts on mountain gorilla population biology and ecology. Approximately 79 people participated in the Workshop with 52 people attending the entire 5 days. Full time participants included 26 nationals from the range states. There were 17 participants with expertise in Rwanda, 6 in Congo, 24 in Uganda and 14 with regional expertise. Eighteen people were from protected area authorities and 16 from NGOs active in range management. The

workshop received generous sponsorship from the Columbus Zoo, the International Gorilla Conservation Programme, the Dian Fossey Gorilla Fund Europe, the Dian Fossey Gorilla Fund International, the Wildlife Conservation Society, Jersey Wildlife Preservation Trust, and Abercrombie and Kent.

While the workshop was held in Uganda, the focus of the process was a regional approach with respect to management needs, governance, finances, research, species biology, habitat requirements, health needs, and threat assessment. This approach can be successfully implemented only through continued cooperation between all range-country organizations.

The objectives of the PHVA workshop process were to assist local managers and policy makers to: 1) formulate priorities for a practical management program for survival, recovery, and long term viability of the two mountain gorilla populations in their wild habitat; 2) develop a risk analysis and population simulation model for the mountain gorilla which can be used to guide and evaluate management and research activities; 3) identify specific habitat areas that should be afforded strict levels of protection and management; 4) identify and initiate useful technology transfer and training; and 5) identify and recruit potential collaborators from central Africa as well as the greater international community.

On the first day, after overview presentations, the entire group engaged in a problems and needs identification exercise. All participants individually contributed to generate a list of about 130 items recorded on flip chart paper to provide an ongoing record of the ideas. This list provided a series of themes that served to guide the formation of six working groups in the afternoon of the first day. The entire group participated in the formulation of these groups. These working groups, whose reports provide the body of this report, began the first afternoon to group the problems into a smaller set of categories or topics which were used for more intensive description and analysis. This process initially appeared very chaotic and confused to observers but on the second day, as the members of the group learned to work together, a strong focus on selected high priority problems emerged in each group. The groups then developed a series of actions that might be used to manage each of the detailed issues that were prepared in the problem analysis. This then led to formulation of recommendations and the selection of those recommendations judged to be of highest priority for action to conserve the mountain gorilla populations in their native habitat. The groups presented progress reports each day in plenary sessions to provide for the exchange of ideas, consideration of factors that may have been omitted and to provide a basis for review and general agreement on the major recommendations from the workshop.

The high priority recommendations from each group were presented to the entire workshop on the afternoon of the 4th day with an intensive discussion and comment on each of the items. The recommendations were then revised and modified in light of these comments by each working group. The entire group again reviewed these revised recommendations on the final morning of the workshop and these recommendations are presented here as part of the executive summary. More detail on each of the recommendations and supporting description of the problems may be found in the body of the working group reports. These recommendations thus represent the consensus agreement of all participants in the workshop. Note that the recommendations as listed here have been translated into French for the benefit of those readers

from the Francophone range countries; additional selected portions of the remaining report have been similarly translated when possible.

Perhaps the most general conclusion of the workshop was the need for recognition that the mountain gorilla is now limited to 2 small populations of about 300 individuals which may be very vulnerable to pressures from surrounding human populations. The current turmoil in these human populations has made the process of monitoring, managing, and protecting the Virungas population difficult if not impossible. It is possible that this population could be rapidly reduced in numbers in the short term and that its habitat could be greatly reduced with longer term negative effects. There is a risk of significant population decline and eventual extinction. The current political/civil situation in the region, if it persists, poses the very threats (namely, war and disease) that simulation modeling at the workshop identifies as the primary agents of this risk. It will therefore be essential for the survival of the mountain gorilla to develop mechanisms for regional collaboration for their protection and management.

Recommendations

Health and Disease Working Group

1. Sustainable Vet Unit
   Fundamental to the conservation of the mountain gorilla is the existence of sustainable national veterinary units responsible for implementation of veterinary services.

   Therefore, we recommend the creation or further development of a wildlife veterinary unit in each of the mountain gorillas' range countries. Inherent to this proposal is the provision of adequate financial and human resources. In order for this to occur, adequate technical assistance and education of host country governments needs to be provided.

2. Diagnostic Capabilities
   At present, there is lack of adequately equipped local/regional laboratories and/or trained personnel available for processing of mountain gorilla samples. Such facilities are essential to rapid diagnosis of disease and routine monitoring of mountain gorilla health.

   Therefore, we recommend that an effort be made to identify potential local/regional diagnostic facilities and that a plan be developed to aid in developing and supporting such a facility, including the training of personnel. At the same time, standardized protocols for sample collection, handling, identification, processing and reporting should be developed, approved and distributed. There is also a need to obtain expedited CITES permits in those cases where samples of diagnostic importance need to be transported internationally to specialty laboratories to support proper disease diagnosis and control.

3. Financial Support
   In order to ensure sustainable and effective veterinary services for mountain gorillas, there is an urgent need of funding for equipment, clinical, diagnostic and research support, and training of local personnel, with input from government agencies, NGOs and other relevant

agencies. Veterinarians responsible for mountain gorilla health should be directly involved in identifying needs and prioritizing them relative to available funds. Budgets should include funds reserved for emergency veterinary management of disease outbreaks. In order for this to occur, adequate technical assistance and education of host country governments needs to be provided.

4. Database
   At present, there is no effective mechanism of orderly, standardized collection, management and dissemination of data and materials relevant to mountain gorilla health.

   We recommend the establishment of an interactive, international computerized database and an organized tissue/serum bank. All concerned agencies and individuals should contribute to the creation and management of this database and identification of an organized agency.

5. Disease Surveillance Plan and Review
   The science of veterinary epidemiology is well-developed at this time and has effective tools to provide a scientific assessment of the health risks to the remaining populations of mountain gorillas. However, to date, it has not been adequately applied.

   Therefore, we recommend the development of a comprehensive epidemiologically-based plan and appropriate research for safeguarding mountain gorilla health. This plan should be based on scientifically sound disease surveillance and control practices, taking into account both human and animal populations. Epidemiological data should serve as the basis for developing policies on mountain gorilla health. However, we recognize that such policies will be finalized and implemented within an interdisciplinary framework. If such policies are based on other, less scientifically rigorous considerations, then effective disease monitoring and control could be compromised.

Human Population Issues Working Group (no priority assigned).

1. Work with humanitarian agencies to ensure their emergency plans fully address conservation concerns. In addition, conservation agencies (governmental and non-governmental) must prepare their own emergency plans which address identified critical interactions of humans with gorillas and their habitat.

2. Promote community participation in conservation through institutional mechanisms which enable consultation with the local population on all aspects of the park that concern these populations and with decisional power on areas that particularly affect them (i.e. revenue sharing, control of crop raiding, conservation education)

3. Guarantee a consistent, reliable source of funds dedicated for sharing with local communities, ensuring: 1) transparency in decision-making; 2) management of expectations; 3) strong conservation linkage; 4) substantial community investment and capacity to sustain; and 5) clear policy guidelines. The most effective, practical mechanism would be to guarantee a proportion of total park revenue for this purpose. In the absence of this policy, it

is recommended that an additional fee be charged for each gorilla permit. However, investigation of means to diversify the source of funds to be shared should be undertaken.

4. Establish a trust fund(s) for Parc National des Volcans and Parc National des Virungas drawing on experience of other trust funds with full collaboration of governmental and non-governmental agencies active in gorilla conservation in the region. Increase the existing Mgahinga and Bwindi trust finds.

5. Conduct a study to consider the possibility of implementing programmes for sustainable utilization of minor forest products (e.g. medicinal herbs, honey, vines, water) in the Virungas (PNV, PNVi, MGNP) taking into account: a) potential threats to mountain gorilla conservation; b) biology of the resources targeted; c) size and shape of the park; d) park history; e) extent of current (illegal) uses; f) potential conservation benefits; g) implementation cost; and h) alternative resource sharing mechanisms (e.g., revenue sharing and trust funds) providing benefits to local communities that could obviate the need to give communities access to forest products.

6. Because park boundaries represent the most acute pressure points of conflict between local people and the park: a) boundaries must be clearly marked and their integrity enforced, b) measures must be taken to address problems caused by crop-raiding wildlife.

Population Biology and Simulation Modeling Working Group

1. During times of relatively minimal intensity of human-gorilla population conflicts, recognition should be made of the potential for resilient gorilla population growth. However, when human population pressures result in severe loss of gorilla habitat and an overall reduction in gorilla population growth potential, an even greater recognition of the acute risks this subspecies faces is required so that extinction risk is minimized.

2. More accurate information regarding impact of disease on gorilla mortality rates and reduced fecundity should be assembled, thereby increasing the predictive value of the modeling process.

3. More accurate assessment is needed of how human disturbance affects mortality rates and fecundity in un-habituated gorillas because there may be a greater effect on unmonitored groups.

4. Population modeling should be applied as an evaluation tool to contingency plans developed as part of a broader long-term mountain gorilla conservation plan.

5. More accurate evaluation and monitoring of the amount and quality of habitat in the Virunga and Bwindi populations should take place.

6. Demographic parameters (e.g., age-specific fertility and mortality, interbirth interval) for the Bwindi population need to be established for accurate assessments of that population's growth rate .

7. Because the mountain gorilla exists in only two small and isolated populations, reduced carrying capacity increases the probability of population extinction, complacency is inappropriate even though a strong extent of population resilience is apparent.

Management and Research Working Group (all are considered equally important)

1. We recommend that research focused on areas which are of critical importance for management be initiated and implemented. The following four key areas were identified:
   - poaching of plant and animal forest products
   - crop raiding by animals from the park
   - impacts of tourism and habituation of gorillas
   - impacts of resource sharing

2. We recommend that standardized ranger-based monitoring be developed and implemented throughout the Virunga Volcanoes and Bwindi regions
   - the programs will focus on monitoring trends in areas considered critical to management

3. We recommend that procedures be developed to enhance collaboration between the park and all stakeholders
   - to raise awareness
   - to enforce and update environmental legislation and to strengthen enforcement procedures
   - to develop policies and systems for problem animal control

4. We recommend that continued support be given to the protected area management authorities to increase the effectiveness of conservation
   - by implementing planning both at strategic and operational level
   - by researching options for sustainable funding for protected area authorities and to develop funding mechanisms
   - by furthering the decentralization of the protected area authorities and building upon existing capacity within those institutions
   - by strengthening existing tourism programs

5. We recommend that sensitization programs targeted at all levels be implemented
   - to raise government awareness
   - by developing strategies and programs for interpretation, for both national and international tourism
   - to encourage national tourism

6. We recommend that a framework be developed for regional collaboration, such as a Peace park. We also recommend that improved mechanisms for communication and collaboration

between partners be developed. One of the objectives of this will be the development of regional tourism

Governance Working Group

1. Legislation and Policy
   - Lead agencies to encourage Ministers of Range States (Uganda, Rwanda, Democratic Rebublic of Congo) to meet to discuss legal issues; IGCP/DFGF to help to facilitate.
   - Lead agencies to encourage countries to give greater priority to nature conservation and related tourism by placing responsibility for the environment, nature conservation and tourism in a single Ministry.
   - Lead agencies to have more contact with political leaders regarding legal issues, e.g. invitation to meetings; press conferences; to open and to address meetings; to be supplied with more information.
   - Lead agencies to improve by action - discussion meetings, dinner debates. Use or form (e.g.) Park Management Advisory Committees at District level.
   - Lead agencies and conservation NGOs to initiate and coordinate implementation of the process of translation of legislation into guidelines, regulations, by-laws. To encourage lead agencies to disseminate information via (e.g.) media, publications, schools, hotels.
   - Form monitoring group for each country. Membership: Lead agencies - 2, IGCP/DFGF - 2, Ministry - 1, Local people/Communities near Parks - 1 or 2. Number of Members: 6 or 7 plus power to co-opt. Funding: by lead agencies with IGCP/DFGF backup. Purpose: Monitor implementation of law. Group to decide on its Terms of Ref.

2. Barrier of Sovereignty
   - Lead agencies to promote, through communication with appropriate governmental authorities, the harmonising of conservation legislation and its implementation and enforcement within the range states.

3. Ownership
   - Immediate Action: To sensitise all stakeholders about importance of use of the correct interpretation of the word 'ownership' - to mean shared responsibility in the joint protection of the mountain gorilla.
   - Longer Term:
     1. To investigate the use of the Migratory Species Convention to strengthen joint protection measures. Although it is recognised that gorillas are not considered migratory (in science).
     2. To investigate the possibility of a World Heritage Site for Uganda and Rwanda.
     3. To investigate management of Virunga Range as a Peace Park.

4. Insecurity and Political Conflict
   - Lead agencies to bring to the attention of the appropriate governmental authorities the draft of the 'Code of Conduct for Trans-Border Areas (TBA/ZPTF) in Peacetime or During Conflicts' - see 'Parks for Peace' Conference Report, 1997.

- Lead agencies and appropriate government departments to request co-operation of military authorities in the coordination of protective conservation measures through range countries.
- Lead agencies and the international conservation community to strengthen awareness programs for the military authorities as to the critically endangered status of the mountain gorilla, and to do everything possible to maintain the conservation viability of the species and its associated habitat.

5. Regional and Institutional Collaboration
   - The Governance Group agrees with the majority of the recommendations of the Finance Group re: the need for improved regional and institutional collaboration and highly recommends the development of Codes of Practice to facilitate this. This is to be achieved through lead agencies establishing NGO coordination offices in the range countries and through informal meetings of stakeholders.
   - These 'in-country' offices to coordinate NGO activities, e.g., terms of referees, M of U's, criteria for project approval, establishment of steering committee, monitoring & evaluation of projects, etc.

6. Research Material
   - Lead agencies/Ministries should make it a condition of any research authorisation that: Samples remain property of state; samples and data should be shared with the host country institution and made available to researchers.
   - Lead agencies to keep records of authorisations, samples, exports, deposits of samples and data.
   - NGOs to have policies on sharing benefits of research with host country including training of local nationals.
   - NGOs and home institutions to ensure compliance by their researchers.

Finance, Revenue, and Economics Working Group

The following recommendations are listed in general priority order. In a broad sense, then, priorities from the highest to the lowest levels respectively focused on 1) revenue and value generation and management, 2) cost-benefit analysis, 3) threats to revenue and opportunities for collaboration and 4) revenue and value generation focused on tourism and education.

1. Types of Revenue Generation and Mechanisms of Finance (1st priority)
   - Stakeholders (governments, NGOs and donors, private sector) should meet to:
     1. discuss appropriate revenue sources and revenue sourcing mechanisms from the extensive work group list included in the report,
     2. make recommendations for a more formal, single-representative body of all stakeholders, to monitor and continue (1) above based on recommendations received from stakeholder organizations.

     These meetings within sectors can be facilitated by using those representative organizations which already exist, such as Ministries of Tourism and Wildlife (government), IGCP (NGOs and donors), Association of Tour Operators (Private Sector).

2. Enhancing Values for Conservation of Mountain Gorillas and their Habitat (1st priority)
   - relevant authorities in each range state be encouraged to promote the mountain gorilla as a symbol of ecotourism and good practice worldwide and they should be supported in developing a full campaign in 1998-1999 to promote the gorilla as an emblem.
   - that existing Africa-based formal and informal education networks (some with international reach) be used to launch a program of deliberate education on the values of gorilla conservation to key target audiences including funding bodies, corporate entities, tourists and the general public internationally, as well as government bodies, companies, expatriate communities and individuals-especially children-in each range state.

3. Cost-benefit analysis: Putting the economic case for gorilla and habitat conservation (2nd priority)
   - There needs to be a cost-benefit analysis for mountain gorilla conservation which will elucidate the resources necessary to support mountain gorilla conservation and provide greater understanding of the entire needs of protecting gorillas in their habitat. Such an analysis will provide a strong economic case for protecting mountain gorillas and their habitat.
   - In addition, there needs to be an exploration of new and promising revenue generating activities such as biodiversity prospecting (conducted in a sustainable fashion), carbon trading initiatives and other innovative financing mechanisms.

4. Threats to Revenue (3rd priority)
   - There needs to be concerted efforts to overcome existing and future threats to revenues that support mountain gorilla conservation. These threats include, among others, war, loss of control of revenues by management authorities, loss of opportunities for providing benefits to local communities, and severe reduction or total loss of the gorilla population.

5. Regional and institutional collaboration (3rd priority)
   - The various stakeholder groups in gorilla conservation and tourism in each range sate (government, non-government, private sector) should meet internationally to share information and to develop mechanisms for promoting a collaborative, regional perspective, with diversification of funding mechanisms and sources.
   - Donors also need to be informed of the long-term need for external funding to ensure the sustainable conservation of mountain gorillas.

   - The group recommends that these informal groupings should progressively evolve into a fully representative, formal body for regional gorilla and habitat conservation.

6. Integration of mountain gorilla tourism into national tourism (4th priority)
   - There is a need to integrate gorilla tourism into the whole tourism sector at both national and regional level.

7. Should mountain gorillas be expected to pay for their own conservation and the associated development of the community? (4th priority)
   - The mountain gorilla is a special case, and the group recommends that:

1. gorilla conservation should **not** have to meet narrow interpretations of financial self-sufficiency [i.e., monetary];
2. an analysis of all costs and benefits to the community [financial and non-financial] of gorilla conservation, including the world's willingness to pay for their survival, be summarized and be made widely available;
3. the mountain gorilla should be used as a special case study which is incorporated into formal and informal education in all range states at all levels to demonstrate the broadest values of species and habit conservation.

Groupe de Travail sur la Sante et le Bien-Etre

1. Organisation de la conservation actuelle
   - L'absence d'informations sur l'historique médicale du gorille de montagne limite l'apport significatif des vétérinaires à leur conservation efficace. Ainsi, toutes les données médicales disponibles sur le gorille de montagne ont besoin d'être immédiatement localisées, identifiées, cataloguées, revues, analysées et présentées ou tout simplement mises à la disposition de la communauté concernée.

2. Unité vétérinaire éfficace
   - L'existence d'unités vétérinaires nationales éfficaces et responsables de la mise en application des services vétérinaires sont indispensables à la conservation du gorille de montagne. A cet effet, nous recommandons la création ou le développement d'une unité vétérinaire des parcs nationaux dans chacun des pays qui abritent le gorille de montagne. L'approvisionnement en ressources financières et humaines adéquates fait partie de cette proposition. Pour arriver à la réalisation de ces objectifs, une assistance technique et une éducation adéquate des gouvernements des pays hôtes devront être fournis.
3. Soutien financier
   - La nécessité de financer les équipements cliniques de diagnostic et de soutien à la recherche et la formation du personnel local avec l'aide des agences gouvernementales, les ONG et les autres agences concernées, en vue d'assurer des services viables et efficaces a été soulignée. Les vétérinaires chargés de la santé du gorille de montagne devraient être directement inclus dans l'identification des besoins et la détermination des priorités par rapport aux fonds disponibles. Les budgets devraient inclure des fonds reservés à la gestion vétérinaire des urgences en cas d'épidémie. A cet effet, des techniques d'assistance et l'éducation des gouvernements des pays hôtes ont besoin d'être fournis.

4. Plan de contrôle et de suivi des maladies
   - La science épidémiologique a à présent un niveau de développement satisfaisant. Il est dôté d'outils efficaces permettant d'assurer une évaluation scientifique des risques de santé de la population restante des gorilles des montagnes. Cependant, elle n'a, jusqu'ici, pas été appliquée de manière adéquate.
   - Nous recommandons ainsi, le développement d'un plan basé sur l'épidémiologie et une recherche appropriée pour la protection de la santé du gorille de montagne. Le plan devrait être basé sur des pratiques de surveillance de maladies scientifiquement fiables, tout en

tenant compte des populations humaines et animales. Les données épidémiologiques devraient servir de base pour développer des politiques sur la santé du gorille de montagne. En fin de compte, ces politiques seront finalisées et mises en application dans un cadre interdisciplinaire.

5. La formation
   - Nous croyons qu'il existe une prise de conscience suffisante des problèmes de santé du gorille de montagne parmi des groupes humains variés qui vivent avec le gorille de montagne. Il existe plusieurs niveaux de formation pour ces groupes différents, qui reposent sur la nature de leurs interactions avec le gorille de montagne.
   - Nous recommandons que toute formation comprenne des informations sur les problèmes de santé relatifs à l'interaction des humains avec les gorilles. De tels outils de formation devront être développés avec la participation des vétérinaires des parcs nationaux, ainsi que celle des docteurs et/ou celle d'autres professionnels de santé appropriés. D'autre part, la formation des vétérinaires travaillant avec les gorilles des montagnes devrait inclure des informations sur le comportement du gorille de montagne, l'écologie, la conservation et la gestion des parcs.

6. Données de base
   - A présent, il n'existe aucun mécanisme efficace qui puisse gérer et diffuser des données et des informations relatives à la santé du gorille de manière ordonnée et normalisée.
   - Nous recommandons donc que soit établi une base de données internationale de tissu/sérum organisée et interactive. Toutes les agences et les individus concernés devraient contribuer à la création et à la gestion des données de base et à l'identification d'une agence organisée.

7. Politique d'intervention
   - L'absence d'une politique d'intervention bien définie (ex. : immobilisation, traitements, vaccination, euthanasie et restreinte physique) sur le gorille de montagne a été remarquée.
   - Ainsi, nous recommandons que les politiques actuelles d'intervention portant sur les épidémies et le bien être individuel contre les politiques de conservation soient revisées. Cette action inclurait les animaux à problème (individus ou groupes), les gorilles des montagnes orphelins ou confisqués.

8. Bien-être vétérinaire, etc...
   - A présent, la gestion de la planification du gorille de montagne ne bénéficie pas souvent de l'apport vétérinaire. Par conséquent, les considérations de santé et de bien-être ne font pas nécessairement partie du processus de prise de décision.
   - Nous recommandons que les vétérinaires fassent partie intégrale de cette planification et que l'analyse des coûts et des bénéfices, qui tentent spécialement de concilier le bien-être de l'individu, avec la conservation de la population, deviennent un processus normalisé.

9. Evaluation des risques de santé
   - La communauté de conservation du gorille est souvent confrontée à des prises de décision difficiles en ce qui concerne les problèmes de santé des cas individuels ou des populations des gorilles. Ex.: orphelins, animaux à problèmes, animaux malades. Aucun mécanisme n'existe pour résoudre ces problèmes.

- Nous recommandons qu'une approche systématique soit développée et mise en application pour apporter un soutien à la résolution des difficultés de prise de décision. Une telle approche inclurait une simulation informatique, une analyse en arbre de décisions et d'autres techniques épidémiologiques.

10. Capacité de diagnostic
    - Il existe à présent un manque de laboratoires locaux/régionaux et de personnel disponible pour le traitement des échantillons des gorilles des montagnes. De telles installations sont indispensables à la capacité de diagnostic des maladies et au suivi de routine de la santé du gorille de montagne.
    - Nous recommandons à cet effet que des efforts soient fournis pour identifier le potentiel des infrastructures de diagnostic au plan local/régional et qu'un plan soit conçu pour assurer la création et le soutien de telles infrastructures, y compris la formation du personnel. Dans le même processus, des protocoles normalisés pour la collecte, la manutention, l'identification, le traitement des échantillons ainsi que les rapports devraient être développés approuvés et distribués.

Groupe de Travail sur le Probleme de la Population Humaine

1. Travailler avec les organisations humanitaires pour s'assurer que leurs plans d'urgence prennent en considération le problème de conservation. De plus, les agences de conservation (gouvernementales et non-gouvernementales) doivent préparer leurs propres plans d'urgence sur les interactions critiques identifiés entre les humains, les gorilles et leurs habitats.

2. Promouvoir la participation de la communauté dans la conservation, par des mécanismes institutionnels permettant la consultation avec la population locale sur tous les aspects du parc les touchant. La population locale devrait avoir un pouvoir de décision sur les aspects qui les affectent directement tel que le partage des recettes, le contrôle des razzias de cultures, l'éducation sur la conservation, etc.

3. Garantir des sources de financement consistant, fiables et destinées aux communautés locales. Il faudrait aussi assurer : (1) la tansparence dans la prise des décisions; (2) la gestion des attentes; (3) le renforcement des liens de conservation; (4) l'investissement substentiel de la communauté locale et sa capacité d'entretien; (5) des lignes directrices bien définies comptant sur les politiques.

   Le mécanisme pratique le plus efficace serait de garantir qu'une proportion des recettes totales du parc soit allouée à ses activités. En l'absense de cette politique, il est recommandable que le prix sur chaque permis de visite des gorilles soit augmenté. Cependant, il est important que des recherches pour trouver des moyens de diversifier les sources financières à partager soient entreprises.

4. Etablir des fonds fiduciaire pour le PNV et le PNVi en se basant sur les expériences des autres fonds fiduciaire avec des organisations gouvernementales et des ONG concernées par la

conservation du gorille dans la région. Augmenter les fonds ficuciaires déjà établispour Mgahinga et Bwindi.

5. Mener une étude sur les possibilités d'établir des programmes d'utilisation des produits simples de la forêt (ex. herbes médicinales, miel, vigne, eau) dans les Virunga (PNV,PNVi, MGNP) en considérant :
   - les menaces potentielles pour la conservation du gorille de montagne;
   - la biologie des ressources visées;
   - la forme et la taille du parc;
   - l'historique du parc;
   - l'étendue de l'utilisation illégale actuelle;
   - les avantages potentiels de conservation;
   - le coût de la mise en application;
   - les mécanismes alternatives de partage de ressources (ex. partage des recettes et fonds de dotation).

6. Recommandations à étre formulées sur les questions des limites frontalières :
   - Marquer clairement les limites
   - Des mesures pour repondre aux razzias des produits écologiques.

Groupe de Travail sur les Simulations

1. Etant donné la tendance à l'élasticité de la population, il est nécessaire de repondre aux préoccupations qui surgiront au moment où les populations auront atteint la capacité maximale d'abri de l'habitat et qui pourrait contribuer à la déstruction de ce dernier (l'habitat), à la présence d'orphelins, au risque accrû de des cas de stress et à des conflits entre humains et gorilles.

2. Il est nécessaire de réunir beaucoup plus d'informations exactes sur l'impact des maladies par rapport aux taux de mortalité des gorilles afin d'augmenter la valeur de prévision du processus de simulation.

3. Beaucoup plus d'évaluation sur les effets des péturbations d'origine humaine sur les taux de mortalité et la fécondité des gorilles non-habitués à l'homme sont nécessaires.

4. Du fait de l' existence du gorille de montagne uniquement en 2 populations petits et isolées, une réduction de l'habitat augmente les possibiltés d'extinction de ces populations.

5. Faire un suivi et une évaluation de plus en plus exactes de la taille et de la qualité de l'habitat pour les populations des virunga et de Bwindi.

6. Des paramètres démographiques, la fécondité et la mortalité à des âges spécifiques, l'intervalle entre les naissances devraient être établis pour les populations de Bwindi afin de simuler correctement le taux de croissance démographique.

7. Etant donné une protection suffisante de l'habitat, un programme d'élevage en captivité ne serait pas nécessaire pour assurer la croissance de la population.

Groupe de Travail sur la Gestion et la Recherche

1. Informations sur la gestion
   - Actions recommandées pour la recherche.
     Ces recherches prioritaires ont été classées par paires afin d'identifier les plus importants pour Bwindi et pour les Virunga, utilisant des critères qui, éventuellement donneront des informations nécessaires pour les gestionnaires afin d'assurer une viabilité à long terme du gorille de montagnes et de son habitat.
     1. braconnage : DFGF/ITFC/UWA/ORTPN/ICCN
     2. razzias des cultures : DFGF/ITFC/DTC
     3. tourisme/habituation : DFGF/ITFC/MGVC
     4. partage des recettes (Bwindi) ITFC/DTC/UWA
   - Actions recommandées sur le suivi
     1. Pour les gardes : IGCP/ITPC/UWA(avec la GTZ)/ICCN/ORTPN
     2. Pour les stations de recherche : ITFC/DFGF/ICCN

2. Recommandation sur la collaboration avec les populations locales
   - accroître la prise de conscience du gouvernement et promouvoir la volonté de collaboration
   - mise à jour des lois/procédures de mise en vigueur pour promouvoir la collaboration
   - mise en application (par le personnel du parc) des programmes de collaboration.
   - concevoir des politiques et des systèmes de controle du problème de contrôle des animaux.

3. Recommandation sur la gestion
   - Mettre en ouvre la planification à un niveau opérationnel et stratégique par les autorités des parcs nationaux/ zones protégées,
   - Financement,
   - Décentraliser et améliorer les structures au sein des zones protégées/ Parcs nationaux
   - Concevoir des programmes touristiques améliorés

4. Recommandations sur la sensibilisation (accroître la prise de conscience et l'éducation)
   - Accroître la prise de conscience du gouvernement et la volonté de soutenir et faciliter les efforts de conservation.
   - Développer des programmes pour accroître la sensibilisation.
   - Développer des stratégies et des programmes d'un tourisme d'interprétation nationale et internationale.
   - Encourager le tourisme national.

5. Recommandations sur la collaboration
   - Collaboration régionale

Concevoir :

1. Un cadre de collaboration régionale
2. Un programme de collaboration régionale (surtout sur le terrain)
3. Des programmes touristiques harmonisés (sur le plan régional)

- Collaboration entre les partenaires
  Concevoir des mécanismes pour la communication et la coordination.

Groupe de Travail sur la Gouvernance

Les 5 priorités principales

1. Le groupe sur la gouvernance s'est accordé sur la majorité des recommandations du groupe sur les finances, portant sur la nécessité d'améliorer la collaboration entre les institutions régionales et a fermement recommandé le développement des codes de conduite pour en faciliter la réalisation. Ces projets seraient mise en application par des bureaux de coordination des ONG installées par les autorités de gestion des aires protégées dans les pays concernés et à travers des réunions informelles des groupes d'intérêts (5a).

2. Les autorités de gestion des aires protégées devront promouvoir l'harmonisation de la législation en matière de conservation à travers la communication avec les autorités gouvernementales appropriées ainsi que sa mise en vigueur et son exécution (2a).

3. Les autorités de gestion des aires protégées devront encourager les pays à accorder une priorité plus importante à la conservation de la nature et au tourisme en plaçant la responsabilité de l'environnement, de la conservation de la nature et du tourisme à un seul ministère (1b).

4. Les autorités de gestion des aires protégées et les ONG de conservation devront initier et coordonner la mise en application du processus de traduction de la législation en règlements, lignes directrices et arrêtés. Encourager les autorités de gestion des aires protégées à diffuser l'information par exemple : les médias, les publications, les écoles et les hôtels (1e).

5. Les autorités de gestion des aires protégées et la communauté internationale de conservation devront renforcer les programmes de sensibilisation des autorités militaires sur le statut critique de l'espèce sous menace d'extinction, du gorille de montagne, et devra faire tout ce qui est possible pour maintenir la viabilité de la conservation de ces espèces et de leur habitat.(4c)

Groupe de Travail sur les Revenus, les Finances et L'Economie

1. Menaces sur les revenus

   Les recommandations suivantes ont été formulées dans le but de promouvoir la viabilité des gorilles des montagnes et de leur habitat tout en assurant les entrées de revenus.

   - Il est nécessaire de séparer les zones de conflits des gorilles et leur habitat. Pour ce faire, il faut exiger la coopération militaire pour expulser tous les illégaux du parc. Cette responsabilité revient aux gouvernements des pays hôtes et à la Communauté Internationale. Il revient aussi aux ONG Internationales et à la communauté internationale d'agir rapidement, avant Mars 1998 si possible.

- Les ministères responsables de l'économie, des finances, de la conservation, du tourisme et de la réhabilitation, devront s'accorder sur les politiques permettant aux Parcs de garder leurs revenus dans le but de payer les salaires et d'assurer le bon fonctionnement des institutions et la réhabilitation de l'infrastructure. Les ONG internationales chargées de la conservation devront publier une liste de recommandations visant les institutions de ces gouvernements, avant juin 1998.
- Développement des lois sur la conservation en vue d'assurer le partage de revenus avec la population locale et une meilleure collaboration entre la gestion du parc, le personnel (ICCN/ORTPN) et la population, avec l'aide des ONG Internationales avant juin 1998 (note : en Ouganda, les politiques de partage de revenus ont été révisées récemment).
- Harmonisation des lois et tarifs de visite du gorille de montagne par les ministères des trois pays hôtes avant juin 1998, avec l'aide des ONG Internationales.
- Prise en charge de la santé des gorilles dans les forêts.

Certaines de ces idées sont débattues dans d'autres groupes.

2. Analyse de rentabilité

Pour une présentation de la situation économique de la conservation du gorille de montagne et de son habitat, une analyse de rentabilité sur la conservation du gorille de montagne devrait être entreprise. Elle comprendra une comptabilité complète des coûts de tous les aspects de la conservation du gorille. Le résultat de cet exercice qui pourrait s'étendre sur toute une année constituera un recensement des populations et de l'habitat des gorilles des Virunga et de Bwindi. Il est recommandé qu'un consultant indépendant ayant un niveau d'expertise élevé en matière d'économie de l'environnement, soit recherché au plan international pour accomplir cette tâche. Les personnees dôtées d'une telle expertise peuvent provenir des universités, des agences spécialisées en comptabilité et d'autres organisations bénévoles ayant de l'expérience sur l'économie de l'environnement. Ce contrat devrait commencer en 1998, si possible, avant les négociations sur le développement des futurs "Parcs pour la Paix", ou le développement d'autres initiatives collaboratives de gestion intégrées. L'audit écologique sera effectué sur les trois pays concernés avec un financement international. Les résultats de l'effort seront utilisés comme une demande conjointe de financement par les pays hôtes membres de différents organismes donateurs tel que la Banque Mondiale.

Comme suivi à l'analyse de rentabilité, il est nécessaire d'effectuer des recherches approfondies sur de nouvelles activités de génération de revenus, tels que :

- Potentiel d'avenir de la biodiversité, et redevances perçues.
- initiatives de commercialisation du carbone "Carbon Trading", ex. : dommages écologiques, ou mises en application conjointe.
- autres.

Ces activités devraient être effectuées pour tous les pays hôtes.

3. Types de Génération de revenus et mécanismes financiers

La portée des divers mécanismes de financement innovateurs doit être reconnue. Il devrait y avoir des moyens d'exploiter ces dernières et de les communiquer aux parties pertinentes. Tout nouveau mécanisme devra intégrer avec la conservation du gorille et de son habitat au sein des differents pays avec l'accord et la contribution des institutions concernées.

Ces problèmes devraient être discutés par des groupes d'intérêt informels (ci-dessous), tout en espérant que ce programme sera adopté par un organisme d'établissement des politiques plus formel qui évoluerait dans le sens d'une conservation internationale collaborative et accrue des gorilles et de leur habitat.

4. Intégration de la visite du gorille de montagne dans le tourisme national

   Il est essentiel d'intéger la visite du gorille dans la stratégie touristique nationale en l'exécutant de la manière suivante:

   - diversification des produits et commercialisation de diverses options.
   - capitalisation sur la visite du gorille en encourageant les touristes à prolonger leurs séjours et visiter autres attractions.
   - assurer la qualité d'un tourisme durabilisé.
   - assurer la sécurité.

5. Collaboration régionale et institutionnelle

   - La collaboration entre les ONG Internationales et d'autres sources de financement exige :
     1. des communications régulières
     2. des lignes directrices pour les différentes activités
     3. échange d'informations sur les programmes actuels/futurs en matière de conservation de gorilles
     4. la création d'un mécanisme de 'table ronde restreinte"
   - Réunions de communication entre groupes importants
     1. le PICG pourrait coordonner une réunion ouverte à toutes les ONG désirant y participer (PICG, d'ici juin 1998).
     2. les opérateurs touristiques, essentiellement ceux qui sont associés au tourisme du gorille de montagne (associations touristiques appropriées, telle que l'Association Ougandaise des Tours Opérateurs (AUTO), d'ici juin 1998)
     3. les représentants gouvernementaux pour le tourisme (Ouganda, Ministère du Tourisme, des Parcs Nationaux et du Patrimoine Culturel (MTWA) d'ici juin 1998)
     4. Gestionnaires Principaux des Parcs (PICG en 1998)
     5. Directeurs Principaux des Parcs (Directeurs, Offices des Parcs Nationaux des 3 pays hôtes, juin 1998)
   - Ces groupes d'intérêt devront
     1. échanger des informations, leurs objectifs, leur engagement et les mécanismes et les sources proposés de financement
     2. s'entendre sur les échanges de communication régulière avec des objectifs à long terme de planification conjointe
     3. communiquer les résultats aux autres groupes
     4. examiner les besoins et la portée d'un organisme d'exécution de politiques représentatif et plus formel, pour établir le lien entre les intérêts de chaque groupe en vue de créer une conservation plus efficace et coordonnée du gorille de montagne et de son habitat, ainsi qu'une industrie touristique responsable.
   - Prise de conscience des bailleurs de fonds et éducation

     Les bailleurs des fonds doivent être sensibilisés sur les besoins à long terme et le soutien coordonné de la conservation du gorille.

Le groupe des ONG Internationales doit concevoir des documents pour la Banque Mondiale et pour d'autres ONG Internationales (entre juin-décembre 1998).
N.B. : Cette idée devrait être approuvée par les gouvernements des pays hôtes.

6. Inculquer les valeurs pour la conservation du gorille de montagne et de son habitat
Le système des valeurs de la communauté locale ou nationale va principalement affecter toutes les décisions économiques et la nature de tout programme générateur de revenues, la redistribution des revenus dans la communauté ainsi que la volonté des particuliers à "payer" et l'engagement des gouvernements des trois pays impliqués à collaborer.

Nous recommandons que l'utilisation générale du gorille comme symbole d'un réel écotourisme soit présentée aux plus grandes organisations touristiques internationales et que ceci soit initiée conjointement avec les ministères appropriés dans les trois pays hôtes et que toute campagne soit développée par eux-même (1998-1999).

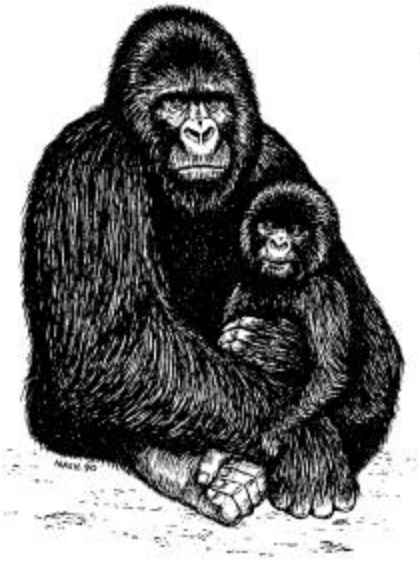
- Nous recommandons donc que les différents réseaux d'éducation formels et informels et les organisations ci-dessous, soient le début d'un programme d'éducation mûrement réfléchi sur les valeurs de conservation du gorille à certaines audiences-clé visées dont : les organisations internationales de financement, la communauté internationale, les gouvernements nationaux et les secteurs privés aussi bien à l'intérieur qu'à l'extérieur des pays hôtes. Nous pouvons nous baser sur les programmes d'éducation des trois organisations principales ci-dessous :
  1. l'East African Wildlife Society avec ses membres internationaux; - les Clubs Amis de la Nature en Ouganda avec tous leurs membres comprenant des familles et des écoles partout dans le pays;
  2. et l'Uganda Wildlife Education Centre (UWEC, mieux connu sous le nom d' Entebbe Zoo) avec un nombre de visiteurs annuels après reconstruction estimé à 250.000, pour l'an 2001 et comprenant 95% d'élèves et d'étudiants participant à des programmes d'éducation formel.

6. Est-ce que le gorille de montagne devra payer pour sa propre conservation et le développement nécessaire de la communauté environnante ?
Le gorille de montagne est un cas particulier et le groupe a recommandé que :

- la conservation du gorille de montagne ne devrait en aucun cas se limiter à des considérations d'autosuffisance financières.
- une analyse de rentabilité a été fait pour présenter tous les avantages (financières et non-financières) de la conservation du gorille, comprenant la volonté de tout le monde à payer pour leur survie.
- le gorille de montagne en tant que "cas particulier" devrait être incorporé dans l'éducation formel et informel à tous les niveaux pour montrer les énormes valeurs de la conservation des espèces et de son habitat.

Population and Habitat Viability Assessment
For *Gorilla gorilla beringei*

8 – 12 December 1997
Kampala, Uganda



Section

2

Introduction

Welcoming Remarks by Norbert Mushenzi
Directeur Provincial Nord Kivu, Institut Congolais pour la Conservation de la Nature

Mot de circonstance du Directeur provincial de l'ICCN, à l'occasion des Travaux du
P.H.V.A des Gorilles de Montagne à Kampala

Excellence Monsieur le Deuxième Vice-Premier Ministre et Ministre du Tourisme, Wildlife et Antiques;
Excellence Monsieur le Directeur Général de l'Uganda Wildlife Authority
Excellence Monsieur le Directeur Général du Tourisme au Rwanda;
Distingueés Invités et chers Collegues;
Mesdames et Messieurs

1º Remerciements

Il a plu au Dieu Tout Puissant et à la légendaire hospitalité du gouvernement Ougandais de nous retrouver dans ce magnifique cadre de l'Hotel Sheraton en vue d'évaluer la viabilité d'une espèce sauvage qui nous est proche, "le gorille de montagne" vivant au Rwanda, Ouganda et Congo.

Qu'il me soit permis, au nom de la délégation congolaise qui m'accompagne d'exprimer aux organisateurs de ces assises notre profonde gratitude pour avoir associé les compétences de notre pays à cette importante rencontre scientifique.

Je reste convaincu que les travaux de ce forum vont nours aider à decider sur les actions prioritaires permettant la sauvegarde des gorilles de montagnes et de leur habitat.

L'expérience et les événements recents de notre pays nous ont fait comprendre la complexité de la mission de la conservation de la biodiversité. Au délà de la conservation classique et de la gestion des aires protégées, des problèmes socio-économiques et politiques conditionnent le travail des gestionnaires don't le dévouement est de fois mis à l'épreuve.

Ainsi, je salue la bravoure de nos gardes et conservateurs qui ont persevéré et travaillé dans les conditions difficiles imposées par une situation de guerre. Certains d'entre eux ont même payé de leur vie pour sauvegarder ces écosystèmes.

Je prie à l'assistance de garder une pensée pieuse en mémoire de nos illustres disparus.

2º Situation dans la zone à gorilles

Il ya a lieu de rappeler que les effectifs de gorilles ont connu des fluctuations importantes au cours des dernières décénies:

- En 1960, la population des gorilles dans les massifs de Virunga était évaluée à 450 individus. Suite aux diverses activités humaines incontrolées (braconnage, déforestation, paturage…), les populations ont été reduites presque à la moitié en 13 ans :
- Ainsi en : 1973 les gorilles étaient estimés à 275 individus
  1978 -- › 268
  1981 -- › 254
  1986 -- › 286

Le dernier recensement de 1989 nous a revelé le nombre de 310 à 318 gorilles dans les massifs des Virunga don't le 1/3 de ces populations vit en Ouganda et au Rwanda et les 2/3 autres se trouveraient en République Démocratique de Congo.

Hormis ces resultats chiffrés qui dénotent de la fragilité des populations des gorilles, il est reconnu que leur habitat est fortement menacé de suite de pressions démographiques. Les données sure les populations humaines autour du secteur à gorille au PNVI-Sud rélèvent 135.242 personnes pour cinq groupements. La forte densité des populations humaines à la périphérie du secteur à gorilles et le système cultural qui ne connait pas de jachère entrainent de plus en plus une convoitise des terres au détriment du parc don't les limites originales ont déjà été serieusement entamées.

A toutes ces menaces, il faut ajoutes l'impact de la crise sociale, politique et économique de la région des Grands Lacs. Cetter crise a commencé en 1990 avec la guerre civile au Rwanda. Nul n'ignore que le secteur de Virunga a été utilisé par diverses opérations et manoeuvres militaires. Le bilan sombre et l'impact de la dite guerre se présente comme suit :

- Juillet 1994, environ 700.000 réfugiés Rwandais ont été insta llés dans cinq camps à la lisière du parc avec comme corollaires la destruction de plus de 150 Km2 de couvert forestier du parc et l'enlaidissement du paysage, suivi d'une reduction du stock en bois dans les plantations villageoises.

- Un massacre sans précédent des animaux du parc (Hippopotames, Elephants, Buffles, Gorilles et antilopes etc….) et une reduction sensible du cheptel animal dans les fermes et pâturages de la région. Point n'est besoin de souligner que les gorilles de montagne ont payé un lourd tribut du fait de la guerre civile qui a caracterisé la region de Grands Lacs en général et plus particulierement le Parc National des Virunga. En effet, en Août 1995, le *silverback* Rugabo et une femelle ont été abattus et un jeune capturé par les braconniers. Au cours du même mois, deux *silverbacks* Salama et Luwawa furent tués dans le secteur Bukima par les braconniers. Et comme si cela ne suffisait guère, tout recemment encore au mois de Mai dans la famille Luwawa, quatre individus ont éte lâchement tués par des militaires en opération. Bien plus, la famille Ndungutse en debandade a connu une dislocation et une disparution d'individus don't le nombre exacte n'est pas connu à ce jour.

- En déhors de la destruction du parc, le tourismea connu une chute drastique suite à l'insecurité et cela a entrainé une perte des revenus pour le parc et l'économie du pays. Six touristes Italiens furent lâchement tués dans le parc et aucun visiteur ne pouvait s'y risquer.

- La législation du parc ne pouvait plus étre respectée.
- L'insecurité généralisée a entrainé l'arrêt des subventions externes aux efforts et projets de conservation qui étaient en cours.

3° Réponse de l'ICCN en faveur de la conservation des gorilles

En réponse à la dégradation spectalaire de la biodiversité du parc consécutive à la présence des réfugiés rwandais et à la problematique de gestion, la direction générale de l'Institut a doté la province d'une nouvelle structure afin de répondre directement aux besoins du parc.

Un plan d'action a été preparé et il inclut diverses actions prioritaires avec comme objectifs de restaurer la capacité structurelle dans le secteur sud du parc de virunga. Es composantes portent sur :

1) le renforcement des capacités struucturelles de l'ICCN ;
2) l'intégration effective de la population locale dans la gestion du PNVi ;
3) Amélioration de l'efficacité de l'ICCN dans ses contavts avec les partenaires exterieurs et renforcer la coordination des actions entreprises ;
4) La sauvegarde durable de la diversité biologique du parc.

Il convient également de signaler que grâce aux multiples contacts entrepris par l'ICCN les autorités politico-administratives se sont impliquées activement das la protection du parc en organisant des séminaires de sensibilisation et en diffusant des textes sur la législation relative à la conservation de la nature.

Cependant la participation active de la population doit étre consolidée de maniére progressive. L'institut s'est aussi impliqué dans le développement des activités touristiques et le suivi regulier des familles des gorilles habitués. Toutefois il est à souligner les contraintes liées à la sécurité au niveau régional, à l'absence de l'harmonisation des politiques touristiques entre les trois pays et aux infrastructures non encore rehabilitées.

4° Relations avec les partenaires extérieurs

Dans le cadre de la coopération bilatérale et inter-agences, l'ICCN est ouvert à tous les partenaires intéressés à soutenir ses efforts de sauvegarde de la biodiversité des aires protégées.

Malgré les divergences des vues ou des stratégies entre les principaux intervenants, l'ICCN a toujours manifesté la volonté d'inciter une cohésion entre ses partenaires, notamment les actions tactuellement entreprises par le Programme Internationale pour la conservation des Gorilles, le Dian Fossey Gorilla fund et le Fonds Mondial pour la Nature et visant à arreter une nouvelle strategie de Conservation au Parc National des Virunga.

Aussi, l'absence de cohésion au niveau des partenaires traditionnels a dispersé les efforts et entrainé une perte de facilités élargies en defaveur de l'Institut.

ATTENTES

J'ose croire que les participants à ces assises analyseront en toute objectivité la problematique de la viabilité de la population de gorilles et leur habitat.
Quant à ce qui concerne la délégation congolaise, elle émet le faisceau de souhaits suivants:

1) La démilitarsation sans delais au mieux, la soustraction des secteurs à gorilles aux manoeuvres et opérations militaires et que les gouvernements s'y engagent fermement;

2) Qu'il y ait une large mobilisation en faveur d'un fonds fiduciaire pour la conservation des gorilles et leur habitat;

3) Que les communautés locales soient effectivement impliquées dans l'élaboration et la mise en oeuvre des politiques sur l'utilisation des ressources naturelles;

4) La nécessité d'un mécanisme ou d'une structure régionale d'échanges dínformations et d'expériences techniques en matiére de conservation des gorilles;

5) L'harmonisation de la politique touristique et du systéme de monitoring des gorilles entre les trois pays concernés;

6) La réactualisation des données scientifiques sur les populations de gorilles et l'élaboration d'un canevas de suivi régulier.

Je vous remercie.

Current Conservation Status of Mountain Gorillas

Samson E. Werikhe
Uganda Wildlife Authority
P.O. Box 3530, Kampala

Background

Mountain gorillas (Gorilla gorilla beringei) occur in two populations. One is in the Virunga volcanoes extending into three countries, i.e., Democratic Republic of Congo (Parc National des Virungas, PNVi), Rwanda (Parc National des Volcans, PNV), and Uganda (Mgahinga Gorilla National Park, MGNP). The other popoulation is in Bwindi Impenetrable National Park, Uganda. It is argued that the Virunga population is of a different subspecies to that of Bwindi (Sarmiento et al. 1996). However, there seems to be inadequate data to support this argument.

All the protected areas housing the endangered mountain gorilla currently enjoy the highest conservation suatus under national parks. The first national park in Africa was carved from the Virunga Volcanoes region in 1925. This park covers 8,000 km^2 but only 3% of this area is used by mountain gorillas. Of these three national parks in the Virunga volcanoes, Mgahinga Gorilla National Park (MGNP) is the smallest (33.7 km^2) and most recent (gazetted in 1991).

Both Gorilla populations occur in areas believed to represent Pleistocene refugia, which are areas that escaped glaciation and therefore experienced an unbroken evolutionary history. As a result of unique and highly endemic biodiversity and history, the Bwindi Impenetrable National Park (BINP) in particular is one of the richest areas in Africa for mammalian diversity. It was on the basis of these protected areas having a considerably high level of endemism, with the mountain gorilla as a flagship species, that they were gazetted national parks, according them the highest form of protection possible.

Uganda alone has two populations of mountain gorillas. The population in Bwindi numbers about 300 animals (current exact figure to given after the ongoing census) and this is much bigger that the population in Mgahinga which houses part of the entire and shared Virunga volcanoes population.

A one-year thorough survey of gorillas was conducted in MGNP from January 1989 (Werikhe 1991) and this survey recorded a total of 45 animals in groups and individuals. None of these was resident in Uganda. The 45 animals were part of 320 total reported from the 1989 gorilla census. The Uganda portion is so small that it cannot sustain a viable population of mountain gorillas on its own (Butynski and Kalina 1993). A formerly encroached area of 10 km^2 was reclaimed 5 years ago and it is hoped that gorillas will spend more time in this area when it fully recovers its natural potential.

Within the region, Parc National des Virungas and Bwindi Impenetrable National Park are recognised internationally as World Heritage Sites for their unique natural and cultural sites. Parc National des Volcans is also a Biosphere Reserve.

Human population density in the region is considerably high. At a population density averaging 300 people/km2 (Werikhe et al. 1997), there is enormous pressure onto these protected areas for livelihood needs especially fertile land for agriculture, fuel wood, construction wood, food, medicine and other forest products. Conservation policies in place have therefore been designed to address the above pressures but also ensure a balanced situation with the adjacent people for enhanced protection and continued existence of the mountain gorilla.

Mountain Gorilla Conservation in the Virunga Volcanoes

During the 1960s and 1970s, the Virunga population declined dramatically from 400-500 animals to a mere 250 by 1981. The cause of this is said to be due to habitat loss, poaching and other forms of human disturbance within the gorilla area. In the 1980s, there was a tremendous improvement in gorilla protection and activities like direct hunting of gorillas and cattle grazing within the forest were stopped. By 1989, when the most recent census was made, the population had increased to an estimated 324 individuals.

Most of the illegal activities in the Virunga volcanoes had been brought under control. In terms of conservation, the effects of the Rwanda civil war which started in late 1990 reversed the whole situation and subjected a good conservation process to a complete change. This war was launched right in the Virunga volcanoes and over the years, conservation in the area experienced direct and indirect impacts.

Effects of War on Parc National des Virungas

1) Refugee Problem: In 1994, the then Rwanda Government was overrun and this led to a mass exodus of Rwandese refugees to Ugand and the Democratic Republic of Congo. Congo took in the largest number and these were resettled in the North and South Kivu regions near Parc National des Virungas.

Over 700,000 refugees were temporarily resettled in five refugee camps on the borders of Parc National des Virungas and definitely, this was a disaster to conservation, especially with respect to mountain gorillas. Foremost, this resettlement contravened the United Nations High Commission for Refugees' (UNHCR) policy against establishment of refugee camps on the borders of protected areas. The minimum distance should not be less than 150 km away. However, the situation with these refugees was incredibly pathetic and large numbers were perishing daily. This forced UNHCR to act against its own policy and establish refugee camps in the neighbourhood of Africa's oldest park and home of the mountain gorilla.

The presence of refugees on the PNVi's boundary resulted in:

a) Destruction of more than 150 km2 of the forest cover of the park. The refugees specialised in charcoal, firewood and game meat trade, all from PNVi. Over 50% of the bamboo on Mt. Mikeno was cut for manufacture of mats, baskets, and for construction purposes.

b) Reduction of the available firewood supply from plantations and village-based forest reserves which as buffer areas to PNVi, thus leaving the park very vulnerable to fuel wood removal.

c) Poaching/massacre of wildlife species. Exact information on numbers affected is yet to be collected but there is evidence that some gorillas were killed. The number of nylon and metallic snares seized by ICCN guards went from 913 in 1994 to 2,795 in 1995, and the number of machetes increased from 1,588 to 4,078 during that same time period. These snares are targeted mostly at ungulate species but end up destroying gorillas. Poaching especially increased with the ultimate decrease of livestock in North Kivu. The unplanned presence of the army in the area did compound tha problem of poaching and other forms of illegal utilisation.

2) Decline in Tourism: There was a marked decline in tourism over the years due to the high level of insecurity and presence of refugees in the area. Six Italian tourists were unfortunately murdered in cold blood and no additional visitirs could risk their lives to visit the region.

3) Lawlessness: There was absolutely no rule of law. Park authorities and the legislation were never respected and taken seriously. There was a general feeling of lawlessness and disrespect for park authorities, especially rangers. The situation was seen as an opportunity to freely and illegally utilise the park's resources which had previously been under strict control. No courts of law were available and hence no legal proceedings could be implemented to convict wrongdoers. The poachers responsible for killing gorillas in 1995 were set free and they went back to their villages in the neighbourhood of gorillas.

4) General Insecurity: This led to suspension of all externally-funded conservation projects. Areas like those near the D.R.C – Rwanda border where the Ndungutse Group of gorillas was living could not be accessed by guides or rangers. With the exclusion of projects, there was no adequate funding to fully cover conservation costs.

Effects of War on Parc National des Volcans

Parc National des Volcans in Rwanda was an area of great interest to the Rwandese Army because this was an area highly suspected to be a hide-out for the Rwandese Patriotic Front. There were considerable defensive arrangements put in the Park and its surroundings to scare off or repulse the enemy. Illegal utilisation of the Park's resources reached very high levels and all park staff were denied the use of firearms. Very similar to what happened in PHVi, the impacts were as follows:

1. Many people lost their lives during the war and many of these were employees of Parc National des Volcans.

2. Poaching: There was a marked increase in poaching. Surveillance patrols were limited to certain parts of the Park because travel in other areas was too risky. Many places in the Park were heavily mined and infiltrated with large forces of militia. Almost all conservation and protection activities were brought to a halt, thus paving the way for poachers and other violators. Bamboo and fuel wood removal was rampant. Areas close to the border with the Democratic Republic of Congo were avoided by Park guards and such areas suffered great loss of wildlife species to poachers. The number of snares collected increased more than two-fold. Two gorillas were trapped in snares and there were promptly rescued.

3. Habitat Destruction: Local people moved into the park to remove forest products and apportioned a chunk of land for cultivation. Agricultural encroachment occurred on the lower slopes of the park were there is prime habitat for mountain gorillas.

4. Destruction of Infrastructure: The well-equipped Karisoke Research Center, the National Park Headquarters, the Visitor Center, housing quarters for staff, vehicles, radios, uniforms, etc. were all looted and/or destroyed.

5. Tourism: Military presence and their activities caused gorillas to flee to areas outside their normal home ranges. This made it difficult to monitor movements of tourist groups for tourism and management purposes. Tourism based on gorilla viewing started in 1984 and by 1990 when the war broke, tourist numbers had risen by 50%.

Effects of War on Mgahinga Gorilla National Park

Mgahinga suffered from the destruction caused by military shells projected into the Park and many parts of the Park were heavily mined. One law enforcement ranger lost his entire leg to a land mine.

1) Tourism: Activities under tourism were suspended due to insecurity. At the time MGNP was reclassified as a National Park, there was already a habituated group of gorillas visiting from the Democratic Republic of Congo. Uganda expected to begin implementing tourism on this group immediately but was delayed until 1995.

2) Ranger Patrols: These were seriously affected and all rangers lost morale and courage to work for fear of their lives. The patrols were now conducted only in parts of the morning and afternoon along the Park's boundary. Land mines were placed in strategic places like the Rugezi and Kabiranyuma Swamps and along the international border. These swamps are prime to wildlife and the local people in the neighbourhood as a sources of water, especially during the dry season.

   One gorilla was reported killed as a result of gun fire. The tops of Sabinyo, Gahinga and Muhavura were heavily shelled, destroying an unknown amount of alpine vegetation and unknown animal species. The alpine flora on the tops of the volcanous is highly endemic and rare, typical of he Albertine Rift biodiversity.

3) Infrastructure. The Park's offices and radio communications were destroyed. Park authorities had to relocate the office to Kisoro Town, about 20km away. This was far from the Park, making it difficult to implement park management activities.

Unlike in the PNVi, refugees did not cause much destruction in this Park. However, about 5,000 of these refugees crossed MGNP on their way back to the Democratic Republic of Congo and Kisoro for asylum. On their way, they camped in the Park and in the process used fuel wood and probably poached animals for food.

Mountain Gorilla Conservation in Bwindi Impenetrable National Park

Conservation efforts in Bwindi have historically faced a variety of obstacles, largely emanating from conflicts of interest over land usage, specifically the desire on the part of local community members to access Park resources. In the past, Bwindi was faced with serious management problems of poaching, pitsawying, gold mining, wildfire, agricultural encroachment, illegal removal of forest products, livestock grazing, crop raiding, lack of personnel and equipment, etc. At this time, the majority of illegal activities have brought under control by law enforcement. However, due to population pressure vis-à-vis increased demand for livelihood needs, the local communities will continue to depend on the Park's resources.

Tourism. Conservation problems in Rwands and the Democratic Republic of the Congo meant that all tourists interested in gorilla viewing headed for Bwindi. At this time, Bwindi can offer only 10 gorilla viewing permits per day. These are not enough and has caused UWA problems of designing the best "Gorilla Permits Sharing Policy". This has not been possible. Scondly, there is enormous pressure to have more gorillas habituated for tourism. This is very risky to the continued existence of gorillas. Already, one of the tourist groups in Bwindi has continued to shrink in group size. The reason in not yet fully known but gorilla contact with humans might be one of the causes.

Nevertheless, another group is being habituated in Bwindi. This will eventually give an additional six permits, but are these enough for the widespread market? Is this pressure compatible with the gorillas' continued existence? The BINP Tourism Programme emphasises continued gorilla tourism activities, constructing and maintaining a network of tourist trails and tourism diversification. The International Gorilla Conservation Programme (IGCP) is helping with this.

Community Conservation. Local communities adjacent to BINP are actively involved in contributing to conservation and management of the Park. Park Management Advisory Committees and Park Parish Committees have been set up and are functional nuits linking the entire local people in the neighbourhood to conservation.

The community conservation programme is addressing community needs as they relate to the long-term conservation of BINP through a multiple-use programme, a reenue-sharing programme, and a Conservation Education Programme. Under this section, there is a crucial issue of crop raiding by gorillas. CARD/DTC is helping in advising and implementing a few initiatives.

Research and Monitoring. Not much research has or is being done concerning gorillas and their habitat. This has been due to a lack of funds, time constraints and a shortage of expertise. At a broader level, the Uganda Wildlife Authority is currently implementing a Collaborative Research and Monitoring Programme, and some of these constraints are addressed under this programme.

Mountain Gorilla Conservation Strategy

Planned activities here vary according to the level of conservation and management constraints in the respective protected areas. The priority planned activiies include:

1. Democratic Republic of Congo
   - Rehabilitation of the Institut Congolais pour la Conservation de la Nature (ICCN)
   - Redevelopment of Ecotourism
   - Implementation of a Monitoring Programme: A monitoring programme has already been set up and now needs to train guards, harmonise their activities with those of Uganda, etc.
   - Improvement of ICN's capacity to be self-sustaining
   - Land purchase near the Uganda – DRC border

2. Rwanda
   - Train Guards in paramilitary skills
   - Implementation of a Monitoring Programme
   - Development of a Community Conservation Programme
   - Demine Parc National des Volcans
   - Open and demarcate the Park boundary
   - Rehabilitation of infrastructure

3. Uganda
   - Policy Development
     i. finalise Gorilla Tourism policy
     ii. finalise policy on revenue sharing
   - Tourism Development
     i. construct visitor centres
     ii. implement Interpretation Plan
   - Land Purchase
   - Effect cross-visits on community conservation policies and programmes with authorities in Rwand and Democratic Republic of Congo

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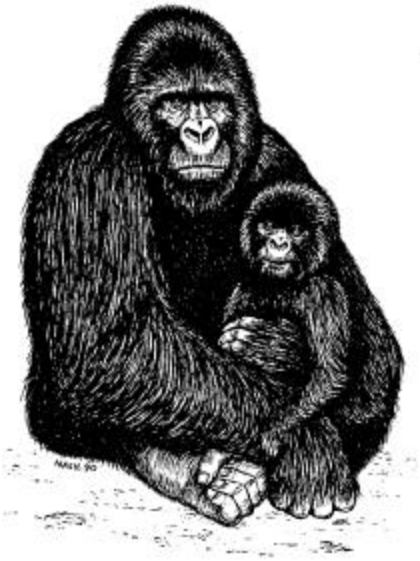
Population and Habitat Viability Assessment
For *Gorilla gorilla beringei*



8 – 12 December 1997
Kampala, Uganda

Section

Mountain Gorilla Health and Disease

3

Health and Disease Working Group Report

Working Group Participants:
Kenneth Cameron, Mountain Gorilla Veterinary Center, Rwanda
Steve Cavell, Mgahinga Bwindi Impenetrable Forest Conservation Trust
John Cooper, Wildlife Health Services
Margaret Driciru, Makerere Univ., Dutch Zoos Lion Project
Annabel Falcon, International Gorilla Conservation Programme
Gladys Kalema, Uganda Wildlife Authority
Antoine Mudakikwa, Mountain Gorilla Veterinary Center
John-Bosco Nizeyi, Mountain Gorilla Veterinary Project, Makerere Univ.
David Sherman, Center for Conservation Medicine, Tufts University
Jonathan Sleeman, Mountain Gorilla Veterinary Project / Colorado State Univ.

Introduction

Health issues are important in the management of all endangered and threatened wildlife, regardless of species. However, health issues take on special and critical importance with regard to endangered primates because of the close evolutionary relationship of great apes to human beings and the shared susceptibility to disease causing agents that this close relationship allows. The risk that mountain gorillas may contract serious disease directly from humans is currently increasing because they are increasingly being exposed in situ to close human contact through ecotourism, civil unrest and demographic pressures on protected area boundaries. Devastating diseases such as polio, influenza and or measles may be readily transmitted to great apes from close contact with infected humans. In this context, the health and disease working group believes that policy makers be fully aware of this special situation and that all mountain gorilla management and conservation policies take into account these special health concerns. This will require a greater commitment to regional veterinary services and to epidemiological research and assessment of mountain gorilla health and disease risks.

Biomedical Information

Our ability to treat disease in and to promote the health of mountain gorillas is hampered by many factors. The most fundamental relate to:

1. Data on Health and Disease
   Normal biomedical values and reliable clinical and post mortem findings are, in most cases, not available. Those that exist are not easily retrievable: there is no central reference point and updating of data is not routine. Often the relevant information is recorded in a variety of different ways by people from different backgrounds. The terminology used in both published and unpublished reports is sometimes medical, sometimes non medical: only very rarely are lesions or clinical signs quantified. The recognition of stress is hampered by our ignorance of normal parameters. Opportunities exist for collaborative research on stress-including behavioral and physiological variations and could help to answer the need for relating veterinary research on mountain gorillas to management practices.

2. Disease incidence, prevalence and spread
   Although specific data on diseases of mountain gorillas are scarce, it is clear that information of relevance could be obtained from a full, international and multilingual literature search on both mountain and lowland gorillas, study of museum material and collation of information on human diseases, especially those of local populations.

3. Recognition and knowledge of the gorillas
   Identification methods such as use of noseprints are still not used uniformly and there is a paucity of genetic data which would assist in unraveling mechanisms of disease transfer and the possible role of inbreeding depression.

In all three of the above, the key factor would appear to be a willingness to collaborate and to exchange information and for the collation and dissemination of data to be truly international with a strong emphasis on regional (Democratic Republic of Congo, Rwanda, Uganda) participation.

Disease Issues

Information on what we should know:

1st postulate: Very little first-hand information about diseases affecting mountain gorillas.

2nd postulate: Extrapolation from lowland gorillas is a reasonable place to start.

3rd postulate: One potential source of epidemiological data would/could be the local human population.

4th postulate: Need to more effectively extract disease data in a systematic way from mountain gorilla samples that are available to us.
- inventory/catalog existing samples
- agree on testing to be done
- settle ownership of samples

5th postulate: Promote and encourage the collection of new samples and data during every opportunity that occurs
- by new non-invasive or minimally-invasive techniques
- develop protocols and agreements for routine sample collection using agreed terminology
- train people in proper sample collection in relevant languages

6th postulate: Better data analysis & information dissemination

7th postulate: Use of new information to revise and inform existing policies on disease control and general knowledge of disease processes

8th postulate: Solicit financial backing and political will to support these initiatives

Potential Sources of Disease

Infectious / Humans: tourists
local population
transient populations

	field staff (vets, researchers, trackers, etc.)
Infectious / Other primates:	chimps
	baboons
	monkeys
Infectious / Other animals:	dogs
	bush pigs/duikers/buffalo/elephants
	cows, goats
	birds
Non-Infectious diseases:	snares
	projectile weapons
	mines
	fires
	intra- and inter-specific aggression
	human attacks

Predisposing Factors of Disease (Conditions)

1. Habituation - increased likelihood of human contact (and all the risks that are associated with that. i.e. due to the close genetic relatedness of humans and gorillas there are many diseases that are and could be shared)
2. Habituation - increased likelihood of stress, in particular during the habituation process
3. Tourist/gorilla ratio and the number of visits/day
4. Climate-cold and wet weather (reference available)
5. Disturbance (e.g. refugee movement, gunfire)
6. Gorilla home ranges overlapping with areas of human activity, including outside of the protected areas
7. Genetic predisposition to disease (including inbreeding). Are there physical indicators such as syndactyly or strabismus?
8. Group composition; smaller gorilla groups or those with larger numbers of infants may be more susceptible
9. Population density; disease risks increase with the increase population density
10. Habitat destruction
11. Snares; direct physical injury and risk of serious secondary infection / possible death
12. Human contact / human waste contact

Actual Diseases - Clinical

*Very little actual prevalence data exists.

1. Scabies - well-documented
2. Respiratory disease
   - upper respiratory disease., including air sacculitis
   - lower respiratory disease
3. Diarrhea with abdominal pain
4. Eye infection
5. Snares
6. Vesicular dermatitis (limited to head)

7. Tapeworm, nodular worm, louse, mite (more likely to be subclinical)
8. Serologic evidence only of alpha herpesvirus, measles, mycoplasma, possibly others
9. Osteoarthritis (joint disease)
10. Facial abscess/tooth infection
11. Spondylitis/spondylosis (back disease)
12. Healed fractures
13. Ankylosis (fusion of joints)
14. Strabismus (crossed eyes)

Potential Disease

1. Known diseases transmissable from humans to captive lowland gorillas and chimpanzees
   a. Viral: measles, mumps, *Herpes simplex*, chicken pox, polio, rotavirus
   b. Bacterial: *Shigella*, *Salmonella*, *Campylobacter*, *Mycobacterium tuberculosis*, *Streptococcus pneumoniae*
   c. Parasitic: *Entamoeba*, *Giardia*, *Balantidium*, pinworm, *Strongyloides* (from humans)

Controls and Interventions

Many of the existing commonly-observed guidelines (generally incorporated into the standard ecotourism routine) are not necessarily based on sound scientific knowledge of established epidemiologic risks. Existing guidelines are as follows:

- Tourists

  5m rule
  1 hour visit, 1 visit/day
  max. 6-8 tourists
  minimum of 15 years of age for visitors
  no evidence of infectious disease in the tourists
  sanitation guidelines (burying waste, no eating, no drinking)
  turn head away if sneezing, coughing
  strict enforcement of behavior (ejection if behavior is inappropriate)
  no touching gorillas
  face masks (has been suggested)
  option to suspend tourist visits in an outbreak

- Field Staff Controls

  Same rules, except:
  veterinary interventions permitted
  protective clothing for interventions such as masks and gloves
  two-week quarantine for new researchers and personnel. This is not consistently observed.
  5 m distance allowed for researchers, certain circumstances allow for 3 m
  special rules for actual outbreaks
  1. visit only one gorilla group/day
  2. change clothes
  3. disinfect boots before and after visits

educate staff on regulations

- Local People (options more limited)
  education of local people
    1. proper reactions to rogue gorillas (e.g., those displaying especially aggressive or aberrant behavior)
    2. crop selection for planting near park borders
    3. sanitation guidelines
    4. park regulations
    5. reporting gorilla problems

  reduce motivation to enter park
    1. enforce bans on park entry
    2. provide water
    3. provide fuelwood
    4. provide alternative animal protein
    5. provide grazing areas for cattle

  disease surveillance of locals
  treatment of health problems of locals

- Transients (Individuals moving through gorilla habitat only sporadically)
  anti-poaching patrols
  law enforcement
  snare removal
  de-mining
  training of military

Actual Disease Reports from Field Veterinarians

1.Liz Macfie MGVP 1989-1992

- 25 animal-respiratory disease outbreak
  responded to antibiotic treatment
  possibly Respiratory Syncytial Virus?, measles?
- air-sacculitis

2. Jonathan Sleeman/Antoine Mudakikwa, MGVP 1995-1997

- 7 snare removals
- 1 amputation
- 1 respiratory infection treated with antibiotics
- 4 gunshot deaths
- 1 silverback fighting death
- 3 neonatal necropsies (1 agalactia, 1 stillborn, 1 ?)

3. Gladys Kalema UWA 1996-1997

- necropsies (1 silverback w/ ht. dz; 2 females w/ inflammatory bowel dz.; 3 infants: 1 scabies, 1 stillborn, 1 ?)
- 4 scabies
- 1 eye infection
- 3-5 intestinal disease
- 1 rectal prolapse of a juvenile

4. Ken Cameron/Antoine Mudakikwa, MGVP 1997
   - snare wound

Clinical and Diagnostic Service Delivery

Health surveillance

1. Habituated Gorillas
   Policy for veterinary intervention: The current MGVC policy, which has been widely recognized, restricts veterinary intervention to cases of life-threatening or human-caused disease. This policy was developed in 1991 and it is the feelng of this working group that a review of current policies is warranted.
   - Guidelines for uniform practice should be developed in order to ensure continuity and quality of veterinary care.
   - A health monitoring program should be established, which should include at least the following elements:
     1. nature and schedule of sampling
     2. define a monitoring team, including veternarians and field staff
     3. mutual support between range country veterinarians is essential
     4. adequate logistical support for these activities should be identified and secured
   - Emergency services
     1. further support services and expertise should be developed, including further involvement of other disciplines
     2. mutual veterinary support
     3. logistical support for activities

2. Non-habituated Gorillas
   The same issues are relevant, but there are additional limitations due to lack of accessibility.

3. Human (Medical)
   - A disease survey of surrounding human populations should be performed to identify potential disease risks to gorillas.
   - This should be followed by on-going disease monitoring, control and education programs.

   These activities should be undertaken in close collaboration with regional health authorities and medical NGO.

4. Other animals
   - Some diseases can be transmitted between gorillas and other animal species (eg. Cattle transmitting *Salmonella*)

Diagnostics

1. Standardization of techniques - what samples, methods of collection and tests from each sample?

2. Maximize data collection
   - Number and type of sample/opportunity
   - Maximize the use of each sample - testing, sharing and banking
3. Provide support for local diagnostic capabilities, including establishment of laboratories and training of personnel.

4. Permits
   Rapid acquisition of necessary permits for international transport of diagnostic materials is essential. CITES procedures should be streamline in the case of biomedical specimens used in the diagnosis of disease outbreaks. In addition, existing regulations need to be harmonized between various governing bodies. For example, CDC (U.S.) regulations demand that such samples not be opened in transit, yet CITES regulations often require inspection of the materials by customs officials.

Dissemination of Information

1. There is a great need for establishment and maintenance of a data bank.
2. Regional Notification of Results - in particular in the face of a disease outbreak in one area
3. Relevant information should be distributed to appropriate bodies, such as:
   - Government agencies
   - Park management
   - Researchers

Clinical Service Needs

1. Identify required equipment and supplies
2. Identify constraints on field care of the gorilla population
3. Discuss potential need of hospitalization of a gorilla and creation of appropriate hospital facilities.
4. Identify adequate laboratory facilities both regionally and internationally.

Training Issues

Specific health and disease information needs to be tailored to fit the needs of the various groups. The recommended content for such training is as follows:

All Target Groups

1. Basic information (which includes)
   - Public Health
   - Impact/risk of fire, firearms, war machinery, snares
   - Risk identification and reporting
   - Risks of injury and disease to people and animal of gorilla harassment
   - Sensitization on appropriate multiple-use levels
2. Sanitation and Hygiene
3. General behavior on contact with gorillas
4. How to minimize gorilla-human contact/distance

5. Value of health and welfare and conservation of gorillas

Local People

1. Legal users (multiple use, forest path users, military users etc)
2. Illegal users
3. Resident neighbors

Park Staff (trackers, rangers, wardens)

1. Basic information, plus
2. Enforcement of relevant laws
3. Park regulations
4. Gorilla identification
5. Health monitoring
   - Accurately identify abnormal behaviours and clinical signs
   - Reliable and timely reporting of abnormalities
   - Veterinary / emergency procedures
6. Communication skills, interpretation, education
7. Information/education given to local populations should also be given to this group.

Tourists

1. Basic information
2. More specific behavioral limitations (e.g. 5m distance, etc.)
3. Zoonotic risks / importance of visitor health status

Researchers

1. Basic information
2. Risks of researchers' behavior
3. Zoonotic risks
4. Health monitoring & recognition of health problems and reporting
5. Importance of preventative medicine for research acclimatization (their own health status and preventive measures)
6. Veterinary procedures and rationale

Veterinarians / Veterinary Assistants

1. Gorilla behavior & ecology
2. Importance of recording and reporting to appropriate authority
3. Protocols (intervention, sample collection and etc.)
4. Research methods and rationale
5. Impact and risks of intervention
6. Legal issues
7. Conservation principles and conservation vs. welfare
8. Database development and management

Policy and Regulatory Issues

Individual Animal Problems

While wildilfe veterinarians are primarily concerned with the health of the populations we are on occasion called upon to deal with individual problem animals such as orphans, animals confiscated from poachers.

1. Orphans/confiscated animals/ problem animals (crop raiding, attacks on humans)
2. Potentially hospitalized animals
3. There are no policies currently implemented for these issues
4. Recommendations:
   - Orphaned Animals
     This is a complex issue
     IUCN recommendations are a good starting point for policy development
     Recommend on-going working groups to address the issues
   - Problem Animals
     Group of gorillas
     Lone animals
     There may be differences regarding tourist vs. research vs. non-habituated

Methods of Management

1. Herding, needs to be established when it is necessary to do it
2. Translocation:
   - There are no current policies
   - Policy is needed regarding veterinary intervention in problem animal cases
   - Destroying policy in extreme circumstances such as a gorilla killing a person needs to be addressed. Is it necessary? Park management issue. Public relations?
3. "Medical problem" animal
   - Euthanasia policy is in existence. Consider reviewing it.

Tourist Regulations

1. There are current regulations in place (see under disease section)
2. Are they adequate?
3. Major research is needed to allow for informed decisions regarding changes to the regulations.

Veterinary Health Policies

1. Currently have non-invasive policy, i.e. life-threatening or severe human-induced disease. These regulations place constraints on our veterinary ability.
2. Rational debate needed on this issue, including a risk/benefit analysis
3. Recommendations for diagnostics in the face of disease, i.e., provisions for the ability to perform strategic immobilizations for diagnostic purposes in the face of an outbreak of an apparent infectious disease.

4. Immobilizations for disease surveillance policy needs to be developed, realizing that this is a controversial issue
5. Issue of welfare needs to be addressed, and policy statement made

Human Health Policies

1. Current guidelines for researchers and park employees. Are they the same as the tourists
2. What improvements can be made?
3. Recommendations: Occupational Health Scheme. Needs to be defined, and constraints recognized, e.g., ethical issues regarding TB testing, informed consent, etc.
   - Education, in particular, community based education

Regional Harmonization

1. Coherence of veterinary practice policies between the three countries
2. Harmonization of sample collection policies, transport, analysis and storage
3. Harmonization of reporting and permits
4. Medical records, standardized terminology (MedARKS)
5. Necropsy/immobilization protocols
6. Issue of veterinary licensure in host countries and recognition of veterinary credentials
7. Recommendation, other countries should follow UWA lead and establish a veterinary unit in the National Parks office staffed by national veterinary officer.

Financial, Institutional and Professional Linkages

1. Veterinarians responsible for mountain gorilla vet care need to form institutional and professional linkages locally, regionally and internationally with governments, NGOs, universities and other relevant institutions, disciplines and individuals for diagnostic, clinical and research support .

2. Researchers and vets need to work together closely and exchange information freely. Veterinary related research should be encouraged and applied to management of mountain gorillas. Veterinarians should participate in inter-disciplinary research so that prospective inputs on health matters are incorporated into research designs and policy considerations.

3. Build local and regional databases linked to international databases that are up to date and accessible.

4. Vet services need to be urgently sustained by funds to provide
   - Training for local personnel
   - Equipment
   - Clinical, diagnostic and research support.

*This can be done with assistance from government agencies, NGOs, and other relevant institutions. A strong need to build vet services within PA authorities.

5. Veterinarians primarily responsible for mountain gorilla health care need to prioritize veterinary needs with regard to funds available.

6. There should be an emergency fund and professional discretion for the attending vet to seek specialized support for diagnosis of fatal disease in the face of an outbreak.

Recommendations

1. Sustainable Vet Unit
   Fundamental to the conservation of the mountain gorilla is the existence of sustainable national veterinary units responsible for implementation of veterinary services.

   Therefore, we recommend the creation or further development of a wildlife veterinary unit in each of the mountain gorillas' range countries. Inherent to this proposal is the provision of adequate financial and human resources. In order for this to occur, adequate technical assistance and education of host country governments needs to be provided.

2. Diagnostic Capabilities
   At present, there is lack of adequately equipped local/regional laboratories and/or trained personnel available for processing of mountain gorilla samples. Such facilities are essential to rapid diagnosis of disease and routine monitoring of mountain gorilla health.

   Therefore, we recommend that an effort be made to identify potential local/regional diagnostic facilities and that a plan be developed to aid in developing and supporting such a facility, including the training of personnel. At the same time, standardized protocols for sample collection, handling, identification, processing and reporting should be developed, approved and distributed. There is also a need to obtain expedited CITES permits in those cases where samples of diagnostic importance need to be transported internationally to specialty laboratories to support proper disease diagnosis and control.

3. Financial Support
   In order to ensure sustainable and effective veterinary services for mountain gorillas, there is an urgent need of funding for equipment, clinical, diagnostic and research support, and training of local personnel, with input from government agencies, NGOs and other relevant agencies. Veterinarians responsible for mountain gorilla health should be directly involved in identifying needs and prioritizing them relative to available funds. Budgets should include funds reserved for emergency veterinary management of disease outbreaks. In order for this to occur, adequate technical assistance and education of host country governments needs to be provided.

4. Database
   At present, there is no effective mechanism of orderly, standardized collection, management and dissemination of data and materials relevant to mountain gorilla health.

We recommend the establishment of an interactive, international database and an organized tissue/serum bank. All concerned agencies and individuals should contribute to the creation and management of this database and identification of an organized agency.

5. Disease Surveillance Plan and Review

   The science of veterinary epidemiology is well-developed at this time and has effective tools to provide a scientific assessment of the health risks to the remaining populations of mountain gorillas. However, to date, it has not been adequately applied.

   Therefore, we recommend the development of a comprehensive epidemiologically-based plan and appropriate research for safeguarding mountain gorilla health. This plan should be based on scientifically sound disease surveillance and control practices, taking into account both human and animal populations. Epidemiologic data should serve as the basis for developing policies on mountain gorilla health. However, we recognise that such policies will be finalized and implemented within an interdisciplinary framework. If such policies are based on other considerations, then effective disease monitoring and control could be compromised.

6. Organization of Existing Knowledge

   The lack of historical medical information on mountain gorillas impairs meaningful veterinary input into their effective conservation. Therefore, all existing medical data on or relevant to mountain gorillas need immediately to be located, identified, catalogued, reviewed, analyzed and presented or made available to the concerned community.

7. Training

   We believe that there is inadequate awareness of mountain gorilla health issues among the various human groups who interact with mountain gorillas. There exist different levels of training needs for these different groups based on the nature of their interaction with mountain gorillas.

   We recommend that all training should include information on health issues related to human/gorilla interactions. Such training materials should be developed with participation of wildlife veterinarians, as well as physicians and/or other appropriate health professionals. In addition, training of veterinarians working with mountain gorillas should include information on mountain gorilla behavior, ecology, conservation and park management.

8. Intervention Policy

   There is lack of a clear policy for intervention (e.g. immobilizations, treatments, vaccination, euthanasia and physical restraint) with mountain gorillas.

   Therefore, we recommend that the current intervention policy be reviewed regarding disease outbreaks, individual welfare vs. conservation and politics. This should extend to problem animals (individuals and groups), orphaned and confiscated mountain gorillas.

9. Veterinary Input in Management Planning for Health And Welfare

At present mountain gorilla management planning does not usually have veterinary input. As a result, health and welfare considerations are not necessarily part of the decision-making process.

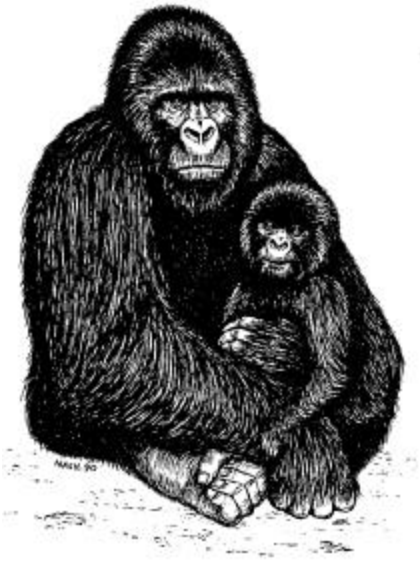
We recommend that a veterinarian be part of such planning and that a cost-benefit analysis, particularly attempting to reconcile welfare of the individual with conservation of the population, becomes standard practice.

10. Health Risk Assessment

Gorilla conservation community is often faced with difficult decisions regarding health intervention issues on the population and individual gorillas e.g. orphans, problem animals, sick animals. No mechanism exists to resolve these problems.

We recommend that a systematic approach be developed and implemented to assist with these difficult decisions. Such approaches would include computer modeling, decision tree analysis and other epidemiologic techniques.

Population and Habitat Viability Assessment
For *Gorilla gorilla beringei*



8 – 12 December 1997
Kampala, Uganda

Section

Human Population Issues

4

Human Population Issues Working Group Report

Working Group Participants:
Jean Bizimana, Office Rwandais de Tourisme et Parcs Nationaux
Onnie Byers, Conservation Breeding Specialist Group
Philip Franks, CARE – Uganda
Charlene Gendry, Columbus Zoo
Leonard Mubalama, Institut Congolais pour la Conservation de la Nature - Congo
Pascal Sicotte, University of Calgary
Amy Vedder, Wildlife Conservation Society
Frances Westley, McGill University

Introduction

Our workshop concentrated on the interactions between local populations and the gorillas as well as with the gorillas' habitat. In order to approach this question, we devised a conceptual framework allowing us to examine key processes relevant to that question in relative isolation before actually trying to link them.

The most crucial processes requiring investigation are the actual interactions between the human population and the gorillas/gorilla habitat. These include both resource extraction by humans from the habitat, and interactions that are potentially beneficial for humans, gorillas, and/or the habitat. In order to understand the factors that influence the type of interactions taking place between the local population and the forest, as well as their intensity and their frequency, a contextual framework was developed that deals with factors affecting the makeup and attitudes of the human population. These include factors such as human population growth, economic values, cultural values associated with the gorillas and the park, population demographics, and political instability. Finally, the third set of processes address the means by which the interactions between the local populations and the gorilla habitat can be influenced. Different types of community participation in the decision making process regarding the management of the park, as well as different mechanisms for resource sharing, are investigated. These three portions of the conceptual framework are elaborated below, first by describing the human context.

Contextual Issues in Human Population-Conservation Interactions.

A model of contextual pressures/issues was suggested that included:

	International	*National/Regional*	*Local*
Cultural • values • traditions • beliefs • rituals	Global culture	National/Culture	Local culture
Economic	Global markets	National markets	Local markets

Social/Demographic	Global trends	National trends	Local trends
• disease • population growth • emigration/ immigration			

Political	Global Actors	National Actors	Local actors
• govts / NGO			

It was noted that most local situations are being affected by global as well as national forces today. This is important to recognize, since solutions to problems must be addressed at the appropriate level. E.g. if causes are global, solutions must, at least in part, be sought at that level.

It was suggested that in many cases, especially nations that are stable such as Uganda, it is National level policy which drives the protection of the parks, given that much of the economic value accrues at that level. The assumption is that local people, given free control over the resources, will, under conditions of need, use the resource to meet those needs. However, what we can hope for under this scenario is that a) local people respect the national government and b) that resource sharing plans of some kind are put in place that are deemed fair by local people. However, "fair" is a moving target, both among different communities and through time. For example, at this point around Bwindi it is likely that the negatives of crop raiding far outweigh perceived advantages coming from the park.

On the other hand, in situations such as that near Virunga in the past three years, national policies provide no protection because of political insecurity in the region. In these contexts, local populations (even if they are recent immigrants/refugees) will determine the fate of the park, possibly mediated by alliances between park staff and INGOs concerned with conservation. (see Hart and Hart re: the role of INGOs and the model of humanitarian aid for conservation activity in times of crisis).

The issue of population pressures were then discussed. It was clear despite some steady outmigration (probably of the young) around the parks in Uganda, there is a steady population growth close to the national average of 3%. This means the population will double in around 30 years. With a fairly high population density already around the parks, this will put additional pressure on the agricultural lands, already suffering from overcultivation/grazing. In terms of agricultural production there is room for more efficiency yet, so the crisis will not be immediate, but pressure will grow. Assuming effective law enforcement this increasing population presssure is most likely to be expressed as a) increasing frustration and environmental violence (eg deliberate fires) and/or b) increasing pressure for policy change (eg degazettment of cetain areas of the park or increased multiple use), rather than gradual, progressive encroachment. This case is possibly different surrounding the Virungas. In Rwanda prior to the outbreak of war in 1994, there was substantial outmigration, resulting in an overall population growth rate of 1.7%.

In Uganda, at the present time, there has been an emphasis on empowerment at the local level. This has caused an improvement in attitudes around the parks as people become hopeful that revenue sharing/multiple use initiatives will bring an improvement in their standard of living.

However, greater local empowerment also brings the possibility that local people will pressure for greater control over/other uses of park lands. For example, economic studies have been carried out and community leaders have urged such options as cutting down parts of the forest to create pine plantations and investing in tea production. At the moment, national pride in the parks and the national government's reliance on tourism largely driven by the parks, as well as an understanding of the ecological services provided by the park, provides a healthy counter balance. But seen in this light, unless economic conditions improve, empowerment may represent a threat to park conservation.

The issue of local populations valuing intrinsic or non-economic benefits of such parks was explored. It was recognized that such values/traditions can modify the effects of population and economic pressures. However, in general when economic need is severe, it is important to address this first. The analogy of a car in a skid was noted. First you steer into the skid (address economic needs) then when the crisis is past you work to encourage recognition of other, non-economic values to help stay on course.

In sum the above discussion gave rise to a model of contextual pressures in a stable scenario: In an agricultural economy in which population growth is continuous, land productivity is in decline, empowerment of local populations is increasing, non-economic environmental values are relatively minor, conservation protection is likely to decline (through policy change or environmental violence) *unless* a)economic situation improves, b) non-economic environmental values increase.

This leads us to a set of questions concerning community relations around the park:

1. What economic programs/opportunities presently exist?
2. How are they working to relieve pressure on park resources?
3. What other ways can we respond to economic needs?
4. How can long term economic benefits to local communities be developed, perceived by them as derived from the park, yet not presenting a threat to gorilla conservation.
5. What economic and non-economic values do local populations currently recognize?
6. What factors might change this?
7. Under what conditions does participation increase support for conservation?

It was also noted that in an unstable situation the model is quite different. Different factors will determine conservation protection or lack there of. (Elaborate here…)

Interactions Between Local Populations and Gorilla Habitat

Concerning the interactions between human populations and the protected areas, we first listed interactions in the two cases of protected areas in the Virunga and Bwindi. Where appropriate, we distinguished between legal and illegal activities.

Bwindi

Legal activities include:

- Bee keeping.

- Gathering of medicinal plants.
- Collection of vines for basket making.

(The possibility of allowing the Batwa to collect fruits in Bwindi is under investigation.) The three activities listed above take place legally, by permit only, in some areas of the forest (one-third of the sectors = 7 sectors out of 21) and limits are set for these particular activities in terms of the quantity of harvesting and/or numbers. (When these same activities take place in other sectors of the park, or by non-permitted people, they become illegal.)

- Use of designated paths for humans and livestock to cross the forest.
- Ecological services rendered by the park can also qualify as "legal interactions". Although difficult to quantify, they bring imprtant economic and non-economic benefits to local communities. These services include water regulation among other things.

Illegal activities include:

- Poaching of various animals including gorillas, although poaching seems to be relatively rare in Bwindi in comparison to the Virunga. (There is probably a need to compare data from Bwindi and Virunga more closely, for example, by comparing number of snares removed per hour of patrol; 30 snares, metallic and nylon, were removed by ICCN guards in November 1997 in the Virungas.)
- Wood cutting for fuel and building materials occurs, although it is minimal.
- Cattle grazing: occurs mainly at the edge of the park.
- Additional illegal activities include bee keeping and the collection of vines and medicinal plants which are done outside the allocated sectors or that exceed the limits that have been set.

Although not "illegal", a final significant negative interaction is that of crop-raiding wildlife. Animals venture out of the park onto cultivated land and cause significant damage to local people's crops. These animals include baboons, gorillas, wild pigs and elephants.

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In the Virunga the interactions between local populations and the parks have been divided between those that occur under "normal" conditions and those that occur under the recent past and present situation of insecurity in Rwanda and Congo. The Virunga protected area includes the Parc des Virunga-Sud (Congo), the Parc National des Volcans (PNV, Rwanda) and the Mgahinga Park (Uganda).

<u>Virunga Normal Conditions</u>

Illegal Activities

- Poaching of both gorillas and other animals.
- Wood and bamboo cutting. (For construction material and fuel).
- Cattle grazing in the forest particularly in the Mgahinga Park.
- Apiculture (introduced beehives): rare
- Clearing of the forest for cultivation of small plots and/or manipulation of the limits of the park by removing park boundary markers (the latter happening apparently often in Central and Northern sectors of Parc des Virunga rather than in Southern sector where IGCP is funding patrols.).

- Access to water, particularly in dry season (illegal but tolerated).
- Use of established paths by the local population as a means of travel through the forest.
- Gathering of wild plants for both food consumption and medicinal purposes.
- Rituals performed, mainly by the Batwa, in the forest (for example at burial sites). This has been documented only on the Mgahinga (Uganda side of the Virunga; where although illegal it is tolerated). The extent to which this happens elsewhere is unknown.
- Military activities in the forest.

Again, though not "illegal", crop-raiding by park wildlife is a significant negative population/park interaction. Buffaloes are a problem in all areas of the Virunga. In Parc des Virunga Sud, gorillas cause damage to banana plantations and maize crops.

Legal Activities

- In the PNV water collection (near Bisate) is allowed just within the park border.
- In Mgahinga, some activities now illegal are in the process of being re-evaluated. collection of roots of bamboo is now legal and bee keeping is probably going to be legal. Also, water will be piped out of the forest for utilisation by the local population.

Ecological services rendered by the park provide further positive interactions. Although difficult to quantify, they bring important economic and non-economic benefits to local communities. These services include water regulation among other things.

<u>Virunga, Recent Past & Current Situation</u>

Illegal Activities:

- Poaching of antelopes, buffaloes, small mammals and gorillas.
- Wood and bamboo cutting for construction and fuel.
- Clearing of forest for cultivation.
- -Utilisation of paths inside forest for human travel.
- Fires set by humans within the forest (cooking of food by those illegally staying in forest) and loss of control of these fires.
- Human presence (refugees) leading to human organic waste (excrement, corpses).
- Land mines and shelling (sound and physical impact).

Further negative interactions: Animals leaving the park and entering cultivated areas (buffaloes and not gorillas).

Positive Interactions:

- Ecological services

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Following assessment of these interactions between local population and gorilla/gorilla habitat in Bwindi and Virunga, some questions were raised in order to help prioritise the risks associated with these interactions.

- What is the relative effect of small-scale, incremental encroachment versus the potential effect of governmental decisions to change the status of land that are now set aside as park land?
- What kind of economic analysis would be convincing in assessing the potential for revenue for a given land?

- Are the gorillas the only reason why a park is being preserved or are there other reasons?
- What could some of these reasons be? For example, maintenance of biodiversity per se? Ecological services that the forest provides to the surrounding areas? These ecological services are quantifiable, their economic value can be estimated.
- What is the impact of national infrastructure development on the interactions between local population and the parks?

Questions in relation to the effect of ecotourism also came up regularly in the discussion, and despite the fact that so far we have been addressing the question of interactions between local populations and the forest, some activities related to ecotourism do fit under this category. The local population interacts with tourists and deal with some of the effects of ecotourism both in the forest and outside. Outside of the forest, the local population can benefit economically by producing and selling items to tourists, though this is a minor activity at present. In the forest, members of the communities near the park benefit economically from working in association with the ecotourism industry (porters, trackers, guides). What is the impact of these activities on the forest itself? These questions are open for investigation.

Another question that has been raised in dealing with interactions of people with the forest is the effect of the Karisoke Research Centre itself (use of wood for fuel, generation of waste, and increased human activity such as porters). When considering human presence within the parks, the presence of local people should be considered alongside that of tourists, researchers and associated park staff.

The next step in our process was to categorize the various interactions/threats in relation to the intensity of their impact on the gorillas and the gorilla habitat. This is a "gorillacentric" approach, which unfortunately limits our analysis. However, this also allows a more direct focus on some issues, especially an assessment of threat to mountain gorillas, and hopefully it might allow some actual quantitative measurements of the impact of the interactions. We are using a scale from 0 to 3 in a first attempt to identify the severity of interactions, allowing a prioritization of interactions for further investigation and/or measurement. "0" means no impact and 3 is intense impact. Remember that some of these interactions between local population and the gorillas/gorilla habitat are legal in Bwindi; this may explain the value "0" that has been attributed.

(Note: the high values attributed to human presence and human waste production in "Virunga/actual" column below are due to refugee presence in park.)

Interactions/Threat	Virunga normal (PNV/PNVi)	Virunga actual	Bw
Poaching of gorillas	2	3	1
Poaching other animals	2	2	1
wood cutting	2	2	1
bamboo cutting	3	3	0
cattle grazing	0	1/0	0
bee hives	0	0	1
clear cutting (illegal)	3	3	1

access to water	1/0	1/0	0
Interactions/Threat	Virunga normal (PNV/PNVi)	Virunga actual	Bw
use of paths	1	2/1	1
plant gathering (med + food)	0/1	0/1	2
Ritual activity	0	0	0
Forest fires1*	0	0	1
Forest fires2**	0	0	2
Forest fires3***	0	0	1
gathering vines	1	1	2
human presence	1	2	1
human waste production	1	3	1
land mines	1	2	0
military act.			0
mining	0	0	0

*Forest 1 = arson

**Forest 2 = fire used as part of agricultural practice close to the border of the park; go out of control sometimes

***Forest 3 = Fire set as a result of collection of wild honey.

Because data are available for the effect of poaching on gorillas in the Virunga (normal), they will be included in the model, even if the effect has been ranked as "2" qualitatively.

Bwindi Interaction Data for Major Identified Threats

Poaching of gorillas

Who?	Poachers are supposedly poor 25-40 male
How often?	An average of 5 snares per month; 70 snares found in the last 9 months, 60 of these were Jan-March 1997 possibly coinciding with national holidays
Where?	Area around guard stations where habituated gorillas reside
Impact on gorillas?	No report in Bwindi of gorilla caught or injured in snare; In Bwindi 4 gorillas killed by poacher attempting to capture a baby; dogs and spears also found in Bwindi; park guards are only patrolling the border points so only observing territory of 25-30 out of 300 gorillas and expressed concern about wild gorillas in more remote parts of the forest...no information on them

Wood cutting

Who?	Unknown
How often?	Last 9 months reports on pitsawing, polecutting and wood cutting, confiscated saws, axes and files, and arrested one person
Where?	South and Northern section of Bwindi and near Congo border
Impact on gorillas?	Cutting of wood while not yet having a proven effect on gorillas is beginning to affect ecosystem and manger is concerned about potential effect on gorillas.

Animals going out of the park

Who?	Baboons, monkeys, gorillas, elephants
How often?	Gorillas (25% of time, one unit out for 3 months), elephants (2x/year so 2 seasons of crop damage per yr)
Where?	Gorillas in banana plantations, western edge of southern sector
Impact on people?	Bwindi park warden, Keith Musana, insists this is greatest threat to gorilla, people are afraid, stop their activities, no recompensation for loss, sometimes attacked by gorillas (5 cases since 1994), increasingly angry local people have threatened to kill the gorilla if nothing is done.

Cattle grazing

Who?	Cattle keepers, fairly wealthy
How often?	Everyday
Where?	Immediate neighborhood of the forest on the periphery
Impact on gorillas?	Little to date

Gathering vines and plants

Impact:	While not yet having a proven effect on gorillas is beginning to effect ecosystem and Musana, Bwindi park manger is concerned about potential effect on gorillas

Forest fires

Who?	Local population setting fires outside park which then spread to the park
How often?	Small fires fairly frequent; occasionally a large fire burns a large area of the park
Impact on gorillas?	Immediate, short term damage to habitat

Virunga Interaction Data for Major Identified Threats

The data of the Virunga have been extracted from Steklis et al. (in press in *Conservation Biology*) for PNV normal and actual. Data for PNVi actual have been communicated by Leonard K. Mubalama.

	PNV normal	PNV actual	PNVi actual
Poaching of gorillas			
Who?	??	??	??
How often?	87-90 (2.5 snares/day)	91-94 (4 snares/day)	total # snares 94: 913 1995: 2795
Where	??	??	??
Impact to gorillas? (# caught, maybe killed)	87-90: betw 2-4/yr	91-94: betw 0-6/yr	??

	PNV normal	PNV actual	PNVi actual
Bamboo cutting			
Who?			
How often?			# machetes seized: 94: 1588 95: 4078
Where?			
Impact to gorillas?			
Clear cutting (illegal)			
Who?			
How often/much?			150 Km^2 cut by refugees
Where?			
Impact to gorillas?			
Human waste production			
Who?			
How often?			
Where?			
Impact to gorillas?			

(Question to the edition people: Given the lack of info/data on this table, should it be removed?? or acknoledge the need for more info??)

We have addressed the effect of clear cutting only in an illegal context. Obviously, if a decision was made at the national level to allow clear cutting of part of the gorilla habitat to produce cash crops or to fill other nedds, the significance of the impact of such a decision would be extremely intense.

Recommendations for Addressing Top Priority Negative Interactions Between Humans and Gorillas and Their Habitat

- Work with humanitarian agencies to ensure their emergency plans fully address conservation concerns.
- Conservation agencies (governmental and non-governmental) must prepare emergency plans which address in particular gorilla poaching, bamboo cutting, clear-cutting of the forest and impacts of human waste.
- Promote alternatives to bamboo eg. on farm bamboo, agroforestry.
- Address encroachment through clear boundary marking and law enforcement and education of communities (including local governmental officials).

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Ways to Influence the Interactions Between Local Population and Gorilla Habitat

Vision: Local populations: Are they part of the problem or are they part of the solution?

It can be both, and it is also likely that there is variation within populations. However, it has been stated that it likely that "no involvement" leads directly to being part of the problem. Implication of the local population can promote the emergence of solutions. A discussion followed about the needs of the populations living around the park. Without going into listing those needs, which would probably not be a useful exercise, the point has been made that if the needs of the population are satisfied without having to use the protected area, then the local population is not part of the problem. This is likely to happen in "rich" country, where basic needs of the population are met, and this leads to the fact that the implication of the local population is not necessary. Education also plays a role in modulating the behaviors towards the park.

A simple graph was presented, suggesting that as the sense of economical security of the population grows, the direct exploitation of the resources of the park tend to decrease, and the population's appreciation of the non-economic value of the park increases. Reasons for this increase probably include the influence of increased exposure to education, and conservation education, which influences values and behaviors.

Following this discussion, we agreed that our goal was to get to a situation where the majority of people around a park would support its protection (instead of merely tolerating it), and that people would feel that they get a "fair deal" from the park. This notion of "fair deal" is quite subjective and may change, that is why throughout our discussion, we will tend the notion of "support" towards the forest. It was pointed out that many project only try to maintain the population's tolerance towards the park, as opposed to promoting support. Tolerance was recognized to be fragile in most cases, and likely to disappear in unstable periods. It was also noted that some projects aim at "getting support" from the local population in fact promote simply tolerance because their approach is only to mitigate the effect of the park, substitute products or activities by something coming from outside the park, compensate losses due to the park.

It was acknowledged that knowledge can change quickly, opinions change more slowly, and values even more slowly.

In order to gain support from the population living around a park, the bottom line is that they must be better off by living near the park than if they were elsewhere in the country. The difference does not have to be large, but has to be sustainable, regular, and occur over the long term.

If this happens, it could lead to immigration into this particular area, thus increasing the pressure on the habitat itself, and also reducing presumably the "margin of benefits" that individuals or communities get from the proximity of the park. In discussion around this topic, it was assumed

that governing bodies at the local level were expected to take decisions that would reflect the interests of the existing community. Their goal should be maintenance of well being.

Various options can possibly insure local involvement. We suggest four here, that represent continuum in terms of consultation vs managing and decisional power.

1. Consultation of the local population on all aspects of the park that concerns them. The mechanism would be something like an advisory board, perhaps at the local, and regional level.

2. Representation of local community on decisional instances, w/representatives of other stakeholders. Representation would likely be minority for community.

3. Consultation of the local population on all aspects of the park that concerns them, with decisional power on areas that influence the local population; the areas need to be defined.

4. All decisional power to the local population (representatives), following progressive period of gradual delegation of powers.

Our group recommends Option # 3. We had initial discussions on the sectors that could be under community control. A preliminary list could include:

- Revenue-sharing for projects outside the park, within the limits imposed by environmental constraints.
- Control of crop-raiding by animals from the park, within the limits of national laws regarding the protection of endangered species
- Conservation-Education programs (money coming from park budget, but planning and strategy of the program could be establish by communities).

It has been acknowledged that consultation on other sectors needs to be done regularly. The mechanism has to be thought through. It has been pointed out that consultation on the selection of members of the communities for jobs related to activities in the forest (ecotourism, guards, etc) should be made by the park managers, and recommendations could be made by communities. In certain aspects, this consultation process may evolve into more of a process of negociation which benefits might be matched by reciprocity / responsibility.

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Type of Participation/Involvement of Population

Revenue Sharing

Revenue sharing advantages

- empowerment of communities
- can provide alternatives to park resource (depending on the nature of projects funded)
- gives communities tangible benefits from the park which are ongoing/continual, dependable and sustainable.

- Supports rural development at community level (but not household level) which helps to move people to the right on the graph.
- Builds trust between park and community

Revenue sharing weaknesses / pitfalls / risks

- Can create unrealistic expectations which lead to frustration
- Can create dependency syndrome, expectation that community problems will be solved by handouts/cadeaux
- Communities may not appreciate the link to the park thus no the programme has little conservation value.
- National park service facing funding shortage may feel they can't afford revenue sharing (eg if the gorilla park is providing funds to support other non-profit-making parks)
- Bypassing normal government planning processes (ie by delegating RS decision making to an independent community-based institutions) can lead to conflict
- Can create jealousy areas around between high revenue parks and other regions of the country in particular communities around other low income park
- May attract or retain more people in the vicinity of the park which could lead to greater demand on the natural resource base.

Recommendations

- Revenue sharing is recommended
- Policy and strategy must be well-conceived and defined prior to implementation
- Revenues to be shared must be consistent, dependable and sustainable
- Benefits must be truly for the community, not for single individuals
- Must clarify limits to the benefits in order to void false expectations for all parties
- Communities must make a substantial contribution, to avoid "dependency syndrome".
- Community must demonstrate sustainability for project to be funded.
- funding should be made conditional on conservation compliance
- Must explain from the onset the decision, making process (conditions, amounts, source of park process) transparent.
- Standardisation of revenue-sharing across programs (Bwindi / Virunga) to maximize consistency of expectations and implementation.
- Ensure that local government participates in the design of the program
- Ensure that the park management understands the crucial/critical link between revenue sharing and community participation in park management.
- Gorilla - permits fees should include a levy earmarked for revenue-sharing.

Utilization of Minor Forest Products

Utilization of minor forest products, if ever possible in gorilla habitats, should never impact on the viability of the gorillas and/or the viability of the resources used by the gorillas themselves. This is perhaps a statement of the obvious, but needs nevertheless to be made very clear from the onset.

Utilization of minor forest products is not necessarily equivalent to the model of multiple use of the forest which has been developed in Bwindi. Indeed, it does not imply that people have access to the forest. One could imagine a model in which harvesting of some minor resources could be made by a very limited number of people, for distribution of the resources to the local markets. Another possibility could be for example piping water out of the park, which once the installation is put in, does not require human presence in the forest.

We realize that simply raising the possibility of conducting a feasibility study on the utilization of minor forest products in a context such as the one in the Virunga might raise expectations. However, development planners in government and non-government agencies sometimes consider the possibility of utilization of minor forest products as a strategy to meet the needs of local population. So there is a need for conservation organizations to clearly address this issue.

There is evidence that in the PNV, gorillas avoid areas of human presence and therefore, it should be clear that the outcome of a feasibility study in the Virunga might advise against utilization of minor forest products. When there are alternatives in terms of direct benefits coming from the protected areas to the local population (such as revenue sharing or trust fund), the need for utilization of minor forest products might not even be necessary. The Virunga is a small high altitude ecosystem, where vegetation regenerates slowly, so the room for error is non-existent.

Advantages

- access (limited) to resources that address important needs in the community
- creates a very direct, tangible link between people and the forest.
- Resource users become de facto conservation education agents in their community.
- Builds support and trust between park and community (sense of stewardship)
- Provides another incentive for conservation compliance
  - Disincentive of permit loss
  - Obligation to report illegal activities
  - Reinforces stewardship
- May help to control activities that currently take place illegally (at lower levels?)

Weaknesses

- Risk of over-exploitation of permitted resources (either because authorised harvest levels are too high or harvesting exceeds authorised levels).
- Demand may exceed sustainable supply which leads to frustration
- Legal users may conduct illegal activities.
- Increased health risks to wildlife, including stress (especially gorillas)
- Risk of users being injured by wildlife.

Recommendations

- A feasibility study to consider the possibility of implementing a programme for utilization of minor forest products in the Virungas (including Mgahinga) taking into account size of parks, history of the parks, extent of current (illegal) uses, demographic pressures, potential for gaining conservation support through benefits, cost of implementation.

- Any programme of utilization of minor forest products that may take place must take into account for each proposed resource the abundance within the park, the potential demand and the ability of the species to regenerate following harvesting.
- Resource users must be educated on codes of conduct to minimize negative impacts on forest/gorillas.

It is recognized that to avoid a depency on gorilla revenue, an effort should be made to diversify the sources of revenue for a programme of revenue sharing.. It is also interesting to note that if it is made clear that a portion of the cost of the gorilla permit and/or other park fees goes to the communities around the park in this programme of revenue sharing, it may be used as a tool of marketing, and might further attract interest from tourists.

Trust Fund

Advantages

- Possible mechanism to increase collaboration among nations, NGOs...
- Increase international awareness
- Sustainable financing
- Relieves pressure on tourism (gorillas) as source of revenue
- Could provide mechanism for protecting other parks and species
- Major benefit provided directly form park to communities
- Translates international value into local benefits
- Builds conservation support in communities
- Can fund development of alternative resources

Weaknesses

- Can create unrealistic expectations and lead to frustrations
- Can create dependency syndrome
- Community may miss the tie to conservation and park: so no support for conservation.
- The bypassing normal government processes, so can cause conflict between communities and local government
- Can create jealousy between high-revenue park areas and other regions of nation and other low-revenue park areas
- May attract or retain more people in park vicinity, so more need for resources
- Legal and technical complexities in establishment
- If regional (Virunga) additional legal and technical complexities (of allocation proportions, reaching consensus, collaboration of multiple partners)
- Requires responsible, reliable implementing body with substantial capacity, collaborating with all conservation partners
- Potential for conflict between conservation agencies
- Potential for lack of accountability
- Invasion of asset base
- Poor investment
- Lack of experience of community.

Recommendations

- Establish trust fund/funds for the PNV and PNVi
- Increase existing trust fund for Bwindi and Mgahinga
- Encourage collaboration among these trust funds (new + existing)
- Design new trust funds in light of lessons learned from Mgahinga and Bwindi trust funds and others around the world.
- Government and non-governmental agencies active in gorilla conservation should collaborate fully in the design of new trust funds and the raising of such funds.

It must be noted in light of the first recommendation that some economic analysis have been done and indicate that the current Bwindi / Mgahinga trust funds are not sufficient and should be increased.

Overall Recommendations (no priority assigned)

- Work with humanitarian agencies to ensure their emergency plans fully address conservation concerns. In addition, conservation agencies (governmental and non-governmental) must prepare their own emergency plans which address identified critical interactions of humans with gorillas and their habitat.

- Promote community participation in conservation through institutional mechanism which enable consultation with the local population on all aspects of the park that concern them and with decisional power on areas that particularly affect them (i.e. revenue sharing, control of crop raiding, conservation education)

- Guarantee a consistent, reliable source of funds dedicated for sharing with local communities, ensuring: 1) transparency in decision-making; 2) management of expectations; 3) strong conservation linkage; 4) substantial community investment and capacity to sustain; and 5) clear policy guidelines. The most effective, practical mechanism would be to guarantee a proportion of total park revenue for this purpose. In the absence of this policy, it is recommended that an additional fee be charged for each gorilla permit. However, investigation of means to diversify the source of funds to be shared should be undertaken.

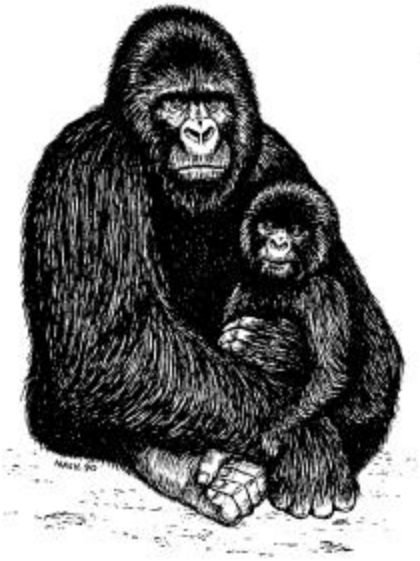
- Establish a trust fund(s) for PNV and PNVi drawing on experience of other trust funds with full collaboration of governmental and non-governmental agencies active in gorilla conservation in the region. Increase the existing Mgahinga and Bwindi trust finds.

- Conduct a study to consider the possibility of implementing programmes for utilization of minor forest products (eg medicinal herbs, honey, vines, water) in the Virungas (PNV, PNVi, MGNP) taking into account: 1) potential threats to mountain gorilla conservation; 2) biology of the resources targeted; 3) size and shape of the park; 4) park history; 5) extent of current (illegal) uses; 6) potential conservation benefits; 7) implementation cost; and 8) alternative resource sharing mechanisms (eg revenue sharing and trust funds) providing benefits to local communities that could obviate the need to give communities access to forest products.

- Because park boundaries represent the most acute pressure points of conflict between local people and the park: 1) boundaries must be clearly marked and their integrity enforced, 2) measures must be taken to address problems caused by crop-raiding wildlife.

Population and Habitat Viability Assessment
For *Gorilla gorilla beringei*

8 – 12 December 1997
Kampala, Uganda



Section

Population Biology and Simulation Modeling

5

Population Biology and Simulation Modeling Working Group Report

Working Group Participants:
Dennis Babaasa, Makerere University
Netzin Gerald-Steklis, Dian Fossey Gorilla Fund
Martha Robbins, Gustavus Adolphus College
Ollie Ryder, San Diego Zoological Society
Dieter Steklis, Dian Fossey Gorilla Fund International and Rutgers University
Philip Miller, Conservation Breeding Specialist Group

Introduction

The need for and consequences of alternative management strategies can be modeled to suggest which practices may be the most effective in conserving the mountain gorilla in Uganda, Rwanda and the Democratic Republic of Congo. VORTEX, a simulation software package written for population viability analysis, was used as a tool to study the interaction of a number of life history and population parameters treated stochastically, to explore which demographic parameters may be the most sensitive to alternative management practices, and to test the effects of a suite of possible management scenarios.

The VORTEX package is a Monte Carlo simulation of the effects of deterministic forces as well as demographic, environmental, and genetic stochastic events on wild populations. VORTEX models population dynamics as discrete sequential events (e.g., births, deaths, sex ratios among offspring, catastrophes, etc.) that occur according to defined probabilities. The probabilities of events are modeled as constants or random variables that follow specified distributions. The package simulates a population by stepping through the series of events that describe the typical life cycles of sexually reproducing, diploid organisms.

VORTEX is not intended to give absolute answers, since it is projecting stochastically the interactions of the many parameters which enter into the model and because of the random processes involved in nature. Interpretation of the output depends upon our knowledge of the biology of the mountain gorilla, the conditions affecting the populations, and possible future changes in these conditions. For a more detailed discussion of population viability analysis and the use of VORTEX in PVA, please see Section 11.

Although the mountain gorillas occupying Uganda's Bwindi Impenetrable Forest National Park and the Virunga Conservation Area may belong to the same subspecies (Garner and Ryder 1996) or may deserve consideration as a separate subspecies (Sarmiento et al. 1995), we consider these two populations as isolated units (i.e., no migration or dispersal between them) with specific threats and conservation priorities (Figure 5-1). The following projections and risk assessments are based on life tables derived by Gerald-Steklis (1995) from data on habituated animals in the Virunga population.The original field data were collected by a variety of researchers working at the Karisoke Research Center from 1967 to 1994 and by those studying groups visited by tourists (1979 - 1994).

Figure 5-1. Current distribution of the mountain gorilla in eastern Africa.

Input Parameters for Simulations

Mating System: Polygynous.

Age of First Reproduction: VORTEX precisely defines breeding as the time at which offspring are born, not simply the age of sexual maturity. In addition, the program uses the mean (or median) age rather than the earliest recorded age of offspring production.

For females, the analysis of Gerald-Steklis indicated a mean of 10.22 years (N=30), broken down into data for one-male groups (11.1 years; N=8) and multi-male groups (9.9 years; N=22). A weighted mean was calculated to generate the baseline first reproductive age. To investigate the sensitivity of a mountain gorilla population to measurement uncertainty in this parameter, we developed a set of models in which the female first age of reproduction was simulated as 9, 10, or 11 years.

Approximately 40% of mountain gorilla social groups are multimale (Schaller 1963; Yamagiwa 1987). Subordinate males have been observed mating, even at probable time of offspring conception. However, estimates of the proportions of offspring sired by dominant and subordinate males is unknown (Robbins 1995, 1996). Additionally, it is possible that some silverbacks may not begin breeding for some years after they become capable. Exact age of sexual maturity in males is unknown, but is estimated to be between 11 and 14 years. For this model, we considered the onset of sexual maturity to be at 13 years. However, their full social maturity which facilitates dominance and access to mates is considered to take place at a somewhat older age, approximately 15. Consequently, these two alternative dates were used in developing models designed to test the sensitivity of a simulated mountain gorilla population to uncertainty in this variable.

Age of Reproductive Senescence: VORTEX assumes that animals can breed (at the normal rate) throughout their adult life.

Direct observations in the field (albeit based on a sample of only 3 individuals) indicate that adult females may live to around 40 years of age. Moreover, there appears to be no evidence of reproductive senescence. Therefore, we set our baseline age of final reproduction at this value. To investigate population sensitivity, we also developed a set of models with an age of final reproduction at 50 years. Based on our assumed inter-birth interval (see below), this increased age would translate into the production of an additional two offspring (on average) per female reproductive lifetime.

Male Breeding Pool: Based on the 1989 Virunga census, there are 32 social groups in which a total of 40 silverbacks exist in heterosexual groups and 6 silverbacks exist as lone (non-breeding) males. To generate an upper-limit estimate, we considered that if all silverbacks in heterosexual groups are breeders, then 87% (40/46) of males would participate in breeding. As a lower limit estimate, we considered that if only one silverback per heterosexual group was reproductively successful, then 70% (32/46) of silverbacks would participate in breeding.

Sex Ratio at Birth: Data presented by both Gerald-Steklis (N=164) and Robbins (N=56) indicate no evidence for birth sex ratios other than 50/50. We therefore set this parameter to equal ratio in all simulations.

Offspring Production: Longterm data from the Virunga populations provide information on the interbirth intervals for reproductive females. This parameter is strongly dependent on the relative probabilities of survival of previous siblings born in the earlier reproductive cycle. For example, if the previous infant born to a given female survives beyond 1-2 years, the interval is calculated to be 3.94 years (N=62). In contrast, when the previous sibling dies during this period, the female can rapidly resume cycling and the interbirth interval declines to 2.02 years (N=39). The weighted mean calculated from these data indicate that the average interbirth interval is 3.195 years. This mean interval translates into an annual probability of a given female producing offspring equivalent to 1/(3.195) = 0.313. In other words, 31.3% of adult females (on average) are expected to produce offspring in a given year.

To test for the sensitivity of a simulated population to measurement uncertainty in this parameter, a set of models was developed in which the mean proportion of females breeding in any given year was set to 26.3%. This is equivalent to an increase in the mean female interbirth interval of about 6 months.

Annual variation in female reproduction is modeled in VORTEX by entering a standard deviation (SD) for the proportion of females that do not reproduce in a given year (SD (Probability of a litter)) = 5%). VORTEX then determines the proportion of females breeding each year of the simulation by sampling from a binomial distribution with a specified mean (e.g., 31.3%) and standard deviation (e.g., 5.0%).

The incidence of twinning in mountain gorillas is extremely rare: only two known cases are documented, with one twin surviving in a single case. We therefore set the maximum number of offspring in the model at one.

Density-Dependent Reproduction: Density dependence in reproduction (proportion of females breeding in a given year) is modelled in VORTEX according to the following equation:

$$P(N) = \left(P(0) - \left[(P(0) - (P(K))(\frac{N}{K})^B \right] \right) \frac{N}{N + A}$$

in which $P(N)$ is the percent of females that breed when the population size is N, $P(K)$ is the percent that breed when the population is at carrying capacity (K, to be entered later), and $P(0)$ is the percent of females breeding when the population is close to 0 (in the absence of any Allee effect). B can be any positive number. The exponent B determines the shape of the curve relating percent breeding to population size, as population size gets large. If B is 1, the percent breeding changes linearly with population size. If B is 2, $P(N)$ is a quadratic function of N. The term A in the density-dependence equation defines the Allee effect. One can think of A as the population size at which the percent of females breeding falls to half of its value in the absence of an Allee effect (Akçakaya 1997).

No evidence for an Allee effect is present in the databases used for this PHVA (Watts 1990, 1991; Gerald-Steklis, 1995; Robbins, 1995).

Mortality Rates: Age- and sex-specific mortality rates were calculated from the age-specific life history tables developed by Gerald-Steklis (1995) based on 27 years of field data from habituated groups. These tables are shown in their entirety below where the relevant statistic is here defined as $q(x)$, or the probability that an individual entering age-class (x) dies before reaching age-class (x+1).

Age-specific life table for female mountain gorillas based on data analysis of Gerald-Steklis (1995). N(x), total number of individuals available for analysis within age class x; D(x), total number of deaths within age class x; S(x), toal number of individuals that survived within age class x; q(x), mortality rate within age class x; p(x), survival rate within age class x.

Age Class (x)	Started in (x)	Missing in (x)	Unfinished in (x)	0.5(Censored)	N(x)	D(x)	S(x)	q(x)	p(x)
0 -1	76	1	5	3	73	17	56	0.233	0.767
1 - 2	53	0	3	1.5	51.5	6	45.5	0.117	0.883
2 - 3	44	0	2	1	43	0	43	0.000	1.000
3 - 4	42	0	3	1.5	40.5	3	37.5	0.074	0.926
4 - 5	36	0	2	1	35	1	34	0.029	0.971
5 - 6	33	0	4	2	31	0	31	0.000	1.000
6 - 7	29	0	1	0.5	28.5	0	28.5	0.000	1.000
7 - 8	28	0	4	2	26	1	25	0.038	0.962
8 - 9	23	0	1	0.5	22.5	1	21.5	0.044	0.956
9 - 10	21	0	4	2	19	0	19	0.000	1.000
10 - 11	17	1	1	1	16	0	16	0.000	1.000
11 -	15	1	14	7.5	7.5	0	7.5	0.000	1.000

Infants of unidentified sex were sorted by those that are alive, dead, and unknown. Within each of these three categories, half were assigned to female and half to male, randomly.

Unfortunately, time-series data useful for the calculation of variance around these mortality values were not available at the workshop. We assumed that seasonal variation in vegetation was not a significant factor in food availability for the Virunga mountain gorillas used as the basis for the demographic modeling described here (Watts 1984; McNeilage 1995). Environmental variation for annual mortality rates was therefore assigned as about 25% of the mean annual rates.

Age-specific life table for male mountain gorillas based on data analysis of Gerald-Steklis (1995). N(x), total number of individuals available for analysis within age class x; D(x), total number of deaths within age class x; S(x), toal number of individuals that survived within age class x; q(x), mortality rate within age class x; p(x), survival rate within age class x.

Age Class (x)	Started in (x)	Missing in (x)	Unfinished in (x)	0.5(Censored)	N(x)	D(x)	S(x)	q(x)	p(x)
0 -1	81	0	2	1	80	16	64	0.200	0.800
1 - 2	63	0	4	2	61	1	60	0.016	0.984
2 - 3	58	0	6	3	55	3	52	0.055	0.945
3 - 4	49	0	4	2	47	3	44	0.064	0.936
4 - 5	42	0	3	1.5	40.5	1	39.5	0.025	0.975
5 - 6	38	0	2	1	37	0	37	0.000	1.000
6 - 7	36	0	6	3	33	0	33	0.000	1.000
7 - 8	30	0	2	1	29	0	29	0.000	1.000
8 - 9	28	0	5	2.5	25.5	0	25.5	0.000	1.000
9 - 10	23	0	5	2.5	20.5	0	20.5	0.000	1.000
10 - 11	18	0	0	0	18	0	18	0.000	1.000
11 -	18	7	9	8	10	2	8	0.200	0.800

Infants of unidentified sex were sorted by those that are alive, dead, and unknown. Within each of these three categories, half were assigned to female and half to male, randomly.

Catastrophes: Catastrophes are singular environmental events that are outside the bounds of normal environmental variation affecting reproduction and/or survival. Natural catastrophes can be tornadoes, floods, droughts, disease, or similar events. These events are modeled in VORTEX by assigning an annual probability of occurrence and a pair of severity factors describing their impact on mortality (across all age-sex classes) and the proportion of females successfully breeding in a given year. These factors range from 0.0 (maximum or absolute effect) to 1.0 (no effect), and are imposed during the single year of the catastrophe, after which time the demographic rates rebound to their baseline values.

The primary catastrophic event we simulated was the spread of disease through mountain gorilla populations. As the extent of human-gorilla interation increases with rising human population pressures, the likelihood of passing human diseases to gorillas is thought to be markedly higher. Data from and discussions with the veterinarians at the workshop led to the construction of the following three catastrophic disease events:

A) Influenza-like disease: 10% annual probability of occurrence; 5% reduction in survivorship; no effect on reproduction
B) Severe, but not pandemic, viral disease: 10% annual probability of occurrence; 25% reduction in survivorship; 20% reduction in proportion of females breeding
C) Hypothetical viral disease with chronic cyclicity, target organ reproductive system: 4% annual probability of occurrence; 25% reduction in survivorship; 100% reduction in proportion of females breeding (i.e., no reproduction that year)

Models were developed which included various combinations of these diseases in order to assess their relative contribution to future gorilla population risk.

Initial Population Size: The 1989 Virunga population census was used to estimate an initial population for all Virunga models of 320 individuals. The 1997 Bwindi Forest census gives an initial population size of 293 individuals. These figures were converted to stable age distributions for the initial population age profiles.

Carrying Capacity: The carrying capacity, K, for a given habitat patch defines an upper limit for the population size, above which additional mortality is imposed across all age classes in order to return the population to the value set for K.

Previous estimates of carrying capacity for the Virunga park region were derived from Schaller's initial observations (Weber and Vedder, 1983) and were extended by McNeilage (1995). All baseline Virunga models included a carrying capacity of 650 individuals. No such studies have been undertaken for the Bwindi population; hence, estimating carrying capacity for this habitat is more difficult. A series of models were developed with carrying capacity equal to 300, 400, or 500 individuals.

Human Concerns: Based on recent historical events, the outbreak of severe political/civil unrest, ultimately resulting in outright war, is a major concern in the context of mountain gorilla conservation. This is especially true for the population of mountain gorillas inhabiting the Virunga region. Effects of such an event are thought to include the potential for large-scale loss of suitable gorilla habitat, an increase in the direct take of gorillas through poaching or accidental shooting/shelling, and decreased reproductive output resulting from the considerable stress put on affected gorilla groups. It is important to note that, while only a small percentage (i.e., 3-5%) of available mountain gorilla habitat in the Virunga region was known to be directly destroyed by people fleeing the 1994 Rwandan civial war, it is possible (and perhaps even likely) that a larger proportion of the total gorilla habitat would be rendered unavailable due to the close proximity of gorillas to large concentrations of refugees.

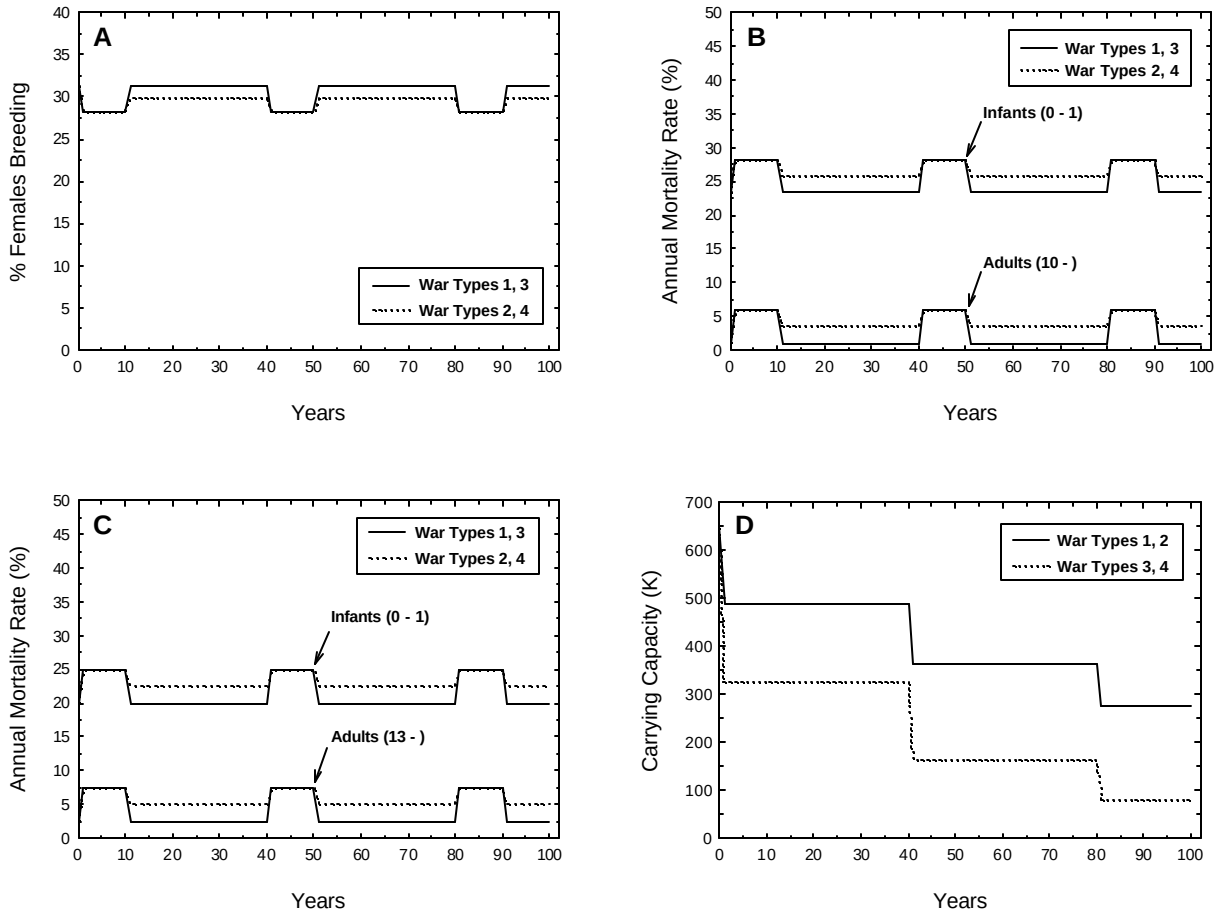
We developed a set of scenarios to simulate this type of event and its potential for impact on mountain gorilla population viability. In all scenarios, the simulation would begin under conditions of war, the war would last for 10 years, and a war in the area would break out every 30 years. Four primary types of war were envisioned:

1) During the war, the average proportion of females succesfully breeding would be reduced by 10% of the baseline value. In other words, if 31.3% of females bred in a year without war, 28.2% would successfully breed under conditions of war. Moreover, an additional 5% annual mortality was imposed on infants and adults (both sexes) during war years. When a given war event is over, breeding and mortality rates would return to their baseline values. Finally, each war event would include a cumulative and permanent 25% reduction in carrying capacity.
2) This scenario is similar to the previous one except that, following a give war event, the simulated reductions in breeding and mortality rates are not eliminated but rather show only a 50% recovery to the baseline values.

3) Identical to type 1 but with a 50% reduction in carrying capacity during and following each war event.
4) Identical to scenario 2 but with a 50% reduction in carrying capacity during and following each war event.

A graphical depiction of the demographic characteristics of these war scenarios is presented in Figure 5-2.

Figure 5-2. Simulated effects of war in the Virungas on the local mountain gorilla population. Specific demographic or environmental variables affected are: A) proportion of females breeding in a given year; B) annual female mortality; C) annual male mortality; D) Virunga habitat carrying capacity.



An additional set of models was constructed that simulated disease and war in a Virunga gorilla population that is fragmented into two isolated subpopulations through human activity. Through continuation of recent military activity in the Virunga region, the entire habitat may soon be divided into two areas (identified as A and B) separated by as much as 2 kilometers of deforested land, unsuitable for gorilla movement. Region A was assigned an initial population size of 202 individuals and a carrying capacity of 413, while region B consisted initially of 116 gorillas and a carrying capacity of 207. War type 1 was used throughout this set of models.

Iterations and Years of Projection: All scenarios were simulated 500 times, with population projections extending for 100 years (this is roughly equivalent to about 5 effective mountain gorilla generations). Output results were summarized at 10-year intervals for use in some of the tables and figures that follow. All simulations were conducted using VORTEX version 8.01 (December 1997).

Results from Simulation Modeling

Output Table Information

The tables that follow present the numerical results from the 168 models developed during this workshop. Within each table, description of the variable input centers around changes made to the age of first reproduction for either females (AFR-E) or males (AFR-Γ), the maximum age of reproduction (or "age of last reproduction", ALR), and the proportion of the adult female population that breeds in a given year (%EE). The results of the models are described in terms of the following:

r_s(SD)	Mean (standard deviation) stochastic growth rate, calculated directly from the observed annual population sizes across the 500 simulations;
P(E)	The probability of population extinction, determined by the proportion of 500 simulated populations within a given model that become extinct during the model's 100-year time frame.
N_{100} (SD)	Mean (standard deviation) population size across those simulated population which are not extinct at 100 years;
H_{100}	Expected heterozygosity (gene diversity) in the simulated populations after 100 years;
T(E)	The mean time to extinction for those populations becoming extinct during the simulation.

Demographic Sensitivity Analysis

The demographic and environmental parameters discussed above were assembled in the VORTEX model to assess the status of a mountain gorilla population relatively free from human interference and consistent with historical data. This model is considered the mountain gorilla baseline population model.

The results of this model are presented in the first row of Table 5-1 (File #601). The projected stochastic growth rate of the population is 3.8% (r_s = 0.038) which is broadly consistent with an estimated observed growth rate of the actual Virunga population of about 3.05% over the period 1981-1989. Under such conditions of strong positive growth, the simulated mountain gorilla population is expected to increase rapidly until the carrying capacity of 650 individuals is reached, after which time the population stabilizes at this value. Based on this simple, generalized model, therefore, we may conclude that mountain gorilla populations have the capacity to grow vigorously under natural conditions.

It is important to remember, however, that these initial models did not include any of the catastrophic disease events discussed in the previous subsection; this may in part explain why our growth rate estimate is slightly higher than the observed estimate for the Virunga population. An additional factor in this overestimate may arise from uncertainty in our estimates of various demographic parameters used as input to the model. It is instructive to use the simulation modeling approach in an investigation of the relative sensitivities of the populations to changes in a range of demographic parameters. In other words, we can determine which parameters are most influential in impacting the future viability of mountain gorilla populations and utilize this information in help prioritize additional data collection. A total of five parameters were chosen for study in this analysis: age of first reproduction in females, age of first reproduction in males, age of last reproduction, percentage of adult males available for breeding, and the percentage of adult females that breed successfully in a given simulation year.

Table 5-1. Mountain gorilla demographic sensitivity analysis. Proportion of adult males available for breeding is 70%, and the mean proportion of adult females successfully breeding in a given simulation year is 31.3%.

File#	AFR-E	AFR-Γ	ALR	r_s (SD)	P(E)	N_{100} (SD)	H_{100}	T(E)
601	10	13	40	0.038 (0.023)	0.0	650 (5)	0.992	—
602		15		0.038 (0.023)	0.0	650 (6)	0.992	—
603	9	13		0.040 (0.023)	0.0	650 (5)	0.992	—
604		15		0.040 (0.023)	0.0	650 (5)	0.992	—
605	11	13		0.035 (0.023)	0.0	649 (6)	0.992	—
606		15		0.035 (0.023)	0.0	649 (6)	0.992	—
607	10	13	50	0.042 (0.023)	0.0	649 (6)	0.992	—
608		15		0.042 (0.023)	0.0	650 (5)	0.992	—
609	9	13		0.045 (0.023)	0.0	649 (6)	0.992	—
610		15		0.044 (0.023)	0.0	650 (5)	0.992	—
611	11	13		0.040 (0.023)	0.0	650 (5)	0.992	—
612		15		0.040 (0.023)	0.0	650 (5)	0.992	—

Tables 5-1 through 5-4 give the results of this analysis. Each of these "uncertain" parameters was run in combination with every other such parameter, yielding a total of 48 alternative models representing possible mountain gorilla population dynamics. All of these models demonstrated strong population growth, with the stochastic growth rate (r_s) ranging from 0.045 to 0.028. As expected, a increase in the age of first reproduction among females leads to a reduction in population growth rate, as does a reduction in the proportion of successfully breeding adult females. In contrast, changes to the male demographic variables, namely age of first male reproduction and the proportion of adult males in the pool of available breeders, resulted in little if any change in final population characteristics.

Table 5-2. Mountain gorilla demographic sensitivity analysis. Proportion of adult males available for breeding is 87%, and the mean proportion of adult females successfully breeding in a given simulation year is 31.3%.

File#	AFR-E	AFR-Γ	ALR	r_s (SD)	P(E)	N_{100} (SD)	H_{100}	T(E)
613	10	13	40	0.038 (0.024)	0.0	649 (6)	0.992	—
614		15		0.038 (0.023)	0.0	649 (5)	0.992	—
615	9	13		0.040 (0.024)	0.0	650 (5)	0.992	—
616		15		0.040 (0.024)	0.0	649 (6)	0.992	—
617	11	13		0.035 (0.023)	0.0	650 (5)	0.992	—
618		15		0.036 (0.023)	0.0	650 (5)	0.992	—
619	10	13	50	0.042 (0.024)	0.0	650 (6)	0.992	—
620		15		0.043 (0.023)	0.0	650 (5)	0.992	—
621	9	13		0.044 (0.024)	0.0	650 (6)	0.992	—
622		15		0.044 (0.024)	0.0	650 (6)	0.992	—
623	11	13		0.040 (0.023)	0.0	650 (5)	0.992	—
624		15		0.040 (0.023)	0.0	650 (5)	0.992	—

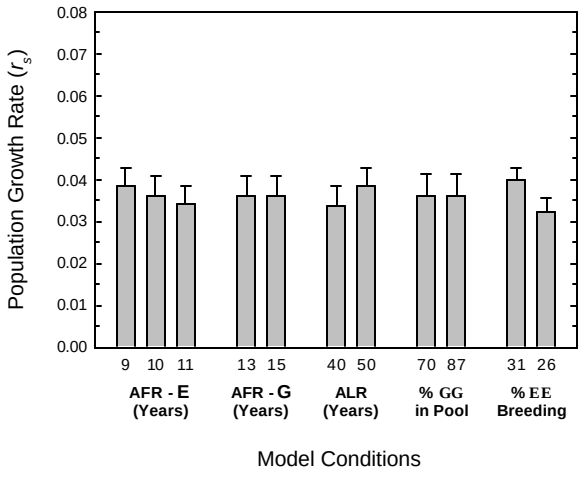
Table 5-3. Mountain gorilla demography sensitivity analysis. Proportion of adult males available for breeding is 70%, and the mean proportion of adult females successfully breeding in a given simulation year is 26.3%.

File#	AFR-E	AFR-Γ	ALR	r_s (SD)	P(E)	N_{100} (SD)	H_{100}	T(E)
625	10	13	40	0.030 (0.024)	0.0	649 (6)	0.992	—
626		15		0.030 (0.023)	0.0	649 (6)	0.992	—
627	9	13		0.032 (0.024)	0.0	649 (6)	0.992	—
628		15		0.032 (0.024)	0.0	649 (6)	0.992	—
629	11	13		0.028 (0.023)	0.0	649 (5)	0.992	—
630		15		0.028 (0.023)	0.0	649 (5)	0.993	—
631	10	13	50	0.035 (0.024)	0.0	649 (6)	0.992	—
632		15		0.035 (0.023)	0.0	650 (5)	0.993	—
633	9	13		0.037 (0.024)	0.0	649 (6)	0.992	—
634		15		0.037 (0.024)	0.0	649 (5)	0.992	—
635	11	13		0.033 (0.023)	0.0	649 (5)	0.993	—
636		15		0.033 (0.023)	0.0	649 (5)	0.993	—

Table 5-4. Mountain gorilla demography sensitivity analysis. Proportion of adult males available for breeding is 87%, and the mean proportion of adult females successfully breeding in a given simulation year is 26.3%.

File#	AFR-E	AFR-Γ	ALR	r_s (SD)	P(E)	N_{100} (SD)	H_{100}	T(E)
637	10	13	40	0.030 (0.024)	0.0	649 (6)	0.992	—
638		15		0.030 (0.023)	0.0	649 (6)	0.992	—
639	9	13		0.032 (0.024)	0.0	649 (5)	0.992	—
640		15		0.032 (0.024)	0.0	650 (5)	0.992	—
641	11	13		0.028 (0.023)	0.0	649 (6)	0.992	—
642		15		0.028 (0.023)	0.0	649 (5)	0.993	—
643	10	13	50	0.035 (0.024)	0.0	649 (5)	0.992	—
644		15		0.035 (0.023)	0.0	649 (5)	0.993	—
645	9	13		0.037 (0.024)	0.0	649 (6)	0.992	—
646		15		0.037 (0.024)	0.0	650 (5)	0.992	—
647	11	13		0.033 (0.023)	0.0	649 (5)	0.993	—
648		15		0.033 (0.023)	0.0	649 (6)	0.993	—

Figure 5-3. Demographic sensitivity analysis summary for simulated mountain gorilla populations.



A graphical summary of these results is presented in Figure 5-3. The individual stochastic growth rates resulting from all models with a given demographic parameter (for example, age of first female reproduction = 9 years) were averaged to obtain a mean growth rate for that particular parameter value. This procedure was repeated for each of the 11 alternative parameter values in order to compare the behavior of the simulated populations when changes to a particular parameter were made, with all other parameters held constant. Analysis of the tables and figure indicate that, under the conditions of this modeling exercise, the growth dynamics of mountain gorilla populations are influenced to a greater degree by: 1) female breeding characteristcs, and 2) the age of onset of reproduction. To illustrate, consider that, based on Figure 5-3, a change in the age of first female reproduction of one year results in a change in the mean stochastic growth rate of 0.02. In contrast, an identical change of one year in the age of last reproduction results in a change in mean r_s of only 0.005. Changes to male breeding pool characteristics have less of an impact because of the polygynous breeding system seen in mountain gorillas; if a breeding male is lost, another silverback may take his place relatively easily. Additionally, because of the relative abundance of younger gorillas compared to those near their maximum age in a stable population, a change in first breeding age in a simulated population affects a larger proportion of the total population and its corresponding reproductive potential.

Based on this analysis, all subsequent risk assessment models described in this section will be run under alternative values of female age of first reproduction (9, 10, or 11 years) and alternative proportions of annual female breeding success (31.3% or 26.3%). This will allow us to incorporate levels of "measurememt uncertainty" into our risk assessments to provide a more comprehensive picture of mountain gorilla population viability.

Disease Risk Analysis

Virunga Population

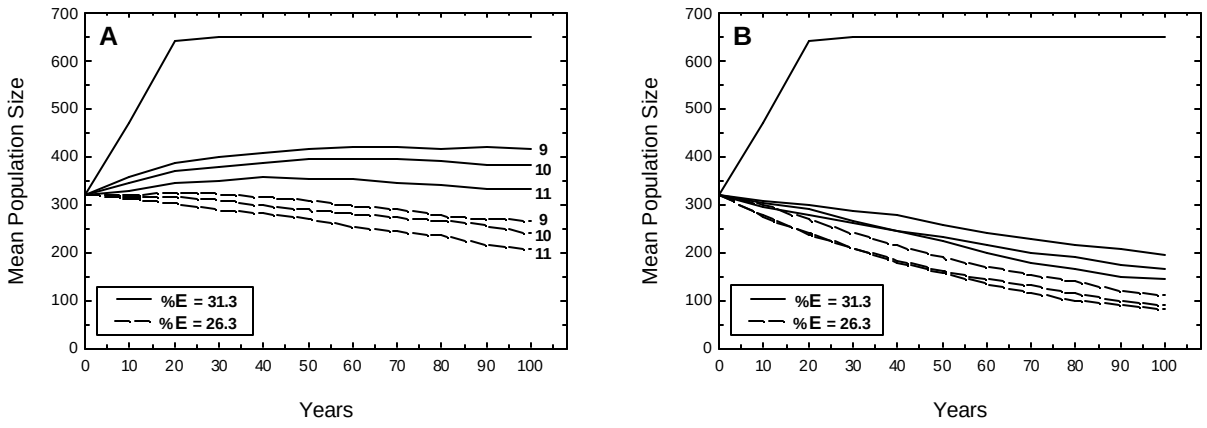
As shown in Table 5-5, two sets of disease risk models were run in an attempt to help tease apart the relative risks posed by individual disease events. The first set included disease types A and B while the second set added the less frequent but very severe event, disease type C. The population trajectories presented here may in fact more accurately portray actual mountain gorilla populations compared to those previously described where disease events were absent. Under the baseline demographic model shown in the top line of Table 5 (File #701), the mean stochastic growth rate over 500 simulations is 0.003, indicating a population that is only very slightly growing in size over time. The large standard deviation in this growth rate indicates that this simulated population may actually fluctuate substantially in size over time as the population is reduced when a disease strikes but, based on our earlier models that showed strong growth potential, have the capacity to rebound from these events.

Table 5-5. Mountain gorilla population risk assessment. Impacts of various disease scenarios on viability of the Virunga population under different ages of first female breeding (AFR-E) and alternative levels of adult female breeding rates (%EE). Proportion of adult males available for breeding is 70%, the age of first breeding in males is 13, and the maximum age of reproduction is 40 years.

File#	AFR-E	%EE	r_s (SD)	P(E)	N_{100} (SD)	H_{100}	T(E)
Diseases A, B only							
701	10	31.3	0.003 (0.095)	0.0	381 (187)	0.982	—
702	9		0.006 (0.096)	0.002	415 (178)	0.983	97
703	11		0.000 (0.096)	0.0	330 (187)	0.981	—
704	10	26.3	-0.005 (0.096)	0.002	239 (167)	0.974	86
705	9		-0.004 (0.097)	0.002	267 (180)	0.975	84
706	11		-0.007 (0.097)	0.004	206 (154)	0.973	96
Diseases A, B, C							
707	10	31.3	-0.011 (0.122)	0.018	165 (151)	0.956	77
708	9		-0.009 (0.122)	0.016	195 (167)	0.960	88
709	11		-0.013 (0.122)	0.026	142 (145)	0.953	86
710	10	26.3	-0.020 (0.124)	0.056	90 (106)	0.932	84
711	9		-0.017 (0.122)	0.030	111 (124)	0.939	85
712	11		-0.021 (0.123)	0.066	80 (88)	0.932	85

Of interest is the observation that, when disease types A and B are included in the models, a reduction in the proportion of successfully breeding females from 31.3% to 26.3% results in a switch from population growth ($r_s > 0$: Files 701-703) to population decline ($r_s < 0$: Files 704-706). This observation points out the importance of acknowledging the interactions between our own uncertainty regarding specific population characteristics and the biological risks these populations must face.

Figure 5-4. 100-year population projections for Virunga mountain gorillas when disease types A and B are present (A, left) and when all three types are included (B, right). The topmost line is the baseline model in the absense of disease events, and the numbers to the right of the curves in figure A indicate the different values for female age of first reproduction. Similar designations apply for the curves in B.



When disease type C is included in this same set of models, all projections indicate population decline (Table 5-5, Figure 5-4). As a result, populations are reduced by as much as 75% after 100 years. The data in Table 5-5 also show, as expected, a higher standard deviation in the stochastic growth rate in response to the severe consequences of the infrequent disease event as populations attempt to recover. Moreover, the extinction risk for populations exposed to all three disease types was higher than those exposed only to types A and B (Table 5-5). It is important to note that the relatively low absolute extinction risk shown in Table 5-5 is in large part a function of the duration of the simulation; extending the simulation to 150 years would, based on the observed rate of population decline seen in Figure 5-4, greatly increase the risk of extinction.

Nevertheless, this analysis clearly points out the severe risk posed by the transmission of disease between gorillas as well as from humans to gorillas, particularly when severe viral disease is included in the modeling process. Population decline is common to nearly all scenarios, the extent of genetic variation retained in the population begins to decline, and overall populaton extinction risk becomes evident.

Bwindi Analysis

The same type of disease risk analysis was conducted using population size data for the Bwindi population, based on the recently completed census for the area. Because of some uncertainty in estimating the carrying capacity for this habitat, alternative models were run with K = 300, 400, and 500. The model results are shown in Tables 5-6 to 5-8, arranged by carrying capacity

estimate. The general population dynamics are very similar to the Virunga population projections, as expected since identical demographic parameters were used in these models for lack of information to the contrary. For example, reducing the proportion of successfully breeding females when disease types A and B are present switches the population from positive to negative growth (e.g., see Table 5-6: Files 801-806). In addition, the impact of infrequent disease type C is shown to be considerable as all models incorporating this disease show a negative growth rate and a noticeable increase in extinction risk. A set of representative model trajectories, with K = 300, is shown in Figure 5-5A.

Table 5-6. Mountain gorilla population risk assessment. Impacts of various disease scenarios on viability of the Bwindi population under different ages of first female breeding (AFR-E) and alternative levels of adult female breeding rates (%EE). Habitat carrying capacity is set at 300 individuals, the proportion of adult males available for breeding is 70%, the age of first breeding in males is 13, and the maximum age of reproduction is 40 years.

File#	AFR - E	% EE	r_s (SD)	P(E)	N_{100} (SD)	H_{100}	T(E)
Diseases A, B only							
801	10	31.3	0.003 (0.097)	0.0	191 (80)	0.973	—
802	9		0.005 (0.098)	0.0	201 (83)	0.973	—
803	11		0.000 (0.098)	0.0	173 (84)	0.971	—
804	10	26.3	-0.006 (0.099)	0.0	137 (82)	0.962	—
805	9		-0.004 (0.099)	0.0	152 (87)	0.963	—
806	11		-0.008 (0.099)	0.01	123 (80)	0.960	87
Diseases A, B, C							
807	10	31.3	-0.011 (0.123)	0.024	99 (76)	0.941	85
808	9		-0.008 (0.122)	0.028	118 (83)	0.950	86
809	11		-0.013 (0.123)	0.024	90 (75)	0.936	84
810	10	26.3	-0.020 (0.127)	0.092	61 (58)	0.919	85
811	9		-0.018 (0.125)	0.064	71 (65)	0.925	85
812	11		-0.021 (0.124)	0.064	59 (61)	0.914	85

The impact of uncertainties in carrying capacity estimation, as measured by final population size in a given set of simulations, is presented in Figure 5-5B. Each of the three disease types is represented in the models summarized in this figure. Mean population size at the end of the 100-year simulation increases as K increases because of the greater opportunity for population growth when K is larger. Inspection of the results in the tables shows that the probability of extinction is indeed greater in the smallest habitat (Table 5-6), but by only a small margin and remains relatively small in absolute terms.

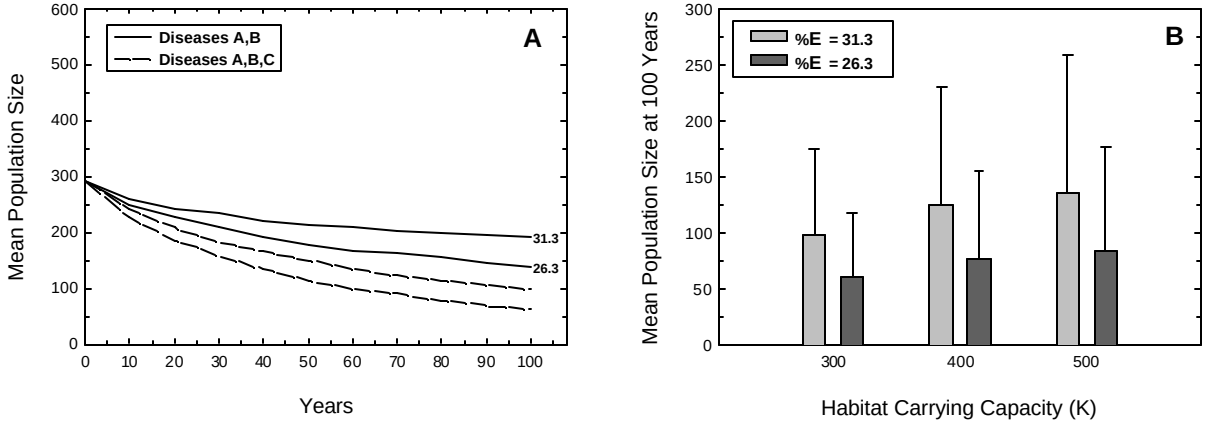
Table 5-7. Mountain gorilla population risk assessment. Impacts of various disease scenarios on viability of the Bwindi population under different ages of first female breeding (AFR-E) and alternative levels of adult female breeding rates (%EE). Habitat carrying capacity is set at 400 individuals with additional input as described in Table 5-6.

File#	AFR - E	% EE	r_s (SD)	P(E)	N_{100} (SD)	H_{100}	T(E)
Diseases A, B							
813	10	31.3	0.002 (0.097)	0.004	242 (108)	0.977	84
814	9		0.005 (0.097)	0.0	264 (109)	0.978	—
815	11		0.000 (0.098)	0.0	222 (113)	0.974	—
816	10	26.3	-0.005 (0.096)	0.0	183 (113)	0.971	—
817	9		-0.003 (0.097)	0.0	200 (114)	0.972	—
818	11		-0.007 (0.097)	0.0	159 (99)	0.966	—
Diseases A, B, C							
819	10	31.3	-0.011 (0.122)	0.016	126 (104)	0.951	85
820	9		-0.009 (0.122)	0.010	139 (106)	0.954	81
821	11		-0.013 (0.122)	0.022	116 (96)	0.947	83
822	10	26.3	-0.019 (0.123)	0.050	78 (79)	0.929	81
823	9		-0.017 (0.124)	0.038	86 (87)	0.932	82
824	11		-0.021 (0.125)	0.078	65 (69)	0.926	83

Table 5-8. Mountain gorilla population risk assessment. Impacts of various disease scenarios on viability of the Bwindi population under different ages of first female breeding (AFR-E) and alternative levels of adult female breeding rates (%EE). Habitat carrying capacity is set at 500 individuals with additional input as described in Table 5-6.

File#	AFR - E	% EE	r_s (SD)	P(E)	N_{100} (SD)	H_{100}	T(E)
Diseases A, B only							
825	10	31.3	0.003 (0.096)	0.0	297 (136)	0.980	—
826	9		0.006 (0.095)	0.0	333 (136)	0.981	—
827	11		0.000 (0.097)	0.0	271 (143)	0.978	—
828	10	26.3	-0.006 (0.098)	0.0	194 (136)	0.969	—
829	9		-0.004 (0.098)	0.002	221 (139)	0.972	94
830	11		-0.008 (0.099)	0.004	172 (127)	0.964	87
Diseases A, B, C							
831	10	31.3	-0.012 (0.123)	0.018	136 (124)	0.950	79
832	9		-0.009 (0.122)	0.014	161 (132)	0.955	89
833	11		-0.013 (0.122)	0.032	131 (114)	0.948	94
834	10	26.3	-0.019 (0.125)	0.056	84 (93)	0.927	87
835	9		-0.017 (0.124)	0.038	95 (96)	0.936	84
836	11		-0.021 (0.123)	0.056	72 (78)	0.925	86

Figure 5-5. (A), 100-year population projections for Bwindi mountain gorillas under alternative disease scenarios and measures of female breeding success. Carrying capacity in these models is set at 300 individuals. (B), summary results for models (mean population size and standard deviation) under alternative carrying capacity values and measures of female reproductive success. Disease scenarios include all three disease events.



Mountain Gorilla Population Viability in the Presence of War

As shown in Tables 5-9 to 5-12 and Figures 5-6 to 5-9, war as modeled here can have a dramatic negative impact on mountain gorilla population viability. When the simulated war is of a type 1 variety, with full rebound in demographic rates following a war and a 25% cumulative reduction in K during and following each event, risk of population extinction ranges from 5% to 20% when disease type C is present with an associated large reduction in population size after 100 years (Table 5-9, bottom; Figure 5-6B).

Figure 5-6. (A), 100-year population projections for simulated mountain gorilla populations in the presence of war type 1 and alternative measures of female breeding success. (B), 100-year extinction probability in the presence and absence of war type 1 and alternative measures of female breeding success. Disease scenarios include all three disease events.

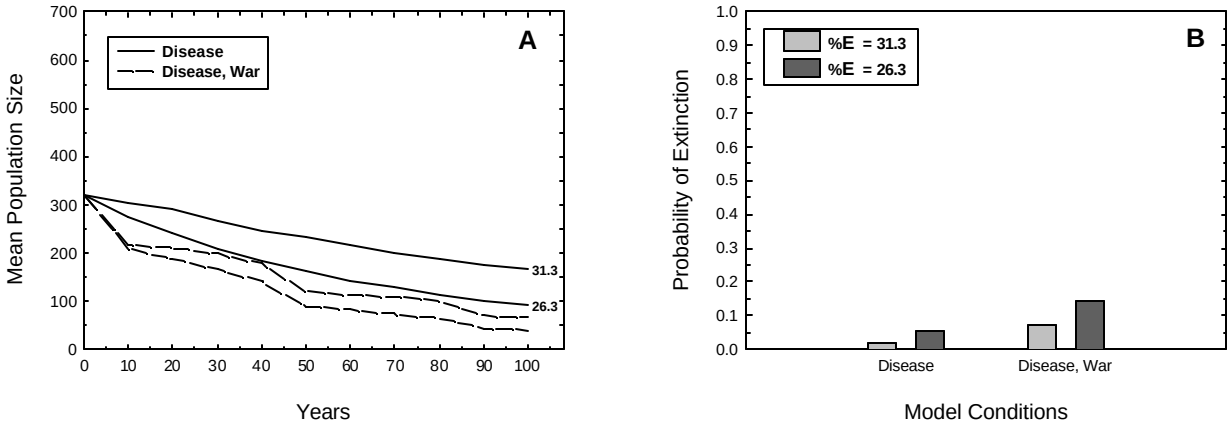


Table 5-9. Mountain gorilla population risk assessment. Impacts of simulated war type 1 on viability of the Virunga population under different ages of first female breeding (AFR-E) and alternative levels of adult female breeding rates (%EE). Additional model conditions are identical to those in Table 5-5.

File#	AFR - E	% EE	r_s (SD)	P(E)	N_{100} (SD)	H_{100}	T(E)
Diseases A, B only							
713	10	31.3	-0.008 (0.099)	0.004	145 (81)	0.963	77
714	9		-0.005 (0.098)	0.002	155 (75)	0.969	86
715	11		-0.009 (0.100)	0.004	128 (76)	0.965	82
716	10	26.3	-0.015 (0.100)	0.012	92 (69)	0.950	91
717	9		-0.015 (0.102)	0.018	97 (72)	0.949	90
718	11		-0.017 (0.101)	0.020	85 (67)	0.944	90
Diseases A, B, C							
719	10	31.3	-0.022 (0.127)	0.072	67 (62)	0.921	84
720	9		-0.020 (0.125)	0.052	72 (64)	0.926	85
721	11		-0.023 (0.127)	0.074	61 (61)	0.913	86
722	10	26.3	-0.029 (0.128)	0.142	39 (41)	0.890	83
723	9		-0.030 (0.132)	0.186	42 (44)	0.895	82
724	11		-0.032 (0.132)	0.196	31 (35)	0.884	84

When war type 2 is modeled, in which demographic rates rebound by only 50% to their baseline values, the steady decline in population numbers is accelerated and extinction risk increases dramatically to as much as 46% (Table 5-10; Figure 5-7). Once again, it is important to recognize the fact that, based on the population size projections shown in Figure 5-7A, this risk would rise considerably if the projections were extended beyond 100 years. In fact, this observation is true for all the risk projections shown here where populations decline steadily as a result of human-induced threats.

Figure 5-7. (A), 100-year population projections for simulated mountain gorilla populations in the presence of war type 2 and alternative measures of female breeding success. (B), 100-year extinction probability in the presence and absence of war type 2 and alternative measures of female breeding success. Disease scenarios include all three disease events.

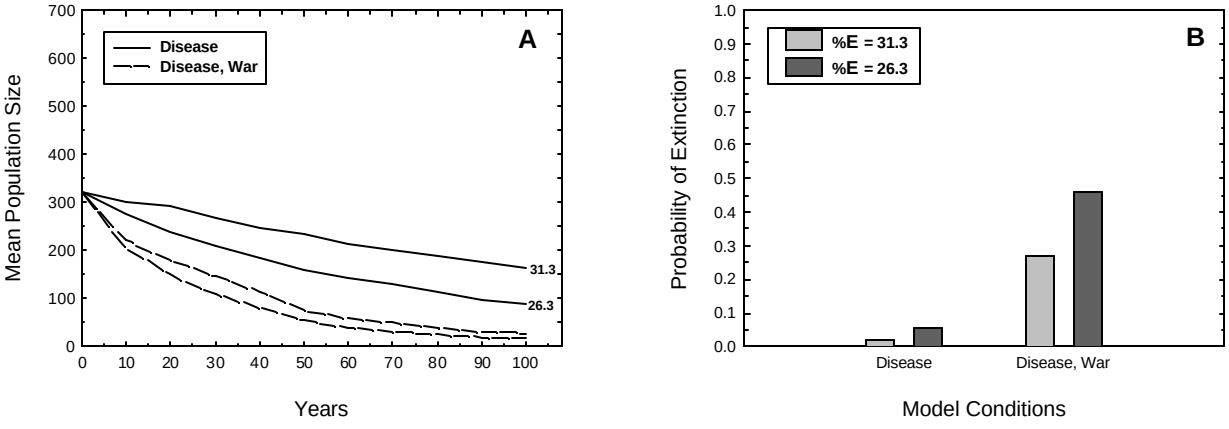


Table 5-10. Mountain gorilla population risk assessment. Impacts of simulated war type 2 on viability of the Virunga population under different ages of first female breeding (AFR-E) and alternative levels of adult female breeding rates (%EE). Additional model conditions are identical to those in Table 5.

File#	AFR - E	% EE	r_s (SD)	P(E)	N_{100} (SD)	H_{100}	T(E)
Diseases A, B only							
725	10	31.3	-0.020 (0.101)	0.026	68 (57)	0.933	91
726	9		-0.020 (0.103)	0.036	71 (59)	0.933	85
727	11		-0.022 (0.103)	0.054	61 (55)	0.927	81
728	10	26.3	-0.029 (0.108)	0.134	35 (34)	0.896	81
729	9		-0.029 (0.108)	0.126	35 (33)	0.898	86
730	11		-0.029 (0.106)	0.112	32 (31)	0.898	84
Diseases A, B, C							
731	10	31.3	-0.034 (0.132)	0.268	27 (30)	0.869	84
732	9		-0.033 (0.132)	0.252	32 (38)	0.876	83
733	11		-0.036 (0.133)	0.298	24 (28)	0.870	81
734	10	26.3	-0.043 (0.136)	0.462	16 (19)	0.828	80
735	9		-0.042 (0.136)	0.446	18 (18)	0.828	80
736	11		-0.043 (0.134)	0.460	16 (19)	0.829	80

War types 3 and 4, which differ from types 1 and 2 in the extent of cumulative habitat destruction as defined by a 50% cumulative loss in K during and after each event, produce similar results to those scenarios just described. Type 3 models (Figure 5-8; Table 5-11) show nearly identical extinction risks compared to type 1 models although final population sizes are reduced in the type 3 models, consistent with their reduced final carrying capacity.

Figure 5-8. (A), 100-year population projections for simulated mountain gorilla populations in the presence of war type 3 and alternative measures of female breeding success. (B), 100-year extinction probability in the presence and absence of war type 3 and alternative measures of female breeding success. Disease scenarios include all three disease events.

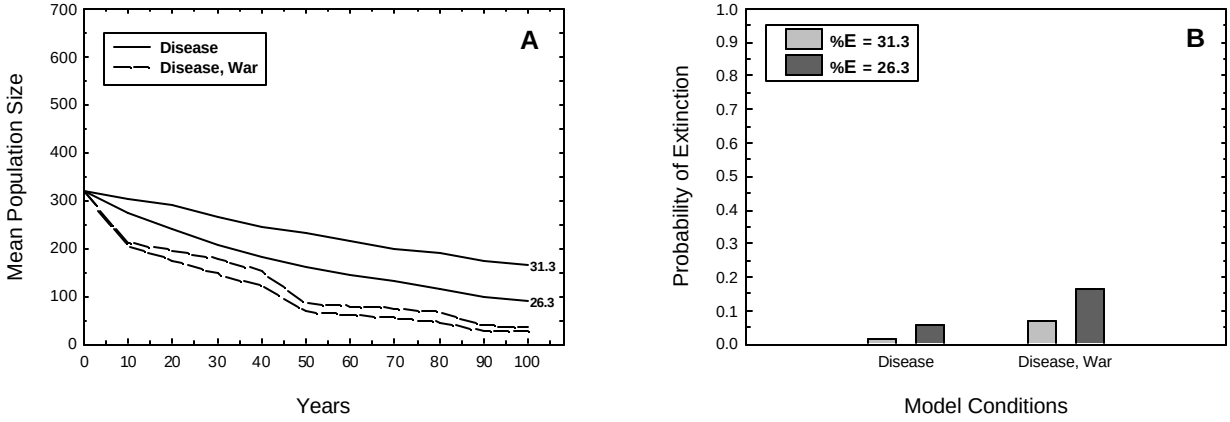


Table 5-11. Mountain gorilla population risk assessment. Impacts of simulated war type 3 on viability of the Virunga population under different ages of first female breeding (AFR-E) and alternative levels of adult female breeding rates (%EE). Additional model conditions are identical to those in Table 5-5.

File#	AFR - E	% EE	r_s (SD)	P(E)	N_{100} (SD)	H_{100}	T(E)
Diseases A, B only							
737	10	31.3	-0.008 (0.102)	0.002	53 (21)	0.945	92
738	9		-0.007 (0.102)	0.004	56 (21)	0.946	83
739	11		-0.009 (0.101)	0.008	51 (20)	0.944	94
740	10	26.3	-0.016 (0.103)	0.018	44 (23)	0.933	89
741	9		-0.016 (0.104)	0.026	44 (23)	0.932	87
742	11		-0.017 (0.103)	0.026	42 (22)	0.930	87
Diseases A, B, C							
743	10	31.3	-0.021 (0.127)	0.070	36 (23)	0.907	84
744	9		-0.020 (0.127)	0.062	37 (22)	0.909	82
745	11		-0.023 (0.127)	0.094	34 (22)	0.906	82
746	10	26.3	-0.030 (0.130)	0.164	26 (19)	0.880	84
747	9		-0.030 (0.132)	0.206	28 (20)	0.888	82
748	11		-0.032 (0.131)	0.204	24 (18)	0.876	82

The most severe consequences are shown in Table 5-12 and Figure 5-9 for the type 4 war models. Under these simulated conditions, including permanent reductions in demographic rates and severe cumulative loss of habitat carrying capacity, final population sizes are reduced by as much as 90% of the original 320 individuals. Moreover, extinction risk remains high and the extent of retention of genetic variation falls below those levels commony thought to be acceptable in conservation genetics theory (~90%).

Figure 5-9. (A), 100-year population projections for simulated mountain gorilla populations in the presence of war type 4 and alternative measures of female breeding success. (B), 100-year extinction probability in the presence and absence of war type 4 and alternative measures of female breeding success. Disease scenarios include all three disease events.

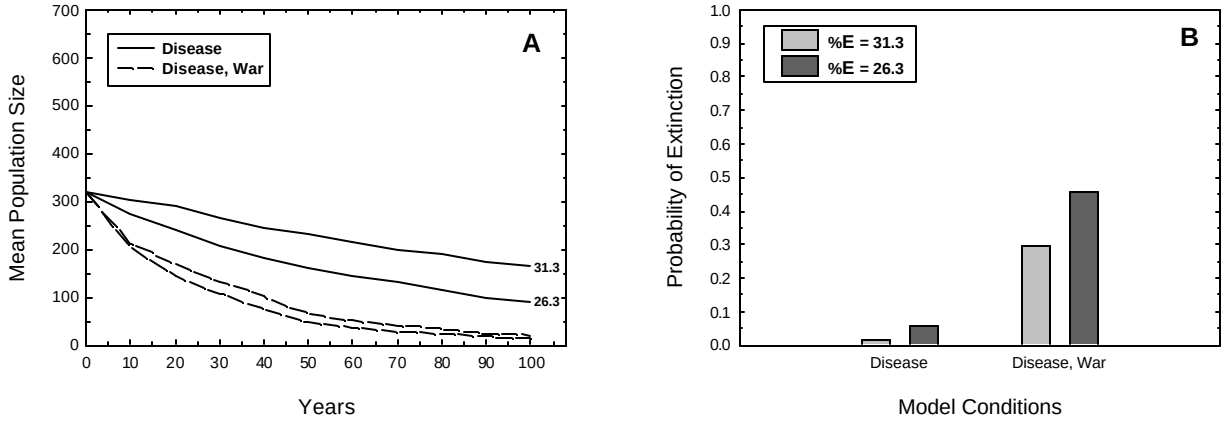


Table 5-12. Mountain gorilla population risk assessment. Impacts of simulated war type 4 on viability of the Virunga population under different ages of first female breeding (AFR-E) and alternative levels of adult female breeding rates (%EE). Additional model conditions are identical to those in Table 5-5.

File#	AFR - E	% EE	r_s (SD)	P(E)	N_{100} (SD)	H_{100}	T(E)
Diseases A, B only							
749	10	31.3	-0.021 (0.104)	0.032	37 (21)	0.917	84
750	9		-0.019 (0.103)	0.038	40 (21)	0.921	87
751	11		-0.023 (0.106)	0.062	35 (21)	0.912	84
752	10	26.3	-0.029 (0.108)	0.128	26 (19)	0.889	84
753	9		-0.029 (0.109)	0.112	26 (19)	0.890	87
754	11		-0.030 (0.108)	0.118	24 (17)	0.885	85
Diseases A, B, C							
755	10	31.3	-0.035 (0.134)	0.298	20 (16)	0.858	83
756	9		-0.033 (0.132)	0.266	22 (17)	0.860	83
757	11		-0.036 (0.133)	0.294	20 (16)	0.852	84
758	10	26.3	-0.043 (0.136)	0.456	14 (13)	0.829	80
759	9		-0.042 (0.136)	0.446	16 (15)	0.819	80
760	11		-0.043 (0.136)	0.438	13 (11)	0.827	79

Modeling a "Cut" Virunga Habitat

Models were run in which the current Virunga habitat was cut into two isolated fragments as described previously. An initial set of models included the full set of three disease threats but did not include war. Consistent with earlier disease risk models, the results from this set of models (Table 5-13) consistently show negative growth rates for each of the isolated mountain gorilla population fragments as well as for the total metapopulation. Another consistent trend seen in the results is the higher extinction risk in the smaller population "B". This again points to the inherently greater extinction risk faced by smaller populations despite identical demographic characteristics.

When a war is included in the simulations (in this case, a type 1 war), extinction risks are at least doubled for both populations as well as for the metapopulation (Table 5-14). An interesting characteristic of metapopulation structure and dynamics presents itself when comparing these extinction risks to those from a single, unfragmented population (as in, for example, Table 5-9). While individual smaller fragments are at a greater risk of extinction (Table 5-14), the total metapopulation extinction risk is actually smaller than that corresponding to the original, unfragmented Virunga population analyzed earlier in this report. This is probably due in large part to the incidence of random disease catastrophes that occur independently in each fragment and, therefore, may not have as large an effect as they would if they were to act on a single population. The fact that extinction of local fragements occurs independently as well may help to explain this further.

Table 5-13. Mountain gorilla population risk assessment. Virunga "cut" habitat metapopulation analysis under different ages of first female breeding (AFR-E) and alternative levels of adult female breeding rates (%EE). The proportion of adult males available for breeding is 70%, the age of first breeding in males is 13, and the maximum age of reproduction is 40 years.

File#	AFR - E	% EE	Population	r_s (SD)	P(E)	N_{100} (SD)	H_{100}	T(E)
767	10	31.3	A	-0.011 (0.124)	0.036	105 (95)	0.936	85
			B	-0.012 (0.130)	0.116	63 (54)	0.903	78
			Metapop.	-0.009 (0.094)	0.004	158 (113)	0.963	96
768	9		A	-0.009 (0.124)	0.034	124 (101)	0.942	83
			B	-0.010 (0.129)	0.084	66 (54)	0.901	77
			Metapop.	-0.006 (0.093)	0.004	182 (117)	0.965	78
769	11		A	-0.014 (0.124)	0.044	91 (90)	0.930	80
			B	-0.015 (0.131)	0.110	49 (48)	0.886	77
			Metapop.	-0.012 (0.094)	0.008	133 (104)	0.956	88
770	10	26.3	A	-0.020 (0.128)	0.094	57 (64)	0.903	83
			B	-0.019 (0.131)	0.170	38 (39)	0.867	77
			Metapop.	-0.017 (0.096)	0.016	85 (71)	0.940	92
771	9		A	-0.018 (0.126)	0.088	74 (81)	0.916	83
			B	-0.019 (0.133)	0.182	40 (40)	0.870	77
			Metapop.	-0.015 (0.095)	0.012	101 (86)	0.946	92
772	11		A	-0.022 (0.128)	0.120	49 (53)	0.898	81
			B	-0.021 (0.130)	0.238	36 (39)	0.867	80
			Metapop.	-0.019 (0.095)	0.030	73 (63)	0.939	90

Table 5-14. Mountain gorilla population risk assessment. Virunga "cut" habitat metapopulation analysis with the inclusion of war type 1 under different ages of first female breeding (AFR-E) and alternative levels of adult female breeding rates (%EE). The proportion of adult males available for breeding is 70%, the age of first breeding in males is 13, and the maximum age of reproduction is 40 years.

File#	AFR - E	% EE	Population	r_s (SD)	P(E)	N_{100} (SD)	H_{100}	T(E)
767	10	31.3	A	-0.023 (0.131)	0.148	43 (39)	0.894	81
			B	-0.023 (0.138)	0.292	26 (21)	0.841	79
			Metapop.	-0.020 (0.101)	0.044	58 (45)	0.921	87
768	9		A	-0.020 (0.130)	0.094	48 (43)	0.894	81
			B	-0.021 (0.135)	0.262	29 (22)	0.855	80
			Metapop.	-0.018 (0.100)	0.028	67 (50)	0.928	91
769	11		A	-0.023 (0.130)	0.138	40 (37)	0.889	83
			B	-0.024 (0.137)	0.278	24 (20)	0.836	78
			Metapop.	-0.021 (0.099)	0.048	55 (41)	0.922	88
770	10	26.3	A	-0.032 (0.136)	0.278	24 (25)	0.844	79
			B	-0.030 (0.139)	0.406	17 (16)	0.796	76
			Metapop.	-0.029 (0.106)	0.082	30 (27)	0.875	84
771	9		A	-0.030 (0.135)	0.278	28 (28)	0.864	80
			B	-0.029 (0.140)	0.418	19 (17)	0.816	76
			Metapop.	-0.028 (0.105)	0.100	35 (31)	0.890	86
772	11		A	-0.031 (0.134)	0.300	25 (23)	0.863	79
			B	-0.031 (0.140)	0.440	16 (14)	0.810	77
			Metapop.	-0.029 (0.104)	0.132	31 (25)	0.890	87

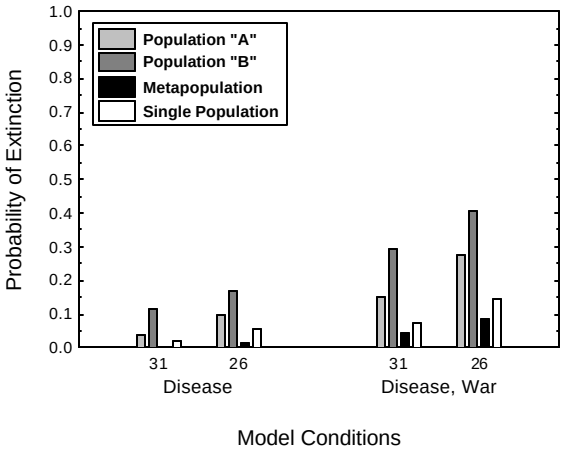


Figure 5-10. Virunga fragmented metapopulation analysis summary under alternative estimates of female breeding success. Extinction probability for each of two population fragments and the combined metapopulation is compared to that for the original unfragmented Virunga population analyzed in earlier models. War type 1 and all three diseases are included in these models with baseline demographic parameters.

Conclusions

1. Demographic sensitivity analysis focused on reproductive characteristics (age of first and last breeding, proportional female breeding success, and extent of male reproductive pool) demonstrated that, based on the VORTEX stochastic modeling exercise described in this secton, estimates of mountain gorilla population growth dynamics is affected most profoundly by uncertainty in estimates of female breeding characteristics, especially early in a given female's reproductive lifetime. In contrast, uncertainty in male breeding parameters has comparatively little impact on those growth estimates, primarily due to the polygynous nature of the mountain gorilla breeding system. This is not to discount, however, the potentially disruptive consequences of the loss of a breeding silverback from a gorilla group.
2. Disease risk analysis for both the Virunga and Bwindi populations points out the considerable threats posed by those disease types to which mountain gorillas are thought to be exposed and vulnerable. When the simulated populations are "exposed" to all three of the identified disease types within a given simulation, populations decline in size over time with a measureable risk of extinction within 100 years.
3. Widespread war in the region surrounding mountain gorilla habitat was modeled as generating acute reductions in female breeding success and survivorship among both infants and adults of both sexes. In all war scenarios, encompassing varying degrees of habitat loss as well as direct and indirect loss of animals, mountain gorilla populations decline steadily over the 100-year time frame of the simulations. Scenarios in which the direct effects of war were more chronic in those intervening time periods (so-called "type 2" and "type 4" wars) resulted in the greatest decline in populaton size and extent of genetic variability, and the greatest risk of populatin extinction.
4. Current observations suggest that the Virunga population may become fragmented into two essentially isolated fragments as a result of human activities in the region. The consequences of such a process were modeled here. While either fragment, necessarily smaller in size than the aggregate population, shows a greater extinction risk than the original unfragmented population, the combined metapopulation actually shows a slightly reduced extinction risk. This may be due in large part to the independent action of random disease events among fragments; an individual disease event, while severe within the isolated fragment, does not impact the entire population and therefore has a lesser overall impact in the metapopulation context.

Recommendations

1. During times of relatively minimal intensity of human-gorilla population conflicts, recognition should be made of the potential for resilient gorilla population growth. However, when human population pressures result in severe loss of gorilla habitat and an overall reduction in their population growth potential, an even greater recognition of the acute risks this subspecies face is required so that extinction risk is minimized.
2. More accurate information regarding impact of disease on gorilla mortality rates and reduced fecundity should be assembled to increase the predictive value of the modelling process.
3. More accurately assess how human disturbance affects mortality rates and fecundity in unhabituated gorillas is needed because there may be a greater effect on nonmonitored groups.
4. Population modeling should be applied as an evaluation tool to contingency plans developed as part of a broader long-term mountain gorilla conservation plan.
5. More accurate evaluation and monitoring of the amount and quality of habitat in the Virunga and Bwindi populations should take place.
6. Demographic parameters, e.g., age-specific fertility and mortality, interbirth interval) for the Bwindi population need to be established for modelling that population to allow accurate estimates of growth rate.
7. Because the mountain gorilla exists in only two small and isolated populations, reduced carrying capacity increases the probability of stochastic population extinction. Management complacency is therefore not appropriate despite the potential for reasonably robust population growth in the absence of human interference.

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Sample VORTEX Input File

```
GOR_719.OUT     ***Output Filename***
Y     ***Graphing Files?***
N     ***Each Iteration?***
500     ***Simulations***
100     ***Years***
10     ***Reporting Interval***
0     ***Definition of Extinction***
1     ***Populations***
N     ***Inbreeding Depression?***
Y     ***EV concordance between repro and surv?***
3     ***Types Of Catastrophes***
P     ***Monogamous, Polygynous, or Hermaphroditic***
10     ***Female Breeding Age***
13     ***Male Breeding Age***
40     ***Maximum Age***
0.500000     ***Sex Ratio***
1     ***Maximum Litter Size (0 = normal distribution) *****
N     ***Density Dependent Breeding?***
31.3-(3.13*(!((FLOOR(Y/10))%4)))  **breeding
5.000000     ***EV--Reproduction***
23.3+(5.0*(!((FLOOR(Y/10))%4)))  *FMort age 0
5.800000     ***EV--FemaleMortality***
11.700000  *FMort age 1
2.930000     ***EV--FemaleMortality***
0.000000  *FMort age 2
0.500000     ***EV--FemaleMortality***
7.400000  *FMort age 3
1.900000     ***EV--FemaleMortality***
2.900000  *FMort age 4
0.700000     ***EV--FemaleMortality***
0.000000  *FMort age 5
0.500000     ***EV--FemaleMortality***
0.000000  *FMort age 6
0.500000     ***EV--FemaleMortality***
3.800000  *FMort age 7
0.950000     ***EV--FemaleMortality***
4.400000  *FMort age 8
1.100000     ***EV--FemaleMortality***
0.000000  *FMort age 9
0.500000     ***EV--FemaleMortality***
1.0+(5.0*(!((FLOOR(Y/10))%4)))  *Adult FMort
0.500000     ***EV--AdultFemaleMortality***
20.0+(5.0*(!((FLOOR(Y/10))%4)))  *MMort age 0
5.000000     ***EV--MaleMortality***
1.600000  *MMort age 1
0.400000     ***EV--MaleMortality***
5.500000  *MMort age 2
1.400000     ***EV--MaleMortality***
6.400000  *MMort age 3
1.600000     ***EV--MaleMortality***
2.500000  *MMort age 4
0.700000     ***EV--MaleMortality***
0.000000  *MMort age 5
0.500000     ***EV--MaleMortality***
0.000000  *MMort age 6
0.500000     ***EV--MaleMortality***
0.000000  *MMort age 7
0.500000     ***EV--MaleMortality***
0.000000  *MMort age 8
0.500000     ***EV--MaleMortality***
```

Sample VORTEX Input File (Contd.)

```
0.000000  *MMort age 9
0.500000     ***EV--MaleMortality***
0.000000  *MMort age 10
0.500000     ***EV--MaleMortality***
0.000000  *MMort age 11
0.500000     ***EV--MaleMortality***
0.000000  *MMort age 12
0.500000     ***EV--MaleMortality***
2.5+(5.0*(!((FLOOR(Y/10))%4)))  *Adult MMort
0.700000     ***EV--AdultMaleMortality***
10.000000     ***Probability Of Catastrophe 1***
1.000000     ***Severity--Reproduction***
0.950000     ***Severity--Survival***
10.000000     ***Probability Of Catastrophe 2***
0.800000     ***Severity--Reproduction***
0.750000     ***Severity--Survival***
4.000000     ***Probability Of Catastrophe 3***
0.000000     ***Severity--Reproduction***
0.750000     ***Severity--Survival***
N     ***All Males Breeders?***
Y     ***Answer--A--Known?***
70.000000     ***Percent Males In Breeding Pool***
Y     ***Start At Stable Age Distribution?***
320     ***Initial Population Size***
487-(122*(Y>40))-(91*(Y>80))     ***K***
0.000000     ***EV--K***
N      ***Harvest?***
N     ***Supplement?***
Y     ***AnotherSimulation?***
```

Sample VORTEX Output File

```
VORTEX -- simulation of genetic and demographic stochasticity


  1 population(s) simulated for 100 years, 500 iterations

  Extinction is defined as no animals of one or both sexes.

  No inbreeding depression

  First age of reproduction for females: 10   for males: 13
  Age of senescence (death): 40
  Sex ratio at birth (proportion males): 0.50000

  Polygynous mating;
 70.00 percent of adult males in the breeding pool.

  % adult females breeding = 31.3-(3.13*(!((FLOOR(Y/10))%4)))
   EV in reproduction (% adult females breeding) = 5.00 SD

   Of those females producing litters, ...
   100.00 percent of females produce litters of size 1

   % mortality of females between ages 0 and 1 = 23.3+(5.0*(!((FLOOR(Y/10))%4)))
    EV in % mortality = 5.80 SD
   11.70 percent mortality of females between ages 1 and 2
    EV in % mortality = 2.93 SD
   0.00 percent mortality of females between ages 2 and 3
    EV in % mortality = 0.50 SD
   7.40 percent mortality of females between ages 3 and 4
    EV in % mortality = 1.90 SD
   2.90 percent mortality of females between ages 4 and 5
    EV in % mortality = 0.70 SD
   0.00 percent mortality of females between ages 5 and 6
    EV in % mortality = 0.50 SD
   0.00 percent mortality of females between ages 6 and 7
    EV in % mortality = 0.50 SD
   3.80 percent mortality of females between ages 7 and 8
    EV in % mortality = 0.95 SD
   4.40 percent mortality of females between ages 8 and 9
    EV in % mortality = 1.10 SD
   0.00 percent mortality of females between ages 9 and 10
    EV in % mortality = 0.50 SD
   % mortality of adult females (10<=age<=11) = 1.0+(5.0*(!((FLOOR(Y/10))%4)))
    EV in % mortality = 0.50 SD
   % mortality of males between ages 0 and 1 = 20.0+(5.0*(!((FLOOR(Y/10))%4)))
    EV in % mortality = 5.00 SD
   1.60 percent mortality of males between ages 1 and 2
    EV in % mortality = 0.40 SD
   5.50 percent mortality of males between ages 2 and 3
    EV in % mortality = 1.40 SD
   6.40 percent mortality of males between ages 3 and 4
    EV in % mortality = 1.60 SD
   2.50 percent mortality of males between ages 4 and 5
    EV in % mortality = 0.70 SD
   0.00 percent mortality of males between ages 5 and 6
    EV in % mortality = 0.50 SD
   0.00 percent mortality of males between ages 6 and 7
    EV in % mortality = 0.50 SD
```

Sample VORTEX Output File (Contd.)

```
   0.00 percent mortality of males between ages 7 and 8
    EV in % mortality = 0.50 SD
   0.00 percent mortality of males between ages 8 and 9
    EV in % mortality = 0.50 SD
   0.00 percent mortality of males between ages 9 and 10
    EV in % mortality = 0.50 SD
   0.00 percent mortality of males between ages 10 and 11
    EV in % mortality = 0.50 SD
   0.00 percent mortality of males between ages 11 and 12
    EV in % mortality = 0.50 SD
   0.00 percent mortality of males between ages 12 and 13
    EV in % mortality = 0.50 SD
   % mortality of adult males (13<=age<=14) = 2.5+(5.0*(!((FLOOR(Y/10))%4)))
    EV in % mortality = 0.70 SD

    EVs may be adjusted to closest values possible for binomial distribution.
    EV in reproduction and mortality will be concordant.

  Frequency of type 1 catastrophes: 10.000 percent
    with 1.000 multiplicative effect on reproduction
     and 0.950 multiplicative effect on survival

  Frequency of type 2 catastrophes: 10.000 percent
    with 0.800 multiplicative effect on reproduction
     and 0.750 multiplicative effect on survival

  Frequency of type 3 catastrophes: 4.000 percent
    with 0.000 multiplicative effect on reproduction
     and 0.750 multiplicative effect on survival

  Initial size of Population 1:      320
    (set to reflect stable age distribution)
 Age 1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17
    18   19   20   21   22   23   24   25   26   27   28   29   30   31   32   33   34
    35   36   37   38   39   40    Total
     8    9    8    7    7    7    7    8    7    7    7    7    8    6    6    6    5
     5    5    4    4    4    3    3    3    2    3    2    2    2    2    2    1    2
     1    1    1    1    1    1   175  Males
     8    7    7    7    6    7    6    6    6    6    6    5    5    4    5    4    4
     3    4    3    3    3    3    2    2    3    2    2    2    1    2    1    2    1
     2    1    1    1    1    1   145  Females

  Carrying capacity = 487-(122*(Y>40))-(91*(Y>80))
    EV in Carrying capacity = 0.00 SD

Deterministic population growth rate (based on females, with assumptions of
  no limitation of mates, no density dependence, and no inbreeding depression):

     r =  -0.041     lambda = 0.960     R0 =     0.457
   Generation time for:  females = 19.10    males = 20.82
```

Sample VORTEX Output File (Contd.)

```
Stable age distribution:  Age class    females    males
                             0         0.033      0.033
                             1         0.024      0.025
                             2         0.021      0.024
                             3         0.021      0.023
                             4         0.019      0.021
                             5         0.019      0.021
                             6         0.019      0.021
                             7         0.019      0.021
                             8         0.018      0.021
                             9         0.017      0.021
                            10         0.017      0.021
                            11         0.016      0.021
                            12         0.015      0.021
                            13         0.014      0.021
                            14         0.014      0.019
                            15         0.013      0.018
                            16         0.012      0.017
                            17         0.011      0.015
                            18         0.011      0.014
                            19         0.010      0.013
                            20         0.009      0.012
                            21         0.009      0.011
                            22         0.008      0.010
                            23         0.008      0.010
                            24         0.007      0.009
                            25         0.007      0.008
                            26         0.006      0.008
                            27         0.006      0.007
                            28         0.006      0.007
                            29         0.005      0.006
                            30         0.005      0.006
                            31         0.005      0.005
                            32         0.004      0.005
                            33         0.004      0.004
                            34         0.004      0.004
                            35         0.004      0.004
                            36         0.004      0.004
                            37         0.003      0.003
                            38         0.003      0.003
                            39         0.003      0.003
                            40         0.003      0.003

Ratio of adult (>= 13) males to adult (>= 10) females: 1.012

Year 10
     N[Extinct] =       0, P[E] = 0.000
     N[Surviving] =   500, P[S] = 1.000
     Population size =          216.10 (   3.20 SE,   71.55 SD)
     Expected heterozygosity =    0.996 (  0.000 SE,   0.002 SD)
     Observed heterozygosity =    1.000 (  0.000 SE,   0.000 SD)
     Number of extant alleles =  304.67 (   3.79 SE,   84.74 SD)

Year 20
     N[Extinct] =       0, P[E] = 0.000
     N[Surviving] =   500, P[S] = 1.000
     Population size =          210.34 (   4.51 SE,  100.95 SD)
     Expected heterozygosity =    0.993 (  0.000 SE,   0.003 SD)
     Observed heterozygosity =    1.000 (  0.000 SE,   0.001 SD)
     Number of extant alleles =  213.32 (   3.54 SE,   79.16 SD)
```

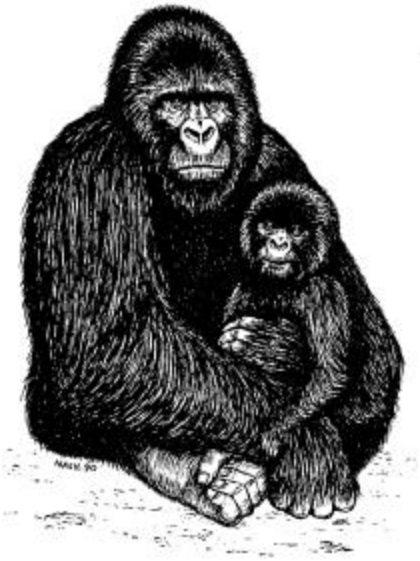
Sample VORTEX Output File (Contd.)

```
Year 30
     N[Extinct] =       0, P[E] = 0.000
     N[Surviving] =   500, P[S] = 1.000
     Population size =           197.52 (   5.06 SE,  113.14 SD)
     Expected heterozygosity =    0.989 (  0.000 SE,   0.006 SD)
     Observed heterozygosity =    0.998 (  0.000 SE,   0.004 SD)
     Number of extant alleles =  160.30 (   3.08 SE,   68.76 SD)

Year 40
     N[Extinct] =       0, P[E] = 0.000
     N[Surviving] =   500, P[S] = 1.000
     Population size =           176.64 (   4.94 SE,  110.45 SD)
     Expected heterozygosity =    0.985 (  0.000 SE,   0.010 SD)
     Observed heterozygosity =    0.997 (  0.000 SE,   0.006 SD)
     Number of extant alleles =  123.98 (   2.64 SE,   58.98 SD)

Year 50
     N[Extinct] =       0, P[E] = 0.000
     N[Surviving] =   500, P[S] = 1.000
     Population size =           119.69 (   3.68 SE,   82.32 SD)
     Expected heterozygosity =    0.977 (  0.001 SE,   0.018 SD)
     Observed heterozygosity =    0.994 (  0.000 SE,   0.009 SD)
     Number of extant alleles =   89.05 (   2.12 SE,   47.33 SD)

Year 60
     N[Extinct] =       2, P[E] = 0.004
     N[Surviving] =   498, P[S] = 0.996
     Population size =           111.69 (   3.81 SE,   84.94 SD)
     Expected heterozygosity =    0.968 (  0.001 SE,   0.030 SD)
     Observed heterozygosity =    0.991 (  0.001 SE,   0.015 SD)
     Number of extant alleles =   70.65 (   1.80 SE,   40.24 SD)

Year 70
     N[Extinct] =       5, P[E] = 0.010
     N[Surviving] =   495, P[S] = 0.990
     Population size =           108.59 (   3.97 SE,   88.24 SD)
     Expected heterozygosity =    0.958 (  0.002 SE,   0.046 SD)
     Observed heterozygosity =    0.986 (  0.001 SE,   0.030 SD)
     Number of extant alleles =   59.34 (   1.63 SE,   36.33 SD)

Year 80
     N[Extinct] =      10, P[E] = 0.020
     N[Surviving] =   490, P[S] = 0.980
     Population size =            99.22 (   3.79 SE,   83.80 SD)
     Expected heterozygosity =    0.949 (  0.002 SE,   0.050 SD)
     Observed heterozygosity =    0.981 (  0.001 SE,   0.032 SD)
     Number of extant alleles =   49.80 (   1.45 SE,   32.13 SD)

Year 90
     N[Extinct] =      23, P[E] = 0.046
     N[Surviving] =   477, P[S] = 0.954
     Population size =            69.05 (   2.71 SE,   59.24 SD)
     Expected heterozygosity =    0.934 (  0.003 SE,   0.062 SD)
     Observed heterozygosity =    0.974 (  0.002 SE,   0.048 SD)
     Number of extant alleles =   39.22 (   1.20 SE,   26.18 SD)
```

Sample VORTEX Output File (Contd.)

```
Year 100
     N[Extinct] =      36, P[E] = 0.072
     N[Surviving] =   464, P[S] = 0.928
     Population size =            66.96 (   2.88 SE,   61.95 SD)
     Expected heterozygosity =    0.921 (  0.003 SE,   0.075 SD)
     Observed heterozygosity =    0.967 (  0.003 SE,   0.055 SD)
     Number of extant alleles =   33.35 (   1.07 SE,   23.03 SD)

In 500 simulations of Population 1 for 100 years:
  36 went extinct and 464 survived.

This gives a probability of extinction of 0.0720 (0.0116 SE),
  or a probability of success of          0.9280 (0.0116 SE).

36 simulations went extinct at least once.
Of those going extinct,
    mean time to first extinction was 83.86 years (1.90 SE, 11.43 SD).

Mean final population for successful cases was 66.96 (2.88 SE, 61.95 SD)

Age 1     2     3     4     5     6     7     8     9    10    11    12  Adults
   2.06  1.9   1.94  1.69  1.6   1.4   1.48  1.47  1.40 1.42  1.16  1.06 17.21  35.91M
   2.02  1.66  1.71  1.45  1.43  1.30  1.17  1.17  1.19                   18.06  31.15F

Across all years, prior to carrying capacity truncation,
  mean growth rate (r) was -0.0215 (0.0006 SE, 0.1266 SD)

Final expected heterozygosity was      0.9210 ( 0.0035 SE,  0.0747 SD)
Final observed heterozygosity was      0.9672 ( 0.0025 SE,  0.0549 SD)
Final number of alleles was             33.35 (   1.07 SE,   23.03 SD)
*******************************************************************************
```

Population and Habitat Viability Assessment
For *Gorilla gorilla beringei*



8 – 12 December 1997
Kampala, Uganda

Section

Protected Area Management and Research

6

Protected Area Management and Research Working Group Report

Working Group Participants:
Grant Anderson, Abercrombie & Kent
Jean Bizimana, Office Rwandais de Tourisme et Parcs Nationaux
Nancy Czekala, San Diego Zoological Society
Jeff Dupain, Royal Society of Antwerp
Takeshi Furuichi, Researcher, Kalinzu Forest
Michele Goldsmith, Dartmouth College
Maryke Gray, Institute for Tropical Forest Conservation, Uganda
Chie Hashimoto, Researcher, Kalinzu Forest
Annette Lanjouw, International Gorilla Conservation Programme
Richard Malenky, Institute for Tropical Forest Conservation, Uganda
Alastair McNeilage, Wildlife Conservation Society
Keith Musana, Uganda Wildlife Authority
Norbert Mushenzi, Institut Congolais pour la Conservation de la Nature
Andrew Plumptre, Wildlife Conservation Society
Johannes Refisch, Berggorilla Regenwald Direkthilfe
Norm Rosen, University of Southern California / Conservation Breeding Specialist Group
Justin Rurangirwa-Nyampeta, Office Rwandais de Tourisme et Parcs Nationaux
Frank Rutabingwa, Ministere de l'Agriculture
Klaus Schmitt, Uganda Wildlife Authority
Popol Verhoestraete, International Gorilla Conservation Programme
Liz Williamson, Dian Fossey Gorilla Fund, Rwanda

Threats to Gorillas and Their Habitat

1. Military Action
   - poaching of animals/bamboo/other forest products
   - sanitation
   - gunfire
   - mines
   - preventing access
   - disarming guards
   - increased stress levels (possibly disease & influenced behavior)
   - habitat destruction

2. Effects of Tourism
   - increased stress (which may lead to reduced reproductive fitness/increased disease)
   - disease transmission
   - habitat destruction (cutting/trampling)
   - influence on ranging/feeding/grouping/behavior
   - pressure to increase number of habituated groups
   - potential tourism on research groups
   - bribery and corruption
   - negative attitudes of local population

3. Local Community/Park Conflict
   - crop raiding by gorillas (and other animals)
   - hunting (fishing)/poaching
   - collection of plants
   - sanitation
   - direct conflict (gorilla attacks on humans)
   - negative attitudes of local community
   - encroachment
   - pitsawing
   - gold mining
   - grazing
   - introduction of exotic species
   - presence of user people in the park

4. Effects of Habituation
   - likelihood of poaching
   - crop raiding
   - direct conflict with humans
   - health risks
   - too many being habituated

5. Effects of Research
   - stress
   - habitat destruction
   - disease introduction

6. Government Action
   - degazetting of protected areas

Management Issues

Information for management

Needs for regular information and input from research and monitoring programs for:
- Understanding of ecosystem processes, including gorilla ecology and population biology
- Understanding impact of threats on gorillas and their habitat
- Understanding impact of management strategies on gorillas and their habitat

Collaboration between park and population

Problems which the parks have in dealing with this area (ordered in chronological order of priority) :
- Because the mountain gorilla/habitat is a potential source of considerable income, authorities are sometimes reluctant to relinquish or devolve control over the park to the local population or other stakeholders - Rwanda, Congo
- Inadequate recognition of importance of the park

- Lack of information and training of higher management - decision makers
- Lack of coordination between government authorities
- Lack of clarity in organization structure hierarchy reporting lines (specifically in Rwanda with two ministries involved
- Lack of clarity and enforcement in legislation
- Lack of funding
- Not enough resource people in parks for this work
- Lack of structure for collaboration (does exist in Uganda)
- Lack of training - information field staff

- Crop raiding and lack of compensation - source of conflict preventing collaboration (problem animal control)

<u>Management Limitations for Protected Area Authority</u>

1. Planning (especially in Rwanda + Congo)
   - Strategic
   - Operational

2. Funding
   - Lack of sustainable funding mechanisms, total dependence on a fragile resource for tourism

3. Structure
   - Organization is too centralized
   - Capacity of organizations need to be strengthened
   - Communication is inadequate
   - Functional organigrammes are needed, including reporting lines, hierarchy, etc.
   - Job descriptions/terms of reference need to be refined
   - Training is needed, especially in-service training
   - Performance appraisal is needed
   - Monitoring and evaluation of performance needs to be done regularly

4. Infrastructure/logistics
   - Lack of proper armament and weaponry
   - Insufficient appropriate equipment
   - Transport mechanisms are missing
   - Training is needed
   - Staff motivation is inadequate
   - Infrastructure is lacking or inadequate
   - Insufficient trained personnel in place

5. External factors (uncontrollable by Management)
   - Security constraints in the region
   - Access to park (Congo and Rwanda) is limited due to security

<u>Sensitization and Interpretation</u> (Raising awareness and education)

- Insufficient interest by higher authorities to develop eco-education programmes

- Lack of sustainable funding mechanisms, over-reliance on fragile resource for funding
- Lack of sufficient interested audience
- Lack of dedicated staff
- Lack of resource people and resources (facilities)
- National tourism an unfamiliar concept.
- No program (DRC - WWF/Kacheche) esp. - Rwanda and Uganda
- Lack of understanding by higher authorities (emphasis tends to be on tourism for generating revenue, rather than a tool for conservation.)

Collaboration with and between partners and PAA

1. Partners (- with and between)
   - Lack of dedicated coordinator
   - Lack of program clarity
   - Agreements are too general and outdated
   - Programs being implemented are not adequately monitored and evaluated
   - Lack of coordination between NGOs at HQ - no structure for coordination.
   - Competition between NGOs
     - funds limited
     - each tries to maintain an identity
     - unequal level of funding
     - each organization has a unique funding 'niche'
   - Penalties for not collaborating are not high enough

2. Regional
   - Inadequate communication - information exchange
   - Lack of security
   - Issues of sovereignty - inflexibility
   - Immigration constraints
   - Administrative constraints
   - Political unwillingness
   - Framework for regional collaboration is lacking
   - Infrastructure is inadequate

Proposed Actions

Research and Monitoring

Research Priorities

	needed in**
• Feeding and ranging behavior	B,C,M
• Effects of other animals on gorilla population - competition	
• Impact of tourism on gorillas and habitat	
• Impact of research on gorillas and habitat (as well as other plant and animal studies)	
• Impact of resource sharing (sustainability)	B

- Impact of habituation
  (increased poaching, controlling number of groups, dispersal and spread of habituation)
- Population genetics
- Social behavior and relations - life history and demographics B
- Research on crop raiding
  (actual impact on human and economic loss - retribution)
- Research on local perceptions
- Research on poaching
- Research on suitability of unused habitat
  (avail foods, etc.- expansion and restoration of park area)
- Research on gap colonization by exotics
- Market research - how much can be charged for gorilla visits

**B=Bwindi, C=Congo, M=Mgahinga

Recommended Actions for Research

These research priorities were ranked using paired ranking to identify the most important for Bwindi and for the Virungas, using criteria which would produce the most urgently required information for managers to ensure the long term viability of the mountain gorillas and their habitat:

1. Poaching - DFGF/ITFC/UWA/ORTPN/ICCN
   - Socioeconomic - who does it and why?
   - Snare distributions - multiple use zones vs other areas
   - Effectiveness of different methods
     intensity of patrolling needed
     prison vs fines
   - Impact on animal populations

2. Crop raiding - DFGF/ITFC/DTC
   - Economic loss faced by local people
   - Which crops destroyed / preferred
   - Best control methods - compensation
   - Gorillas - are habituated animals more likely to crop raid

3. Tourism / Habituation - DFGF/ITFC/MGVC
   - Establish limit to number of habituated animals
   - Stress levels (cortisol levels - has been started) / parasite loads
   - Damage to habitat by tourists / regeneration / restoration
   - Ranging behaviour - day range length
   - Behavioural observations with and without tourist visits - gorillas time budgets
   - Vulnerability to disease / poaching - evaluation of risk of habituation
   - Transfer / spread of habituation with transfer of individuals between groups

4. Resource Sharing (Bwindi) - ITFC/DTC/UWA/BRD
   - Focus on key species (based on current demand, life history, availability)

- Effect of utilisation on life history, availability of exploited plants
- On farm substitution - can exploited plants be cultivated outside to reduce pressure on forest?
- Human impact on habitat (secondary effects)
- Illegal activities associated with resource extraction
- Impact on gorillas distribution and ranging patterns - their use of exploited areas

Monitoring Priorities

- Life history and demographics
- Poaching (snares and market meat)
- Human traffic (tourists, locals, researchers, staff, etc.)
- Stress monitoring (cortisol levels)
- Health monitoring and reproductive status
- Habitat use by gorillas
- Census of gorilla numbers
- Monitoring multiple use and other conservation efforts and intervention (bee-keeping, anti crop raiding measures)
- Community monitoring (local perception)
- Tourism control (keep track of numbers, etc.)
- Impact of tourism
- Monitoring by GIS
- Hair genotypes and group dynamics (issues of paternity)

Recommended actions for monitoring

1. Ranger based - IGCP/ITFC/UWA(with GTZ)/ICCN/ORTPN
    - Better coordination between above
    - Consider all above issues for inclusion in ranger data sheets
    - Establish database and setup system to maintain it
    - Determine who is responsible for analysis - should be collaborative venture between DFGF/ITFC and park authorities
    - Standardization of methods - workshop

2. Research station based - ITFC/DFGF/ICCN
    - Better coordination between above
    - Look for funding for (v. expensive)
    - Establish database and setup system to maintain it
    - Research stations to be responsible for analysis
    - Standardization of methods - workshop

General recommendations for research and monitoring

1. Improve communication between research centers - via e-mail
2. Improve communication between research centers and management
3. Regular visits between stations, including yearly seminars with all involved

4. Dissemination of results - national/international level
5. Interpretation of results with park managers into specific actions
6. Recognition that gorilla research groups are important and should be kept separate from tourist groups
    - Establish a protocol for the behavior of researchers to be developed with vets - PAA/DFGF/ITFC/MGVC
    - Review of proposals to consider the potential impact of research/monitoring on the environment

Recommendations for Park-Population Collaboration

*Recommendations addressed by one or more organizations, or one which constitutes a gap in programming

1. Raise government awareness and willingness to promote collaboration at higher political and policy level
    a) dissemination of information/report of PHVA, regional meeting, etc. to higher authorities
    b) organize study tours for decision makers (training)
    * IGCP in Feb'98
    c) develop policy by transferring information vertically (upwards)
2. Legislation updated/enforcement procedures to promote collaboration
    a) a,b.,c., as above (dissemination of information, study tours, develop policy)
    b) training
        i) identify target group
        ii) identify needs
        iii) training
        iv) evaluation of results

* gap in the Rw/DRC, not in Uganda

3. Implementation (by park staff) of programmes for collaboration
    a) seek funding
    b) technical expertise harnessed
    c) develop structure for programmes
        i) promoting marketing of crafts
        ii) community rangers to raise awareness
    d) evaluate effectiveness

*ongoing in Uganda, in DRC/Rw it's an important gap

4. Develop policies and systems for Problem Animal Control
    a) develop systems
    b) demarcation of park boundaries
    c) seek funding to implement systems

* a. beginning in Ug; gap in Rw and DRC
* b. Ug,Rw,DRC ongoing
* c. Ug: CARE; gap in Rw and DRC

Recommendations for management

1. Implement planning at strategic and operational level by Protected Area Authorities
    a) National Environment Action Plan
    b) vision and strategic plan for PAA

c) Protected Area Management Plan
d) operational monthly work plans
e) monitoring and evaluation of planning/implementation

* a. needs to be updated
* c. done in Ug, not in Rw,DRC
* d. going on in DRC, Ug, Rw
* e. gap

2. Develop sustainable funding mechanisms
   a) researching options for sustainable funding mechanisms for the PAA
   b) developing these options
   c) explore mechanisms of linking funding with other activities and areas (i.e. revenue sharing; supporting other protected areas not generating funds; small scale development projects around parks, with local participation)

* gap throughout

3. Decentralize and improve structure within PAA
   a) develop mechanisms for communication and coordination (national and regional)
   b) refine organisational structure
   c) update job descriptions and terms of reference
   d) implement training
   e) performance appraisal (link with career plan-promotion-salaries)
      i) increase staff salaries

* all ongoing, but improvement and updating is required

4. Develop improved tourism programmes
   a) improve reservations/booking policies
   b) evaluate pricing for permits
   c) develop more rigorous agreements with tour companies (benefiting conservation)
      i) concessions and "user-permits"
      ii) EIA for proposed developments
      iii) develop and impose penalties for irresponsible companies
   d) develop infrastructure to reduce impact on parks
   e) develop regulations that are harmonized regionally, including
      i) number of habituated gorillas
      ii) impact of tourism on gorillas and habitat

<u>Recommendations for sensitisation and interpretation</u>
(raising awareness, education)

1. Raise government awareness and willingness to support and facilitate conservation efforts
   a) disseminate information
   b) channeling information through key players
   c) involve key people in national and international fora
   d) study tours for decision makers

2. Development of programmes for raising awareness, sensitization
   a) i.e. seminars on gorilla behaviour/health rules and conservation with military

b) investigate the option of developing a "green contingent" within the military deployed around the parks

3. Develop strategies and programmes for interpretation for both national and international tourism
   a) involve facilitator/resource people
   b) identify target groups
   c) identify needs
   d) develop program
   e) obtain funding
   f) develop materials
   g) training of staff involved in tourism, including, for example:
      i) how to deal with uncooperative tourists/professional ethics
   h) monitoring and evaluation

4. Encourage national tourism
   a) develop policy within PAA
   b) develop and implement incentives
   c) encourage local participation through clubs, societies, associations, competitions (singing, painting, poetry,…),…
   d) monitor and evaluate

Recommendations for collaboration

Regional collaboration

1. Develop framework for regional collaboration at political level
   a) further development of Peace Parks
      *this is ongoing in VVR-BINP by IGCP
   b) involve international community in Peace Park development
      i) UNHCR, IUCN, UNESCO, governments, NGOs
   c) involve high-level government authorities in the regional framework and stress the importance of and need for regional collaboration
      i) building on current initiatives to develop a Regional Economic Community in the Great Lakes Region between Ug-Rw-DRC and stress potential for cooperation in environmental and tourism issues
   d) Build on the Afromontane Forest Meetings

2. Develop a program for regional collaboration at field level
   a) identify needs
   b) develop mechanisms
   c) obtain funds and infrastructure
   d) harmonize regional monitoring programs
      *a.b.c. are partly done in each country
   e) store, analyze and disseminate the information on a regional basis
   f) monitor and evaluate
      * this is currently being developed

3. Develop harmonized regional tourism programs
    a) input from research on impact of tourism
        i) number of gorilla groups to habituate
        ii) impact of tourism on gorillas
        iii) impact of tourism on habitat
    b) develop standardized regulations
        i) increased pricing structure for tourism activities
    c) work towards the development of regional tourism circuits (potential for a Great Lakes Visa, rather than a visa for each country)

Collaboration with and between partners

1. Develop mechanisms for coordination and communication
    a) assign a dedicated coordinator within PAA at national level
        i) the coordinator would be responsible for updating contracts/agreements between partners and the government, and would have input in developing annual plans
    b) submit quarterly reports and circulate these between all partners and PAA involved in VVR-BINP at regional level. These reports should include
        i) bullet-points of past quarter activities
        ii) bullet-points of planned quarter activities
        iii) they could be written and circulated by e-mail or hard-copy
        iv) assign the leadership to one neutral lead agency
    c) hold annual meeting at regional level between <u>all</u> partners (from the field) and PAA (VVR-BINP) for:
        i) annual planning
        ii) monitoring and evaluation of programme implementation

    * include national level coordinator
    * partners pay for own participation and contribute to costs of PAA participation
    * circulate venue between 3 countries

    NB these are informal meetings and would not need to be costly or time-consuming

Summary of Recommendations for Management and Research Working Group

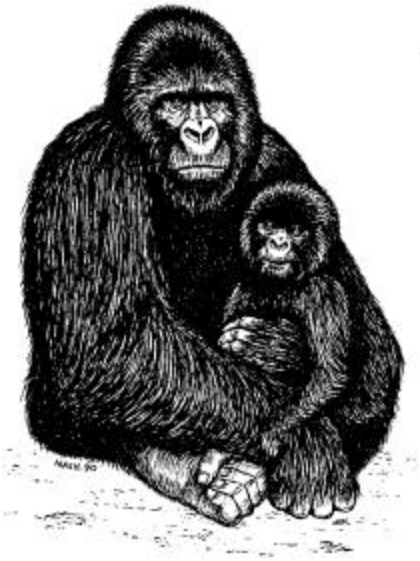
Not listed in any order of priority, as all are considered equally important

1. We recommend that research focused on areas which are of critical importance for management be initiated and implemented. The following four key areas were identified:
   a) poaching of plant and animal forest products
   b) crop raiding by animals from the park
   c) impacts of tourism and habituation of gorillas
   d) impacts of resource sharing
2. We recommend that standardized ranger-based monitoring be developed and implemented throughout the VVR and Bwindi region
   a) the programs will focus on monitoring trends in areas considered critical to management
3. We recommend that procedures be developed to enhance collaboration between the park and all stakeholders
   a) to raise awareness
   b) to enforce and update environmental legislation and to strengthen enforcement procedures
   c) to develop policies and systems for problem animal control
4. We recommend that continued support be given to the protected area management authorities to increase the effectiveness of conservation
   a) by implementing planning both at strategic and operational level
   b) by researching options for sustainable funding for protected area authorities and to develop funding mechanisms
   c) by furthering the decentralization of the protected area authorities and building upon existing capacity within those institutions
   d) by strengthening existing tourism programs
5. We recommend that sensitization programs targeted at all levels be implemented
   a) to raise government awareness
   b) by developing strategies and programs for interpretation, for both national and international tourism
   c) to encourage national tourism
6. We recommend that a framework be developed for regional collaboration, such as a Peace park. We also recommend that improved mechanisms for communication and collaboration between partners be developed. One of the objectives of this will be the development of regional tourism

Acronyms

AWF	African Wildlife Foundation
BINP	Bwindi Impenetrable National Park
BRD	Berggorilla Regenwald Direkthilfe
CARE-DTC	CARE-Development through Conservation
CBSG	Conservation Breeding Specialist Group
DFGF	Dian Fossey Gorilla Fund
DRC	Democratic Republic of Congo
FFI	Fauna and Flora International
GIS	Geographic Information System
GPS	Global Positioning System
GTZ	Gesellschaft für Technische Zusammenarbeit (German Technical/Development Cooperation)
HQ	Headquarters
ICCN	Institut Congolais pour la Conservation de la Nature
IGCP	International Gorilla Conservation Program
ITFC	Institute of Tropical Forest Conservation
IUCN	World Conservation Union
KRC	Karisoke Research Center (DFGF)
MAF	Morris Animal Foundation
MBIFCT	Mgahinga-Bwindi Impenetrable Forest Conservation Trust
MGNP	Mgahinga Gorilla National Park
MGVC	Mountain Gorilla Veterinary Center (MAF)
NGO	Non-governmental organization
ORTPN	Office Rwandais du Tourisme et des Parcs Nationaux
PAA	Protected Area Authority
PHVA	Population and Habitat Viability Assessment
PNV	Parc National des Volcans-Rwanda
PNVi	Parc National des Virunga- Democratic Republic of Congo
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNHCR	United Nations High Commissioner for Refugees
UWA	Uganda Wildlife Authority
VVR	Virunga Volcano Region
WCS	Wildlife Conservation Society
WFP	World Food Program
WWF	World Wide Fund for Nature
ZPB	

Population and Habitat Viability Assessment
For *Gorilla gorilla beringei*



8 – 12 December 1997
Kampala, Uganda

Section

Governance

7

Governance Working Group Report

Working Group Participants:
Margaret Cooper, University Federation for Animal Welfare
Vital Katembo, Dian Fossey Gorilla Fund-Europe / Congo
Jeremy Mallinson, Jersey Wildlife Preservation Trust
Kakule Vwirasihikya, Institut Congolais pour la Conservation de la Nature
Emmanuel Werabe, Rwandan Ministry of Tourism
Samson Werikhe, Uganda Wildlife Authority

Legislation and Policy

Issues

1. Lack of and inadequate legislation - inconsistent and not respected.
2. Lack of contact at Ministerial level and between lead agencies and politicians.
3. Lack of communication between government and local government levels.
4. Failure to translate legislation to users.
5. Failure to monitor current legislation.

Actions / Recommendations

1. Lead agencies (perhaps primarily NGOs) to encourage Ministers of Range States (Uganda, Rwanda, Congo) to meet to discuss legal issues, IGCP/DFGF to help to facilitate.
2. Lead agencies to encourage countries to give greater priority to nature conservation and related tourism by placing responsibility for the environment, nature conservation and tourism in a single Ministry.
3. Lead agencies to have more contact with political leaders regarding legal issues, e.g. invitation to meetings; press conferences; to open and to address meetings; to be supplied with more information.
4. Lead agencies to improve by action - discussion meetings, dinner debates. Use or form (e.g.) Park Management Advisory Committees at District level.
5. Lead agencies and conservation NGOs to initiate and coordinate implementation of the process of translation of legislation into guidelines, regulations, bye-laws. To encourage lead agencies to disseminate information via (eg) media, publications, schools, hotels.
6. Form monitoring group for each country. Membership: Lead agencies - 2, IGCP/DFGF - 2, Ministry - 1, Local people/Communities near Parks - 1 or 2. Number of Members: 6 or 7 plus power to co-opt. Funding: by lead agencies with IGCP/DFGF backup. Purpose: Monitor implementation of law. Group to decide on its Terms of Ref.

Barrier of Sovereignty

Issues

1. Mountain gorilla distribution straddles three international boundaries.
2. Each country has separate laws e.g. poachers subjected to different penalties.

Actions / Recommendations

1. Lead agencies to promote, through communication with appropriate governmental authorities, the harmonising of conservation legislation and its implementation and enforcement within the range states.

Ownership

Issues

1. The mountain gorilla is critically endangered and therefore should be regarded as a joint responsibility of the 3 range countries and thereby come under joint protection.
2. Ownership is a term in law, i.e. gorillas are legally owned by the State. Concern about the definition/interpretation of the word "OWNERSHIP". This variance in interpretation of the word could lead to abuse e.g. unilateral decisions.
3. Local communities - Expectation of "The Owner" e.g. revenue benefit.

Actions / Recommendations

Recognising that the current position on the law of ownership is favourable, our recommendations are intended to strengthen and not change legislation. Lead Agencies are advised to:

Immediate Action:

1. To sensitise all stakeholders about importance of use of the correct interpretation of the word 'ownership' - to mean shared responsibility in the joint protection of the mountain gorilla.

Longer Term:

1. To investigate the use of the Migratory Species Convention to strengthen joint protection measures. Although it is recognised that gorillas are not considered migratory (in science), they are listed in Appendix I of the Convention.
2. To investigate the possibility of a World Heritage Site for Uganda and Rwanda.
3. To investigate management of Virunga Range as a Peace Park.

Insecurity and Political Conflict

Issues: Threats to

1. Gorillas and habitat.
2. Tourism and associated revenue.
3. Park personnel and local communities.

Actions / Recommendations

1. Lead agencies to bring to the attention of the appropriate governmental authorities the draft of the 'Code of Conduct for Trans-Border Areas (TBA/ZPTF) in Peacetime or During Conflicts' - see 'Parks for Peace' Conference Report, 1997.

2. Lead agencies and appropriate government departments to request co-operation of military authorities in the coordination of protective conservation measures through range countries.
3. Lead agencies and the international conservation community to strengthen awareness programmes for the military authorities as to the critically endangered status of the mountain gorilla, and to do everything possible to maintain the conservation viability of the species and its associated habitat.

Regional and Institutional Collaboration

Issues - Institutional Conflicts

1. Lack of trust between governmental and non-governmental stakeholders; local and international NGOs.
2. Lack of willingness and failure to cooperate in and to coordinate conservation activities.
3. Unnecessary duplication of time, finance and effort.
4. Lack of appropriate expertise.
5. Projects lacking sustainability.

Actions / Recommendations

1. The Governance Group agrees with the majority of the recommendations of the Finance Group re the need for improved regional and institutional collaboration and highly recommends the development of Codes of Practice to facilitate this. This to be achieved through the lead agencies establishing NGO coordination offices in the range countries and through informal meetings of stakeholders.
2. These 'in-country' offices to coordinate NGO activities e.g. terms of referees, M of Us, criteria for project approval, establishment of steering committee, monitoring & evaluation of projects, etc.

Research Material

Issues

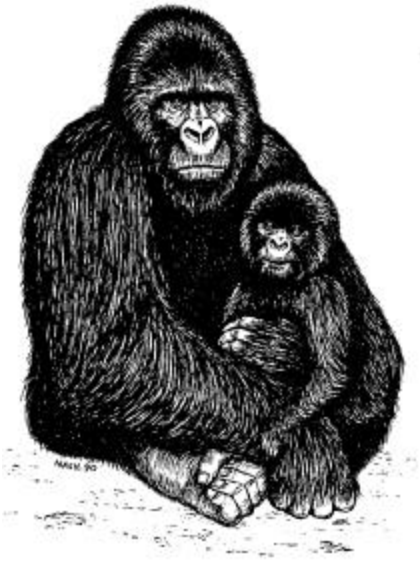
1. Ownership
2. CITES and other national permits
3. Benefit to range country
4. Genetic cloning
5. Bioprospecting

Actions / Recommendations

1. Lead agencies/Ministries should make it a condition of any research authorisation that: Samples remain property of state; samples and data should be shared with the host country institution and made available to researchers.
2. Lead agencies to keep records of authorisations, samples, exports, deposits of samples and data.
3. NGOs to have policies on sharing benefits of research with host country including training of local nationals.

4. NGOs and home institutions to ensure compliance by their researchers.

Population and Habitat Viability Assessment
For *Gorilla gorilla beringei*



8 – 12 December 1997
Kampala, Uganda

Section

Revenue, Finance and Economics

8

Revenue, Finance and Economics Working Group Report

Working Group Participants:
Eve Lawino Abe, Ministry of Tourism Wildlife and Antiquities,Uganda
Lilly Ajarova, Uganda Wildlife Authority
Jim Holden, Abercrombie & Kent
Jillian Miller, The Dian Fossey Gorilla Fund, UK/Rwanda
Claude Sikubwabo, Institut Congolais pour la Conservation de la Nature
Mark Stanley Price, African Wildlife Foundation
Gary M. Tabor, Center for Conservation Medicine, Tufts University
Nancy Thompson-Handler, Zoological Society of Milwaukee; Institute of Tropical Forest Conservation, Uganda
Dedee Woodside, Taronga Zoo, Australia

Introduction

In our workshop we focussed on trying to define the economic context in which gorilla conservation is operating and on the range of revenue opportunities and finance mechanisms that could be availble to support gorilla conservation. We restricted our discussion to the opportunities and barriers in these areas that would affect the primary goals of ensuring a viable gorilla population and its habitat into the future and encouraging collaboration between participating institutions and range states.

In preparing the scope of our workshop exercise, we found it useful to separate the concepts of revenue, finance and economics and allocate them to a hierarchy where the definition of each builds on the definition of the pervious one(s). The resulting definitions were as follows:

1. **Revenue:** all sources of income and value of capital assets
2. **Financing:** refers to all mechanisms for acquisition of funds, distribution and accountability
3. **Economics:** refers to the nonmonetary and monetary values of the community and the resulting structures at both a national and local community level. The economic framework of the three range nations is clearly different from each other whereas many of the revenue and financing issue may be similar.

We feel that a collaborative effort by the three range nations will ultimately reap some great financial benefits which would not necessary be gained by operating independently. We note that such regional collaboration is one of the goals of this PHVA meeting and that the synergy that would result from working together are very clearly demonstrated by the revenue and financing potential we have itemised in this section of the PHVA report. For example, creation of a Peace Park or similar concept, which could only result from collaboration, would give a status to the gorilla habitat and access to international funding which would not otherwise be available to individual range countries. It also has a major public appeal which could translate into new and higher levels of funding. In this report, we introduce some innovative approaches to future funding that should be considered which go beyond conventional revenue generation through fee, licences and grants etc to captilise on the increble value of the the existing four park areas to the global community and their inherent natural assets (e.g., biodiversity).

Structure of the workshop

We structured our discussion to fit primarily into four sections to address four most important issues we identified regarding revenue, finance and economy associated with mountain gorilla conservation. The first section centered on the need to conduct a full cost-benefit analysis of gorilla conservation so that a strong economic case could be put forward for gorilla and habitat conservation in each of the range states. The second, included a review of potential revenue sources, including methods, instruments and their sustainability. In this section we asked, "who should pay, who could pay and how could they pay?" We also review some innovative ideas that could be significant in the long-term management of the area. The third section reviewed the available financial mechanisms and management and ideas for future mechanisms, especially those that involve collaboration between institutions and renge states. The fourth and concluding part of our discussion focussed on the major question, "should gorillas be expected to pay their own way? That is, should they pay for their own conservation, their habitat protection and to community development as currently seems to be the case?"

During our discussions we compiled a list of the major assumptions that we had to make as a group and some of these had been expanded upon in our recommendation section. These include:

1. the revenues generated will be shared with other stakeholders (at this point Uganda only);

2. in all three range nations, there is a national biodiversity policy and an agreement with the Convention on Biological Diversity;

3. the "communities" that are referred to, can be defined (ie delineated), are adequately managed as units and can be seen as financial stakeholders in gorilla conservation;

4. gorillas have a special global value which is fundamental to the potential to gain revenue through gorillas, to finance their conservation and give them some global priority;

5. social responsibility is integral to gorilla conservation programs and that on behalf of thecommunity we should seek ensure equitable access to revenue gained, not just maximise that revenue [refer to Agenda 21 and pricples of ESD];

6. conservation of the mountain gorillas is the primary goal and the maximising revenue is to this end and revenue activites should not put gorillas at risk

7. gorilla tourism does not operate independently of tourism in the rest of the country or region and should be ntegrated with other tourism structures and strategies.

General Threats to Revenue and Financing

Threats to Revenue

The subgroup in charge of revenue and benefits analysis generated by gorilla conservation and the habitat has underlined several contributing factors that are threatening or slowing down the income revenues. The most important ones are the following:

1. War and insecurity :
   - loss or reduction of tourism (loss of revenues)
   - lack of access to the forests
   - decline in population of gorillas caused by war, lack of control and follow up of gorillas. some gorillas were caught in cross-fire between soldiers.
2. Lack of effective revenue policies : an important amount of revenues from parks is taken by the Public Revenue Office and the park is left without means. This leads to the non payment of rangers (e.g. recent experience in Congo).
   - the park staff is not motivated and is easily corrupted.
   - the park is not effectively controlled and gorillas not effectively monitored
3. Pressures due to poverty and overpopulation :
   - pressures on park resources causing land encroachment.
   - antagonistic attitudes of the communities against tourists and rangers who tend to adopt suspicious or violent attitudes towards them.
   - Envy towards gorillas and their habitat and attempts to collaborate with traffickers of young gorillas (8 gorillas died in this process in 1995).
4. Lack of international cooperation between the 3 range countries:
   - inadequate coordination of conservation efforts at agency / NGO level.
5. Poorly managed health/welfare of gorillas.

Conclusion

All these factors contribute to the reduction in the number of gorillas and to the loss of their habitat. The viability of the gorilla is therefore affected, creating a loss of control by conservation institutions and a drop in revenues.

Recommendations

The following recommendations were formulated in order to promote the viability of gorillas and their habitat while ensuring the flow of revenue.

1. There is need to secure the gorilla population and their habitat from military conflict. This is the responsibility of the governments of the range countries. It is the international NGOS duty to encourage prompt action by the respective governments and to request the assistance of the international community on this specific issue by encouraging, for example, the “Peace Park” concept.
2. The ministries responsible for economy, finances, conservation, tourism, and rehabilitation, will have to agree on policies allowing the park to keep the biggest part of their revenues in

order to ensure the smooth running of the institutions and the rehabilitation of infrastructure. The international NGOS responsible for conservation will have to list recommendations targeting these governments institutions (preferably started by summer 1998).

3. Development of laws on conservation in order to ensure the sharing of revenues with the local population and a better collaboration between park and population. Park Management (ICCN / ORTPN) staff with assistance of International NGOS (note: in Uganda, the policies for revenue sharing have been recently revised. Preferrably start elsewhere by summer 1998).
4. Harmonizing the laws, tariffs of tourism of mountain gorillas, by the Ministries of the 3 countries by summer 1998, with the help of International NGOS by 1998.
5. Taking care of gorilla health in the wild.

Cost-Benefit Analysis: Putting the Economic Case for Gorilla and Habitat Conservation

Challenge: Mountain gorilla conservation provides many benefits to Uganda, Rwanda and Congo, to the region and to the world at large. Economic and social stability priorities play a key role in determining range state levels of commitment and action toward mountain gorilla conservation aims. Present valuations of mountain gorilla conservation do not adequately encapsulate the full benefits, both economic and noneconomic, of this activity. In order to assist range state members in making better informed decisions about allocation of precious economic resources, a sound economic case for protecting mountain gorillas and their habitat can be a useful tool for ongoing and future development efforts.

Recommendations

A cost-benefit analysis for mountain gorilla conservation needs to be undertaken. This activity will include a full cost accounting of all aspects of gorilla conservation. The product of such an exercise, which may take one year to complete, is an environmental audit of both Virunga and Bwindi gorilla populations and habitat.

It is recommended that an independent contractor/consultant with a high level of expertise in environmental economics be sought internationally to perform this task. Sources for such expertise might come from academia, professional accounting firms or other appropriate nonprofit organizations with experience in environmental economics.

The timing of the consultancy should begin in 1998 if possible and in advance of future "Peace Park" negotiations or the development of other cooperative/integrated management initiatives. The environmental audit will be performed for all three range nations with international funding. The results of the effort will be used as a large joint funding application by the range state members to various world donor bodies such as the World Bank.

Subrecommendations

As a follow on to the cost-benefit analysis, there needs to be further explorations of new and promising revenue generating activities such as:

- biodiversity prospecting potential and royalties gained
- economic carbon trading initiatives, i.e., carbon levies or joint implementation

These activities should be performed for all range states.

Approach

In order to quantify and identify costs and benefits of mountain gorillas, an illustrative list of issues and activities relating to mountain gorilla conservation is presented below.

A) Direct costs include:

- infrastructure, equipment
- operation (in and out of park), admin., personnel
- research, monitoring, education, interpretation
- extra costs/programs
  - tourism
  - community and external affairs
- regional initiatives
- community issues
- revenue-sharing
- advocacy

B) Indirect costs (or downstream costs) include:

- community loss of access to the parks
- war and associated disturbance, instability, uncertainty
- poaching
- climatic changes from habitat alteration
- tourism- adverse side effects
- local immigration pressures related to development activities from gorilla tourism and development programs in periphery of parks

C) Benefits

There are many benefits to gorilla conservation. Some of these benefits are quantifiable but many lie outside the realm of traditional economic valuation approaches. Those benefits that can be assessed with a market value include:

- jobs
- direct funding and revenues
- tourism development as a whole
- the development of regional service industries and regional developmental enterprise
- ecotourism that is low impact and sustainable
- other standard indicators of economic activity and trends

Those benefits which are less easily quantifiable include:

- the full benefit of Mountain Gorilla conservation
- the maintenance of ecosystem services, e.g., prevention of soil erosion, watershed protection, local climate stabilization

- national pride relating to the showcasing of the protection of gorillas
- education awareness
- research and understanding of the species, its habitat and regional biodiversity
- biodiversity conserved and habitat protected
- enhanced local governance
- controlled equitable access to natural resources, sustainability

Recommendations For Revenue Generation and Mechanisms

The work group considered only sources of revenue and the mechanisms of accessing those sources for the conservation of mountain gorillas. Lists were prepared of potential sources and mechanisms. Potential sources of revenue were identified as follows, categorized by level of utilization:

Park Level Revenues

- government appropriations
- gate receipts, entry accommodations
- grants: private, public, bi- and multi-lateral
- loans
- local taxes: resource extraction, license/fees (minerals, grazing, etc.)
- fines
- landing and transit fees
- license fees (concessions and operators fees)
- guiding and activities (fishing, filming, etc.)
- retail and merchandising
- royalties
- biodiversity prospecting and development
- research fees
- individual/good will donations
- in kind services/goods

Community Level Revenues

- merchandising
- accommodation & services
- concessions & land leases
- revenues from park (20% Uganda)
- cultural products
- sales of legally harvested park products
- compensation
- loans for enterprise
- subsidies and environmental incentives

National Level Revenues

- tax and levy revenues
- license fees
- international grants (e.g., UNESCO)

- international loans
- treasury bonds

Potential mechanisms for sourcing revenue were similarly identified and listed below:

- Memorandums of Understanding between community and park
- contracts
- royalties and copyrights
- licensing
- concession agreements
- possible incentives to funding [matching grants from parks for funds raised by community]
- bonds
- trust funds [various forms]
- ecolabelling .... certification
- pricing strategies
- carbon levies and sinks
- "Debt for Nature" tradeoff.
- subsidies/incentives, e.g., grants for planting on perimeter of park or for not grazing/cropping.

Appropriate pay scale and other innovative means to pay rangers…(describe Indonesian type mechanisms).

- privatization of parks [this is seen as unacceptable in Uganda and possibly also Rwanda and D. R. Congo as well]
- contracting of park management
- management of some park programs such as tourism through program management using external donor funds.

Recommendation

There is scope to develop and implement many innovative financing mechanisms and these possibliities should be communicated to all relevent parties and institutions involved with mountain gorillas. Any new mechanisms need to be integrated with gorilla/habitat conservation within and between countries, with the knowledge and involvement of all the relevant institutions.

The responsiblity and timelines for preparing a summary of options and communicating them should negotiated among the international NGO's (INGO's) as soon as possible.

These options should be discussed by an informal forum of INGO's and relevant institutions, resulting in a suite of proposals that could be adopted by a more 'formal body' that will grow out of a more structured and coordinated approach to conservation of gorillas and their habitats.

Gorilla Tourism is Integrated Part of Tourism Sector

The work group made the above assumption with the following observations:

- Tourism is one of the world's largest industry

- Tourism development could be used as a tool for conservation.
- Gorilla viewing is one of the world's unique tourism product
- Currently there is too much emphasis on gorilla tourism

Recommendation

There is need to integrate gorilla tourism into national and regional tourism strategy, considering the following points or principles:

- avoid overdependence on gorilla through direct linking of community benefits to each gorilla permit. Therefore, there is need to encourage diverse revenue sources in each and all the Protected Areas.
- need to look at pricing, considering the market, tolerance, motivation to pay and consistency across the range states.
- in the short term, there is need to establish a special dedicated fund through donation to implement revenue sharing policy.
- a long-term policy has to be developed as a serious policy for equitable distribution of the revenues.
- ensure high quality/sustained tourism
- ensure security

Specific to the different countries in the region and immediate (beginning of 1998) implementation should be made as follows.

- In Uganda the tourism Master Plan has to be updated and implemented through UWA and UTB, while security is ensured by Ministry of Defence.
- In Congo the implementation has to be considered by Ministries of Reconstruction, Tourism and, Economics and Finance.
- In Rwanda the recommendation has to be considered by Ministere des Art, Mines et Tourism.

Regional and Institutional Collaboration

Challenges for Collaboration for Revenue, Finance:

- Governments only provide small proportions of the funds needed to meet the 'Goal' (ie. Conservation of mountain gorillas and their habitat)
- Donors are many - INGOs, local NGOs, diverse agencies etc., providing funds directly, through' NGOs etc.
- Donors currently do their own thing, perhaps individually effective, but
  - little collaboration
  - little communication
  - not best value for money
  - some large gaps in funding targets evident
- The Goal requires the active involvement and support of many stakeholder groups, who must have a mechanism for meeting jointly, and consulting

Approach taken:

- we considered a wide array of costs for meeting the Goal
- we considered a wide array of benefits from meeting the Goal

- we considered a wide array of potential financial mechanisms
- we were aware of a diversity in involved NGOs, their diverse sizes, interests, structures and sensitivities
- the major stakeholder groups were identified as Donors, NGOs, Management Authorities, Range State Governments, Tourism Industries

Outcome of Discussions:

- Donors must get together, communicate and collaborate in pursuit of more complete and sustainable achievement of the Goal
- Sensitivities among NGOs will ensure they cannot be pushed too far, or too quickly
- Management authorities must collaborate and be informed of, and encourage, coordinated donor efforts
- All stakeholders must be represented at a senior level forum

Recommendations

1. Collaboration between INGO's and other current funding sources will require that the following mechanisms are put in place as soon as possible:
   - regular communication
   - operating guidelines
   - exchange of information on current/future programs for gorilla conservation
   - possibly a "tiered round table mechanism"

2. Communication within and between other significant stakerholder groups will require that a number of key meetings are convened and the results communicated to each other. The groupings and organisers are restricted to those listed below and may be otherwise negotiated.
   - IGCP may coordinate an open meeting for all NGOs who wish to participate (IGCP by June 1998)
   - Tourism Industry Operators primarily those associated with Mountain Gorilla tourism (appropriate tourism association such as AUTO by June 1998)
   - Govt.Tourism representatives (Uganda MTWA before June 1998)
   - Key Park Managers (IGCP in 1998)
   - Key Park Directors (Directors, Wildlife Authorities of free range states, June 1998)

3. These stakeholder groups will:
   - begin communicating internally
   - share information, their missions, their dollar support commitments and proposed revenue sources and mechanisms
   - agree on regular communications with the longer-term aims of
     - planning together
     - cooperating
   - communicate the results to other groups
   - will explore the need and scope of a fully representative, more formal policy-setting body to link the interests of each stakeholder group with the aim of effective, coordinated international conservation of the mountain gorilla and its habitats, and of a responsible tourism industry

4. Donor Awareness and Education
   - Donors are to be sensitized about the need for long-term, coordinated support for gorilla conservation.
     - INGO group is to develop materials for World Bank and others
     - **Important**: This idea needs endorsement by the range state governments
     - INGOs in JUNE-DEC.1998

Beyond Revenue Generation to Instill Values that Affect Economic Outcomes

A major theme in all our discussions was the need to consider non-monetary values and benefits of Gorilla conservation on all three range states. It is our opinion that the value system of the local or national community will fundamentally affect all economic decisions and the nature of any revenue generation program that are initiated, the commitment to collaborate and the ultimate redistribution of benefits of conservation throughout the community. Value systems are the basis of all decisions or 'willingness' to pay, whether the payee be a local citizen, national government or international organization. Just how much we all 'value' mountain gorillas is therefore, fundamental to the generation of adequate revenue and development of appropriate financing mechanisms for theirconservation.

We have therefore considered a number of ways in which the value of gorilla its habitat conservation can be instilled and reinforced locally, nationally and internationally. We feel that mountain gorilla could be used as an "engine" for wider conservation, for development of "sustainable" enterprise especially tourism through the range states. Mountain gorillas, like the panda are a global symbol of conservation and can be used to symbolize sensitive tourism and the need for all tourists wherever they are to "tread lightly" and "contribute locally". We recommend that this concept of using gorillas as a symbol of true ecotourism globally should be presented to peak tourism bodies internationally but should be initiated jointly by the relevant Ministries in the range states.
We also considered various formal and informal education networks, facilities and programs that gorilla conservation could "piggy back" on to instill values for conservation of these animals and their habitat. The options discussed below include a number of target audiences including education to the international organizations, global public, national government bodies, corporate sectors within and outside the countries, tourists, ex-communities and the nationals (especially children) in each range state.

We can recommend three key organizations who can deliver on this kind of conservation education in Uganda and internationally but are not able at this time to recommend similar bodies in Congo or Rwanda. These include:

- the East African Wildlife Society with its international membership,
- the Uganda Wildlife Clubs with their strong national membership including families and schools throughout the country,

- The Uganda Wildlife Education Centre (UWEC, or better known as Entebbe Zoo) with an annual attendance of about 120,000 of which more than 95% are Ugandans school children from all around the country (projected attendance after reconstruction is 250,000). The internationally community is currently engaged in assisting the reconstruction, development of a range of informal and formal education programs for environmental eduction and full integration with the school curriculum. With appropriate inanimate and dynamic gorilla exhibits this could become a major "shop-front" or showcase for updates on gorilla conservation.

Summary Recommendations for Instilling Conservation Values:
The value system of the local or national community will fundamentally affect all economic decisions and the nature of any revenue generation program, the redistribution of revenue in the community and the willingness of individuals and governments to "pay" as well as the commitment of the three range state governments to collaborate.

1. We recommend that this concept of using gorillas as a symbol of true ecotourism globally should be presented to peak tourism bodies internationally but should be initiated jointly by the relevant Ministries in the range states and that a full campaign be developed by them (in 1998-99).

2. We recommend that the various formal and informal education networks, facilities listed be low be the start of a program of deliberate education on the values of gorilla conservation to a number of key target audiences including: international funding bodies, global public, national government bodies, corporate sectors within and outside the countries, tourists, ex-communities and the nationals (especially children) in each range state. The following lists key organizations on whose education programs we can "piggy back" (*those below reach primarily a Ugandan audience, similar organizations that provide outreach to Rwandans and Congolese should be contacted*.)
   - the East African Wildlife Society with its international membership,
   - the Uganda Wildlife Clubs with their strong national membership including families and schools throughout the country,
   - The Uganda Wildlife Education Center (UWEC, or better known as Entebbe Zoo) with an annual attendance projected at 250,000 by 2001 after reconstruction and consisting of 95% school children participating in formal education programs.

Should Mountain Gorillas Be Expected to Pay?

The assumption that conservation, especially mountain gorilla conservation, justify itself by generating sufficient revenue to meets its own costs and the costs of local community development was at the heart of our workshop. We saw this assumtion as fundamentally dangerous unless it embracesthe full range of revenue options and full considerationa of who should pay. This is an issue that should be debated at many levels and in many forums. This issue should be used to stimulate thinking about the value of ecosystem conservation and the benefits to the community both locally, regionally and globally.

The issue of whether or not gorillas should pay their own way allows us to also look at why we expect conservation in general to compete with other pressures for resource use. It begs the question as to why conservation is seen to complete successfully only if it generates revenue ('cash in hand'). Instead we need to consider the multitude of other ways in which the gorilla may benefit (or pay back) the community for caring for their habitat -- both monetary and nonmonetary. We need to emphasize such benefits as maintenance of clean water in a protected catchment that result fromhabitat protection, maintenance of a biological reservoir as a future resource, stabilization of local climate and the ability of natural systems to compensate for greenhouse gas emissions caused by other developments.

On the other hand, we believe that conservation needs to hold a strong competitive position among land use planners and decision makers and must be adept at putting the case for conservation effectively. It will not operate on sentiment alone. For this reason a full cost-benefit analysis would be useful and would provide a model for use elsewhere.

The working group for Revenue, Finance and Economics brainstormed on these issues for some time. We tried to arugments for and against the proposition that "gorillas should pay for their own conservation. Some of our thoughts are listed below:

Gorillas should pay because:

- their "existence value" is too high a direct cost to local people, therefore, they must fund themselves
- if they don't pay their way, other land pressures will remove their habitat
- their conservation is the best land use activity in the sense of economic return (it returns more than agriculture)
- associated revenues enable them to compete in most economic decision-making
- if we give them conservation priority, we must ensure their costs are budgeted for adequately and the cash found: gorillas are in themselves a source of funds through tourism.

Gorillas should not pay because:

- they have a right to live and to hold their own as part of the world ecosystem
- the gorilla's existence value is high to the global community
- people are concerned at man's impact including species extinction, which means we must conserve entire ecosystems
- their close relationship to man imposes a special obligation on us to conserve them
- they are an icon for conservation in an ecosystem that provides many other services to local and global communities

<u>Recommendations</u>

The mountain gorilla is a special case, and the group recommends that:

- gorilla conservation should definitely **not** have to meet narrow interpretations of financial self-sufficiency
- a cost benefit analysis is done to lay out all the benefits [financial and nonfinancial] of gorilla conservation, including the world's willingness to pay for their survival
- that the mountain gorilla as a special case should be **incorporated into formal and informal education** at all levels to demonstrate the broadest values of species and habitat

conservation.

Appendix 7-1:
General Threats to Revenue and Financing

L'equipe chargee d'analyser les revenues (recettes) , l'economie et les bene fices que peuvent procurer la conservation des gorilles et de leur habitat a remarque que plusieurs facteurs se conjuguent pour freiner ou menacer l'entree des recettes. Les plus importantes sont:

1. La guerre et l'insecurite qui provoquent enentiellement
   - la perte ou baisse du tourisme (perte des revenues)
   - blocage de l'acces a la foret
   - la baisse en nombre des populations des gorilles provoquee par la guerre, manque de controle et des suivis des gorilles: les gorilles ont ete pris entre les feux de tirs des militaires.

2. L'absence d'une politique effective pour les recettes; une partie des recettes du parc va vers le tresor public et le parc generateur se retrouve sans moyen de functionnement. Ceci occasionne:
   - le non paiement des salaires ou primes aux gardes
   - le staff du parc est peu motive et facilement corruptible
   - parc est peu controle et la population des gorilles peu surveille

3. Pression due a la pauvrete et a la surpopulation.
   - pression sur les resources du parc d'ou leur destruction (land encroachment)
   - antagonistes de la communatues vis a vis du tourisme et des gardes qui affichent souvent des attitudes policieres ou mefiantes envers la population locale.
   - convoitise pour les gorilles, leur habitat et tentatives a collaborer avec des marchands de jeunes gorilles (8 gorilles ont trouve la mort dans cette partique en 1995 en Uganda et au Congo)

4. L'absence d'une cooperation internationale au niveau de trois pays ou se trouvent les habitats des gorilles
5. mauvaise coordinatio des efforts pour la conservation au niveau des agences, ONGI---
6. Insuffisane d'un programme de suivi de l'etat de sante des gorilles en milieu naturel.

<u>Conclusion</u>
Ce situation provoquent la baisse des gorilles et la diminution de leurs habitats, ce qui joue negativement sur la viabilite de ceux-ci par la perte de controle par les institutions chargees de la conservation, la baisse des revenue.

Recommandations

Les recommandations ci-desous sont formulees dans le but principal de promouvoir la viabilite des gorilles et de leurs habitats tout en assurant la promotion des revenues.

1. Il faudra soustraire le secteur a gorilles aux manoeuvres militaires et inciter une collaboration internationales militaires pour soustraire tous les irreguliers du parc.
   - Cette responsabilite incombe aux gouvernements de trois pays et la communaute Internationale.
   - Les ONGI ont le devoir d'inciter les gouvernments respectifs et la communaute internationnale a agir le plus rapidement possible ----- Mars 1998 si possible.

2. Les ministeres ayant en charge l'economie, les finances, la conservation-tourisme et la reconstruction devront s'accorder pour laisser les recettes au niveau du parc en vue d'assurer la paie des salaires, le bon fonctionnement des institutions, la rehabilitation des infrastructures.
   - Les ONGI chargees de la conservatin devront formuler des recommandations a l'intention de ces cadres du gouvernement --- Juin 1998

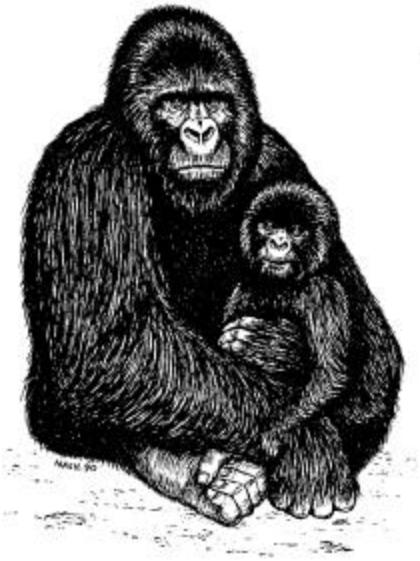
3. La developpemement des lois et sur la conservation en vue de rendre effectif le partage des revenues avec les populatios locales en bordure du parc et assurer une meilleur collaboration entre parc et population.
   - Direction generale du Parc - ICCN/ORTPN - staff du parc avec assistance des ONGI --- Juin 1998 (Note: en Uganda,les strategies de partage des revenues ont ete recemment revisees).

4. L'harmonisation des lois, tarifs sur le tourisme aux gorilles de Montagne.
   - ministeres du tourisme pour les 3 pays ---- Jui 1998
   - ONGI chargees de conservation des gorilles pour incitation -- Mars 1998

5. Prendre soins de l'etat de sante des gorilles en milieu naturel.

Quelques unes de ces idees seront exploitees largement par les autres groupes de travail.

Population and Habitat Viability Assessment
For *Gorilla gorilla beringei*



8 – 12 December 1997
Kampala, Uganda

Section

List of Workshop Participants

9

MOUNTAIN GORILLA POPULATION & HABITAT VIABILITY ANALYSIS PARTICIPANTS - ADDRESS LIST

Dr. Eve ABE
Projects Coordinator
Project Coordinating Unit - Ministry of Tourism Wildlife & Antiquities
PO Box 21957, Kampala UGANDA
Tel: 256-41-233562
Fax: 256-41-234054
email: abe@imul.com

Lilly AJAROVA
Visitor Services Coordinator
UGANDA WILDLIFE AUTHORITY
PO Box 3530, Kampala UGANDA
Tel: 256-41-346288/346287
Fax: 256-41-346291
email: sab@starcom.co.ug

Grant ANDERSON
Camp Director, Gorilla Forest Camp, Bwindi
Abercrombie & Kent Ltd.
PO Box 7799, Kampala UGANDA
Tel: 256-41-266700
Fax: 256-41-266701
email: mbifct@imul.com

Dennis BABAASA
Research Fellow
Makerere University / Dutch Zoos' Lion Project
PO Box 7062, Kampala UGANDA
Tel: c/o MUIENR 256-41-53013 5
Fax: c/o MUIENR 256-41-530134

Jean BIZIMANA
Chef de Service, Parcs Nationaux ORTPN - RWANDA
National Representative, IGCP - RWANDA
BP 905, Kigali RWANDA
Tel: 250-76514
Fax: 250-76512

Alexis BYAMANA
Director, AREDI
Association Rwandais pour l'Environment et Developpement Integre
BP 923, Kigali RWANDA
Tel / Fax: c/o DFGF-Europe - Rwanda 250-76006

Onnie BYERS
Programme Officer
CONSERVATION BREEDING SPECIALIST GROUP
12101 Johnny Cake Ridge Road, Apple Valley, MN 55124-8151 USA
Tel: 1-612-431-9325
Fax: 1-612-432-2757
email: cbsg@epx.cis.umn.edu

Dr. Ken CAMERON
Director
MOUNTAIN GORILLA VETERINARY CENTER - RWANDA
BP 1321 Kigali RWANDA
Tel: 250-74315
Fax: 250-74315
gorvetctr@aol.com

Steve CAVELL
Trust Administrator - MBIFCT
Mgahinga Bwindi Impenetrable Forest Conservation Trust
PO Box 1064, Kabale UGANDA
Tel: 256-486-24120
Fax: 256-486-24122
email: mbifct@imul.com

Brooke CHARLES
Conservation Projects Officer
Zoological Parks Board of New South Wales
PO Box 20, Mosman, NSW 2023 AUSTRALIA
Tel: 61-2-99784711
Fax: 61-2-99784502
email: bcharles@zoo.nsw.gov.au

Prof. John COOPER
Independent Veterinary Pathologist
Former Director, Volcano Veterinary Centre, RWANDA
Wildlife Health Services, PO Box 153, Wellingborough, NN8 22A, UK
Tel / Fax: 44-1933-228560
email: jecooper@jwpt.org

Margaret COOPER
Representative
Universities Federation for Animal Welfare
Wildlife Health Services, PO Box 153, Wellingborough, NN8 22A, UK
Tel / Fax: 44-1933-228560

Deby COX
Regional Technical Director
Jane Goodall Institute
PO Box 4187, Kampala UGANDA
Tel: 256-42-20520
Fax: 256-42-20073
email: chmpldy@imul.com

Nancy CZEKALA
Center for Reproduction of Endangered Species
SAN DIEGO ZOOLOGICAL SOCIETY
PO Box 551, San Diego, CA 92112 USA
Tel: 1-619-557-3942
Fax: 1-619-557-3959
email: czekala@sunstroke.sdsu.edu

Dr. Margaret DRICIRU
Researcher
Makerere University - Dutch Zoos Lion Project
c/o PO Box 8885, Kampala UGANDA
email: Lkoma@starcom.co.ug

Jeff DU-PAIN
Project Manager, Bonobo-in-Situ
Royal Zoological Society of Antwerp
G. Gezellelaan 110 B-2640, Mortsel, BELGIUM
Tel: 32-3-2024579
Fax: 32-3-2024547
email: bonobo@uia.ua.ac.be

Dr. Jim ELSE
EU Policy and Planning Advisor
Ministry of Tourism Wildlife and Antiquities
Project Coordination Unit, PO Box 221957, Kampala UGANDA
Tel: 256-41-233562
Fax: 256-41-234054
email: jelse@imul.com

Annabel FALCON
IGCP Regional Programme Officer
International Gorilla Conservation Programme
PO Box 10950, Kampala UGANDA
Tel: 256-41-344510
Fax: 256-41-257945
email: awfccuwa@imul.com or igcp@imul.com

Philip FRANKS
Project Manager, Development through Conservation Project
CARE - UGANDA
PO Box 702, Kabale UGANDA
Tel: 256-486-23518
Fax: 256-486-22307
email: carekba@imul.com

Takeshi FURICHI
Researcher - Kalinzu Forest - UGANDA

Dr. Netzin GERALD-STEKLIS
Director, Scientific Information Resource Center
DFGF- INTERNATIONAL
Dept. of Anthropology, Rutgers Universtiy, Box 270, New Brunswick, NJ, 08903-0270 USA
Tel: 1-520-455-9257
Fax: 1-520-455-5892
email: science@gorillafund.org

Dr. Michele GOLDSMITH
McKennan Post-Doc of Anthopology / Gorilla - Chimpanzee Study Bwindi Dartmouth College
Department of Anthropology, Dartmouth College, Hanover, NH 03255-3570 USA
Tel: 1-603-646-3436
Fax: 1-603-646-2810
email: michele.goldsmith@dartmouth.edu

Maryke GRAY
Monitoring Coordinator
Institute for Tropical Forest Conservation
PO Box 44, Kabale UGANDA
Tel: c/o Bwindi Trust 256-486-24120
Fax: c/o Bwindi Trust 256-486-24122
email: mbifct@imul.com

Chie HASHIMOTO
Researcher - Kalinzu Forest - UGANDA
OBSERVER

Jim HOLDEN
Regional Managing Director
Abercrombie & Kent, East Africa
PO Box 59749, Nairobi Kenya
Tel: 254-2-334955
Fax: 254-2-215752

Charlene JENDRY
Partners In Conservation
COLUMBUS ZOO
PO Box 400, Columbus , OH 43065 USA
Tel: 1-614-645-3465
email: charjend@aol.com

KAKULE Vwirasihikya
Conservateur Principal - Parc National des Virunga Sud
INSTITUT CONGOLAIS POUR LA CONSERVATION DE LA NATURE - CONGO
Parc National des Virunga, Station Rumangabo
BP 106, Goma D.R.Congo
Tel: IGCP/ICCN Goma 871-683-026540
Fax: c/o IGCP-Congo: 871-683-026542

Dr. Gladys KALEMA
Veterinary Officer
UGANDA WILDLIFE AUTHORITY
PO Box 3530, Kampala UGANDA
Tel: 256-41-346288 / 346287
Fax: 256-41-346291 / 257539

Vital KATEMBO
DFGF-Congo Programme Manager
DIAN FOSSEY GORILLA FUND - EUROPE
BP 660 Goma
Tel: 243-064-8885727 (Telecel)
Fax: 377-93-107272
in care of osso: emcon10@hgfuas01.unicef.org

Annette LANJOUW
Regional Coordinator
INTERNATIONAL GORILLA CONSERVATION PROGRAMME
PO Box 48177, Nairobi KENYA
Tel: 254-2-710367
Faxl: 254-2-710372
email: Alanjouw@awfke.org

Dr. Liz MACFIE
Programme Manager, IGCP-Uganda
INTERNATIONAL GORILLA CONSERVATION PROGRAMME
PO Box 10950, Kampala UGANDA
Tel: 256-41-344510 / 235824
Kabale office: 256-486-23010
Fax: 256-41-257945 / 235824 Kabale office: 256-486-23010
email: igcp@imul.com

Dr. Richard MALENKY
Director, Institute for Tropical Forest Conservation
Mbarara University of Science and Technology, WWF
PO Box 44, Kabale UGANDA
Tel: c/o Bwindi Trust 256-486-24120
Fax: c/o Bwindi Trust 256-486-24122
email: mbifct@imul.com

Jeremy J.C. MALLINSON
Director
JERSEY WILDLIFE PRESERVATION TRUST
Les Augres Manor, Trinity, JERSEY JE3 5BP
Tel: 44-1534-864666
Fax: 44-1534-865161
email: Ldexecbusiness.co.uk

Dr. Alastair McNEILAGE
Researcher
Wildlife Conservation Society
Greenwood, Lochwinnoch Rd, Kilmalcolm, PA 13 4D2 UK
Tel: 44-1505-87-2821
Fax: 44-1505-87-2821
email: amcneilage@msn.com

Jillian MILLER
Director of Development
Dian Fossey Gorilla Fund - Europe
110 Gloucester Avenue, Primrose Avenue, Primrose Hill, London NW1 8JA UK
Tel: 44-171-916-4992
Fax: 44-171-722-0928
email: jilliandot@aol.com

Philip MILLER
Programme Officer
CONSERVATION BREEDING SPECIALIST GROUP
12101 Johnny Cake Ridge Road, Apple Valley, MN 55124-8151 USA
Tel: 1-612-431-9325
Fax: 1-612-432-2757
email: cbsg@epx.cis.umn.edu

Dr. Yakobo MOYINI
Acting Executive Director - Deputy Director, Planning Monitoring and Research
UGANDA WILDLIFE AUTHORITY
PO Box 3530, Kampala UGANDA
Tel: 256-41-346288 / 346287
Fax: 256-41-346291

Leonard MUBALAMA
Scientific Wildlife Officer - Sud Kivu
INSTITUT CONGOLAIS POUR LA CONSERVATION DE LA NATURE - CONGO
BP 852 Bukavu Democratic Republic of Congo

Dr. Antoine MUDAKIKWA
Co-Director
MOUNTAIN GORILLA VETERINARY CENTRE - RWANDA
BP 1321 Kigali RWANDA
Tel/Fax: 250-74315 email: gorvetctr@aol.com

Keith MUSANA
Warden-in-Charge, Bwindi Impenetrable National Park
UGANDA WILDLIFE AUTHORITY
PO Box 3530 Kampala UGANDA
Tel: 256-41-346288 / 346287 Kabale office - 256-486-24121
Fax: 256-41-346291 Kabale c/o CARE 256-486-22307

Norbert MUSHENZI
Provincial Director ICCN North Kivu
INSTITUT CONGOLAIS POUR LA CONSERVATION DE LA NATURE - CONGO
BP 106 Goma, DRCongo
c/o IGCP-Nairobi P.O. Box 48177 , Nairobi KENYA
Tel: c/o IGCP-Congo - 871-683-026540
Fax: c/o IGCP-Congo: 871-683-026542

Dr. Jean-Bosco NIZEYI
Field Assistant - MGVP Uganda
MOUNTAIN GORILLA VETERINARY PROJECT
Faculty of Veterinary Medicine, Makerere University, PO Box 7062, Kampala UGANDA
Tel: 256-41-534061 / 530065
Fax: 256-41-530412
email: mgvp@uga.healthnet.org

Michele ONISFOROU
51 Suttie Road, Double Bay NSW 2028 AUSTRALIA
Tel: 61-2-93271436

Dr. Andy PLUMPTRE
Assistant Director - Africa Program
The Wildlife Conservation Society
185th Street and Southern Boulevard, Bronx, NY 10460 USA
Tel: 1-718-220-7159
Fax: 1-718-364-4275
email: wcsafrica@compuserve.com

Johannes REFISCH
Researcher
BERGORILLA REGENWALD DIREKTHILFE
Albrecht-Durer Str. 4E, 9544 Bayreith, GERMANY
Tel: 49-921-83861
Fax: 49-921-83861
email: johannes.refisch@uni-bayreuth.de

Dr. Martha ROBBINS
Visiting Assistant Professor
Gustavus Adolphus COllege
Department of Biology, 800 W. College Drove, St Peter, MN 56082 USA
Tel: 1-507-933-7331
Fax: 1-507-933-6285
email: mrobbins@gac.edu

Norm ROSEN
Great Ape Programme Coordinator
CONSERVATION BREEDING SPECIALIST GROUP
27 16th Street, Hermosa Beach, CA 90254, CA USA
Tel: 1-310-318-3778
Fax: 1-310-798-0576
email: nrosen@cmp.com

Linda ROTHEN
Representative
Jane Goodall Institute
PO Box 4187, Kampala UGANDA
Tel: 256-41-341574
Fax: 256-41-236852
email: orothen@imul.com

Justin RURANGIRWA-NYAMPETA
Conservateur, Parc National des Volcans
ORTPN - RWANDA
BP 12, Ruhengeri (or BP 905, Kigali)
Tel: 250-46675 / 46575
FaxL 250-46645

RUTABINGWA, FRANK
Project Coordinator - Environment and Development
Ministere de l'Agriculture - RWANDA
BP 621 Kigali RWANDA
Tel: 250-77930
Fax: 250-76958

Eugene RUTAGARAMA
Director, IGCP-Rwanda
INTERNATIONAL GORILLA CONSERVATION PROGRAMME
PO Box 931, Kigali RWANDA
Tel: 250-83574
Fax: 250-83574

Dr. Oliver RYDER
Centre for Reproduction of Endangered Species
SAN DIEGO ZOOLOGICAL SOCIETY
PO Box 551 San Diego, CA 92112-0551 USA
Tel: 1-619-557-3950
Fax: 1-619-557-3958
email: oryder@ucsd.edu

Dr. Klaus SCHMITT
Technical Advisor
UWA Monitoring and Research - GTZ
PO Box 10346, Kampala UGANDA
Tel: 256-75-719127
Fax: 256-41-234685
email: gtzuwa@swiftuganda.com

Dr. Ulie SEAL
Chairman - CBSG
CONSERVATION BREEDING SPECIALIST GROUP
12101 Johnny Cake Ridge Road, Apple Valley, MN 55124-8151 USA
Tel: 1-612-431-9325
Fax: 1-612-432-2757
email: cbsg@epx.cis.umn.edu

Dr. David SHERMAN
Associate Professor and Head, Section of International Veterinary Medicine
Tufts University, School of Veterinary Medicine, Center for Conservation Medicine
200 Westboro Road, North Grafton, MA 01536 USA
Tel: 1-508-839-5302 x 4755
Fax: 1-508-839-7946
email: dsherman@opal.tufts.edu

Dr. Pascale SICOTTE
Dept. of Anthropology,
University of Calgary
2500 University Dr. NW, Calgary AB, T2N 1N4 CANADA
Tel: 1-403-284-5467
Fax: 1-403-220-6688
email: sicotte@ucalgary.ca

Claude SIKUBWABO
Chef de Service Scientifique et Technique - Nord Kivu
INSTITUT CONGOLAIS POUR LA CONSERVATION DE LA NATURE - CONGO
BP 660 Goma, Democratic Republic of Congo
Tel: Local Telecel: 8885203, 8885020.
International: 243-664-8885727
Fax: 377-93-107272

Dr. Jonathan SLEEMAN
Interim Director
Mountain Gorilla Veterinary Project, Morris Animal Foundation
Colorado Statue University, 300 West Drake Road, Ft. Collins, CO 80523-1620
Tel: 1-970-491-1210
Fax: 1-970-491-1205

Dr. Mark STANLEY PRICE
Chairman, Reintroduction Specialist Group
Director of African Operations, African Wildlife Foundation
PO Box 48177, Nairobi KENYA
Tel: 254-2-710367
Fax: 254-2-710372
email: Mstanleyprice@awfke.org

Dr. Dieter STEKLIS
Chief Director, International Science and Conservation Programme
DFGF - International
Department of Anthropology, Rutgers University, PO Box 270, New Brunswick, NJ 08903-0270 USA
Tel: 1-520-455-9257
Fax: 1-520-455-5892
email: science@gorillafund.org

Dr. Gary TABOR
Executive Director
Center for Conservation Medicine
Tufts University, 200 Westboro Road, N. Grafton, MASS 01536
Tel: 1-508-839-5302 Ext. 4763
email: taborgm@aol.com

Dr. Nancy THOMPSON-HANDLER
Representative, Foundation for Wildlife Conservation
Zoological Society of Milwaukee
Institute for Tropical Forest Conservation
PO Box 44, Kabale Uganda
Tel: c/o Bwindi Trust 256-486-24120
Fax: c/o Bwindi Trust 256-486-24122
email: mbifct@imul.com

Dr. Amy VEDDER
Director - Africa Program
The Wildlife Conservation Society
185th Street and Southern Boulevard, Bronx, NY 10460 USA
Tel: 1-718-220-7159
Fax: 1-718-364-4275
email: wcsafrica@compuserve.com

Popol VERHOESTRAETE
Project Officer, IGCP-Congo
INTERNATIONAL GORILLA CONSERVATION PROGRAMME
c/o ICCN-Goma BP 106 Goma, DRCongo
Tel: 871-684-026540 mobile - 243-88-85333
Fax: ICCN / IGCP-Congo: 871-683-026542
Emmanuel WERABE
Directeur du Tourisme
Ministere de l'Artisanat, des Mines, et du Tourisme
BP 2378, Kigali RWANDA
Tel: 250-72093 / 72059

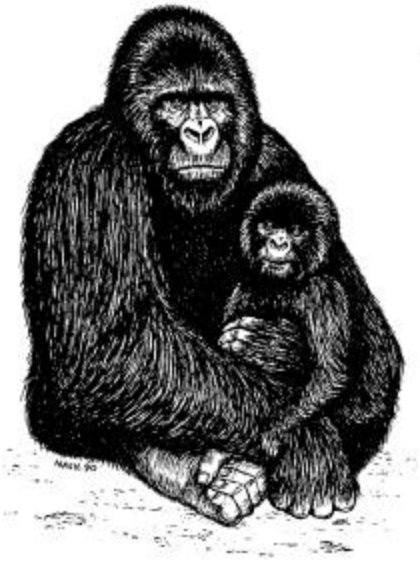
Samson WERIKHE
Research and EIA Coordinator UGANDA WILDLIFE AUTHORITY
National Representative, INTERNATIONAL GORILLA CONSERVATION PROGRAMME
PO Box 3530, Kampala, UGANDA
Tel: 256-41-346287 / 346288
Fax: 256-41-346291
email: pcu@imul.com

Dr. Frances WESTLEY
Associate Professor of Strategy, McGill University
CONSERVATION BREEDING SPECIALIST GROUP
Faculty of Management, McGill University, 1001 Sherbrooke Steet West, Montreal, QUEBEC H3A 1G5, CANADA
Tel: 1-514-398-4042
Fax: 1-514-398-3876
email: westley@management.mcgill.ca

Dr. Liz WILLIAMSON
Director, Karisoke Research Centre
Dian Fossey Gorilla Fund - RWANDA
BP 1321, Kigali RWANDA
Tel: 250-74315
Fax: 250-76541 Mille Collines Hotel
email: DFGF-RWANDA@maf.org

Dr. Dedee WOODSIDE
Director, Environmental Programs & Education and Australian Conservation Training Institute (ACTI)
New South Wales Parks Board / Australian Conservation Training Institute
POBox 20, Mosman, NSW 2088 Australia
Tel: 61-2-9978 4636 or 61-2-9969 2777
Fax: 61-2-9978-4502
email: dwoodside@zoo.nsw.gov.au

Population and Habitat Viability Assessment
For *Gorilla gorilla beringei*



8 – 12 December 1997
Kampala, Uganda

Section

Selected Gorilla Bibliography

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Selected Gorilla Bibliography

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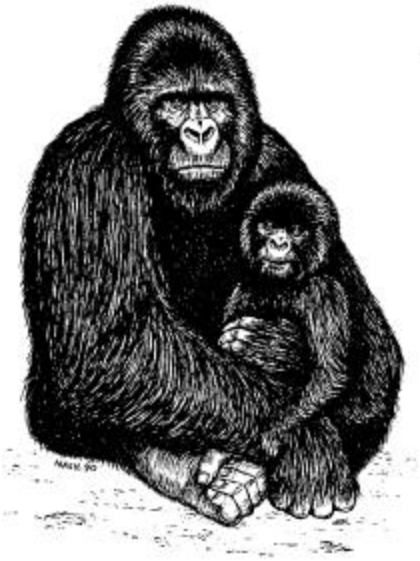
Population and Habitat Viability Assessment
For *Gorilla gorilla beringei*



8 – 12 December 1997
Kampala, Uganda

Section

IUCN Guidelines

11

IUCN GUIDELINES FOR THE PLACEMENT OF CONFISCATED LIVE ANIMALS[1]

Statement of Principle:

When live animals are confiscated by government authorities, these authorities have a responsibility to dispose of them appropriately. Within the confines of national and international law, the ultimate on disposition of confiscated animals must achieve three goals: 1) to maximise conservation value of the specimens without in any way endangering the health, behavioral repertoire, genetic characteristics, or conservation status of wild or captive populations of the species[1]; 2) to discourage further illegal or irregular[2] trade in the species; and 3) to provide a humane solution, whether this involves maintaining the animals in captivity, returning them to the wild, or employing euthanasia to destroy them.

Statement of Need:

Increased regulation of trade in wild plants and animals and enforcement of these regulations has resulted in an increase in the number of wildlife shipments intercepted by government authorities as a result of non-compliance with these regulations. In some instances, the interception is a result of patently illegal trade; in others, it is in response to other irregularities. While in some cases the number of animals in a confiscated shipment is small, in many others the number is in the hundreds. Although in many countries confiscated animals have usually been donated to zoos and aquaria, this option is proving less viable with large numbers of animals and, increasingly, for common species. The international zoo community has recognized that placing animals of low conservation priority in limited cage space may benefit those individuals but may also detract from conservation efforts as a whole. They are, therefore, setting conservation priorities for cage space (IUDZG/CBSG 1993).

With improved interdiction of the illegal trade in animals there is an increasing demand for information to guide confiscating agencies in the disposal of specimens. This need has been reflected in the formulation of specific guidelines for several groups of organisms such as parrots (Birdlife International in prep) and primates (Harcourt in litt.). However, no general guidelines exists.

In light of these trends, there is an increasing demand - and urgent need - for information and advice to guide confiscating authorities in the disposition of live animals. Although specific guidelines have been formulated for certain groups of organisms, such as parrots (Birdlife International in prep.) and primates (Harcourt 1987), no general guidelines exist.

[1] Although this document refers to species, in the case of species with well-defined subspecies and races, the issues addressed will apply to lower taxonomic units.

When disposing of confiscated animals, authorities must adhere to both national and international law. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) requires that confiscated individuals of species listed on the treaty's Appendices be returned to the "state of export . . . or to a rescue centre or such other place as the Management Authority deems appropriate and consistent with the purpose of the Convention." (Article VIII). However the treaty does not elaborate on this requirement, and CITES Management Authorities must act according to their own interpretation, not only with respect to repatriation but also as regards what constitutes disposition that is "appropriate and consistent" with the treaty. Although the present guidelines are intended to assist CITES Management Authorities in making this assessment, they are designed to be of general applicability to all confiscated live animals.

The lack of specific guidelines has resulted in confiscated animals being disposed of in a variety of ways. In some cases, release of confiscated animals into existing wild populations has been made after careful evaluation and with due regard for existing guidelines (IUCN 1987, IUCN 1995). In other cases, such releases have not been well planned and have been inconsistent with general conservation objectives and humane considerations, such as releasing animals in inappropriate habitat, dooming these individuals to starvation or certain death from other causes against which the animals are not equipped or adapted. Such releases may also have strong negative conservation value by threatening existing wild populations as a result of: 1) diseases and parasites acquired by the released animals while in captivity spreading into existing wild populations; 2) individuals released into existing populations, ro in areas near to existing populations, not being of the same race or sub-species as those in the wild population, resulting in mixing of distinct genetic lineages; 3) animals held in captivity, particularly juveniles and immatures, acquiring an inappropriate behavioral repertoire from individuals of other species, and/or either losing certain behaviors, or not developing the full behavioral repertoire, necessary for survival in the wild. Also, it is possible that release of these animals could result in inter-specific hybridisation.

Disposition of confiscated animals is not a simple process. Only on rare occasions will the optimum course to take be clear-cut or result in an action of conservation value. Options for the disposition of confiscated animals have thus far been influenced by the public's perception that returning animals to the wild is the optimal solution in terms of both animals welfare and conservation. A growing body of scientific study of re-introduction of captive animals suggests that such actions may be among the least appropriate options for many reasons. This recognition requires that the options available to confiscating authorities for disposition be carefully reviewed.

Management Options:

In deciding on the disposition of confiscated animals, priority must be given to the well-being and conservation of existing wild populations of the species involved, with all efforts made to ensure the humane treatment of the confiscated individuals. Options for disposition fall into three principal categories: 1) maintenance of the individual(s) in captivity; 2) returning the individual(s) in question to the wild; and 3) euthanasia.

Within a conservation perspective, by far the most important consideration in reviewing the options for disposition is the conservation status of the species concerned. Where the confiscated animals represent an endangered or threatened species, particular effort should be directed towards evaluating whether and how these animals might contribute to a conservation programme for the species. The decision as to which option to employ in the disposition of confiscated animals will depend on various legal, social, economic and biological factors. The "Decision Tree"[1] provided in the present guidelines is intended to facilitate consideration of these options. The tree has been written so that it may be used for both threatened and common species. However, it recognizes that the conservation status of the species will be the primary consideration affecting the options available for placement, particularly as the expense and difficulty of returning animals to the wild (see below) will often only be justified for threatened species. International networks of experts, such as the IUCN-Species Survival Commission Specialist Groups, should be able to assist confiscating authorities, and CITES Scientific and Management Authorities, in their deliberations as to the appropriate disposition of confiscated specimens.

Sending animals back automatically to the country from which they were shipped, the country in which they originated (if different), or another country m which the species exists, does not solve any problems. Repatriation to avoid addressing the question of disposition of confiscated animals is irresponsible as the authorities in these countries will face the same issues concerning placement as the authorities in the original confiscating country.

OPTION 1-- CAPTIVITY

Confiscated animals are already in captivity; there are numerous options for maintaining them in captivity. Depending on the circumstances, animals can be donated, loaned, or sold. Placement may be in zoos or other facilities, or with private individuals. Finally, placement may be either in the country of origin, the country of export (if different), the country of confiscation. or in a country with adequate and/or specialised facilities for the species in question. If animals are maintained in captivity, in preference to either being returned to the wild or euthanized, they must be afforded humane conditions and ensured proper care for their natural lives.

Zoos and aquaria are the captive facilities most commonly considered for disposition of animals, but a variety of captive situations exist where the primary aim of the institution or individuals involved is not the propagation and resale of wildlife. These include:

Rescue centres, established specifically to treat injured or confiscated animals, are sponsored by a number of humane organisations in many countries.

Life-time care facilities devoted to the care of confiscated animals have been built in a few countries.

Specialist societies or clubs devoted to the study and care of single taxa or species(e.g., reptiles, amphibians, birds) have, in some instances, provided an avenue for the disposition of confiscated animals without involving sale through intermediaries.

Placement may be made directly to these organisations or to individuals who are members.

Humane Societies may be willing to ensure placement of confiscated specimens with private individuals who can provide humane life-time care.

Research laboratories (either commercial or non-commercial, e.g. universities) maintain collections of exotic animals for many kinds of research (e.g. behavioural, ecological, physiological, psychological, medical). Attitudes towards vivisection, or even towards the non-invasive use of animals in research laboratories as captive study populations, vary widely from country to country. Whether transfer of confiscated animals to research institutions is appropriate will therefore engender some debate. However, it should be noted that transfer to facilities involved in research conducted under humane conditions may offer an alternative -- and one which may eventually contribute information relevant to the species' conservation. In many cases, the lack of known provenance and the risk that the animal in question has been exposed to unknown pathogens will make transfer to a research institution an option that will be rarely exercised or desired.

CAPTIVITY - Sale, Loan or Donation

Animals can be placed with an institution or individual in a number of ways. It is critical, however. that two issues be separated: the ownership of the animals and/or their progeny, and the payment of a fee by the institution/individual receiving the animals. Paying the confiscating authority, or the country of origin, does not necessarily give the person or institution making the payment any rights (these may rest with the confiscating authority). Similarly, ownership of an animal can be transferred without payment. Confiscating authorities and individuals or organizations participating in the placement of confiscated specimens must clarify ownership. both of the specimens being transferred and their progeny. Laws dictating right of ownership of wildlife differ between nations, in some countries ownership remains with the government, in others the owner of the land inhabited by the wildlife has automatic rights over the animals.

When drawing up the terms of transfer many items must be considered, including:

-- ownership of both the animals involved and their offspring (dictated by national law) must be specified as one of the terms and conditions of the transfer (it may be necessary to insist there is no breeding for particular species, e.g. primates). Either the country of origin or the country of confiscation may wish to retain ownership of the animals and/or their progeny. Unless specific legal provisions apply, it is impossible to assure the welfare of the animals following a sale which includes a transfer of ownership.

-- sale or payment of a fee to obtain certain rights (e.g. ownership of offspring) can provide a means of placement that helps offset the costs of confiscation.

--sale and transfer of ownership should only be considered in certain circumstances, such as where the animals in question are not threatened and not subject to a legal proscription on trade (e.g., CITES Appendix I) and there is no risk of stimulating further illegal or irregular trade.

--sale to commercial captive breeders may contribute to reducing the demand for wild-caught individuals.

--sale may risk creating a public perception of the confiscating State perpetuating or benefitting from illegal or irregular trade.

--if ownership is transferred to an organization to achieve a welfare or conservation goal, the confiscating authority should stipulate what will happen to the specimens should the organization wish to sell/transfer the specimens to another organization or individual.

--confiscating authorities should be prepared to make public the conditions under which confiscated animals have been transferred and, where applicable, the basis for any payments involved.

CAPTIVITY-- **Benefits**

The benefits of placing confiscated animals in a facility that will provide life-time care under humane conditions include;

a) educational value;
b) potential for captive breeding for eventual re-introduction;
c) possibility for the confiscating authority to recoup from sale costs of confiscation;
d) potential for captive bred individuals to replace wild-caught animals as a source for trade.

CAPTIVITY- **Concerns**

The concerns raised by placing animals in captivity include:

A) **Disease.** Confiscated animals may serve as vectors for disease. The potential consequences of the introduction of alien disease to a captive facility are more serious than those of introducing disease to wild populations (see discussion page 9); captive conditions might encourage disease spread to not only conspecifics. As many diseases can not be screened for, even the strictest quarantine and most extensive screening for disease can not ensure that an animal is disease free. Where quarantine cannot adequately ensure that an individual is disease free, isolation for an indefinite period, or euthanasia, must be carried out.

B) **Escape**. Captive animals maintained outside their range can escape from captivity and become pests. Accidental introduction of exotic species can cause tremendous damage and in certain cases, such as the escape of mink from fur farms in the United

Kingdom, the introduction of exotics can result from importation of animals for captive rearing.

C) **Cost of Placement**. While any payment wi11 place a value on an animal, there is little evidence that trade would be encouraged if the institution receiving a donation of confiscated animals were to reimburse the confiscating authority for costs of care and transportation. However, payments should be explicitly for reimbursement of costs of confiscation and care, and, where possible, the facility receiving the animals should bear all such costs directly.

D) **Potential to Encourage Undesired Trade**. Some (e.g., Harcourt 1987) have maintained that any transfer - whether commercial or non-commercial - of confiscated animals risks promoting a market for these species aud creating a perception of the confiscating state being involved in illegal or irregular trade.

Birdlife International (in prep.) suggests that in certain circumstances sale of confiscated animals does not necessarily promote undesired trade. They offer the following requirements that must be met for permissible sale by the confiscating authority: I) the species to be sold is already available for sale legally in the confiscating country in commercial quantities; and 2) wildlife traders under indictment for; or convicted of, crimes related to import of wildlife are prevented from purchasing the animals in question. However, experience in selling confiscated animals in the USA suggests that it is virtually impossible to ensure that commercial dealers suspected or implicated in illegal or irregular trade are excluded, directly or indirectly, in purchasing confiscated animals.

In certain circumstances sale or loan to commercial captive breeders may have a clearer potential for the conservation of the species, or welfare of the individuals, than non-commercial disposition or euthanasia. However, such breeding programmes must be carefully assessed as it may be difficult to determine the effects of these programmes on wild populations.

OPTION 2-- RETURN TO THE WILD

These guidelines suggest that return to the wild would be a desirable option in only a very small number of instances and under very specific circumstances. The rationale behind many of the decision options iii this section are discussed in greater detail in the IUCN Re-introduction Guidelines (IUCN/SSC RSG 1995) which, it is important to note, make a clear distinction between the different options for returning animals to the wild. These are elaborated below.

I) **Re-introduction**: an attempt to establish a population in an area that was once part of the range of the species but from which it has become extirpated.
Some of the best known re-introductions have been of species that had become extinct in the wild. Examples include: Pere David's deer (*Elaphurus davidanus*) and the Arabian oryx (*Oryx leucoryx*.). Other re-introduction programmes have involved species that exist

in some parts of their historical range but have been eliminated from other areas; the aim of these programmes is to re-establish a population in all area, or region, from which the species has disappeared. An example of this type of r~introduction is the recent re-introduction of the swift fox (*Vulpes velox*) in Canada.

2) **Reinforcement of an Existing Population**: the addition of individuals to all existing population of the same taxon.

Reinforcement can be a powerful conservation tool when natural populations are diminished by a process which, at least in theory, can be reversed. An example of a successful reinforcement project is the golden lion tamarin *(Leontopithecus rosalia*) project in Brazil. Habitat loss, coupled with capture of live animals for pets, resulted in a rapid decline of the golden lion tamarin. when reserves were expanded, and capture for the pet trade curbed, captive-bred golden lion tamarins were then used to supplement depleted wild populations.

Reinforcement has been most commonly pursued when individual animals injured by human activity have been provided with veterinary care and released. Such activities are common in many western countries, and specific programmes exist for species as diverse as hedgehogs and birds of prey. However common an activity, reinforcement carries with it the very grave risk that individuals held in captivity, even temporarily, are potential vectors for the introduction of disease into wild populations.

Because of inherent disease risks and potential behavioural abnormalities, reinforcement should only be employed in instances where there is a direct and measurable conservation benefit (demographically and/or genetically, and/or to enhance conservation in the public's eye), for example when reinforcement will significantly add to the viability of the wild population into which an individual is being placed.

3) **Conservation Introductions:** (also referred to as Beneficial or Benign Introductions - IUCN 1995): an attempt to establish a species, for the purpose of conservation, outside its recorded distribution but within a suitable habitat in which a population can be established without predicted detriment to native species.

Extensive use of conservation introductions has been made in New Zealand, where endangered birds have been transferred to off-shore islands that were adjacent to, but not part of the animals' original range. Conservation introductions can also be a component of a larger programme of re-introduction, an example being the breeding of red wolves on islands outside their natural range and subsequent transfer to mainland range areas (Smith1990).

RETURN TO THE WILD - CONCERNS

Before return to the wild of confiscated animals is considered, several issues of concern must be considered in general terms; welfare, conservation value, cost, and disease.

a) **Welfare**. While some consider return to the wild to be humane, ill-conceived projects may return animals to the wild which then die from starvation or suffer an inability to adapt to an unfamiliar or inappropriate environment. This is not humane. Humane considerations require that each effort to return confiscated animals to the wild be thoroughly researched and carefully planned. Such returns also require long-term commitment in terms of monitoring the fate of released individuals. Some (e.g., International Academy of Animal Welfare Sciences 1992) have advocated that the survival prospects for released animals must at least approximate those of wild animals of the same sex and age class in order for return to the wild to be seriously considered. While such demographic data on wild populations are, unfortunately, rarely available, the spirit of this suggestion should be respected -- there must be humane treatment of confiscated animals when attempting to return them to the wild.

b) **Conservation Value And Cost**. In cases where returning confiscated animals to the wild appears to be the most humane option, such action can only be undertaken if it does not threaten existing populations of conspecifics or populations of other interacting species, or the ecological integrity of the area in which they live. The conservation of the species as a whole, and of other animals already living free, must take precedent over the welfare of individual animals that are already in captivity.

Before animals are used in programmes in which existing populations are reinforced, or new populations are established, it must be determined that returning these individuals to the wild will make a significant contribution to the conservation of the species, or populations of other interacting species. Based solely on demographic considerations, large populations are less likely to go extinct, and therefore reinforcing existing very small wild populations may reduce the probability of extinction. In very small populations a lack of males or females may result in reduced population growth or population decline and, therefore, reinforcing a very small population lacking animals of a particular sex may also improve prospects for survival of that population. However, genetic and behavioural considerations, as well as the possibility of disease introduction, also play a fundamental role in determining the long term survival of a population.

The cost of returning animals to the wild in an appropriate manner can be prohibitive for all but the most endangered species (Stanley Price 1989; Seal et al. 1989). The species for which the conservation benefits clearly outweigh these costs represent a tiny proportion of the species which might, potentially, be confiscated In the majority of cases, the costs of appropriate, responsible (re)introduction will preclude return to the wild. Poorly planned or executed (re)introduction programmes are no better than dumping animals in the wild and should be vigorously opposed on both conservation and humane grounds.

c) **Founders And Numbers Required**. Most re-introductions require large numbers of founders, usually released in smaller groups over a period of time. Hence, small groups of confiscated animals may be inappropriate for re-introduction programmes, and even larger groups will require careful management if they are to have any conservation value for re-introduction programmes. In reality, confiscated specimens will most often only be

of potential value for reinforcing an existing population, despite the many potential problems this will entail.

c) **Source of Individuals**. If the precise provenance of the animals is not known (they may be from several different provenances), or if there is any question of the source of animals, supplementation may lead to inadvertent pollution of distinct genetic races or sub~species. If particular local races or sub-species show specific adaptation to their local environments mixing in individuals from other races or sub-species may be damaging to the local population. Introducing an individual or individuals into the wrong habitat type may also doom that individual to death.

a) **Disease**. Animals held in captivity and/or transported, even for a very short time, may be exposed to a variety of pathogens. Release of these animals to the wild may result in introduction of disease to con-specifics or unrelated species with potentially catastrophic effects. Even if there is a very small risk that confiscated animals have been infected by exotic pathogens, the potential effects of introduced diseases on wild populations are so great that this will often prevent returning confiscated animals to the wild (Woodford and Rossiter 1993, papers in *J Zoo and Wildlife Medicine* 24(3), 1993).

Release of any animal into the wild which has been held in captivity is risky. Animals held in captivity are more likely to acquire diseases and parasites. While some of these diseases can be tested for, tests do not exist for many animal diseases. Furthermore, animals held in captivity are frequently exposed to diseases not usually encountered in their natural habitat. Veterinarians and quarantine officers, taking that the species in question is only susceptible to certain diseases, may not test for the diseases picked up in captivity. It should be assumed that all diseases are potentially contagious.

Given that any release incurs some risk, the following "precautionary principle" must be adopted: *if there is no conservation value in releasing confiscated specimens, the possibility of accidentally introducing a disease, or behavioural and genetic aberrations into the environment which are not already present, however unlikely, may rule out returning confiscated specimens to the wild as a placement option.*

RETURN TO THE WILD: BENEFITS

There are several benefits of returning animals to the wild, either through re-introduction for the establishment of a new population or reinforcement of an existing population.
a) **Threatened Populations**: In situations where the existing population is severely threatened, such an action might improve the long-term conservation potential of the species as a whole, or of a local population of the species (e.g., golden lion tamarins).

b) **Public Statement**: Returning animals to the wild makes a strong political/educational statement concerning the fate of animals (e.g., orangutans (*Pongo*

pygmaeus) and chimpanzees *(Pan troglodytes*) - Aveling & Mitchell 1982, but see Rijksen & Rijksen-Graatsma 1979) and may serve to promote local conservation values. However, as part of any education or public awareness programmes, the costs and difficulties associated with the return to the wild must be emphasized.

OPTION 3- EUTHANASIA

Euthanasia: the killing of animals carried out according to humane guidelines -- is unlikely to be a popular option amongst confiscating authorities for disposition of confiscated animals. However, it cannot be over-stressed that euthanasia may frequently be the most feasible option available for economic, conservation and humane reasons. hi many cases, authorities confiscating live animals will encounter the following situations:

a) Return to the wild in some manner is either unnecessary (e.g., in the case of a very common species), impossible, or prohibitively expensive as a result of the need to conform to biological (IUCN/SSC RSG ~995) and animal welfare guidelines (International Academy of We1fare Sciences 1992).

b) Placement in a captive facility is impossible, or there are serious concerns that sale will be problematic or controversial.

c) During transport, or while held in captivity, the animals have contracted a chronic disease that is incurable and, therefore, are a risk to any captive or wild population. hi such situations, there may be no practical alternative to euthanasia.

EUTHANASIA -ADVANTAGES:

a) From the point of view of conservation of the species involved, and of protection of existing captive and wild populations of animals, euthanasia carries far fewer risks (e.g. loss of any unique behavioural/genetic/ecological variations within an individual representing variation within the species) when compared to returning animals to the wild.

b) Euthanasia will also act to discourage the activities that gave rise to confiscation, be it smuggling or other patently illegal trade, incomplete or irregular paperwork, poor packing, or other problems, as the animals in question are removed entirely from trade.

c) Euthanasia may be in the best interest of the welfare of the confiscated animals. Release to the wild will carry enormous risks for existing wild populations and may pose severe challenges to the survival prospects of the individual animals, who may, as a result, die of starvation, disease or predation.

d) Cost: euthanasia is cheap compared to other options. There is potential for diverting resources which might have been used for re-introduction or lifetime care to conservation of the species in the wild.

When animals are euthanized, or when they die a natural death while in captivity, the dead specimen should be placed in the collection of a natural history museum, or another reference collection in a university or research institute. Such reference collections are of great importance to studies of biodiversity. if such placement is impossible, carcasses should be incinerated to avoid illegal trade in animal parts or derivatives.

EUTHANASIA- RISKS

a) There is a risk of losing unique behavioural, genetic and ecological material within an individual or group of individuals that represents variation within a species.

DECISION TREE ANALYSIS

For decision trees dealing with "Return to the Wild" and "Captive Options" the confiscating party must first ask the question:

Question 1: Will "Return to the Wild" make a significant contribution to the conservation of the species?

The most important consideration in deciding on placement of confiscated specimens is the conservation of the species in question. Conservation interests are best served by ensuring the survival of as many individuals as possible. The release of confiscated animals therefore must improve the prospects for survival of the existing wild population. Returning an individual to the wild that has benn held in captivity will always involve some level of risk to existing populations of the same or other species in the ecosystem to which the animal is returned because there can never be absolute certainty that a confiscated animal is disease- and parasite-free. In most instances, the benefits of return to the wild will be outweighed by the costs and risks of such an action. If returning animals to the wild is not of conservation value, captive options pose fewer risks and may offer more humane alternatives.

Q1 Answer: No: Investigate "Captive Options"
Yes: Investigate "Return to the Wild Options"

DECISION TREE ANALYSIS: CAPTIVITY

The decision to maintain confiscated animals in captivity involves a simpler set of considerations than that involving attempts to return confiscated animals to the wild.

Question 2: Have animals been subjected to a comprehensive veterinary screening and quarantine?

Animals that may be transferred to captive facilities must have a clean bill of health because of the risk of introducing disease to captive populations.

Theses animals must be placed in quarantine to determine if they are disease-free before being transferred to a captive-breeding facility.

Q2 Answer: Yes: Proceed to Question 3.
No: Quarantine and screen and move to Question 3.

Question 3: Have animals been found to be disease-free by comprehensive veterinary screening and quarantine or can they be treated for any infection discovered?

If; during quarantine animals are found to harbour diseases that cannot reasonably be cured, they must be euthanized to prevent infection of other animals. If the animals are suspected to have come into contact with diseases for which screening is impossible, extended quarantine, donation to a research facility, or euthanasia must be considered.

Q3 Answer: Yes: Proceed to Question 4
No: If chronic and incurable infection, first offer animals to research institutions. impossible to place in such institutions, euthanize.

Question 4: Are there grounds for concern that sale will stimulate further illegal or irregular trade?

Commercial sale of Appendix I species is not permitted under the Convention as it is undesirable to stimulate trade in these species. Species not listed in any CITES appendix, but which are nonetheless seriously threatened with extinction, should be afforded the same caution.

Sale of confiscated animals, where legally permitted, is a difficult option to consider. while the benefits of sale -- income and quick disposition -- are clear, there are many problems that may arise as a result of further commercial transactions of the specimens involved. Equally, it should be noted that there may be circumstances where such problems arise as a result of a non-commercial transaction or that, conversely, sale to commercial captive breeders may contribute to production of young offsetting the capture from the wild.

More often than not, sale of threatened species should not take place. Such sales or trade in threatened species may be legally proscribed in some countries, or by CITES. There may be rare cases where a commercial captive breeding operation may purchase or receive individuals for breeding, which may reduce pressure on wild populations subject to trade. In all circumstances, the confiscating authority should be satisfied that:

1) those involved in the illegal or irregular transaction that gave rise to confiscation cannot obtain the animals;
2) the sale does not compromise the objective of confiscation; and, finally,
3) the sale will not increase illegal, irregular or otherwise undesired trade in the species.

Previous experience with sale in some countries (e.g., the USA) has indicated that selling confiscated animals is beset by both logistic and political problems and that, in addition to being controversial, it may also be counter-productive to conservation objectives.

Q4 Answer: Yes: Proceed to Question 5a.
No: Proceed to Question 5b.

Question 5a: Is space available in a non-commercial captive facility (e.g., life-time care facility, zoo, rescue centre, specialist society, their members or private individuals)?

Question 5b: Is space available in a non-commercial captive facility (e.g., life-time care facility, zoo, rescue centre, specialist society, their members or private individuals) or is there a commercial facility breeding this species, and is the facility interested in the animals?

Transfer of animals to non-commercial captive-breeding facilities, if sale may stimulate further illegal or irregular trade, or commercial captive breeding facilities, an option only if sale will not stimulate further illegal or irregular trade, should generally provide a safe and acceptable means of disposition of confiscated animals. when a choice must be made between several such institutions, the paramount consideration should be which facility can:

1) offer the opportunity for the animals to participate in a captive breeding programme;
2) provide the most consistent care; and
3) ensure the welfare of the animals.

The terms and conditions of the transfer should be agreed between the confiscating authority and the recipient institution. Terms and conditions for such agreements should include:

I) a clear commitment to ensure life-time care or, in the event that this becomes impossible, transfer to another facility that can ensure life-time care, or euthanasia;
2) clear specification of ownership of the specimens concerned (as determined by national law) and, where breeding may occur, the offspring. Depending on the circumstances, ownership may be vested with the confiscating authority, the country of origin or export, or with the recipient facility.
3) clear specification of conditions under which the animal(s) or their progeny may be sold.

In the majority of instances, there will be no facilities or zoo or aquarium space available in the country in which animals are confiscated. Where this is the case other captive options should be investigated. This could include transfer to a captive facility outside the country of confiscation particularly in the country of origin, or, if transfer will not stimulate further illegal trade, placement in a commercial captive breeding facility. However, these breeding programmes must be carefully assessed and approached with caution. It may be difficult to monitor these programmes and such programmes may unintentionally, or intentionally, stimulate trade in wild animals. The conservation potential of this transfer, or breeding loan, must be carefully weighed against even the smallest risk of stimulating trade which would further endanger the wild population of the species.

In many countries, there are active specialist societies or clubs of individuals with considerable expertise in the husbandry and breeding of individual Species or groups of Species. Such societies can assist in finding homes for confiscated animals without involving sale through intermediaries. In this case, individuals receiving confiscated animals must have demonstrated expertise in the husbandry of the species concerned and must be provided with adequate information and advice by the club or society concerned. Transfer to specialist societies or individual members must be made according to terms and conditions agreed with the confiscating authority. Such agreements may be the same or similar to those executed with Lifetime Care facilities or zoos. Placement with these societies or members is an option if sale of the confiscated animals may or may not stimulate trade.

Q5 Answer: Yes: Execute agreement and Sell
No: Proceed to Question 6.

Question 6: Are institutions interested in animals for research under humane conditions?

Many research laboratories maintain collections of exotic animals for research conducted under humane conditions. If these animals are kept in conditions that ensure their welfare, transfer to such institutions may provide an acceptable alterative to other options, such as sale or euthanasia. As in the preceding instances, such transfer should be subject to terms and conditions agreed with the confiscating authority; in addition to those already suggested, it may be advisable to include terms that stipulate the types of research the confiscating authority considers permissible. If no placement is possible, the animals should be euthanized.

Q6 Answer: Yes: Execute Agreement and Transfer.
No: Euthanize.

DECISION TREE ANALYSIS -- RETURN TO THE WILD

Question 2: Have animals been subjected to a comprehensive veterinary screening and quarantine?

Because of the risk of introducing disease to wild populations, animals that may be released must have a clean bill of health. These animals must be placed in quarantine to determine if they are disease free before being considered for released.

Q2 Answer: Yes: Proceed to Question 3.
No: Quarantine and screen and move to Question 3

Question 3: Have animals been found to be disease free by comprehensive veterinary screening and quarantine or can they be treated for any infection discovered?

1. If during quarantine, the animals are found to harbour diseases that cannot reasonably be cured, unless any institutions are interested in the animals for research under humane conditions, they must be euthanized to prevent infection of other animals. If the animals are suspected to have come into contact with diseases for which screening is impossible, extended quarantine, donation to a research facility, or euthanasia must be considered.

Q3 Answer: Yes: Proceed to Question 4
No: if chronic and incurable infection, first offer animals to research institutions. if impossible to place in such institutions, euthanize.

Question 4: Can country of origin and site of capture be confirmed?

The geographical location from which confiscated individuals have been removed from the wild must be determined if these individuals are to be re-introduced or used to supplement existing populations. In most cases, animals should only be returned to the population from which they were taken, or from populations which are known to have natural exchange of individuals with this population.

If provenance of the animals is not known, release for reinforcement may lead to inadvertent hybridisation of distinct genetic races or sub-species. Related species of animals that may live in sympatry in the wild and never hybridise have been known to hybridise when held in captivity or shipped in multi-Species groups. This type of generalisation of species recognition under abnormal conditions can result in behavioural problems compromising the success of any future release and can also pose a threat to wild populations by artificially destroying reproductive isolation that is behaviourally mediated.

Q4 Answer: Yes: Proceed to Question 5.
No: Pursue 'Captive Options'.

Question 5: Do the animals exhibit behavioural abnormalities which might make them unsuitable for return to the wild?

Behavioural abnormalities as a result of captivity can result in animals which are not suitable for release into the wild. A wide variety of behavioural traits and specific behavioural skills are necessary for survival, in the short-term for the individual, and in the long-term for the population. Skills for hunting, avoiding predators, food selectivity etc. are necessary to ensure survival.

Q5 Answer: Yes: Pursue 'Captive Options'.
No; Proceed to Question 6.

Question 6:Can individuals be returned expeditiously to origin (specific location), and will benefits to conservation of the species outweigh any risks of such action?

Repatriation of the individual and reinforcement of the population will only be options under certain

conditions and following the IUCN/RSG 1995 guidelines:

1) Appropriate habitat for such an operation still exists in the specific location that the individual was
removed from; and
2) sufficient funds are available, or can be made available.

Q6 Answer: Yes: Repatriate and reinforce at origin (specific location) following IUCN guidelines.
No: Proceed to Question 7.

Question 7: For the species in question, does a generally recognized programme exist whose aim is conservation of the species and eventual return to the wild of confiscated individuals and or their progeny? Contact IUCN/SSC, IUDZG, Studbook Keeper, or Breeding Programme Coordinator.

In the case of Species for which active captive breeding and or re-introduction programmes exist, and for which further breeding stock/founders are required, confiscated animals should be transferred to such programmes after consultation with the appropriate scientific authorities. If the Species in question is part of a captive breeding programme, but the taxon (sub-species or race) is not part of this programme (e.g. Maguire & Lacy 1990), other methods of disposition must be considered. Particular attention should be paid to genetic screening to avoid jeopardizing captive breeding programmes through inadvertent hybridisation.

Q7 Answer: Yes: Executer agreement and transfer to existing programme.
No: Proceed to Question 8.

Question 8: Is there a need and is it feasible to establish a new r~introduction programme following IUCN Guidelines?

In cases where individuals cannot be transferred to existing r~introduction programmes, return to the wild, following appropriate guidelines, will only be possible under the following circumstances:
1) appropriate habitat exists for such an operation; 2) sufficient funds are available, or can be made available, to support a programme over the many years that (re)introduction will require; and 3) either sufficient numbers of animals are available so that re-introduction efforts are potentially viable, or only reinforcement of existing populations is considered. In the majority of cases, at least one, if not all, of these requirements will fail to be met. In this instance, either conservation introductions outside the historical range of the Species or other options for disposition of the animals must be considered.

It should be emphasized that if a particular species or taxon is confiscated with some frequency, consideration should be made as to whether to establish a re-introduction, reinforcement, or introduction programme. Animals should not be held by the confiscating authority indefinitely while such programmes are planned, but should be transferred to a holding facility after consultation with the organization which is establishing the new programme.

Q8 Answer: Yes: Execute agreement and transfer to holding facility or new programme.
No: Pursue 'Captive Options'.

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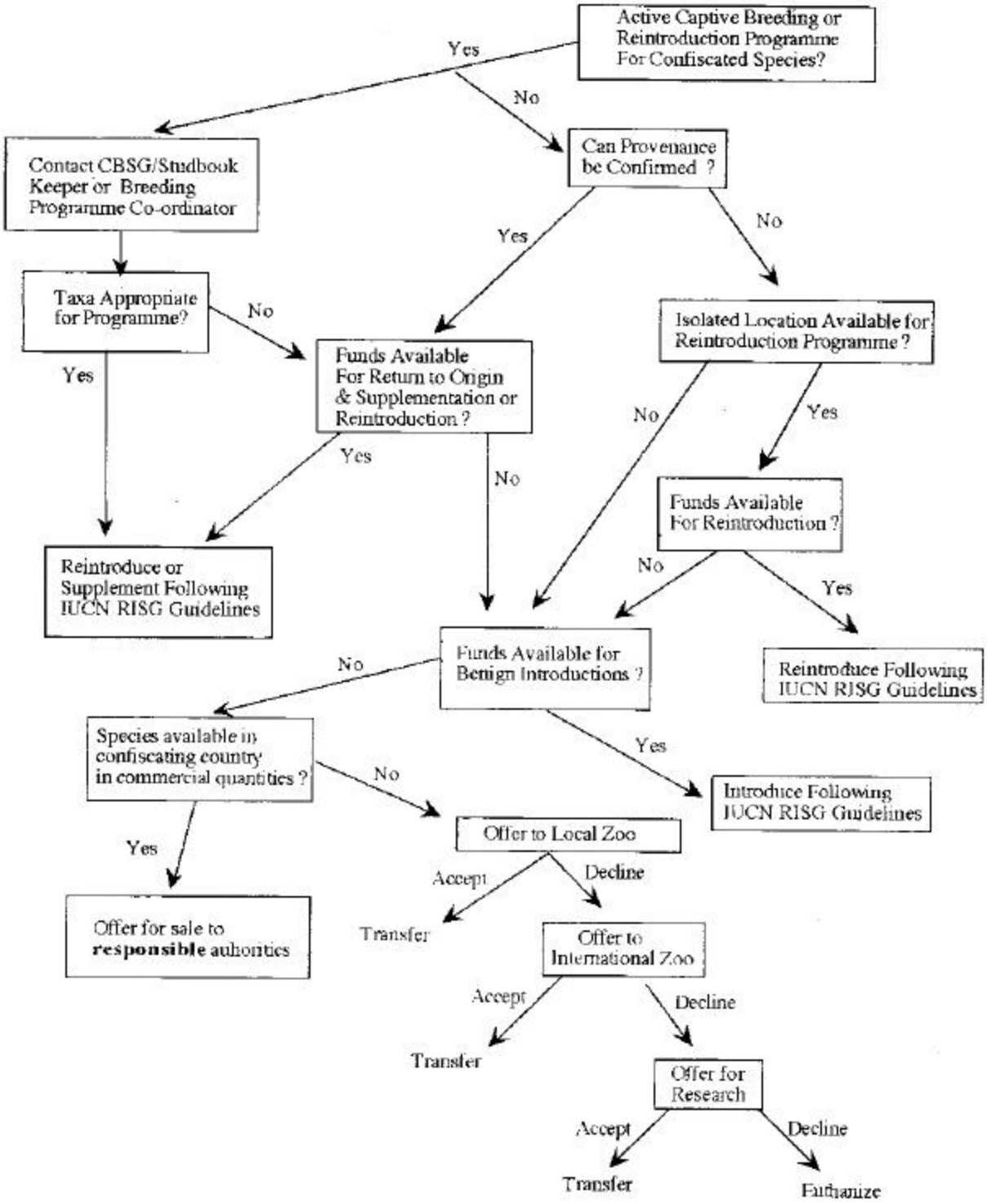
Flow Chart for the Disposition Of Confiscated Animals



Approved by the 27th Meeting of IUCN Council

IUCN POLICY STATEMENT ON RESEARCH INVOLVING SPECIES AT RISK OF EXTINCTION

PROLOGUE

IUCN holds that all research on or affecting a threatened species carries a moral responsibility for the preservation or enhancement of the survival of that species. Conservation of the research resource is clearly in the interest of the researchers.

IUCN recognizes that the taking and trading of specimens of threatened species are covered by international agreements and are normally included in national legislation which provides authorized exemptions for the purpose of scientific research.

Basic and applied research is critically needed on many aspects of the biology of animal and plant species at risk of extinction (e g. those listed by IUCN as Vulnerable, Rare, Endangered, or indeterminate) to provide knowledge vital to their conservation.

Other scientific interests may involve the use of threatened species in a wide variety of studies. Taking into account the importance of many kinds of research, as well as potential threats such species could be subject to in such activities, IUCN, after careful consideration, adopts the following statements as policy.

POLICY

IUCN encourages basic and applied research on threatened species that contributes to the likelihood of survival of those species.

When a choice is available among captive-bred or propagated, wild-caught or taken, or free-living stock for research not detrimental to the survival of a threatened species, IUCN recommends the option contributing most positively to sustaining wild populations of the species.

IUCN recommends that research programmes on threatened species that do not directly contribute to conservation of the species should acknowledge an obligation to the species by devoting monetary or other substantial resources to their conservation, preferably to sustaining populations in the natural environment.

Whether animals involved are captive-bred, wild-caught, or free living, or whether plants involved are propagated, taken from the wild, or in their natural habitat, IUCN opposes research that directly or indirectly impairs the survival of threatened species and urges that such research not be undertaken.

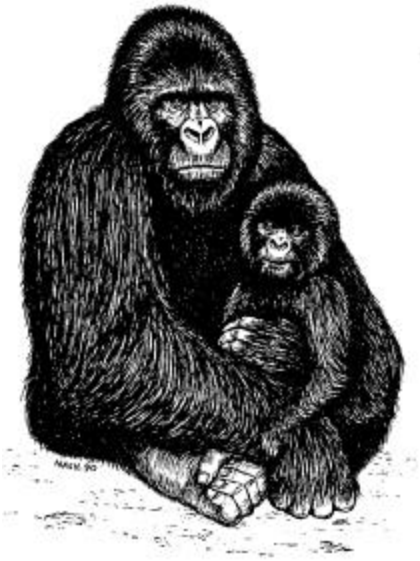
PROTOCOLS

In this context IUCN urges researchers to accept a personal obligation to satisfy themselves that the processes by which research specimens are acquired (including transportation) conform scrupulously to procedures and regulations adopted under international legal agreements. Further, researchers should adopt applicable professional standards for humane treatment of animal specimens, including their capture and use in research.

IUCN urges that any research on threatened species be conducted in conformity with all applicable laws, regulations and veterinary professional standards governing animal acquisition, health and welfare, and with all applicable agricultural and genetic resource laws and regulations governing acquisition, transport, and management of plants.

Population and Habitat Viability Assessment
For *Gorilla gorilla beringei*

8 – 12 December 1997
Kampala, Uganda



Section

VORTEX Reference

12

VORTEX Reference:
Simulation Modeling and Population Viability Analysis

(Excerpted from: Ballou, J.D., R.C. Lacy, and S. Ellis, eds. 1998. Leontopithecus II: The Second Population and Habitat Viability Assessment for Lion Tamarins (*Leontopithecus*). CBSG: Apple Valley, MN, USA

A model is any simplified representation of a real system. We use models in all aspects of our lives, in order to: (1) extract the important trends from complex processes, (2) permit comparison among systems, (3) facilitate analysis of causes of processes acting on the system, and (4) make predictions about the future. A complete description of a natural system, if it were possible, would often decrease our understanding relative to that provided by a good model, because there is "noise" in the system that is extraneous to the processes we wish to understand. For example, the typical representation of the growth of a wildlife population by an annual percent growth rate is a simplified mathematical model of the much more complex changes in population size. Representing population growth as an annual percent change assumes constant exponential growth, ignoring the irregular fluctuations as individuals are born or immigrate, and die or emigrate. For many purposes, such a simplified model of population growth is very useful, because it captures the essential information we might need regarding the average change in population size, and it allows us to make predictions about the future size of the population. A detailed description of the exact changes in numbers of individuals, while a true description of the population, would often be of much less value because the essential pattern would be obscured, and it would be difficult or impossible to make predictions about the future population size.

In considerations of the vulnerability of a population to extinction, as is so often required for conservation planning and management, the simple model of population growth as a constant annual rate of change is inadequate for our needs. The fluctuations in population size that are omitted from the standard ecological models of population change can cause population extinction, and therefore are often the primary focus of concern. In order to understand and predict the vulnerability of a wildlife population to extinction, we need to use a model which incorporates the processes which cause fluctuations in the population, as well as those which control the long-term trends in population size (Shaffer 1981). Many processes can cause fluctuations in population size: variation in the environment (such as weather, food supplies, and predation), genetic changes in the population (such as genetic drift, inbreeding, and response to natural selection), catastrophic effects (such as disease epidemics, floods, and droughts), decimation of the population or its habitats by humans, the chance results of the probabilistic events in the lives of individuals (sex determination, location of mates, breeding success, survival), and interactions among these factors (Gilpin and Soulé 1986).

Models of population dynamics which incorporate causes of fluctuations in population size in order to predict probabilities of extinction, and to help identify the processes which contribute to a population's vulnerability, are used in "Population Viability Analysis" (PVA) (Lacy 1993/4). For the purpose of predicting vulnerability to extinction, any and all population processes that impact population dynamics can be important. Much analysis of conservation issues is conducted

by largely intuitive assessments by biologists with experience with the system. Assessments by experts can be quite valuable, and are often contrasted with "models" used to evaluate population vulnerability to extinction. Such a contrast is not valid, however, as *any* synthesis of facts and understanding of processes constitutes a model, even if it is a mental model within the mind of the expert and perhaps only vaguely specified to others (or even to the expert himself or herself).

A number of properties of the problem of assessing vulnerability of a population to extinction make it difficult to rely on mental or intuitive models. Numerous processes impact population dynamics, and many of the factors interact in complex ways. For example, increased fragmentation of habitat can make it more difficult to locate mates, can lead to greater mortality as individuals disperse greater distances across unsuitable habitat, and can lead to increased inbreeding which in turn can further reduce ability to attract mates and to survive. In addition, many of the processes impacting population dynamics are intrinsically probabilistic, with a random component. Sex determination, disease, predation, mate acquisition -- indeed, almost all events in the life of an individual -- are stochastic events, occurring with certain probabilities rather than with absolute certainty at any given time. The consequences of factors influencing population dynamics are often delayed for years or even generations. With a long-lived species, a population might persist for 20 to 40 years beyond the emergence of factors that ultimately cause extinction. Humans can synthesize mentally only a few factors at a time, most people have difficulty assessing probabilities intuitively, and it is difficult to consider delayed effects. Moreover, the data needed for models of population dynamics are often very uncertain. Optimal decision-making when data are uncertain is difficult, as it involves correct assessment of probabilities that the true values fall within certain ranges, adding yet another probabilistic or chance component to the evaluation of the situation.

The difficulty of incorporating multiple, interacting, probabilistic processes into a model that can utilize uncertain data has prevented (to date) development of analytical models (mathematical equations developed from theory) which encompass more than a small subset of the processes known to affect wildlife population dynamics. It is possible that the mental models of some biologists are sufficiently complex to predict accurately population vulnerabilities to extinction under a range of conditions, but it is not possible to assess objectively the precision of such intuitive assessments, and it is difficult to transfer that knowledge to others who need also to evaluate the situation. Computer simulation models have increasingly been used to assist in PVA. Although rarely as elegant as models framed in analytical equations, computer simulation models can be well suited for the complex task of evaluating risks of extinction. Simulation models can include as many factors that influence population dynamics as the modeler and the user of the model want to assess. Interactions between processes can be modeled, if the nature of those interactions can be specified. Probabilistic events can be easily simulated by computer programs, providing output that gives both the mean expected result and the range or distribution of possible outcomes. In theory, simulation programs can be used to build models of population dynamics that include all the knowledge of the system which is available to experts. In practice, the models will be simpler, because some factors are judged unlikely to be important, and because the persons who developed the model did not have access to the full array of expert knowledge.

Although computer simulation models can be complex and confusing, they are precisely defined

and all the assumptions and algorithms can be examined. Therefore, the models are objective, testable, and open to challenge and improvement. PVA models allow use of all available data on the biology of the taxon, facilitate testing of the effects of unknown or uncertain data, and expedite the comparison of the likely results of various possible management options.

PVA models also have weaknesses and limitations. A model of the population dynamics does not define the goals for conservation planning. Goals, in terms of population growth, probability of persistence, number of extant populations, genetic diversity, or other measures of population performance must be defined by the management authorities before the results of population modeling can be used. Because the models incorporate many factors, the number of possibilities to test can seem endless, and it can be difficult to determine which of the factors that were analyzed are most important to the population dynamics. PVA models are necessarily incomplete. We can model only those factors which we understand and for which we can specify the parameters. Therefore, it is important to realize that the models probably underestimate the threats facing the population. Finally, the models are used to predict the long-term effects of the processes presently acting on the population. Many aspects of the situation could change radically within the time span that is modeled. Therefore, it is important to reassess the data and model results periodically, with changes made to the conservation programs as needed.

VORTEX Population Viability Analysis Model

For the analyses presented here, the VORTEX computer software (Lacy 1993a) for population viability analysis was used. VORTEX models demographic stochasticity (the randomness of reproduction and deaths among individuals in a population), environmental variation in the annual birth and death rates, the impacts of sporadic catastrophes, and the effects of inbreeding in small populations. VORTEX also allows analysis of the effects of losses or gains in habitat, harvest or supplementation of populations, and movement of individuals among local populations.

Density dependence in mortality is modeled by specifying a carrying capacity of the habitat. When the population size exceeds the carrying capacity, additional morality is imposed across all age classes to bring the population back down to the carrying capacity. The carrying capacity can be specified to change linearly over time, to model losses or gains in the amount or quality of habitat. Density dependence in reproduction is modeled by specifying the proportion of adult females breeding each year as a function of the population size.

VORTEX models loss of genetic variation in populations, by simulating the transmission of alleles from parents to offspring at a hypothetical genetic locus. Each animal at the start of the simulation is assigned two unique alleles at the locus. During the simulation, VORTEX monitors how many of the original alleles remain within the population, and the average heterozygosity and gene diversity (or "expected heterozygosity") relative to the starting levels. VORTEX also monitors the inbreeding coefficients of each animal, and can reduce the juvenile survival of inbred animals to model the effects of inbreeding depression.

VORTEX is an *individual-based* model. That is, VORTEX creates a representation of each animal in its memory and follows the fate of the animal through each year of its lifetime.

VORTEX keeps track of the sex, age, and parentage of each animal. Demographic events (birth, sex determination, mating, dispersal, and death) are modeled by determining for each animal in each year of the simulation whether any of the events occur. (See figure below.) Events occur according to the specified age and sex-specific probabilities. Demographic stochasticity is therefore a consequence of the uncertainty regarding whether each demographic event occurs for any given animal.

VORTEX requires a lot of population-specific data. For example, the user must specify the amount of annual variation in each demographic rate caused by fluctuations in the environment. In addition, the frequency of each type of catastrophe (drought, flood, epidemic disease) and the effects of the catastrophes on survival and reproduction must be specified. Rates of migration (dispersal) between each pair of local populations must be specified. Because VORTEX requires specification of many biological parameters, it is not necessarily a good model for the examination of population dynamics that would result from some generalized life history. It is most usefully applied to the analysis of a specific population in a specific environment.

Further information on VORTEX is available in Lacy (1993a) and Lacy et al. (1995).

Dealing with uncertainty

It is important to recognize that uncertainty regarding the biological parameters of a population and its consequent fate occurs at several levels and for independent reasons. Uncertainty can occur because the parameters have never been measured on the population. Uncertainty can occur because limited field data have yielded estimates with potentially large sampling error. Uncertainty can occur because independent studies have generated discordant estimates. Uncertainty can occur because environmental conditions or population status have been changing over time, and field surveys were conducted during periods which may not be representative of long-term averages. Uncertainty can occur because the environment will change in the future, so that measurements made in the past may not accurately predict future conditions.

Sensitivity testing is necessary to determine the extent to which uncertainty in input parameters results in uncertainty regarding the future fate of the pronghorn population. If alternative plausible parameter values result in divergent predictions for the population, then it is important to try to resolve the uncertainty with better data. Sensitivity of population dynamics to certain parameters also indicates that those parameters describe factors which could be critical determinants of population viability. Such factors are therefore good candidates for efficient management actions designed to ensure the persistence of the population.

The above kinds of uncertainty should be distinguished from several more sources of uncertainty about the future of the population. Even if long-term average demographic rates are known with precision, variation over time caused by fluctuating environmental conditions will cause uncertainty in the fate of the population at any given time in the future. Such environmental variation should be incorporated into the model used to assess population dynamics, and will generate a range of possible outcomes (perhaps represented as a mean and standard deviation)

from the model. In addition, most biological processes are inherently stochastic, having a random component. The stochastic or probabilistic nature of survival, sex determination, transmission of genes, acquisition of mates, reproduction, and other processes preclude exact determination of the future state of a population. Such demographic stochasticity should also be incorporated into a population model, because such variability both increases our uncertainty about the future and can also change the expected or mean outcome relative to that which would result if there were no such variation. Finally, there is "uncertainty" which represents the alternative actions or interventions which might be pursued as a management strategy. The likely effectiveness of such management options can be explored by testing alternative scenarios in the model of population dynamics, in much the same way that sensitivity testing is used to explore the effects of uncertain biological parameters.

Results

Results reported for each scenario include:

Deterministic r -- The deterministic population growth rate, a projection of the mean rate of growth of the population expected from the average birth and death rates. Impacts of harvest, inbreeding, and density dependence are not considered in the calculation. When r = 0, a population with no growth is expected; r < 0 indicates population decline; r > 0 indicates long-term population growth. The value of r is approximately the rate of growth or decline per year.

The deterministic growth rate is the average population growth expected if the population is so large as to be unaffected by stochastic, random processes. The deterministic growth rate will correctly predict future population growth if: the population is presently at a stable age distribution; birth and death rates remain constant over time and space (i.e., not only do the probabilities remain constant, but the actual number of births and deaths each year match the expected values); there is no inbreeding depression; there is never a limitation of mates preventing some females from breeding; and there is no density dependence in birth or death rates, such as a Allee effects or a habitat "carrying capacity" limiting population growth. Because some or all of these assumptions are usually violated, the average population growth of real populations (and stochastically simulated ones) will usually be less than the deterministic growth rate.

Stochastic r -- The mean rate of stochastic population growth or decline demonstrated by the simulated populations, averaged across years and iterations, for all those simulated populations that are not extinct. This population growth rate is calculated each year of the simulation, prior to any truncation of the population size due to the population exceeding the carrying capacity. Usually, this stochastic r will be less than the deterministic r predicted from birth and death rates. The stochastic r from the simulations will be close to the deterministic r if the population growth is steady and robust. The stochastic r will be notably less than the deterministic r if the population is subjected to large fluctuations due to environmental variation, catastrophes, or the genetic and demographic instabilities inherent in small populations.

P(E) -- the probability of population extinction, determined by the proportion of 500 populations

of that scenario which have gone extinct in the simulations. "Extinction" is defined in the VORTEX model as the lack of either sex.

N -- mean population size, averaged across those simulated populations which are not extinct.

SD(N) -- variation across simulated populations (expressed as the standard deviation) in the size of the population at each time interval. SDs greater than about half the size of mean N often indicate highly unstable population sizes, with some simulated populations very near extinction. When SD(N) is large relative to N, and especially when SD(N) increases over the years of the simulation, then the population is vulnerable to large random fluctuations and may go extinct even if the mean population growth rate is positive. SD(N) will be small and often declining relative to N when the population is either growing steadily toward the carrying capacity or declining rapidly (and deterministically) toward extinction. SD(N) will also decline considerably when the population size approaches and is limited by the carrying capacity.

H -- the gene diversity or expected heterozygosity of the extant populations, expressed as a percent of the initial gene diversity of the population. Fitness of individuals usually declines proportionately with gene diversity (Lacy 1993b), with a 10% decline in gene diversity typically causing about 15% decline in survival of captive mammals (Ralls et al. 1988). Impacts of inbreeding on wild populations are less well known, but may be more severe than those observed in captive populations (Jiménez et al. 1994). Adaptive response to natural selection is also expected to be proportional to gene diversity. Long-term conservation programs often set a goal of retaining 90% of initial gene diversity (Soulé et al. 1986). Reduction to 75% of gene diversity would be equivalent to one generation of full-sibling or parent-offspring inbreeding.

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