

# 16    Considering risks of pathogen transmission associated with primate-based tourism

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## Introduction

Sustainable, nature-based tourism should attempt to educate visitors about wildlife and the environment, while minimizing modification or degradation of the natural resources in the sites they visit. When possible, these activities should broadly benefit the social and natural environments by involving the participation of local communities (Ceballos-Lascuráin, 1996). And, if managed well, nature-based tourism should facilitate species conservation by raising the needed funds for wildlife and habitat conservation, while increasing public awareness of conservation issues. Unfortunately, rapid and unmonitored development of tourism projects in protected areas can produce deleterious effects on the very species we wish to conserve. Such risks may include habitat degradation caused by pollution and environmentally damaging development of infrastructure; animal crowding into restricted areas; and the introduction of invasive species.

These issues take on special importance when the species in question are (non-human) primates. Most wild populations of primates are relatively small and their reproductive cycles are protracted (with low reproductive rates relative to most mammals of similar size), so they are particularly vulnerable to population decreases, including those that result from human activities. Humans have contributed to significant population declines of wild primates through hunting and bushmeat consumption, habitat loss and fragmentation, and illegal capture of live primates for entertainment or other purposes. Tourism activities involving primates in their native habitat (including free-living rehabilitants as well as their wild counterparts) could benefit primate conservation but we must remain diligent about monitoring potential negative consequences, especially since primate tourism has been increasing in popularity over the past few decades. For example, the habituation to human presence essential to primate tourism may increase the likelihood that these animals will raid crops, invade garbage pits, and break into vehicles or lodgings for food. They may also become more vulnerable to poaching as a result of their loss of fear, their natural diet and ranging may become permanently altered, and their normal social behaviors may become altered (e.g. the appearance of a group of tourists

may interrupt mating behaviors). Many of the chapters in this volume document these tourism impacts on the primates visited. Habituation could even lead to alterations in animal stress responses, possibly leading to immunosuppression with decreased reproductive success and increased susceptibility to infectious diseases (Muehlenbein, 2009; Muehlenbein *et al.*, 2012).

We focus this chapter on describing human pathogen transmission to primates, positioning the potential role of tourists in the spread of these pathogens, and discussing important steps toward minimizing the impact of tourist-borne diseases in the face of many roadblocks to success. A key feature of a successful primate tourism experience is visitor access to these popular species, and rewarding sightings often depend upon relatively close encounters, that is outside a vehicle. This makes zoonotic (nonhuman animal to human) and anthroponozoonotic (human to nonhuman animal) pathogen transmission of vital concern, particularly given the increasing demand from tourists to visit free-ranging primates.

## Pathogen transmission to nonhuman primates

Pathogen transmission from humans to nonhuman primates is arguably one of the most dangerous outcomes of human–wildlife interactions (see chapters by Sapolsky, Williamson & Macfie in this volume for additional details). Infectious organisms include thousands of species of viruses (and bacteriophages), bacteria (including rickettsiae), parasitic protozoa and helminthes (nematodes, cestodes, and trematodes), and fungi. These parasitic organisms live all or part of their lives in or on a host from which biological needs are derived. This state of metabolic dependence usually results in host energy loss, lowered survival, and reduced reproductive potential.

Several pathogen transmission events from human to nonhuman primate populations have been either suspected or confirmed to date. These outbreaks have affected nearly all major long-term chimpanzee and gorilla study populations, such as Bwindi, Mahale, Gombe, and others. Confirmed cases that have spread through some type of fecal–oral transmission include *Giardia duodenalis* in gorillas (Graczyk *et al.*, 2002a; Johnston *et al.*, 2010; Salzer *et al.*, 2007) and *E. coli* in chimpanzees (Goldberg *et al.*, 2007) and gorillas (Rwego *et al.*, 2008). Other highly suspected cases of intestinal pathogen transmission include several helminthes and protozoa in gorillas (Ashford *et al.*, 1990), *Schistosoma mansoni* in olive baboons (Mueller-Graf *et al.*, 1997), *Campylobacter* and *Salmonella* in gorillas (Nizeyi *et al.*, 2001), *Encephalitozoon* in gorillas (Graczyk *et al.*, 2002b), a variety of gram-negative bacteria in yellow baboons (Rolland *et al.*, 1985), and polio in chimpanzees (Goodall, 1986; Kortlandt, 1996).

Respiratory infections have long been suspected to be major causes of mortality in wild primates. Confirmed cases include: respiratory syncytial virus in chimpanzees (Köndgen *et al.*, 2008), metapneumovirus in chimpanzees (Kaur *et al.*, 2008; Köndgen *et al.*, 2008), and metapneumovirus in gorillas (Palacios *et al.*, 2011). Other

suspected cases include *Streptococcus pneumoniae* in chimpanzees (Chi *et al.*, 2007), *Pasteurella multocida* in chimpanzees (Chi *et al.*, 2007), influenza in chimpanzees (Hanamura *et al.*, 2008; Hosaka, 1995a, 1995b; Lukasik-Braum & Spelman, 2008; Nishida *et al.*, 2003; Wallis & Lee, 1999; Williams *et al.*, 2008), influenza in bonobos (Sakamaki *et al.*, 2009) and gorillas (Macfie, 1991; Sholley & Hastings, 1989), and measles in gorillas (Byers & Hastings, 1991; Ferber, 2000; Sholley, 1989). We also know from studies of captive primates that they can be very susceptible to tuberculosis (Burgos-Rodriquez, 2011).

Wild primates are also susceptible to a number of other pathogens. For example, Ebola virus infection has devastated several gorilla and chimpanzee populations in Gabon, Cameroon, and Democratic Republic of Congo over the past several decades (Huijbregts *et al.*, 2003; Leroy *et al.*, 2004). Scabies can cause significant morbidity in gorillas (Kalema-Zikusoka *et al.*, 2002; Macfie, 1996) and *Bacillus anthracis* has been particularly deadly in chimpanzees (Klee *et al.*, 2006; Leendertz *et al.*, 2006). Both herpesvirus type 1 and yellow fever can be very deadly in New World monkeys (Almeida *et al.*, 2012; Costa *et al.*, 2011). Tuberculosis can be fatal in wild primates, as evidenced by death of baboons that fed on contaminated meat at a tourist lodge garbage dump (Sapolsky, this volume).

Although human populations (particularly through environmental contamination) are suspected as the primary source of most of the above-mentioned cases in wild primates, the precise reservoirs or points of transmission for these pathogen “spill-overs” are unknown. The most likely sources of these transmission events have been local populations (including park personnel) or researchers (Muehlenbein & Ancrenaz, 2009; Wallis & Lee, 1999). There are no documented cases of pathogen transmission from tourists to wildlife, and this is quite understandable. It is difficult to confirm with complete certainty the origin of pathogen transmission events, particularly those involving indirect human contact. Pathogens spread during short-term visits by tourists would likely reveal themselves only after the tourist is gone, making it impossible to trace the exact source of infection. However, we contend that tourists should be considered a health risk to wildlife, particularly to primates whose immune systems are usually naïve to new human pathogens and who, because of the genetic similarity to humans, are particularly sensitive to many of our pathogens (Brack, 1987).

## The potential role of tourists in pathogen transmission

The relative contribution of tourists to the spread of pathogens to wildlife is unknown, but the number of tourists visiting wildlife areas worldwide has increased steadily over recent years. A major shortcoming of international travelers in general is their poor knowledge, attitudes, and practices about travel health (Hamer & Conner, 2004; Wilder-Smith *et al.*, 2004). Many travelers do not use pre-travel preventive health strategies, including physician advice and chemoprophylaxes (Crockett & Keystone, 2005; Van Herck *et al.*, 2003). Moreover,

traveler compliance to physician advice is surprisingly low, even with regard to avoiding dangerous food items such as salads, shellfish, and non-treated water (Steffen *et al.*, 2004). Many travelers do not understand the basic risks of infection, including their sources and causes (Van Herck *et al.*, 2004; Wilder-Smith *et al.*, 2004; Zuckerman & Steffen, 2000).

A significant proportion of travelers to tropical regions (where most primate-based tourism takes place) are not protected against vaccine-preventable illnesses (Lopez-Velez & Bayas, 2007; Prazuck *et al.*, 1998; Schunk *et al.*, 2001; Van Herck *et al.*, 2004). A majority of these travelers demonstrate poor recall of their actual vaccination status (Hamer & Connor, 2004), as verified by reference to vaccination certificates or serological testing (Hilton *et al.*, 1991; Toovey *et al.*, 2004; Van Herck *et al.*, 2004). Long-distance travelers may also be stressed due to sleep dysregulation, unfamiliar diets and climate, and exposure to novel pathogens, and this stress may make them even more susceptible to health problems. Although some aircraft are designed to circulate cabin airflow to minimize disease transmission, travelers may contract respiratory disease during long flights. Moreover, once in a country, tourists may find themselves traveling in close proximity to others on buses, trains, boats, and other local transport. Consequently, illness during travel is very common, particularly gastrointestinal and respiratory infections (Rack *et al.*, 2005).

Like most other travelers, the majority of tourists that visit primates in their native habitat (which may include both wild and rehabilitated/released but not zoo-living individuals) probably underestimate their own risk of infection, as well as their potential contribution to the spread of diseases. Even conservation-oriented tourists who select travel itineraries that take them to view endangered species may be largely unaware of their potential impact on the health of the wildlife they visit.

Risk of pathogen transmission at primate-based tourism destinations varies with a number of factors, including the species visited, frequency of sightings, degree of proximity, possibility of contact, use of legal or illegal provisioning, and the behavior and infection status of tourists. Thus, as proximity, contact, and food sharing between humans and nonhuman primates vary by location (Fuentes, 2006), risk of pathogen transmission also varies from site to site.

### **Case study: Tourists at the Sepilok Orangutan Rehabilitation Centre**

Here we describe a study by M. Muehlenbein and colleagues that illustrates tourist attitudes and behaviors at a large primate tourism destination, the Sepilok Orangutan Rehabilitation Centre (SORC) in the Malaysian state of Sabah in northern Borneo. Operated by the Sabah Wildlife Department, SORC was established in 1964 as a center for the rehabilitation of orphaned, injured, and/or confiscated orangutans (*Pongo pygmaeus morio*) and other endangered species. Following a six-month quarantine period, orangutans are helped to learn how to navigate the forest, forage for food, and live within an orangutan community. Following rehabilitation and health inspections, the orangutans are eventually released into the adjacent Kabili Virgin Jungle Reserve, the Tabin Wildlife Reserve, or other locations.

To facilitate public education and generate operational funds, the public is allowed to view two daily feedings of the free-ranging orangutans. A multilingual information sign indicates that smoking, eating, and spitting are not allowed; that visitors should keep their distance from the orangutans and macaques; that visitors should not bring medications, bags, or insect repellent; and other miscellaneous information. Park rangers are present during orangutan feedings, and the visitor viewing area is separated from the actual feeding platforms by approximately 10 m. Although tourist visits tend to be relatively short (approximately 30 minutes), the number of tourists at any given feeding is not restricted. In recent years, approximately 100 000 visitors attended these feedings annually (Ambu, 2007). The orangutans and macaques that surround Sepilok exhibit much terrestrial activity and proximity to humans, and direct contact between tourists and orangutan or macaque populations does happen occasionally.

To understand better the risks of anthroponozoonotic pathogen transmission from tourists to Sepilok's orangutans and macaques, a team led by M. Muehlenbein began surveying tourists at SORC. In 2007, 633 visitors at SORC completed a detailed survey regarding travel health and nature-based tourism. A little more than half of the respondents reported having current vaccinations against tuberculosis, hepatitis A, hepatitis B, polio, and measles (Muehlenbein *et al.*, 2008). Despite the fact that the majority of visitors to SORC are from temperate regions where influenza is more prevalent, 67.1% of those surveyed *with medical-related occupations* (and so some formal training in infection risks) reported not being currently vaccinated for influenza (Muehlenbein *et al.*, 2008). Such results lend support to the recommendation of requiring all visitors to present standardized vaccination certificates at wildlife tourism locations, particularly those with primates. However, routine, required, and recommended vaccines vary between countries and by age and health status of the recipient. And because vaccination certifications are not usually standardized between countries, it is difficult to accurately ascertain current immune status for most travelers. Despite these difficulties, travelers should be urged to examine their actual vaccination status prior to traveling, and update it in consideration of the wildlife species they plan to visit.

In 2007, 15% of tourists surveyed at SORC self-reported at least one of the following current symptoms: cough, sore throat, congestion, fever, diarrhea, and vomiting (Muehlenbein *et al.*, 2010). Those participants reporting recent animal contact (e.g. livestock, wildlife at other sanctuaries, unfamiliar domestic pets) were more likely to report current respiratory symptoms compared with individuals with no such animal contact. Such results highlight the fact that currently ill and potentially infectious tourists still visit wildlife sanctuaries, creating a risk of direct pathogen transmission to the primates they come to visit as well as to local human inhabitants and staff, which the latter could in turn spread to the primates. Some tourists may ignore such risks, whereas most (we suspect) are unaware or uninformed about such risks prior to travel. They not only underestimate their potential contribution to the spread of disease, but also underestimate their own risk of acquiring infection.

An additional 650 tourist surveys were obtained in 2009 at SORC. Of the respondents, 48% had visited other countries to specifically view monkeys or apes. Only 11% of these were made aware of health regulations at their destinations, and only 5.7% thought that such health regulations were enforced (Muehlenbein *et al.*, unpublished data). Despite the fact that 96% of respondents believed humans can give diseases to wild animals, 35% of these respondents reported that they would try to touch a wild primate if they had the opportunity. If tourism and conservation professionals are to prevent disease transmission, then we must find effective ways to educate tourists about their risky behaviors.

### Recommendations for disease prevention and future research

We agree with the recently published IUCN Best Practice Guidelines for Great Ape Tourism (Macfie & Williamson, 2010). Some of their key recommendations for preventing disease transmission to great apes through tourism include minimum participant ages and viewing distances, with maximum visit durations and group sizes. Visitors are usually required to report voluntarily any current illnesses. Human feces must be adequately buried, and littering, smoking, eating, flash photography, feeding or touching great apes, coughing, spitting or nose blowing are not permitted. Other recommendations include the use of disposable face masks (see Figure 16.1) and gloves; mandatory hand washing and shoe disinfection before and after visiting great apes; medical screening of tourists; and required current vaccinations. Park personnel and surrounding local populations should be educated about disease risks, and efforts should be made to provide for adequate healthcare for park personnel, including vaccinations.

There is no doubt that adoption of many of these recommendations will require extensive resources for materials, personnel, and infrastructure. Risk assessment at different locations must be increased if we are to identify what precautions are most effective in preventing pathogen transmission from tourists to primates. Costs of implementing such monitoring and intensification of regulations may reduce immediate revenue, but may increase the long-term availability of healthy primates. It is understandable that many tourists will be inconvenienced by such regulations, having spent a large amount of money to travel to exotic destinations to view wildlife. Yet tourist lack of knowledge over issues such as disease prevention cannot be justified. We cannot risk the lives of the last remaining wild primates when we know that preventive measures could protect them. Of course, additional research is necessary to quantify and document actual disease risks, but this cannot stop us from implementing more strict regulations at primate tourism destinations now. Experts have been discussing such issues for years, yet little has changed since the seminal report by Homsy (1999) detailing unacceptably high disease risks.

Central to minimizing the costs of primate-based tourism is increased education of tourists. While several organizations (e.g. World Conservation Union, The International Ecotourism Society, Convention on Biological Diversity, Conservation





**Figure 16.1** Face masks are provided to visitors at several wildlife sanctuaries, such as Ngamba Island Chimpanzee Sanctuary, Entebbe, Uganda. However, tourists may not always wear masks properly (incorrect use observed here). (Photograph by Michael Muehlenbein.)

International, the Cooperative Research Centre for Sustainable Tourism, the World Tourism Organization, the United Nations Environment Programme) provide some basic guidelines for nature tour operators, including how to minimize visitor impacts on the environment through proper behavior in the field, specific health-related behaviors are not emphasized. Such information is also not usually available on commercial travel websites (Horvath *et al.*, 2003). Tourists must be informed better about health risks before they enter wildlife parks. Improved tourist brochures and informational videos will be useful, and risks of zoonoses and anthroozoonoses should be part of information readily available to tourists before they begin traveling. The relative absence of detailed, yet accessible information regarding the justification for such regulations may be one reason why tourists often violate the rules at some primate tourism destinations (Sandbrook & Semple, 2006). Park personnel, tour operators, hoteliers, and surrounding community members must also be informed about the justifications for rules, be empowered to enforce the rules, and be rewarded when they do so.

Throughout this process, we must be cautious not to give the impression that wildlife health is more important than human health (Wallis & Lee, 1999). Such an attitude can lead to a bad relationship between researchers and local populations, which could lead to negative consequences for primate conservation in general. In addition, we must avoid causing alarm. Engendering fear of wildlife and their potential zoonotic diseases will not facilitate the much-needed support from local



**Figure 16.2** Visitors are allowed to feed wild monkeys at several places throughout the world. Despite the fact that feeding Japanese macaques (*Macaca fuscata*) is only permitted through a wire barrier at Arashiyama, Kyoto, Japan, this practice perpetuates the view that close proximity and direct contact with primates are acceptable, even encouraged, and thereby increases risks of disease transmission. (Photograph by Michael Muehlenbein.)

human populations. Still the public must be educated about the risks of anthro-zoonoses as well as zoonoses. Over half of all human infections are zoonotic in origin (Woolhouse & Gaunt, 2007) and several pathogens have been transmitted from nonhuman primates to humans. These include malaria (*Plasmodium knowlesi*; Cox-Singh & Singh, 2008), Cercopithecine herpesvirus 1 (B virus) (Huff & Barry, 2003), and several retroviruses like simian foamy virus, simian T-lymphotropic virus, and simian immunodeficiency virus (Gao *et al.* 1999; Jones-Engel *et al.* 2008; Santiago *et al.*, 2005; Van Heuverswyn *et al.*, 2006).

Despite the fact that many people may realize the potential for pathogen transmission between humans and primates, our affinity for gaining close proximity with primates often makes us behave irresponsibly at tourist destinations. What makes a tourist participate in risky behaviors? One likely factor is their experience viewing others doing the same thing. We see hundreds of photographs on the internet showing people holding or feeding wild primates. Unfortunately, many





**Figure 16.3** Up-close visits between tourists and monkeys (*Macaca sylvanus* pictured here) are even available in Europe, for example at Trentham Monkey Forest, Staffordshire, England. In this situation, tourist and monkey behaviors are monitored by staff. While such experiences may foster our affection for these monkeys, allowing affection to take priority over visitor and wildlife health effectively undermines the behavioral precautions established to protect against zoonoses and anthroponoses. (Photograph by Michael Muehlenbein.)

professional primatologists are guilty of this as well, often with their own websites or books picturing themselves making physical contact with these animals (including embracing, holding hands, and allowing primates to crawl on them). This is irresponsible behavior by scientists who, of all people, should know the risks of disease transmission and the harm in setting a bad example. Famous actors are portrayed in documentaries caring for orphaned primates, further suggesting that close contact is acceptable and something to admire. Indeed, there are several sites in Mexico, Belize, Costa Rica, Honduras, Panama, and other locations where a tourist can hold a monkey, and close proximity is permissible at many locations in Europe, Indonesia, China, Uganda, and South Africa, among others (see Figures 16.2 and 16.3).

Additional factors that may influence tourists to exhibit risky behaviors include the playful behavior of primates. We can easily see behaviors in these animals that mirror our own; immature primates can be very cute, and even adults of some species can be quite neotenuous. The question remains, why do such notions outweigh the use of common sense and healthy behaviors?

As responsible primatologists, we need to increase awareness of the health issues described in this chapter. Perhaps future research could focus on cross-cultural

analysis of tourists' environmental values and attitudes, assessing ways to foster ecologically sensitive behaviors in travelers. We must educate tourists through various means of communication, providing understandable reasons for our regulations, and be willing to enforce the rules against violations. Of course, in most sites, the management of tourists is not under the control of researchers but is part of the site personnel's responsibility. Therefore, primatologists need to form collaborative relationships with tourist site staff and management to help raise awareness about these issues.

We must also work to learn why tourists and others in the tourism industry may violate safety and health regulations, and what information – or compensation – would prevent them from doing so. Such analyses must be conducted at a variety of locations that vary by tourist health knowledge, attitudes, and practices. In the interim it is critical that we proceed at once with intensive evaluation of current regulations at primate tourism destinations.

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