Photo: J. Kalpers

APE TOURISM AND HUMAN DISEASES: How Close Should We Get?

A Critical Review of the Rules and Regulations Governing Park Management & Tourism for the Wild Mountain Gorilla, *Gorilla gorilla beringei*

Report of a Consultancy for the International Gorilla Conservation Programme

February 1999

Jaco Homsy, MD, MPH

Gorillas are wild,
let’s allow them to utilise their natural way of living
and concentrate on [ensuring that] human beings who interfere with them
are free of diseases that they may transmit to them…

A Guide / Bwindi Impenetrable National Park
December 1998

Table of Contents

List of Tables

Acknowledgements

I would like to thank all the people contacted through this consultancy, whether in Uganda, at the University of California at Davis, USA, or anywhere else on the other continents (through cyberspace!), for their patience, interest and helpful insight while I managed to bother them with my multiple calls or emails into their offices or at home, at any time of the day or night !

Special thanks go to:

* Dr Liz Macfie and Annabel Falcon of IGCP in Uganda, who were the guiding lights of this effort, and without whom many of the very helpful contacts established and material collected for this work would have been nearly impossible to achieve;
* the Gilardi family who provided exceptionally warm hospitality and help towards my explorations of the vast Campus of the University of California at Davis in the US (where it's so easy to get lost!),
* the Lone Tree Road family who provided me with a home base while in the US.
* my friend and companion Rachel who was as patient with me as gorillas can be with restless tourists during the months it took for this work to be completed!…

Finally, I would like to express my gratitude for having been entrusted with the task of documenting such an important issue as the one addressed in this report. In my view, besides representing my main heart-felt interests in life, public health and conservation are two fields of science that must be brought together if we are to seriously address the threats to the survival of our planet ecosystem.

List of Abbreviations

BINP	Bwindi Impenetrable Forest National Park (Uganda)
CBSG	Conservation Breeding Specialist Group
CMV	Cytomegalovirus
DRC	Democratic Republic of the Congo
EBV	Epstein-Barr virus
EIA	Environmental Impact Assessment
HIV	Human Immunodeficiency Virus
HAV	Hepatitis A Virus
HBV	Hepatitis B Virus
HSV	Herpes Simplex Virus
HTLV	Human T Cell Lymphotropic Virus
ICCN	Institut Congolais pour la Conservation de la Nature
IGCP	International Gorilla Conservation Programme
IUCN	International Union for the Conservation of Nature
MAF	Morris Animal Foundation
MGNP	Mgahinga Gorilla National Park (Uganda)
MGP	Mountain Gorilla Project
MGVP	Mountain Gorilla Veterinary Project
ORTPN	Office Rwandais pour le Tourisme et Parcs Nationaux
Pers. comm.	Personal communication
Pers. obs.	Personal observation
PHVA	Population Health Viability Assessment
PNV	Volcanoes National Park (Rwanda)
PNVi	Virungas National Park (Democratic Republic of Congo)
RSV	Respiratory Syncitial Virus
SB	Silverback
SSC	Species Survival Commission (of the IUCN)
SIV	Simian Immunodeficiency Virus
SRV	Simian type D retroviruses
TB	Tuberculosis
UNP	Uganda National Parks (now merged with Game Department to become UWA)
UWA	Uganda Wildlife Authority

Glossary of Technical Terms

Aetiology	Identification of the causative agent of a disease
Asymptomatic	Lacking external signs or symptoms (said of a person having an infection without symptoms)
Cirrhosis	Degenerative liver disease
Conjunctivitis	Inflammation of the conjunctiva (inner membrane of the eyelids)
Coprophagia	Habit of eating faeces
Oedema	Swelling / accumulation of fluid
Encephalomyelitis	Inflammation of the nerve tissues in the brain and the spine
Endemic	Describes a disease or condition constantly present at a regular prevalence rate in a particular place or among a certain population
Enteric	Refers to the gastro-intestinal system - the intestines
Enteritis	Inflammation of the intestines
Epidemic	Describes an infectious disease whose prevalence has suddenly peaked from its habitual rate in a particular place or among a certain population
Epizootic	An epidemic of disease among animals
Gastro-enteritis	Inflammation of the stomach and the intestines
Geophagia	Habit of eating soil
Enterocolitis	Inflammation of the large intestine
Fomite	Non-living objects acting as potential carriers/vectors for transmission of infectious agents
Hyperplasia	Excessive cell replication
Immunology (gical)	The science studying the defence mechanisms of the body
Immunologically naïve	Qualifies an individual or population whose natural defence system has never been exposed, thus is "naïve", to certain germs
Immunosuppressed	Qualifies an individual whose natural defence mechanisms are weakened or impaired, transiently or permanently
In vitro	Latin term qualifying laboratory situations or experiments
In vivo	Latin term qualifying situations or experiments with living subjects
Meningoencephalitis	Generalised inflammation of the brain tissue and of the rich network of blood vessels in the brain called the meninges
Morbidity	The symptoms or clinical manifestations of disease
Mucosa	The soft, lubricated pink skin layer lining the inside of the eyes, mouth, intestines and genital organs
Nephrosis	Diffuse inflammation of the kidneys
Oncogenic	Capable of causing cancer
Orchitis	Inflammation of the testicles
Otitis	Inflammation of the ear canals
Pandemic	Describes an infectious disease which is widespread over an entire area or among a given species
Parotiditis	Inflammation of the parotid glands (situated around the thyroid gland and responsible for controlling the calcium/phosphorus balance of the body)
Pathogen	An infectious agent capable of causing disease
Pustules	A small swelling of the skin filled with pus
Predisposing	Making vulnerable
Quarantine	An observation period during which a newly arrived person/animal is kept away from others to allow for incubating or recent infections to become apparent and be treated if necessary
Rhinitis	Inflammation of the nasal respiratory conduits
Subclinical	Said of a disease whose external signs are weak or little apparent
Syndrome	A specific group of signs or symptoms defining a condition or disease
Vectors (disease)	Germ carrier - can be alive or not, micro- or macroscopic
Zoonotic /zoonosis	Qualifies diseases that can be transmitted from animals to humans

EXECUTIVE SUMMARY

Tourism has become the most universally accepted, supported and lucrative tool to foster the conservation of gorillas and other endangered great apes in Africa. It is a successful business operation, generating considerable revenue and publicity for Rwanda, Uganda and the Democratic Republic (DR) of Congo (ex-Zaire), which protect the last remaining populations of mountain gorillas. However, this booming activity is bringing thousands of people from all continents into close proximity with the gorillas, raising another important threat to their survival. This threat is in the form of human diseases to which these animals can be extremely susceptible, with potentially devastating consequences. Together with the high population pressure surrounding the parks, disease exposure thus ironically makes tourism one of the single greatest threats to mountain gorilla survival.

The present consultancy was commissioned by the International Gorilla Conservation Programme (IGCP) to assess the effectiveness of gorilla tourism rules in minimising health risks to gorillas, with the ultimate goal of enhancing the sustainability of gorilla tourism programmes at national and regional levels. The findings present evidence from the current literature on the susceptibility of mountain gorillas to human pathogens, advice and opinions of various experts in the field of veterinary medicine, pathology, conservation biology and anthropology regarding the risks associated with gorilla tourism, and an analysis of the relevance of the rules. Further, the report analyses the benefits and implications of possible additional protective/preventive actions that could be implemented for the preservation of mountain gorillas. It concludes with a set of recommendations that were finalised after presentation and discussion at the IGCP Regional Meeting in Gisakura, Rwanda, in January 1999.

FINDINGS

A. RESULTS OF LITERATURE REVIEW / CONSULTATIONS

A1 Documented evidence of shared susceptibility to pathogens

Gorillas are, as members of the great ape family, among our closest relatives and are therefore susceptible to a large number of human pathogens. Although there is little published evidence demonstrating proof of *direct transmission* of pathogens from humans to great apes in the wild, a number of cases have been documented in the literature providing ample evidence of *definite susceptibility* of apes to human diseases. In addition, there have been several cases of transmission of human disease to gorillas and chimpanzees in zoos that are well documented but have never been published.

Cases of illnesses in apes that have been associated with human respiratory viruses and bacteria include influenza, adenovirus, rhinovirus, respiratory syncitial virus, pneumococcal pneumonia, Herpes viruses, measles, mumps, and cytomegalovirus. Enteric germs include polioviruses, coxsackie viruses, Salmonella, Shigella, Campylobacter, as well as numerous parasites. This variety of agents leaves no doubt about a widely shared susceptibility to pathogens among great apes and humans.

Even though the disease threats inherent in the interaction of humans with a wild environment is generally greater for wildlife than for humans, the risks for **humans** to acquire a new germ to which they have not previously been exposed cannot be underestimated. HIV, Ebola and other viruses of the filovirus family are obvious examples.

A2 Diseases of concern

The human diseases of concern for gorillas are those that are easily transmitted without requiring direct or prolonged contact with people. In the wild, the threat of particular microbes is directly related to their route of transmission and their survival in droplets, soil, water, food or faeces. Some agents like polio are capable of surviving for several months in soil, while others like measles can be transported over great distances in the open.

Until recently, the focus of concern over human disease transmission to gorillas during tourism activities has been on respiratory infections (i.e. measles, TB, pneumonia, influenza and RSV) which are known, clinically obvious risks. Yet, diseases that can be contracted via the faecal-oral route or via fomites are of equal, if not greater, significance. They include Shigella, Trichuris, hepatitis A (HAV) and B (HBV) viruses, herpes simplex, scabies, intestinal worms, and polio among others.

A3 Gorilla exposure to humans

A3.1 Tourists

Based on the current number of gorilla groups habituated for research and tourism in each park, and given that tourism occupancy rates average 80% in times of political stability, habituated gorilla groups are each exposed to an average of greater than 2,000 visitor-hours per year. In addition, a group is exposed to over 900 hours of visits by guides, rangers and trackers that accompany each tourist group. These figures are based on the current rule, which limits tourist viewing of gorillas to one hour. They show that habituated gorillas are exposed to a far greater number of individuals per year than an average person is likely to receive in his or her own house over a lifetime!

The current trend in tourism based on 'unique' adventures translates into more tourists increasingly entering remote, isolated and sometimes poorly accessible regions of the world in search of rare and meaningful encounters. Tourists visiting gorillas thus often arrive from distant and varied locations, and are likely to have travelled previously to other countries and continents. This represents, from an epidemiological point of view, a very effective means of transport for an increased number of exotic germs due to the speed and diversity of modern transport systems.

A3.2 Park staff and researchers

Habituating gorillas for research or tourism requires regular, continuous and close human presence near the gorillas in their natural habitat. Researchers usually spend several hours at a time with gorilla groups, and therefore represent a similar degree of exposure to gorillas as tourists (in person-hours), even though they may not visit gorillas as often as tourists. In addition, occasional emergency veterinary interventions are inevitable and imply staff getting in direct contact with gorillas through clothes, hair and other fomites, despite the required use of masks and gloves, thus representing an acute additional source of exposure for gorilla groups.

A3.3 Surrounding park population

The area surrounding the Virungas and Bwindi is one of the most densely populated areas in Africa, with an average of over 200 inhabitants per km^2, reaching 300 per km^2 in Kisoro District, Uganda. Malaria, respiratory infections and diarrhoeal diseases account for the majority of illnesses among adults, and deaths among children. Some areas like Kisoro District in Uganda have particularly acute water and sanitation problems due to the volcanic basaltic structure of the subsoil. These conditions, combined with poor hygiene practices, greatly favour the spread of faecal-oral germs. These include not only germs directly responsible for diarrhoea, but also other important non diarrhoea-causing pathogens spread via the faecal-oral route and shed through the intestines like hepatitis A and E and enteroviruses like the polio virus.

Among the major respiratory pathogens prevailing in the local population, streptococcus, influenza, tuberculosis, measles and respiratory syncitial virus (RSV) figure prominently. Tuberculosis (TB) is of particular concern due to its association with the Human Immunodeficiency Virus (HIV), or AIDS virus, and the emergence of multi-drug resistant TB strains, which is most probably due to partial or inadequate treatment.

Besides TB, HIV-infected individuals are susceptible to a number of other opportunistic infections, including both respiratory and intestinal pathogens that can be spread further given the conditions described above. Diarrhoea-causing agents include *Cryptosporidium, Microsporidium, Isospora belli,* and *Mycobacterium avium.* Agents causing pulmonary diseases include fungi or yeast such as *Candida*, *Pneumocystis*, *Aspergillus* and *Cryptococcus*, bacteria such as *Streptococcus* and *Haemophilus*, viruses such as Cytomegalovirus (CMV), influenza and paramyxoviruses, as well as mycoplasma and chlamydia. In addition, many of the latter agents causing respiratory infections can cause bouts of diarrhoea as a result of the generalised immunosuppression suffered by people with AIDS.

B. ASSESSMENT OF THE CURRENT GORILLA TOURISM RULES

B1 Methodology

The assessment was based on:

- answers given by people contacted through this consultancy (see **Appendix 3**), either through interviews (n=12) or questionnaires (n=40) circulated by correspondence (see **Appendices 4 & 5**),
- existing epidemiological and/or physiological data and facts regarding the rationale of the rules, and
- a critical analysis of the different possible options for change

The recent *Population and Habitat Viability Assessment* (PHVA) for the Virunga and Bwindi mountain gorilla populations showed that among the main catastrophic scenarios considered (war, disease and population fragmentation), diseases can have the most drastic consequences for the survival of the species. The best that tourism rules can do is to attempt to control the determinants of transmission, in other words, to *prevent* incidents or catastrophes, rather than *cure* them. In light of this, in reviewing the rules for this consultancy, the aim was to provide sufficient risk reduction in order to avoid any event with catastrophic potential for the species.

B2 Results and Recommendations

B2.1 Rule a: Limiting the frequency of visits (current limit: 1 visit per day per habituated gorilla group)

Increasing the number of daily visits was considered. Every additional daily visit doubles the exposure time of gorillas to visitors, thus increasing the risk of disease transmission. In addition, the duration of any disturbance to the gorillas' normal activities and the amount of associated stress induced would be doubled. Since stress, especially over prolonged periods of time, has been associated with immunosuppression (Hudson 1992, Hofer & East 199), it could have negative health implications for gorillas. Stress would particularly be an issue as the logistics for scheduling two daily visits for a given gorilla group would very likely imply close or consecutive visits, especially in the case of groups at great distance from tourist camps. An associated risk of increased daily visits is that each visitor group entering the forest conceivably causes additional ecological disturbance.

Recommendation on visit frequency

- The recommendation is to maintain the status quo on this rule, i.e. limiting the number of visits to one per day per habituated gorilla group.

B2.2 Rule b: Limiting the number of visitors (current limit: 6 in Uganda, 8 in Rwanda and DR Congo)

The major considerations regarding this rule include the fact that each additional visitor represents a potential contamination source, and that the susceptibility of gorillas to diseases greatly affects the outcome of exposure to humans. Based on past and recent incidents in both wild and captive situations, gorillas are assumed to be in a state of high vulnerability, or immune *naïveté*, to human diseases. Thus, it would only take one individual gorilla to be infected for an infection to potentially spread very rapidly to the rest of the group, and the larger the group, the larger the number of animals infected. In addition, depending on interactions with other groups in the forest, the potential for spread to other wild, and perhaps even more susceptible animals, cannot be underestimated. These facts also point out that visitor group size cannot be reviewed without considering the size of the gorilla group.

Recent recommendations of the 1998 IGCP Regional Meeting in Kigali suggested a compromise for the discrepancy between 6 and 8 in visitor limits in different parks. The recommendation stated that larger gorilla group sizes (> 10 gorillas) with better visibility conditions (Virungas) can allow for larger tourist groups (8) that are able to remain further back, minimising risk of disease or behavioural disturbance, with **no** visitors allowed to groups of less than 6 gorillas. This consultant feels that while this recommendation affords protection to smaller gorilla groups, it does not account for the increased risk of spread of a disease if introduced into larger groups.

A recommendation should then include both upper and lower size limits of visited gorilla groups as well as an upper limit for tourist groups. However, as gorilla group sizes vary over time, it should be noted that the upper limit stipulated in the following proposition is not intended as a retroactive measure to de-habituate groups already habituated or undergoing habituation. Rather, it should serve as a guideline for future habituation:

Recommendation on visitor group size

- The recommendation is not to allow tourism for gorilla groups smaller than 6 or larger than 15 animals.
- Between 6 and 15 animals, no more than a total of 10 people per visiting tourist group (including guides, trackers, rangers and any other accompanying person) should be allowed.
- In the future, groups larger than 15 animals should not be considered suitable for habituation.
- In cases where staff and researchers may need to have access to groups for which tourism is not recommended, it is suggested that a maximum of 3 persons per visit be set.

B2.3 Rule c: Maintaining a minimum distance between visitors and gorillas (current limit: 15 feet or ~5 metres)

Sneeze particles can cross a distance of 20 feet (6 metres) in a controlled environment, i.e. in the absence of any wind or ventilation factor. Very light wind or indoor ventilation can greatly increase this distance for aerosol or dust particles. Therefore the rule should be strengthened to provide a safety factor against both avoidable (intentional) and unavoidable (wind) fluctuations in effective distance. The strengthening of this rule is all the more justified as the current 5 metre rule is difficult for guides to enforce, therefore keeping tourists further back would reduce exposure from the occasional violation of the minimum distance. This rule should apply not only to tourists, but also to all other gorilla visitors, including researchers, veterinarians, park guides, trackers and rangers and any other forest users.

Recommendation on minimum distance

- The recommendation is to increase the minimum distance to 25 ft or 7.5 meters for all people approaching or visiting gorillas in non-emergency situations.

B2.4 Rule d: Limiting the duration of the tourist visit (current limit:1 hour)

It is difficult to dissociate the discussion of time from that of distance, as the shorter the viewing time, the greater the pressure and expectations exerted from tourists anxious to capture the best photos of gorillas, which might cause challenges to any distance rule. Conversely, the longer the viewing time, the greater the exposure of gorillas to potential disease transmission. This rule must therefore balance visitor satisfaction against increased exposure time. One means of enhancing visitor satisfaction would be, in cases of bad visibility of gorillas at the time of tourists' arrival, to allow guides to stay back with visitors at a safe distance from the gorillas (20m or more) for a **limited** time, suggested at 15 minutes. Guides could wait at this distance for improved visibility before officially starting the one-hour clock. In addition to lessening the pressure on guides, it could provide time for the guides to remind tourists of the rules one last time before approaching the gorillas.

Recommendation on visit duration

- The recommendation is to maintain the one-hour viewing time, while allowing a maximum 15-minute waiting period, at 20 metres or more from gorillas , before starting the clock, *if and only if*, gorillas are not visible at the time of initial encounter. During this time, the guide is to remind tourists of the critical distance and behavioural rules as well as to indicate the exact time the viewing will start and stop. To avoid misinterpretations or "bargaining" by visitors, it should be clearly stated that once counting has started, it will not be stopped until the hour is up, even if gorillas move again out of view during that time.

B2.5 Rule e: Eating before or after gorilla viewing (current limit: no eating "near" gorillas)

Food is a source of direct exposure, which carries a much more efficient rate of disease transmission than the airborne route. In addition, several human diseases of concern for apes are transmitted via the faecal-oral route. Some viruses and other germs can survive in food for hours or days, and food can act as a strong attractant to apes and other animals in the park. Rangers and researchers, who may occasionally spend days or weeks at a time in proximity of gorillas, eating meals in the forest with great regularity, also represent a source of food contamination to gorillas, even greater than tourists. Food scraps dropped by community and other forest users represent another substantial contamination source.

No standard minimum distance for eating is stipulated in the current rules. Although a minimum of 200m was proposed by several survey respondents, it is difficult for guides or rangers to estimate such great distances in the uneven environment of the forest. Translating distance into time would put this rule into more practical terms.

Recommendations on eating in the vicinity of gorillas

- The recommendation is to enforce for all people a 5-minute minimum walking distance away from gorillas before eating, as well as strict removal of all food remains.
- Care should be taken to carry all food scraps and other regular rubbish out of the park.
- In case of prolonged stays in the park, researchers, trackers or other staff should make all efforts not to leave any food behind. In case this is not feasible, remnants should be buried as deep as possible.

B2.6 Rule f: Disposal of human faeces (current rule: bury faeces 1ft deep)

The potential for transmission of human viruses or parasites through faeces is not only much more efficient than the airborne route, but also much more dangerous than through food, due to the concentration of germs that can be found in faeces. In addition, the number of potential sources of contamination from faeces is compounded by the fact that significantly higher numbers of park staff and local community residents deposit faeces in the park than do tourists.

A number of important questions have thus been raised concerning this rule:

- *Is it sufficient to bury faeces?*
- *Is 1 foot deep enough?*
- *Is it feasible for tourists to dig such a hole before defecating?*
- *Is this rule respected by and/or adequate for guides, trackers, rangers and researchers?*
- *What can be done about faeces resulting from other uses and misuses of the park (multiple users, poachers, hunters, military, etc.)?*

Rainfall is high in all parks, and can easily wash out faeces buried in a one-foot deep hole. Gorillas are known to be both geophagic and coprophagic and therefore can be attracted to shallow or exposed faeces. Another factor is that tourists and other park users may often have diarrhoea and may not be able or willing to dig even a shallow hole before defecating.

As carrying faeces out of the park is not an option and might only be enforceable with tourists, who are the least source of faeces in the parks, a number of recommendations are made below.

Recommendation on faeces disposal

- Minimise possibility of defecation by tourists in park by promoting and allowing time for toilet use before start of tour
- Ensure that guides or trackers dig holes at least 0.5 metres (2 ft) deep for tourists and for themselves
- Treat faeces with an antiseptic solution before filling holes (150 ml of a 2% chlorine solution)
- Sensitise staff and researchers on the importance of this rule for the health of gorillas, tourists and all people in and around the parks, themselves included.

B2.7 Rule g: Prohibiting littering in park (current rule: carry out all rubbish, including biodegradables)

This rule is adequate, although it is in contradiction with the faeces rule, and does not address the disposition of rubbish once carried out of the park.

Recommendation on litter

The recommendation is to strengthen enforcement of the current rule through:

- training and monitoring of staff
- ensuring and monitoring safe and adequate rubbish deposits and removal around parks, and
- preventing animal of animals to rubbish disposal sites.

B2.8 Rule h: Limiting the minimum age of eligibility to visit gorillas (current limit: 15 year old)

The health rationale of an age limit is to prevent the transmission of "childhood" diseases to gorillas. There is no absolute clear-cut age limit to universally define the end of the "childhood disease" period. It is however widely admitted that the majority of childhood disease episodes occur before puberty. As adolescence sets in at varying ages between 12 and 16 depending on gender, origin and individual characteristics, the 15 year-old limit by and large corresponds to a reasonable average to differentiate children from adults

Recommendation on minimum age

- The recommendation is to maintain the current age limit of 15.

B2.9 Rule i: Prohibiting access to people who are ill (current rule: sick tourists are required to self-report)

The greatest challenge to this rule is its limitation in scope and enforcement. Infected people can shed viruses or bacteria before and after the appearance of symptoms and this rule does not address the situation of sick guides, trackers or rangers which may arise at least as often, if not more often, than with tourists. Difficulties in enforcement are also considerable, as tourists may lack the motivation to self-report and guides may not be qualified to judge whether or not a tourist is ill.

Recommendation on illness rule

There is no actual modification suggested on this rule, but determined action needs to be taken to strengthen it. Measures recommended include:

- active sensitisation of tourists before booking of tour
- immunisation of tourists and park staff against specific diseases of concern (see C1.3 below)

B2.10 Rule j: Controlling smoking, eating, sneezing, and coughing in the presence of gorillas

This rule is self-explanatory but addresses controllable (smoking and eating) as well as uncontrollable reflex behaviours (sneezing and coughing). Spitting or nose-blowing on the ground in the park are controllable behaviours that should be added to this rule, as they carry a substantial contamination risk.

Recommendation on self-control rule

- Clarify statement by differentiating action for controllable behaviours and uncontrollable reflexes
- Include spitting or nose-blowing on the ground as controllable behaviours from which to refrain

C. POSSIBLE ADDITIONAL PROTECTIVE/PREVENTIVE MEASURES

C1 Measures designed to reduce the human risk

C1.1 Wearing of protective devices – masks or gloves – by tourists (currently mandatory for park staff and veterinarians when handling immobilised gorillas)

At various times since the early days of gorilla tourism, the wearing of protective masks and gloves by tourists while viewing the gorillas has been discussed. The idea is to further reduce the likelihood of aerosol or fomite transmission of disease-causing germs to gorillas. Several limitations and difficulties are inherent to the implementation of this proposition:

- Efficacy: masks lose their effectiveness once saturated by moisture, as droplets can cross through the wet membrane.
- Disposal (whether outside the park or accidentally within the park) could generate additional sources of contamination.
- Compliance depends on willingness of tourists and on the empowerment and training of guides to enforce the rule.
- Feasibility: who will, and how to, ensure adequate supply, management, disposal, and monitoring?
- Could be viewed as excessive from a tourist comfort/satisfaction point of view.
- Possibly traumatic and fear-inducing (for the gorillas)

Recommendation on the wearing of protective devices

- The recommendation is to ensure regular and strict (100%) compliance of park and veterinary staff regarding the wearing of protective devices during hands-on interventions. This is especially important in light of the numerous cases of contamination in captive animals as well as the growing concern about new pathogens "jumping" from primates to humans.

C1.2 Disinfection and hygiene

Washing hands before or after a visit to gorillas is not a foolproof way to eliminate the risk of possible contamination or disease transmission, but rather is a means of decreasing the likelihood of transmission. Besides its ease of implementation, this measure would have several positive side effects:

- As an educational measure for tourists and park staff, reinforcing awareness of the seriousness of the risk.
- As a reminder that the risk of contamination does work both ways (washing hands **after** tourist visit).
- By setting the stage for establishing the same recommendation for researchers and park staff.
- As a beneficial measure for the health of all people concerned, as hand hygiene is the single most effective basic preventive method for many communicable diseases.

Boot soles can be a major mode of transport for material contaminated with viruses, spores and parasites. Boot disinfection by dipping soles in an antiseptic bath is relatively easy to implement given the availability, low cost and effectiveness of antiseptics. To ensure effectiveness and safety of products utilised, mud should be removed from soles before dipping and only appropriate non-toxic biodegradable products should be used.

Ensuring safe and adequate rubbish deposits and latrines is of paramount important in the reduction of disease risks associated with littering, defecation and improper disposition of faeces and rubbish, as discussed in the rule review. However, present rules need to address not only situations linked to gorilla visits and habituation, but should also reduce exposure from all rubbish and faeces generated by staff and visitors near parks.

No spitting or nose-blowing on the ground in the park is equally necessary to include in park rules as sputum and nasal secretions can harbour high concentrations of germs dangerous to gorillas, especially in case of a recent or subclinical infection. TB, influenza and measles are among the many examples that could be quoted. Tourists as well as researchers, park staff, and other human forest-users must be regularly reminded of this simple guideline to avoid putting gorillas and other apes at unnecessary risk of infection.

Recommendations on disinfection and hygiene

- Institute hand and boot disinfection (0.2% chlorine) before and after gorilla tracking
- Make hand washing mandatory following defecation
- Ensure safe and adequate rubbish deposits and latrines out of reach of roaming animals in all parks

C1.3 <u>Immunisations and/or testing of tourists, researchers and park staff</u>

This proposition concerns tourists, staff and researchers, albeit in different ways. Diseases for which human vaccines are available and efficacious include influenza, measles, TB, polio, tetanus, yellow fever and hepatitis. Given the efficacy, limitations and feasibility of different vaccines, and the epidemiological background of the people concerned, the recommendation is as follows:

<u>Recommendation on immunisations for tourists, staff and researchers</u>

- FOR TOURISTS FROM TEMPERATE ZONES ONLY: Require proof of current (same year) immunisation against influenza in winter (October through March in the Northern hemisphere, April through September in the Southern hemisphere).
- FOR ALL (VISITORS, STAFF & RESEARCHERS): Require proof of current immunisation against yellow fever (< 10 years), polio, tetanus (< 10 year), hepatitis A and measles (if born after 1956), and of clear TB status.

C1.4 <u>Systematic health monitoring of park staff and researchers</u>

<u>Quarantine for researchers</u> is widely used in zoos, veterinary and research facilities to prevent potential introduction of foreign germs and diseases. It has been used in some gorilla parks in the past, albeit inconsistently, and this should now be instituted in all parks.

<u>Monitoring the health status of park staff (including researchers)</u> is an important complementary measure to reduce the risks of contagion of gorillas by these personnel. Currently, neither staff nor researchers are under obligation to submit to regular medical checks and there is no specific health worker or service attached to park personnel. An equitable and mutually beneficial program should include regular health checks, provisions for outpatient treatment and referral, and a standard and regularly-updated prevention programme including routine testing and immunisation schedule, as well as periodic health education sessions. It is essential that such a programme be established primarily for the benefit of the staff themselves, and not only out of consideration for gorilla health.

<u>Recommendations on staff health monitoring</u>

- Establish a 3-week quarantine system in all parks for all newly arrived foreign researchers
- Schedule regular medical checks for park staff and researchers, including TB testing, administration of vaccines, provision of curative services and appropriate referral, within existing resources in all parks
- Establish disease-specific guidelines to regulate forest and/or gorilla access to people in prodromic (i.e. incubation), active or convalescent disease stages
- Organise regular sensitisation sessions, exchanges and updates on disease transmission risk, among park staff, veterinarians, researchers and conservationists
- Define, in collaboration with local health authorities, objectives, strategies and implementation plan towards the establishment of a comprehensive health monitoring system and referral service for all staff and researchers in each park

C1.5 <u>Improving the health status of local communities</u>

Efforts at supporting and strengthening primary health care and prevention programs among the general population surrounding the parks are essential to reduce the threat of human disease in a sustainable way over the long term. Although the challenges to current public health programmes are substantial, integrating public health and conservation is an important stepping stone towards building the indispensable public and professional awareness of the relationship between human and gorilla survival.

Recommendation on local community health issues

- Encourage and support protected area authorities to advocate collaboration and partnership between human medical institutions and wildlife veterinary and / or conservation institutions in the design and implementation of research and intervention programmes addressing local community health issues.

C1.6 <u>Active information/sensitisation campaign about the dangers of human disease for gorillas</u>

Reinforcing guides training and increasing public awareness about the existence and significance of disease threats to gorillas should be an essential element of an integrated approach to gorilla conservation (McNeely 1992). Yet surprisingly little has been done or publicised for the general public on this issue. Until this awareness is established, rules can always be broken, no matter how strict and stiff the enforcement. The potential to create a *gorilla-conscious tourism* movement not only exists, but could be the most effective way to promote participatory enforcement of the rules and subsequent endorsement by policy makers and the tourism private sector.

However, education of the public does not eliminate the need for adequate enforcement. Guides should be better trained and regularly updated on this issue as part of an overall strategy to increase park staff motivation to strictly enforce rules.

Recommendation on active information/sensitisation on the human disease threat

- Institute regular information/discussion sessions for guides, trackers and rangers to update their knowledge on disease transmission and ensure their adequate understanding, and ability to explain and enforce the disease rationale of the tourism rules, both among themselves and in dealing with tourists
- A similar programme should be instituted for tour operators with a view to enlisting their full cooperation in promoting and ensuring rules enforcement by their clients
- Plan and implement an active sensitisation campaign for surrounding park communities, tourists and tour operators about the importance of the human disease threat to sustainable gorilla tourism. Such an intervention should involve the international print and audio-visual media as well as the production of educational materials

C2 Measures designed to enhance gorillas' protection

C2.1 Fencing BINP visitor centre off to keep animals from roaming in or around tourist settlements

This proposition stems from the risk of disease contamination inherent in having gorillas ranging in and around human settlements. This is of particular concern for parks where such dwellings are located near to gorilla home ranges. Fencing has recently been one of the interventions evaluated by an environmental impact assessment (EIA) in Bwindi National Park where tourist and staff infrastructure is located at the edge of the forest, in areas frequented by gorillas. Another possible mitigation measure under consideration in this EIA is to create a buffer zone of non-attractive crops or open space along the edge of the forest to deter the gorilla from exiting the forest, which would essentially be a natural (non-fenced) barrier to gorilla movements. As the EIA mentioned above specifically addresses these questions and stresses the need for an integrated approach, this consultancy will refer to it in lieu of recommendation.

Provisional recommendation on fencing

- Identify and fence off potential sources of immediate contamination such as high concentration rubbish sites near park borders

C2.2 Active protection of habituated gorillas

The question underlying this proposition is: Should we take the chance and let the gorillas acquire the necessary resistance to potentially deadly diseases through natural selection (minimal intervention ethic), or should we, whenever possible, pro-actively and pre-emptively protect them against these diseases through immunisation? The idea here is not to immunise all mountain gorillas, which would be practically impossible, but to vaccinate habituated animals in order to create a buffer population. This buffer population would be resistant to the dangerous diseases to which they are exposed, and would therefore represent a lesser risk for their unhabituated counterparts in the forest.

While it was not the purpose of this review to make recommendations about gorilla immunisation, the issue was explored as part of a comprehensive disease prevention programme for gorillas. Advantages and limitations were considered and a number of misconceptions relating to the risk, testing and administration of vaccines clarified. And whether or not there is a need to discuss gorilla immunisation, there should be sufficient knowledge and understanding, as well as preparedness regarding potential emergencies and immunisation processes, in the event that such intervention may become necessary

The conclusion was that, given the size of the remaining gorilla population and both the actual and potential levels of disease threats, contingency plans are a must. All parties should be equally aware of the effects, advantages, implications, constraints, and limitations of vaccines and other protective intervention methods as well as be fully prepared to take action an case of need.
.

Recommendations on gorilla immunisation and other protective interventions

- Develop contingency plans for curative and prophylactic interventions in case of epidemic outbreaks or other emerging threats among gorilla populations.
- Contingency plans should clearly define criteria for intervention with clear decision-making guidelines and authority, as well as specific action plans corresponding to different levels of intervention
- Contingency plans need to be regularly revised and updated as health monitoring data becomes available, as well as rehearsed and disseminated among park staff, researchers and other parties who will take part in potential interventions

C2.3 Systematic gorilla health monitoring and research

Sound curative and preventive measures for gorillas, including contingency plans, should rely on a monitoring system that methodically collects health data on mountain gorilla populations in every park. This data will also be useful for the establishment and revision of policies and guidelines relating to tourism rules, forest use and conservation objectives.

Up to now, health monitoring has been carried out either through specific research projects, or on an opportunistic basis following guidelines for sample collection established by the Morris Animal Foundation (1989/90 – MAF Scientific Advisory Committee). However, collection has been inconsistent over time and between different parks, with samples and data scattered among different laboratory facilities in different countries, making it difficult to use or analyse existing information in its entirety.

A comprehensive health sampling and data collection policy should thus be developed, adopted and enforced by all parks. In the meantime, the practice of opportunistic sampling of serum and tissue should be standardised and applied or re-activated systematically in all parks. Serum samples should be sent to and stored both locally and/or in a provisionally approved location until a centralised facility is designated and agreed upon by all parties.

Non-invasive research offers wide and necessary opportunities to fill the gaps resulting from the opportunistic sampling approach currently used to monitor basic health variables of the gorillas. Research is also needed to further inform gorilla tourism rules, to support public and staff education, and can serve as an early surveillance system for emerging diseases, both among humans and primates. Finally, research is essential to monitor the various variables associated with predictive modelling of the viability of mountain gorillas.

Recommendation on gorilla health monitoring and research

- A comprehensive biological sampling and data collection policy for gorillas should be developed, adopted and systematically enforced in all parks.
- The data and material collected should be stored both on site and at a central facility designated to compile, analyse and disseminate regularly updated information to all sites
- There is a need to design and support research protocols for the long-term assessment of tourism impact on gorilla morbidity and mortality with particular emphasis on immunity and reproduction

D. CONCLUSIONS

Rules are only meant to limit the potential damage that tourism may cause. There is no question that by entering the wilderness *en masse*, we transform both the environment and its inhabitants, especially those we are so eager to see, encounter and experience, like the mountain gorillas. For as long as tourism will be practised, rules will have to be in place, constantly revised and refined, and enforced as well as possible. Yet, the most powerful enforcement tool is motivation and self-control.

No matter the level or sophistication of punitive or coercive schemes that are used or have been articulated, rules can - and will - always be broken. The best hope for minimising the damage from a tourism programme resides in the widespread sensitisation, awareness and understanding of the catastrophic consequences of unconscious gorilla tourism. This is admittedly a medium, if not long-term, goal that requires careful planning and sustained efforts and certainly cannot be considered in isolation. Other immediate actions can and should be undertaken to limit the risks in the meantime. They have been explored in this report, and are summarised in its final recommendations.

Eventually however, it is not the rules, but the attitude of the human community towards its non-human environment that will decide of the fate of the gorillas, and indeed of many life forms on this planet, including our own. Therefore, awareness raising, albeit a long and strenuous process, is the only sure investment. It may not be a guarantee of success, but it undoubtedly is a vital ingredient in the balance of the many choices that will have to be made, now and in the future, for this and other conservation programmes.

1. INTRODUCTION

Since Dian Fossey's pioneering work with the mountain gorillas of the Virungas Volcanoes in Rwanda (Fossey 1983), gorilla tourism has become the most universally accepted, supported and lucrative way to foster the conservation of these and other endangered great apes both within and outside the African region (Oates 1986, Foster 1992). At the time, tourism emerged as the only immediate option capable of galvanising sufficient and immediate support to save mountain gorillas from poaching, habitat encroachment and possible extinction. The governments of all three countries harbouring the few remaining mountain gorillas, Rwanda, Uganda and the then Republic of Zaire (now the Democratic Republic of the Congo - DRC), took active steps towards protecting the gorillas' natural forest habitat around the Virunga Volcanoes by declaring the areas national parks. The Parc National des Volcans of Rwanda was the first to be opened to gorilla tourism in 1979. It was soon followed by the Parc National des Virungas of Zaire in 1984. Bwindi Impenetrable National Park (BINP) and Mgahinga Gorilla National Park (MGNP) in Uganda were gazetted in 1991 and 1992 respectively (Butynski & Kalina 1993).

Subsequent measures to open the parks to mountain gorilla tourism effectively enabled people from around the world to view the last representatives of this most charismatic sub-species in their natural habitat, generating tremendous enthusiasm and success for the programme. As a result, gorilla tourism has become one of the most successful tourist operations in these countries, generating considerable revenues and publicity for the region. However, this booming tourist activity every year brings thousands of people from all continents into close proximity to the gorillas. This raises another important threat to their survival in the form of human diseases to which these animals can be extremely susceptible, with potentially devastating consequences (Acha & Schildkraut 1987, PHVA for *G.g. beringei* 1997; Butynski 1998, Butynski & Kalina 1998).

Population pressure and human diseases remain two intrinsically linked threats to the survival of mountain gorillas. The Virunga Volcanoes region of Central East Africa indeed is one of the most densely populated areas of the world (Ministry of Planning and Economic Development, Uganda, 1997). Unfortunately, this region has also been most prone historically to political conflicts and warfare, its population is characterised by very low socio-economic status, and has high levels of endemic respiratory and diarrhoeal diseases to which the gorillas are particularly vulnerable. These conditions make the survival of mountain gorillas a questionable issue in the long term.

Gorilla tourism provided the common ground for governments, the business community, conservationists and biologists, to cooperate for the preservation of mountain gorillas. Obviously, every party in this effort had, and still has, its own priorities. While conservationists see or accept ape tourism as a means towards preserving endangered primates and their habitat, tourist operators focus on the financial viability of the enterprise, and governments lean towards varying interests depending on the most pressing issues on their social, economical and political agenda at any one time.

The conservationists who set up gorilla tourism in the mid-1970's adopted a number of rules to regulate gorilla tracking. These rules were based on safety, conservation and tourist satisfaction and are, for the most part, still in effect today. The conservation aspect of these rules was based on the best available knowledge regarding the risk of exposure to human diseases as well as to the different factors affecting gorilla behaviour and habitat (Vedder A, pers. comm.). As the interest in gorilla tourism grew unabated, so did the number of tourists and the need to ensure that the rules in place are appropriate both from the tourism and conservation standpoints.

The present consultancy was a first step taken by the International Gorilla Conservation Programme (IGCP) in this direction. This report summarises the consultant's finding and presents evidence from the literature on different causes and cases of morbidity (illness) and mortality among mountain gorillas and their close relatives, the eastern and western lowland gorillas. It analyses the risks associated with gorilla tourism and relevance of the current rules using available data as well as advice and opinions from various experts in the field of veterinary medicine, pathology, conservation biology and anthropology. Recommendations on possible modifications to the current rules are discussed. Finally, the report explores various aspects and related implications of possible additional protective/preventive actions that could be taken for the preservation of mountain gorillas, and makes recommendations on each. All recommendations were presented and discussed at the January 1999 IGCP Regional Meeting in Rwanda, which was attended by park managers and headquarters staff form the three protected area authorities (UWA, ORTPN, and ICCN), as well as representatives from conservation organisations active in the region. Following discussion at the regional meeting, Final Recommendations were produced and are included at the end of this document.

2. BACKGROUND AND OBJECTIVES

Tourism was started in the parks of all three countries harbouring mountain gorillas with a similar intent. The goal was to establish a successful conservation-minded programme that would ultimately serve the interests of all by generating revenues and benefits for local communities and governments, thereby eliciting much needed support for conservation research, as well as protection and long-term management of these parks. Thus, from its inception, organised mountain gorilla tourism was planned to be a sustainable activity aimed, as were all other activities, at serving the goals of conservation. Management plans of both BINP and MGNP indeed stress that "*tourism is secondary to conservation, though it will be complementary by providing funds to support conservation*" (Uganda National Parks 1992, 1995 & 1996).

IGCP, formerly known as the Mountain Gorilla Project (MGP), has been responsible for the aiding in the establishment of gorilla tourism in Rwanda and Uganda, and the provision of tourism management advice to its collaborators, the relevant government authorities in all three countries. For Uganda National Parks (UNP), IGCP produced a Tourism Development Plan that strongly emphasised the risks posed by the introduction of human borne pathogens for the health of the gorillas (UNP 1992). Indeed, gorillas like all great apes share a high degree of genetic similarity with humans and as such are susceptible to many of the pathogens found to infect humans (Gibbons 1990, Kalter 1980, Ott-Joslin 1983 & 1993, Marks 1988). However, because they have evolved separately from humans in the wild, gorillas are immunologically non-resistant, or “naïve”, to a number of human diseases. In other words, they have not built resistance to these diseases as a population, and are therefore extremely vulnerable to them. This is very similar to the way islanders or native human populations on newly “discovered” continents experienced severe epidemics upon first contact with an “immune” population of colonisers carrying one or more infectious agents to which it had become resistant.

By bringing humans in close proximity to wild apes, tourism thus is an effective means of introduction of potentially dangerous germs into gorilla habitat. Once an animal is infected, it becomes an efficient source of contamination to other members of its group, as habituated and non-habituated groups are known to interact regularly (Watts 1991 & 1998). Therefore an infected gorilla group is obviously a threat to the entire population within its range.

The rules first established in Rwanda and subsequently adopted to the parks in ex-Zaire and Uganda thus attempted to set a number of limits to reduce, as much as possible, potential transmission from tourists to animals (UNP 1992, 1995 & 1996). Over time, these rules have been enforced and respected with varying degrees of success, depending on the training and motivation of the park staff, the socio-economic situation of the country, and the willingness of tourists to respect the rules. Recently, the increasing frequency and severity of political conflicts in the region have virtually brought the Rwanda and DRC (ex-Zaire) tourism programmes to a standstill, and putting the Uganda parks under increased pressure from a world-wide growing demand for gorilla and nature tourism (Morris 1997, Miller 1996, Nowak 1995, Roberts 1993). As a result, gorilla visits in Uganda have been booked for a year or more in advance and the pressure to relax limits on gorilla tourism has increased accordingly.

This situation leads to a dilemma that is inherent in the establishment of many conservation programmes. Tourism, as a sustainable utilisation programme, is intended to provide both use and preservation of the parks and their wildlife, including the gorillas, using each of these two ends to support the other. Use and preservation are however mutually limiting. Tourism is aimed at protecting gorillas but can also destroy them, while conservation alone without exploitation stands little chance of surviving the enormous population pressure that surrounds the parks and their resources. Tourism rules therefore are the line along which a balance must be found to allow each of these two ends to meet their common goal of sustaining the programme. A full recognition of this fact is essential before a realistic and thorough review of the rules can be undertaken.

The formal objectives of this review were specified in the terms of reference (TOR) of this consultancy, which are annexed to this report (**Appendix 2**). In brief, the main objective of the consultancy was:

To assess the effectiveness of gorilla tourism rules in minimising health risks to gorillas with the ultimate goal of developing a sustainable tourism programme, both at the national and the regional levels.

3. METHODS

In accordance with the Terms of Reference (**Appendix 2**) of this consultancy, the methods used to carry out this assignment included:

- Literature review in the fields of gorilla conservation, risk of human disease, and management of protected areas among others, using Medline and Melvyl computer literature search systems, and personal communications.
- Consultations with veterinary and human infectious disease specialists either through personal (mostly at the University of California at Davis, USA) or telephone interviews. The list of people met or interviewed is annexed to this report (**Appendix 3**)

- Additionally, contacts were made with some tour operators and conservation organisations in order to gather additional information and opinions relevant to the discussion and recommendations of the consultancy.
- Circulation of a questionnaire among managers, academics, advocates and organisations/institutions with knowledge of wildlife veterinary medicine, conservation, anthropology, and other primate-related fields as well as park guides, rangers and trackers. The survey was to gather information and assess knowledge, attitudes and beliefs about:
    - human diseases among wild or captive gorillas
    - gorilla tourism rules
    - additional changes or measures for transmission prevention

  The list of people who participated in this survey is also in **Appendix 3** and sample survey forms of these questionnaires are attached in **Appendices 4 & 5**.
- Presentation and discussion of preliminary findings and recommendations at IGCP Annual Regional Meeting held in Gisakura, Rwanda, January 11th-14th, 1999
- Amendment and production of final report incorporating the results of discussions at the IGCP Regional Meeting

4. THE CURRENT RULES AND THEIR RATIONALE

As mentioned above, the rules have been established to minimise behavioural disturbance, habitat (ecological) damage and disease transmission to the gorillas. The health-related aspects of these rules have focused on:

a) limiting the number of daily tourist visits to gorillas (current limit = 1 visit per day per habituated gorilla group)

b) limiting the numbers of tourists per group visiting the gorillas (current limit = 6 tourists/group in Uganda, . 8 tourists/group in Rwanda and DR Congo)

c) maintaining visitors at a minimum distance from gorillas (currently 15 feet =~5 meters)

d) limiting the amount of time tourists spend near gorillas (current limit = one hour)

e) eating away from the gorillas before or after visit

f) preventing deposition of rubbish and other infectious waste within gorilla habitat

g) burying faeces in 1-foot deep hole

h) preventing access by children (current minimum age limit = 15 years)

i) preventing access by people who are known to be ill

j) controlling behaviours such as smoking, sneezing, and coughing while viewing the gorillas

This report will first present findings concerning the susceptibility of gorillas to human diseases and pathogens, before engaging in the analysis of the rules and their relevance.

5. RESULTS OF LITERATURE REVIEW / CONSULTATIONS

5.1 Evidence of shared susceptibility to and transmission of pathogens between apes and humans

As members of the great ape family, gorillas are among our closest relatives and are therefore susceptible to a host of human pathogens (Gibbons 1990, Kalter 1980, Ott-Joslin 1983 & 1993). Although there is little published evidence demonstrating **direct transmission** of pathogens from humans to animals **in the wild**, a number of cases have been documented in the literature providing ample evidence of these animals' definite **susceptibility** to human diseases. Indeed, many cases of illnesses associated with human germs have been documented **in captive animals** including both respiratory and enteric microbes (Kalter 1980, Ott-Joslin 1983 & 1993, Benirschke & Adams 1980, Bielitzki 1996). Respiratory viruses and bacteria include influenza, adenovirus, rhinovirus, respiratory syncitial virus, pneumococcal pneumonia, Herpes viruses, measles, mumps, and cytomegalovirus. Enteric germs include polioviruses, coxsackie viruses, Salmonella, Shigella, Campylobacter, as well as numerous parasites. This variety of agents leaves no doubt about a widely shared susceptibility to pathogens among great apes and humans. **Table 1** below lists the documented evidence showing that gorillas (whether in captivity or in the wild) can either harbour, be affected, or have been exposed to human parasites, bacteria and viruses. This list is obviously not exhaustive as it only includes those cases that have been reported in the literature.

While humans and other apes may share similar receptivity to pathogens, we do not necessarily have the same resistance to these disease-causing agents. Even within our own human species, groups or individuals who evolved separately adapted specifically to their environment, and any permanent change in this environment can have (and has had) a critical impact on the survival of distinct populations. Such was the reason for example of the massive die-off among native populations in the Americas when they met Europeans setting foot on their continent for the first time. The longer the evolutionary separation between population groups, individuals, or species, and the greater the differences in exposure and/or behaviour between them, then the wider is the divergence in adaptation (in this case resistance to disease).

Illustrating this evolutionary gap between apes and humans is the example of malaria, the most prevalent human infection among people in proximity of gorilla habitat. Malaria does not seem to be transmitted from humans to apes, and apes do not appear to be a reservoir for the causative plasmodium parasite (Ollomo et al. 1997). Another example is that apes, like humans, harbour retroviruses, but some of them are highly species-specific. Thus, chimpanzees can be infected by the Simian Immunodeficiency Virus (SIV) (Gardner et al. 1992, Georges-Courbot et al. 1996), as well as its homologue HIV, the human AIDS virus (Locher et al. 1996), yet HIV does not infect gorillas *in vivo* or *in vitro* and does not seem to kill or affect chimpanzees as easily as it affects humans (Novembre et al. 1997). A third example is Epstein-Barr virus (EBV), responsible for causing infectious mononucleosis in humans, that may infect gorillas but in addition a unique EBV from gorilla origin has been isolated (Neubauer et al. 1979).

Thus, despite being very closely related genetically, humans and non-human primates have evolved separately for a long enough time - in evolutionary terms - to have diverged in terms of resistance to microbes. This is why either species or population group which comes in contact with the other can experience severe reactions to an infectious agent carried by the other group. It is important to note that this event may occur on both sides, as either group can potentially carry germs it has become accustomed to but that are totally new to the other. Following this logic, humans should be as threatened by ape pathogens as apes are by human pathogens!

The number of human diseases that can be acquired from animals (called zoonotic diseases) is large (Reinquist & Whitney 1987, Sedgwick et al. 1975, Shortridge 1992, Siemering 1986). Diseases that are transmitted from humans to animals (called anthropozoonotic diseases) are also numerous, but less documented (Acha & Szyfres 1987, Ott-Joslin 1993). What determines which species is most severely affected by interacting with another is the degree and variety of previous microbial exposure experienced by each group. Over generations, humans have acquired resistance to many infectious agents from a multitude of environments on all five continents of the globe. Therefore, the disease threat associated with the penetration of humans into a wild environment is generally greater for the wildlife than for the humans. This is because the probability of humans acquiring a new germ to which they have never been exposed is small. Yet, though small, this latter risk does exist as human resistance can never be absolute to all pathogens, and because pathogens themselves adapt and new forms continuously emerge. Such is the case of the HIV epidemic and, more recently, of the Ebola virus outbreaks.

To illustrate potential diseases that can be acquired from apes, **Table 2** lists a number of ape pathogens known to infect humans. Little data exists concerning transmission of zoonotic diseases to humans from wild gorillas. Yet there is good evidence of transmission from other wild primates (particularly chimpanzees and baboons), including widely publicised Ebola cases, and it is to be expected that the same can occur with gorillas, if it has not happened already. Therefore, even though still have little knowledge of these germs and their prevalence among wild gorillas, it is important to recognise this risk, and that tourism rules can and must account for it as much as they do for human diseases dangerous to apes.

Table 1: Documented evidence of susceptibility of apes to human pathogens and their survival in the environment

Note: some ape data may have to be added, completed or improved by participants at the meeting

Pathogen	Pathology/symptoms in humans	Pathology/symptoms in apes	Transmission	References	Survival *
VIRUSES		(susceptible apes)			*Pirtle & Beran 1991
Adenovirus	Respiratory + various syndromes, but often asymptomatic	none ? (chimp, **gorilla**)	aerosol [1] contact [2]	Dick et al. 1974	Resists up to 60C
Arbovirus	*Yellow fever*: haemorrhagic fever	same (chimp, **gorilla**)	Mosquito	Kalter 1980	
Coxsackie virus	Often asymptomatic; or wide variety of clinical syndromes	fatal respiratory + enteric syndrome (chimp)	faecal oral [3]	Kapikian 1996 Ott-Joslin 1983& 1993	150-170 days in soil 15 days in food
Cytomegalovirus	Mostly asymptomatic in healthy individuals, multiple pathologies in immunosuppressed humans	same ? (**gorilla**, chimp)	sexual [4] blood [5]	Ott-Joslin 1983 & 1993 Tsuchiya et al. 1970	Up to 2 days on fomites
Hepatitis viruses	HAV: *Hepatitis A*, acute hepatitis HBV: *Hepatitis B*, acute and chronic, predisposing factor for liver cancer HCV: *Hepatitis C*, usually asymptomatic, often followed by chronic disease	usually asymptomatic (**all**) often asymptomatic (**all**) asymptomatic, possible chronic hepatitis, cirrhosis (chimp)	faecal oral blood sexual blood	Anan'ev et al. 1984 Bielitzki 1996 Linnemann et al. 1984 Ott-Joslin 1983 & 1993 Warren et al. 1998 Zuckerman et al. 1978	HAV: several weeks at 25°C Hep B: at least 7 days on fomites
Herpes viruses **Herpes Simplex 1&2** **Herpes zoster** **Epstein-Barr virus**	Herpes syndrome (fever, rash, conjunctivitis, diarrhoea, CNS signs) *Varicella* *Mononucleosis*	same (**all**) same (**all**) ? (chimp, **gorilla**)	aerosol contact sexual	Ablashi et al. 1979 Benirschke et al. 1980 Eberle et al. 1989 Heldstab et al. 1981 Neubauer et al 1979 Ott-Joslin 1983 & 1993 Padovan et al. 1986 Rabin et al. 1980 Warren et al. 1998 Roberts J, pers. comm.	Hours on fomites Days on dry absorbent surface
HTLV I (Human T-Cell Leukemia virus)	Lymphoma	same (**gorilla**)	sexual blood	Srivastava et al. 1986 Lee et al. 1985	
Orthomyxovirus	*Influenza* (flu)	more severe (chimp, gibbon)	aerosol	Kalter et al. 1978 Johnsen et al. 1971 Ott-Joslin 1983 & 1993 Wack, pers. comm.	< 3 days in dry food 1-2 day on hard surface, < 12h on porous surface. Up to 2 months at 4C.
Parainfluenza (type 3)	Few signs in humans	Flu-like symptoms (chimp, gibbon, **gorilla**?)	aerosol	Clements et al. 1991 Jones et al. 1984	4-10 hrs on absorptive / non-absorptive surfaces
Pathogen	**Pathology/symptoms in humans**	**Pathology/symptoms in apes**	**Transmission**	**References**	**Survival ***
VIRUSES		(susceptible apes)			*Pirtle & Beran 1991
Paramyxovirus	*Measles*: fever, rash, conjunctivitis, GI and respiratory signs	from asymptomatic to fatal (**all**, but gorilla not confirmed)	aerosol contact	Ott-Joslin 1983 & 1993 Hastings et al. 1991	• Can survive and conserve infectivity in droplet

	Mumps: parotiditis, orchitis	same (chimp, orang, **gorilla**)			nuclei for > 2 hours
Papillomavirus	Common and genital warts (potentially oncogenic)	oral hyperplasia (chimp)	contact blood	Bielitzki 1996	Resistant to common disinfectants, sterilisation
Poliovirus	Meningitis, encephalomyelitis, paralysis	same (chimp, orang, **gorilla**)	faecal-oral	Ott-Joslin 1983 & 1993 Froeschle et al. 1965	150-170 days in soil 50 days in cockroaches 15 days in food
Poxvirus	*Molluscum contagiosum***:** small skin nodules, usually benign, except in immunocompromised patients	same (chimp)	contact	Ott-Joslin 1983 & 1993	
Respiratory syncitial virus	Respiratory infections incl. bronchopneumonia	same (chimp) serological evidence (**all**)	aerosol	Clarke et al. 1994 Lerche 1993 Lowenstine L, pers. comm. Richardson et al. 1981	1-6 hrs on skin-fomites
Rhinovirus	Common cold, rhinitis, (may be more severe in newborn & children w/ diarrhoea, pneumonia, vomiting)	subclinical to mild respiratory infection ? (chimp, gibbon)	aerosol faecal-oral	Ott-Joslin 1983 & 1993 Dick et al. 1968	
Rotavirus	Gastroenteritis (diarrhoea, vomiting, low grade fever)	same (chimp, orang, **gorilla**)	faecal-oral	Ott-Joslin 1983 & 1993 Ashley et al. 1978 Ijaz et al. 1994	• Resistant to chemical disinfectants • Aerosols stable for 24hr+ at 50% humidity
BACTERIA					
Campylobacter jejuni	Enteritis, colitis	enterocolitis	faecal-oral	Ott-Joslin 1983 & 1993	
Bordetella pertussis	*Whooping cough*	(chimp)	aerosol	Kalter 1980	
Escherichia coli	Gastroenteritis	(chimp)	faecal-oral	Benirschke et al. 1980 Van Kruiningen et al. 1991	
Mycobacterium tuberculosis	Pulmonary/extra-pulmonary TB	same (**all**)	aerosol	Ott-Joslin 1983 & 1993	
Proteus mirabilis	Gastro-intestinal/ Genito-urinary tracts infections	otitis/meningoencephalitis (**gorilla**)	faecal-oral	Benirschke & Adams 1980 Iverson & Popp 1978	
Salmonella sp.	*Typhoid fever*	enterocolitis (?)	faecal-oral	McDermid et al.1996 Ott-Joslin 1983 & 1993	>2h at 75% humidity, 24ºC
Shigella sp.	Dysentery	enterocolitis (**gorilla**)	faecal-oral	Lemen et al. 1974 Stetter et al. 1995	
Streptococcus sp.	Multiple pathologies	same (**gorilla**)	aerosol	Ott-Joslin 1983 & 1993 Bar-Dayan et al. 1997	Airborne Strep more invasive
Treponema pertenue	*Yaws:* lesions of skin, mucosa and bone	same ? (**gorillas** in Gabon?)	contact	Benirschke et al. 1980	
Yersinia enterocolitica	Gastro-intestinal disease	diarrhoea (?)	faecal oral	Swenson	

* Germ survival reference: (Pirtle & Beran 1991)

Pathogen	Pathology/symptoms in humans	Pathology/symptoms in apes	Transmission	References	Survival *
Mycoplasma	Pneumonia	arthritis (?)	aerosol	Benirschke et al. 1980	
PARASITES					
Ankylostoma duodenale	Hookworm disease: anaemia, intestinal and pulmonary signs	same ? (**gorilla**?)	faecal-oral	Benirschke et al. 1980	

Ascaris lumbricoides	Tapeworm	same (**all**)	faecal-oral	Benirschke et al. 1980	Eggs in soil for months
Balantidium coli	Often asymptomatic, but also chronic diarrhoea, severe dysentery, acute appendicitis	same ? (**gorilla** particularly sensitive: fatal enterocolitis)	faecal-oral	Marsden et al. 1991 Lee et al. 1990 Teare et al. 1982 Swenson Wack RF, pers. com.	
Cryptosporidium					
Echinococcus multilocularis	Hydatidosis (liver cysts)	same (**gorilla**)	faecal-oral	Kondo et al. 1996 Benirschke et al. 1980	
Entamoeba histolytica	Amoebic dysentery		faecal-oral		
Enterobius vermicularis (pinworm)	Anal/vulvar itch	same (**all**, may cause fatal enterocolitis in chimp)	faecal-oral	Ott-Joslin 1983 & 1993	
Giardia lamblia	Diarrhoea, malabsorption	same (**all**)	faecal-oral	Ott-Joslin 1983 & 1993 Swenson Wack RF, pers. comm.	Can survive in water for months
Isospora belli	Traveller's diarrhoea		faecal-oral	Benirschke et al. 1980	
Leptospira	*Leptospirosis:* systemic disease of kidneys, liver, nervous system	(chimp)	faecal-oral transdermal [6]	Kalter 1980	
Loa loa **Mansonella**	*Filariasis* (often asymptomatic, chronic lesions in the long term)	same (**gorilla**)	Insect vectors	Bain et al. 1995 Haberman et al. 1968	
Sarcoptes scabies	*Scabies*	same (**all**)	contact	Kalema et al. 1998 Macfie 1996	
Schistosoma sp.	*Schistosomiasis/Bilharzia::* intestinal or urinary pathology	same (chimp, **gorilla**?)	transdermal	Kalter 1980	Reproduces in water
Strongyloides stercoralis	Intestinal & pulmonary disease	enterocolitis (**all**)	faecal-oral	Benirschke et al. 1980 Ashford et al. 1990	
Trichuris sp.	Often asymptomatic	same ? (**all**)	faecal-oral	Benirschke et al. 1980	

[1] Transmission via dust or water particles transported by suspension in the air
[2] Transmission by direct (skin or mucosal) touch
[3] Transmission via faeces, contaminated food, water, any other ingested substance or object coming in contact with the mouth (e.g. the hands)
[4] Transmission through sexual contact (exchange of fluids)
[5] Transmission through exchange of blood or internal bodily fluids (semen, milk, etc)
[6] Transmission from contaminated water through the skin
? = suspected but not confirmed

Table 2: Ape pathogens known to infect humans

Pathogen	Pathology/symptoms in apes	Pathology/symptoms in humans	Transmission	References
PARASITES				
Balamuthia mandrillaris	Meningoencephalitis (**gorilla**)	same (often fatal)	faecal oral	Rideout et al. 1997
Cryptosporidium				
Enterobius vermicularis	Pinworms, diarrhoea (**all**)	Anal itch	faecal oral	Ott-Joslin 1983 & 1993
Filariae (several sp.)	(**gorilla**, chimp)	Filariasis	insect vectors	Ott-Joslin 1983 & 1993
Hymenopsis nana	Tapeworm (chimp)	Same (esp. in children)	contact faecal oral	Ott-Joslin 1983 & 1993
Leishmania sp.	Experimental infection	*Leishmaniasis*: subclinical to severe or fatal systemic or skin lesions, depending on type of *Leishmania*	sandfly	Ott-Joslin 1983 & 1993
Plasmodia	Usually none (**all**?)	Malaria	mosquitoes	Ott-Joslin 1983 & 1993 Swenson
Strongyloides	Can be fatal (chimp, orang, gibbon)	*Strongyloidiasis*: (see Table 1)	faecal oral	Ott-Joslin 1983 & 1993
VIRUSES				
Cytomegalovirus	Often asymptomatic, but can cause severe diarrhoea, colitis, pneumonia, nephrosis, etc (**gorilla**, chimp)	same for healthy humans, causes multiple pathologies in immuno-suppressed individuals	contact blood	Ott-Joslin 1983 & 1993
Ebola / Cote d'Ivoire	Haemorrhagic fever (chimp)	fever, acute diarrhoea and rash (1 case, non-fatal)	blood, tissue?	Le Guenno et al. 1995 Morrell
Herpesvirus simiae (Herpes B)	Asymptomatic (chimp)	Fatal myelitis, encephalitis	contact (especially brain tissue), aerosol	Ott-Joslin 1983 & 1993
Hepatitis viruses	See table 1	See table 1	faecal oral	Bielitzki 1996
Monkeypox	Fever, facial oedema, multiple pustules (chimp, orang, gibbon)	similar to smallpox	scratch	MMWR 1997 Ott-Joslin 1983 & 1993
Paramyxovirus	From asymptomatic to fatal in many monkeys and apes, but not confirmed in **gorilla**	*Measles* (see Table 1)	aerosol	Ott-Joslin 1983 & 1993 Roberts J, pers. comm.
Poliovirus	From asymptomatic to paralysis (chimp, orang, **gorilla**)	Polio	faecal-oral	Ott-Joslin 1983 & 1993 Froeschle et al. 1965
Respiratory syncitial virus	Originally isolated from a chimp with URI in 1955	Multiple respiratory pathologies	aerosol	Morris et al. 1956
Rhinovirus	Subclinical to mild respiratory infection (chimp, gibbon)	Mostly to the young (diarrhoea, pneumonia, vomiting)	aerosol faecal-oral	Ott-Joslin 1983 & 1993 Dick & Dick 1968/74.
Rotavirus	Diarrhoea, vomiting, anorexia (chimp, orang, **gorilla**)	Same	faecal-oral	Ott-Joslin 1983 & 1993 Ashley et al. 1978

5.1.2 Evidence of actual transmission of human disease to gorillas and chimpanzees

As said above, even though there is no direct proof of transmission of human disease to gorillas in the **wild**, there have been several cases of transmission of human diseases to **captive** animals. **Table 3** summarises some of these cases, yet is far from exhaustive, as most of these instances have occurred in zoos, which avoid negative publicity associated with such events[1]. As a result, the table is missing a number of dates and places, and several additional cases of variola, chicken pox, reproductive problems linked to HSV2, and streptococcal pneumonia were mentioned verbally but are not in the table.

As a corollary to transmission to gorillas, numerous occurrences of human disease transmission to **chimpanzees** have been recorded. A few published cases strongly linked to human transmission have been of invasive pneumococcal disease linked to parainfluenza-3 virus infection (Jones et al. 1984), RSV infections in young chimps (Clarke et al. 1994), and various polio outbreaks among captive (Froeschle & Allmond 1965) or orphaned chimps in Gombe (Wallis, in press).

5.2 Diseases of particular concern

In the wild, the threat of particular microbes is directly related to their route of transmission and their survival in droplets, soil, water, food or faeces. Examples of these characteristics and their wide variation among different organisms have been outlined in **Table 1**. The TB bacillus, several viruses such as measles, polio and coxsackie as well as various agents responsible for pneumonia, such as influenza, pneumococcus and the respiratory syncitial virus can all survive in the open on fomites or in droplets, ranging from a few days to years given appropriate conditions (Pirtle & Beran 1991; Wallis F, in press; Lavanchy D, Hay A, Webster R, pers. comm.). And some agents like polio are capable of surviving for several months in soil, others like measles can be transported over great distances in the open (Ehresmann et al. 1995).

The human diseases of concern for gorillas are those that are easily transmitted without requiring direct or prolonged contact with people. Until recently, the focus has been on respiratory infections that are transmitted by air ("airborne" or "aerosol" transmission) and are relatively easy to detect in humans and gorillas. Yet, of equal if not greater significance, are those diseases that can be contracted via the faecal-oral route or via fomites. As pointed by a survey respondent:

> *"[…] People have focused on the aerial transmission of disease and did not include faecal-oral routes. Hence, my worry over the habituation of gorillas that range onto agricultural lands outside the park…*

Obviously, a great number of diseases fall into the category of human diseases of concern for gorillas. Among them, diseases of greatest importance are those for which apes have not developed immunity and by which they can therefore be seriously affected or even killed. Key examples for which we have direct or indirect evidence of clinical or pathological significance have been discussed and are shown in **Table 3.** This table however is certainly not exhaustive as the potential may exist for other infections which have not yet occurred or been reported in gorillas. This is especially of concern in view of incidents of disease transmission to other, closely related apes, e.g. the case of polio transmission to chimpanzees.

Apes have been known to be particularly vulnerable to human respiratory infections since the early days of big game hunting in Africa (Burbridge 1928). Among respiratory diseases particularly dangerous to apes, measles, tuberculosis (TB), pneumonia, influenza and RSV infections figure prominently. Although no definitive evidence exists yet of transmission to wild animals, deadly outbreaks or epidemics presenting a clinical picture of, or associated with pathological findings consistent with these diseases have occurred among both captive and free ranging apes. Transmission of respiratory viruses between caretakers and captive gorillas or chimpanzees is often observed in zoos. As keepers or visitors become ill during winter when respiratory virus infections occur routinely among humans, captive apes also come down with similar illnesses (Zuba J, Lerche N, Roberts J, Wack R, pers. comm.). Specific diseases of concern are further discussed below.

Paramyxoviruses (measles) and related viruses: In 1988, an respiratory disease outbreak affected more than 20 gorillas in Rwanda's Parc National des Volcans. Two juveniles and three adult females died. Pathology results showed that one juvenile had seroconverted to measles and *Mycoplasma pneumoniae*, and two others (a mother-daughter pair) had low antibody titres to *M. pneumoniae* (Hastings et al. 1991). In 1990, another outbreak of cough, nasal discharge, lethargy, and anorexia affected a similar number of animals in this park including a silverback that died with severe bronchopneumonia from which *Klebsiella sp* was cultured. This animal had inclusions and syncytia (cellular aggregates) in his laryngeal air sac, which on electron microscopy showed material strongly suggestive of paramyxoviral nucleocapsids (Hastings 1991).

In the same year as the first Rwanda outbreak, a measles outbreak occurred at the Primate Research Centre (3,400 animals) of the University of California at Davis in the US, killing 60 animals. Although this colony has no gorillas, this event illustrated the great infectious potential of paramyxoviruses. The cage of the first monkey showing signs of infection was equipped with a virus-proof air filter. The virus, carried by an infected intern/student, is thought to have been introduced via aerosol passing through the cage door when it was opened briefly (Lerche N & Roberts J, pers. comm.).

Tuberculosis: There is no definitive evidence of TB outbreaks or fatalities in wild gorillas. However, many non-human primates are very susceptible to TB, and may be killed by it (Brack 1987; Wallis F, in press).

[1] In several cases, zoo representatives were very reluctant to give details about these cases, often requesting the zoo not be identified.

Table 3: Examples of reported / documented cases of possible transmission of human diseases or pathogens to gorillas

Source *	Date	Environment	Number & age of gorillas affected	Event and cause	Outcome and/or intervention
Hastings, Lowenstine, *Pers. comm.*	1988	PNV –Rwanda	5 animals dead, numerous others affected, wide age range	- 23/31 animals showed signs of respiratory illness. - 3 deaths (1 neonate, 1 juvenile, 1 adult) ensued. Measles was suspected: giant cells in post-mortem in 2 cases consistent with morbilivirus. One juvenile from whom paired samples were available seroconverted for measles during the 5 days between samples. Also seroconverted for mycoplasma (Hastings et al, 1990) - 3 other deaths during this time did not show respiratory signs and only weak serological evidence of exposure to influenza, mycoplasma and/or herpesvirus simplex.	• Measles vaccination program • Antibiotic treatment for ill animals • Boot disinfection for all visitors & staff visiting >1 group
Macfie & Lowenstine	1990	PNV -Rwanda	20 animals ranging from adult to young.	- 20 out of 33 animals in Susa group (tourist group) had coughs, nasal discharge, lethargy, anorexia. One dominant silverback (SB) died with severe bronchopneumonia. Post-mortem yielded viral pneumonia with secondary bacterial (Klebsiella on culture). Second SB and two females showed serious signs of pneumonia, other cases in younger animals showed only URTI signs. - Histopathology on SB strongly suggestive of paramyxovirus, possibly RSV or measles. Measles unlikely as many of those affected were previously vaccinated in the '89 measles vaccination programme (Measles vaccine has proven effective in zoo populations).	• 4 animals darted with antibiotics (long acting tetracycline + trimethoprim sulfa) after first case died. • Outbreak died out over 2 weeks. • No further deaths. • Interesting that severity of adult cases > subadults > juveniles > infants
UWA records Kalema Macfie L, 1996	1996	BINP – Uganda	4 animals in group of 4	Scabies – confirmed (Kalema)	• One infant died (of secondary pneumonia) • Others treated with Ivermectin
Wack, *pers. comm.*	?	Captive (zoo)	All	Influenza – confirmed via serology – matched keeper serology	Supportive care, nearly all affected, no deaths
Wack, *pers. comm.*	?	Captive (zoo)	All	Giardia – confirmed on faecals – keepers confirmed on faecals – never before seen in gorilla collection - assume came from keeper	Treatment with flagyl, no deaths
Wack, *pers. comm.*	?		All	Balantidium coli – confirmed on faecals, endemic problem in collection	Prophylactic treatment during times of stress
Lerche, *pers. comm.*	?	Captive (zoo)	Adult breeding gorillas	HSV infections	
Lerche, *pers. comm.*			Infant gorilla	RSV	
Kalpers J, *pers. comm.*		Captive (zoo)	Silver back	Shigellosis	Animal died
Campbell M, *pers. comm.*		Captive (zoo)	All ages	Seasonal colds and flus, suspected to be transmitted by keepers	
Karesh W, *pers. comm.*	1984-89	Captive	2 yrs - adults	Balantidiasis, Giardiasis, Salmonellosis, Shigellosis E. coli and Candida septicaemia Staphylococcal dermatitis (Impetigo) Reovirus and Rotavirus diarrhoea	All treated, no fatalities

* Sources contacted through:Information gathering survey, October-December 1998, Direct interviews , Telephone interviews, Electronic mail

Influenza: A wide variety of non-human primate species demonstrate antibodies to influenza, including apes (Kalter & Heberling 1978). Epizootics of influenza associated with fatal infections have been reported in gibbons (Johnsen et al. 1971). Influenza may not be as lethal to gorillas, but is very infectious and can lead to secondary infections by other respiratory pathogens. In 1990, a suspected influenza outbreak erupted among captive gorillas at a US zoo after an influenza outbreak in keepers. Although aetiology and transmission were not confirmed, nearly 100% of the gorillas were infected and several went through multiple episodes, strongly suggesting they had never been previously exposed (Wack R, pers. comm.).

Respiratory syncitial virus: Although most clinical accounts of RSV infection in apes are in chimps (Lerche N, unpublished), serologic surveys have identified antibody positive orangutans, gorillas, and gibbons, as well as Old and New World monkeys (Richardson-Wyatt et al.1981).

Parainfluenza and pneumococcal meningitis: A case of parainfluenza infection observed in a captive gorilla in a Texas colony was the precursor event of a subsequent pneumococcal meningitis. A study in chimpanzees has shown that damage to the respiratory mucosa caused by the virus predisposed animals for pneumococcal entry to the lungs (Jones et al. 1984).

Varicella Zoster: In 1984, a captive 6-month old gorilla developed shingles as a result of a varicella zoster infection (Herpes zoster) confirmed by pathology (Myers et al. 1987). The virus is known to cause high rates of morbidity and mortality among primates (Padovan & Cantrell 1986) and is readily transmitted via aerosols (Sawyer et al. 1994).

Shigella, Trichuris, and other faecal-oral pathogens: As seen above, many pathogens are transmitted via the faecal-oral route. In 1995, a few months after a juvenile Eastern lowland gorilla (*Gorilla gorilla graueri)* confiscated in Rwanda joined a group in a Belgian zoo, an adult male died from *Shigella* infection (Kalpers J, pers. comm.). More recently, a case of Trichuris was reported in a BINP gorilla (Kalema G, pers. comm.). In different parks, wild gorillas carry in their faeces various degrees of parasite similarity compared to humans from surrounding communities (Hastings et al. 1992, Holmes 1996, McCallum & Dobson 1995, Meader et al. 1997, Swenson 19 , Toft 1996, Ashford et al. 1990 & 1996, Cooper 1996, Eilenberger 1997).

Hepatitis: Both hepatitis A (HAV) and B (HBV) viruses have been found to infect captive gorillas (Linneman et al. 1984, Anan'ev et al.1984, Zuckerman et al. 1978). A case of likely human transmission was reported among a captive group which seroconverted after exposure to an HAV-positive keeper (Cameron K, pers. comm.). Also, HBV was found to be the most prevalent viral infection (60% prevalence) in 143 confiscated orangutans who were serologically screened for a series of specific viral infections cross reacting with human viruses (Warren et al. 1998).

Scabies: In 1996, four habituated gorillas were infected with scabies in BINP (Macfie 1996, Kalema G, pers. comm.). Affected adult animals were treated with Ivermectin, but one infant died. On post-mortem the cause of death appeared to be secondary pneumonia. Human origin was suspected for the scabies, due to the clinical severity, suggesting the gorillas were naïve to the parasite, and the high prevalence of scabies among the local population (Kalema G, pers. comm.).

Yaws: In northern Republic of Congo (not DRC) and Gabon, large numbers of lowland gorillas are afflicted by a facial skin condition that researchers call yaws, due to its resemblance to a common condition in the local population, but the diagnosis has not been confirmed. Most Congo gorilla groups have at least one individual showing signs of this disease, and >20 of the 420 identified individuals are seriously affected. In a one-year period (6/97-8/98), three animals may have died of this condition, and the pattern of infection suggests mother to infant transmission (Aveling C & Magliocca F, pers. comm.). Yaws is an endemic ulcerating skin disease among children in the tropics caused by *Treponema pertenue*, a parasite morphologically and serologically indistinguishable from the syphilis parasite, *Treponema pallidum*. *Treponema* is rarely found naturally outside of the human reservoir.

Miscellaneous: Confiscated orangutans have often spent long periods in close contact with humans in dirty conditions and show evidence of scabies and gastrointestinal infections (Warren et al. 1998, Aveling C, pers. comm.), HAV, herpes simplex viruses, human T-lymphotropic virus (HTLV types I and II), the simian type D retroviruses (SRV) types 1 to 3 and the simian immunodeficiency virus-SIV (Warren et al. 1998, Prowten et al. 1985). Recently, extensive forest fires on Borneo brought orangutans into closer contact with humans and ~90% in one rehab centre (Wanaariset Samboja) had human diseases, including hepatitis, influenza, intestinal worms, and TB (AP Worldstream ex-Antara News Agency, 1998). Gorillas appear to be susceptible to simian T-lymphotropic virus I, a close relative of the human virus (Blakeslee et al. 1987).

As mentioned earlier, disease transmission can go either way. There are diseases that can be transmitted from gorillas to humans at considerable distances, like measles, and veterinarians report having caught influenza after exposure to sick animals. Intestinal parasites are of equal concern as they can easily contaminate water sources and be transmitted despite usual protection. As noted by survey respondents:

> *"[...] Right now, most folks are concerned about human diseases going to gorillas... What happens if it is the other way around? How will local villagers view gorillas if their watershed is contaminated with crypto[sporidium] ?"*
> "[…] *Researchers at Lopé, Gabon, contract[ed] gorilla intestinal parasites. We handled gorilla and chimp faeces regularly (almost daily), and although we wore disposable gloves, we usually needed a treatment of Vermox every three months"*

Finally, it is important to mention that apes may also harbour unknown, undocumented infections that may be dangerous to humans and one day find their way into the human population, as exemplified by recent occurrences (Jaax et al. 1995, Le Guenno et al. 1995, Feldmann et al. 1996). Even though the small size of the mountain gorilla population may somewhat reduce the likelihood of such an occurrence, the possibility cannot be ignored, especially as there is growing interest in developing tourism with other apes such as lowland gorillas, chimps, bonobos and orangutans.

5.3 Gorilla exposure to humans

5.3.1 Gorilla exposure to tourists

Gorilla tourism is a component of comprehensive sustainable management programmes in the four parks harbouring mountain gorilla populations. Tourism has been established at different times in each place since the first rules were drawn up in 1976 in Rwanda. In most cases, tourism was established as a necessity for financing sustainable conservation efforts, while recognising that it may have little other benefit, and may even have negative effects on parks. As stated in the most recent management plans for both Bwindi and Mgahinga National Parks in Uganda (UNP 1995 & 1996):

> "*Due to the complexity of [tropical] ecological systems [...], and the difficulty presented to authorities in safeguarding the survival of rare fauna and flora populations which may be already below minimum viable size, the ideal for the park would be one in which no tourism was allowed."*

These management plans further emphasise the fragility of the "island" ecosystems of BINP and MGNP which have been gradually isolated from adjacent forests by the surrounding human populations. Yet the authors acknowledge the "unrealistic and untenable" nature of the above proposition, and lay out the rationale for tourism as "*an important source of generation of funds for research, management, and revenue-sharing programmes which will benefit local communities and encourage good public relations*".

The operational objective of the programme is thus to manage tourism as a sustainable enterprise ideally characterised by:

- *low environmental impact*
- *benefits to local communities*
- *economic viability*
- *and supporting biodiversity conservation*.

Gorilla viewing has undoubtedly been, and remains, the single most successful attraction to the four parks inhabited by mountain gorillas. Currently, tracking permits for BINP are booked 12 months or more ahead of time, mirroring the success experienced by the Rwandan and Congo parks in times of political stability. This success translates into a constant flow of visitors that can be readily estimated, at least for Uganda, according to the occupancy rates recorded in recent years. These estimates are shown in **Table 4**. Based on the current number of gorilla groups habituated for tourism or research in each park, and given the fact that tourism occupancy rates average around 80% in times of political stability, habituated groups are each exposed to an average of >2,000 visitor-hours per year. In addition, a group is exposed to over 900 person-hours of visits by guides, rangers and trackers that must accompany tourists. These figures are based on the current rule, which limits tourist viewing to one hour. They show that habituated gorillas are exposed to a far greater number of individuals per year than an average person is likely to receive in his or her own house over a lifetime!

Although demographic data on tourists were not available for this report, it is a fact that tourists visiting gorillas come from all over the world with a majority from the US and Europe where the popularity of conservation issues, ecotourism, and the particular plight of mountain gorillas has been greatly publicised. For the last decade, the price of airfares has sharply declined in industrialised countries, and people from all walks of life are now able to travel to and from any destination with unprecedented ease and speed. Moreover, the current ecotourism trend echoes a quest for "unique" adventures, translating into more tourists increasingly entering remote areas of the world in search of rare and meaningful encounters. Tourists visiting gorillas thus often from distant and varied locations and are like to have travelled previously through other countries and continents. This represents, from an epidemiological point of view, a very effective means of transport for an increased number of exotic germs due to the speed and diversity of modern transport systems (Ostroff & Kozarsky 1998, Wilson 1994, Cossar et al. 1990, Marbet 1990, Royal & McCoubrey 1989)

5.3.2 Gorilla exposure to park staff and researchers

One of the first things Dian Fossey undertook after establishing contact with the mountain gorillas of the Virungas, was to establish a systematic research programme to study the behaviour, ecology and biology of the species. Doing so required habituating gorillas for regular, continuous and close observation in their natural habitat. Over the last twenty years, research programmes on gorilla in Rwanda and Uganda have attracted numerous international scientists, who spend many hours with the gorillas. An estimate of the number of person-hours of exposure this activity translates into for the gorillas is shown in **Table 4**. As researchers usually spend several hours at a time with the gorillas, they represent a similar degree of exposure (in person-hours) as tourists.

Behavioural, anthropological and veterinary field work and research all require long hours of close observation that result in more intensive habituation of gorillas than tourist groups. In the early days at Karisoke research centre in Rwanda many factors, including the wish to experience closeness with these charismatic animals, led Dian Fossey and other researchers to come into direct physical contact with gorillas, sometimes for (relatively) long periods of time (Fossey 1983, Mowat 1987). Even though this practice is no longer encouraged due to fear of disease transmission or unexpected gorilla behaviour, researchers often have to actively chase away juveniles or adults who come as close as touching them to play or to investigate research equipment (pers. comm. from several field staff). This is not always successful, as many instances of direct contact or successful snatching of equipment have been reported.

Table 4: Gorilla Exposure to Humans

Current number of mountain gorillas habituated for tourism or research

Park	No. of groups habituated for tourism	No. of gorillas habituated for tourism	No. of groups being habituated for tourism	No. of gorillas being habituated for tourism	No. of groups habituated for research	No. of gorillas habituated for research	Estimated no. of non habituated groups	Estimated no. of non habituated gorillas
BINP	3	41	1	22	1	13	?	~224
MGNP	1	8	-	-	-	-	?	
Virungas [a]	11	150	-	-	3	82	?	~80
Total	**15**	**199**	**1**	**22**	**4**	**95**	**?**	**304**

Source: IGCP Kampala, 1998

Statistical estimates of mountain gorilla exposure to tourists, park staff and researchers

in Person-hours

Park	Maximum no of tourists allowed per group per daily visit	Maximum possible no of visitors / year (n groups x n tourists/group x 365)	No. of tourist visits/year at 80% capacity	Average annual tourist exposure per habituated tourist group based on 80% capacity (n visitors/yr ÷ n. hab. tourist groups)	Average annual staff exposure per habituated tourist group [c] (n staff/yr ÷ n. hab. tourist groups)	Total annual researcher [d] exposure per research group based on 75% daily visit rate (9 months a year) (n researchers/yr ÷ n. hab. research groups)
BINP	6	6,570	5,256	**1,752**	**730**	**2,190**
MGNP [b]	6	1,643 [b]	1,314	**1,314**	**548** [b]	
Virungas [a]	8	32,120	25,696	**2,336**	**730**	**2,190**
Total or Average	**7**	**40,333**	**32,267**	**2,151**	**718**	**2,190**

[a] Includes combined figures of Parc National des Volcans-Rwanda and Parc National des Virungas-Congo

[b] Gorillas available for visits for 9 months a year on average due to migration pattern to Congo side of park

[c] taking into account an average of 2 trackers/guides visiting daily for an hour throughout the year

[d] counting an average of 1 researcher and 1 tracker and/or guide per group, spending 4 hours daily with the gorillas (Malenky R, Steklis D, pers. comm.). for 9 months a year

In addition to observational research, invasive veterinary interventions are sometimes required, especially for removing snares, or treating poaching-related wounds. These interventions induce varying degrees of stress, ranging from relatively mild (darting), to very stressful when animals have to be immobilised, during which the whole group often displays severe anxiety. For this reason, current management plans restrict such interventions to situations of absolute necessity (UNP 1995 & 1996). In these cases, veterinarians and park staff are to protective devices (masks and gloves) to reduce contamination risks while handling animals. While this is practically always observed by the staff, cases have been mentioned when such devices had either not been restocked in time or were not accessible at the time of emergency, resulting in bare hand handling of animals. In any case, staff handling of immobilised animals imply direct contact of gorillas with human clothes, hair and other fomites, thus represents an acute additional source of exposure for entire gorilla groups.

Finally, habituation requires regular daily tracking and visiting of gorilla groups by rangers for months or years. As this means travelling considerable distances away from park bases, trackers often camp in the park, prepare food, and bury their waste during these stays, providing additional sources of exposure to contamination.

5.3.3 Gorilla exposure to local human population

Tourism, however, is not the only source of gorilla exposure to human pathogens. The region surrounding the Virungas and Bwindi is one the highest densely populated area of Africa, with an average of over 200 inhabitants per km^2, reaching 300 people per km^2 in Kisoro District, Uganda. In all three countries, this population lives mostly from subsistence agriculture with limited income, has irregular food supply due to economic and weather conditions, and often has limited access to health care services, especially away from main trading centres (Ministry of Planning, Uganda 1997, Hall et al. 1998). The main pathologies affecting this population are characteristic of the epidemiological profile in the region, with malaria, respiratory infections and diarrhoeal diseases accounting for the majority of the morbidity among adults and mortality among children (UNICEF 1994, Hess 1994)

Some areas like Kisoro District in Uganda have particularly acute water and sanitation problems due to the volcanic basaltic structure of the subsoil, making it very difficult to dig wells or latrines and causing regular sewage spills during the rainy season. These conditions greatly favour the spread of germs transmissible via the faecal-oral route, making diarrhoeal diseases the main cause of morbidity in this area in the rainy season (UNICEF 1994). Given the poor hygiene, the potential for spread and transmission of pathogens through diarrhoea is even greater than normal. This includes not only germs directly responsible for diarrhoea, but also other important non diarrhoea-causing pathogens spread via the faecal-oral route and shed through the GI tract. Such germs of major public health concern include *Escherichia coli*, *Shigella*, *Campylobacter Staphylococcus*, *Yersinia, Giardia lamblia*, *Entamoeba histolytica* (amoebas), *Salmonella* (typhoid), *Schistosoma mansoni* (bilharzia), *Necator americanus* (hookworm), *Vibrio cholerae* (cholera), as well as intestinal worms, hepatitis A and E viruses and enteroviruses like polio.

The high prevalence of respiratory diseases among local populations is associated with poverty, under-nutrition, and lack of health care services, as well as the wet and cool weather conditions prevailing in this area. Among the major respiratory pathogens, streptococcus, influenza, tuberculosis, measles and respiratory syncitial virus (RSV) figure prominently.

Tuberculosis (TB) is of particular importance in local communities. Once thought to be under control, tuberculosis is now the number one cause of infection-related death world-wide and the 6^{th} most significant cause of death overall (WHO 1998, Ostroff & Kozarsky 1998, Griffith & Kerr 1996). This resurgence of TB has been exacerbated in the past decade by sexually transmitted diseases (STDs), including HIV/AIDS, of which Uganda, Rwanda and DR Congo have a prevalence amongst the highest in the world (UNAIDS fact sheet). TB is one of the major clinical manifestations of HIV infection in sub-Saharan Africa, and is often more difficult to treat in HIV-infected patients due to immunosuppression caused by the virus (Castro 1995). This fact, together with low level of detection and poor treatment compliance has plagued world-wide efforts to control TB, despite the effectiveness, availability and low cost of treatment (WHO 1998). Moreover, multi-drug resistant TB strains have emerged, probably as a result of inadequate treatment, and have become a serious public health concern for many HIV-affected countries (Rao 1998). Accordingly, the rate of *Mycobacterium tuberculosis* carriers in the East African region has continued to grow despite an overall decrease in HIV prevalence (WHO 1998, Ostroff & Kozarsky 1998).

Besides TB, HIV-infected individuals are susceptible to a number of opportunistic infections, including both respiratory and intestinal pathogens that can be spread further given the conditions described above. Thus, people living with HIV/AIDS are a potential source of additional intestinal pathogens including *Cryptosporidium, Microsporidium, Isospora belli,* and *Mycobacterium avium* as well as agents causing pulmonary diseases like fungi or yeast such as *Candida*, *Pneumocystis*, *Aspergillus* and *Cryptococcus*, bacteria such as *Streptococcus* and *Haemophilus*, viruses such as *Cytomegalovirus* (CMV), *Influenza* and *Paramyxoviruses*, as well as *Mycoplasma* and *Chlamydia* (Hollander & Katz 1997). Many of the latter agents causing respiratory infections can also cause bouts of diarrhoea as a result of the generalised immunosuppression caused by HIV.

Finally, it is worth mentioning the growing importance of *Mycobacterium bovis*, the cause of bovine-type tuberculosis, which has an exceptionally wide host range with susceptible species including cattle, humans, non-human primates, goats, cats, dogs, pigs, and buffalo, among others (Morris et al. 1994, O'Reilly & Daborn 1995).

6. DISCUSSION – DETERMINANTS OF DISEASE TRANSMISSION

Before assessing the tourism rules with respect to disease transmission, it is important to clarify the relationships that exist between the various factors that contribute disease transmission. Simply put, in a context of exposure at a distance in the open, the risk of transmission of a germ from a source (e.g. a visitor) to a target (e.g. gorilla) can be expressed as:

a) directly related to the ***Degree of Exposure*** of the target to the source: i.e. ↑ exposure ➔ ↑ risk of transmission
b) and inversely related to the ***Target's Resistance Factor*:** ↑ resistance ➔ ↓ risk of transmission

For more explanation, see box below[2]:

***** Determinants of Disease Transmission *****

Risk of transmission (from individual source) ≈

{Degree of exposure} and {Target Resistance Factor}$^{-1}$

where:

Degree of Exposure is a function of:

~ Duration of exposure
~ the probability of contact *P[contact]* between a potential target and an viable infectious germ
~ the Source's Infectivity Factor

Source Infectivity Factor expresses the probability of any potential source (e.g. visitor) to transmit an infection, and is a function of:

~ germ carrier status,
~ infectious stage (or germ shedding), and
~ behaviour (coughing, sneezing, etc.).

Target Resistance Factor expresses the ability of any potential target (e.g. gorilla) to resist infection, and is a function of:

~ genetic make-up
~ age
~ previous exposure to germ, and
~ immune status (i.e. whether immunosuppressed or not)

There are two types of disease transmission of concern to gorilla tourism: airborne and faecal-oral. In both, exposure is directly related to the probability of contact, *P[contact],* between the potential target (gorilla) and the infectious germ.

For airborne transmission, *P[contact]* is inversely related to the distance between source and target, and depends on airflow, i.e. the wind factor. The power of the inverse relationship with distance varies with the capacity of different germs to be carried airborne, while the wind factor can either be nil, positive or negative (no wind, or wind blowing towards, or away from the target).

For faecal-oral transmission, *P[contact]* between a potential target (gorilla) and a viable germ is a function of the numbers of germs deposited in the environment, their ability to survive in this environment, and the gorillas' frequency of contact with the germ.

Exposure is also a function of the duration of the exposing event (visit), and each source's degree of infectivity, i.e. their contagious potential, depending on:

- their being infected or not (germ carrier status)
- their shedding or not shedding infectious organisms (infectious stage) - see box below
- and whether they help transmission or not through talking, shouting, laughing, coughing, or sneezing in the presence of the gorillas (behaviour).

In addition, an individual's ability to resist a given infection will depend on heredity (genetic make-up), immune maturity (age), whether this is his or her first exposure to the germ (previous exposure), and strength of the immune system at the

[2] This explanation does not pretend to be a mathematical demonstration or to derive a mathematical model to quantify the probability of disease transmission. Rather, this model simply aims at illustrating some basic epidemiological facts and factors underlying the rules. For this reason, some oversimplification is inevitable - and should be forgiven!

time of exposure/infection (immune status). Immune status can be greatly influenced by factors such as concurrent diseases as well as stress induced by a variety of causes (i.e. anxiety, pregnancy, exercise, trauma, lack of sleep, smoking, nutritional status, etc) (Gennaro & Fehder 1998, Kehrli et al. 1999, Keusch 1998, Schäffer & Barbul 1998, Homsy et al. 1986).

From this model, it is easy to see that changes in one factor can be modulated by changes in other factors, and that each factor depends on a number of interrelated variables. Thus, in a real situation (e.g. a given tourist visit), while some variables are fixed (e.g. group size), several others are dynamic and constantly subject to change, according to fluctuating conditions in the environment (e.g. wind), among gorillas (e.g. movements), or among visitors (e.g. coughing). In other words, these variables are not independent from each other.

Virus or germ shedding - a critical factor in disease transmission

Virus (or germ) shedding characterises the stage(s) at which an infected individual is contagious. Shedding can occur in both symptomatic and asymptomatic individuals harbouring an infectious agent. In people with active disease, shedding occurs before, during and after the symptomatic stage (e.g. Foy et al. 1987, Keitel et al. 1997). The duration of shedding varies with each germ, as well as with each individual and each disease episode. The shedding period can range from a few hours to several weeks before or after the appearance of symptoms (e.g. Gwaltney 1995).

7 ASSESSMENT OF THE OVERALL DISEASE RISK TO GORILLAS

As an assessment of the perceived importance of human diseases to the survival of gorillas, people interviewed during this consultancy were asked to rank the importance of human diseases as compared to others known threats to gorillas. Their responses ranged as follows:

Human diseases are a:

medium risk 22 (61%)
highest risk 8 (22%)
lowest risk 4 (11%)
2 additional respondents (6%) did not indicate a rank, stating that more information was needed.

In two cases, respondents pointed to the relative nature of the disease risk, noting that assessments are likely to vary with the area and over time:

> "*[It is] very difficult to make one ranking. In Rwanda it may be one of the highest risk factors. In other areas I would guess it is a low risk, in comparison to habitat destruction, bush meat trade etc. "*
>
> *"When tourism began in Rwanda, the risk of disease was "lowest", since cattle ranching was being planned for major portions of the park, […which] would have spelled the end of the Virunga population of gorillas, since it would have severed the population into three distinct fragments So in comparison, significant poaching, and many local people in the park from whom gorillas could contract many other diseases, tourist-borne disease was a low risk."*

Another respondent on the contrary stressed that human diseases represent the "*highest risk based on the potential for rapid transmission within island populations*", arguing that *"if the transfer of a virulent organism occurs, it only has to happen once."*

These results and comments reflect a wide range of perception on this issue, even among the professionals involved in daily management or research activities concerning the gorillas. As previously stressed in this document, there is little doubt as to the susceptibility of wild gorillas to human pathogens, including ones that could have potentially devastating effects on such a small population as the mountain gorillas. The scenario hinted at in the latter quote above may sound catastrophic, but the recent *Population and Habitat Viability Assessment* (PHVA) for the mountain gorillas shows that among the three main catastrophic scenarios considered (war, diseases and population fragmentation), diseases could have the most drastic consequences for survival of the two populations (PHVA 1997). In addition, it is important to recognise that the best that tourism rules can do is attempt to control the determinants of transmission, that is *prevent* incidents or catastrophes, but they can do little if anything to *cure* them. **Therefore, in reviewing the rules, the position must be held that until further evidence allows a more precise predictive value of the models that have been considered by the PHVA exercise, the aim of the rules should be to provide sufficient risk reduction in order to avoid any catastrophic event for the survival of the species**.

8. ASSESSMENT OF THE CURRENT GORILLA TOURISM RULES

The susceptibility of gorillas to human disease has been one of the major reasons for establishing visiting rules, but it is not the only one. This review is thus based mainly, but not solely, on the best available body of biomedical and epidemiological knowledge, facts, and professional opinion. Many management, tourist satisfaction, and logistic issues are other considerations which, whenever intricately linked to the rules, have been taken into account as well.

In discussing the rules, and in accordance with the gorillas' human exposure detailed earlier, it is important to consider all potential sources of health threat to the gorillas. These sources include tourists, park staff, volunteers and researchers, as well as the surrounding park community whether through the multiple use programme, illegal encroachment of people in the forest or gorillas roaming or raiding crops outside the parks. Although of different nature and degree, these sources should all be considered with regard to prevention of disease transmission to or from the gorillas, on the basis of the potential risks inherent to any contact between people and gorillas, as explained below. Therefore, in most of this discussion, the emphasis is placed on 'visitors', or 'potential sources of infection' rather than 'tourists'.

8.1 Methodology

The present assessment of the gorilla tourism rules is based on:

- answers given by people contacted through this consultancy (see **Appendix 3**), either through interviews (n=12) or the questionnaires (n=40) circulated by correspondence (see **Appendices 4 & 5**)
- existing epidemiological and/or physiological data and facts regarding the rationale of the rules
- and a critical analysis of the different possible options for change

In the sections below, each rule is explored starting with its rationale, followed by the implications of changes in either more restrictive or more relaxed ways. Rules and their relevance are examined in relation to *all* potential sources of transmission, both direct and indirect. Suggestions are made on how rules could be modified, with discussion of the implications, advantages and disadvantages of possible changes. **Table 5** summarises this discussion as well as the various arguments and comments of the survey respondents. A discussion for each rule or set of related rules follows, further exploring some of the arguments underlying proposed changes and concluding with a recommendation for the given rule(s).

Lastly, it must be noted that the effects or inherent limitations of many, if not all, of the rules discussed here are strongly interconnected. Therefore a meaningful analysis of some of the variables considered and related changes cannot be undertaken without looking at the possible impact on, or effects from, other rules. For this reason, some of the rules, being intricately linked, are discussed together.

Table 5: Advantages (+) and Disadvantages (-) of Possible Actions on Current Rules Regulating Gorilla Tourism

Note: Survey ranking as *adequate*, *inadequate*, *insufficient* or *excessive* refer to the ability to prevent disease transmission to gorillas

CURRENT RULE	RATIONALE	SURVEY RANKING (n=48)	POSSIBLE ACTIONS			COMMENTS (Extracted from survey quotes)
			RELAX RULE	TIGHTEN RULE	NO CHANGE	
a) one visit per day per gorilla group	• to minimise disturbance to gorillas, their habitat and the forest • to limit gorilla exposure to human diseases	**Adequate** **47** (20 guides) Inadequate 1 (1 guide)	• 2 visits a day would: + allow greater tourist access + generate more park revenues + be an alternative to increasing group size BUT would also imply: – more disturbance to gorillas & habitat – more exposure to diseases – logistical feasibility	• 1 visit day 6x/week (one day off a week): + would make staff more available for other duties (and training) + could be compensated by increasing group size (8) BUT: – may not substantially reduce exposure	• Keeping current rule: + has proven feasible and manageable + would allow time to assess potential impact of increased frequency BUT: – would fail to meet high demand	• *A question of disturbance to gorillas rather than disease transmission risk (3)* • *One could imagine 2 visits per day without the gorillas suffering* • *For gorilla groups of 20 or more, we could have 2 visits a day two hours apart* • *More than one visit /day would interrupt feeding, interactions with other gorilla groups, and travel, which could have great implications for normal social and ecological aspects of gorilla life.*
b) 6 tourists per group in Uganda, 8 in Rwanda and Congo	Group size concerns are: • to minimise gorilla and environmental disturbance • safety: to reduce potential for gorilla charges • to allow good visibility for tourists • to ensure a number manageable for guides	**Adequate** **37** (13 guides) Inadequate 14 (8 guides)	• 8 tourists per group in all parks would: + standardise rule + be apparently manageable based on Rwanda & DRC experience + better meet demand BUT would also: – increase exposure and disturbance – increase viewing interference (esp. in dense vegetation) – not have the same impacts in every park depending on terrain, vegetation and other ecological variables	• 6 tourists per group in all parks would: + reduce exposure and ecological disturbance + allow better viewing + preserves 'private' character of encounter + is easier to manage for guides BUT also: – would further widen the demand-offer gap – may be difficult to enforce in PNV/PNVi	• Keeping current rule: + appears manageable, is apparently safe + would allow time to assess differential impacts of group sizes increase in Virungas and BINP BUT also: – maintains discrepancy (double standard) among parks – does not account for 'extra' visitors (non tourists: PCVs, guests) – does not respond to increased demand	• *Should be standard in all parks (4)* • *6 is ideal (for visibility, visitor satisfaction, disturbance, health risks) (3), 8 seems bad - tourists too squeezed* • *Not a health issue; to minimise disturbance and maximise tourist satisfaction (2)* • *Total number of visitors (incl. non tourists) should not exceed 10* • *Tourist group size should depend upon gorilla group size (up to a max. of 8)* • *Is the difference between 6 and 8 substantial? If no, 8 is ok!* • *"It is always being broken by bosses…"* • *Number should be uniform as long as gorillas are more than 12 in a group* • *The more tourists per group, the greater the risk for gorillas to get human diseases* • *With large gorilla groups (≥20), we could have 11 or 12 visitors* • *The number allowed must optimise viewing and satisfaction (low numbers), income (higher numbers), and health (low).*

Table 5 (continued) - **ADVANTAGES (+) AND DISADVANTAGES (-) OF POSSIBLE ACTIONS ON CURRENT RULES**

Current Rule	Rationale	Survey Ranking (n=48)	Possible Actions			Comments (extracted from survey quotes)
			Relax Rule	Tighten Rule	No change	
c) 5m minimum distance	• to establish safe distance from gorillas • to avoid direct contact with gorillas • to prevent/ minimise potential transmission of airborne human diseases • to allow for good viewing of gorillas	**Adequate** **41** (21 guides) Inadequate 6 Can't say 1	• 3-4 m (10-12ft) would: + allow better viewing + provide a more 'intense' experience + attract more business BUT would also: – significantly increase potential for direct contact with gorillas – significantly increase transmission potential as distance is the most critical barrier for airborne germs – multiply transmission potential from relaxing any other rule – increase stress to, thus potential charges, by gorillas	• 7m (23ft) would: + provide a safer barrier to sneeze particles which can travel 20ft and over + be safer for viruses that are highly contagious even in the open + better account for wind conditions that can greatly affect distance travelled by aerosols + reduce stress to gorillas + increase safety from direct contact (juveniles) and/or potential charges BUT may also: – somewhat reduce gorilla visibility – be difficult to enforce – imply increased staff training	• Keeping 5m rule: + would allow needed research on stress and potential transmission at various distances + may be ok as no drastic epidemic has been recorded since 1989 + is widely accepted and reasonably well respected/enforced BUT also does not: – address the fact that it is often broken by young gorillas – account for wind, and sneezes or cough – provide any 'safety' factor against inevitable fluctuations by visitors or animals	• *Difficult to enforce... (5)* • *The fewer visitors, the easier to enforce* • *Impossible to keep young gorillas from coming closer (2)* • *Often violated; 10 m would be better* • *Suggestion: 10-20 meters* • *Distance has to be actively maintained by tourists, or if gorillas get closer, tourist group should get back* • *"Sometimes guides push too hard to get good views of the gorillas within the one hour limit"* • *"Perhaps if tourists were aware that they could catch some dreaded disease from the gorillas, they may be more respectful of the 5m rule"...* • *Increasing the distance could decrease viewing, but with good guides & shuffling position, most visits should still be excellent*
d) 1hr long visit	• to limit gorilla disturbance and stress • to limit gorilla exposure to potential human pathogens • to allow for a good view of the gorillas	**Adequate** **46** (20 guides) Excessive 2 (1 guide)	• 1.5-2 hour visits could: + significantly increase tourist satisfaction + be an alternative to group size increase + be compensated by increased distance + justify possible future price permit increase + be acceptable as visit duration is less critical than distance BUT could: – increase disturbance / stress level to gorillas – translate into increased likelihood of breaking distance and other rules (eating, faeces, etc) – leave less time for return on long trip – increase tourist fatigue	• 40-45' visit could: + shorten exposure and lessen disturbance for gorillas BUT could also: – make tour cost less attractive – decrease chances for good view of gorillas – lessen tourist satisfaction (too short) – not make a significant difference in exposure yet have a substantial (negative) impact on tourism – fail to meet tourism demand for greater access to gorillas	• Keeping current rule: + is apparently well accepted according to continued high demand + is not a main source of concern as visit duration is less critical than distance BUT also: – would not justify possible future price permit increase	• *Excessive. A couple of hours is perfectly reasonable and doesn't need not disturb the gorillas any more than 1 hour. It all depends on how the guide behaves.* • *Less disturbance (and more visitor satisfaction) would be caused if tourists were allowed to stop the clock and hang back say 50 m away until gorillas moved into a better place for viewing, and then to approach to 5m again and restart the clock.* • *Little or nothing to do w/ disease transmission, but instead w/ minimising disturbance to gorillas* • *At least 1.5 hrs b/c sometimes gorillas are in a very thick jungle or it might be raining*

Table 5 (continued) - **ADVANTAGES (+) AND DISADVANTAGES (-) OF POSSIBLE ACTIONS ON CURRENT RULES**

Current Rule	Rationale	Survey Ranking (n=48)	Possible Actions			Comments (extracted from survey quotes)
			Relax Rule	Tighten Rule	No change	
e) eating before or after viewing at a distance from gorillas	• to avoid fomite contamination of gorillas • to prevent gorilla attraction to/ conditioning by human food	**Adequate** **38** (20 guides) Inadequate 9 Excessive 1 (1 guide)	• Relaxing this rule is not an option as – eating near gorillas could be dangerously attracting them – food is a major source of contamination and disturbance for gorillas	• Setting a safe limit (200 meters, farther?) for eating during tour: + is already a rule in Uganda (?) + could reduce/eliminate (?) attraction risk + would reduce risks of fomite contamination (food scraps) + not affect in any way the quality of the visit, thus tourist satisfaction BUT: – will not change the potential for inadvertent food rubbish – enforcement ?	• Current rule: + is not a source of complaint ? + has not been associated with particular incidents ? BUT: – its enforcement has not been evaluated ? – is not similar in all park – is not very strongly emphasised with tourists, staff, researchers ?	• *This is only valid in BINP (not in Congo nor Rwanda)* • *Should specify some minimum distance (4): 'reasonable', 200m, 500m….* • *Tourists should move off a minimum of 500m (1 km is better)* • *May be inadequate, potentially risky if close enough for any gorilla to smell, see food etc. Can expose tourists to risk if gorilla wants food (3)* • *Should stress trash disposal. don't like the idea of eating near the gorillas, but if everything is cleaned up I don't see a health risk.* • *Adequate if combined with carrying out all waste and if picnics are held far enough away from gorillas* • *There should be no eating inside the park, or smoking*
f) bury human faeces 1 foot deep	• to avoid infection/ contamination of gorillas and other wildlife by human germs	**Adequate** **38** (19 guides) Inadequate 10 (2 guides)	• Shallower hole would: + be easier to enforce BUT would also: – increase risk of contamination for gorillas and other wildlife – increase chances of water contamination – be a nuisance (smell)	• Bury faeces deeper /carry faeces out of park would reduce chances of: + animals digging out waste + rain washing it out + gorilla contamination + water contamination BUT would also: – be difficult to enforce (harder to dig, container or bag cumbersome to carry, unpleasant for tourists) – not be always feasible / practical (terrain not always easy to dig(slope, structure, vegetation), diarrhoea difficult to collect) – not be acceptable culturally for trackers or guides to carry faeces	• Current rule: + is already planned to be strengthened by having guides dig holes + is well accepted + may be the only practical option BUT: – even staff may fail to enforce minimum depth – rains can easily wash out a 1' deep hole – gorillas and many other animals may dig out faeces buried at that depth (gorillas are known to be geo- and coprophagic) – diarrhoea is a common occurrence among tourists or park s (potential for germs)	• *Adequate if enforced (4).* • *Deeper hole (3 ft/50cm) would be better (3), but is it practical?* • *Inadequate - animals (canids, genets) can dig it up (2)* • *Heavy rains can easily wash a 1 ft deep hole away* • *Is it ever monitored ?* • *Tourist unlikely to dig deep enough or cover all faeces - especially if they have diarrhoea. Guides should dig holes to make sure it is done properly (2)* • *Tourists don't defecate often in forest. Other forest users are more likely to be infected, and not likely to bury faeces.* • *No provision for urine (2): should mandate burying, as for faeces, or establish some minimum distance from gorillas (50m?)* • *Carry out faeces* • *"Fine, but on guided trails, a toilet is vital around resting huts"*

Table 5 (continued) - **ADVANTAGES (+) AND DISADVANTAGES (-) OF POSSIBLE ACTIONS ON CURRENT RULES**

Current Rule	Rationale	Survey Ranking (n=48)	Possible Actions			Comments (extracted from survey quotes)
			Relax Rule	Tighten Rule	No change	
g) rubbish to be carried out of park	• to preserve ecological integrity of park • to avoid fomite contamination	**Adequate** **47** (21 guides) Inadequate 1	• Burying rubbish would: + be less cumbersome for tourists and guides + reduce amount of rubbish spilled around visitor centre BUT also: – would substantially increase ecological contamination and gorilla exposure – could present the same problems of burying faeces, i.e. be dug up by animals or washed out by rains	• Prohibit carrying disposable material into park would: + eliminate risk of littering in park + reduce risk of fomite transmission BUT would also be: – impractical as tourists need to carry snacks, hence wrappings or containers – difficult (impossible?) to enforce (how to check?)	• Current rule: + appears to be well tolerated and enforced + garbage containers are available throughout visitor centre BUT: – greatly depends on guides' vigilance and enforcement – trash is not always contained in pits or containers	• *Adequate if strictly enforced (2)* • *Extremely important: everything brought in must be taken out (2)* • *Perhaps needs to emphasise that this concerns all trash – i.e. biodegradable as well as non-biodegradable* • *Important to collect trash that may be found- that has been left by others (e.g., soldiers etc)* • *Trash should be carried way beyond the Park boundary and buried* • *Can also be buried 50cm deep*
h) age limit: 15	• to minimise introduction of infectious human diseases frequently acquired during childhood • to protect young visitors from gorillas	**Adequate** **43** (20 guides) Inadequate 1 (1 guide) Excessive 3 Don't know 1	• Age limit 12: + most childhood diseases occur in early childhood + is not a substantial risk if youngster is clinically healthy + may attract more families BUT: – some teenagers may still develop diseases after 12 – some 12 year-olds may not have strength for long tracking trips	• Age limit 18: + would account for the fact that childhood diseases may occur up to this age BUT: – few childhood diseases occur after 15 – most teens have grown enough by 15 not to pose safety risk with gorillas – may turn young people away from gorilla conservation cause	• Keeping current rule: + is apparently not a problem given current tourist demand + could encourage diversification of activities for families with children <15 BUT: – does not have a very strong rationale (no absolute scientific evidence for or against 14, 16, etc)	• *Adequate, if followed strictly* • *Very difficult to enforce. Does 15 make sense to a paediatrician? Why not less?* • *15 years is ok - but 13 would be acceptable* • *12 is appropriate* • *Excessive given the vaccination protocol most children now receive* • *"Guides should be given power to refuse those under age even if they are authorised by the President"* • *A high enough minimum age should be set to reduce the possibility of immature behavior in front of the gorillas*

Table 5 (end) - **ADVANTAGES (+) AND DISADVANTAGES (-) OF POSSIBLE ACTIONS ON CURRENT RULES**

Current Rule	Rationale	Survey Ranking (n=48)	Possible Actions			Comments (extracted from survey quotes)
			Relax Rule	Tighten Rule	No change	
i) tourists to self-report sickness	• to avoid gorilla exposure to contagious tourists	**Adequate** **38** (21 guides) Inadequate 10	• No penalties to tourists who fail to self-report: + may be more practical as rule is difficult to enforce + may encourage tourists to self-report BUT could also: – encourage tourists to not self-report – set bad precedents in case of future incidents – decrease awareness of transmission risk among all, incl. park staff – increase gorilla exposure to sick, more contagious people	• Tourists to be vaccinated /tested where possible against diseases of concern (TB, measles, influenza, etc, see section 9.1.3): + would reduce the chance of transmission of preventable diseases + could be used as an educational tool to enhance tourists' awareness of health threat to gorillas before departure + could have a positive marketing impact ('gorilla-conscious') BUT also could: – would have to be done before departure from country of origin , thus increasing cost and burden on tourists, – presents difficulty for non-US tourists who cannot have skin test for TB as most non-US nationals are vaccinated against TB at birth – be misinterpreted by tourists (danger to them) – create additional problems if tourists show up without certificates or vaccines – have negative marketing impact	• Current rule: + may not have been broken often as no apparent serious epidemic since 1989 + may be a sufficient deterrent + provides opportunity for guides to educate tourist about issue BUT is: – not easy to enforce – difficult to monitor and evaluate – completely dependent on tourists' awareness/ motivation to protect gorillas – also dependent of guides' ability to assess tourists' health status	• *A sensible rule* • *Very difficult to enforce: "The idea that a tourist who has come all the way from New Zealand to see the gorillas is going to own up to a slight cold and opt out at the last minute is ludicrous. And I don't see how a guide is qualified to judge whether someone is ill or not! An unenforceable regulation in my view." (3)* • *Probably not effective as it is easy for visitors desiring to see gorillas to hide their illness (3)* • *Difficult to come up with an alternative (3)* • *[Require} mandatory tuberculosis skin test within 3 months of visit. Proof of measles, mumps vaccination.* • *Health screening may need to be improved as travel to and from Uganda gets easier. Tourists are flying in from all over the world, and sometimes within just a couple of days are tracking gorillas; and local residents are travelling further afield (one ranger in MGNP has just been visiting Sweden)* • *Tourists may not be aware that they are ill (during incubation period); or they can "mask" symptoms of flus/colds with tablets (2)* • *A strict fine is needed to prevent people from hiding symptoms* • *G: A refund should be given in case of sudden illness (e.g. altitude sickness)* • *Adequate, but enforcement is not adequate*

8.2 Rule a: Limiting the frequency of visits

(current limit: 1 visit per day per habituated gorilla group)

The justifications for this rule are multiple. It aims first at minimising disturbance to both the gorillas' habitat and their daily activities, which alternate between foraging, resting and moving (Schaller 1976, Harcourt 1995, Butynski 1998). Visits are usually programmed to start early in the day to reach the gorillas by mid- to late-morning when they have finished foraging and are resting. Other reasons relate to issues of feasibility and to the fact that limiting the number of daily visits limits exposure of gorillas to both stress and disease.

Increasing the number of daily or weekly visits, without changes to any other rule, would be an option to meet growing tourist demand, and would also generate additional revenue. It could be further argued that by increasing the daily frequency of visits, one could allow for a decrease in visitor group size, which would minimise the risk of disease transmission per visit. However, in thinking about options for changing daily frequency, with or without a change in visitor group size, we must consider the relative importance of access and income versus behavioural/habitat disturbance and disease exposure. An additional consideration would be the feasibility of carrying out two visits a day.

Assuming that an increase in frequency is feasible, it is important to note that every additional daily visit would add to the ecological disturbance caused by visitors. It would also double the gorillas' exposure time to visitors, thereby increasing the risk of disease transmission, the duration of any interference with gorillas' normal activities and the amount of stress induced. Stress would be a particularly important issue if, as expected, the logistics of scheduling two visits to a given gorilla group would imply close or consecutive visits, especially when they are far from tourist camps. Lastly, staff numbers would be increased to take additional tourist groups every day, thereby increasing gorilla exposure to park staff.

Decreasing the number of visits was considered as well. One option would be to maintain one visit per gorilla group, but exclude one or more days a week, thereby reducing the exposure of the gorillas and their habitat to human impacts and diseases. An associated advantage would be increased staff availability for training and other park activities. Another option would be to increase the number of tourists per day to compensate for places not used during off-days, but this wouldn't make any difference in overall exposure, as it is the number of person-hours exposure, not the number of visits, that determine the risk of disease transmission. (See epidemiological facts above and visitor group size review below.)

Lastly there is the argument that, as this rule has proven feasible and manageable to-date, **the one visit a day limit should be maintained**. While this does not address the high demand in some parks (i.e. Uganda in 1998) due to closures in other parks (i.e. in Rwanda and Congo), it would have the advantage of maintaining the *status quo* while research could be conducted on the impact of increased visit frequency. The methodology of research looking at impacts on gorilla behaviour might theoretically include monitoring the effect of a temporary increase in the number of visits (or visitors). However, in view of the present knowledge, the recommendation should be to maintain the *status quo* on this rule until evidence allows informed decision about the possibility of additional visits.

VISIT FREQUENCY Recommended action:

- **No change – maintain the status quo on this rule, i.e. limiting the number of visits to one per day per habituated gorilla group**

8.3 Rule b: Limiting the number of visitors

(current limit: 6 in Uganda, 8 in Rwanda and DR Congo)

Even in the early days of organised gorilla tourism in Rwanda, the limit on the number of tourists was based on controlling the risk of human impacts. The initial limit of six was based on a technical assessment of what would be a reasonable limit that would not disturb the gorillas or expose them to undue risk of disease (Vedder A, Macfie L, pers. comm.). In 1989, park authorities in Rwanda (ORTPN) changed this limit to 8 in two of their larger gorilla groups. The reasons behind this change were mostly commercial, as the demand for gorilla tourism exceeded availability of permits in high seasons. The Mountain Gorilla Project, at that time the technical advisory body to ORTPN, opposed this move on the grounds of health concerns, and a compromise decision was reached. The increase was to occur temporarily during the high season (June-Sep) after which the numbers would return to 6, allowing comparisons between groups visited by 6 and 8. However, this compromise was never implemented, and with the war and resultant events, institutional memory within ORTPN was lost and the limit was officially established at 8 in Rwanda, and soon thereafter in Zaire/Congo (Macfie L, pers. comm.).

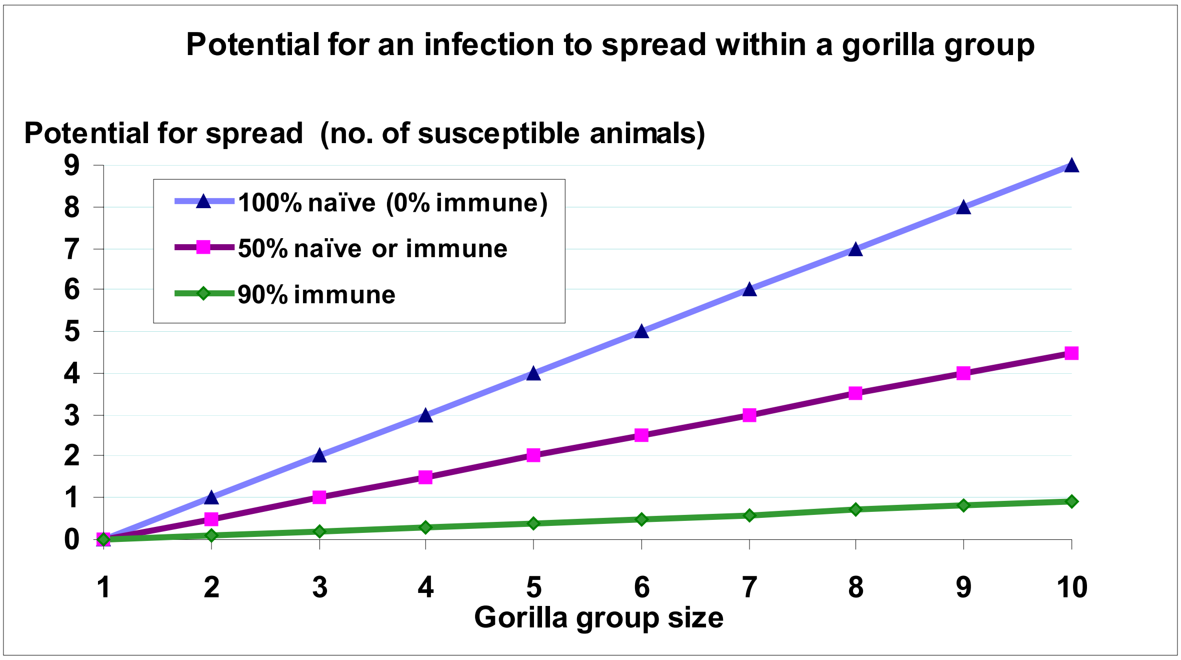
The rationale behind this rule is the same that underlies most rules: limiting the number of people limits the number of potential carriers of germs hazardous to gorillas. Other reasons are that the smaller the group, the easier for the guide to control it, the easier for all tourists to enjoy a good view of the gorillas, and the less likely the gorillas will feel threatened and stressed. All these reasons have health-related implications. As mentioned above, stress can increase receptivity to diseases through immunosuppression. Even with habituated gorillas, a large group of people might be disturbing and threatening. Also, good viewing is an important factor to consider in discussing the minimum distance rule as it is the main reason for tourists to break this limit when becoming impatient to get better views and photos of the gorillas.

Even though the idea of limiting visitor group size has been generally accepted, the actual limit was not set based on definitive scientific evidence. Although no specific data relating disease exposure and group size has been found in the literature, it is possible to assess the weight of visitor group sizes on given gorilla groups, all other variables being equal. In other words, if we know that transmission is a direct function of exposure, the question is: *how would a change in visitor group size affect gorilla exposure, ignoring other factors involved*? Epidemiological facts reviewed above show that the degree of exposure is directly related to the number of infectious sources. This means that each additional visitor represents an additional potential source of infection, *both direct and indirect* (via fomites, faeces, food, etc.).

Before reviewing possible actions, two additional points need to be made. First, as noted earlier, the variables determining the risk of transmission from individual sources are not independent from each other. If all variables were independent, a target exposed to one single or 100 different sources each representing a probability of infection of say 1 in 10, would always have a 1 in 10 chance of acquiring the infection from any one source, independent of the number of sources or the duration of exposure. However, practically or biologically speaking, a longer exposure increases the chances of contact between source and target, through fluctuations in either distance, wind, and target's (gorillas) or source's (tourists) behaviour. An increased number of sources also translates into a greater amount of potential virus or germ shedding, which directly increases the degree of exposure, hence the risk of transmission.

The second point concerns the vulnerability of gorillas to human diseases, and the potential for spread of a disease once introduced into a group/population. As mentioned in the preamble to this discussion, until further evidence is available on gorilla health and resistance to human diseases, one must approach the rules from a "catastrophe prevention" perspective. We must avoid the possibility of any single event that could greatly reduce or extinguish the remaining population. It must be assumed that gorillas are in a state of high vulnerability to human diseases, as shown in examples reviewed above in both wild and captive situations. Therefore the point is that if one individual gorilla is infected, the potential for spread in the group is related to the vulnerability - or the immune status - of the animals. An illustration of this is shown in Figure 1.

Figure 1



The linear nature of this model may not reflect more complex effects from exposure to large visitor groups or dynamics of transmission within gorilla groups. However, it shows that the larger a habituated (i.e. exposed) gorilla group and the more naïve - or less immune - its members, the more animals will be at risk once a group member has been infected. Moreover, the larger the group, the greater potential for an infection to spread to the entire population. In other words, this shows that in assessing the risk of disease transmission from humans, **gorilla group size must also be considered**, although this has not been the case in the past. Actual events show such scenarios to be very real possibilities: both the 1988 "measles-like" and the 1990 respiratory outbreaks were characterised by rapid spread of disease within large habituated groups.

The immediate conclusion from this consideration is that small habituated gorilla groups represent a lesser risk for potential disease spread to park populations. At the extreme of the scale however, very small gorilla groups are less stable, thus are more susceptible to stress and disturbance. Small groups also offer lesser tourist satisfaction and may not be the best for the considerable investment of time and effort required for habituation, as they have a greater chance to disintegrate or be absorbed by larger groups.
With the above factors in mind, one can consider potential options for changing this rule. **Increasing the number of tourists from 6 to 8** could have the advantage of standardising group size across the 4 parks, allowing more tourists to see

the gorillas, and increasing park revenues. It could also be argued that as this limit has been in effect in Rwanda and DRC for nearly 10 years with no apparent detrimental consequences, it would be safe to adopt it. Further, a group of 8 tourists is reasonably manageable for guides and does not affect the "exclusivity" of the gorilla encounter. Finally, if habituated gorillas are no longer 100% naïve to human diseases[3], the increase in risk would be relatively small, as seen in Figure 1.

The argument against this increase is that any additional person in proximity to gorillas directly increases exposure. The increase may appear insignificant for a given encounter, but over time adds up to a considerable number of person-hours exposure (for example, see the difference between annual exposure in BINP or MGNP and the Virungas in Table 3). Also, these scenarios assume that exposure increases linearly in relation to the number of tourists. It is conceivable that this correlation could be gradually incremental, if not exponential, as the more tourists in a group, the greater the likelihood of their breaking rules (such as distance or littering), or presenting additional risks (such as sneezing or defecating). Lastly, it is unwise to use the apparent resilience of the Virunga population to vindicate the *status quo* of the 8-tourist limit, without an analysis of their morbidity/mortality data with respect to possible human transmission (Byers & Hastings 1991).

Decreasing or standardising the number of visitors per group to e.g. 6 in all parks would reduce the disease exposure of gorillas to people, and any associated behavioural disturbance and stress induction. It would also allow easier viewing, a more "exclusive" tourist experience, and a more manageable group for guides. However, the reduction it would entail for the Rwanda and Congo programmes would likely meet with resistance, and the relative gorilla protection benefits of such a change should be compared with the benefit from other possible changes, such as increasing viewing distance.

Echoing these considerations, recent recommendations at the February 1998 Regional IGCP Meeting in Kigali suggested a variable limit with larger gorilla groups / better visibility allowing for larger tourist groups, and vice-versa:

Gorilla group size	Tourism Allowed?	Number of Tourists	Visibility factor
0-5	No	0	-
6-10	Yes	6	Any
11+	Yes	8	Except in Bwindi where limit is 6 due to visibility

New option – setting a maximum gorilla group size for tourism: While the above recommendations from the Kigali meeting afford protection to smaller gorilla groups, they don't account for increased risk of disease spread once introduced into large groups as discussed above. With this new risk factor in mind, it would be prudent to set an upper as well as a lower limit on gorilla group size as, once introduced, diseases can quickly infect entire groups and the larger the group, the greater the risk of spread to the entire population. Ideally, this upper limit should be set below the level at which disease outbreaks risk reaching epidemic proportions. Epidemic spread between groups would depend on the frequency of group encounters in the forest, but this statistic is not known exactly. In the absence of such data on gorillas, and given that epidemic thresholds vary for different diseases and different environments, a reasonable estimate should be developed for a maximum gorilla group size that minimises population exposure. An acceptable approach would be to base the upper limit of gorilla group size on the **average group size** in the environment considered. For example, in the Virungas where the population is estimated at about 300 individuals, and the average group size is 15, the upper limit would be 15. This should not be seen as overly conservative, as it represents a very substantial proportion (5% or 15/300) of the population.

The following recommendation will thus include both upper and lower size limits for visited gorilla groups as well as an upper limit for tourist groups. Since gorilla group sizes vary over time however, it should be noted that the upper limit in this recommendation is not intended as a retroactive measure to de-habituate groups already habituated or undergoing habituation. Rather, it should serve as a guideline for future habituation decisions:

VISITOR GROUP SIZE - Recommended action:

Gorilla group size	Risk of spread for population	Tourism Activity?	Recommended no of visitors (tourist + staff)
0-5	**Small**	**Not recommended**	**No tourists [a]**
6-15	**Medium**	**Acceptable risk**	**up to 10 visitors [b]**
16+	**High**	**Not recommended**	**No tourists [a]**

Note:
a) Cases where staff and researchers may need to have access to groups for which tourism is not recommended, should be covered by the rule as well. It is suggested that for both monitoring and research, a maximum of 3 persons per visit be set.
b) In cases where tourism is acceptable, the limit recommended (10) includes all persons in the group, including trackers, guides, rangers, researchers, volunteers, guests, and any other person.

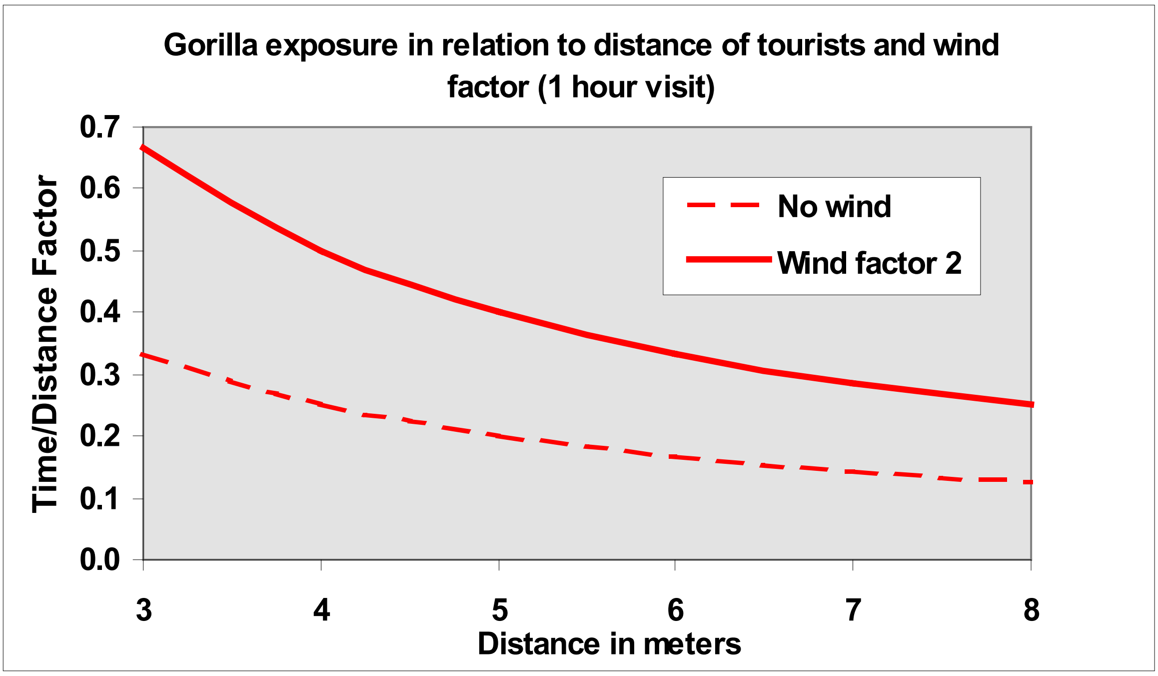
[3] An assumption that could be supported given the years of habituated gorilla exposure to humans through tourism and research.

8.4 Rule c: Maintaining a minimum distance between visitors and gorillas

(current limit: 15ft or ~5 meters)

Of all the rules aimed at protecting gorillas from human disease transmission, the minimum distance rule has often been considered the most critical. As illustrated in Figure 2, when distance decreases, exposure increases dramatically and this effect is further augmented if wind blows in the direction of the gorillas. Yet, nearly 50% of the 21 guides, trackers and rangers who answered the guide questionnaire mentioned this as the rule they have the most difficulty enforcing.

Figure 2



Two basic facts should underlie the discussion of distance. First, sneeze particles can cross a distance of <u>20 feet</u> (<u>6 metres</u>) in a controlled environment, i.e. in the absence of any wind or ventilation factor. Second, airborne organisms can remain stable long enough for very light wind or indoor ventilation to transport them over considerable distances (Baker 1995, Cox 1995, Ehresmann et al. 1995, Ungs 1995, Menkhaus et al. 1990).

The potential effectiveness of airborne transmission is well documented. Droplet nuclei or aerosols (important in transmission of TB and measles) can reach persons/animals in another room if air circulation is shared. In an outdoor environment, factors such as wind strength and direction, dilution and ultraviolet light greatly influence risk. Influenza can be transmitted at ranges of 15-20m (Webster R, Lavanchy D, Hay A, Wilson M, pers. comm.) and the effectiveness of measles transmission in the open has already been mentioned. For this reason, the plexiglass structures now built by zoos to separate primates from visitors are not, as most people believe, primarily for safety reasons, but to protect animals from human disease transmission. Indeed, respiratory disease outbreaks are a common occurrence among primates after school trips to zoos in the winter (Chamove 1998, Roberts J, Lerche N, Campbell M, pers. comm.).

Given the above, it is difficult to consider the option of **relaxing this rule**. If doing so would allow better viewing and provide a more "intense" experience, it would also significantly increase the potential for airborne transmission as well as direct contact with gorillas, particularly young gorillas that tend to be curious or playful. It would also multiply the risk associated with relaxing any other rule and increase the gorillas' stress and vulnerability to disease.

Distance is therefore an eminent example of a dynamic variable in assessing the risk of transmission, as it is effectively constantly fluctuating over time and is greatly influenced by other variables. As such, most infectious disease specialists interviewed during this consultancy agreed that the **current 5-metre limit appears inadequate**, especially in view of the very high infectious potential of pathogens like influenza, paramyxoviruses, and herpes viruses. Thus, if both wind effects and potential sneezing or coughing are to be accounted for by this rule, the 5m distance is not adequate.

Increasing this limit to protect gorillas from a potential sneeze would be all the more justified given that the 5m rule is difficult for guides to enforce and is occasionally broken. Increasing distance would provide a safety factor against both avoidable (intentional) and unavoidable (wind) fluctuations in effective distance. As increasing the distance might on some occasions slightly reduce gorilla viewing, the additional level of protection provided could allow for consideration of other possible safe ways to compensate for this effect.

The efficacy of increasing the minimum distance would obviously greatly depend on adequate enforcement, implying a need for staff training in all four parks to ensure compliance. It is important to stress that this rule should apply not only to tourists, but also to all other gorilla visitors, including researchers, park staff, and other users of the forest. An exception for park staff or veterinarians in case of emergencies or medical interventions should be clearly spelled out in order to avoid undermining enforcement, as it could be seen to be a double standard.

The following recommendation accounts for the factors above while safeguarding the primary intent of gorilla tourism:

MINIMUM DISTANCE - Recommended action:

Increase the minimum distance to 25 ft or 7.5 meters for all people approaching or visiting gorillas in non-emergency situations.
The use of protective devices and other rules regulating handling of animals requiring veterinary interventions are discussed below (see *Possible Additional Protective/Preventive Measures*, p.34)

8.5 Rule d: Limiting the duration of the tourist visit

(current limit: 1 hour)

The time rule was initially aimed at limiting disturbances to the gorilla activities, while providing sufficient viewing for tourists. Limiting time obviously also reduces chances of human disease transmission, both directly and indirectly (see *Determinants of disease transmission*, p.16).

While **reducing the time spent with gorillas** would reduce gorilla exposure to potential germ-carrying people, it would also decrease chances for a good viewing, thereby putting additional pressure on tourists and guides to get a satisfactory encounter within that time. It would also produce a negative response from tourists, as time is probably the most restrictive constraint perceived by tourists, considering the time and expense of a gorilla tracking safari. It is easy to see how reducing the length of the visit could go against their expectations. Further, it would be difficult to significantly reduce exposure as the time allotted is already short and couldn't be reduced by more than 15-20 minutes.

On the other hand, **increasing visit time** to e.g. 1.5-2 hours could significantly increase viewing time, thus tourist satisfaction. Such a change could balance out additional protective measures for disease transmission such as increased distance or reduced tourist group size, as well as any increases in the price of gorilla permits. However longer visits could result in an increased chance that gorillas will "violate" the distance rule, as they often do with researchers and habituators. Lastly, longer visits would prolong the duration of the activity, thus making it more tiresome for unfit or elderly tourists.

It is difficult to dissociate the time limit from the distance rule. Even though tracking permits clearly stipulate there is no guarantee of viewing gorillas, great pressure is exerted from tourists to get a good view within the time allotted, which can lead to violations of the distance rule. The question is therefore whether or not a longer visit could provide greater satisfaction without substantially increasing exposure. The current practice is that guides start counting time from the moment that gorillas are first seen. Yet, it can often take time for the gorillas to settle in an area where they can be seen. There is also a possibility that tourists are close to the gorillas without being able to see them due to thick undergrowth or other obstacles, as is often the case in Bwindi or Parc National des Virungas where vegetation is particularly dense (Pers. obs. & Aveling C, pers. comm.). In such cases, starting the clock at the first encounter may provide a very short actual viewing time, depending on the gorillas' movements.

One survey respondent suggested a means of improving tourist satisfaction: guides could be allowed to keep the visitors back from the gorillas (20m or more) for a limited time (maximum 15 minutes) while waiting for a better view before starting the clock. The advantage of this idea is that it would increase the chances that gorillas move into a better place for viewing without increasing the duration of actual exposure. It would also lessen the pressure on guides who may sometimes unwisely try to force the gorillas into good viewing position. However, as participants of the IGCP Regional Meeting in January '99 stressed while discussing this rule, the notion of "waiting" or "hanging back" must be clearly defined and limited, as there is no guarantee that the view will improve.

In view of the above, the recommendation of this consultancy is as follows:

VISIT DURATION - Recommended action:

Maintain one-hour visits; but when and where necessary, allow a 15-minute waiting period at 20 m or more from gorillas before starting the clock in case - and only in case - gorillas are not visible at initial encounter.
• *During this time, the guide is to remind tourists of the critical distance and behavioural rules as well as to indicate the exact time the viewing will start and stop.* • *To avoid misinterpretations or "bargaining" by visitors, guides should clearly state that once counting has started, it will not be stopped until the hour is up, even if gorillas move again out of view during that time.*

8.6 Rule e: Eating before or after gorilla viewing

(current limit: no eating "near" gorillas)

As we share many taste preferences with apes, food is a major source of attraction - and contamination - for gorillas. Food (and faeces) are sources of *direct* exposure, which carries a much more efficient rate of transmission than the airborne route. In addition, several human diseases of concern for apes are transmitted via the faecal-oral route. Food can act as a fomite, as viruses and other germs can survive in food for hours or days (see Table 1).

This is why park policy in all three countries with mountain gorillas prohibits the practice of feeding animals by staff or tourists. However, as gorilla tracking can take several hours over rugged terrain, tourists are encouraged to bring adequate food and water with them. Because it is difficult to eat without dropping food bits on the ground, they are asked "*not to eat near gorillas"* and visitors stop to eat only when the guide approves. This rule may not be observed by habituation rangers or researchers who may spend days or weeks at a time in proximity of gorillas, eating regularly and therefore representing a much greater potential source of food contamination to gorillas than tourists.

No specific eating distance from the gorillas is stipulated in current rules. However, as it is impractical and unrealistic to prevent introduction of food into the park, setting a safe distance for eating in the vicinity of gorillas and minimising the deposition of food or food remains are essential measures to reduce the potential of contamination through this route. Several survey respondents proposed a distance of 200m or more. While such a distance would certainly be safe to minimise the odour attraction of food, participants in the discussion of this review rightly pointed to the difficulty for guides or rangers to estimate such distances in uneven terrain. To be more practical, the recommendation is therefore:

EATING IN PARK - Recommended action:

Establish and enforce in all parks and for all people a minimum 5-minute walking distance away from gorillas before eating, as well as strict removal of all food remains.

- *This implies walking at a regular pace away from the gorillas for at least 5 minutes before stopping to eat.*
- *Care should be taken to carry all food scraps and other rubbish out of the park (see rubbish rule, p.31).*
- *In case of prolonged stay in the park, researchers, trackers, or other staff should make all efforts not to leave any food behind. In case this is not feasible, remnants should be buried as deep as possible.*

8.7 Rule f: Disposal of human faeces

(current rule: bury faeces 1 foot deep)

Current park regulations stipulate that all human faeces must be buried a minimum depth of 1 foot. The intention of this rule is to ensure that gorillas or other animals cannot touch, eat or otherwise come in contact with human faeces. Faeces are known to be a vector for a number of pathogens of concern both for apes and other humans transmitted via the faecal-oral route, as reviewed in the section on *Diseases of Particular Concern* above (p. 10).

A number of important questions have been raised concerning this rule: *Is 1 foot deep enough? Is it feasible for tourists to dig such a hole before defecating? Is this rule respected by and/or adequate for guides, trackers, rangers and researchers? Is it safe enough to bury faeces? And why is there no provision for urine?* The last of these questions is the simplest to answer: urine represents a far lesser risk than faeces, as normal urine is sterile.

Although there has been no research on gorilla behaviour around buried faeces, faecal-oral transmission of human viruses or parasites is known to be not only much more efficient than airborne transmission, but also much more dangerous than contact with food. The reason is that human faeces are likely to carry high concentrations of live, virulent pathogens that can survive for months or years in soil or water, especially if deposited by a sick or infected person. As such, faeces in shallow earth can contaminate water and food supply with pathogens like *Giardia, Amoebas, Rotavirus, Shigella,* and *Cryptosporidium*. Consequently, it is critical that the rule concerning this practice be adequate, respected and enforced.

The first question is the effectiveness of the one foot-depth. Gorillas are known to be both geophagic and coprophagic (Mahaney et al. 1990, 1993 & 1995, Akers & Schildkraut 1985). If attracted by the smell of human faeces, they and many other animals would have no difficulty digging out faeces from a one-foot hole in the moist forest soil, especially if recently dug. Also, rainfall is high in all parks, and even a mild rain could easily wash out a one-foot hole. Moreover, tourists and other park users may have diarrhoea and not be able or willing to dig even a shallow hole before defecating. In light of this fact, park managers have suggested shifting the responsibility of digging holes to guides or trackers to ensure compliance.

In countries with strong environmental laws, tourists in many wilderness areas are strictly required to carry their faeces out of the area in plastic bags and containers, no matter how long their stay. This is done to avoid a cumulative risk from the many thousands (sometimes millions) of visitors visiting parks annually. Although this option would definitely be ideal to ultimately protect gorillas and other wildlife from the continuous risk of faecal germ contamination, it might be difficult to implement in the geophysical and cultural context of the Virunga and Bwindi regions.

Survey respondents and discussants of the preliminary report at the Regional IGCP Meeting expressed their concerns about this possibility, stressing it could be a challenge - and a hazard - for several reasons. These include the difficulties in handling faecal containers over rugged terrain, the potential for spills and increased rubbish, health implications of handling cases of diarrhoea, disposal outside of the forest, and last but not least cultural taboos regarding handling faeces. These difficulties would likely result in poor or non-compliance. But perhaps the strongest argument against investing in such a possibility was expressed in the following comment:

> *"There must be so many more faeces in the park as a result of the multiple use programme, illegal [...] and military/rebel activities, that the faeces from tourists must represent a small proportion (albeit probably concentrated in areas of high gorilla use)"*

Indeed, defecation by tourists may not be the greatest source of concern as trackers, rangers and researchers spend many more hours inside park boundaries than tourists given the demands of their work with and around gorillas. When they camp in the forest for days or weeks at a time to habituate or study gorillas, remove snares or maintain trails, the possibility of carrying faeces out of the park becomes even more remote. At the same time however, this fact further points to the insufficiency of the current rule in reducing the risk of disease spread.

Many survey respondents suggested burying faeces in substantially deeper holes (2-3') in order to prevent the possibility for gorillas, other animals, or rain to expose them. Although this might be even harder to enforce in some areas of the park where the terrain is hard, steep or covered with thick undergrowth, it could be agreed upon and implemented whenever possible. As such, it would go a long way in reducing the potential of contamination from extended stays in the parks. In addition, simple chemical treatment of faeces (with a 2% chlorine solution[4]) could almost totally reduce germ viability, smell, and attraction of animals. Finally if, as suggested by some respondents, tourists rarely defecate on gorilla walks, an additional strategy to further reduce this likelihood would be to sensitise them on the associated risks and give them time to use toilets before the start of the tour. In summary, the recommendation is as follows:

FAECES DISPOSAL - Recommended action:

- **Minimise possibility of defecation by tourists in park by promoting and allowing time for toilet use before start of tour**
- **Ensure that guides or trackers dig holes at least 0.5 meters (2 ft) deep for tourists and for themselves.**
- **Treat faeces with antiseptic solution before filling holes (150 ml of a 2% chlorine solution*)**
- **Sensitise staff and researchers on importance of this rule for the health of all gorillas, tourists and all people in and around the parks, themselves included.**

* Chlorine solutions can be made from a number of substrates including activated lime, calcium hypochlorate, or simply *Jik*. 150 ml is equivalent to a small glass or half a cup.

Needless to say, these actions are largely dependent on proper implementation, which further points to the need for training and strong monitoring of park staff.

8.8 Rule g: Prohibiting littering in park

(current rule: carry out all rubbish, including biodegradables)

In park regulations, all rubbish is to be carried out of the park. This rule is self-explanatory as rubbish pollutes and degrades the ecology of the forest, and can carry germs, not only from humans but also from animals attracted to it. In addition some rubbish may be directly harmful to gorillas or other animals that may try to eat or chew it. Most survey respondents viewed this rule as adequate but largely dependent on satisfactory enforcement. Although no systematic monitoring is done on this rule, foreign tourists are usually well educated about cleanliness in wilderness areas, and no reports about visible rubbish were recorded during the consultant's informal interviews of past gorilla tourists[5]. Therefore, it seems that this rule is respected and enforced, at least in Uganda and Rwanda where information was gathered.

However, there is some contradiction between this and the faeces rule. Both deal with similar degrees of disease risk for gorillas, as both organic and inorganic rubbish can last as long or longer than faeces and may carry odours and tastes attractive to wildlife. Yet rubbish has to be carried out while faeces can be buried. This difference may not have much significance for tourists who rarely need to apply both rules, but actions relating to eating and defecating in the park are common for staff who may spend prolonged periods of time inside the park. During their stay they cook, eat, and wash, generating faeces and rubbish that includes food scraps, plastic bags, and other implements. These are all possible sources of contamination, and if rubbish is not removed and faeces buried, the risks accumulate. Park staff are trusted to self-enforce this rule, yet it is easy to see how it could seem logical to them - or anyone for that matter - that rubbish should be as safe to bury as faeces, even if there are good reasons for not enforcing the removal of faeces. Training and monitoring of staff are therefore critical to ensure adequate respect for this rule.

[4] Chlorine stocks or solutions should be stored in non-metallic containers in ventilated areas, and made fresh every week, as chlorine is inflammable and inactivated by metal, light, and heat. Contact with skin should be avoided as a 2% chlorine solution is corrosive.

[5] Although this is only a relative indicator of enforcement, it should be weighed in comparison to the situation in some national parks in Uganda or elsewhere, where trash piles can be found around remote camp sites or trails.

Finally, this rule does not address the disposal of rubbish once carried out of the park. In many instances, rubbish is dumped in containers or pits near visitor camps or staff quarters. This poses another contamination problem even if pits are covered with metal grids as small animals can easily get into pits or bins, carry rubbish out, and disperse it. In parks like Bwindi where staff quarters and tourist camps are on the edge of the forest, habituated gorillas groups are often foraging in the vicinity of these pits, so exposure to such possible contaminants is more likely. Therefore, ensuring proper rubbish disposal and preventing animal access to disposal sites are important considerations, which are explored in the section on *Possible Additional Actions* below (p.46). In the meantime, the recommendations on this rule are as follows:

LITTER RULE - Recommended action:

Strengthen enforcement through:
- **training and monitoring of staff**
- **ensuring and monitoring safe and adequate rubbish deposits and removal around parks**
- **preventing animal access to rubbish disposal sites** *(see also 9.2.1, Additional measures on p.46)*

8.9 Rule h: Limiting the minimum age of eligibility to visit gorillas

(current limit: 15 years old)

Setting a minimum age limit to visit gorillas was aimed at preventing transmission of "childhood" diseases to gorillas, and ensuring the safety of visitors by only allowing grown individuals to visit.

Humans develop immunity against diseases in two ways: passively (naturally) or actively through immunisations. Natural immunity is built during early years of life when an individual first comes into contact with pathogens, goes through the corresponding infections or illnesses and builds defensive mechanisms called immune responses, which in many cases will protect for life. These "first contact" diseases are called "childhood diseases". During such episodes, infected children actively shed the infectious agent and can infect others, which is one of the main ways they contaminate each other. For these reasons, children represent a large risk for disease transmission to unexposed individuals or species, such as gorillas.

There is no absolute clear-cut age limit by which to universally define the end of the childhood disease period. Childhood diseases can occur from birth to as late as 18 years of age and even beyond, depending on various genetic and environmental factors. As an illustration, the definitions of paediatric age in US, African or European hospitals all differ (up to 18, 15, or 16 years). However, it is widely admitted that the majority of childhood disease episodes occur before puberty. As adolescence sets in at varying ages between 12 and 16 depending on gender, origin and individual characteristics, the 15 year-old limit by and large corresponds to a reasonable average to differentiate children from adults.

Lowering or increasing the age limit thus could only be considered for a few years of age that may not have substantial impact on disease risk. However, the lower the age limit, the greater the variation in physical development, and therefore the more difficult to ensure both the safety of smaller visitors and that disease risk associated with their presence doesn't accrue. Another outcome of lowering the age limit would be to provide increased access to gorillas for young people. But given current tourist demand, it does not seem urgent to increase the number of gorilla visitors. In fact, **maintaining the current limit** could encourage diversification of park activities for families with younger children. From both a medical and conservation standpoint, the recommendation for this rule is as follows:

AGE LIMIT - Recommended action:

No change – maintain current age limit of 15.

8.10 Rule i: Prohibiting access to people who are ill

(current rule: sick tourists required to self-report)

Tourists showing up for a gorilla visit are asked to self-report any sickness and encouraged to do so by entitling them to a refund or rescheduling of the visit in case of voluntary reporting. The guide can exclude any sick tourists failing to self-report from the trip, in which case they lose their tracking permit. This severe rule is intended to reduce the dangers from what is perceived to be the most serious health threat to the gorillas, namely a sick, hence highly infectious human.

The greatest challenge to this rule is its limitation in scope and enforcement. As said above, infected people can shed viruses or bacteria before and after the appearance of symptoms. This rule also does not address the situation of sick guides, trackers or rangers, which may arise at least as often, if not more often, than with tourists. As for enforcement, the difficulty is best summed up in the following quote from one of the questionnaire respondents:

> *"The idea that a tourist who has come all the way from New Zealand to see the gorillas is going to own up to a slight cold and opt out at the last minute is ludicrous. And I don't see how a guide is qualified to judge whether someone is ill or not. An unenforceable regulation in my view."*

This pessimistic statement may well reflect the reality in the field as well as similar attitudes on the part of park staff. It thus raises some important questions. First, can anything be done to strengthen this rule? Second, are there ways to motivate tourists or park staff to exercise self-restraint? Third, if this rule is inadequate for both tourists and park staff, what alternatives are available to prevent visitation by tourists who are ill?

Some survey respondents suggested imposing a heavy fine as a deterrent to tourists who hide illness, but it is doubtful whether this would have the desired effect, as it leaves the problem of *how to identify* a hidden illness totally unsolved. Another suggestion was to require tourists to present a doctor's certificate of good health, but this would be of little use if not done just prior to gorilla tracking, given the potential for catching any infection in the meantime. Another option is to hire qualified medical personnel to carry out health checks of tourists before tracking gorillas, but this would not only be extremely cumbersome, but would also entail high costs for limited clinical results.

The only plausible means to encourage self-restraint is *awareness*. Tourists who travel to see gorillas can be assumed to have an interest in learning about this highly endangered species. Yet little, if anything, is done *before* their trip to inform them about the risk of human diseases. Besides the fine print on the tracking permit that few tourists are likely to read, it is only when they arrive in the park on the day of their tour that they are briefed by the guide on this risk and other rules.

A great deal more could be done prior to tourists' arrival to avoid the difficult task of disqualifying a tourist from his/her scheduled visit. From the moment of booking to the time of their arrival in the country, both tour operators and park authorities could **educate tourists** on this issue. In addition, while many written articles and films have been produced about apes, little has been done to educate the general public about disease and other potential side effects of gorilla tourism. Such an effort could have a more deep-rooted and lasting effect on tourists' motivation to protect gorillas than any threatening rule. If successful, tourist education could have wider implications for conservation of gorillas, other apes and their habitat. This option is explored further in section 9.1.6 under "*Possible Additional Preventive Actions"* (p.44).

In further improving this rule, we need to explore possible avenues for *preventing* transmission from tourists rather than relying solely on clinical evidence of disease. As mentioned above, guides may not be qualified to assess a person's state of health or sickness. In addition, tourists may be unaware of, or can easily hide their infectious status since they can be carrying germs for days before the onset of symptoms (i.e. during incubation) as well as during convalescence. This applies equally to park staff, who are likely to carry a substantial number of respiratory and gastrointestinal infections, according to the epidemiological profile of the population surrounding the parks (see section 5.3.3, p.15). Researchers coming from overseas present a similar level of risk as tourists, compounded by their longer and closer exposure to gorillas, and the fact that nobody is assigned to monitor their health status during the duration of their research.

In light of these facts, one option to consider is the possibility of requiring tourists and researchers to be immunised. Currently, neither tourists nor researchers or park staff are required to be immunised or tested against many of the diseases of concern for gorillas, except for yellow fever which is mandatory for tourists coming to East Africa. In contrast, most zoos with primates in their collections require animal keepers and researchers to be routinely tested for TB and vaccinated against measles, two diseases with potentially fatal consequences which are easily transmitted through droplets and/or fomites, as described above. Although this option should be discussed in light of local epidemiological conditions and feasibility, vaccination of tourists, park staff and researchers could reduce the frequency of diseases, thus the risk of gorilla contamination. This is explored further in section 9.1.3 under "*Possible Additional Preventive Actions"* (p.40).

In summary, there is no recommended change to this rule, but determined action needs to be taken to reinforce it. In particular, emphasis should be placed on the importance of this rule at the time and point of tour purchase.

SICKNESS RULE - Recommended action:

Strengthen enforcement through additional measures through:
- **active sensitisation of tourists before booking of tour (*see section 9.1.6 below*)**
- **immunisation of tourists and park staff against specific diseases of concern (*see 9.1.3 below*)**

8.11 Rule j: Controlling smoking, eating, sneezing, and coughing in the presence of gorillas

Although this rule is self-explanatory, it contains very different behavioural elements. Smoking and eating are voluntary, controllable behaviours. In contrast, sneezing and coughing are reflexes, sometimes impossible to control, hence difficult to "regulate". In reality, the rule asks tourists to turn away from gorillas before sneezing or coughing to avoid propelling droplets in their direction. While this is a good recommendation, it depends completely on the tourists' self-control, thus cannot be counted on. This has implications in terms of the definition of a safe distance between gorillas and tourists, which has been discussed under rule c) above.

In addition, spitting and nose blowing on the ground are controllable behaviours that are missing from the current rule statement, yet these behaviours carry substantial risk of contamination. Sputum and nose secretions can harbour high concentrations of germs dangerous to gorillas, especially in case of a recent infection (Kok & Higgins 1997). TB, influenza and measles are among several such examples. Tourists as well as researchers, staff, and other users of the park must be regularly reminded of this simple guideline to avoid putting gorillas at unnecessary risk of infection.

SELF-CONTROL RULE - Recommended action:

- **Clarify statement by differentiating action for controllable behaviours and uncontrollable reflexes**
- **Include spitting or nose-blowing on the ground as controllable behaviours from which to refrain**

9. POSSIBLE ADDITIONAL PROTECTIVE/PREVENTIVE MEASURES

In relation to discussions above, several additional measures could be taken to prevent or reduce the risk of disease transmission to and from gorillas. They relate to either protecting the gorillas themselves, or reducing the human risk from tourists, park staff or local communities. The corresponding reactions, comments and suggestions from survey respondents as well as their relevance, feasibility and potential benefits are presented in Table 6 (p.35), and discussed hereafter.

9.1 Measures designed to reduce risks from the human side

9.1.1 Wearing of protective devices – masks or gloves – by tourists

The wearing of gloves, masks and gowns to handle animals has become standard practice in most institutions and facilities with captive primates around the world. For example, since the 1988 measles epidemics at the University of California at Davis, USA, all staff and visitors are required to wear such devices before entering the animal facility (Lerche N & Roberts J, pers. comm.). In the gorilla parks, it is a rule that veterinarians and all other staff who handle gorillas wear these devices.

Since the early days of gorilla tourism, the use of protective devices by tourists at time of viewing the gorillas has often been discussed. Limitations and difficulties inherent to the implementation of this proposition for wild gorilla tourism have caused their use to be rejected in the past. Survey respondents submitted similar views on limitations of gloves and masks.

Gloves and masks were discussed following the 1988 suspected measles outbreak in Rwanda. The idea was discarded due to the following reasons:
- Compliance would be a problem as tourists would tend to remove masks when hot or when condensation caused by breathing fogs glasses/camera/binoculars.
- Reliance on mask/gloves may lead to artificial sense of security and visitors/guides/rangers might feel it is safer to get closer to gorillas with masks on.
- Possible increase of waste in forest from accidental disposal of gloves/masks.
- Presence of mask may frighten gorillas.
- A general feeling that if masks and gloves had to be used, then people shouldn't be there at all.

Additional comments by survey respondents included:
- Disposal: (adequate or accidental) could generate additional potential sources of infection.
- Compliance: assumes that tourists are properly educated and guides properly empowered to enforce rule.
- Feasibility: who will and how to ensure supply, management, disposal, and monitoring?
- Excessive from a tourist comfort/satisfaction point of view.

A discussion that should be added to these comments concerns the efficiency of wearing masks. A number of viruses or bacteria of concern for gorillas, such as influenza and TB, are transported by droplets or aerosols and thus could be stopped by masks (Fennelly 1997, Nicas 1995). Yet once saturated by moisture, masks lose their effectiveness and they allow droplets to cross the membrane. This effect is enhanced by high temperature and humidity which prevail in gorilla habitat, making masks considerably less likely to be effective over an hour-long visit (Nicas 1995; Lavanchy D, Hay A, pers. comm.).

However, the most important conclusion from this discussion is that it is essential to ensure strict and systematic compliance of park and veterinary staff in wearing protective devices when handling gorillas. Veterinarians, researchers and trackers who come in direct contact with gorillas represent a maximal potential for germ transmission in both directions. Working conditions in the field imply that compliance with this rule relies as much on planning and regular supply of devices as on awareness and willingness of the staff to use them. More often than not, animals that have to be immobilised represent emergency cases, and if gloves or masks are not readily available and stocked along with veterinary equipment, one or more members of the intervening crew may be forced to handle animals without protection. There is little question that all measures must be taken to prevent unprotected handling of gorillas. This is extremely important in light of numerous cases of contamination in captivity, as well as growing concern over new pathogens like HIV, Ebola or related viruses which can "jump" from primates to humans (Le Guenno et al. 1995, Feldmann et al. 1996, Gao et al. 1999).

PROTECTIVE DEVICES - Recommended action:

None for tourists
Ensure 100% compliance by park and veterinary staff while handling animals
- *This is especially important in light of numerous cases of contamination in captive animals as well as the growing concern about new pathogens "jumping" from primates to humans.*

Table 6: Strengths, Weaknesses, Opportunities, and Limitations of Possible Additional Measures to Protect Gorillas from Human Disease Transmission

PROPOSED MEASURE	RATIONALE	SURVEY RANKING (n=31)	STRENGTHS	WEAKNESSES	LIMITATIONS	OPPORTUNITIES
REDUCING THE HUMAN RISK						
a) Wearing of protective devices	• Prevent gorilla exposure to potentially infectious fomites and aerosols	• Yes 5 • Yes but… 2 • **NO 9**	Would protect gorillas from: • *Sneezes and cough* • *Transmission of unseen respiratory infections* • *Direct contact with humans of apes (juveniles) likely to approach people* • *Masks and gloves could be provided by sponsors - thus, costing nothing (or very little)* Also: • *Should reduce transmission in both directions, i.e. protect tourists from catching germs from gorillas or other sources*	• *May give tourist false sense of security and legitimacy to approach gorillas or stay longer* • *May not be complied with (cumbersome, hot, humid, difficult breathing, fogging up of camera/ lenses)* • *Who would supply stock?* • *Could increase amount of contaminated trash left behind accidentally* • *May make little difference if the 5 m rule is followed and if there is no direct human-gorilla contact.* • *Gorillas' reactions ?* • *Diminishes quality of experience*	• *Only if proper disposal facilities exist* • *Must still be used in conjunction with the strict maintenance of the 5m buffer distance* • *Would require that tourists are properly educated and guards properly empowered to enforce it.* • *Would likely not prove to be significant if visitors are kept over 10 meters away*	• *Strengthen strict enforcement of rules by staff / researchers during field interventions* • *Been considered but not implemented anywhere. Should be required of all visitors to the gorillas, including researchers.* • *Maybe someone can design a mask of minimal size, with lots of comfort and perhaps in safari colours* • *Good idea suggested around 1992 by MAF scientific advisory committee for Rwanda gorillas - but never brought out*
b) Washing of hands / disinfection of boots before and after gorilla tour	• To reduce potential direct or indirect/ fomite contamination to and from gorillas	• **YES 8** • Yes but… 2 • No 6	• *Easy to do* • *Would remind tourists (and staff) of the importance of the risks they pose* • *Would also protect tourists from possible zoonotic diseases* • *Increases general hygiene*	• *Doesn't make much difference if other rules are followed* • *High likelihood of recontamination (by touching clothing, face, etc.) by the time the gorillas are reached* • *Inconvenient* • *Poor compliance?*	• *Not effective if people are infectious* • *Ineffective if visitors urinate/defecate after start of visit without washing hands afterward* • *May only be useful if anti-bacterial soap/lotion is used*	• *Should also include obligatory washing of hands following defecation, urination* • *Consider waterless disinfectant products* • *Should be instituted for researchers as well* • *Also dipping of boots/shoes in a shallow disinfectant "pool" prior to entering forest to view gorillas*
c) Require tourists to be tested and/ or immunised (TB, influenza, measles, polio, yellow fever, tetanus, hepatitis)	• To reduce the overall germ carrying capacity of tourists	not surveyed	• *Can be easily done before departure along with other standard immunisations required from or recommended for tourists* • *Could enhance awareness of importance of issue* • *Can reduce shedding and the number of hidden exposures (from asymptomatic carriers)*	• *Would create difficult situations in case of non-compliance (e.g. if tourists show up without required proof)* • *Vaccines never completely eliminate the possibility of disease*	• *Enforcement may be limited without proper information campaign and tour operator support* • *Limitation of TB testing for non-US tourists*	• *Carry out educational campaign among tour operators and general public* • *Produce educational pamphlet?*

Table 6 (continued) - Possible additional measures to protect gorillas from human disease transmission

Proposed measure	Rationale	Survey ranking (n=31)	Strengths	Weaknesses	Limitations	Opportunities
REDUCING THE HUMAN RISK *(cont'd)*						
d) Immunisation of staff and researchers (TB, measles, polio, yellow fever, tetanus, hepatitis)	• To improve human health status • To reduce the incidence of diseases communicable to gorillas	not surveyed	• *Highly effective and safe vaccines are available for measles, **yellow fever, tetanus and polio*** • *Much easier (and cheaper) to prevent than cure viral or chronic infections (e.g. TB)* • *Would reduce 'baseline' infectivity of staff / researchers*	• *Would not completely eliminate the possibility of disease* • *May differ from national health policy* • *Limitation of TB immunisation for staff (high prevalence area)*	• *Are vaccines accessible, affordable ?* • *Implies existence of a monitoring system* • *May not have expected efficiency in HIV-infected individuals*	• *Setting a standard for all 4 parks* • *Setting a precedent for tourists*
e) Systematic health monitoring of park staff & researchers incl. regular testing (TB, HIV?)	• To improve human health status • To minimise risk from park staff and researchers who are an important source of potential contamination for gorillas	• **YES** **12** • yes but 3 • no 1	• *Regular medical checks of staff & researchers would reduce their disease rate and improve their health status* • *Improved health status of staff & researchers would reduce risks of gorilla contamination* • *Regular checks would enhance awareness of risks among staff / researchers, hence could improve tourism rule enforcement*	• *Could be perceived as invasive* • *Could create imbalance (discrimination?) Between park staff and local population* •	• *Feasibility: are health services / testing available, accessible ?* • *Ethical questions: should staff have option to test for HIV? How to provide the services ? What to do about people who test positive ?* • *May not be effective lest immediate relatives, communities are involved as well* • *Considered in 1992 for Rwanda PNV. Could meet public resistance in the face of AIDS: Would require strong sensitisation-education programme*	• *Developing health benefit package for staff could have multiple impact, incl. improved human & gorilla health, and staff motivation* • *Other viral diseases e.g.. hepatitis as well as intestinal parasites, dermatophytes, scabies can be included as well* • *Contingency plans could be made in case of human or animal epidemics* • *Establish a health unit in or nearer park staff quarters?* • *Rangers, guides and researchers should all be examined for particular diseases (including parasites) every 6 months*
f) Quarantine for researchers	• To reduce the risk of transmission of imported germs	not surveyed	• *A widely practised and simple measure to avoid potentially devastating infections from foreign introduced germs*	• *Not applicable to <u>all</u> foreigners (i.e. tourists)* •	• *Poor compliance to date* • *Lack of researchers' motivation / management's enforcement ?*	• *Strengthen researchers' awareness* • *Design an effective enforcement/monitoring system*
g) Minimising local community diseases and improving sanitation…	• To reduce the overall risk of disease transmission from people surrounding and using the parks	not surveyed	• *The only effective strategy for overall and sustainable risk reduction in the long term* • *Surrounding human population is a constant risk as regular interactions with gorillas occur (multiple use program, crop raiding, transients, poaching)* • *Disease burden of surrounding human population may be / is of equal if not greater concern than this of tourists*	• *Long-term goal which cannot be expected to yield immediate results* • *Primary exposure sources are park staff and tourists*	• *Totally dependent on national political, social and economic situation* • *A strategy that will require considerable input over the long term and face serious challenges*	• *Integrate public health and conservation concerns, objectives and strategies* • *Keep health authorities informed / involved* • *Develop emergency plans in case of epidemics*

Table 6 (continued) - Possible additional measures to protect gorillas from human disease transmission

Proposed measure	Rationale	Survey ranking (n=31)	Strengths	Weaknesses	Limitations	Opportunities
REDUCING THE HUMAN RISK *(end)*						
h) Active information-education-communication (IEC) campaign for tourists and tour operators	• To educate tourists about the dangers of human disease for gorillas	• **YES** **14** • yes but… 1 • no 1	• *Rules are generally broken as a result of tourist demand* • *If tourists understand the rules and how important they are, they are more likely to respect them, listen to guides, as well as prefer 'rule or gorilla conscious' operators* • *"the biggest problem a guide can face is his lack of leadership while taking tourists to see gorillas"* • *Very little is currently done to prepare tourists to deal with issue at time of booking/purchasing tour* • *Would also provide a forum to educate about the possibility of zoonotic transmission which is rarely, if ever mentioned*	• *Long-term objective; cannot be expected to yield immediate results* • *Target audience, i.e. tourists, is a very heterogeneous group* • *…?*	• *Would require appropriate resources and funding* • *Education would be more effective if data was available to demonstrate link between tourism and disease transmission* • *May not be sufficient to deter over-zealous tourists from breaking the rules* • *"Awareness is not a one-off event. [there is a need to] maintain it, through monitoring & evaluation…"*	• *A widely broadcasted and sustained campaign could be the most effective way to further mobilise public awareness and support to the cause of endangered apes* • *Requires a well-planned, focused, and coordinated pilot strategy to gather support, mobilise resources and sensitise public opinion in various locations,* • *Could provide an additional source of support for gorilla conservation* • *Could involve surrounding park community as well*
PROTECTING THE GORILLAS						
a) Fencing visitor centre off	• To keep animals from roaming in or around tourist settlements	• Yes 5 • **YES BUT… 8** • No 1	• *Would limit potential of gorillas' contamination from rubbish pits and other waste* • *Would reduce chance of unsafe unaccompanied encounters w/ gorillas* • *Would be a one-time cost with presumably minimal upkeep* • *Especially useful for areas where visitor centre is near forest (BINP)*	• *Limited impact as many other areas inhabited by humans should also be fenced off and maintained* • *Cost-effectiveness ?* • *Could be easily torn by gorillas*	• *Only relevant to specific small areas where gorillas come into contact with people (BINP)* • *Fence should be strong enough to deter gorillas* • *"Impossible… Unless you fence the entire park"*	• *Conduct cost-benefit analysis* • *See visitor centre EIA* • *Should be considered in conjunction with efforts to remove objects attracting gorillas beyond the fence/demarcation line* • *If gorillas are on public land whether it is tourist settlements or fields they need to be chased back into the forest*

Table 6 (continued) - Possible additional measures to protect gorillas from human disease transmission

Proposed measure	Rationale	Survey ranking (n=31)	Strengths	Weaknesses	Limitations	Opportunities
PROTECTING THE GORILLAS *(end)*						
b) Active (prophylactic) immunisation of habituated gorillas	• To protect habituated gorillas from specific human diseases for which vaccines are safe and effective	• Would support 3 • Feasible but.. 4 • **Only in emergency or in the future 7** • Needs research 3 • Not feasible, not in support 7	• *Effective and safe (non-live) vaccines are available and have been used with captive animals* • *Technically feasible (darting)* • *Prophylactic immunisation of habituated animals would create a buffer between humans and wild non-habituated gorilla population* • *Can be considered / planned separately for BINP or Virungas* • *Would provide effective long-term protection before emergence of dangerous threats* • *Allowing natural resistance to build up may present a significant risk for devastating outbreak(s)*	• *Not well explored, not enough baseline data to make informed decision* • *Could not be performed on all habituated gorillas at once, thus present a temporary risk of exposure of non-immunised animals if live vaccines are used* • *Different age groups need different vaccines and number of vaccinations* • *Could induce significant levels of disturbance / stress* • *Oral admin would be useful but goes counter practice of not feeding gorillas* • *Would not allow acquisition of natural resistance to human diseases* • *Shifts prevention focus from exposure (to humans) to disease (in gorillas)*	• *Feasibility ? 60-70% of target population need to vaccinated to achieve herd immunity* • *Side effects?* • *What if immunisation can not be completed on targeted number of animals ?*	• *Needs to be tested first* • *Could/should be part of contingency plans* • *"there may come a time when vaccination is absolutely necessary for the gorillas' survival"* • *'opportunistic' immunisation (with non-live vaccines) could be a viable alternative to group vaccination. Could be tested in captive animals* • *One has to face the issue of habituated gorillas no longer being a truly 'wild' population, and the long-term implications of inevitable continuous and increased human exposure…* • *Vaccination is appropriate only if disease risk is known and real. Should be done in the least intrusive, least risky (for gorilla and vet) possible way*
c) Systematic monitoring and research on gorillas health	• To build a stronger data base on morbidity, mortality, and normal ranges of gorilla health variables	not surveyed	• *Policy of systematic opportunistic collection of material exists, but is irregularly enforced* • *Data would allow to build stronger rationale for treatment protocols as well as preventive measures (incl. tourism rules)* • *No definitive evidence / background data exists for human-to-animal disease transmission in the wild*	• *A long-term objective that cannot be expected to yield information to review rules in the short term*	• *To yield reliable data, requires:* – *Considerable resource input* – *Political stability in order* – *Effective coordination between 3 countries*	• *Multiple opportunities for multi-disciplinary research linking health, ecology, behaviour, tourism and population pressure (see PHVA)*

9.1.2 Disinfection and hygiene

Hand washing

It is safe to say that regular washing of hands is to disease transmission what fastening seat belts is to vehicle accident fatalities! Dirty hands are one of the main, if not the major, transmission route for faecal-oral diseases and number of other skin, ophthalmic and even respiratory diseases (Jacobs RA 1997, Olsen et al. 1993). Thus by washing hands both at the start and end of a gorilla visit, tourists would reduce substantially the risk of contamination to and from gorillas. Comments on this option from survey respondents ranged from "*why not?*" to "*why bother*", reflecting uncertainty about effectiveness. One of the main questions raised concerned the possibility of recontamination between the tour start and reaching the gorillas, especially if one were shedding viruses or bacteria.

Washing hands before or after a visit would certainly not *eliminate* the risk of possible contamination or transmission, but rather would *decrease* its likelihood. Hand washing can drastically reduce the quantity of germs on the skin at the beginning of a visit, thus reducing by the same amount the "load" that would accrue from further self-contamination. This concept may seem irrelevant, but in fact germ load at the time infection is directly correlated with the pathogenicity or virulence of a germ (Shibata et al. 1997, Mumford et al. 1990, Berendt et al. 1980). Moreover, washing hands would have several additional positive side effects, as noted by survey participants themselves:

- as an educational measure for both tourists and park staff, reinforcing awareness of the disease risk
- as a reminder that the risk of contamination exist for both gorillas and humans
- by setting the stage for establishing the same practice for researchers and park staff
- lastly, as a health benefit for all people concerned

If the direct effectiveness of washing hands thus remains moderate, its ease and educational potential for tourists, staff and researchers alike, makes it a simple and attractive way to support compliance of other critical rules. Implementation would require soap, an adequate location, and a few additional minutes for tourists to wash before and after tracking.

Boot disinfection

Boot soles can be a major mode of transport for soil contaminated with viruses, spores and parasites. As the majority of pathogens will be destroyed on contact with most antiseptic solutions, the practice of disinfecting boots upon entering and exiting animal facilities is used in many primate centres in the world (Lerche N, Roberts J, pers. comm.). During the 1988 and 1990 disease outbreaks in Rwanda, all personnel were required to dip boot soles in an antiseptic between visiting different gorilla groups (Macfie L, pers. comm.). In boot disinfection, the emphasis is on reducing the load of *exotic* contaminants as fomites can stick on soles for a long time. For this reason, boots should always be disinfected during disease outbreaks, and to prevent importation of contaminants by occasional (i.e. tourists) or regular (i.e. staff) visitors to the gorillas' habitat.

This measure is relatively easy to implement, given the availability, low cost and effectiveness of antiseptics. Like hand washing, it would also be an educational reminder for tourists and park staff. Its weakness is the rapid accumulation of mud in the bath, rendering the solution ineffective, as well as the possible toxicity of antiseptics for the flora and fauna of the forest. However, both inconveniences can be avoided by selecting appropriate biodegradable products (such as chlorine bleach) and by removing mud from boot soles before dipping. For ease of removing thick mud after tracking, and to avoid wasting antiseptics, water should be used to remove mud before dipping soles in antiseptic.

In summary, even if boot disinfection has its limits, it is simple enough to implement and its benefits, both in the reduction of introduced germs and in education, largely outweigh their minimal cost and burden.

Ensure safe and adequate rubbish deposits and latrines

The rule review associated with litter and human faeces in sections 8.7 and 8.8 above addressed situations linked to gorilla visits and habituation. Equally important is to reduce exposure from rubbish and faeces generated by tourists, staff, or communities near the parks. This is of particular relevance in Bwindi where the visitor and park quarters are located at the edge of the forest. One survey participant described this situation:

> *"At present if a gorilla approaches camps from the forest up the hill in BINP, the first thing they reach is a large open trash pit"*

In such cases, it is critical to prevent access of animals to rubbish pits or latrines. The possibility of fencing has been the object of a recent environmental impact study discussed below under section 9.2.1 in *Possible Additional Measures*. Whether or not a fence is constructed, it is essential that rubbish pits and latrines be contained as much as possible not only from gorillas, but from smaller animals who can act as vectors for dangerous fomites or germs.

DISINFECTION AND HYGIENE - Recommendations:

- **Institute hand and boot sole disinfection* before and after tracking**
- **Make hand washing mandatory following defecation**
- **Ensure safe and adequate rubbish deposits and latrines out of reach of roaming animals in all parks**

* 0.2% chlorine solution

9.1.3 Immunisations and/or testing of tourists, researchers and park staff

Another way to reduce the risk of human disease to gorillas is through active immunisation of the people who come close to them: staff, tourists, and researchers. Active immunisation implies using vaccines to attempt to confer protection to individuals *prior* to exposure to a given pathogen. Vaccines are only available to protect against certain diseases. Only a few vaccines confer absolute (100%) protection against infection, while the majority confer only partial (<100%) protection, the percentage protection varying with the disease and the individual vaccinated (Jacobs RA 1997, Gardner P et al. 1996). Vaccines are still not available for a number of diseases for which immunity may or may not be acquired naturally[6]. For these, the alternative to active immunisation is active prevention, i.e. to avoid infection by adopting adequate protective measures and/or preventive behaviour. Only those diseases for which vaccines are available and efficacious are discussed here. These include influenza, measles, TB, polio, tetanus, yellow fever and hepatitis.

<u>Influenza</u>
Influenza is of particular concern for tourists who come from temperate zones as “flu” epidemics have a seasonal pattern, occurring mostly in winter (Webster 1997, Denny 1995, Shortridge 1992). Influenza vaccines are highly efficacious, reducing both the incidence (rate of new cases) and virus shedding, provided they are targeted against the prevailing viral strain(s) (Gross et al. 1995, Palache 1997, Keitel et al. 1997, Belshe et al. 1998, Grotto et al. 1998). Vaccines are only available in winter because manufacturers in temperate countries must adapt vaccines yearly to new virus strains, and so stop production at the end of winter (Lavanchy D, Hay A, pers. comm.). However, very little data is available on the prevalence and epidemiology of influenza in sub-Saharan Africa, where the vaccine is rarely found or used (Webster R, Lavanchy D, and Hay A, pers. comm.), so this vaccine could only be required for tourists coming from temperate zones in winter.

<u>Measles</u>
Before the advent of the first measles vaccine in 1957, measles was endemic, and those who survived the infection during childhood acquired natural immunity[6]. Although the vaccine is widely available in most countries today, measles remains particularly deadly for children, causing 1 million deaths world-wide annually (Burström et al. 1995, Nokes et al. 1995). This is mainly due to lack of sufficient immunisation coverage and differences between the strain of the vaccine and that of the circulating virus (Luthi et al. 1997, Kim et al. 1995). Sporadic outbreaks in adults, adolescents and unvaccinated pre-school children have occurred recently, particularly in densely populated areas. In vaccinated individuals, antibody titres (the capacity of the immune system to respond to infection) decrease with time, so a second dose for adults is recommended (Jacobs RA 1997). Current guidelines for adult immunisation vary from country to country, but it is generally recommended that vaccination be carried out for all persons from low-risk areas (industrialised countries) born after 1956 travelling to high risk areas, unless they have high antibody titres from past exposure, or proof of vaccination (Jacobs RA 1997).

Given the high pathogenicity of measles in apes, its high contamination potential through aerosols, and its substantial shedding periods, from 5 days before to 21 days after the onset of symptoms in infected individuals, measles immunisation should be considered for all persons visiting gorillas. This measure is currently implemented in most zoos and primate research facilities in the world (Lerche N, Roberts J, pers. comm.). The history of suspected measles outbreaks among gorillas in Rwanda (Hastings et al. 1991) and the documented efficiency of aerosol transmission (Ehresmann et al. 1995), justify requiring proof of current measles vaccination for tourists and park staff to protect gorillas from exposure. As the following quote reveals, a formal rule may be the best prevention against such problems:

> *“At Kibale National Park, a researcher had measles, and wasn’t aware of it, or prepared to listen to advice, until this researcher collapsed…”*

Survey respondents gave strong positive feedback on the option of requiring measles immunisation. Current measles vaccine is available and efficacious (WHO-EPI 1997, Vetter & Johnson 1995), although relatively expensive (Attenuvax-MSD costs US$18 a dose in the U.S.). While price should not pose a problem for tourists or researchers, necessary funds or subsidies should be mobilised for immunisation of park staff.

<u>Tuberculosis</u>
As stated previously, TB may be a lesser threat from tourists than from local residents. However, given its world-wide re-emergence, especially in low-income, medically under-served communities, and its close association with HIV (WHO Fact Sheet 1998), TB deserves careful consideration for all gorilla visitors, including tourists, researchers and park staff.

TB immunisation policy differs in the US, so a distinction must be made between US-born and non-US born visitors. US individuals are not vaccinated against TB at birth and are therefore expected to test negative on the TB skin test unless infected. However, in both vaccinated and non-vaccinated individuals, HIV and other conditions may complicate the picture, causing both false positive and false negative reactions (Hollander & Katz 1997). Without going into detailed explanations of such cases, it is important to know that in developed countries, all individuals who display a significant skin test reaction ($\geq$10mm) are regarded as infected by the TB bacillus, independent of their vaccine status (Stauffer 1997).

[6] Natural immunity is the immune protection acquired by going through disease and/or infection and surviving.

When considering recommending mandatory TB testing for visiting or working with gorillas, we must avoid the associated ethical problems of HIV testing. An alternative appropriate for foreigners and park staff alike is to request a medical certificate attesting to the *absence of active TB,* which would avoid HIV status disclosure and leave the doctor with the responsibility of establishing the diagnosis in a confidential way.

In most sub-Saharan countries, TB is highly endemic and national policy in Uganda is to vaccinate infants at birth. Given this and other factors that can affect TB skin test reactivity (including HIV), the standard detection measure is by microscopic examination of sputum smears. For park staff, TB status could be monitored through regular health checks as proposed below. Sputum examination is a standard test widely performed in the region and should not present any particular technical difficulty, except for the need of appropriate facilities, supplies, and a technician.

To avoid added economical and logistical burden, TB checks could be carried out concurrently with immunisations and other prophylactic measures for tourists (and researchers) before travelling, provided they are informed of this requirement at the time of purchasing their permits. Staff should be tested as part of a staff health monitoring system (see 9.1.4 below).

<u>Polio, tetanus and yellow fever</u>
Polio and tetanus vaccines are included in routine vaccinations given to almost every child in the world today, and yellow fever is mandatory for foreigners from low-risk countries entering the region. In addition, most adults receive tetanus booster shots to prevent infection from wounds. It is reasonable to assume that tourists and researchers are current on polio and tetanus and have been checked at the border for yellow fever, but checking vaccination cards would provide proof.

<u>Hepatitis</u>
Hepatitis A immunoglobulin or vaccine is frequently recommended to travellers from non-endemic countries due to the high potential of contamination from water and food. It would therefore add little burden to require tourists and researchers to show proof, depending on their length of stay (vaccination of researchers who stay over 3 months should be required).

<u>Limitations</u>
Besides the problems concerning TB testing mentioned above, imposing an immunisation schedule on tourists or park staff poses a number of challenges that must be addressed before deciding on appropriate measures.

Vaccines and HIV
A general difficulty in administering vaccines to park staff stems from the substantial proportion of adults in the area who are likely to be infected with HIV. The immune responses of HIV-infected people to vaccines may be sub-optimal, i.e. weaker and of shorter duration than expected (Loutan 1997, Wallace et al. 1994, Hess et al. 1995). In addition, they may experience adverse reactions (Talbot et al. 1997), particularly among people with low CD4 lymphocyte counts, an indicator of the severity of immune deficiency and disease progression. However, negative occurrences are rare (Marsh et al. 1997) and there is no difference in the WHO recommendations for immunisations among people living with HIV (Dabis et al. 1994). Nevertheless, informed consent should be required from individuals submitting to immunisations, which may necessitate addressing the need for HIV testing with the people concerned.

This problem is not new, least of all in this region where people are confronted daily to the professional or personal challenge of dealing with HIV and AIDS. It only emphasises the need for comprehensive health services for staff, beyond an isolated immunisation programme, which is discussed in the following section (9.1.4).

Proof of immunisation
As most African adults are unlikely to have a vaccination card unless they were part of a recent immunisation campaign, it must be assumed that most if not all park staff should receive the vaccines considered. If as suggested by one survey respondent, vaccinations for other diseases of concern are considered as well, the cost may become prohibitive. It thus becomes all the more important to carefully select vaccines of greatest relevance to gorilla and human health and plan for appropriate funds and services (see section 9.1.4 below).

Also, requiring tourists to show proof of immunisation implies that tourists purchasing their tour locally (in Uganda, Rwanda or DR Congo) may have to undergo immunisations or medical checks on site, which they may not be willing to do. Widespread and clear information about vaccine requirements should therefore be an integral part of such a recommendation in order to avoid potential conflicts with tourists not willing to get injections locally. The other limitation to consider before an informed recommendation can be made should be the availability of services and vaccines required.

<u>IMMUNISATIONS FOR TOURISTS, RESEARCHERS & PARK STAFF</u> - Recommendations:

- **FOR TOURISTS AND RESEARCHERS FROM TEMPERATE ZONES ONLY: Require proof of current (same year) immunisation against influenza in winter (October through March in the Northern hemisphere, April through September in the Southern hemisphere)**
- **FOR ALL (VISITORS, STAFF & RESEARCHERS): Require proof of current immunisation against yellow fever (< 10 years), polio, tetanus (< 10 year), hepatitis A and measles (if born after 1956), and of clear TB status.**

9.1.4 Systematic health monitoring of park staff and researchers

Quarantine for researchers

Just like any other foreigner, researchers arrive in-country with all the required immunisations for entry. However, they are not under any systematic obligation to undergo a quarantine period before starting work with gorillas. The principle of quarantine is to allow a sufficient observation period for any incubating or recent infection to become apparent in a newly arrived individual and to be treated if necessary. This measure, widely used in zoos, veterinary and research facilities to prevent potential introduction of foreign germs and diseases, has been used in some parks, albeit inconsistently:

> *"A system of quarantine used to be in force [in Uganda} for all newly arrived researchers, but is now less stringently applied"*
>
> *"Researchers newly arrived in Rwanda are not allowed to visit gorillas for two weeks"*

In addition to preventing the introduction of potentially dangerous diseases, a quarantine system is simple to enforce and would serve as a reminder for staff of the seriousness of the disease threat. In order to be effective, the quarantine should last a period of time equivalent to or longer than the longest possible incubation period of diseases of concern for gorillas. As measles can incubate for 3 weeks, this should be the minimum duration of quarantine imposed on foreign researchers.

Monitoring park staff (including researchers)

Many scientists involved in current or previous research in the parks mentioned the lack of a health monitoring or advisory system for researchers. Moreover, discussion of the issue of staff immunisation highlights the need for a comprehensive health programme for park staff, which could apply to researchers as well. Currently, at least in principle in Uganda, a local health worker checks guides, rangers, and trackers, but it is not clear how regularly these health checks occur. However, it appears that neither staff nor researchers are **required** to have regular medical checks. There is no health worker assigned to the park to attend to advise on staff health status in relation to the risk for gorillas or other fauna (Kalema G & IGCP-Uganda, pers. comm.).

The benefits of regular medical check ups for staff/researchers are many and obvious, as seen from survey responses:

> *"Regular medical check ups for park staff would make it easier to test for TB, or to arrange for measles immunisation. Also, if an individual is bitten by a gorilla, s/he could be tested for various diseases to determine the risk of disease transfer to [or from] the gorilla."*
>
> "*Recently we went for medical check up and the doctor said that the fever which we have is from some insects that follow the animals in the forest"* [Guide]
>
> "*A routine health program would be valuable not only to protect the health of the gorillas but as a valuable incentive to the employees"*
>
> *"At Karisoke, all researchers and trackers were tested for TB and HIV with the understanding that we would treat any illness (for Rwandans) and the outcome would not result in a tracker losing his job."*

From the survey and interviews, it appears that park staff are very aware of both the risks they pose to, and they run from, gorillas. Almost all of survey respondents (33/34 or 97%) overwhelmingly supported the idea of establishing systematic health monitoring of park personnel and researchers. Although the design of such a programme is beyond the scope of this consultancy, strategic aspects are discussed below as a preliminary step toward this important goal.

First and foremost, it is essential that such a programme be established for the benefit of the staff themselves, and not only out of consideration for gorilla health. A mutually beneficial program would ensure that all personnel are covered by a common policy and that anyone whose job entails visits to the gorillas abides by the relevant tourist rules. The basic components of a comprehensive health policy include regular health checks, provisions for outpatient treatment and referral (both routine and emergency). In addition, a regularly updated prevention programme should include routine testing, immunisations, as well as health education with sessions on the risk of disease transmission to and from gorillas.

Health checks should be performed on all new park employees upon hiring, and on a quarterly or twice yearly basis thereafter. These regular check-ups should follow standard medical procedures, focusing on general fitness and communicable diseases of concern for both humans and gorillas. Outpatient care should follow national guidelines for major diseases prevalent in the area (malaria, respiratory infections, diarrhoeal diseases and sexually transmitted diseases).

Staff testing positive for TB should be offered the Directly Observed Treatment Short course (DOTS)[7] following the WHO recommendation, which is now national policy in Uganda (WHO 1998). DOTS includes on-site treatment and regular monitoring for treatment compliance and infectivity. TB-positive personnel should not be allowed in the park or near gorillas until they have two consecutive negative sputum examinations at a one-month interval. Standard prophylactic measures and counselling should also be offered to the family of patients in order to prevent treatment failures and spread.

[7] DOTS is a 6-month treatment under direct observation of treatment by health, community workers and volunteers trained to observe and record patients swallowing the correct dosage of anti-TB medicines for the duration of the treatment. DOTS requires basic microscopy services and drug supplies, and has produced cure rates of up to 95 percent even in the poorest countries

Other respiratory or airborne diseases of concern include common colds, influenza and pneumonia (Campbell 1995, Gwaltney 1995, Turner 1997). Rhinitis and flu are common in the region. Pneumonia is also common, especially in adults and children infected with HIV. While antibiotics should be widely available through national essential drug programmes, influenza treatments are of moderate efficacy and certainly not an option in the rural sub-Saharan context (Hayden 1996).

All staff should also be monitored for diarrhoeal diseases and a regular vermifugal prophylaxis should be considered[8]. Routine testing could be carried out for skin conditions of concern for humans and gorillas such as scabies and yeast or fungi (dermatophytes).

For all illnesses (other than TB – see above) clinically ill people should not be allowed in the park or near gorillas until they are free of symptoms for at least 3 consecutive days.

Health workers should be trained about diseases of concern for both humans and gorillas, and guidelines should be established for each disease in order to regulate forest and/or gorilla access to people in prodromic (i.e. incubation), active or convalescent disease stages. Similarly, park staff and their families should receive regular and comprehensive disease prevention and health promotion education.

Finally, referral systems should be set up for conditions that cannot be dealt with at park dispensary level, for both emergency and non-emergency conditions.

The most important challenge to this proposition is the ethical problem raised by establishing what could be perceived by surrounding communities as a selective health programme for park staff and their relatives. Moreover, this strategy may be self-limiting as the surrounding park population is a substantial source of contamination for gorillas through the regular incursions that gorillas and people both make into each other's territory. Yet, there is no question that park staff and researchers are the primary source of gorilla exposure to human diseases and of human exposure to gorillas. As such, they must be targeted first. This is a main and sufficient justification for such an intervention. Nevertheless, these questions point to the importance of addressing the entire issue of health prevention and care for the surrounding communities, both from a conservation and a public health perspective, and this is the object of the next section.

In summary, a systematic health monitoring system standardised in all gorilla tourism parks would go a long way towards significantly reducing the potential of disease transmission between park staff and gorillas. It would require significant inputs, but the health benefits for staff, the gorillas and the tourism programme in general are hardly questionable.

HEALTH MONITORING OF PARK STAFF & RESEARCHERS - Recommendations:

- **Establish a 3-week quarantine system in all parks for all newly arrived foreign researchers**
- **Schedule regular health checks for park staff and researchers, including TB testing, administration of vaccines, provision of curative services and appropriate referral, within existing resources in all parks**
- **Establish disease-specific guidelines to regulate forest and/or gorilla access to people in prodromic (i.e. incubation), active or convalescent disease stages**
- **Organise regular sensitisation sessions, exchanges and updates on disease transmission risk, among park staff, veterinarians, researchers and conservationists**
- **Define, in collaboration with local health authorities, objectives, strategies and implementation plan towards the establishment of a comprehensive health monitoring system and referral service for all staff and researchers in each park**

9.1.5 Improving the health status of local communities

A comprehensive programme for the prevention and treatment of communicable diseases in local communities would be of benefit for both the human and the endangered gorilla populations, and would imply the participation and collaboration of health care providers, at both governmental and non-governmental levels. Designing such a programme targeted at the local population around the parks goes well beyond the scope of this consultancy. Suffice it to say that the human public health priorities in this region of Africa (malaria and TB control, immunisation coverage, improved sanitation and hygiene, and disease prevention education) widely overlap with the objective of reducing the human disease threat to gorillas. Efforts at supporting and strengthening primary health care and prevention programs among the general population surrounding the parks could therefore in themselves be instrumental in reducing this threat. Some new initiatives are currently under development in this effort (see box below for one example). They illustrate a bridging approach between public health and conservation that needs to be further emulated and developed in order to broaden the base for sustainable management of conservation and tourism projects (Whitney 1990).

[8] e.g. Mebendazole 200mg tid x 2 days

A collaborative proposal addressing health threats to great apes is currently in the design phase in Uganda[9]. The project strategies are to build institutional capabilities to address health threats to Uganda's great apes, develop a collaborative network of organisations and institutions involving great ape research and conservation, create human and institutional resources to train veterinarians in wildlife medicine, and establish a liaison between conservation activities and human public health initiatives. In order to minimise disease risks to apes, the public health aims of the project are to:

- Identify and map potential infectious disease risks
- Form linkage with human health efforts in proximity to the great ape habitats
- Recommend policy regarding health risks/screening of tourists, researchers, field assistants, veterinarians, park personnel, and great apes
- Educate the same groups of people regarding health risks to primates
- Establish contingency plans in case of disease outbreaks

In preparation for the project, a preliminary assessment of the human diseases endemic to the areas surrounding the parks was recently conducted in order to identify potential disease threats to the apes (Rooney & Sleeman, in preparation). Among collaborators for its public health component, the project cites Harvard Medical School (USA), and the Ugandan Ministry of Health.

The breadth of the above project's objectives not only points out the multiplicity of threats to the health and survival of gorillas, but also exemplifies the complexity of an integrated approach to conservation. If threats are to be addressed in a comprehensive way to improve the viability of endangered species, only a sustained and participatory strategy with the contribution of conservationists, health workers, government officials, and key community members can have a chance of success. The most significant ingredient for success is *commitment* from all parties.

The Makerere/Tufts/Morris proposal is an important step towards the integration of community health issues into the conservation of mountain gorillas. Yet, simply put, poor communities like those residing around the parks cannot be expected to care more for the gorillas' well-being than for their own. And they will probably not be in a position to do so until they reach what they perceive to be an acceptable level of wellness, both from a health and economic perspective. In that sense, integrating public health and conservation may be a first and crucial step towards improving the health of communities and fostering the indispensable awareness that the gorillas' fate and ours are intrinsically linked.

IMPROVING LOCAL COMMUNITY HEALTH- Recommendations:

- **Encourage and support protected area authorities to advocate and initiate collaboration and partnership between human medical institutions and wildlife veterinary and / or conservation institutions in the design and implementation of research and intervention programmes addressing local community health issues**.

9.1.6 Active information/sensitisation campaign about the dangers of human disease for gorillas

For tourists and tour operators

In view of all the issues covered in this document regarding the risk of human disease for gorillas, increasing awareness of the public about the existence and significance of this threat should be an essential element of an integrated approach to sustainable tourism (Rossiter 1990). Surprisingly little has been published for the public at large on this issue, besides a few publications in specialised magazines (Anon 1986, Sholley & Hastings 1989, Litchfield 1997). This is in contrast to numerous publications and films about other aspects of mountain gorilla biology and conservation. Indeed, the average tourist, who is also unlikely to read the fine print regarding tourism rules on their tracking permits, does not perceive disease as one of the major threats to gorillas' survival. Yet, awareness is paramount to building the necessary momentum not only to secure better compliance to the rules reviewed here, but also as said above, to forward the general cause of ape conservation.

Until this awareness is established, rules will always be broken, no matter how strict the attempted enforcement. Given the emotional response of the international public to the plight of endangered species such as whales, dolphins, and apes, the potential exists to use education to create a *gorilla-conscious tourism movement*. This can be done at several levels, using well-documented information-education-communication (IEC) methods directed at both a wide audience as well as a focused target of tourist organisations, tour operators and tourists themselves. Some of this can be carried out in the parks at facilities such as the planned visitor centre in Bwindi. However, informing the public at large can reach potential tourists *before* they book their tour, and would have the advantage of building broad-based popular support and pressure that could eventually be the single most efficient positive rule enforcement tool.

[9] Proponents include the Wildlife and Animal Resource Management (WARM) Department of Makerere University Faculty of Veterinary Medicine in Uganda, the Centre for Conservation Medicine (CCM) at Tufts University School of Veterinary Medicine, and the Mountain Gorilla Veterinary Project (MGVP) of Morris Animal Foundation (MAF) in the US.

The overwhelming majority of survey respondents (38/40 or 95%) as well as tour operators and conservation organisations contacted through the consultancy demonstrated support for such a proposition, adding several supporting reasons[10]:

- *If people understand why the rules are there and how important they are, they'll be more likely to follow them.*
- *... if tour leaders are supportive of the rules - [tourists] will be more likely to willingly comply with the rules.*
- *The time has come to inform the public of potential danger when it comes to the transmission of diseases. I think most people would be in agreement with strict rules to protect the health of the gorillas. If they do not agree then they obviously do not respect the intention of keeping the gorillas healthy, thus, they should not be allowed to visit them. Sooner or later, [stricter] rules and regulations will have to be instituted to protect the health of these gorillas. Even gorillas in zoos have better protection from visitors than the mountain gorillas do.*
- *[We should] stress behavioural disturbances [...] as well as health risks. I have spoken to various visitors who have come away thinking that the guides were too pushy, cutting vegetation too close to gorillas etc. Emphasising the dignity of gorillas, that they should be seen as wild animals and disturbed as little as possible, not objects of amusement or animals to play with, could perhaps get through to tourists as well.*
- *Rules are generally broken as a result of tourist demand (including the link between getting closer to the gorillas and a big tip). Education of tourists as to why it is so vital rules are adhered to may in itself help to alleviate some of the pressure off the park staff and minimise potential risks to the gorillas.*
- *There are sceptics, who say unfortunately many tourists/tour operators actually don't care. I think this is incorrect. Certainly for some it would make little difference, but for the majority I think it would. Plus, tourists tend to travel in groups so if you can convince one in a group you may be able to convince a number of them…*
- *Yes [I would support the idea], but awareness is not a one-off event. We should initially create the awareness, then [...] maintain it, through monitoring & evaluation, surveillance, etc. ...*
- *Almost all overland trucks advertise and promote their companies by showing humans touching gorillas in their brochures. Thus, overland tourists come to BINP expecting to touch the gorillas. This kind of advertising needs to be changed. Can it be regulated?*
- *Absolutely, this has not been adequately explored by the conservation organisations. Much more can and should be done here.*

Perhaps the last, but not least, reason supporting this idea is that once public pressure mounts both policy makers and the tourism business community will respond. Eventually, this strategy could make the greatest difference in the acceptance of rules and the impact of tourism on gorilla survival. Incidentally, such a public educational campaign for tourists on the issue of disease transfer to and from apes would come at an opportune moment given the recent news that scientists have identified the origin of the AIDS virus in chimpanzees (Gao et al. 1999). This report has triggered world-wide declarations in support of effective conservation of chimpanzees and other apes in their natural habitat as they now are viewed as possibly harbouring new clues to a cure for this deadly disease.

<u>For guides, trackers and rangers</u>

Education of the public does not eliminate the need for adequate enforcement. On the contrary, enforcement remains central to a comprehensive approach to effective prevention. As pointed out by a survey respondent:

> *"The biggest problem a guide can face is his lack of leadership while taking tourists to see gorillas. Guides are too often too shy to make tourists understand that they are the ones in charge, and that tourists should "obey" the instructions"*

Therefore, the need for education and training of guides and trackers cannot be overemphasised. Guides should be better trained in understanding and explaining the rationale for rules, especially when managing tourist visits. The aim of training should be to enhance a sense of responsibility and to empower staff to educate and control tourists. This should be part of an overall strategy of increasing staff motivation to strictly enforce rules. Indeed, guides are the final level of authority for tourists in the field, thus their own motivation can greatly determine the ultimate outcome of each gorilla visit.

<u>ACTIVE INFORMATION CAMPAIGN ON THE HUMAN DISEASE THREAT</u>
Recommendations:

- **Institute regular information/discussion sessions for guides, trackers and rangers to update their knowledge on disease transmission and ensure their adequate understanding, and ability to explain and enforce the disease rationale of the rules, both among themselves and in dealing with tourists**
- **A similar programme should be instituted for tour operators with a view to enlisting their full cooperation in promoting and ensuring rules enforcement by their clients**
- **Plan and implement an active sensitisation campaign for surrounding park communities, tourists and tour operators about the importance of the human disease threat to sustainable gorilla tourism. Such an intervention should involve the international print and audio-visual media as well as the production of educational materials**

[10] The question (# 11) asked in the survey was: "*What do you think of increasing both awareness and visibility of the threat of human diseases to the survival of apes among eco-tourism players and promoting this issue as a marketing strategy to strengthen enforcement and respect of visit rules?*"

9.2 Measures Designed to Enhance Disease Prevention from the Gorillas' Side

9.2.1 Fencing BINP visitor area off to keep animals from roaming in or around tourist settlements

There are many problems resulting from the gorilla's habit of roaming around human settlements (IGCP and CARE-DTC 1997), one of which is the risk of disease transmission. The major disease risk is due to potential contamination from either direct contact with people or exposure to rubbish deposited around human dwellings. As mentioned earlier, fencing has been discussed during a recent environmental impact assessment (EIA) in Bwindi where tourist and staff infrastructure is located at the edge of the forest (Kazoora et al. 1999). This problem is compounded by the attraction of gorillas to regenerating vegetation in agricultural land acquired by the park, with an added risk of uncontrolled viewing by tourists:

"I found 16 tourists with the gorillas below the community bandas. I forced them to leave and I chased the gorillas" [A guide]

For this reason, one of the EIA recommendations is to create a buffer zone of non-attractive crops or open space to deter gorillas from exiting the forest. The possibility of building a fence remains under study, given the several pros and cons regarding this option. They were summarised in comments received through the survey, which question the feasibility and cost-benefit of constructing gorilla-proof fencing, the need for removal of attractants to gorillas that leave the forest, and whether other areas inhabited by humans should also be fenced, which might be too much to expect.

In lieu of a specific recommendation on fencing infrastructure, readers are referred to the results of the EIA, which specifically addresses this question. However, as mentioned under the review of the rubbish rule (section 8.8), one immediate need is to fence off rubbish pits or latrines that represent an obvious disease risk:

FENCING - Provisional recommendation:

- **Identify and fence off potential sources of immediate contamination such as high concentration rubbish sites near park borders**

9.2.2 Active protection of habituated gorillas

One of the impelling reasons for gorilla conservation is the small number of wild animals remaining. In the case of habituated gorillas, the term *wild* must be critically examined in relation to disease exposure. With regard to the degree of human exposure (Table 4), it is difficult to say that habituated gorillas can be considered as wild as non-habituated gorillas, as their human exposure and the likelihood of disease transmission is high enough that, from a purely immunological standpoint, they should be considered closer to a captive rather than a wild population.

Considering that close to 70% of the gorillas in the Virungas have been habituated and that tourism is only one of several sources of continuous and multiple human exposure, two assumptions can be made:

1) Gorillas have already started to undergo selective pressures from exposure to human pathogens and
2) Given the size of the remaining population, this selective pressure may or may not succeed, depending on whether or not catastrophic disease outbreaks occur as a result of such exposure.

The reality of catastrophic disease scenarios was illustrated in population modelling exercises at the gorilla PHVA (PHVA for *G. g. beringei,* 1997). The results of modelling various disease and war scenarios showed that for both populations, diseases pose considerable threats and that when "*gorilla populations are "exposed" to all 3 simulated disease types within a given simulation, populations decline in size over time with a measurable risk of extinction within 100 years*".

The question is then: should we take the chance and let the gorillas acquire the necessary resistance to potentially deadly diseases through natural selection (according to what has been termed the *minimal intervention ethic*), or should we, whenever possible, pre-emptively protect them against these diseases through immunisation? The idea would not be to immunise all mountain gorillas, which would be practically impossible, but to vaccinate habituated animals in order to create a buffer population. The buffer population would be resistant to the dangerous diseases to which they are exposed, and would therefore represent a lesser risk for their wild counterparts in the forest.

It is not the purpose of this review to make specific recommendations about gorilla immunisation. Rather, gorilla immunisation is explored here as component of a comprehensive disease prevention programme, since immunisation, when available, is one of the most effective options available to protect individuals and populations against diseases and epidemics. The elements of the discussion below are thus intended to inform possible future decision-making on the issue.

Immunisation is commonly used to protect captive primates from human diseases, and was used on wild gorillas during the 1988 measles-like epidemic in Rwanda without apparent side-effects. Yet it remains controversial for a number of reasons expressed by survey respondents. The main hesitation stems from the minimal intervention ethic adopted until now. Several respondents believed immunisation should be a last resort to be used *only* in case of "*absolute necessity*". From a strictly biomedical viewpoint, this statement is inherently contradictory as it likens the use of a vaccine to a cure, yet by definition the purpose of a vaccine is to *prevent*, not to treat epidemics. Vaccines *are* used in some human epidemics, but these epidemics usually emerge where vaccines were either not available or not used consistently.

Other questions concerning habituated gorilla immunisation include the justification for intervention (*i.e. what should be the decision criteria?*) and the level of disturbance or trauma caused by a broad immunisation programme. There are also questions about logistical feasibility of immunising entire groups, particularly in parks where large numbers of animals are habituated. How to ensure that all animals receive the vaccine, in the appropriate dosage (e.g. for young animals), and what would the best route of administration? What should be the extent of coverage, and at what rate should it be reached?

These questions are important but won't be answered here, as more specialist input is needed. Yet survey comments concerning immunisation revealed a wide knowledge variation among participants. For example, a frequent question concerned the risk for the remaining population from immunisation of habituated animals and the answer is straightforward. Modern vaccines are made of either live germ material, killed extracts or synthetic preparations. The only vaccine type carrying any risk of disease transmission to unvaccinated individuals is live vaccine, as killed or synthetic material cannot replicate, thus *cannot* cause disease. Nevertheless, any vaccine introduced into a population must be tested for its safety, immunogenicity (ability to elicit effective immune response) and efficacy (ability to confer protection). Most vaccines used for captive primates are human vaccines that have had extensive human testing (Loomis 1990). Although they have not been tested in gorillas, they are considered safe and efficacious based on human and captive animal experience.

Another belief expressed by survey respondents was that all animals should be immunised at once. This is not necessary for prophylactic immunisation intended to prevent infections in a non-epidemic situation. However it may be required in epidemic situations when, to limit disease spread, protection must be given to as many individuals as possible in the shortest time. The goal in both situations is to achieve "herd immunity", which implies conferring protection to a sufficient proportion of the population (70%) in order to arrest epidemic spread. In non-epidemic situations, immediate herd immunity is not necessary and can be built gradually, especially with vaccines that confer long-lasting protection.

Some respondents argued that, as it isn't possible to immunise gorillas against all diseases, the idea is not practical. Needless to say, if the same logic were applied to humans, immunisation programmes which are by definition selective (we can only immunise against diseases for which vaccines exist!), would never have been implemented. Yet, they were - and still are – for millions of people, preventing many serious disease epidemics. Other survey respondents called gorilla immunisation downright dangerous, based on the assumption that animals would have to be anaesthetised to receive the vaccine. However, immunisations do *not* require immobilisation, and can be administrated by darting or orally (via food).

These misconceptions aside, there remains the fundamental question of whether or not to take an active role in protecting gorillas from human diseases. Rather than answering this question, this review points to some crucial issues that must be addressed before this issue can be decided upon in an informed and meaningful way:

- First, all parties should be aware of advantages, implications, constraints, and limitations of immunisation programmes.
- Second, even in the absence of current need or intent to discuss gorilla immunisation, there should be sufficient preparedness about the process in advance of potential situations where such intervention may be necessary.

Contingency Plans: This consultant was surprised that no disease outbreak contingency plans currently exist in any of the gorilla parks, even though such outbreaks have occurred in the past. Given the small size of the remaining gorilla populations and the actual and potential levels of disease threat, the lack of contingency plans could be seen as negligence, as they are standard parts of any basic disease surveillance programme.

In contingency plans, both preventive and curative measures must be considered. The type and degree of incidents and emergencies that should trigger action must be defined, as well as action plans corresponding to the varying levels of emergency. These plans should be established by experienced veterinarians and park managers without delay, and should be regularly revised, updated, disseminated and rehearsed. Lastly, but importantly, contingency plans need to rely on a monitoring system that collects basic health data on mountain gorilla populations in every park (see 9.2.3 below).

Without such plans, we are left to count on the rules and their enforcement to prevent serious diseases and to wait for an outbreak before considering the possibility of intervention. While this might be a valid plan from a conservation standpoint, it should be simply the result of a lack of action, but should be actively decided upon with full awareness and careful consideration of the risks involved.

ACTIVE GORILLA PROTECTION - Recommendations:

- **Develop contingency plans for curative and prophylactic interventions in case of epidemic outbreaks or other emerging threats to gorilla populations.**
- **Contingency plans should clearly define criteria for intervention with clear decision-making guidelines and authority, as well as specific action plans corresponding to different levels of intervention**
- **Contingency plans need to be regularly revised and updated as health monitoring data becomes available, as well as rehearsed and disseminated among park staff, researchers and other parties who will take part in potential interventions**

9.2.3 Systematic gorilla health monitoring and research

Monitoring

Health monitoring of gorillas should not only provide indispensable data for establishing contingency plans, it would also help establish “normal” reference ranges for biochemical and immunological laboratory values. Regular monitoring is also needed to inform policy decisions on tourism rules, forest use, and conservation objectives (Karesh & Cook 1995). Presently, “normal” baseline data on wild gorillas are not known due to the lack of sufficient data.

Up to now, monitoring has been carried out either through specific research projects or on an opportunistic basis following guidelines established in 1989/90 by the Scientific Advisory Committee of the Morris Animal Foundation (MAF) (Lowenstine L, pers. comm., Foster 1993). These guidelines include:

- systematic collection of blood and basic clinical data on every immobilised animal
- systematic post-mortems on every dead animal, including tissue collection for histopathology whenever possible
- regular clinical observation of animals through the daily tracking and snare removal programs

The MAF policy rationale was over time to collect sufficient data on a large number of animals to create a reference base. In actuality however, collection has been irregular over time and in different parks, with samples and data scattered among different facilities in different countries, making it difficult to use or analyse existing information (Lowenstine L, pers. comm.). This has been the result of several weaknesses in the system:

- the lack of continuity in the practice instituted by the MAF Scientific Advisory Committee due to staffing changes.
- the lack of a regional policy for collection, analysis and storage of material from all parks
- the lack of designated central and/or peripheral facility(ies) to coordinate data collection, storage and management.

The need to set up a strong gorilla health monitoring component was stressed in conclusions of the recent gorilla PHVA (PHVA for *G. g. beringei* 1997) and cannot be overemphasised. A monitoring policy should particularly consider:

- maximising data collection and analysis from daily observations, immobilised animals and post mortems
- ensuring that every dead gorilla undergoes thorough post-mortem and histopathology examination
- ensuring that routine cultures are done on both clinically healthy and ill animals
- exploring alternative non-invasive systematic screening and data collection methods such as dung sampling
- improving data reporting accuracy, consistency and regularity
- the possibility of pro-active screening for viruses

A comprehensive policy should thus be developed, adopted and enforced by all parks. In the meantime, the practice of systematic opportunistic sampling should be applied or re-activated in all parks and sera sent to and stored both locally and/or in a provisionally approved location until a centralised facility is designated and agreed upon by all parties.

Research

Limitations in the opportunistic sampling approach suggest that research is urgently needed to provide information for gorilla conservation management and to provide data for predictive models based on the demographic and epidemiological characteristics (Karesh & Cook 1995). Currently available data on captive gorillas, all of which are lowland gorillas, or on mountain gorillas in one population, cannot be generalised for wild mountain gorillas in general. For example, while a parasite survey in Bwindi showed little overlap in intestinal fauna of humans and gorillas (Ashford et al. 1990), clear overlap occurs in Rwanda (Meader et al. 1997) and in lowland gorillas in Central African Republic. (Doran D, pers. comm.).

Ashford et al. (1990) carried out a baseline survey of Bwindi gorilla faecal parasites before the introduction of tourism. They found that only one intestinal parasite, *Strongyloides fuelleborni*, was shared by both humans and gorillas. This and other similar studies were meant to allow future monitoring efforts on the potential health effects of habituation on gorillas. Follow-up research indeed showed changes in intestinal fauna of the gorillas over time. For example, in a 1996/97 faecal study of PNV habituated gorillas, Mudakikwa et al. (1998, unpublished data) found evidence of new or increased presence of parasites including *Entamoeba, Trichuris, Chilomatix,* and *Endolimax nana*, leading investigators to conclude that these newly identified parasites may have resulted from increased contact with human faecal matter or other waste, following years of exposure to tourists and other humans using the park.

Using new epidemiological and/or molecular techniques to identify viral infections or other pathologies in conjunction with the type of systematic non-invasive sample collection illustrated above would provide opportunities for even more sophisticated prospective or retrospective analyses. The need for such research is critical in view of the many unknowns underlying the discussion undertaken in this review. This was well reflected in the comments of the survey respondents:

In the survey, respondents noted that:

- *“Much of the information needed requires field research epidemiology.. What is attempted requires a more extensive, deliberate methodology to obtain all critical information relating to…gorilla-human health issues without which results could be misleading…”*
- *“The rules are liable to challenges unless data can be generated to support them”*
- *“… Until necessary data is collected and researched, the precautionary principle for health management needs to be utilised”*
- “*Education [about rules] would be more effective if there were data which actually demonstrate.. link between tourist and disease..”*

Some research projects currently planned or under way are aimed at answering some of these questions. In Rwanda, a study is under way to measure gorilla faecal steroid levels to explore the degree of stress induced by tourism/research (Nizeye J, pers. comm.). Results will provide guidance for reviewing rules, namely visit frequency, length and group sizes. Another proposed study to conduct experiments in captivity to explore the distance at which germs can be transmitted by aerosols could also yield important data to support or suggest revision of the corresponding rule (Gilardi K, pers. comm.)

Primate research can also serve as an early warning system for emerging diseases or epidemics, both among humans and primates (Wolfe et al. 1998, Osborn & Lowenstine 1998, Bieniasz et al. 1995, Eberle 1992). For example, the respiratory syncitial virus (RSV) was originally isolated from a chimp with an upper respiratory tract infection in 1955, only to be subsequently identified as a significant human pathogen (Morris et al. 1956). More recently, discovery of a variant of the SIV virus has allowed the establishment of the chimpanzee as the origin of HIV (Gao et al. 1999).

Continuous monitoring and research are essential to monitor variables associated with species viability, both in terms of disease susceptibility and reproductive capacity. Despite the encouraging results from modelling exercises in the recent gorilla PHVA (which by definition analysed what *could* happen to gorillas), it is impossible to predict what actually *will* happen to this small population. An interesting illustration of the need for more data to inform management decisions is the collection of widely divergent interpretations of population viability and the results of the PHVA by scientists, veterinarians and managers interviewed in this consultancy. The survey asked *Do you think the remaining gorilla population is a viable one?* Some extracts from responses follow:

- *Population dynamics, genetic diversity and expectations are not my expertise but it would be reasonable to believe that the population is in dangerously low numbers.*
- *It is probably viable as long as the habitat remains stable and relatively well protected. If there were major changes in the environment, it would be hard for the gorillas to adapt, given the small population size, presumed low levels of genetic variation, and the lack of leeway for population crashes.*
- *According to the PHVA computer simulations, both populations are biologically viable.*
- *I don't know…we need genetic expertise to answer.. and I'm not sure that even genetic information will provide a definitive answer..*
- *If the numbers stay stable (which they appear to be doing), and the 2 populations do not fragment into smaller groups that can no longer ensure gene flow (i.e., by losing habitat, and becoming isolated), then the present population is certainly biologically viable.*
- *I don't think it is viable given the intensive economic pressure, corruption, the high risk of disease transmission and other insurmountable pressures.*
- *As long as catastrophic disease and human-caused disasters such as poaching, war, and habitat destruction are prevented, then yes, it is viable.*
- *Hard to know. The population at Bwindi looks stable based on … surveys, however, given the slow reproductive rate and long life span of the gorilla it could be slowly decreasing and in more danger than we think. The animals are in a … very densely populated area. …. Unless there is a drastic change in the trajectory of human population growth, the gorilla is in trouble.*
- *Absolutely, see CBSG report [i.e. PHVA]*
- *Judging from the … modelling .. at the PHVA …, it appears that the risk of human - gorilla disease transmission is an important factor… when analysing the future viability... This risk, in addition to the … issue of … civil unrest in the immediately surrounding area, cast some real doubt on whether the two populations of mountain gorillas can be considered viable over the long-term.*
- *Yes, [it is viable], and please note that there is evidence to support that view.*
- *There are only c. 320 mountain gorillas and these are all in one population. This is very likely a viable population if numbers stay at 320 individuals or more. A disease epidemic could, I believe, quickly take this population below 100.*
- *In my view, I didn't think so, but the PHVA we did last December suggest that it is. … Is 290 large-bodied, long-lived, long-gestation time, long-interbirth interval animals a viable population? I wouldn't think so.*
- *Yes, I think it is. It has grown from a lower population and the animals appear healthy. I don't know how much larger the population could become, given the constraints on habitat size.*
- *Because this population is split up, and because of deforestation going on, I think there is no hope for it*
- *There are really two biological populations (Bwindi and Virunga), which may be genetically distinct (if the morphological work holds up). Recent population viability modelling suggests each is viable at its present size of about 300*
- *No, a population of 650 does not strike anyone here as biologically viable; one dangerous epidemic could wipe them out.*
- *Current populations may be viable, though may require genetic transfer at appropriate times to maintain genetic heterogeneity. Fine monitoring of the populations will be required, and intervention should not be ruled out.*
- *I don't think they have a big chance; in the violent environment they live in, it might be wise to consider promoting research into captive breeding which could be relied on by future generations.*

Perhaps best of all, this remarkable divergence of opinions summarises the need for health monitoring and research…

GORILLA HEALTH MONITORING AND RESEARCH - Recommendations:

- **A comprehensive biological sampling and data collection policy for gorillas should be developed, adopted and systematically enforced in all parks.**
- **The data and material collected should be stored both on site and at a central facility designated to compile, analyse and disseminate regularly updated information to all sites**
- **There is a need to design and support research protocols for the long-term assessment of tourism impact on gorilla morbidity and mortality with particular emphasis on immunity and reproduction**

10. ADDITIONAL SURVEY COMMENTS ON RULES

A number of issues indirectly related to the rules and their enforcement were raised by participants in this review. They have not been specifically analysed in this report, as they relate to areas of management and administration which go beyond the disease threat analysis. They are however significant enough to the success of the tourism program to be briefly listed here:

Standardisation:
- *Rules and their enforcement must be standardised in all locations where gorilla tourism is carried out.*

Monitoring of guides::
- ***Rule enforcement has generally been a bigger problem/concern than the rules themselves…***
- *Guides should be periodically monitored to make sure they convey clearly all the rules to the tourists and why they are important to keep….*
- *Monitoring of guides is difficult, but tourists could be asked to (independently) fill out a questionnaire after their visit, [to find out if the rules were abided by]*
- *In the same rules we could add a clause that urges visitors to avail park managers with information that will contribute towards sustainable management of gorillas and their habitat.*
- *There should be monitoring and punishment of trackers/guides who break rules of visitation (e.g., taking more tourists or more frequently, violating distance).*

Enforcement
- *Perhaps tourists should make a financial deposit before viewing, which is withheld if they are judged to have broken the rules.*
- *Enforcement is more likely if it is clearly beneficial for those enforcing the rules. Perhaps penalising tour operators for visitors who do not comply would be added incentive to make sure visitors follow the rules.*
- *Gorilla-based tourism ... does not meet the definition of "ecotourism".*
- *I think the rules are probably not bad. Enforcement of the rules is far from good. Emphasis must be on strengthening the reinforcement of the rules and sanctioning tourists and tour operators that break the rules. At present, tourists are still considered as the "customer who is always right, and who brings in the bacon".*

Corruption*:*
- *The issue of corruption must be dealt with by the management authorities of all the parks – no matter how strict and effective the rules are, if there are rangers, trackers, guides, wardens who have an incentive to break the rules for financial gain, then the rules are essentially impotent.*
- *Rules [are] broken by management themselves [imposing] excess number of visitors, double visit. […] If possible 'officials' [should] have their own groups [of visitor instead of] adding themselves to the number [of tourists]*
- *It is an absolute waste of time and money if you are setting up rules that are going to be implemented at the mercy of [people who want] to make money.*

Others
- *For sure it would be better to get a person who is specifically for this [health threat] issue in the park. We need regular meetings with the management enforcing the rules and regulations.*
- *The rules should not be "loosened". To do so would only increase the risks to the remaining gorillas and chimpanzees. If tourism is to be sustainable in the long-term, beyond just the next few years, then keeping the rules as stringent as possible is essential. Once the situation in Rwanda and DR Congo stabilises, the recent pressure on Ugandan sites should lessen (i.e., huge numbers of tourists). Further increasing the cost of a permit would be a better option than allowing more people to visit, or more than one group, or longer than an hour.*

As can be seen, the issue of guide monitoring is greatly emphasised. Echoing this concern, the sale of stand-by permits was recently stopped in the Ugandan parks to stem an apparently increasing pattern of the selling of unauthorised gorilla visits by guides, as well as solicitation for such illegal viewing opportunities by tourists (The New Vision 1998). This trend further supports the need for a strong monitoring component of the program. In order to identify and address critical issues that may underlie the situations experienced or created by the staff, a monitoring plan should be designed and implemented with the participation of both staff and management.

11. CONCLUSIONS

It is widely believed, and respondents to this consultancy survey were no exception, that habitat destruction is the first and foremost threat to wild gorilla survival (e.g. Harcourt 1996, Yamagiwa et al. 1993). While this is undeniable, loss of habitat is mostly a result of human encroachment which, in turn, cannot be dissociated from human, hence disease, exposure.

The threat of disease to the survival of gorillas cannot be underestimated. Indications are that not so long ago, mountain gorillas were several times as numerous as the currently remaining population. Although we do not know with certainty the precise causes of this decline, the apparently abrupt character strongly suggests a succession of catastrophic events, among which disease outbreaks should figure as a prime suspect.

As concisely put by a conservation specialist, gorilla tourism is "*an all or nothing decision. If the risk of disease transmission is as great as [suggested], then logically we shouldn't be doing gorilla tourism at all since the risk [always] remains. [...] By the same logic, the presence of substantial numbers of people in the forest hunting and collecting etc.. must represent a potential source of diseases. [Thus], park managers will always have difficulty eliminating this risk*"

The initiation of gorilla tourism was decided upon long ago, and rules are only there to limit the potential damage it may cause. There is no question that by entering the wilderness *en masse*, we transform this environment and all its inhabitants, especially those species we are so eager to encounter and experience, like the mountain gorilla. Thus, as long as tourism will be practised, rules will have to be in place, constantly revised and refined, and enforced as strictly as possible.

However, the best law is one which is not needed. In other words, the most powerful enforcement tool is self-limitation, or viewed more positively, self-motivation. For no matter how many sophisticated punitive or coercive schemes we can conceive, rules can - and will - always be broken. It is therefore the belief of this consultant that the best hope for a least damaging tourism programme resides in the widespread sensitisation, awareness and understanding of the catastrophic consequences of unconscious gorilla tourism. It is admittedly a long-term goal that requires careful planning and sustained efforts and certainly cannot be considered in isolation. Other immediate actions can and should be taken to limit the risks in the meantime. They have been explored in this report, and are summarised in the final recommendations that follow.

Eventually however, it is not the rules, but the attitude of the human community towards its non-human environment that will decide the fate of the gorillas, and indeed of many life forms on this planet, including our own. Awareness therefore, albeit a long and strenuous process, is the only sure investment. It may not be a guarantee of success, but undoubtedly is a vital ingredient in the balance of the many choices that will have to be made, now and in the future, for this and other conservation issues.

12. FINAL RECOMMENDATIONS

Recommended Actions on Current Rules

VISIT FREQUENCY: Maintain one visit a day per gorilla group

GROUP SIZE: Limit both the potential for transmission from visitors and for disease spread among the gorilla population in the following way:

Gorilla group size	Risk of spread	Recommended no. of visitors
0-5	Small	No tourists [a]
6-15	Medium	10 persons[b] maximum
16+ [c]	High	No tourists [a]

[a] Staff and researchers may need to have access to these groups
[b] All persons including tourists, staff and any other accompanying person
[c] Based on average group size in parks

Note: a) Cases where staff and researchers may need to have access to groups for which tourism is not recommended, should be covered by the rule as well. It is suggested that for both monitoring and research, a maximum of 3 persons per visit be set

MIN. DISTANCE: 25ft / 7.5 meters for all people approaching or visiting gorillas in non-emergency situations to allow for inadvertent sneezes, coughs and movement of people and gorillas during visit

VISIT DURATION: Maintain one hour long visits; where and when needed, allow up to 15 minutes waiting at 20m or more from gorillas before starting the clock in case - and only in case - gorillas are not visible at initial encounter.

EATING IN PARK: Establish and enforce in all parks and for all people a minimum 5-minute walking distance from gorillas before eating as well as strict removal of all food remains from the park

In case of prolonged stays in the park, researchers, trackers or other staff should make all efforts not to leave any food behind. In case this is not feasible, remnants should be buried as deep as possible.

FAECES DISPOSAL: Minimise possibility of defecation by tourists in park by promoting and allowing time for toilet use before start of tour

Ensure that guides and trackers dig holes at least 0.5m (~2 ft) deep for tourists and for themselves. Sensitise staff and researchers on importance of this measure.

Treat faeces with antiseptic solution before filling holes (150 ml 2% chlorine)

LITTER DISPOSAL: Strengthen enforcement through:
- training and monitoring of staff
- ensuring and monitoring safe and adequate rubbish deposits and removal around parks, and
- preventing access of animals near rubbish disposal sites.

AGE LIMIT: No change - maintain the 15-year old limit

SICKNESS RULE: Strengthen enforcement through:
- Active sensitisation of tourists before booking of tour through direct information, IEC campaign, and development/distribution of a pamphlet dedicated to this issue
- Immunisation of tourists and park staff against diseases of concern

SELF-CONTROL: Clarify statement by differentiating action for controllable behaviours and uncontrollable reflexes
Include spitting or nose-blowing on the ground as a controllable behaviours from which to refrain

ALL RULES: **ENFORCEMENT**: Establish clear alternate rules or guidelines when and where tourism rules cannot/do not apply to park staff or researchers.

MONITORING: There should be a well defined, independent and feasible monitoring system for tourists as well as park staff and researchers, especially with regard to distance, faeces and rubbish disposal rules.

Recommendations on Additional Preventive Measures

Immediate action

For Tourists:

- **For gorilla visitors and researchers coming from temperate zones only:** Require proof of current (same year) immunisation against influenza in winter (October through March in the Northern hemisphere, April through September in the Southern hemisphere)
- For all visitors, staff and researchers: Require proof of current (<10 years) immunisation against yellow fever, polio, tetanus, hepatitis A and measles, and of clear TB status.

For Park Staff and Researchers:

- Establish a 3-week quarantine system in all parks for all newly arrived foreign researchers
- Schedule regular health checks for park staff and researchers, including TB testing, administration of vaccines, provision of curative services and appropriate referral, within existing resources in all parks
- Establish disease-specific guidelines to regulate forest and/or gorilla access to people in prodromic (i.e. incubation), active or convalescent disease stages
- Organise regular sensitisation sessions, exchanges and updates on disease transmission risk, among park staff, veterinarians, researchers and conservationists
- Define, in collaboration with local health authorities, objectives, strategies and implementation plan towards the establishment of a comprehensive health monitoring system and referral service for all staff and researchers in each park

For Tourists, Park Staff and Researchers:

- Washing of hands (soap) and disinfection of boot soles (0.2% chlorine) before and after tracking
- Make hand washing mandatory following defecation
- Ensure safe and adequate rubbish deposits and latrines out of reach of roaming animals in all parks

For Gorillas:

- Promote and support efforts to keep gorillas from roaming outside park boundaries, including the proposed establishment of a buffer zone around the tourist infrastructure in BINP
- Identify strategies / support efforts to reinforce implementation and monitoring of data and blood / tissue collection, storage and analysis from sick or deceased gorillas in all parks.

Medium term

For Gorillas:

- A comprehensive biological sampling and data collection policy for gorillas should be developed, adopted and systematically enforced in all parks.
- The data and material collected should be stored both on site and at a central facility designated to compile, analyse and disseminate regularly updated information to all sites
- Establish and regularly review, update and rehearse contingency plans for curative and prophylactic interventions in case of epidemic outbreaks or other emerging threats among gorillas. Such plans should clearly define criteria for intervention with clear decision-making guidelines and authority, as well as specific action plans corresponding to different levels of interventions.
- Identify and fence off potential sources of immediate contamination such as high concentration rubbish sites near park borders

For Park Staff and Tour Operators:

- Institute regular information/discussion sessions for guides, trackers and rangers to update their knowledge on disease transmission and ensure their adequate understanding, explaining and enforcement of the disease rationale of the rules, both among themselves and in dealing with tourists
- A similar programme should be instituted for tour operators with a view to enlist their full cooperation in promoting and ensuring rules enforcement by their clients

For the community at large:

- Plan and implement an active sensitisation campaign among surrounding park communities, tourists and tour operators about the importance of the human disease threat to sustainable gorilla tourism. Such an intervention should involve the international print and audio-visual media as well as the production of educational material.

Long-term

For Gorillas:

- There is a need to design and support research protocols for the long-term assessment of tourism impact on gorilla morbidity and mortality with particular emphasis on immunity and reproduction.

For the community at large:

- Encourage and support protected area authorities to advocate and initiate collaboration and partnership between human medical institutions and wildlife veterinary and / or conservation institutions in the design and implementation of research and intervention programmes addressing local community health issues.

* * *

Appendix 1: References

1. Ablashi DV; Gerber P; Easton J. **Oncogenic herpesviruses of nonhuman primates**. Comp Immunol Microbiol Infect Dis 1979, 2:229-41.
2. Acha PN, Szyfres B. **Zoonoses and communicable diseases common to man and animals**. 2nd ed. Pan Am Health Organization 1987. Scientific Publication No. 503.
3. Akers JS, Schildkraut DS. **Regurgitation/reingestion and coprophagy in captive gorillas [*Gorilla gorilla gorilla*].** Zoo Biology 1985, 4(2):99-110.
4. Anan'ev VA; Viazov SO; Garanina NM; Doroshenko NV; Zhilina NN. **Viral hepatitis A and B in anthropoid apes of the Moscow Zoo**. Vopr Virusol 1984, 29:434-7.
5. Anon. **Coughs and feces spread diseases that can kill mountain gorillas**. New Scientist 1986, 109:20.
6. AP Worldstream ex Antara news agency: **Human Diseases, Orangutans - Indonesia**. 29 Nov 1998. <http://www.healthnet.org/programs/promed.html> and <http://www.fas.org/promed/ahead>
7. Ashford RW, Lawson H, Butynski TM, Reid GDF. **Patterns of intestinal parasitism in the mountain gorilla Gorilla gorilla in the Bwindi-Impenetrable Forest, Uganda**. Journal of Zoology 1996, 239(3):507-514.
8. Ashford RW, Warhurst DC, Reid GDF. Human Infection with Cyanobacterium-Like Bodies. Lancet 1993, v.341, n.8851,:1034.
9. Ashford RW, Reid GD, Butynski TM. **The intestinal faunas of man and mountain gorillas in a shared habitat**. Annals of Tropical Medicine and Parasitology 1990, 84(4):337-40.
10. Ashley CR, Caul EO, Clarke SK, Corner BD, Dunn S. **Rotavirus infections of apes**. Lancet 1978, 2:477.
11. Aveling C, Aveling R. Gorilla Conservation in Zaire. Oryx, v.23, n.2, 1989:64-70.
12. Bain, O; Moisson, P; Huerre, M; Landsoud-Soukate, J; Tutin, C. **Filariae from a wild gorilla in Gabon with description of a new species of Mansonella.** Parasite 1995, 2 3 :315-22.
13. Baker SA. **Airborne transmission of respiratory diseases**. Journal of Clinical Engineering 1995, 20(5):401-406.
14. Bar-Dayan Y, Bar-Dayan Y, Shemer J. **Food-borne and air-borne streptococcal pharyngitis-A clinical comparison**. Infection 1997, 25(1):12-15.
15. Belshe RB; Mendelman PM; Treanor J; King J; Gruber WC; Piedra P; Bernstein DI; Hayden FG; Kotloff K; Zangwill K; Iacuzio D; Wolff M. **The efficacy of live attenuated, cold-adapted, trivalent, intranasal influenza virus vaccine in children**. N Engl J Med 1998, 338(20):1405-12
16. Benirschke K; Adams FD. **Gorilla diseases and causes of death**. J Reprod Fertil Suppl 1980, Suppl 28:139-48,
17. Berendt RF; Young HW; Allen RG; Knutsen GL **Dose-response of guinea pigs experimentally infected with aerosols of Legionella pneumophila**. J Infect Dis 1980, 141(2):186-92
18. Bielitzki JT. **Emerging viral diseases of non-human primates**. In: Zoo and Wild Animal Medicine (ME Fowler, ed) WB Saunders, Philadelphia, 1996
19. Bieniasz, PD; Rethwilm, A; Pitman, R; Daniel, MD; Chrystie, I; McClure, MO**. A comparative study of higher primate foamy viruses, including a new virus from a gorilla**. Virology 1995, 207 1:217-28.
20. Blakeslee JR Jr, McClure HM, Anderson DC, Bauer RM, Huff LY, Olsen RG. **Chronic fatal disease in gorillas seropositive for simian T-lymphotropic virus I antibodies**. Cancer Letters 1987, 37 1 :1-6.
21. Brack M. **Agents transmissible from simians to man**. Springer-Verlag, Berlin, 1987.
22. Burbridge B. **Gorilla: Tracking and capturing the ape-man of Africa**. George G. Harrap & Co., London, 1928.
23. Butynski TM, Kalina J. **Gorilla Tourism: A critical look**. In: Conservation of Biological Resources. EJ Milner-Gulland and R Mace (eds). Blackwell Science Ltd 1998, Oxford, pp. 280 - 300.
24. Butynski TM. **Africa's Great Apes: An Overview of Current Taxonomy, Distribution, Numbers, Conservation Status and Threats**. Paper presented at a workshop titled "Great Apes and Humans at an Ethical Frontier" , Disney Institute, Orlando, Florida, July 1998.
25. Burström B; Aaby P; Mutie DM. **Measles in infants: a review of studies on incidence, vaccine efficacy and mortality in East Africa**. East Afr Med J 1995, 72(3):155-61
26. Butynski TM; Kalina, J. **Three new mountain national parks for Uganda**. Oryx, v.27, n.4, 1993:214-224.
27. Byers AC; Hastings B. **Mountain gorilla mortality and climatic factors in the Parc-National-des-Volcans, Ruhengeri-Prefecture, Rwanda**, **1988**. Mountain Research And Development 1991, v11 n2 :145-151.
28. Castro KG. **Tuberculosis as an opportunistic disease in persons infected with human immunodeficiency virus**. Clin Infect Dis 1995, 21 Suppl 1:S66-71
29. Campbell H. **Acute respiratory infection: a global challenge**. Arch Dis Child 1995, 73(4):281-3
30. Chamove A; Cameron G; Nash V. Primate disease and breeding rates. Lab Anim 1979, 13:313-6
31. Chamove A. **Visitors excite primates in zoos**. Zoo Biology 1988, 7:359-369.
32. Clarke CJ, Watt NJ, Meredith A, McIntyre N, and SM Burns. **Respiratory syncytial virus-associated bronchopneumonia in a young chimpanzee**. Journal of Comparative Pathology 1994, 110: 207-212.
33. Clements, ML, RB Belshe, J King, F Newman, TU Westblom, EL Tierney, WT London, and BR Murphy. **Evaluation of bovine, cold-adapted human, and wild-type human parainfluenza type 3 viruses in adult volunteers and in chimpanzees**. Journal of Clinical Microbiology 1991, 29(6): 1175-1182.
34. Cooper JE. **Parasites and pathogens of non-human primates**. Veterinary Record 1996, 139:48.
35. Cossar JH; Reid D; Fallon RJ; Bell EJ; Riding MH; Follett EA; Dow BC; Mitchell S; Grist NR**. A cumulative review of studies on travellers, their experience of illness and the implications of these findings**. J Infect 1990, 21:27-42

36. Cox CS. **Stability of airborne microbes and allergens**. Cox, C. S. and C. M. Wathes (Ed.). Bioaerosols Handbook. CRC Press/Lewis Publishers Inc. Boca Raton, Florida, USA & London, England, UK, 1995:77-99.
37. Dabis F; Lepage P; Msellati P; Van de Perre P; Nsengumuremyi F; Hitimana DG; Ladner J; Leroy V. **Routine vaccinations in children and adults infected with HIV**. Santé 1994, 3:173-82
38. Denny FW. **The clinical impact of human respiratory virus infections**. American Journal of Respiratory Critical Care Medicine 1995, 152: S4-S12.
39. Dick EC, Dick CR. **Natural and experimental infections of nonhuman primates with respiratory viruses**. Laboratory Animal Science 1974, 24(1): 177-181.
40. Dick EC, Dick CR. **A subclinical outbreak of human rhinovirus 31 infection in chimpanzees**. American Journal of Epidemiology 1968, 88(2): 267-272.
41. Eberle R. **Evidence for an alpha-herpesvirus indigenous to mountain gorillas**. Journal of Medical Primatology, 1992 Jul, 21 5 :246-51.
42. Eberle, R; Hilliard, JK. **Serological evidence for variation in the incidence of herpesvirus infections in different species of apes**. Journal of Clinical Microbiology 1989, 27 6 :1357-66.
43. Ehresmann KR; Hedberg CW; Grimm MB; Norton CA; MacDonald KL; Osterholm MT. **An outbreak of measles at an international sporting event with airborne transmission in a domed stadium**. J Infect Dis 1995, 171(3):679-83
44. Eilenberger U. **Endoparasites in gorillas and humans in the same habitat**. *Gorilla Journal*, 1997, *15*, 11-14
45. Feldmann H; Slenczka W; Klenk HD. **Emerging and reemerging of filoviruses**. Arch Virol Suppl 1996, 11:77-100
46. Fennelly KP. **Personal respiratory protection against Mycobacterium tuberculosis**. Clin Chest Med 1997, 18:1-17
47. Fossey D. **Gorillas In The Mist**. Boston, Mass.: Houghton Mifflin, 1983.
48. Foster JW. **Health plan for the mountain gorillas of Rwanda**. In: Zoo and Wild Animal Medicine (ME Fowler, ed) WB Saunders, Philadelphia, 1993
49. Foster JW. **Mountain Gorilla conservation: a study in human values**. Journal of the American Veterinary Medical Association 1992, 200(5):629-633.
50. Foy HM; Cooney MK; Allan ID; Albrecht JK. **Influenza B in households: virus shedding without symptoms or antibody response**. Am J Epidemiol 1987, 126:506-15
51. Froeschle J, Allmond B. **Polio outbreak among primates at Yerkes Primate Center**. Laboratory Primate Newsletter 1965, 4(2):6.
52. Gao F, Bailes E, Robertson D, et al: **The origin of HIV-1: a puzzle solved?** [Abstract S2]. 6th Conference on Retroviruses and Opportunistic Infections, Chicago, Ill, USA Feb 1999.
53. Gardner P. et al. **Adult immunizations**. Ann Emerg Med 1996, 124:35
54. Gennaro S; Fehder WP. **Stress, immune function, and relationship to pregnancy outcome.** Nursing Clinics of North America 1996, 31(2):293-303
55. Georges-Courbot MC; Moisson P; Leroy E; Pingard AM; Nerrienet E; Dubreuil G; Wickings EJ; Debels F; Bedjabaga I; Poaty-Mavoungou V; Hahn NT; Georges AJ. **Occurrence and frequency of transmission of naturally occurring simian retroviral infections (SIV, STLV, and SRV) at the CIRMF Primate Center, Gabon**. J Med Primatol, 25:313-26, 1996
56. Gibbons A. **Our chimp cousins get that much closer**. Science 1990, 250:376.
57. Griffith DE; Kerr CM. **Tuberculosis**: **disease of the past, disease of the present**. J Perianesth Nurs 1996, 11(4):240-5
58. Gross PA; Hermogenes AW; Sacks HS; Lau J; Levandowski RA. **The efficacy of influenza vaccine in elderly persons. A meta-analysis and review of the literature**. Ann Intern Med 1995, 123(7):518-27 Oct 1.
59. Grotto I; Mandel Y; Green MS; Varsano N; Gdalevich M; Ashkenazi I; Shemer J. **Influenza vaccine efficacy in young, healthy adults**. Clin Infect Dis 1998, 26(4):913-7.
60. Gwaltney JM Jr. **Rhinovirus infection of the normal human airway**. Am J Respir Crit Care Med 1995, 152(4 Pt 2):S36-9
61. Habermann RT; Menges RW. **Filariasis (Acanthocheilonema perstans) in a gorilla**. Vet Med Small Anim Clin 1968, 63:1040-3.
62. Hall JS, Saltonstall K, Inogwabini B-I, Omari I. **Distribution, abundance and conservation status of Grauer's gorilla**. Oryx 1998, v.32, n.2,:122-130.
63. Harcourt AH**. Is the gorilla a threatened species - How should we judge ?** Biological Conservation 1996, v75 n2 :165-176.
64. Harcourt AH. **Population viability estimates: Theory and practice for a wild gorilla population**. Conservation Biology 1995, 9:134-142.
65. Hastings BE. **The veterinary management of a laryngeal air sac infection in a free-ranging mountain gorilla**. Journal of Medical Primatology, 1991, 20 (7) :361-4.
66. Hastings BE, Kenny D, Lowenstine LJ, Foster JW. **Mountain gorillas and measles: Ontogeny of a wildlife vaccination program**. Proceedings of the American Association of Zoo Veterinarians Annual Meeting, September 28 - October 3, 1991, Calgary, Alberta, Canada, pp. 198-205.
67. Hastings BE, Gibbons LM, Williams JE. **Parasites of free-ranging mountain gorillas: survey and epidemiological factors**. Joint proceedings of the American Association of Zoo Veterinarians and American Association of Wildlife Veterinarians, Annual Meeting, November 15-19, 1992, Oakland, California. p. 301-302.
68. Hayden FG. **Combination antiviral therapy for *respiratory* virus infections**. Antiviral Res 1996, 29(1):45-8
69. Heldstab A; Ruedi D; Sonnabend W; Deinhardt F. **Spontaneous generalized Herpesvirus hominis infection of a lowland gorilla (Gorilla gorilla gorilla).** J Med Primatol 1981, 10:129-35.
70. Hess G; Clemens R; Bienzle U; Schĺonfeld C; Schunck B; Bock HL. **Immunogenicity and safety of an inactivated hepatitis A vaccine in anti-HIV positive and negative homosexual men**. J Med Virol 1995, 1:40-2

71. Hess GR. **Conservation corridors and contagious disease: A cautionary note**. Conservation Biology 1994, 8, 256-262.
72. Hofer H, East ML. **Biological conservation and stress**. Advances in the Study of Behavior 27:405-525.
73. Hollander H, Katz MH. **HIV Infection**. In: Current Medical Diagnosis and Treatment 1997. Tierney LM, McPhee SJ, Papadakis MA, Eds. Appleton & Lange, Stanford, CT, USA, 1997.
74. Holmes JC. **Parasites are threats to biodiversity in shrinking ecosystems**. Biodiversity & Conservation 1996, 5:975-983
75. Homsy J, Morrow WJW, Levy JA. **Nutrition and Autoimmunity: a Review**. Clin Exp Immunol 1986; 65: 473.
76. Hudson, HR. **The relationship between stress and disease in orphan gorillas and its significance for gorilla tourism**. Gorilla Conservation News 1992, 6:8-10
77. **Human Monkeypox - Kasai Oriental, Zaire, 1996-97**. Morbidity Mortality Weekly Report 1997, 46:304.
78. IGCP and CARE-Development through Conservation. **The Problem Gorilla. A report of the East and Central African workshop on problem mountain gorillas using the situation in Bwindi Impenetrable National Park as a basis for solution development**. Uganda, Feb. 1997
79. Ijaz MK; Sattar SA; Alkarmi T; Dar FK; Bhatti AR; Elhag KM. **Studies on the survival of aerosolized bovine rotavirus (UK) and a murine rotavirus**. Comp Immunol Microbiol and Infect Dis 1994, v.17, n.2,:91-98.
80. Iverson WO; Popp JA. **Meningoencephalitis secondary to otitis in a gorilla**. J Am Vet Med Assoc 1978, 173:1134-6.
81. Jaax N; Jahrling P; Geisbert T; Geisbert J; Steele K; McKee K; Nagley D; Johnson E; Jaax G; Peters C. **Transmission of Ebola virus (Zaire strain) to uninfected control monkeys in a biocontainment laboratory**. Lancet 1995, 346:1669-71
82. Jacobs RA. **General Problems in Infectious Diseases**. In: Current Medical Diagnosis and Treatment 1997. Tierney LM, McPhee SJ, Papadakis MA, Eds. Appleton & Lange, Stanford, CT, USA, 1997.
83. Johnsen DO, et al. **An epizootic of A2/HongKong/68 influenza in gibbons**. J. Infect. Dis. 1971, 123:365-370.
84. Jones EE, Alford PL, Reingold AL, Russell H, Keeling ME, Broome CV. **Predisposition to invasive pneumococcal illness following parainfluenza type 3 infection in chimpanzees**. J Am Vet Med Assoc 1984, 185(11):1351-1353.
85. Kalema G, RA Kock, and E Macfie. 1998. **An outbreak of sarcoptic mange in free-ranging mountain gorillas (Gorilla gorilla berengei) in Bwindi Impenetrable National Park, Southwestern Uganda**. Joint proceedings of the American Association of Zoo Veterinarians and American Association of Wildlife Veterinarians annual meeting 1998, Omaha, Nebraska. p. 438.
86. Kalter SS. **Infectious diseases of the great apes of Africa**. J Reprod Fertil Suppl 1980, Suppl 28:149-59. The need for studies of infectious diseases in the wild is stressed.
87. Kalter SS, Heberling RL. **Viral battery testing in nonhuman primate colony management**. Laboratory Animal Science 1990, 40 1 :21-3.
88. Kalter SS, Heberling RL. **Serologic response of primates to influenza viruses**. Proc. Soc. Exp. Biol. 1978, 159:414-417.
89. Kapikian AZ. **Overview of viral gastroenteritis**. Arch Virol 1996, 12:7.
90. Karesh WB, Cook RA. **Applications of veterinary medicine to in situ conservation efforts**. Oryx 1995, 29:244-52.
91. Kazoora C, Williamson L, McNeilage A, Bell G. **Proposed Buhoma Visitor Centre and Administrative Facility, Environmental Impact Assessment (EIA), BINP**. African Wildlife Foundation, Jan 1999.
92. Kehrli ME; Burton JL; Nonnecke BJ; Lee EK. **Effects of stress on leukocyte trafficking and immune responses: implications for vaccination.** Advances in Veterinary Medicine 1999, 41:61-81
93. Keitel WA; Cate TR; Couch RB; Huggins LL; Hess KR **Efficacy of repeated annual immunization with inactivated influenza virus vaccines over a five year period**. Vaccine 1997, 15(10):1114-22..
94. Keusch GT. **Nutrition and immunity: from A to Z.** Nutrition Reviews 1998, 56(1 Pt 2):S3-4.
95. Kim SK; Son BK; Chung CY; Ahn YM; Park CY; Lee HJ. **Efficacy of measles vaccine during the 1993 measles epidemic in Korea**. Pediatr Infect Dis J 1995, 14(5):346-9
96. Kok T; Higgins G. **Prevalence of respiratory viruses and Mycoplasma pneumoniae in sputum samples from unselected adult patients**. Pathology 1997, 29:300-2,
97. Kondo H; Wada Y; Bando G; Kosuge M; Yagi K; Oku Y. **Alveolar hydatidosis in a gorilla and a ring-tailed lemur in Japan**. J Vet Med Sci 1996, 58:447-9.
98. Landsoud-Soukate, J; Tutin, CE; Fernandez, M. **Intestinal parasites of sympatric gorillas and chimpanzees in the Lope Reserve, Gabon**. Annals of Tropical Medicine and Parasitology 1995, 89 1 :73-9.
99. Le Guenno B, Formenty P, Wyers M, Gounon P, Walker F, Boesch C. **Isolation and partial characterisation of a new strain of Ebola virus**. Lancet 1995;345:1271-4
100. Lee, RV; Prowten, AW; Anthone, S; Satchidanand, SK; Fisher, JE; Anthone, R. **Typhlitis due to Balantidium coli in captive lowland gorillas**. Reviews of Infectious Diseases 1990, 12(6):1052-9.
101. Lee, RV; Prowten, AW; Satchidanand, SK; Srivastava, BI. **Non-Hodgkin's lymphoma and HTLV-1 antibodies in a gorilla**. New England Journal of Medicine 1985, 312 2 :118-9.
102. Lemen R; Lemen S; Morrish R; Tooley W. **Marasmus and shigellosis in two infant gorillas**. J Med Primatol 1974, 3:365-9.
103. Lerche NW. **Emerging viral diseases of non human primates in the wild**. In: Zoo and Wild Animal Medicine (ME Fowler, ed) WB Saunders, Philadelphia, 1993.
104. Linnemann CC Jr; Kramer LW; Askey PA. **Familial clustering of hepatitis B infections in gorillas**. Am J Epidemiol, 1984, 119:424-30.
105. Litchfield C. **Treading Lightly: Responsible Tourism with the African Great Apes**. Travellers Medical and Vaccination Centre, Adelaide, South Australia, 1997
106. Locher, C P; Blackbourn, D J; Castro, B A; Brasky, K M; Levy, J A**. Susceptibility of peripheral blood mononuclear cells from gorillas, orangutans and baboons to diverse HIV isolates**. AIDS London , v.10, n.12, 1996:1438-1440.

107. Loomis MR. **Update of vaccination recommendations for nonhuman primates**. Proceedings Am Ass Zoo Vet 1990, p. 257.
108. Loutan L. **Vaccination of the immunocompromised patient**. Biologicals 1997, 25(2):231-6.
109. Luthi JC; Kessler W; Boelaert M. **A survey on vaccine efficacy in the city of Bongor (Chad) and its operational consequences for the vaccination program**. Bull WHO 1997, 75(5):427-33
110. Macfie L. **Case report on scabies infection in Bwindi gorillas**. Gorilla Journal 1996, 13:19-20.
111. Mahaney WC; Aufreiter S; Hancock RGV. **Mountain Gorilla Geophagy - A Possible Seasonal Behavior For Dealing With The Effects Of Dietary Changes**. International Journal Of Primatology 1995, 16(3) :475-488.
112. Mahaney, W C. **Scanning electron microscopy of earth mined and eaten by mountain gorillas in the Virunga Mountains, Rwanda**. Primates 1993, 34(3):311-319.
113. Mahaney, WC; Watts, DP; Hancock, RGV. **Geophagia by mountain gorillas *Gorilla gorilla beringei* in the Virunga Mountains, Rwanda**. Primates 1990, 31(1):113-120.
114. Marks J. **Relationships of humans to chimps and gorillas**. Nature 1988, 334 6184 :656.
115. Marbet UA. **Diarrhea caused by parasites**. Schweiz Rundsch Med Prax 1990, 79:877-81.
116. Marsden PD. **Infections due to Balantidium coli in primates**. Reviews of Infectious Diseases 1991, 13(4):765-6.
117. Marsh BJ, von Reyn CF, Edwards J, Ristola MA, Bartholomew C, Brindle RJ, Gilks CF, Waddell R, Tosteson AN, Pelz R, Sox CH, Frothingham R, Arbeit RD. **The risks and benefits of childhood bacille Calmette-Guerin immunization among adults with AIDS**. International MAC study groups. AIDS 1997, 11(5):669-72
118. McCallum H, Dobson A. **Detecting disease and parasite threats to endangered species and ecosystems**. Trends in Ecology and Evolution 1995, 10(5):190-194.
119. McDermid, AS; Lever, M S. **Survival of Salmonella enteritidis PT4 and Salm. typhimurium Swindon in aerosols**. Letters in Applied Microbiology 1996, 23(2):107-109.
120. McNeely JA. **Protected areas in a changing world: The management approaches that will be required to enable primates to survive in the 21st century**. In Topics in Primatology, vol. 2, Behavior, Ecology and Conservation (Itoigawa N et al, eds). University of Tokyo Press, Tokyo, Japan, 1992.
121. Meader LL, Sleeman JM, Mudakidwa AB, Patton S**. The prevalence of gastrointestinal parasites in gorillas from the Virunga mountains, Rwanda**.. Proceedings of the Southeastern Society of Parasitologists, Greenville, 1997.
122. Menkhaus NA; Lanphear B; Linnemann CC. **Airborne transmission of varicella-zoster virus in hospitals**. Lancet 1990, 336(8726):1315.
123. Miller SK. **Gorillas caught up in civil war**. New Scientist 1993, v137 n1863 :7-7
124. Ministry of Planning and Economic Development, Uganda. **The Republic of Uganda: 1997 Statistical Abstract**. 1997.
125. Morris J. **Trouble for International Gorilla Conservation Programme**. Oryx, 1997, 31(4):225-225.
126. Morris JA, et al. **Recovery of a cytopathogenic agent from chimpanzees with coryza**. Proc. Soc. Exp. Biol. 1956, 92:544-549.
127. Morris RS, Pfeiffer DU, Jackson R. **The epidemiology of Mycobacterium bovis infections**. Vet Microbiol 1994, 40:153-77,.
128. Mowat F. **Woman in the mists: the story of Dian Fossey and the mountain gorillas of Africa**.: Warner Books,. New York, NY, 1987.
129. Mudakikwa T. et al. **An Indicator of Human Impact: Gastrointestinal parasites of mountain gorillas (Gorilla gorilla beringei) from the Virunga Volcanoes, Central Africa**. Joint Proceedings of the American Association of Zoo Veterinarians and American Association of Wildlife Veterinarians annual meeting 1998, Omaha, Nebraska.
130. Mumford JA; Hannant D; Jessett DM. **Experimental infection of ponies with equine influenza (H3N8) viruses by intranasal inoculation or exposure to aerosols**. Equine Vet J 1990, 22(2):93-8
131. Myers MG, Kramer LW, Stanberry LR. **Varicella in a gorilla**. Journal of Medical Virology 1987, 23 (4):317-22.
132. Naughton-Treves L. **Uneasy Neighbors.** Dissertation Thesis. University of Florida, 1996.
133. Neubauer RH; Rabin H; Strnad BC; Nonoyama M; Nelson-Rees WA. **Establishment of a lymphoblastoid cell line and isolation of an Epstein-Barr-related virus of gorilla origin**. J Virol 1979, 31:845-8.
134. Nicas M. **Respiratory protection and the risk of Mycobacterium tuberculosis infection**. Am J Ind Med 1995, 27:317-33,
135. Nishihara, T; Kuroda, S. **Soil-scratching behavior by western lowland gorillas**. Folia Primatologica 1991, 57(1):48-51.
136. Nokes DJ; Williams JR; Butler AR. **Towards eradication of measles virus: global progress and strategy evaluation**. Vet Microbiol 1995, 44(2-4):333-50
137. Novembre FJ; Saucier M; Anderson DC; Klumpp SA; O'Neil SP; Brown CR 2nd; Hart CE; Guenthner PC; Swenson RB; McClure HM. **Development of AIDS in a chimpanzee infected with human immunodeficiency virus type 1**. - J Virol 1997, 71:4086-91
138. Nowak R. **Conservation Biology - Gorillas killed in Ugandan park**. Science 1995, v268 n5207 :25-25.
139. Nutter FB. Respiratory disease claims the lives of at least seven Gombe chimps. Pan African News 1996, 31:3
140. Oates JF. **Africa's Primates: Status Survey and Conservation Action Plan**. IUCN/SSC Primate Specialist Group. IUCN, Switzerland, 1996.
141. Ollomo, B; Karch, S; Bureau, P; Elissa, N; Georges, AJ; Millet, P. **Lack of malaria parasite transmission between apes and humans in Gabon**. Am J Trop Med Hyg 1997, 56 4 :440-5.
142. Olsen RJ et al. **Examination gloves as barriers to hand contamination in clinical practice**. JAMA 1993, 2170:350.
143. O'Reilly LM, Daborn CJ. **The epidemiology of Mycobacterium bovis infection in animals and man: A review**. Tubercle and Lung Disease 1995, v.76, n.suppl. 1:1-46.
144. Osborn KG, Lowenstine LJ. **Nonhuman primates in biomedical research; diseases**. BT Bennett, CR Abee and R. Henrickson (eds). Chapter 7, Academic Press 1998.
145. Ostroff SM, Kozarsky P. **Emerging infectious diseases and travel medicine**. Infect Dis Clin North Am 1998, 12:231-41.

146. Ott-Joslin JE. **Zoonotic diseases of non human primates**. In: Zoo and Wild Animal Medicine (ME Fowler, ed) WB Saunders, Philadelphia, 1993.
147. Ott-Joslin JE. **Viral diseases in non human primates**. In: Zoo and Wild Animal Medicine (ME Fowler, ed) WB Saunders, Philadelphia, 1983.
148. Padovan D, Cantrell CA. **Varicella-like herpesvirus infections of nonhuman primates**. Laboratory Animal Science 1986, 36 (1):7-13.
149. Palache AM. **Influenza vaccines. A reappraisal of their use**. Drugs 1997, 54(6):841-56
150. Pirtle EC; Beran GW. **Virus survival in the environment**. Rev Sci Tech 1991, 10:733-48
151. Population and Habitat Viability Assessment (PHVA) for *Gorilla gorilla beringei*. **Can the Mountain Gorilla Survive?** Kampala, Uganda, December 1997.
152. Prowten, A W; Lee, R V; Krishnamsetty, R M; Satchidanand, S K; Srivastava, B I S. **T Cell lymphoma associated with immunologic evidence of retrovirus infection in a lowland gorilla**. Journal of the American Veterinary Medical Association 1985, v.187, n.11:1280-1282.
153. Rabin H, Strnad BC, Neubauer RH, Brown AM, Hopkins RF 3d, Mazur RA. **Comparisons of nuclear antigens of Epstein-Barr virus (EBV) and EBV-like simian viruses**. J Gen Virol 1980, 48:265-72,
154. Rao GG. **Risk factors for the spread of antibiotic-resistant bacteria**. Drugs 1998, 55:323-30
155. Reinquist DM, Whitney RA. **Zoonoses acquired from pet primates**. Veterinary Clinics of North America: Small Animal Practice 17(10):219-240.
156. Richardson-Wyatt LS, et al. **Respiratory syncytial virus antibodies in nonhuman primates and domestic animals**. Lab. Anim. Sci. 1981, 31:413-415.
157. Rideout, BA; Gardiner, CH; Stalis, IH; Zuba, JR; Hadfield, T; Visvesvara, GS. **Fatal infections with Balamuthia mandrillaris a free-living amoeba in gorillas and other Old World primates**. Veterinary Pathology 1997, 34 1 :15-22.
158. Robbins, M M; Czekala, N M. A preliminary investigation of urinary testosterone and cortisol levels in wild male mountain gorillas. American Journal of Primatology, v.43, n.1, 1997:51-64.
159. Roberts J. **Rwandan war threatens gorilla research project**. Nature 1993, 362(64), 15:7-7.
160. Rooney M, Sleeman J. **Identifying potential disease threats to the mountain gorillas (*Gorilla gorilla beringei*) and chimpanzees (*Pan troglodytes schweinfurthii*) of Uganda by establishing the diseases endemic to the human populations living in close proximity to the great ape habitats**. In preparation.
161. Rossiter PB. **The increased risk of infectious disease with intensive utilization of wildlife**. In: Wildlife Research for Sustainable Development (eds. J.G. Grootenhuis, S.G. Njununa & P.W. Kat), pp. 124-136 KARI/KWS/NMK, Nairobi, 1990
162. Royal L; McCoubrey I. **International spread of disease by air travel**. Am Fam Physician 1989, 40:129-36
163. Sawyer MH; Chamberlin CJ; Wu YN; Aintablian N; Wallace MR. **Detection of varicella-zoster virus DNA in air samples from hospital rooms**. J Infect Dis 1994, 169:91-4
164. Schäffer M; Barbul A. **Lymphocyte function in wound healing and following injury.** British Journal of Surgery 1998, 85(4):444-60
165. Schaller GB. **The mountain gorilla : ecology and behavior**. University of Chicago Press, Chicago, 1976.
166. Sholley CR. & Hastings B. **Outbreak of illness among Rwanda's gorillas**. Gorilla Conservation News 1989, 3:7
167. Sholley C. **Mountain Gorilla Update**. Oryx 23:57-58, 1989.
168. Sedgwick CJ; Robinson PT; Lochner FK. **Zoonoses: a zoo's concern**. J Am Vet Med Assoc 1975, 167:828-9
169. Shibata R; Maldarelli F; Siemon C; Matano T; Parta M; Miller G; Fredrickson T; Martin MA. **Infection and pathogenicity of chimeric simian-human immunodeficiency viruses in macaques: determinants of high virus loads and CD4 cell killing**. J Infect Dis 1997, 176(2):362-73
170. Shortridge KF. **Pandemic influenza: a zoonosis?** Semin Respir Infect 1992, 7:11-25
171. Siemering H. **Zoonoses**. In Zoo and Wild Animal Medicine. M Fowler (ed). WB Saunders, Philadelphia, 1986, p. 64-7.
172. Srivastava, BI; Wong-Staal, F; Getchell, JP. **Human T-cell leukemia virus I provirus and antibodies in a captive gorilla with non-Hodgkin's lymphoma**. Cancer Research 1986, 46 9 :4756-8.
173. Stauffer JL. **Lung**. In: Current Medical Diagnosis and Treatment 1997. Tierney LM, McPhee SJ, Papadakis MA, Eds. Appleton & Lange, Stanford, CT, USA, 1997.
174. Stetter, MD; Cook, RA; Calle, PP; Shayegani, M; Raphael, B L. **Shigellosis in captive western lowland gorillas Gorilla gorilla gorilla**. Journal of Zoo and Wildlife Medicine 1995, 26(1):52-60.
175. Swenson RB. **Protozoal parasites of great apes**. In: Zoo and Wild Animal Medicine (ME Fowler, ed) WB Saunders, Philadelphia, 1996
176. Talbot EA, Perkins MD, Fagundes S, Silva M, Frothingham R. **Disseminated bacille Calmette-Guerin disease after vaccination: case report and review**. Clinical Infectious Diseases 1997, 24(6):1139-46
177. Teare JA; Loomis MR. **Epizootic of balantidiasis in lowland gorillas**. J Am Vet Med Assoc 1982, 181:1345-7.
178. The New Vision, Kampala, Uganda. **Gorilla Permits Stopped**. December 3, 1998.
179. Toft JD. **The pathoparasitology of non-human primates: A review**. In Primates: The Road to Self-Sustaining Populations, ed. K. Benirschke: 571-679. Springer-Verlag, New York, 1996.
180. Toida I. **HIV-infection, AIDS and BCG vaccination**. Kekkaku 1993, 6:435-44
181. Tsuchiya Y; Isshiki O; Yamada H. **Generalized cytomegalovirus infection in a gorilla**. Jpn J Med Sci Biol 1970, 23:71-3.
182. Turner RB. **Epidemiology, pathogenesis, and treatment of the common cold**. Ann Allergy Asthma Immunol 1997, 78(6):531-9; quiz 539-40

183. Uganda Wildlife Authority. **Bwindi Impenetrable National Park - A Tourism Development Plan**, produced by the International Gorilla Conservation Programme, July 1992.
184. Uganda Wildlife Authority. **Bwindi Impenetrable National Park - Management Plan 1995-1999**, ed. by Gubelman E, Schoorl J, Achoka E, March 1995.
185. Uganda Wildlife Authority. **Mgahinga Gorilla National Park - Management Plan 1996-2000**, February 1996.
186. UNICEF. **Equity and Vulnerability: A Situational Analysis of Women, Adolescents and Children in Uganda.** The Government of Uganda National Council for Children 1994.
187. Ungs TJ. **Airborne transmission of infectious diseases aboard aircraft**. Aviat Space Environ Med 1995, 66(9):913-4
188. Veber B. **Pulmonary tuberculosis in 1996. Recent data and practical consequences for the anesthesiologist**. Ann Fr Anesth Reanim, 15(7):1080-7 1996
189. Vetter RT, Johnson GM. **Vaccination update. Diphtheria, tetanus, pertussis, mumps, rubella, measles**. Postgrad Med 1995, 98(4):133-7, 141-2, 144-5 passim
190. Van Kruiningen, HJ, Dobbins, WO, John, G. **Bacterial histiocytic colitis in a lowland gorilla *Gorilla gorilla gorilla*** . Veterinary Pathology 1991, 28 6 :544-6.
191. Wallace MR, Hooper DG, Graves SJ, Malone JL. **Measles seroprevalence and vaccine response in HIV-infected adults.** Vaccine 1994, 12(13):1222-4.
192. Wallis J, Lee DR. **Primate Conservation and Health: II. Prevention of disease transmission**. Unpublished manuscript / in prep.
193. Warren KS, Niphuis H, Heriyanto, Verschoor EJ; Swan RA, Heeney JL. **Seroprevalence of specific viral infections in confiscated orangutans (Pongo pygmaeus)** . Journal of Medical Primatology 1998, 27(1),:33-37.
194. Watts DP. **Strategies of habitat use by mountain gorillas**. Folia Primatologica 1991, v.56, n.1:1-16.
195. Watts DP. **Long-term habitat use by mountain gorillas *Gorilla gorilla beringei*. I. Consistency, variation, and home range size and stability**. International Journal of Primatology, 1998, 19(4):651-680.
196. Webster RG. **Influenza virus: Transmission between species and relevance to emergence of the next human pandemic**. Archives of Virology, Supplement, n.13, 1997:105-113.
197. Whitney RA Jr. **The conservation of non-human primates and its importance to public health**. Arambulo, P. III., et al. Ed.. Primates of the Americas: Strategies for Conservation and Sustained Use in Biomedical Research; First Ordinary Meeting of the Regional Primatology Committee for the Americas, Seattle, Washington, USA, October 29-31, 1990.. Battelle Press: Columbus, Ohio, USA.
198. Wilson ME. **Travel and the emergence of infectious diseases**. Emerging Infectious Diseases 1(2):39-46.
199. Wolfe ND, Escalante AA, Karesh WB, Kilbourn A, Spielman A, Lal AA**. Wild primate populations in emerging infectious disease research: The missing link?** Emerging Infectious Diseases 1998. 4(2): 149-157.
200. WHO - World Health Organization. **Tuberculosis Fact Sheet**. October 1998.
201. WHO - World Health Organization Expanded Programme on Immunization (EPI). **Safety and efficacy of measles vaccine/vitamin A supplementation**. Wkly Epidemiol Rec 1997, 72(44):329-31
202. Yamagiwa, J; Mwanza, N; Spangenberg, A; Maruhashi, T; Yumoto, T; Fischer, A; Steinhauer-Burkart, B. **A census of the Eastern Lowland Gorillas (*Gorilla g. graueri*) in Kahuzi-Biega National Park with reference to Mountain Gorillas (*Gorilla g. beringei*) in the Virunga Region, Zaire**. Biological Conservation 1993, v.64, n.1,:83-89
203. Zuckerman AJ; Thornton A; Howard CR; Tsiquaye KN; Jones DM; Brambell MR. **Hepatitis B outbreak among chimpanzees at the London Zoo**. Lancet 1978, 2:652-4.

Appendix 2: Terms of Reference for the Consultancy

Consultancy to Assess Visitation Rules for Control of Disease Risk for Mountain Gorilla Tourism and Research in Uganda, Rwanda, and Congo

BACKGROUND:

The International Gorilla Conservation Programme's Uganda Project is a USAID-funded project which is assisting the Uganda Wildlife Authority to develop sustainable ecotourism programmes in Bwindi Impenetrable and Mgahinga Gorilla National Parks in Southwest Uganda. IGCP-Uganda is one component of a regional programme which also works in Rwanda and the Democratic Republic of Congo supporting park systems in which there are long histories of gorilla tourism, but which have been under recent threat from security crises in the area. Despite intensive efforts to diversify tourism in these areas, the current focus of tourist interest is on gorilla tourism and all three countries have been put under pressure to increase the exploitation of gorillas for tourism. This can come in the form of pressure to increase visitor numbers (i.e. more visitors per group, double visits, etc.) and/or to habituate additional groups of gorillas for tourism. At no time in history has the pressure been as high as it is now, due to the current security crisis in Rwanda and Congo leading to closure of tourism in Rwanda and unpredictable closures and security risks in Congo. This situation results in Uganda's two gorilla parks coming under increasing pressure for changes in tourism limits, as well as increasing attempts to bribe park officials to allow illegal visits in excess of the limits.

Up to the present time, it has been concluded that mountain gorilla habituation for tourism and research has had a positive impact on the conservation status of the mountain gorilla, and this conclusion has led to the expansion of gorilla tourism programmes in all three range countries. This conclusion has been based on observations since the inception of gorilla tourism in the Virunga Volcanoes in the late 1970's. Trends in monitored parameters have included an increase in population size and an increase in percentage of immature gorillas in habituated groups. Much of this success can be attributed to minimisation of poaching due to improved surveillance of gorillas during daily visits by rangers accompanying tourists and researchers. However, this success must be seen in conjunction with successful prevention and/or control of introduced diseases which would cancel out the surveillance benefits of habituation.

Gorilla tourism rules and regulations put in place in all three mountain gorilla range countries have a basis in minimising the negative impact of tourism on gorillas. The negative impacts to be minimised include behavioural disturbance, habitat destruction, and the introduction of disease. The latter is the focus of this consultancy.

GORILLA TOURISM RULES:

Gorillas are closely related to humans and, as such, are known to be susceptible to human diseases. By bringing tourists, porters, and park rangers into close proximity to gorillas, it is assumed that this increases risk of human disease transmission. Regulations have been developed to attempt to control this risk by:

a) *limiting the numbers of people who visit the gorillas (recommended limit = 6 tourists / day + 2-3 guides/rangers);
b) *limiting the amount of time these people spend near the gorillas (recommended limit = one hour);
c) *preventing visitors from approaching gorillas at a distance closer than 5 metres/15 feet;
d) *preventing access by children (recommended minimum age limit = 15 years);
e) preventing access by people who are known to be ill;
f) preventing deposition of rubbish and other infectious waste within gorilla habitat;
g) a number of other health rules regarding behaviour while visitors are near the gorillas, controlling behaviours such as smoking, eating, sneezing, and coughing.

Among the above regulations, the four items marked with an asterisk* are the original recommended limits that were developed based on epidemiological risk factors. The assumption is that increasing exposure (by increasing numbers and time, and decreasing distance and age of visitor) leads to increased risk of disease transmission. In all four cases, the actual limits recommended have been presented as informed estimates of reasonable risk. Therefore, up to the present, the limits on visitation have been relatively unchallenged until recent times, with the following exceptions:

a) original tourist limits of 6 visitors a day were increased to 8 in Rwanda and Congo ~ 1989.
b) corruption of tourism personnel leading to violation of limits on numbers of visitors each day, either in over 6 (or 8) tourists per group, or more than one group a day.
c) researchers spend more than the one-hour tourist limit near the gorillas
d) researchers often come in closer proximity to gorillas than the recommended 5 metre distance.

With recent intense pressure on the management of the national parks to increase tourism numbers, the rules and limits imposed on gorilla tourism have come under increasing scrutiny. They have been judged by those who would like to increase gorilla tourism to be "arbitrary" limits without concrete scientific justification. This judgement is understandable, given that in reality the actual numbers are arbitrary, but based on the premise that a lower limit minimises risk, so a fixed number must be chosen. In addition, a low limit recognises that in certain cases the limits will be violated and attempts to provide a conservative limit that will not lead to excessive risk if moderately violated (i.e. a 13 year old child visits, or a seventh or eighth person is let in very occasionally).

Gorillas are also visited by researchers, who attempt to follow limits, although distance and time limits are not followed. However, quarantine is possible before a new researcher visits the gorillas as they are generally in country for a much longer period of time than tourists. Park and research staff/rangers who visit the gorillas are also a risk. Health monitoring programs have been attempted but are not yet adequate.

Assessing the rules

As IGCP is currently developing gorilla tourism in Uganda, and continuing to support it in Rwanda and Congo, we feel that an assessment of tourism rules and regulations is essential. Such an assessment will be a useful, even necessary, tool to support the long-term control of gorilla tourism in Uganda. With French translation, it has added benefit to our sister programmes in Rwanda and Congo.

The consultancy will build on the results of previous research on habituation risks and will go further to critically scrutinise visitation limits as to their credibility with respect to current human medical knowledge of the specific types of diseases of concern, which are assumed to be primarily respiratory diseases, but will include other diseases with a significant potential for transmission from visitor to gorilla.

The consultancy will have one very specific output. The output will be the production of a management-oriented document targeted at the protected area authorities in the three countries that manage gorilla tourism. The current tourism rules and regulations, that have been termed "arbitrary" and have been criticised for being too conservative, will receive a critical assessment that addresses these concerns and makes recommendations on modifications if necessary.

The consultancy will be carried out by a human health professional with access to reference material and expertise in the human infectious disease field. The focus should not only be on the more dramatic viral diseases, as one of the most important considerations when dealing with healthy international tourists is simply the common viral and bacterial diseases, like the common cold and flu.

The added risk from local human populations, park staff, etc. should be addressed, as the exposure factors and infectious agents in question are different, but this is to be the focus of the Tabor initiative as it involves much more localised research in the field) }}

Specific Terms of the Consultancy:

- Examination of the currently recommended rules and regulations for gorilla tourism
- Wide-based medical literature review
  - A. human disease transmission
  - B. sneeze particle physics?
  - C. tourist-related diseases - air travel risks etc..
  - D. colds and flu
  - E. parasitic diseases
- Review of management literature for the protected areas
  - F. Management plans
  - G. IGCP Tourism Development plan
- Consultation with human infectious disease specialists.
- Consultation with guides and tourists at the different parks and Field Veterinarians, Wardens, Managers, and Coordinators with the different organizations involved in mountain gorilla tourism and research (Mountain Gorilla Veterinary Project, Mountain Gorilla Veterinary Centre, International Gorilla Conservation Programme, Karisoke Research Center, Institute for Tropical Forest Conservation, Uganda Wildlife Authority).

1. The following are the expected outputs of the consultancy:

- Assessment of the current rules and regulations with respect to human epidemiologial knowledge on disease transmission.
- Production of a management-orientated document targeted at the protected area authorities in the three countries that manage gorilla tourism based on the critical assessment of the current rules and regulations, and outlining recommendations on modifications if necessary.

2. Specifically, the outputs will include:

- Examination of the currently recommended rules and regulations for gorilla tourism
- Review of management literature for the protected areas
- Consultation with human infectious disease specialists
- Consultation with field people

Appendix 3: List of People Consulted

List of persons / organisations contacted by email:

- **Ray Ashton**, Executive Director, Ashton, Ashton & Assoc. Inc.
  Email: <Tortfarm2@aol.com>
- **Conrad Aveling**, Coordinator, Ecosystèmes Forestiers d'Afrique Centrale (ECOFAC)
  B.P. 15115, Libreville, Gabon
  Tel: +241-73 23 43/4, fax: +241-73 23 45 - E-mail: <ecofac.coord@internetgabon.com>
- **John Bosco Nizeyi**, DVM, Mgahinga Gorilla National Park & Wildlife and Animal Resources Management (WARM) Department, Faculty of Veterinary Medicine, Makerere University
  Box 7062, Kampala, Uganda
  Tel: +256-41-534061, Fax: +256-41-530412. Email: <warm@uga.healthnet.org>
- **Thomas M. Butynski,** PhD, Senior Conservation Biologist
  Vice-Chair, Africa Section, IUCN/SSC Primate Specialist Group
  Zoo Atlanta, P.O. Box 24434, Nairobi, Kenya
  Tel: +254-2-884369; fax: +254-2-890615 - E-mail: < Butynski@thorntree.com>
- **Kenneth Cameron**, DVM, Field Director**,**
  Mountain Gorilla Veterinary Project, B.P. 1321, Kigali, Rwanda
  Phone/fax: +250-74315 - Email: <gorvet@rwandatel1.rwanda1.com> or <gorvetctr@aol.com>
- **Mark Campbell**, DVM, Director, Veterinary Services, Cincinnati Zoo and Botanical Gardens
  3400 Vine Street, Cincinnati, Ohio 45220, USA
  Tel: +1 (513) 559-7751 - Fax: +1 (513) 559-7773 - Email: <hospital@cincyzoo.org>
- **Mike Cranfield,** Director, Mountain Gorilla Veterinary Project
  Morris Animal Foundation, Baltimore Zoo, USA
  Email: < mrcranfi@mail.bcpl.lib.md.us>
- **Nancy Czekala,**
  Email: <czekala@sunstroke.sdsu.edu>
- **Jennifer Coyle**, Assistant Editor, Sierra Club, San Francisco, CA, USA
  Email: <jenny.coyle@sfsierra.sierraclub.org>
- **Diane Doran,** PhD. Associate Professor, Department of Anthropology
  SUNY at Stony Brook, Stony Brook, NY 11794
  Tel: +1 (516) 632-9445 - Fax: +1 (516) 632-9165 - Email: <ddoran@mail.som.sunysb.edu>
- **Annabel Falcon**, Technical Support Officer**,** International Gorilla Conservation Programme/Uganda
  Box 10950, Kampala, Uganda.
  Tel/fax: 256-41-235824 - E-mail: <igcp@imul.com>
- **Michele L. Goldsmith**, Asst. Professor, Centre for Animals and Public Policy
  Dept. of Environmental and Population Health, Tufts University School of Veterinary Medicine
  200 Westboro Road, N. Grafton, MA 01536, USA
  Tel: +1 (508)-887-7708, fax: +1 (508)-839-3337 - Email: <mgoldsmith@infonet.tufts.edu>
- **Jane Goodall,** Director, The Jane Goodall Institute, PO Box 559, Ridgefield, CT 06877,, USA
  Tel: +1 (203) 431-2099; Fax: +1 (203) 431-4387 or (301) 565-3188
- **The Gorilla Foundation,**
  Box 620-530, Woodside, CA 94062, USA
  Tel: +1 (650) 851’8505 - Fax: +1 (650) 851-0291, Email : <hellobaw@aol.com>, Web: www.gorilla.org
- **José Kalpers**, Regional Technical Adviser, International Gorilla Conservation Programme
  P.O.Box 48177, Nairobi, Kenya
  Fax. +254 (2) 710 372 - +32 (4) 355 13 54 - Email : <JKalpers@compuserve.com>
- **Adonia Bintoora Kamugasha**, Community Conservation Warden, Mgahinga Gorilla National Park
  Box 124, Kisoro, Uganda
- **William B. Karesh**, DVM., Department Head, Field Veterinary Program
  Wildlife Conservation Society, 185th and Southern Blvd., Bronx, NY 10460
  Phone: +1 (718) 220-5892, Fax: +1 (718) 220-7126 - Email: <wkaresh@wcs.org>
- **Annette Lanjouw**, Regional Coordinator, International Gorilla Conservation Programme
  c/o AWF, P.O.Box 48177, Nairobi, Kenya
  Tel: +254 (2) 710’367, Fax: +254 (2) 710’372 - Email: <alanjouw@awfke.org>
- **Carla Litchfield**, Lecturer, Psychology Department
  Flinders University of South Australia, Sturt Road, Bedford Park, S.A., Australia
  Phone: +61 (8) 85 567 367, Fax: +61 (8) 85 567 232, Email: <aclitch@terra.net.au>
- **Liz Macfie,** DVM**,** Veterinary Advisor, International Gorilla Conservation Programme
  PO Box 302, Watamu, Kenya
  Tel/Fax: 254-2-32015 - Email: phiz@africaonline.co.ke

List of persons contacted by email (continued):

- **Florence MAGLIOCCA,** "Ethologie, Evolution, Ecologie"
  UMR 6552, CNRS-Université de Rennes 1, Station Biologique, 35380 Paimpont, France
  Phone : 02.99.61.81.55, fax : 02.99.61.81.88 - Email: <florence.magliocca@univ-rennes1.fr>
- **Rita McManamon**, DVM, Senior Veterinarian and Director of the Conservation Action Resource Center
  Zoo Atlanta, 800 Cherokee Avenue SE, Atlanta, GA 30315-1440, USA
  Tel: 1-404-624-5920, Fax: 1-404-624-5955 - Email: <ritamcm@mindspring.com>
- **Richard Malenky**, Project Executant, Support to Tropical Forest Conservation, WWF
  Box 44, Kabale, Uganda
  Fax: +(256) 486-24122; Email: <mbifct@imul.com>
- **Alastair McNeilage**, PhD, Research Ecologist
  Wildlife Conservation Society, 185th and Southern Blvd., Bronx, NY 10460
  Email: <Mcneilage@aol.com> or <igcp@imul.com>
- **Ellen Messner**, DVM, International Programs and the Center for Conservation Medicine
  Tufts University Veterinary School, 200 Westboro Rd, North Grafton, MA 01536, USA
  Tel: +1 (508) 839-5395 ext 84755, fax: +1 (508) 839-7946 - Email: <emessner@infonet.tufts.edu>
- **Philip S. Miller**, PhD, Program Officer, Conservation Breeding Specialist Group (SSC/)
  IUCN, 12101 Johnny Cake Ridge Road, Apple Valley, MN 55124-8151, USA
  Phone: +1 (612) 431-9325, Fax: +1 (612) 432-2757, E-mail: <pmiller@cbsg.org>, <office@cbsg.org>
- **Tony Mudakikwa,** DVM,
  Mountain Gorilla Veterinary Project, B.P. 1321, Kigali, Rwanda
  Phone/fax: +250-74315 - Email: <gorvet@rwandatel1.rwanda1.com> or <gorvetctr@aol.com>
- **Graham Reid**, PhD, IDRC/EHIP Project Manager
  Tanzania Essential Health Interventions Project, P.O.Box 78487, Dar es Salaam, Tanzania
  Phone (mobile): +255 811 321 671 - E-mail: <greid.tehip@twiga.com>, <kasale.tehip@twiga.com>
- **Ulie Seal,** Chairman, Conservation Breeding Specialist Group
- **Jonathan Sleeman,** MRCVS
- **H. Dieter Steklis**, Professor of Anthropology, Rutgers University, New Brunswick, NJ, USA
  Director, Science and Conservation Program, The Dian Fossey Gorilla Fund International, Atlanta, GA, USA
  Tel: +1 (732) 932-9351 (Rutgers), Fax: (520) 455-5892 - Email: < MntGorilla@aol.com>, <science@gorillafund.org>
- **Gary Tabor,** Director, Center for Conservation Medicine
  Tufts University Veterinary School, 200 Westboro Rd, North Grafton, MA 01536, USA
  Tel: +1 (508) 839-5395 ext 84755, fax: +1 (508) 839-7946 - Email: < TaborGM@aol.com>
- **Amy Vedder,** Director, Africa Program
  Wildlife Conservation Society, 2300 Southern Blvd., Bronx, NY 10460
  Phone: +1 (718) 220-5892, Fax1(718) 364-4275- Email: <avedder@wcs.org>
- **Raymund F. Wack**, DVM, Dipl ACZM, Director of Animal Health
  Columbus Zoo, PO Box 400 Powell OH 43065,
  Tel: +1 (614) 645-3414. Fax: +1 (614) 645-3564, Email: <wack.1@osu.edu>
- **Janette Wallis**, PhD, Department of Psychiatry & Behavioral Sciences
  University of Oklahoma Health Sciences Center, P.O.Box 26901, Oklahoma City, Oklahoma 73190, USA
  Phone: +1 (405) 271-5251 ext. 47612; Fax: +1 (405) 271-3808 - E-mail: <janette-wallis@ouhsc.edu>
- **Liz Williamson**, PhD, Director, Karisoke Research Center,
  Dian Fossey Gorilla Fund, P.O.Box 1321, Kigali, Rwanda
  Tel/Fax: +250 - 74315; Email: <DFGF-RWANDA@maf.org>
- **Samson Werikhe,** Deputy Programme Manager
  International Gorilla Conservation Programme, Box 10950, Kampala, Uganda.
  Tel/fax: +256-41-235824 - E-mail: igcp@imul.com
- **Mary E. Wilson**, MD, Assistant Professor of Population and International Health Epidemiology, Harvard School of Public Health, and Chief of Infectious Diseases, Mount Auburn Hospital
  330 Mt. Auburn St, Cambridge, MA 02238 USA
  Tel: +1 (617) 499 55026; Fax: +1 (617) 499 5453 - Email: <Mary_wilson@harvard.edu>
- **Richard Wrangham**, Professor of Anthropology
  Dept of Anthropology, Harvard University, Boston, MA , USA
  Phone: +1 (617) 495-5948 (office), Fax: +1 (617) 496-8041, Email: <wrangham@fas.harvard.edu>
- **Juichi Yamagiwa**, Associate Professor, Laboratory of Human Evolution Studies
  Faculty of Science, Kyoto University, Sakyo, Kyoto, 606-8502, Japan
  Tel: 81-75-753-4108 Fax: 81-75-753-4098 - E-mail: <yamagiwa@jinrui.zool.kyoto-u.ac.jp>
- **Jeffery R. Zuba**, DVM, Staff Veterinarian, San Diego Wild Animal Park, Zoological Society of San Diego
  15500 San Pasqual Valley Road - Escondido, CA 92027, USA
  Phone: +1 (760) 735-5504 - Fax: +1 (760) 747-3168 - Email: <jzuba@sandiegozoo.org>

List of guides, trackers and rangers who answered the guide questionnaire (*year when hired*):

BINP/MGNP - Uganda

1. **Benjamin Byamugisha**, Ranger Guide, MGNP, 1992
2. **Gakwerere Denis,** Ranger Patrol, MGNP, 1993
3. **Hanyurwa Sheba**, Park Ranger, MGNP, 1989
4. **Kajambere Mathew,** Ranger Patrol, MGNP, 1993
5. **Mugisha Emmanuel,** Ranger Guide, MGNP, 1992
6. **Mutabazi Didas,** Ranger Guide, MGNP, 1992
7. **Ndayakunze Sunday,** Guide in charge, MGNP, 1992
8. **Ntibiringirwa Joseph,** Ranger Patrol, MGNP, 1997
9. **Opio Charles,** Ranger Patrol, MGNP, 1996
10. **Taban Shaban,** Ranger Guide, MGNP, 1992
11. **Tumusiime Benson,** Ranger Guide, MGNP, 1994
12. **Twinomujumi Alfred**, Bird Guide, BINP, 1994
13. **Vumiriya Phenny Gongo**, Head Guide, BINP, 1992

PNV - Rwanda

14. **Bigirimana Antoine**, Guide, PNV, 1996
15. **Bigirimana François**, Guide, PNV, 1984
16. **Mudaherannya Mihingano**, Guide, PNV, 1995
17. **Muhinzi Alphonse,** Guide, PNV, 1995
18. **Nkanika Jean**, Guide, PNV, 1996
19. **Nteziryayo Vincent,** Guide, PNV, 1996
20. **Nzamurambaho Augustin,** Guide, PNV, 1995
21. **Serunhungo Claude,** Driver, PNV, 1986

List of persons interviewed:

- **Dr Pat Conrad,** Professor of Parasitology, Department of Pathology, Microbiology and Immunology
  School of Veterinary Medicine, University of California, Davis, CA 95616, USA
  Phone: +1 (530) 752-7210 - Email: < paconrad@ucdavis.edu >
- **Dr Nancy Cox**, Chief, Influenza Branch
  Center for Disease Control, Atlanta, GA, USA
  Phone: +1 (404) 639-3591
- **Dr Kirsten Gilardi**, DVM
  University of California, Davis, CA 95616, USA
  Phone: +1 (530) 752-4896, Fax: +1 (530) 752-3318 - Email: <kvgilardi@ucdavis.edu>
- **Dr Gladys Kalema**, DVM, Veterinarian, Uganda Wildlife Authority
  Box ...., Kampala, Uganda
  Tel: +256 (41) , Fax: +256 (41) - Email: <gkalema@starcom.co.ug>
- **Alexander H. Harcourt**, Professor
  Dept. of Anthropology, University of California, Davis, CA 95616, USA
  Tel: +1 (530) 752 0670; Fax: +1 (530) 752 8885; E-mail: <ahharcourt@ucdavis.edu>
- **Alan Hay**, Director, WHO Influenza Centre, National Institute of Medical Research
  Medical Research Council, The Ridgeway, Mill Hill, London, NW7 1AA, UK
  Phone: +44 (181) 959 3666 - Email: <ahay@nimr.mrc.ac.uk>
- **Daniel Lavanchy**, Chief, Viral Diseases, Emerging & Communicable Diseases
  WHO, 20 Avenue Appia, 1211 Geneva 27, Switzerland
  Phone: +41 (22) 791-2656/2850 - Email: <lavanchyd@who.int>
- **Nick Lerche**, DVM, MPVM, Associate Adjunct Professor, Virology and Immunology Unit
  California Regional Primate Research Center, University of California, Davis, CA 95616, USA
  Phone: +1 (530) 752- 6490, Email: <nwlerche@ucdavis.edu>
- **Jay A. Levy**, Professor of Medicine
  Cancer Research Institute, University of California, San Francisco, CA 94143, USA
  Phone: +1 (415) 476-4071, Fax: +1 (415) 476-40, E-mail:
- **Linda J. Lowenstine**, DVM, PhD, dip ACVP, Professor of Veterinary Pathology
  Veterinary Medicine: Pathology, Microbiology and Immunology
  1062 Haring Hall, One Shields Ave, University of California, Davis, CA 95616, USA
  Phone: +1 (530) 752-1182 Fax: +1 (530) 752-3349 - E-mail: <ljlowenstine@ucdavis.edu>
- **Jeff Roberts**, DVM, Assistant Director, California Regional Primate Research Center
  ,University of California, Davis, CA 95616, USA
  Phone: +1 (530) 752-3670, Email: <jaroberts@ucdavis.edu>
- **Kelly Stewart,** Research Associate. Dept. of Anthropology
  University of California, Davis, CA 95616, USA
  Tel: +1 (530) 752 0670; Fax: +1 (530) 752 8885; Email: < kjstewart@ucdavis.edu>
- **Dr Robert Webster**, Chairman, Department of Virology & Molecular Biology
  St Jude Children's Research Hospital, Memphis, TN 38101-0318, USA
  Phone: +1 (901) 495-3400 - Fax: +1 (901) 523-2622 - Email: <robert.webster@stjude.org>

Appendix 4: Information & Opinion Survey Questionnaire–General Version

<u>Mountain Gorilla Tracking Rules Review Questionnaire</u> **Appendix 3**

This questionnaire is to inform a review to assess the effectiveness of tourism rules in minimizing health risks to wild mountain gorillas in Africa, with the ultimate goal of developing a sustainable tourism programme, both at the national and the regional levels. This review concerns the rules for gorilla visits in the 4 parks of the Great Lakes region of Eastern/Central Africa, namely Bwindi and Mgahinga National Parks in Uganda, the Parc National des Volcans in Rwanda, and the Parc National des Virungas in the DR of Congo.. These parks harbor in total a mountain gorilla population of about 650 individuals of which 184 have been or are being habituated. Together they can receive up to 40,000 visitors a year (at 100% capacity), not counting guides, rangers, trackers, and researchers, who can add up to over 2,000 person-hours of exposure a year for each habituated gorilla research group and 700 person-hours a year for each tourist group.

Thank you for taking the time to answer these questions to the best of your knowledge. Please don't hesitate to add as many lines as you need for your answers. We'd appreciate your answering all questions that are in your area of expertise and/or that you feel comfortable or concerned with. Feel free to skip those you don't think you should answer.

1□ Do you know of morbidity/mortality cases of captive/wild gorillas caused by human diseases? (Please list data/evidence to the best of your knowledge)

Year (month?)	Environment (captive/wild)	Approx. age of gorilla (infant/ juvenile/adult)	Event and cause (suspected, confirmed, method)	Intervention and outcome (Rx/survived/died)

…..

2□ What are the human diseases great apes are most susceptible to in the environment you're most familiar with ?
Captive:

Wild:

3□ How would you rank the risk of tourist-borne human diseases among the various threats to the survival of wild gorillas or other apes in managed parks ? (please check appropriate rank with an X)

- highest risk
- medium risk
- lowest risk

4□ The current gorilla tracking rules are listed below followed by a corresponding check list. In view of your current knowledge regarding the risk of human diseases, do you think these are adequate, inadequate or excessive to reduce the exposure of wild habituated animals to human diseases and if inadequate or excessive, would you have any suggestions for modifying or amending them ?

- a□ no of tourists per visit — 6 in Uganda, 8 in Rwanda and Congo
- b□ no of visits per day — 1 per group
- c□ duration of visit — 1 hr
- d□ minimum distance — 5m
- e□ age restriction — 15
- f□ human waste — tourists are supposed to dig a 1 foot deep hole before defecating
- g□ eating — picnic taken with guides in park right before or after gorilla viewing
- h□ health — tourists self-reporting sickness are entitled to a refund or another visit; tourists failing to self report and excluded upon guide's decision lose their tracking permit
- i□ trash — to be carried out of park by tourists and/or guides

Please check whichever applies (X):

Adequate	Inadequate	Excessive	Suggestions
a)			
b)			
c)			
d)			
e)			
f)			
g)			
h)			
i)			

6. To your knowledge, has any of the following alternatives for protecting animals from tourist diseases been considered and what is your opinion about them ?

I. Wear of protective devices (gloves, masks, etc) at time of viewing
II. Obligatory washing of hands and disinfection of boots before start of visit
III. Fencing visitor center off to keep animals from roaming in or around tourist settlements
IV. Carrying feces out of park in plastic bags
V. Testing of park guides, rangers and researchers for TB and immunization against measles

1. How appropriate and feasible would it be in your view to immunize habituated gorilla groups ? Would you support such an intervention ? If so, how would you go about it ?

2. In your view, is the present population of mountain gorillas (currently estimated at ~ twice 300) a biologically viable one ?

3. How serious is the risk of *gorilla to human* disease transmission ? Do you know of any evidence, data available ?

4. In your view, is the risk of zoonosis, if any, covered by current tracking rules ? If no, what should be done ?

5. What do you think of increasing both awareness and visibility of the threat of human diseases to the survival of apes among eco-tourism players and promoting this issue as a marketing strategy to strengthen enforcement and respect of visit rules ?

6. Any other suggestions regarding the rules and their enforcement?

7. Do you know of, or are you involved in any plan, proposal or project to evaluate/study/research the management, prevention, impact of human diseases on gorilla survival, or any other aspect related to it? If so, can you please identify the project location, and is it possible to have a summary of the objectives, strategy and time line ?

- *Do you mind if I contact you again for any other question I may have for this review ?*
- *Please indicate your full title, position, affiliation, complete contacts, incl tel/fax, email, etc*
- *Please indicate if you don't want to be quoted by name in the final evaluation report*

Thank you very much for having taken the time to answer these questions. We sincerely hope this information will help establish better rules and gather innovative ideas for their respect and enforcement

Appendix 5: Information & Opinion Survey Questionnaire–Guide Version

Mountain Gorilla Tracking Rules Review Questionnaire
Guides, Rangers and Trackers

At the upcoming January meeting in Kigali, one of the points on the agenda is to hold a discussion on the review of tourism rules for gorilla tracking, in order to help us develop a sustainable tourism programme, both at the national and the regional levels. This review concerns the rules for gorilla visits in the 4 parks of the Great Lakes region of Eastern/Central Africa, namely Bwindi and Mgahinga National Parks in Uganda, in Volcanoes National Park in Rwanda and in Virungas National Park in Congo.

As it is very important that everyone's views are represented in this discussion, we would like to ask you a few questions that we could use to represent the opinion and ideas of guides, rangers and trackers, who are the people in most regular contact with the gorillas. We therefore would be very grateful if you could take the time to answer these questions to the best of your knowledge. If there are questions you don't feel comfortable or concerned with, feel free to skip them, but please write 'don't know' or whatever you feel could explain why you don't answer. Please, this is NOT a test or an exam at all ! We just want YOUR views on these questions because we think they could help us greatly in making the right decisions.

1. Could you please list below all the experiences you can remember of sick or dead gorillas in the park, the cause of the sickness or death as you know it, what was done (if anything) to the animal, and what finally happened to the animal in case of sickness.

When did it happen ? (year, month?)	Approx. age of gorilla (infant/ juvenile/adult)	What was the sickness ? Or what did the gorilla die of ? (please indicate who diagnosed the cause)	What was done to the animal after it was found sick or dead ?	What happened to the animal in the end ? (died? Survived?)

2. The current gorilla tracking rules as you know them are listed below followed by a corresponding table. In view of your experience as guide or tracker, we would like you to indicate in the table for each rule if you think they are adequate, inadequate or excessive to protect wild habituated gorillas? If inadequate or excessive, please write any suggestions you would have for modifying them ?

   a) no. of tourists per visit 6 in Uganda, 8 in Rwanda and Congo
   b) no. of visits per day 1 per group

c) duration of visit — 1 hr
d) minimum distance — 5m
e) age restriction — 15
f) human waste — tourists are supposed to dig a 1 foot deep hole before defecating
g) eating — picnic lunch taken with guides in park right before or after gorilla viewing
h) health — tourists self-reporting sickness are entitled to a refund or another visit; tourists failing to self report and excluded upon guide's decision lose their tracking permit
i) trash — to be carried out of park by tourists and/or guides

Please check with an 'X' whichever applies:

Rule	Adequate	Inadequate	Excessive	Suggestions
a)				
b)				
c)				
d)				
e)				
f)				
g)				
h)				
i)				

3. We would like to know your opinion on which are the greatest threats to the survival of mountain gorillas in the wild (both habituated and nom habituated). We have listed some of the main threats below but they are not listed by any order of importance. We would like you to tell us what you think is their order of importance by writing the number 1 next to what you think is the greatest threat, 2 next to the second greatest threat, and so on, up to the last one. If you think we have forgotten one important threat, please add it in the blank spaces and put the number you think it should have next to it.

- Wars and conflicts
- Loss of habitat
- Human diseases
- Poaching
- Crop raiding
- …
- …
- …
- …

4. We would like to build on your experience as park guide, ranger or tracker to make the rules as realistic and useful as possible. For this, we need to know if you have faced any problems in enforcing these rules with tourists, and if so, to describe what was/were the problem(s) and if and how you addressed the problem.
   - ☐ No problem
   - ☐ Problem

Nature of problem	Was the problem addressed ?	How was it addressed ?

5. Do you think great apes like gorillas or chimps can get contaminated by human diseases?

   ☐ Yes — If yes, which diseases do you think they are susceptible to?
   ☐ No

6. Do you think humans can contract diseases from gorillas or chimps? (please check ‘yes’ or ‘no’)

   ☐ Yes — If yes, which diseases do you think humans can get from gorillas or chimps ?
   ☐ No

7. Any other comments / suggestions regarding the rules and their enforcement?

Please indicate:

Your full name (optional):	Age	Gender	Your job title	The park you work in	Since when ?

Thank you very much for having taken the time to answer these questions. We sincerely hope this information will help establish better rules and gather innovative ideas for their respect and enforcement.