Trypanosomiasis in Livestock of the Chad Basin: Modeling Risks for Animals and Humans

A summer research experience funded by the T25 International Practicum Grant

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Summary of international practicum activities

The practicum occurred between 14 June 2010 and 23 July 2010 in the country of Cameroon. Most activities were conducted in the Far North region of the country, with trips from Maroua to smaller villages and to camps within the bush.

My primary research interest was to describe trypanosomiasis in cattle. I used semi-structured interviews with mobile pastoralists in the area to construct the disease known as *ousse* in the Fulfulde language. Through my interviews, I learned about identification of this disease, treatments, prevention, and identification of the fly vectors of this disease.

The mobile pastoralists are groups of people who move across large areas of land (and across national borders) in search of grazing land for their animals. I had the opportunity to collaborate with local researchers, translators, and the pastoralists themselves, which was a valuable cross-lingual, cross-cultural experience that I could not obtain at OSU.

While I was not directly diagnosing or treating animals with trypanosomiasis, I had the opportunity to directly encounter livestock diseases that are not present in the United States, but are crucial to global trade and animal health, such as Foot and Mouth Disease and trypanosomiasis. Interviewing the mobile cattle herdsmen in the area also helped me to understand and consider a livestock husbandry system and cultural concept of disease that is very different than in the US.

A herder with one of his favorite bulls

Goals of the practicum

"To obtain competence performing interviews with local cattle owners and pastoralists. Interviews will focus on currently used methods of treatment and prevention for trypanosomiasis in cattle, and areas of known tsetse fly (trypanosome vector) infestation near common herding routes."

During my fieldwork, I performed 30 interviews with mobile pastoralist men, each lasting between 30 minutes and 1.5 hours. I arrived in the country planning to ask about the currently used methods of treatment and prevention for trypanosomiasis in cattle, and about areas of known tsetse fly (trypanosome vector) infestation near common herding routes. In order to do this, I spent the first few interviews establishing important vocabulary in Fulfulde, the local language in which the interview was conducted. Although I was working through a translator, there were certain terms that were best left untranslated from Fulfulde to English.

For example, *ousse* is the disease complex whose symptoms are varied between herders, but seems to always include many of the signs associated with trypanosomiasis. *Pechi* are flies that bite cattle, and include multiple species of *Glossina* (the tsetse fly vector) which have their own names in Fulfulde. When asking about drug names, the responses almost never matched the chemical compound or brand name on the bottle. These were categorized best in Fulfulde, and the parameters of each name was defined as interviews continued.

Interviews were conducted at times of the day when the researchers' presence would be least obtrusive to the herders' daily schedule. Interview methods were further adapted (and sometimes paused for other activities) to fit the needs of the camp. Most semi-structured interviews occurred after morning prayers but before cattle and men left for grazing (between 7 and 9AM), or once they had returned to the camp and finished evening chores (between 8 and 10PM). Other interviews were conducted near mid-day in villages with a market day. These markets often drew nearby herders into the villages, and was an excellent time for my guide to be able to track their camp locations in the bush, as well as an opportunity to talk with them while they waited for business transactions to take place during the day.

It was often required to chat and drink milk with the herders before beginning formal interviews. In some camps, one must be a visitor overnight before the 'business' of interviewing can take place. After each interview, I would ask the herder if he had any questions for me. Sometimes they would ask personal questions: How many kids do you have? Why aren't you married yet? Sometimes leaders of the camp would use this time to make their feelings known about past injustices in their camps. Some leaders were concerned about promised money from NGOs that had never materialized, or about conflicts between the herders and villagers with encroaching farmland. They voiced frustration about inadequate access to drugs for their animals and for their families, and about many other issues.

Though these questions were often uncomfortable, I appreciated this time to get a perspective on what issues mattered most to the people I was interviewing. They cooperated with me and my questions about cattle disease and flies, and at the end the topic could be anything that they wanted to speak about. While I believe they understood

that I, as a student from OSU, could not immediately change or rectify all their problems, it was my responsibility to listen closely and take as many notes on these topics as I did during the interview process. Mostly, I learned not to make promises that may lead to future sources of complaint.

"To translate raw data into maps of tsetse infestation, in collaboration with other researchers. This can be compared with published maps of tsetse risk and can be used in the local ecology of trypanosome transmission in an endemic region such as the study site (Far North region of Cameroon)."

While the data was collected during my practicum in Cameroon, the research and analysis continues here in Columbus. My research approach, based in participatory epidemiology, collected data on fly types, distribution, severity, and seasonality based on the knowledge of the people who come into contact with these flies during their daily lives. In order to collect further data on the fly vectors for trypanosomiasis and track local changes in trypanosome transmission ecology, the maps produced from my study can be used in further attempts at direct fly trapping. By focusing on sites of fly activity identified by the herders in my study, research costs and manpower can be reduced by pinpointing known areas of fly density, areas where control measures would make an impact that is visible to the herders that use the land in these areas.

"To practice interview skills using translators, and continue to learn French"

I feel this goal could more aptly be called "mastering daily life skills", and will be discussed in more detail in later sections of the report. Specifically, though, French was useful in town, as most people who have been to school, operate stores, cell phone minute booths, or restaurants will speak French fluently. While I had a translator who spoke English for my interviews, I needed some knowledge of French to speak with the driver, the guide, the shopkeeper who sold cookies and laundry soap, or most of the staff of CARPA, the non-profit with which I collaborated on my research project. In general, I found that people were very forgiving of my poor grammar skills and sometimes creative vocabulary. Acting sometimes went a long way in getting my point across.

To speak with the herders, and to purchase things in markets or in the villages, Fulfulde was the language that everyone had in common. I was only able to pick up minimal Fulfulde language skills, including greeting phrases, thank you, and names for food items, diseases, and cattle terminology.

Because of my inadequate language skills in either French or Fulfulde, I relied heavily on a translator for my interviews and interactions with the herders. Translation itself takes a strong partnership, and a level of understanding between all three parties involved: the interviewer, translator, and interviewee. Translation was from Fulfulde to English, with some words or terms in French for clarification. I found it very helpful to explicitly discuss my expectations with the translator in advance, specifically about summarizing and omitting irrelevant information (I did not want either to occur). At the same time, I was grateful for my translator's astute translation in times of confusion. Because he knew what sort of questions I had be asking of every herder, he was

exceedingly helpful in clarifying a response or redirecting a conversation, all the while translating for my benefit whatever the unrelated topic the interview had drifted toward.

Both my translator and local guide's rapport with the herder was invaluable in creating a safe space to speak openly about the subjects at hand. Without their jokes and cultural connections to the herders and their families, I would not have been able to accomplish nearly the quantity or quality of interview that I collected.

An interview in progress

Focus on: Current and historic means of vector control and trypanosomiasis treatment in cattle of Cameroon

African Animal Trypanosomiasis is a major concern in Cameroon, where more than 2/3 of the land area, and over 90% of the cattle population is at risk for infection with trypanosomes (Hamadama 2001 in Mamoudou et al, 2009a). In a survey of farmers, trypanosomiasis was ranked the most important cattle disease problem, and the most common lethal disease as well, accounting for 69% of disease reported in their cattle (Mbahin et al, 2006).

Tsetse invasion of Cameroon began in the 1950s, with the arrival of *Glossina morsitans submorsitans* to the Adamawa plateau. Since then, two additional species, *Glossina fuscipes fuscipes* and *Glossina tachinoides* have also been reported. The invasion of the tsetse fly has caused drops in cattle fertility, birth rate, and weight gain, and caused increases in mortality (Mamoudou et al, 2009b).

From 1960-1975, the Cameroonian government implemented a biannual trypanocidal treatment campaign in the Adamawa, North, and East regions of Cameroon. This consisted of preventative treatment of all cattle before the start of transhumance with isometadium chloride, and curative treatment with dimazene aceturate when animals returned for grazing in the dry season, or as clinical cases were identified (Mamoudou et al, 2009b). In 1967, this effort began to be supplemented in the Far North region with ground spraying with DDT for tsetse control. This program resulted in the creation of a regional coalition of Lake Chad Basin interests, which culminated in the Cameroonian organization Mission Speciale pour l'Eradication des Glossines (MSEG, or Special Unit for Tsestse Eradication), based in Ngoundere, in 1974. Under MSEG, spraying was expanded to include aerial spraying by helicopter in the Adamaoua division (Mamoudou et al, 2009a, 2009b)

Reinfestation of previously cleared tsetse areas occurs regularly, as evidenced by a tsetse survey in 1988 (Mamoudou et al, 2009b). This prompted the government to start additional campaigns of pyrethroid spraying, supplemented with organochlorides spread by helicopter in hard to reach terrain. The occasional failure of insecticide spraying is likely multifaceted. It is hypothesized that insecticides did not last as long in the harsh environmental conditions as expected, and the underfunding of the various eradication programs often left the cleared zones without proper maintenance and surveillance (Mamoudou et al, 2009b). Travel between cleared and infested zones is also an issue. Transhumance and travel to cattle markets likely re-introduced tsetses to some cleared zones, especially when cattle would re-enter the Adamawa plateau region without passing through government-sponsored insecticide application stations. Vehicular travel could also transport flies; as the slow-moving trucks travel up steep roads, they have been shown to attract tsetse flies, and could carry them to cleared zones (Mamoudou et al, 2009b).

In 1994, a barrier system of targets and traps was constructed to prevent tsetse reinvasion from the plains to the north of the Adamaoua plateau into the cleared areas to the south. This consisted of rows of insecticide-impregnated screens with biconical traps between them, creating a barrier for tsetse flies. This method was effective at preventing the reinvasion of cleared areas (Mamoudou et al, 2009b), but most were destroyed in a bush fire in December 1994.

In 1995, the trap barrier system was replaced by the creation of a buffer zone where all cattle are insecticide-treated with pyrethroids at regular intervals. Success of this method is mixed, as the financial resources of livestock owners is variable, and likely insecticide treatments have been irregular (Mamoudou et al, 2008 in Mamoudou et al, 2009a). Additional methods of control have been piloted throughout the country, and more are expected since Cameroon joined the Pan-African Tsetse and Trypanosomiasis Eradication Campaign in 2000.

Present-day methods in the Adamaoua region is dependent on chemotherapy, mainly isometamidium chloride as prevention and diaminizene aceturate as curative treatment. The treat of tsetse reinvasion looms large from the Far North province and from forested areas and game reserves where tsetses were never successfully eradicated (Mamoudou et al, 2009b).

Mamoudou et al (2009a) found a 23% prevalence rate in cattle of the Faro and Deo zones, Adamoua division. This includes multiple *Trypanosoma* species: *T. congolense, T. brucei, T. vivax,* and mixed infections of *T. congolense* and *T. brucei*. The dominant species of infection is *T. congolense,* which is also the most prevalent and pathogenic species across most of Cameroon. Drug resistance is also an issue. In one laboratory-based study, 100% of *T. congolense* isolates were resistant to both diminazene and isometamidium trypanocidal drugs (Mamoudou et al, 2008b).

The abundance of tsetse fly vectors also varies. A recent study found that generally the abundance of tsetse flies is highest in areas closest to the game reserves in the rainy season, while flies are present in the transhumance areas of the valley mostly when cattle are occupying the area in the dry season (Mamoudou et al, 2008a). Wildlife living in and around the game reserves are an important host for tsetses, and remain in the area even when transhumance takes the cattle population elsewhere. Similarly, in areas with low numbers of wildlife, the cattle may have a higher tsetse burden, as the flies do not have an alternative food source in local wildlife populations (Mamoudou et al, 2006). The seasonal changes in cattle density due to transhumance therefore can cause substantial changes in distribution and density of the tsetse flies (Mamoudou et al, 2008a).

Future efforts to break the trypanosomiasis disease cycle require a combination of maintaining current methods and adding new techniques. First, tsetse-cattle contact must be reduced; reliance on chemotherapy and chemoprophylaxis cannot keep disease at bay. Mamoudou et al (2009a) suggests the PATTEC plan of action, which identified areas that are created into tsetse-free zones, while use of insecticides on herds within buffer zones and before transhumance should be continued (Mamoudou et al, 2009b). An increase in programs that encourage livestock owners and herders to appropriately use trypanocidal drugs and other tsetse control measures is also needed. To combat drug resistance, treatments with trypanocidal drugs should be limited in buffer zone areas to only the clinically ill and anemic animals (Mamoudou et al, 2009b). Additionally, education of farmers and herders through the veterinary extension service should include topics such as proper usage of trypanocidal and insecticidal compounds (Mbahin et al, 2006).

Further research is necessary to characterize trypanosome drug resistance. Mamoudou et al (2009b) has reported widespread resistance to both isometamidium

chloride and diminazene aceturate, but no studies have established whether multiple drug resistant clones of trypanosomes are circulating in Cameroon. It is suggested that Cameroon should institute government control of sale of generic trypanocidal drugs, as distribution of drugs with subtheraputic levels of ingredients are known to be sold in many markets (Mamoudou et al, 2009b). Finally laboratory tests for resistance require more development. The gold-standard *in vivo* single dose mouse test is labor-intensive and requires a two month wait before results are possible. New PCR-based tests show some promise, but at present are not capable of detecting the multiple phenotypes of drug resistance that vary across trypanosome species and across geographic areas (Mamoudou et al, 2008b).

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Student responsibilities in Cameroon

While staying in Maroua, meals were eaten at the home of the director of CARPA, Saidou Kari. Food quality was good, and there was always more than enough to eat. Housing in Maroua was at the CARPA office. I had my own room with a door that locked; inside it was a foam mattress and a rug on the concrete floor. There was a separate covered structure for bathroom facilities, which contained a shower spigot and a pit-latrine style toilet. With the exception of some nocturnal cockroach residents in the bathroom, facilities were clean and adequate. CARPA also had access to a potable water spigot, which was extremely valuable both to bring water to field sites, and for daily drinking purposes. At night, a guard slept on the premises, and occasionally other guests of CARPA (herders traveling in town or CARPA employees) would also stay at the facility.

Most travel in town was by truck or car, though in Maroua, there is a motorbike 'taxi' system that is well-used by the local residents. The city is large enough that some sites are not walkable from CARPA, but I was able to walk along the street and encounter a small store, multiple cell phone minute vendors, peanut vendors, and other food sales. Within the city, there was adequate access to internet cafes, food options, pharmacies, and anything else one might need.

During fieldwork, plans and accommodations were more fluid due to the nature of the bush and changing weather conditions. Meals were eaten at small restaurants if we were near a village with a restaurant, and these establishments usually had a choice of two sauces served with either millet or rice. Water was not potable, and there were often a large number of houseflies and lizards who seemed to reside in the restaurant area. Meals in camps were prepared by wives of herders or other women in the camp, and were eaten with or without some of the male herders. Most meals consisted of a large millet ball, sauce, and milk fresh from the cow. Most camps were willing to boil the milk for me before I drank it (both brucella and tuberculosis are seen in the cattle population), but it is not clear if the milk actually reached boiling temperature very often. Water for drinking or washing was carried in from Maroua, and was thus in limited supply.

Typical meal at a herder camp

Housing in the bush was in a tent set up adjacent to the herder camp. Tents were comfortable, single-occupant size backpacking tents, though they were not meant to stand up to the high wind conditions that sometimes occurred on the open plains in the bush. My tent lost its rain fly one night during a storm, while the translator lost the entire tent when he moved into the truck during a storm. When traveling through villages, housing consisted of an empty room in the chief of the villlage's home. These rooms usually had not electricity or running water, and an outdoor pit latrine with a variable height of privacy walls. The entire research team would share the floor space of this room.

Transportation in the bush was by truck, which was often inhibited by rain and mud on poorly maintained (or absent) roads in rural areas. The truck also had fairly regular mechanical failures, ranging from broken windshield wipers in rain storms to a battery that could not start the car without a running push across the camp.

Responsibility for decision-making in the bush was a constant dilemma. I traveled together with another student researcher from OSU, and we had control over deciding which days to do field work, and directing our team of a driver, translator, and guide. Generally, we depended on the guide to know which roads to take, and he was responsible for money distributed by CARPA. When a decision had to be made, the team would address my male colleague, and never me. I was able to respond in these situations only through my colleague. If large changes to the itinerary were to be made, someone would call the director of CARPA to get approval

Other tips for travelers to the Far North Province of Cameroon

- Check that your chair on in-country airline flights has a working recline mechanism. Twice I ended up in the lap of the person behind me during take-off, because the seat back could not support itself. Also, do not eat the tuna sandwich.
- Things move slowly. Embrace the afternoon nap; there's nothing that can be done when it is that hot out, anyway.
- Search out the yogurt drink for something cool and refreshing to drink without all the sugar of Coke or Fanta
- When possible, try to speak Fulfulde. People don't seem to mind when you mix French and Fulfulde, as long as you're making an effort.
- Children, especially in the camps, love to see themselves on the digital camera screen. Hold on tight to the camera, though, or someone will run with it to go show their mother.
- Do note the position of dogs and bulls when venturing out of the camp. Unless there is someone from the camp to shake a stick and send the animal running, there will soon be a dog or bull running after you!

Scientific Abstract

Vector-borne diseases, such as trypanosomiasis and malaria, are causes of significant economic losses to livestock production and human productivity in the developing world. We conducted 35 semi-structured interviews with FulBe mobile pastoralists of the Far North region of Cameroon. After comparing perceptions on disease prevention, we found that pastoralists are more likely to take an active role in preventing a vector-borne disease in cattle rather than in human populations. This suggests that when working in an international public health setting, it is important to recognize how economic and cultural significance can affect the utilization of preventative medicine resources.

Our local guide, crossing a flooded road on motorbike