

**CONSORTIUM ON LAW AND VALUES
CONSORTIUM SCHOLAR FINAL REPORT**

“A Mixed-Methods Study of Bushmeat Hunting and Zoonotic Disease Risk Among Indigenous Waiwai in the Konashen Community Owned Conservation Area, Guyana”

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Project Summary

While bushmeat hunting is a key component of the traditional subsistence strategies of many Amazonian indigenous groups, it is also a major source of zoonotic disease. Wildlife populations can act as important disease reservoirs and the close contact between humans and wildlife that occurs during the hunting, butchery, and consumption of bushmeat provides a particularly high risk of pathogen exchange. Unfortunately, although numerous studies have documented that hunting is a major source of disease risk in Africa and Asia, relatively little research has focused on infectious diseases from bushmeat within the Neotropics. Further, few researchers have used ethnographic methods to understand the influence of cultural factors like identity, food taboos, and gender roles on human-animal pathogen exchange. As indigenous reserves now make up over 20% of the land area of Amazonia, it is critically important that researchers work with indigenous groups to identify and mitigate the risk of zoonotic disease transmission from bushmeat consumption.

In this study, I combined methods from veterinary medicine and anthropology to understand the importance of bushmeat hunting for the culture and livelihoods of indigenous Waiwai in Guyana, and identify and mitigate the risk of zoonotic disease transmission via bushmeat. My primary research questions are: 1) how important is bushmeat to the food security and cultural identity of the Waiwai, 2) how might the harvesting of bushmeat put Waiwai individuals at risk for acquiring zoonotic diseases, and 3) what diseases with zoonotic potential are present in the wildlife hunted by the Waiwai.

To address questions 1 and 2, I used ethnographic methods, including structured, semi-structured, and unstructured interviews and participant observation. I conducted structured interviews with 30 individuals on topics like hunting frequency, bushmeat consumption, butchery practices, and interactions with domestic animals. I also conducted semi-structured interviews with hunters to better understand hunting and butchery methods, injuries associated with handling animal carcasses, and perceptions of zoonotic risk. I used in-depth unstructured and life history interviews with key informants to understand the relationship of hunted animals to Waiwai identity and belief systems. I employed participant observation during hunts, food preparation, and butchery to better understand zoonotic disease risk factors and contextualize interview data.

To address question 3, I conducted necropsies on 24 animals killed by Waiwai hunters during the study period. During each necropsy, I collected the following samples in RNAlater and formalin: liver, spleen, kidney, heart, lung, brain, lymph nodes, and feces. Fecal samples were subsequently analyzed for parasite diversity at the Gillespie Lab (Emory University) and tissue samples were analyzed at the Terio Lab (University of Illinois) to assess general health.

My ethnographic results showed that bushmeat was critical for Waiwai food security and culture. Most Waiwai eat bushmeat 2-3 times/week and primates and rodents are among the most frequently harvested prey. Hunting is integral to Waiwai identity and they exhibit a cultural aversion to domestic meats. While the Waiwai engaged in several practices that mitigated the potential for zoonotic disease transmission, 67% of respondents report receiving butchery related injuries. In addition, although animal entrails are

discarded, subsequent consumption by dogs may represent an important pathway for disease transmission.

My initial histopathological and parasitological results indicated that the primates consumed by the Waiwai were relatively healthy, and only one individual showed significant disease (myocarditis potentially due to trypanosomal infection). Although the primates had relatively low parasite diversity, several primate individuals had potentially zoonotic and pathogenic parasites.

Financial Summary: The funds from this grant were primarily used to purchase RNAlater for the preservation of tissue and fecal samples and for histopathological analysis of tissue samples at the Veterinary Diagnostic Lab at the University of Illinois. Approximately \$2000 was used to pay the required village research fee to the Konashen Village Council and for food and accommodation during the study period.

Results

Publications:

- Milstein, M.S., Shaffer, C.A., Gillespie, T.R., Terio, K.A., Wolf, T.M., and Travis, D. (Revising to Resubmit). An anthropological approach to assessing human-animal health in an indigenous reserve in Guyana. *Ecohealth*.
- Shaffer, C.A., Milstein, M. S., Yukuma, C., Marawanaru, E., Suse, P., Wolf, T., Travis, D. A. (In Press). Integrating ethnography and hunting sustainability modeling for primate conservation in an indigenous reserve in Guyana. *International Journal of Primatology*.
- Shaffer, C.A., Milstein, M. S., Suse, P., Marawanaru, E., Yukuma, C. (In Press). Co-management of primate hunting in Amazonian indigenous reserves: A case study from Guyana. In Behie, A.M., Teichroeb, J.A., and Malone, N. (eds.), *Primate Research and Conservation in the Anthropocene*. Cambridge: Cambridge University Press.
- Shaffer, C.A., Milstein, M.S., Yukuma, C., Marawanaru, E., and Suse, P. (2017). Sustainability and comanagement of subsistence hunting in an indigenous reserve in Guyana. *Conservation Biology* 31: 119-1131.
- An additional manuscript summarizing the histopathological and parasitological results is in preparation for publication in the International Journal of Primatology.

Presentations:

- **Milstein M.S.**, Shaffer C.A., Suse P., Yukuma C., Gillespie T. R., Terio K.A., Wolf T.M., Travis D.A. 2016. Human-nonhuman primate disease transmission in the Neotropics: The use of hunter based surveillance among indigenous Waiwai in the Konashen Community Owned Conservation Area, Guyana. *American Journal of Primatology*.

Grant Applications:

- Submitted - "Integrating an Anthropological Approach within the One Health Framework," \$30,000 University of Minnesota Grant in Aid, co-PI with Dominic Travis (PI).
- Awarded - "Hunting sustainability and zoonotic disease risk among indigenous Waiwai in the Konashen Community Owned Conservation Area, Guyana, \$19,950 National Geographic Committee for Research and Exploration Grant, co-PI with Christopher Shaffer (PI), Karen Terio (co-PI), and Thomas Gillespie (co-PI)

Future Project Plans

The funded research was critical in helping me to gain admittance into the PhD program at the University of Minnesota's College of Veterinary Medicine (in Fall of 2018), where I will be addressing questions generated by this research for my dissertation. During the study period, I was able to work closely with Waiwai hunters to develop a hunter-based disease surveillance program. Hunters are now conducting samples year-round and preserving samples for histopathological and parasitological analysis. This program is providing me with a virtually unparalleled data set on animal health that will generate many publications and grant applications in the future. Finally, the funding provided by this grant was invaluable for the development of a long-term partnership with the Waiwai focused on understanding and mitigating zoonotic disease risk. This partnership, called the Konashen Ecosystem Health Project, will serve as a model for co-management of bushmeat hunting in communities throughout Amazonia.