

Tick-borne disease in cattle:
Kiserian, Kenya Summer, 2013 Project
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Summary of activities for international practicum

Tick-borne diseases including East Coast fever *Theileria parva*, *Anaplasma marginale*, *Ehrlichia* spp. and *Babesia bigemina* are important veterinary concerns for cattle throughout Eastern Africa, including Kenya (Gakuya and Mulei, 2005). Tick-borne diseases are an important cause of morbidity and mortality in adult cattle and are also a minor cause of calf mortality in the countryside surrounding Nairobi (Gitau et al. 2010). The goals of this research project included continuation of a study of the biodiversity of tick species in Rimpa, Kiserian, Kenya and to determine and compare the prevalence of *Theileria parva*, *Anaplasma marginale*, *Ehrlichia* spp. and *Babesia bigemina* in cattle on farms where cattle are and are not exposed to wildlife species.

Five farms were selected for use in the study; three were located in the Rimpa, Kiserian region, one in Ngong, and one in Rongai. The farms were selected based on the accessibility of wildlife species to interact with the cattle. One Simmental beef ranch, Rimpa Estates, is a conservancy at which cattle and wildlife, including zebras, giraffes, elands, Thompson's gazelles, and Grant deer are utilize the same pasture and water sources. The other four farms used in the study were small dairy operations in which the cattle were confined in pens to prevent interaction with wildlife.

Ninety-nine cows and bulls from Rimpa Estates and fifty-two Holstein and Jersey cows from confined dairy operations were used for the study. Blood was collected from the coccygeal vein of all the cows and bulls tested. All blood collection was done between July 10 and 19, 2013. DNA extraction was conducted at Kenya Wildlife Services veterinary laboratory and Real-Time PCR was conducted at the International Center for Insect Physiology and Ecology laboratory and at The Ohio State University. The only pathogen tested for in Kenya was *Ehrlichia* spp. Testing of *Anaplasma*, *Babesia*, and *Theileria* will be conducted at Ohio State. As anticipated, based on the tick species observed, none of the cattle were positive for *Ehrlichia*.

Tick sampling was confined to Rimpa Estates. A total of 1134 ticks were collected from 54 cows and six bulls on July 16, 2013. The location of the tick on the animal including, ears, neck, limbs, upper perineum, lower perineum, tail, and other was recorded. The vast majority of ticks were engorged *Rhipicephalus (Boophilus) decoloratus* females. Male specimens of *R. (Boophilus) decoloratus* were the second most commonly collected and few unengorged *Rhipicephalus evertsi evertsi* females were also collected from the cattle. Because most of the specimens had blood fed, we elected not to test for the pathogens because the results should mirror the pathogen prevalence in the cattle upon which they had fed.

Environmental sampling for ticks was conducted on three occasions in July using the drag sheet technique, direct collection from non-livestock species, and direct collection from human researchers. Environmental sampling did not yield a high volume of ticks, but did have a greater biodiversity of ticks than those collected from the cattle. Four species of ticks including, *Haemophysalis leachi*, *R. (Boophilus) decoloratus*, *Rhipicephalus pulchellus*, and *Rhipicephalus praetaxtatus* were collected on the farm.

Responsibilities during the practicum

The practicum in Kiserian and Nairobi, Kenya ran from July 8 to August 16, 2013. My responsibilities during the practicum were to conduct the proposed research goals.

Although a research proposal had been agreed upon prior to leaving the United States, upon arrival in Kenya Dr. Kariuki and I made modifications to the project to enhance the quality of the information we could gain. Originally I had planned to blood sample from cattle on the Rimpa Estates farm where I was living, but we decided that doing a comparative study between cattle that interact with wildlife and those that are confined away from wildlife would be more interesting and informative. It became my responsibility to organize other farm visits to collect blood samples. Fortunately, my host mom has been working in agriculture for many years and she was able to help me find other farmers who allowed me to sample their cattle.

All of the field and lab work was my responsibility. Although there was another Ohio State student helping me for the first two weeks of my project, I was the only one who had previous experience bleeding cattle. I was able to teach her how to collect blood from the tail vein, so we were both able to bleed which made the process much faster. I completed all of the DNA extraction from the cattle blood, but will require assistance with PCR. I also organized and conducted, with the assistance of my colleague and some of the farm workers, the collection of ticks from the cattle. I did drag sheet sampling of ticks from the environment. In the lab I did all of the tick species identification with spot checks by Dr. Kariuki to ensure that I was identifying the specimens correctly.

The laboratory equipment was not always available for my use, so I also assisted Dr. Kariuki with other parasitology related projects. I helped complete necropsies on 26 quail that had died suddenly to determine if they had any respiratory or gastrointestinal parasites. Results are still pending for this project. I completed fecal floats for a buffalo calf that had experienced acute diarrhea and died as well as his gazelle pen mate. The gazelle, that was not experiencing any signs of illness, had a low fecal egg count and the buffalo feces did not yield any nematode or protozoan parasites. Dr. Kariuki is currently completing his PhD in parasitology, so I also had the opportunity to assist him with creating a map showing the location of all known tick collections in Kenya for his dissertation work.

Accomplishment of goals and objectives

Collection of cattle blood and detection of tick-borne pathogens

I successfully blood sampled 151 heifers, cows, and bulls for my study. The original research plan only called for me to collect from cattle at Rimpa Estates farm where I was staying. The owner of the farm was aware that I was planning to collect blood and was prepared in advance of my arrival. When I arrived in Kenya, my preceptor and I decided to modify the proposal to make it more scientifically rigorous and informative. This change in protocol demanded that I work with other farmers who were unfamiliar with the project. With the great assistance of my host mom, we were able to work with four other farmers who were willing to let me sample their cattle.

I learned how to bleed cattle from the coccygeal vein earlier in the summer during the completion of an externship with Select Sires Inc., in Plain City, Ohio. I was glad that I was able to apply the skills I

gained in a previous work experience to this research project. I was also able to teach an Ohio State MPH student who helped me with the field work aspects of my project how to tail bleed cattle as well.

Continuation of tick biodiversity study

Last July and August, another Ohio State veterinary student, Rebecca Lauer, lived at Rimpa Estates to do a pilot study of the biodiversity of tick species on the farm. She used the same techniques that I employed, including drag sheets and direct collection from cattle, dogs, and humans. She was also able to do wildlife sampling using traps at the farm to collect ticks from a mongoose and genet. She found seven species of ticks including *Boophilus decoloratus*, *Rhipicephalus evertsi evertsi*, *Amblyomma variegatum*, *Haemophysalis leachi*, *Rhipicephalus praetextatus*, *Rhipicephalus pulchellus*, and *Ixodes* spp. Due to the added component of testing cattle for tick-borne diseases, I did not sample as frequently as she was able, however, I did collect similar species through environmental and cattle tick sampling. I think that a more intensive study of just tick collecting and pathogen analysis could be completed by another student in the future. We opted not to test the ticks for pathogens because the majority of ticks sampled had blood fed on the cattle we were already planning to test for tick-borne diseases. It would be redundant to test the engorged ticks.

Improving my communication skills with clients

One goal that I had not initially considered was improving my communication skills with clients. I had thought that I would only be working with a single farmer who was aware of my research proposal prior to my arrival in Kenya. With the change in protocol, I was able to interact with additional farmers who had not been warned of my project. I experienced unique challenges to those I will face as a veterinarian in the United States. Communication and gaining trust with the farmers was not without difficulty. Several of the farmers we initially contacted wanted me to pay them to be allowed to take the blood or were suspicious of my motives. Some thought that I was going to infect their animals with a disease that could only be treated with medicine produced in the United States. One of the farmers who did allow me to bleed his cows wanted me to pay for treatment if any of his animals were found to be infected.

I think a major issue was that I am a foreigner, so I had to gain their trust. Fortunately, my host mom is well known in the community and has many contacts throughout the livestock industry in Kiserian. She came to all of the farms with me and helped to explain to the farmers what I was trying to accomplish and that taking a small amount of blood is not dangerous to the animal. I think that it was useful for me to, at least, communicate simple greetings and expressing my appreciation to them in Kiswahili.

I did struggle with communication more than I probably would in the United States because of the language barrier. While almost everyone in Kenya can speak English to some extent, it is often their third language after their tribal language and Kiswahili. When I was explaining what I was doing and the diseases I was testing for, I was occasionally unsure at what level to be discussing my project. I did not want to overwhelm the farmers by using vocabulary that they were unfamiliar with, while at the same time I did not want to speak down to them because I had misinterpreted their level of understanding English.

I think that overall I did a good job of communicating with the farmers because all those who allowed me to bleed their cows seemed satisfied when I left. Communication skills will continue to be an area

to work on even if I decide to practice in the United States after graduation. Appropriate and successful communication allows a veterinarian to gain the trust of a client which will result in more successful diagnosis and treatment of patients.

One Health Aspect

Although the focus of my project and career will be the health and protection of animals, it is impossible to separate animal from human and environmental health completely. Zoonotic diseases affect both human and animal species, certain farming practices may be damaging to the environment, and there is concern of disease transmission at the wildlife/livestock interface. It is important to think of human, animal, and environmental health in a continuum together when determining how to solve a health problem focused on one of the three components.

For the farmers that I was working with, their livestock make up most or all of their income. Even if the farmers are not affected by the diseases through infection, their animals' health has a major impact on the economic stability of the family. Earlier this year at Rimpa Estates, 18 cattle died of Anaplasmosis. All of them were pregnant heifers and cows which means increased economic losses; they lost not only the animals that died, but also their fetuses. Fortunately, the family has enough cattle and sheep that they are still functioning, but for some farms this might be beyond losses that they are able to survive.

Environmental health is the third component of one health and is often the first to be forgotten or ignored. If the cattle exposed to wildlife are more likely to be infected with tick-borne diseases than those that are confined away from other species, there is the potential for negative backlash against wildlife through hunting or blocking off of the land. Rimpa Estates is a wildlife conservancy, so I am not worried about the loss of animal habitat, but there has been discussion of changing from a pasture based model to a feed lot to reduce the number of ticks feeding on the cattle. This system will be more expensive than raising and maintaining the cattle on pasture because feed will have to be cut, stored, and fed out every day instead of simply letting the cattle out to pasture in the morning.

Prevention of ticks using chemicals can lead to resistance even if the treatments are applied appropriately. The cattle at Rimpa Estates are run through an insecticide dip once a week, but I still collected an average of nearly twenty ticks off of each animal. This indicates that the chemicals are not adequate for protecting the cattle from tick infestation. The predominately collected tick species, *Rhipicephalus (Boophilus) decoloratus* already has documented resistance to common acaricides used in Africa (Mekonnen et al. 2002). The most likely cause of resistance at Rimpa Estates is that the cattle are dipped weekly in an attempt to keep the population under control. Unfortunately, because this species is a one host tick, meaning they mature from larvae to nymph to adult on the same animal, they are exposed about three times to the same acaricide which increases the likelihood of resistance in the population (Ntondini et al. 2008). Resistance can have devastating effects for the farmers if they are unable to control the tick population and the diseases they carry.

Changes in land use throughout Africa have the potential to increase disease transmission between wildlife and domestic livestock species. The majority of wildlife individuals inhabit privately owned land which increases the possibility of wildlife/human conflict and wildlife/livestock disease transmission (Bengis et al. 2002). *Theileria parva*, East Coast Fever, is a tick-borne disease of cattle that is strongly associated with the presence of Cape buffalo (Bengis et al. 2002). The pathogen causes little to no reported disease in the buffalo population, but results in high mortality in infected cattle

herds (Bengis et al. 2002). Although wildlife species are typically blamed for spreading disease to domestic species, it is important to remember that the transfer of diseases goes both ways. Domestic animals may be the source of an outbreak of disease in wildlife populations (Bengis et al. 2002). Numerous diseases were imported to the continent of Africa by colonists through the importation of domestic animals. Canine distemper virus was brought to Africa by domestic dogs and has accounted for severe lion population depression and suspected declines in the African painted dog population (Roelke-Parker et al. 1996, Alexander and Appel 1994). Similarly, bovine tuberculosis was spread throughout the world by Europeans, infecting numerous African wildlife species, and causing severe damage to the wild populations of buffalo and lions (Bengis et al. 2002).

Veterinarians should consistently consider the impacts on human and environmental health, in addition to animal health when conducting research or prescribing treatment for diseased animals. Each component of one health is essential for the other two to function at their peak level.

Positives and negative aspects

Positives

Living with a host family

I lived with a host family in Kiserian, which is approximately 25 km from Nairobi where I conducted my laboratory work. I stayed at Rimpa Estates beef and sheep ranch where most of my fieldwork was done. I think that I had a better experience than I would have if I had stayed in a hostel or an apartment with other foreign students. The family whom with I lived was very welcoming and willing to help me with the manual labor aspects of my work. I was able to learn about Kenya life and current events comprehensively. We would watch the local and national news every night and would purchase a newspaper most days of the week. I learned a lot about local and national events that would not normally be highlighted in American foreign news. I enjoyed discussing the current events with my family so that I could gain insight on the opinions of government, crime, tribal conflict, and the environment with people who live in Kenya.

One woman cooked lunch and dinner for the whole family every day. Because I was living with a family, the meals were traditional Kenyan and Maasai foods. We usually had any combination of rice, beans, lentils, beef, kale, cabbage, pumpkin, cassava, arrow root, watermelon, bananas, mango, and cantaloupe always served with a mug of delicious, milky sweet tea. There was always plenty of food and I was often encouraged to eat more.

I stayed in a bedroom with another OSU student. We had two twin beds, mosquito nets, a closet, and a desk in our room. We were always welcome to use the common spaces of the house. The family would often gather in the living room to watch TV or interact with each other. “Mom”, my host grandmother would sit on the porch and teach me new Kiswahili words almost every day.

I was also able to help out on the farm on days when I did not have to go into the laboratory. I practiced milking cows by hand, which had a bit of a learning curve for me as I am used to hand stripping each teat and applying a milking machine. On the day when I bled the cattle, I helped run the cows through the insecticide dip. Perhaps my proudest moment was after I had helped a couple of the farm hands

deworm the sheep, one of them told my host mom that she should not allow me to go back to the United States, so I could stay there and help them farm.

Working with multiple farmers

I am glad that I was able to visit multiple farms to learn about farming practices in Kenya. In general the idea that dairy cattle are confined and fed harvested feed was similar to that in the United States. The difference was in the reasoning for the confinement. Farmers in Kenya kept their animals confined to prevent them from being eaten by lions. While there are predators in the United States that can kill calves, it is unlikely that a full grown cow will be eaten. All of the dairy farmers I met with had few cows, so they milked them all by hand twice a day.

As previously mentioned, working with multiple farmers allowed me to practice the communication skills that will be crucial to my success as a veterinarian in the future. This experience expanded my communication skills because the farmers were sometimes distrustful of me and because of the language barrier.

Practicing and teaching laboratory skills

I have taken a molecular techniques class in graduate school and performed DNA extraction and PCR to complete my MS thesis, but I was appreciative of the opportunity to continue to work on my technique. The lab director offered me some insight into how to ensure that my samples were extracted properly and helped me to troubleshoot when the blood was not lysing appropriately. I will have the opportunity to practice PCR when I return to the United States to complete my project at Ohio State.

Not only was I able to practice and hone my techniques, but I was also able to teach new techniques to members of the lab staff. We were tasked with completing fecal floats to analyze a buffalo calf and gazelle for gastrointestinal parasites. The veterinarian was leaving, so I was able to teach one of the lab personnel how to do a fecal float and look for parasite eggs and protozoa under the microscope.

Negatives

Lack of organization in the lab

Having worked in several laboratories in the past, I have my own ideas about how a lab should be run and how samples should be organized and stored. I did find it frustrating when simple tasks that seem obvious to me were not done by lab personnel. For example, when I was making aliquots of blood, I expected that as I was handing them to my assistant that he would put them in that order. Unfortunately this did not happen, so I had to sort out the samples the next day which wasted time in the laboratory. Along the same lines, in previous labs that I have worked in, when samples are removed from the freezers, those that had been moved would be put back in the same order. This is not the standard operating procedure in the Kenya Wildlife Service lab, so again there was unnecessary wasted time in looking for samples.

Both of these instances provided me with the opportunity to practice my communication skills. I learned that putting samples in order is not commonly done in the preparatory stages of a project. They

will organize in the end, but no one was worried about order in the beginning. This concept still confuses my American mind that has been taught to keep everything organized.

Unique experiences or events

Kenya Wildlife Service

Working with Kenya Wildlife Service allowed me to see veterinary medicine performed on animals outside the common domestic species with whom I am familiar. A leopard with a large, >20cm, laceration caused by a human laid trap was brought in to be cleaned and sutured. I saw a veterinarian treat a vervet monkey that had become blind due to fighting.

Elephant Orphanage

The David Sheldrick Wildlife Trust runs an elephant orphanage for calves whose mothers have been killed, most commonly due to poaching or human-wildlife conflict, or those calves that were somehow separated from their mothers by falling down a well or unknown reasons. I adopted one of the elephant calves named Kithaka. He is a nearly two-year-old bull calf that is reported to be the “naughtiest” baby that they have at the orphanage. If a person adopts one of the babies, they are able to go to baby bed time to interact with the calves. Kithaka was fond of putting his trunk up to my mouth and blowing into it.

National Parks

During my time in Kenya I was able to visit a few National Parks either in or near Nairobi. I hiked Mt. Longonot, walked through Hell’s Gate, and did a game drive at Nairobi National park. On our game drive we saw two lionesses and one cub hunting, a herd of buffalo, many zebras, giraffes, kudu, elands, hartebeest, Thompson’s gazelles, baboons, and rock hyraxes. We also saw a few hippos, crocodiles, a baby python, vultures, and numerous other bird species.

Assessment of the practicum

Overall, this was an amazing experience. I have traveled to numerous countries prior to this trip, but I have never spent six weeks in the same place before. I feel that I truly was able to learn about the culture and customs of the Kenyan people. I think that every student should step outside their comfort zone and travel around the world to discover how different people approach the same problems and how to solve problems that we do not experience in the United States.

My preceptor is incredibly busy, which did make working with him a bit of a challenge. Because I do not have the same connections as him, it could be frustrating at times when I needed to get my work done and he was not available as planned.

I am very appreciative of the opportunity that the R25 funding and the OSU Health Sciences Center for Global Health has provided me.

Scientific Abstract

Blood samples from cattle exposed and confined from wildlife were collected from 151 animals on five different farms in Kiserian and Ngong, Kenya. Cattle will be tested for *Anaplasma*, *Babesia*, and *Theileria* at The Ohio State University College of Veterinary Medicine. Ticks were collected from sixty cattle that are pasture raised. The overwhelming majority of ticks collected were *Rhipicephalus (Boophilus) decoloratus*, perhaps due in part to their documented resistance to some acaricides. Ticks were also collected from the environment. The species collected, including *R. (Boophilus) decoloratus*, *Haemaphysalis leachi*, *Rhipicephalus pulchellus*, and *Rhipicephalus praetextatus* were consistent with specimens collected in a prior biodiversity study in the same area.

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Travel tips

Vaccinations/Medication- Follow the CDC recommended vaccination list prior to coming to Kenya. Kenya never checked for the Yellow Fever vaccine, but I took a weekend trip to Zanzibar and the Tanzanian officials checked to make sure you had the yellow card or you had to be vaccinated at the airport, a scary proposition! Be sure to take malaria medication. One of the farm hands where I was staying got malaria while I was there.

Visa- A single entry visa costs \$50 USD and can be purchased at Jomo Kenyatta Airport upon arrival. If you plan to travel outside Kenya, but remain in East Africa, you may do so on a single entry visa. If you go outside of East Africa, however, you must buy a multiple entry visa.

Money- The local currency is Kenya shillings (KSH). While I was there, the exchange rate was about 85 KSH to the US dollar. Certain places such as national parks will accept US dollars for entrance fees. ATMs are common throughout Nairobi, but it is best to carry cash if going to more remote regions. Credit cards can be used in many Nairobi restaurants and higher-end shops, but not outside the city in many places.

Transportation- Matatus are 14 passenger vans that are quite inexpensive and can take you almost anywhere you want to go. The problem is that the schedules are not posted anywhere, so you either have to know which matatu to get on or get a Kenyan friend to help you the first time you ride them. I took a matatu to work every day and to visit friends in Nairobi on the weekends with no problems. Occasionally the conductors will try to charge you more because they suspect that you do not know the prices. If possible pay with exact change. Taxis are much more expensive. You should always ask the price beforehand as they do not use meters. If you find a driver that gives you a good price make sure you take his phone number for use in the future. The international terminal at Jomo Kenyatta Airport at the time of writing had just burned down. Even before the fire, the airport was a bit disorganized, so make sure you get to the airport early.

Culture- The Kenyan people come from 42 different tribes. They all have their own language in addition to speaking Kiswahili and English. People in general are friendly and will help you if you look lost or confused. Even the matatu conductors would help me get on the correct connecting vehicle if I asked.

Dress- Most young people tend to dress in Western styles, especially in Nairobi, but to be on the safe side and because I attracted so much attention anyway, I dressed conservatively, i.e. no tank tops or shorts.

Language- Most people know their tribal language, Kiswahili, and English. Despite the widespread knowledge of English, I found that people liked if I greeted them in Kiswahili. “Habari yako?” means how are you? And the appropriate response is “nzuri”. All of my interactions were done in English, but I always thanked them “asante sana” in Kiswahili. Most people appreciate your effort.

Food- Nyama choma is the most popular type of restaurant I saw in Kenya. There is a butcher shop where you pick out your meat, beef, goat, chicken and they cook it for you. Ugali and chapatti are bread products which are served with the meat. In my home I ate a lot of rice, beans, lentils, pumpkin, cassava, and arrow root. Many places people eat with their hands. Servers bring water to wash your

hands with before and after the meal. I only drank bottled water. Tea is served multiple times per day and it is considered rude to refuse to go to tea time if invited.

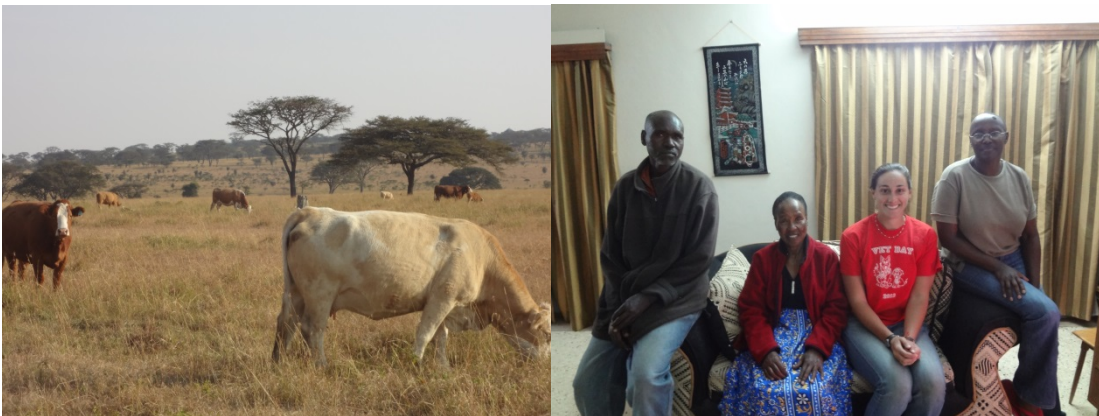
Sights- There are many National Parks throughout Kenya including around Nairobi. Even if you do not have much time to get outside the city, you can easily visit Mt. Longonot, Hell's Gate, Nairobi National Park, and Lake Nakuru National Park. The Nairobi National Museum was also nice, although I do not recommend the associated snake park. The David Sheldrick Wildlife Trust has daily elephant baby viewing time and an additional bed time if you adopt a baby. Once the babies are ready at about three-years-old they are released into Tsavo National Park. The giraffe center allows you to hand feed giraffes. They also release giraffes back into the wild. The downtown Maasai market is a great place to get souvenirs, but make sure you barter. They will start much higher than they expect to get. If you cannot get the price down, just walk away, they may come running after you to accept your price.

Phone/internet- There are many internet cafes around Nairobi, but I found it easier to bring my laptop and purchase an internet USB stick. I also purchased a cell phone for 1500 KSH.

Annoyances- If you are white, you will stand out. People will shout mzungu (white person) at you frequently. This is less common in Nairobi as many ex-pats live there, but it still happens and in the smaller towns it can become annoying. Men will come up to you and ask if you are married; just say yes.

Photo Diary

Home away from home



Work





Wildlife medicine



Hell's Gate and Mt. Longonot



Nairobi National Park Game Drive



Elephant Orphanage

