Gastrointestinal parasite analysis of mountain gorillas (*Gorilla beringei beringei*) as a conservation tool for tourism and community development in the Virunga Mountains

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Disease ecology and conservation are continuously becoming intertwined as cofactors affecting ecosystem health. Anthropozoonoses are emerging and re-emerging (e.g. Zika virus), causing a growing symbiosis between public health officials, biologists, disease ecologists and conservationists. Nowhere is this more apparent than in primatology, especially among great ape studies, where physiological similarities with non-human hominids offer insight on human health, such as disease susceptibility and immunoresponse. The ways in which viruses, bacteria and parasites interact with their hominid hosts can connect human health with that of our closest relatives and, ultimately, the surrounding environment. To explore these connections, I examined gastrointestinal parasites of two gorilla subspecies in the eastern Democratic Republic of Congo: the mountain gorilla (*Gorilla gorilla beringei*) and Grauer's gorilla (*Gorilla gorilla graueri*). These subspecies are particularly useful in researching zoonotic diseases because of their frequent contact with humans, due to their role in ecotourism and their proximity to rural communities encroaching on national park borders. In the past 30 years, multiple reports by Gorilla Doctors, Dian Fossey Gorilla Fund International, and Conservation Through Public Health, have shown evidence for disease transmission between gorillas and humans in these areas.

In the present study, faecal samples were collected from gorillas in Virunga National Park and Kahuzi-Biega National Park, as well as from humans living in surrounding areas. Samples were analysed using standard flotation and sedimentation techniques practiced in veterinary medicine. Additionally, the samples were cultured into larvae using a modified Harada-Mori method; this aided in taxonomic identification to the species and genus level. Samples were grouped and compared for parasite richness, both for eggs and larvae, using Kruskall-Wallis and Mann-Whitney U tests. Host species, habitat type, sample group, and whether individuals were wild or captive (non-wild) were factors considered in this study.

Overall there were at least nine types of parasite found in the gorillas and humans in this study: *Anoplocephala gorillae*, *Trichuris* sp., *Ascaris* spp., *Oesophagostomum* sp., *Entamoeba coli*, hookworms (Ancylostomidae), *Strongyloides* sp. and other unidentified strongyles, and spirurids. In gorillas, *Anoplocephala gorillae* and strongylids were the most common with 84% and 73% prevalence, respectively. This coincides with previous studies in Bwindi (Ashford et al. 1990; Rothman et al. 2008) and Virunga (Sleeman et al. 2000). Mean parasite egg richness varied significantly among all categories. Both gorilla subspecies were richer in parasite species than humans. Additionally, wild habitats were richer in parasites than rural and urban areas. Finally, wild sample groups were significantly richer in parasites than non-wild groups.

The differences in parasite richness were much less extreme in the larvae study, and in fact most were not statistically significant. Wild groups however, still had significantly more parasite species than non-wild groups. Multiple environmental factors could be contributing to differences in egg richness and larvae richness, such as age/sex of the host, group composition, or host diet. These data were not available at the time of writing.

Upon completion of the study, faecal and larval samples were stored at the Gorilla Doctors compound in Ruhengeri, Rwanda for future genetic analysis and at the Institute of Vertebrate Biology in Brno,

Czech Republic. Veterinarians at Gorilla Doctors plan to use the modified Harada-Mori method to culture larvae in the future.

Many of the parasites found in this study were zoonotic. Due to the high interaction rate between wildlife and humans in this region, disease control is of utmost concern for conservation. This is especially true of mountain gorilla populations, which are confined to limited home ranges within national parks. Because mountain gorilla numbers are growing (due to extreme conservation efforts and lucrative ecotourism) gorilla group interactions are growing, potentially affecting the epidemiology and transmission rates of zoonotic diseases.

Many thanks to the Primate Society of Great Britain and for the Ymke Warren Memorial Award for helping fund this study. The aim of this project was simply to explore the intestinal fauna of gorillas, but much more came out of it, including new veterinary techniques and biological samples for databanks. The Ymke Warren Memorial Award is a fantastic way to honor the late primatologist and will surely continue to open avenues for gorilla conservation.

References

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