Analysis of Zoonotic Pathogen Presence among Humans and Mountain Gorillas in and around Volcanoes National Park, Rwanda

Gabriel Andrle1; Jessica Deere2; Fallon Frappier3; Tyrell Kahan3; Tanya Witlen3

1Department of Environmental Sciences, Emory College of Arts and Sciences; 2Environmental Health, Rollins School of Public Health; 3Master’s in Development Practice, Laney Graduate School

Background
- Human population growth causes more frequent interactions between humans and non-human primates. As a result, non-human primate habitats are decreasing and the potential exposure to zoonotic and anthroponotic pathogens is increasing.
- Volcanoes National Park in Rwanda is an ideal ecosystem to investigate the consequences of the interactions between humans and mountain gorillas (Gorilla beringei beringei) because of the increasingly dense human population that lives in close proximity to critically endangered mountain gorillas.
- There are approximately 480 mountain gorillas remaining in the Virunga Massif, which includes parks spanning Rwanda, Uganda, and the Democratic Republic of Congo. The genomic similarities between non-human primates and humans provide the opportunity for diseases to be introduced into the mountain gorilla population that could hamper conservation efforts and threaten their survival.
- Bisate primary and secondary schools border Volcanoes National Park. Knowledge on proper water, sanitation, and hygiene (WASH) practices is important for disease prevention. Storytelling among children can provide a holistic understanding of local experiences that can lead to improved culturally specific and need-based WASH services to the population of Bisate.

Objectives
- To determine if humans and mountain gorillas co-habiting the area in and around Volcanoes National Park share the same enteric pathogens
- To train University of Rwanda students and Karisoke Research Center interns on parasite identification techniques
- To better understand knowledge, attitudes, and practices surrounding water, sanitation, and hygiene among youth in Bisate, Rwanda

Methodology
Pathogen Identification
- Non-invasively collected fresh fecal samples from mountain gorillas
- Processed samples both for immediate in-country microscopic analysis and for future molecular analysis at Emory University
- Conducted a modified sedimentation method to identify parasite eggs
- cultured L3 larvae to identify the genus of intestinal parasites present
- Employ molecular analysis to determine if humans and mountain gorillas share the same species of enteric pathogens

WASH Story Contest
- Recruited student participation in a story contest to illustrate knowledge, attitudes, and practices regarding WASH practices and provided necessary supplies and support to submit a story
- Conducted a quantitative analysis with coding methods to determine common themes and gaps in student knowledge
- Analysis informed DFGFI WASH curricula in Bisate schools to improve knowledge dissemination on the topic

Progress to Date
- Awaiting Rwandan governmental approval to collect fecal samples from humans.
- 100 mountain gorilla fecal samples were processed and analyzed between May and August 2015.
- A University of Rwanda student, 3 Karisoke Research Center interns, and a laboratory technician from the Bisate Clinic were trained in fecal sample collection, sample preservation, and laboratory processing.
- DNA extraction from samples is currently underway in the Gillespie Global Health and Biodiversity Conservation Lab at Emory University.
- Collected 89 story submissions and translated 18 finalist stories picked by a jury of Bisate school teachers for analysis.

Next Steps
- Larvae identification will be reconfirmed and molecular analyses will be provided by Dr. Gillespie’s collaborator, Dr. David Modry at the University of Veterinary and Pharmaceutical Sciences in Brno, Czech Republic
- Samples will be screened for other enteric diseases of anthropoontic interests, such as Giardia and Entamoeba histolytica
- Secure funding to generate radio pieces using student stories as inspiration
- Community mapping and interviews to supplement information gathered from student stories

Implications
- Potentially pathogenic and zoonotic parasites, Necator spp., Oesophagostomum sp., and Trichostrongylus sp., were identified.
- A laboratory manual was created to support the on-going and future research of parasites affecting humans and mountain gorillas.
- Results will inform conservation efforts for mountain gorillas and the development efforts for humans in the area.
- The story contest revealed that students are generally aware of the importance of WASH, but there are still barriers, such as the belief in witchcraft, holding families back.

Acknowledgements
We would like to thank the following for making this project possible: our Emory mentors Drs. Thomas Gillespie, David Nugent, and Christine Moe; our field mentors Drs. Winnie Eckardt and Tara Stoinski, Idephonse Munyarugoro, Félix Ndayigama, and the rest of the DFGFI Karisoke Research Center staff; Rwandan students Alexandre Gategoko, Epiphanie Dusabona, Yvonne Muhizi, and Anne Niyansabimana; and Emory students Giselle De La Torre, Morika Hensley, Sahana Kuthy, and Leo Ragazzo.