Human Organization, Vol. 72, No. 1, 2013

0018-7259/13/010001-11$1.60/1

On Not Knowing Zoonotic Diseases: Pastoralists' Ethnoveterinary Knowledge in the Far North Region of Cameroon

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In this article, we consider the implications of Murray Last's (1981) *Knowing About Not Knowing* for the study of ethnoveterinary knowledge of mobile pastoralists in the Far North Region of Cameroon. Specifically, we ask two interrelated questions: (1) what is the nature of this knowledge, and (2) what is the best way to study it? We conducted a study of pastoralists' knowledge of human and animal infectious diseases to evaluate the claim that mobile pastoralists in the Chad Basin do not have a concept for zoonotic diseases. We used a combination of free lists and semi-structured interviews to study pastoralists' knowledge. The results suggest that pastoralists do not have a concept for zoonotic diseases. Moreover, we found considerable variation in pastoralists' ethnoveterinary knowledge and examples of not knowing, which contrasts with previous studies that do not describe much variation in ethnoveterinary knowledge. In our discussion, we consider to what extent descriptions of ethnoveterinary knowledge are the product of researchers' conceptual framework and methodology.

Key words: ethnoveterinary knowledge, zoonotic diseases, practical knowledge, pastoral systems, Africa

Introduction

Whereas earlier ethnoveterinary research on pastoral systems focused primarily on animal health (McCorkle 1986), there has been an increasing interest in research projects that examine animal and human health as an integrated system (Zinsstag et al. 2005). These integrative projects are informed by the concepts of One Medicine (Schwabe 1984) and One Health (Kahn et al. 2008; Zinsstag et al. 2011). An integrative approach to human-animal health is particularly relevant in pastoral systems in which keeping livestock is not only a way to make a living but also a way of life. Researchers have found high morbidity and mortality levels among mobile pastoralists but also considerable variation within and among populations (Hill 1985), which may be due to limited access to clean water and health services, which is often aggravated by drought and insecurity (Pike 2004). Moreover, because of their close proximity to livestock, there is a high risk of exposure to zoonotic diseases such as anthrax, brucellosis, and bovine tuberculosis, many of which are endemic in much of sub-Saharan Africa. Surprisingly, there is evidence that pastoralists do not always recognize zoonotic diseases despite their wealth of ethnoveterinary knowledge (Krönke 2004). However, there are few studies of pastoralists' knowledge of zoonotic diseases.

We conducted an ethnoveterinary study of pastoralists' knowledge of human, animal, and zoonotic diseases to evaluate the claim that mobile pastoralists in the Chad Basin do not recognize endemic zoonotic diseases (Krönke 2004). In this article, we describe and explain the considerable variation in pastoralists' knowledge of animal diseases, in particular cattle diseases. Drawing on Murray Last's (1981) *Knowing About Not Knowing*, we argue that pastoralists' ethnoveterinary knowledge is best described as everyday practical knowledge

The authors would like to thank the mobile pastoralists in the Far North Region of Cameroon and, in particular, those who took the time to participate in the study. They also thank the members and research assistants of the Centre d'Appui a la Recherche et au Pastoralisme (CARPA) in Maroua, Cameroon for research support in the field, in particular, Alhaji Saïdou Kari, Alhaji Mouhaman Arabi, Haman Wabi, Hama Djoda Atour, and Alhaji Mouazamou Ahmadou. This research has been financially supported by a Research Experience for Undergraduates (REU) grant from the National Science Foundation (BCS-0748594), a grant from the Ecology of Infectious Diseases (EID) program from the National Science Foundation (DEB-1015908), the Public Health Preparedness for Infectious Diseases (PHPID) at the Ohio State University, and by R24-HD058484 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development awarded to the Ohio State University Initiative in Population Research (IPR). They would like to thank the Ministry of Scientific Research and Innovation (MINRESI) for granting research permission (2009-2010) and the University of Maroua for research affiliation. Finally, they thank their collaborators of the Disease Ecology and Computer Modeling Laboratory (DECML): Jessica Healy, Song Liang, Sam Valerius, Emily Walsh, and Ningchuan Xiao for their support and Daniel Hruschka, Matthew Lauer, Henry Tourneux, and the anonymous reviewers for their critical comments on earlier versions of this article.

in which individual pastoralists manage the health of their animals by integrating traditional and western medicinal practices. We end with a discussion of the implications of our study for research and development of animal health in pastoral systems.

Background

In an ethnographic study of FulBe pastoralists in Chad, Krönke (2004) found that they do not have a concept for zoonotic diseases and that they characterize diseases either as animal or human diseases. This is surprising because pastoralists' lives and livelihoods are centered on cattle, and one would expect that they would be aware of the transmission of infectious diseases from animals to human. However, one of his informants noted, "The risk of animals making us sick is minor since we live in close proximity and are still alive" (Krönke 2004:80). Krönke's study of FulBe pastoralists' knowledge of human and animal diseases was part of a multi-year, interdisciplinary research project that developed a One Health approach (Zinsstag et al. 2005). In his study, Krönke compared FulBe knowledge of three zoonotic diseases (brucellosis, tuberculosis, and anthrax) and found that the names and descriptions of causes, symptoms, and modes of transmission are quite different for animal and human versions of these biomedical diseases.

Krönke's study is an example of ethnoveterinary research, which is an interdisciplinary field that uses a mix of anthropological methods and theories to study animal health holistically within the larger context of production systems (Mathias 2004; McCorkle 1989; McCorkle, Mathias, and Schillhorn van Veen 1996; McCorkle and Mathias-Mundy 1992). Ethnoveterinary research and development (ERD) focuses on folk knowledge and beliefs, practices, technology and resources, and social organization pertaining to any aspects of health of livestock (McCorkle 1986). Ethnoveterinary research is inherently a comparative enterprise in which folk and biomedical knowledge systems are matched. Ethnoveterinary studies have demonstrated that pastoralists have a detailed knowledge about livestock diseases, even though many of the explanations, treatments, and preventative strategies are considered incorrect from a biomedical perspective (McCorkle 1986; Schwabe and Kuojok 1981). Nevertheless, understanding pastoralists' beliefs and practices is a critical first step to facilitate meaningful communication between pastoralists and veterinary professionals and to evaluate and improve the effectiveness and appropriateness of interventions that aim to improve animal health (Catley 2004; McCorkle 1986; McCorkle, Mathias, and Schillhorn van Veen 1996).

Most ethnoveterinary studies have been descriptive, focus on indigenous knowledge systems, in particular pharmacopeia, and are done by non-specialists, as there are still few researchers that identify as ethnoveterinarians. The results of these ethnoveterinary studies are reported as grey literature or as short reports in professional journals, while few are published in academic journals. (For an extensive annotated bibliography, see Martin, Mathias, and McCorkle 2001). Most studies emphasize the richness of indigenous knowledge and warn that it is rapidly disappearing (Gradé, Tabuti, and Patrick Van Damme 2009; Mathias 2007), often due to increased use of western veterinary medicines (Heffernan, Heffernan, and Stem 1996; Jacob, Farah, and Ekaya 2004). However, despite an excellent outline of the field of ethnoveterinary research as a holistic science (McCorkle 1986), the field seems to have narrowed over the years as it focuses primarily on indigenous knowledge systems and pharmacopeia, rather than the concerns of pastoralists themselves: the integrative management of animal health, that is, all practices geared towards the health and well-being of animals, including grazing strategies, mobility patterns, use of fire to control flies, and the use of vaccines and other biomedical products (see also Mathias 2004; Zinsstag et al. 2005).

Methods

This study is part of a larger, interdisciplinary study of the transmission and persistence of infectious diseases in humans and animals in the Far North Region in Cameroon conducted by the Disease Ecology and Computer Modeling Laboratory (DECML) at the Ohio State University. The goal of our study was to examine pastoralists' ideas about animal and human infectious diseases in the Far North Region of Cameroon. We examined whether there were similarities in pastoralists' descriptions of transmission, causation, treatment, and prevention of infectious diseases that affected animals and humans. We also asked explicitly whether they knew of any zoonotic diseases that affected both humans and animals, in particular cattle.

First, we asked 16 pastoralists to free list and briefly describe the human, animal, and zoonotic disease that they knew. Responses were analyzed using ANTHROPAC software to compile a list of most salient animal and human diseases, which is a combination of the frequency an item is mentioned by informants and the rank in informant's list (Borgatti 1996). Then, we used semi-structured interviews to get more detailed descriptions of the animal and human diseases that emerged as the most salient in the analysis of the free lists. Using open-ended questions, pastoralists were asked to describe, in detail, the transmission, causes, symptoms, treatments, and prevention for three human diseases (*paBBooje*, *gilDi*, *peewri*), two animal diseases (*haahaande*, *mbooru*) and one animal disease (*gawyel*) that some informants said could also affect humans. We conducted 35 semi-structured interviews in 10 different locations in the Far North Region of Cameroon. Interviews were conducted over a five-week period in June and July 2010. We used a convenience sample and worked with herders who were available in a given geographic location. Our assumption was that ethnoveterinary knowledge was widely shared, and we think that our sample is representative of the larger population of mobile pastoralists. The sample consisted of FulBe and Arab pastoralists, with ages ranging from 18 to 62, and included hired herders and independent herders, which has no bearing on the quality of their knowledge and expertise as *ngaynaaka* (herders) (see Moritz, Ritchey, and Kari 2011).

We only interviewed men because they have the primary responsibility for the care of cattle. There is strict sexual division of labor and sex segregation in Arab and FulBe pastoral households in the Far North Region of Cameroon; women are responsible for the house, and men are responsible for the herd (see also Stenning 1958). We assumed that men knew more about cattle diseases, which was underscored by one of our informants who argued that "women do not know anything about animals—they do not even remove ticks from cattle," which men do throughout the day. Similarly, Hampshire (2002) has shown in her research with mobile pastoralists in Chad that reproductive health and home-based treatments for humans are the domain of FulBe women, and that health resources are strongly gendered.

Questions and responses were translated from English into Fulfulde (and back) with the assistance of an interpreter (an MA student at the University of Maroua). Most interviews took place in pastoralists' camps in the mornings before they took their herds to pastures and in the evenings when they returned. Some interviews took place at local and regional livestock markets.

Descriptions obtained from the semi-structured interviews were analyzed using a grounded theory approach. Interviews were transcribed, read line-by-line, and coded for themes related to causes, symptoms, transmission, prevention, and treatment of the diseases. These codes were then organized into analytical memos that described common themes across diseases. The use of grounded theory approach ensured that we could explore themes that were emerging from our data that were not in our original research design. Finally, we compared pastoralists' descriptions with those of the biomedical diseases to which the FulBe diseases are conventionally translated (Noye 1989; Tourneux 2007).

Study Area and Population

The Far North Region of Cameroon has a semi-arid climate with a single rainy season. During the eight-month dry season, cattle lose considerable weight and become more susceptible to diseases. Animal losses are the highest during this season. Pastoralists have developed strategies to overcome the difficulties of the dry season. This is achieved through a focus on animal nutrition, in particular increasing weight in the rainy season so that animals have enough reserves to survive the long dry season, and limiting weight loss in the dry season. Mobile pastoralists in the Far North Region prevent weight loss of their animals through transhumance, taking their animals to the rangelands with the highest quality and quantity of forage. This opportunistic grazing strategy closely tracks resources, which is a highly appropriate and effective way to cope with the variable, unpredictable, and heterogeneous environments of Africa's drylands (Behnke, Scoones, and Kerven 1993).

The mobile pastoralists in the region belong to different Arab and FulBe groups. The FulBe group consists of Jamaare'en, Mare'en, Alijam'en, Adanko'en, Anagamba'en, and Uuda'en groups. All the groups are highly specialized in animal production. In most groups, the key animal is cattle, but they also keep sheep and goats to cover small expenses and donkeys and horses for transport.

The veterinary infrastructure is extensive, as there are currently 144 *Centres Zootechniques et de Contrôle de Sante Vétérinaire* (or CSV) in the Far North Region. The main functions of the CSV are the annual vaccinations and veterinary health controls at livestock markets and along transhumance and trade routes. However, there is only one CSV in the Logone Floodplain where it serves approximately 100,000 cattle in the dry season and only two near Lake Maga, which is used by as many cattle as in the Logone Floodplain. The number of CSVs is based on the distribution of cattle in the rainy season when cattle are vaccinated, but at that time there are no mobile pastoralists in the two aforementioned areas. The low number of CSVs in the Logone Floodplain and Lake Maga underscores that their main function is vaccinations, not the treatment of livestock diseases. Veterinarians and veterinarian assistants from the CSV rarely come to the camps of mobile pastoralists, except for the annual vaccinations.

Cattle are vaccinated annually against infectious diseases that cause the greatest losses and have the most readily available vaccines: anthrax, blackleg, lumpy skin disease, hemorrhagic septicemia, and contagious bovine pleuropneumonia. However, other livestock, including sheep, goats, and donkeys, are not vaccinated and can potentially transmit some of these diseases. Moreover, there are many other infectious diseases for which there are no vaccinations in the Far North Region, like foot-and-mouth disease, brucellosis, and leptospirosis. Most of these diseases are endemic in the region, and the rates of infection are very high. In a cross-sectional serosurvey of 30 herds, we have found prevalence rates of 81 percent for foot-and-mouth disease and 21 percent for brucellosis. Surprisingly, livestock losses due to diseases are relatively low (2 percent to 3 percent) (Moritz 2003). Most self-reported losses are due to *mbooru* (foot-and-mouth disease) and *haahaande* (heartwater), but there are no good biomedical data on what diseases are responsible for livestock losses.

There are a number of zoonotic diseases in the Far North Region, and most of them are endemic, including the familiar anthrax, brucellosis, and tuberculosis. In addition, there are many other zoonoses, like *Cryptosporidium* (which causes diarrhea), dermatophytosis (or ringworm, which causes skin problems), round and tapeworms (which may cause diarrhea and other intestinal problems), and mange (skin mites, which cause an itchy rash).

Mobile pastoralists use a wide range of strategies to manage the health of their animals. To prevent diseases, they remove ticks daily and light smoky fires in the corral to chase away mosquitoes and biting flies. Some also move their animals either upwind or downwind from a herd infected with foot-and-mouth disease to either avoid or seek exposure so that animals develop immunity. This depends on the time of the year. When animals are weak towards the end of the dry season, they avoid exposure, but they seek it when animals are

Table 1. Freelist Results of Animal Diseases (*n*=16)

Animal Diseases	Conventional Translation	Frequency (%)	Average Rank	Salience
Mbooru	Foot-and-Mouth Disease	100	2.6	0.60
Haahaande	Heartwater	91	2.8	0.51
Awsere	Trypanosomiases	82	3.0	0.46
Gawyel	Blackleg	73	3.4	0.37
BumsuDe	Contagious bovine pleuropneumonia	73	4.4	0.30
Daamol	Anthrax	55	4.2	0.25
Joola	Trypanosomiases	45	3.8	0.20

healthy towards the end of the rainy season. Amulets are used for protection against thieves and to promote the productivity of the herd. To treat diseases, pastoralists often cauterize their animals and use medicines from trees and plants as well as veterinary medicines that they buy from ambulant sellers at local markets. There are no ethnoveterinary specialists, but some pastoralists have more expertise than others; for example, dealing with difficult deliveries. There are a few magico-religious specialists who prepare magical protections against thieves and predators; for example, by making herd and herders invisible. In general, each individual pastoralist is responsible for managing the health of his animals in an extremely challenging disease ecology with limited support from veterinary centers.

Results

We will briefly describe pastoralists' descriptions of three animal diseases that were considered highly salient (haahaande, mbooru, and gawyel). We will give pastoralists' descriptions of symptoms, causes, patterns of transmission, possible treatments, and prevention as well as a summary of the variation in informants' descriptions of causes in table format. For each disease, we also provide descriptions of the most likely equivalent biomedical diseases, which is based on pastoralists' description and conventional translations (Noye 1989; Tourneux 2007) and analysis of pastoralists' descriptions by the veterinarian on our team. We note that there are no perfect matches between pastoralists' and western biomedical concepts (see also Grandin and Young 1996; Krönke 2004; McCorkle 1986). For example, the descriptions of gawyel match those of blackleg (as it is commonly translated) as well as anthrax, and we, therefore, give the biomedical descriptions for both diseases. But first, we will briefly discuss the results from the free lists and whether mobile pastoralists recognize zoonotic diseases.

Table 2. Freelist Results of Zoonotic Diseases (*n*=16)

Responses	Translation	Frequency
Mi anndaa	Do not know	10
Haahaande	Heartwater	2
Gawyel	Blackleg	1
Pentellu	Tapeworm	1
Caayoori	Inflammation	1
Mbuunya	Fungus	1

Free List Results

Animal diseases that were mentioned by more than one informant are listed in Table 1. There were not enough responses to run a quantitative analysis of the free list results for zoonotic diseases, but the qualitative analysis suggests strongly that pastoralists do not recognize zoonoses. First, the majority of the pastoralists interviewed did not know of any diseases that affected both animals and human (10 out of 16). Second, the ones that said that there was a disease that affected both animals and humans mentioned only one disease. Third, only four mentioned a specific disease and only two mentioned the same disease: *haahaande* (usually translated as heartwater, which is not a zoonosis). The other diseases mentioned were *gawyel* (usually translated as blackleg, not a zoonosis) and *pentellu* (tapeworm). Most mentioned symptoms that characterized the disease (e.g., inflammation, diarrhea, coughing) or a specific parasite (e.g., tapeworm). The fact that they gave so few answers and that there was so little agreement among informants suggests that the responses may be an artifact of the interview in the sense that the informants wanted to help the interviewer.

However, the data collected in the semistructured interviews shows that some pastoralists recognize that diseases may be transmitted from animals to humans. For example, one-fourth of the informants noted that *gawyel* (blackleg) might be transmitted to humans through consumption of meat and milk from an infected animal, although they have not observed it. In addition, a common belief among FulBe pastoralists is that drinking milk causes *paBBooje* (malaria), however FulBe do not think that cattle have paBBooje.

Haahaande

The word *haahaande* (plural *kaakaale*) literally translates to gall bladder; however, respondents argued that the disease

Table 3. Haahaande Causes Mentioned in Semi-Structured Interviews (*n*=22)

Young but dry grass	1		1	1	1	1		1					1	1	1	1	1	1	1				13	59%
Rainy season			1	1					1	1	1	1	1										7	32%
Don't know (or only Allah knows)	1					1	1	1	1					1									6	27%
Horse flies		1					1					1	1									1		5	23%
Drink water after eating grass					1					1										1		1	4	18%
Dirty water	1																						1	5%
Blood from infected cow		1																					1	5%
Born with it		1																					1	5%
Total	3	3	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	38	

Rows represent the different causes mentioned by an informant during the semi-structured interviews. The columns represent the different informants. The last column represents the percentages of informants that mentioned a particular cause.

could affect multiple parts of the animal. The disease is typical of the start of the rainy season. Respondents recognize both internal and external symptoms of haahaande. External symptoms include: mysteriously falling down, rolling eyes, inability to eat, seizures, shaking, and other strange and dangerous behavior. The internal symptoms attributed to haahaande include a swollen stomach and a swollen gall bladder. One respondent stated that pastoralists recognize when an animal is affected by haahaande because it cannot digest grass and develops a quite visible bloated stomach. All internal symptoms are discovered once the animal dies and is butchered.

The majority of respondents explained that the main cause of haahaande is new grass. One respondent explained, "In the beginning of the rainy season, new grass sprouts. When there is a brief dry spell, the young grass dries. When the cattle eat the new dry grass, they can get haahaande." Another two respondents explained that it is a specific type of new grass—one that has a large bulb that sprouts seeds. However, a few respondents stated that *peeci* (horse flies; Tabanidae sp.)—are the source of haahaande. One respondent said that it must be peeci, because they are so numerous in the beginning of the rainy season; he stated that the more flies in the area, the more animals are infected with haahaande. As well, some respondents stated that only Allah knows the true reason to the appearance of haahaande every year.

Treatments for haahaande include a wide array of techniques and strategies including both traditional and western treatments. Some pastoralists suggest that when an animal becomes sick with haahaande, it must remain at camp and have limited amounts of food and water. A few respondents explained that they use a red-hot iron to cauterize a cross onto the head of infected cattle and a series of lines on its chest and sides. Likewise, some people suggested that the bark and roots from trees found in the bush could be used to treat haahaande. One respondent suggested using a special medicine contained in a *laayaru* (leather satchel) and placed around the neck and horns of the cattle. Likewise, a few respondents suggested that modern veterinarian medicine could be utilized to treat haahaande; this includes drugs bought at the market.

Respondents stated unanimously that nothing could be done to prevent this disease. A few suggested that the veterinarian might be able to create some sort of vaccine, but most respondents only act when cattle become sick.

Haahaande is usually translated as the biomedical disease heartwater, a disease caused by *Ehrlichia ruminantium*, which is a *rickettsial* pathogen transmitted primarily by ticks. Clinical signs of the infection are mostly due to leaks in blood vessels and include respiratory distress, neurologic abnormalities, and diarrhea. Changes in the gall bladder are not usually noted with this disease, but hemorrhage into the gall bladder is certainly possible. Seasonal pulses of disease can be related to seasonal emergence of ticks. The recommended treatment for Heartwater is tetracycline administration. Some of the symptoms pastoralists described below also point to other diseases. For example, new grass can also cause magnesium deficiency and frothy bloat, which could cause some of the signs noted by herders. A recent report suggests that *E. ruminantium* has zoonotic potential because it was found in humans, although there is no evidence yet that it causes disease in humans (World Organisation for Animal Health 2009).

Mbooru

Pastoralists said that mbooru is very common and hold it responsible for many livestock losses and severe economic losses. Symptoms of mbooru that pastoralists describe include cuts on the hoof and mouth, problems with the tongue, and profuse salivation. In certain cases, the combined symptoms of disease can be fatal in some animals; they become "good for the butcher" as one respondent stated. Likewise, many pastoralists explained a higher rate of fatalities in calves that contract mbooru. The calves, infected from their mothers (likely those without maternal immunity), are most likely to die within a few days or even a few hours.

Unanimously, pastoralists acknowledged that mbooru could be transmitted within and between herds. A majority of pastoralists concluded that a sort of contamination is responsible for the high prevalence and transmission of mbooru. Pastoralists listed three transmission scenarios. First, cattle infected with mbooru contaminate a common travel route

Table 4. Mbooru Causes Mentioned in Semi-Structured Interviews (n=28)

Only Allah knows	1	1	1		1				1	1	1			1	1	1	1		1		1	1	1						15	54%
Contamination animals	1			1				1	1			1	1	1	1	1								1	1	1			12	43%
Crossing paths	1	1		1		1	1			1	1	1						1		1									10	36%
Contaminated grass	1	1	1		1	1	1		1		1																	1	9	32%
Saliva			1	1	1		1	1					1																6	21%
Contaminated water		1		1		1				1							1										1		6	21%
Blood from other cattle			1				1	1																					3	11%
Cow to calf (via milk)						1						1	1																3	11%
Via humans			1															1											2	7%
Cold					1																								1	4%
Wind		1																											1	4%
Breathing	1																												1	4%
Total	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	69	

with blood from its hooves and saliva from its mouth. Second, cattle may eat grass contaminated by infected saliva. Third, some pastoralists stated that the disease could be transmitted through women's milk marketing activities to other camps. A few pastoralists offered alternate theories. One herder stated that respiration could transmit the disease; another said that a bird could carry the disease from one herd to the next. A few pastoralists suggested that dirty water could transmit mbooru.

Most pastoralists acknowledged that there is little, if nothing, that one can do to treat mbooru. Some respondents acknowledged that the use of drugs, bought at the market or administered by the veterinarian, could help. However, pastoralists suggested that these are ultimately ineffective. Some respondents use folk treatments for mbooru, such as placing special herbs up the nostrils of the animal, hanging leather satchels full of powder on the animal, as well as using special fruits found in the bush. Others argued that these treatments were ineffective. A few pastoralists stated that a constant network of communication between herders is crucial to prevention: knowledge of outbreaks is shared between pastoralists.

Mbooru (also known as *njoobu*) is usually translated as the biomedical disease foot-and-mouth disease, which is caused by a highly infectious virus that is considered one of the most transmissible pathogens known today. It is transmitted by direct contact, contact with contaminated materials, and aerosols (though the later is still contended). Blisters in the mouth and along the band between the leg and the hoof, which burst and become ulcers, are the primary clinical signs of disease reported in biomedical literature. These lead to salivation, decreased food and water intake, limping, and secondary infections. Acute mortality in calves is also reported. While treatment with antibiotics may prevent secondary infections that would prolong suffering in animals, there are no treatments for the virus itself that are known to be effective and feasible in cattle. Highly effective vaccines are available in many parts of the world to prevent clinical disease, but the vaccines must be tailored to match the viral strains circulating in the area.

Gawyel

Some herders stated that they could not describe gawyel because they had never seen it. However, most herders described gawyel as a disease that could infect both animals and humans. It is a very dangerous disease, often leading to the death of the afflicted animal or human. Gawyel is derived from *gaw*, meaning hunter, because according to Noye (1989), the disease hits livestock like a hunter's arrow. In cattle, most herders stated that localized swelling is a common symptom of gawyel. The legs, chest, and entire body of the animal can swell when it is infected with gawyel. Some herders suggested that the skin of infected cattle becomes black and hardens, developing large dark pustules. If an infected animal is slaughtered, then the carcass is buried or burned. Some herders stated that after slaughtering an infected animal, the meat and byproducts are dangerous to humans and other animals. Herders explained that the symptoms of gawyel are similar for humans and cattle. Humans develop localized swelling and pustules on their hands, arms, and legs. A few herders suggested that the disease could also be fatal for humans.

Herders reported that the transmission of gawyel differs between animals and humans. For cattle, many herders described the disease origins as unknown. Some herders suggested that gawyel came directly from the environment in which cattle live; the grass, the water, and the ground may be contaminated. One herder suggested a specific water hole, located in Ndiyam Shinwa, as a source of infection. Two herders stated that it was *henndu* (spirit wind) that brings gawyel to a campsite. Gawyel spreads from animal to animal; when an infected animal dies, herders stated that other cattle could become infected from touching the carcass. Likewise, a few herders suggested that even the area where an infected animal had died could be a potential source of contamination for other cattle.

Some herders suggested that the human form gawyel has completely different origins and could not be transmitted from animal to human. These herders stated that the transmission of gawyel to humans is unknown; some suggested that it simply exists within the environment. Other herders stated

Table 5. Gawyel Causes Mentioned in Semi-Structured Interviews (*n*=15)

Don't know							1	1	1	1	1	1	1	1		8	53%
Environment	1	1	1	1	1											5	33%
Meat consumption (humans)	1	1				1									1	4	27%
Cattle to cattle	1		1	1	1											4	27%
Milk consumption (humans)						1										1	7%
Pastures around Lake Maga		1														1	7%
Henndu (spirit)			1													1	7%
Total	3	3	3	2	2	2	1	1	1	1	1	1	1	1	1	24	

that gawyel could transmit from animals to humans through the consumption of infected meat and byproducts. Likewise, a few herders suggested that touching the puss from the black pustules of an infected animal could infect humans.

Many herders stated there was little to nothing they could do to prevent or treat gawyel. Some herders suggested that veterinarians and doctors might have vaccines to prevent this disease. Likewise, some herders suggested that the injection of procaine might help alleviate the symptoms of this disease. Ultimately, the herders who recognized this disease as a dangerous problem present for both animal and human populations had discovered no viable treatment or preventative measures.

Gawyel is usually translated as the biomedical disease blackleg, which is an infectious bacterial disease that affects cattle and sheep. Many of the symptoms described above also resemble those of anthrax, known as *daamol* or *kiku* among FulBe pastoralists. Blackleg and its close cousin, malignant edema, are anaerobic putrefactions of muscle and subcutaneous tissue with a very characteristic dark color, bubble-wrap like feeling (crepitus) and sweet smell caused by *Clostridium chauvoei* and *Clostridium septicum*. Some animals may die before any clinical signs are observed, but others will develop painful swelling of the muscles and surrounding tissues. In blackleg, swollen muscles gradually lose blood supply and die. Cattle may die of these diseases within one to two days. Both of the bacteria are found in the soil and in the intestinal contents of healthy animals. It is unclear exactly why apparently healthy animals succumb to these diseases, but blunt trauma resulting in loss of blood supply to muscle tissues is one risk factor for blackleg, and malignant edema is usually associated with wounds. While *Clostridium chauvoei* is not a zoonotic disease, *Clostridium septicum* can cause similar disease in people.

These diseases should not be confused with another anaerobic infection, *Bacillus anthracis* or anthrax (known as *daamol* or *kiku* among FulBe pastoralists). Transmission of anthrax in cattle occurs when cattle contact spores of the bacteria that are in infected carcasses or in areas where animals have died of the disease previously. Biting flies may also have a role in transmitting the disease during outbreaks. The most dramatic signs of anthrax in cattle include rapid death and bloody discharge from all natural body openings. However, a chronic form of anthrax exists that may have diffuse swellings like in blackleg and malignant edema but in different areas of the body. In humans, anthrax is often acquired through wounds that are contaminated from infected animals or their hides, for example in butchering. These wounds have a characteristic black appearance and can be extremely painful. Because of the biology of *Bacillus anthracis*, carcasses of infected animals should be left intact (1) to prevent spores from forming, and (2) to prevent serious disease in people from consumption of infected meat and wounds during butchering. Specific diagnosis of these diseases can be dangerous and usually requires culture of the organism. Good quality vaccines exist for all three bacterial species, and all can be treated in the early stages with penicillin. Avoidance of contaminated areas is also recommended.

Discussion

We have found no consistent evidence that mobile pastoralists in the Far North Region of Cameroon have a concept of zoonoses as a category of diseases that affect both humans and animals. This confirms earlier findings of Krönke (2004) with FulBe pastoralists in Chad. This is remarkable since pastoralists live in such close proximity to their animals, and so many zoonoses are endemic in the region. It raises the question why pastoralists do not recognize this category of diseases and do not have a specific term for zoonoses. It is easier to recognize a disease as zoonotic if the signs are recognizable in humans and animals in the same place at the same time. Brucellosis looks different in humans and animals, so a non-medical person might not make the connection. The symptoms for tuberculosis are similar in humans and animals, but take a long time to develop, so pastoralists might not be able to connect the disease in humans with disease in animals several years ago. Anthrax does occur in people and animals at the same time and the signs of the disease are unique enough that pastoralists may be able to connect them, but the disease is somewhat rare in the Far North of Cameroon. Zoonotic diseases that have similar symptoms in humans and animals are dermatophylosis (ringworm), cryptosporidiosis (diarrhea) and mange (skin diseases). However, it is possible that rashes and diarrhea are so common in humans that these zoonotic causes are not distinguished from a host of other possible causes. We hypothesize that pastoralists experience the symptoms very differently for humans and animals. For

example, pastoralists were reluctant to describe human diseases that they had not experienced personally, but they did not hesitate to describe the symptoms of animal diseases. In addition, many animal diseases may have similar symptoms (e.g., blackleg and anthrax); some of these diseases may be zoonotic while others are not. All this makes it difficult for pastoralists to discern patterns in infectious diseases among humans and animals. Krönke (2004) has suggested that FulBe pastoralists do not consider an important transmission pathway for zoonoses—milk consumption—because they have no knowledge of microbial agents of infection. Although pastoralists may not know of these transmission pathways for zoonoses and other infectious diseases, they are keenly aware of when these diseases emerge, for example at the beginning of the rainy season when grasses start to grow, milk production increases, and mosquitoes and biting flies become more prevalent.

Pastoralists' descriptions of animal diseases in the Far North Region are similar to what others have found among FulBe pastoralists in West Africa (e.g., Ba 1994; Bonfiglioli, Diallo, and Fagerberg-Diallo 1996). However, the main difference between our findings and the literature is that we found considerable variation and many cases of not knowing during our interviews, whereas in the literature, FulBe ethnoveterinary knowledge is always presented as if there is a strong consensus among pastoralists (e.g., Bonfiglioli, Diallo, and Fagerberg-Diallo 1996). There are no discussions of variation, let alone not knowing. However, we suspect that there is variation in ethnoveterinary knowledge among FulBe pastoralists in other parts of West Africa and that the pastoralists in our sample are not unique. Yet, the way the aforementioned ethnoveterinary studies are written up would suggest that is not the case. We think that most ethnoveterinary studies are conducted with the assumption that there is system of knowledge with common, consistent body of theory. But that may not be an accurate description of ethnoveterinary knowledge of contemporary African pastoralists. The knowledge systems described in the literature may be produced by researchers systematizing and over interpreting their interview data (Littlewood 2007).

When we designed our exploratory study, we also assumed that we would be describing a rich indigenous knowledge system and that there would be considerable consensus among our informants. However, we found considerable variation in knowledge about human and animal diseases among our informants. Moreover, we were surprised that in many cases the responses to our questions about the causes and patterns of transmission were: "I don't know," "only Allah knows," "only the doctor knows," or "only the veterinarian knows," which made us wonder whether there was a system of knowledge, that is, a coherent and systematic body of knowledge concerning animal and human diseases.

Systems and Non-Systems of Knowledge

The terms ethnomedical and ethnoveterinary systems imply coherent and systematic bodies of knowledge concerning human and animal health respectively. However, anthropologists have raised the question whether there are always systems of knowledge (Last 1981) and if they are the product of the locals or the ethnographers studying them (Littlewood 2007). Studying medical beliefs and practices in Northern Nigeria, Last (1981) was struck by how much people did not know and did not care about knowing traditional Hausa medicine. It made him question whether there was a system or non-system of knowledge. Last argues that there is an uneven distribution of knowledge in a society, and that it is hierarchically layered, with greater systematicity at the top (hospital medicine, Islamic medicine) than at the bottom (Hausa medicine). Last speaks of a medical system if practitioners adhere to a common, consistent body of theory, patients recognize the practitioners and their body of theory as valid, and this theory is used to explain and treat most illnesses that people experience. One of the lines of evidence of the lack of a coherent theory among patients and practioners of Hausa medicine was the absence of an agreed medical vocabulary; a large number of health-related terms did not have a standard meaning.

The assumption of the ethnomedical systems can set researchers on the wrong foot. Randall (1993), for example, explains that she was surprised that her Tamasheq informants showed ignorance, surprise, and contradictions when asked about humoral (hot-cold) classifications, because the literature suggested that it was the primary explanatory system guiding Tamasheq illness behavior. She writes: "Kel Tamasheq, like most people, use treatments in order to relieve symptoms, without asking 'why?' that treatment. Politeness dictates that they answer researchers' questions, and although some answered 'I don't know' or 'it wasn't relevant,' others tried to find an answer and a justification even where this had no influence on their management of the illness episode" (Randall 1993:679). The experiences of Last and Randall raise the question of how to study ethnomedical and ethnoveterinary knowledge if there is no system of knowledge.

Others have followed up on Last's work and examined the limits of coherence of local health-related knowledge in other settings and reflected on the epistemological consequences for ethnomedical studies (Littlewood 2007). The possibility of not knowing raises two key questions for the ethnomedical and ethnoveterinary studies: (1) what is the nature of local health-related knowledge (i.e., variation, coherence, systematicity of knowledge); and (2) how do we study local health-related knowledge (i.e., what methods are appropriate for what kind of knowledge) (Littlewood 2007). For example, Last (1981) argues that you can practice management of human health without knowing much, just as we can use computers without knowing anything about how they work. Much ethnomedical knowledge may be practical knowledge, meaning that people do health-related stuff without thinking much about it, for example washing and treating wounds or removing ticks.

Tourneux's (2007) *Dictionnaire Peule du Corps et de la Santé* (Fulfulde Dictionary of Body and Health) is a good example of an ethnomedical approach that assumes

"not-knowing", that is, that there is no coherent system of beliefs and practices. The book is based on interviews with a wide range of informants, including healers, housewives, Muslim scholars, nurses, patients, and herders. Quotes from these interviews, which are first given in Fulfulde and then translated into French, give a good sense of how different people talk about these health-related terms and concepts in everyday speech. They also show the variation in health-related beliefs and practices, including contradictions and statements that are pertinently false from a biomedical perspective. Tourneux (2007) writes that he did not want to create an artificial consensus among informants because the goal of the dictionary is to make development interventions more effective by facilitating communication between local people on the one hand and development professionals on the other. Therefore, it is critical to know how different people think and talk about health, including what they do not know or disagree about, which is one of the major goals of ethnoveterinary research and development (McCorkle 1986).

Variation in Ethnoveterinary Knowledge

What is the evidence for a system of ethnoveterinary knowledge among mobile pastoralists in the Far North Region? First, there is no distinction between practitioners and lay folk as there are no ethnoveterinary specialists or healers, and everyone is a practitioner managing the health of his own herd. Second, there is no common, consistent body of theory that explains causes, treatment, and prevention of diseases, even though there are common themes in description of transmission patterns (e.g., insects, water, grasses, seasonality). Thirdly, there is no common or consistent theory that is used to explain and treat most animal diseases. There is a great variation in ethnoveterinary knowledge, and pastoralists in our sample frequently gave conflicting descriptions of diseases.

Unfortunately, we cannot quantify the variation because we used open-ended semistructured interview to document what pastoralists knew broadly about infectious diseases that affect humans and animals. Ethnomedical studies that have measured intra-cultural variation either focus on one particular disease or one dimension of diseases using free list, pile sorts, and rankings (Bernard 2006). For example, Weller (1983) has used quantitative analyses to show considerable variation among Guatemalan women with regard to hot-cold classification of diseases, but not with regard to the contagiousness of diseases. However, our qualitative analysis clearly shows that there is considerable intra-cultural variation in pastoralists' ethnoveterinary knowledge.

How can we explain the considerable variation in ethnoveterinary knowledge and why might there be no system of ethnoveterinary knowledge? One reason is that there are no healers as in other pastoral groups (Schwabe and Kuojok 1981). Another reason is that pastoralists often receive conflicting information about the treatment and prevention of diseases from one another as well as from veterinarians and ambulant vendors at the local markets. First, much traditional ethnoveterinary knowledge is considered personal and secretive; it may be shared with friends but rarely discussed with others. Second, when veterinarians are consulted about sick animals, which happens rarely, it is often at the livestock market when the animal itself is not present. Veterinarians are, thus, unable to give an accurate diagnosis, also because so many diseases have similar symptoms. Third, most ambulant vendors have neither a veterinary nor pastoral background and are selling veterinary medicine, often of dubious quality, directly to pastoralists in order to make a profit. They also recommend medicines based on descriptions of the symptoms by pastoralists without ever seeing sick animals. It is not surprising that pastoralists do not trust the information from vendors, veterinarians, or other pastoralists. It is only after they themselves have experimented with the medicines and evaluated its effectiveness that they will incorporate a treatment in their own repertoire. Finally, pastoralists are not primarily interested in the causes of the diseases; they are concerned with preventing and treating the diseases. They want to know whether treatments work, not how they work.

Five decades earlier, Dupire (1957) already noted that FulBe pastoralists in Niger and Cameroon were quick to adopt practices and preparations from outside sources; they were equally quick to reject practices that proved ineffective (as described in Martin, Mathias, and McCorkle 2001). Pastoralists in the Far North are also actively and continuously seeking effective methods to manage the health of their animals. This process results in the integration of traditional and western strategies. For pastoralists, there is no logical contradiction or conflict between the two approaches. However, most pastoralists do not use these western medicines correctly, for example, they use antibiotics to treat viruses like foot-and-mouth disease (although the antibiotics may prevent infections resulting from the sores), use the wrong quantities, or medicines that have expired or been improperly stored (see also McCorkle 1989). Thus, for various reasons, the treatments with western veterinary medicine are not always effective, and neither are traditional medicines.

The ecology of infectious diseases in the Far North Region of Cameroon is complex; many diseases are endemic, their symptoms often quite similar, and they are difficult to treat and prevent with both traditional and western medicines. Everyday pastoralists are facing the challenges of managing the health of their animals, and they alone are ultimately responsible because the veterinary infrastructure is inadequate. The result is that in this context, ethnoveterinary knowledge is highly personalized.

Studying Ethnoveterinary Knowledge

Most ethnoveterinary studies focus almost exclusively on traditional knowledge systems, but there are practically no studies of pastoralists' beliefs and practices concerning western veterinary medicines diseases (see also Grandin and Young 1996; Heffernan, Heffernan, and Stem 1996; McCorkle 1989), even though pastoralists themselves clearly use and recognize

the value of western medicines and vaccinations. There are also few systematic observations of pastoralists' ethnoveterinary practices, that is, how they use their knowledge to prevent, diagnose, and treat animal diseases. Instead, most ethnoveterinary studies focus on knowledge in the abstract collected in interviews, rather than on knowledge in practice collected through observations. However, there are multiple modalities of knowledge, and not all knowledge is declarative knowledge that is transmitted through language. Much local knowledge is learned through observation, imitation, and practice (Fiske 2000), which means that this kind of knowledge is best studied through participant observation as practical knowledge rather than through interviews as knowledge in the abstract. (For a similar discussion about local ecological knowledge, see Lauer and Aswani 2009.) In a study of ethnoveterinary knowledge, researchers could, for example, systematically observe and interview pastoralists as they are treating their animals. Of course, such a methodological approach requires a much greater time commitment than free lists and semistructured interviews.

It is possible that, had we used a combination of observations of pastoralists' ethnoveterinary practices and interviewed pastoralists as they treated their animals (see also Lauer and Aswani 2009), instead of relying solely on interviews of their knowledge of infectious diseases, we might have found an ethnoveterinary knowledge system. In other words, the non-system may be an artifact of our methodological approach. Not knowing may be an artifact of the semi-structured interviews, as informants who said *mi anndaa* (I don't know) continued by giving a number of possible causes for the diseases (see also Foster 1979), which may also suggest not that they do not know, but that they generally do not think much about it.

We caution the reader that we are not drawing a distinction between the nature of ethnoveterinary knowledge of the pastoralists in our research project and knowledge of other professionals. We suspect that if we were to do a similar study of Cameroonian veterinarians, our collaborators at the University of Maroua, and veterinarians and anthropologists at Ohio State University, we would also find considerable variation and cases of not knowing because we too practice science without always reflecting on what we know and how we know it (see also Latour and Woolgar 1979).

Conclusion

The findings of our study of pastoralists' ethnoveterinary knowledge indicate that we are dealing with a non-system. The variation in knowledge and not knowing is not so much because pastoralists do not care—they care very much about the health of their animals—but because they are actively seeking and experimenting with traditional and western medicines that may be effective in preventing and treating diseases that threaten their animals in an ecological context in which many dangerous infectious diseases are endemic. Consequently, ethnoveterinary knowledge of pastoralists is best described as practical knowledge, and the most appropriate way to study this kind knowledge is through a combination of observations and interviews rather than interviews only. Researchers should carefully consider the nature of ethnoveterinary knowledge and how to best study it because conceptual and methodological choices directly shape studies' outcomes.

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