

THE BIOCULTURAL LANDSCAPE OF ZOONOTIC DISEASE: EXAMINING
HUMAN-ANIMAL VULNERABILITY TO ANTHRAX ON THE COLOMBIAN-
VENZUELAN BORDER

by

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Abstract

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The Biocultural Landscape of Zoonotic Disease: Examining Human-Animal Vulnerability to
Anthrax on the Colombian-Venezuelan Border

Thesis Directed by Professor Darna Dufour

The focus of this thesis is to provide a holistic understanding of the political, cultural, environmental, and biological factors that may be contributing to increased vulnerability to anthrax in Wayuu and non-Wayuu human and livestock communities in La Guajira, Colombia. Qualitative data collection was undertaken during a three month period from May to August 2014. A total of 14 semi-structured interviews were conducted with Wayuu and non-Wayuu herdowners, veterinarians, and government public health officials. Direct observations were collected on *rancherías* and farms in La Guajira throughout the duration of the study. The findings of this study suggest that the anthrax-drought relationship is mediated by several high-impact factors, primarily large and small scale animal movement. These anthropological insights will contribute to a greater understanding of human-animal relations in complex ecological contexts and to the ongoing reframing of international public health into a more holistic, locally-responsive, global health practice.

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CHAPTER 1

INTRODUCTION

Overview of Thesis

In this thesis, I conduct a biocultural analysis of human-animal vulnerability to anthrax on the Colombian-Venezuelan border. I do so via 1) thematic literature reviews and 2) analysis of qualitative data collected during three months of field study with the Wayuu, an Amerindian indigenous group, and non-Wayuu in La Guajira, Colombia. First, I present the thematic literature reviews, and then the focused research questions which I developed following initial data collection and in light of the complex biocultural landscape in La Guajira. The complexity of this landscape is attributable to 3 factors: 1) anthrax is endemic to Wayuu and non-Wayuu territory, 2) drought persists in the region, and 3) political, cultural, and species boundaries are present. The research questions to be addressed are: How does animal movement influence human-animal vulnerability to anthrax during drought periods in La Guajira, Colombia? Does vulnerability vary cross-culturally within La Guajira?

I then describe the context of the study utilizing the Triangle of Human Ecology framework, state the methodology, and present the results retrieved through semi-structured interviews and direct observations. Lastly, I discuss the drought-anthrax relationship and argue that this relationship is mediated by several high-impact factors, primarily both large and small-scale animal movement over political and cultural boundaries.

Overview of Introduction

In the introduction, I review key theoretical frameworks and relevant literature to aid in the conceptualization of the central focus of this thesis: biocultural factors of zoonotic disease

transmission. First, I introduce zoonotic diseases and their global health relevance, giving particular attention to the importance of the intersection of human and animal health. I then conduct a systematic literature review on human-animal interactions, particularly those with implications for cross-species disease transmission, and operationalize the term ‘human-animal interactions’. I review the work that has been done both within and outside of anthropology. I discuss the OneHealth discourse and its explicit call for social scientists to make a contribution to this field of study, and I suggest a means by which anthropology can make a more substantial contribution through the study of ethnoveterinary medicine. Lastly, I present the focus of the current case study.

Zoonotic Disease: Intersection of Human and Animal Health

“Between animal and human medicine there is no dividing line --- nor should there be.”

Rudolph Virchow (as cited in Brown, 2006, p. 6).

Throughout many parts of the world, especially in developing countries, people and animals live in close proximity to one another (Karaimu, 2010). It is not uncommon for sheep, pigs, goats, chickens, and cows to move freely over rural homesteads throughout the day, efficiently using relatively small spaces (Karaimu, 2010). It allows the animals to feed on excess food there may be from the household, making tending to the animals easier as the owners do not have to walk great distances to feed and water them, and the resulting animal manure fertilizes the cropland (Karaimu, 2010). Livestock are extremely important to smallholder farmers. They depend on these animals to feed their families, generate household income, and provide security in resource scarce environments (de Vries et al., 2006).

However, for some this comes at a great risk. Living in close proximity to animals puts

these families at risk for contracting zoonotic diseases (Karaimu, 2010), contagious diseases transmitted between people and animals. In recent years, the major emerging infectious diseases have originated in animal populations. According to the International Livestock Research Institute (ILRI), 56 zoonoses are responsible for 2.4 billion zoonotic disease cases a year and kill 2.2 million people (MacMillan, 2012). The majority of these deaths are from only 12 zoonoses, including leptospirosis, tuberculosis, rabies, cysticercosis, and brucellosis. Zoonotic diseases represent 67% of all human pathogens and more significantly 75% of emerging and re-emerging diseases (Coker et al., 2011). Recently emerged diseases include Nipah virus, avian influenza, severe acute respiratory syndrome (SARS), West Nile virus, bovine spongiform encephalopathy (BSE), and HIV/AIDS (Coker et al., 2011). Less sensationalized, ancient zoonotic diseases are now re-emerging within the context of the processes of globalization (Coker et al., 2011). Such zoonotic diseases include anthrax, bovine tuberculosis, brucellosis, rabies, and trypanosomiasis. Of particular importance to people who share their everyday lived experience with cattle are brucellosis, anthrax, and bovine tuberculosis. These diseases have the propensity to easily jump the livestock-human boundary.

The overlapping nature of animal and human health, brought about by close contact of animals and humans, requires that we focus our attention on improving *both* animal and human health, and that we gain an in-depth understanding of locale-specific cultural contexts. Framing the intersection of animal and human health within cultural contexts and placing increased value on lived experience is critical to understanding and therefore preventing zoonotic disease transmission.

Human-Animal Interactions

While the body of scientific literature on emerging zoonotic diseases has grown exponentially over the last 15 years, it has remained narrowly focused on biological pathways, genetic evidence, and ecological drivers of emergence. In examining the seminal works in the field (Chua et al., 2000; Daszak et al., 2007; Taylor et al., 2001) and reflecting upon the most recent zoonotic crises (i.e. Ebola, SARS, avian influenza), it is evident that human-animal interactions play a central role in zoonotic spillover events. Although the importance of human-animal interactions has been consistently acknowledged in previous studies, an in-depth understanding of the context of human-animal interactions has not often been the core focus of these works.

A transdisciplinary literature search illustrated the highly-variable conception of the term “human-animal interactions”, ranging from direct physical contact to indirect contact (e.g. overlapping territories, shared homes). It also included cases in which human behaviors are directly influencing or manipulating animal environments (e.g. poultry ranging, livestock grazing, captive wildlife enrichment, clinical testing). The search produced results that were both empirical and theoretical in study design, yet systemic and individually-based with regard to scale. However, there was a marked abundance of studies in which the context of human-animal interactions was mentioned, but not intentionally studied. The multitude of interpretations of “human-animal interactions” among research scientists may be leading to interdisciplinary barriers. If the term were more explicitly defined and carefully delineated we would be better positioned to take a multi-scalar approach to understanding such dynamic interactions and more effectively mitigating zoonotic emergence.

Those studies that directly evaluated the context of human-animal interactions and their potential for zoonotic disease transmission largely focused on nonhuman primates, particularly macaques (Engel et al., 2002; Fuentes, 2006; Fuentes et al., 2008; Jones-Engel et al., 2005a; Jones-Engel et al., 2005b; Jones-Engel et al., 2008; Loudon et al., 2006; Ostrowski et al., 1998; Yong, 2013). Aggressive interactions (i.e. biting, scratching, chasing) between humans and nonhuman primates are readily observed in the contexts of tourism at temples, ecotourism at national parks, pet ownership, and within research settings. Those involved in such interactions include tourists, tour guides, taxi drivers, pet owners, zoo workers, researchers, and temple residents in Indonesia, Gibraltar, Bangladesh, China, Sulawesi, and Singapore.

Research focused on bushmeat hunting and butchering in Cameroon, Congo, and Sierra Leone represented a significant portion of collected literature. Using qualitative methodologies, such as behavioral questionnaires, the authors identified the mechanisms of exposure, including contact with bodily fluids and blood of wildlife, often through accidental cuts during meat processing (LeBreton et al., 2006; Subramanian, 2013; Wolfe et al., 2004a; Wolfe et al., 2004b). Although they did provide details on type of harvesting and hunting practices, some of these studies did not explicitly reference human-animal contact (contact with blood, etc.) (Fa and Yuste, 2001; Wilkie et al., 1992).

In collecting the literature for this review, studies were divided into two categories: human-animal interactions with associated disease outcome and human-animal interactions with any other associated outcome. Human-animal interaction studies with *implications* for zoonotic transmission were the most common (Fuentes, 2006; Fuentes et al., 2008; Jones-Engel et al., 2005a; LeBreton et al., 2006; Ly et al., 2007; Subramanian, 2013; Wolfe et al., 2004). Those that took it one step further by serologically testing either the human or animal community were less

common (Engel et al., 2002; Wolfe et al., 2004b; Yong 2013), and those that tested both communities and combined those data with behavioral observations or surveys were the least common (Jones-Engel et al., 2005b; Jones-Engel et al., 2008). Additionally, there were few studies that examined human-nonhuman primate interactions without associating such interactions with health outcomes.

The primatologists provided a more nuanced cultural context, while the bushmeat research seemed to have added behavioral questionnaires as supplemental data. The behavioral contexts presented in the latter were less substantive than the ethnographic settings described in the human-macaque studies. Because behavioral interactions are driven and enabled by cultural context and sociopolitical infrastructure, collecting data on physical contact interactions alone will only help to solve half the puzzle. It provides the ‘what’, but not the ‘why’.

Cases in which humans were interacting with swine, poultry, and wild birds were also present in the literature, although did not represent a significant proportion. For instance, Olsen et al. (2002) collected both serological data and questionnaires on H1 swine influenza among pig farmers and veterinarians in Wisconsin. They focused on the demographics of the human population, including sex, age, and occupation of participants, and associated certain behaviors (i.e. visits to a swine barn) with seropositivity. The importance of behavioral context is acknowledged here, although not thoroughly addressed, while cultural context is nonexistent. Ly et al. (2007) administered structured questionnaires to local people, specifically farmers, to understand human-poultry interactions in Cambodia. The behavioral context among rural people in Cambodia is more directly evaluated here. The authors were particularly concerned with risky behaviors involved in poultry handling processes. The cultural context was acknowledged in so much that they discussed or attempted to address the relationship between knowledge, attitude,

and practice. Although the authors use the term “interview” to describe the methodology, they actually administered structured questionnaires and presented their results quantitatively. Round (1990) addresses the political context of hunting activities, conservation regulations and relevant legislation, and the role of the Bangkok market in wildlife trade in Thailand. Although the author does provide this broader context for understanding human-animal interactions in Thailand, the data he collected were counts of birds and sellers, not assessments of contact. In his concluding remarks, he returns to the broader context in making policy recommendations, but does not actually bridge this larger sociopolitical context with a more narrowly-focused behavioral context.

Other studies found through this preliminary literature search included those on the public health implications of smuggling infected eagles (Van Borm et al., 2005), human occupational cases of bacterial infection from primates (Kennedy et al., 1993), and the role of wet markets¹ in zoonotic transmission (Woo et al., 2006). This last study, although it suggests a number of provocative research directions, merely alluded to the significance of context and did not support said insights with observational or qualitative data on human-animal interactions at wet markets.

There are a number of studies that have focused on human-livestock interactions and their effect on production. For instance, Gonyou et al. (1986) evaluated the influence of human contact and attention on the development of pigs. The observational data collected through this study were coupled with measurements of pig adrenal gland morphology to shed light on the effect negative and positive handling practices by stockpeople may have on pig growth. Other works (Hemsworth et al., 2000; Hemsworth et al., 2011; Jago et al., 1999; Rushen et al., 2001)

¹ Wet markets are markets that sell meat or live animals (Woo et al., 2006).

addressed similar issues among cattle and sheep, particularly as they pertain to milk production, suggesting that positive interactions with humans (i.e. touching, rubbing, patting) lead to greater milk production. While the objectives of these studies did not articulate the implications of such interactions on human and animal health, the data from the behavioral observations are worth considering in light of the potential for increased cross-species pathogen exposure, particularly by bacterial agents.

Existing gaps in human-animal interaction research represent areas of future collaborative work between social scientists, animal behavioral ecologists, and veterinarians. Furthermore, gaps that link genetic evidence with in-depth understandings of human-animal interactions and dynamic cultural contexts could be effectively addressed by multidisciplinary work. Such research will be a necessary undertaking in an age of inevitable anthropogenic change and increasing zoonotic emergence.

Working Definition

Human-animal interactions exist on rather subjective planes. They are situated within a behavioral context, yet influenced by a broader cultural context. For this concept to be more effectively utilized as a research variable, it is more specifically delineated here as:

- 1) humans and animals present within a shared context, human behaviors influencing animal behaviors and environments (e.g. adding enrichment to captive animals' habitats, destroying habitats through forest fragmentation, confining livestock and poultry movement, trafficking livestock), and animals intervening on human practices (e.g. crop raiding, dumpster foraging),

- 2) indirect human-animal contact (i.e. consumption, feeding of animals, chasing humans, lunging at humans, threatening humans, selling, buying, and trading animals, hunting),
- 3) And, direct human-animal contact, with the potential for blood or bodily fluid exchange (i.e. touching, biting, scratching, butchering).

For the purposes of this paper, human-animal interactions will include all categories, but will primarily focus on category 1, humans and animals present within a shared context and human behavior influencing animal behavior and environment.

Animal Movement

Because the human-animal interaction evaluated in the present case study is large and small-scale animal movement, a brief review of literature that links this behavior with disease transmission is presented. An understanding of the global, national, and local movement of animals is crucial to understanding the risk of zoonotic disease transmission. Fèvre and colleagues' (2006) study exemplifies how the movement of animals has led to the introduction of novel pathogens to geographic areas in which the presence of specific pathogens was unprecedented. For instance, the translocation of three dogs to Flores Island in Indonesia led to the introduction of rabies to an area once free of that disease, resulting in 113 fatal cases among humans (Fèvre et al., 2006). Of particular importance to the present research is the significant role that the movement of cattle plays in zoonotic disease transmission, especially in the development of novel strains of diseases such as bovine tuberculosis in new geographic areas. The work of Gilbert et al. (2005) demonstrates the positive correlation between cattle movement in Great Britain with the spread of bovine tuberculosis. The results of this study suggest that the movement of cattle can be used as a predictor for the introduction of bovine tuberculosis to

previously disease-free areas, or, in the case of Great Britain, to areas where bovine tuberculosis had been substantially mitigated. However, a simple understanding of “contact networks”, as Fèvre (2006, p. 129) suggests is necessary in predicting the spread of such diseases, is insufficient. In order to really understand such “contact networks”, a detailed understanding of the political, economic, and surrounding cultural context that influences livestock owners’ decisions and behaviors is essential. These decisions, based on a number of complex cultural factors, directly influence the movement of cattle, their subsequent “contact networks”, and consequently, the spread of infectious disease.

Biocultural Approach

The growing presence of zoonotic diseases remind us that biology and culture are intertwined in such a way that can pose a significant challenge to the standard approaches of animal and human public health practices. It is apparent that anthropologists have the necessary tools to make a valuable contribution to the work already being done by epidemiologists, veterinarians, and ecologists. To effectively address zoonoses, I argue that we must turn our attention to the intersection of human and animal health and explore these connections from a biocultural anthropological perspective. The urgency created by continuing trends in globalization calls for innovative, multidisciplinary approaches to such an issue.

Outside the Discipline

Multidisciplinary approaches have been implemented by organizations such as EcoHealth Alliance, the International Livestock Research Institute (ILRI), and health initiatives such as OneHealth (Miller and Olea-Popelka, 2013). These approaches have focused their attention on

examining zoonotic diseases from a number of perspectives including the intersection of animal and human health, along with a variety of other perspectives including ecological, epidemiological, and biological. The OneHealth perspective, which frames human and animal health as inseparable, suggests that new methods for addressing emerging and re-emerging zoonotic diseases will need to be developed as current practices will become insufficient (Coker et al., 2011; Zinnstag et al., 2011). For example, the veterinary arm of public health is not generally allocated sufficient resources to support the singular degree of responsibility that they have generally been given for controlling zoonoses. Additionally, veterinarians do not often receive sufficient cultural training to assess the human element of animal management. They therefore typically lack the necessary understanding of cultural perceptions and behaviors required to successfully collaborate with many of the rural populations most vulnerable to these potential outbreaks.

Cultural contexts powerfully engender individual and community perceptions of animals. These perceptions, in turn, directly influence human behavior, and therefore how people interact with animals. These interactions then in turn determine the risk or prevention of human-animal disease transmission. This process can be seen as cyclical as zoonotic transmission will also inevitably affect cultural perceptions of animals. Particularly telling is that some non-anthropological researchers working under the OneHealth perspective have acknowledged not just the importance of social relationships, but of cultural influences (Coker et al., 2011). However, they largely lack the expertise to address these questions, and the literature on this material can be read as an explicit call for social scientists, especially anthropologists, to step forward and make their unique contribution to this vital research. Unfortunately, it is clear that

there is nevertheless a tendency within the discipline of anthropology to avoid the study of topics related to animals other than primates, even and perhaps especially in relation to health.

Within the Discipline

Although anthropologists have recently given greater attention to the study of human-animal interactions as they pertain to pathogen transmission, the focus of this work has been predominately investigating human-nonhuman primate relations (Fuentes and Hockings, 2010; Riley, 2006). Although this work has been indispensable to understanding the human-nonhuman primate interface, we now need to extend these ideas and apply this framework to other species as pathogen transmission is not exclusive to the human-nonhuman primate interface. Although primate research is of significant importance to anthropologists, this should not preclude us from conducting research with non-primate animals.

One of the few anthropologists giving analytic attention to emerging zoonotic diseases beyond the human-primate interface is Melanie Rock. In particular, her work demonstrates the potential for applying medical anthropologist and public health researcher Merrill Singer's notion of syndemics to this growing problem (Singer and Clair, 2003; Rock et al., 2009). A syndemic can be understood as the intertwining of two or more health-related burdens in a manner that makes each worse than it would be alone. Rock et al. (2009) suggests that the theory of syndemics can shed light on the interconnected nature of human and animal disease and can help alleviate the tendency within both clinical and public health discourses to think about these as discrete issues. It is the social and environmental conditions in which animals and humans interact with one another that increases or decreases the probability that a given microbe will successfully jump the boundary between them and infect a new host.

Thinking syndemically also calls more direct attention to the fact that when crossing species boundaries some diseases become more virulent. Overlooking this tendency can unnecessarily result in more serious epidemics or epizootics (Singer, 2009). For example, the relatively common human bacterial infectious disease of the gastrointestinal tract, shigellosis, is typically benign in the otherwise healthy human host, with the most severe symptom being short-term diarrhea. However, if the bacteria is transmitted to rhesus macaques, it becomes deadly within a very short period of time (Ida et al., 2013). The reverse potential for increased severity of the disease can also exist. For instance, the herpes B virus, which is endemic, but relatively benign in rhesus macaques, becomes fatal in the human host within a week if untreated (Ida, 2011).

Social science research focused on human health (such as with the case of HIV/AIDS) has often noted the powerful significance of not only being *infected* with a disease, but the impact on a population or community of having members who are more broadly *affected* by the presence of a disease (Rock et al., 2009). The application of this concept to zoonoses urges us to prioritize gaining a more profound understanding of how people are affected by the health burdens present in their animal communities, especially those which carry the propensity to cross the human-animal boundary. For example, while Hoof-and-Mouth Disease is not generally considered transmissible to humans, its presence in a local animal population can be highly detrimental to livestock owners, both economically and perhaps emotionally. As Rock and colleagues (2009, p. 993) note, “Animals are part of the fabric of life,” and their presence cuts across all aspects of the cultural experience – economic, social, and symbolic (Singer, 2009).

Ethnoveterinary Medicine

So, what *can* we as anthropologists do to address zoonotic diseases---especially those transmitted from livestock, as people are more likely to share their daily lives with livestock, not primates? One way may be through the study of ethnoveterinary medicine. Ethnoveterinary medicine is a term coined by ecological anthropologist, Constance McCorkle, in 1989, and refers to:

the holistic, interdisciplinary study of local knowledge and its associated skills, practices, beliefs, practitioners, and social structures pertaining to the healthcare and healthful husbandry of food, work, and other income-producing animals, always with an eye to practical development applications within livestock production and livelihood systems, and with the ultimate goal of increasing human well-being via increased benefits from stockraising. (McCorkle, 1995, p. 53)

In other words, it seeks to explain how local people identify and classify livestock diseases, how they conceptualize physiological and anatomical systems, how they recognize causal agents of disease, modes of transmission, and finally how they treat and/or prevent those diseases (Mathias et al., 1996). Ethnoveterinary medicine plays a significant role in the health maintenance and care of livestock in developing countries (Tabuti et al., 2003). Often this is due to the fact that the western veterinary system is considered to be inefficient and expensive. This system of knowledge is usually passed from generation to generation through oral tradition.

The overall research objective of ethnoveterinary medicine has been to improve livestock productivity in developing countries (McCorkle, 1989). To do so, this approach gives concerted effort to first improving the health of the livestock with the implication being that healthy livestock will reproduce and continue to support the livelihoods of local people through the

production of meat, milk, and wool. In order to improve the health of livestock, an in-depth understanding of the traditional ways used to identify and treat animal diseases and conditions is necessary. At its core, economic concerns seem to be the sole impetus for the creation of this field. However, it is obvious that this field can have vital impacts for both humans and animals alike.

McCorkle (1989) states that the ultimate goal (perhaps more philosophically) is to contribute to the well-being of the human. Here she refers to human well-being again as it pertains chiefly to livelihood and not necessarily health. However, I am arguing that the ethnoveterinary approach can also significantly contribute to the protection of human health.

One key element of this approach is to combine anthropological fieldwork methods, including interviews, and participant and direct observation, with the applied skills of veterinarians. For this reason, another term also used to describe this work is veterinary anthropology. According to McCorkle (1989), the first task of the veterinary anthropologist is to translate the traditional veterinary identifications, descriptions, and treatments of diseases into the western veterinary terms. However, this approach should not solely focus on translating practices, but rather understanding the ecological, biological, and cultural context in which those practices are developed, influenced, and implemented.

From Ethnoecology to Ethnoveterinary Medicine

The overarching principles on which ethnoveterinary medicine was founded are quite similar to those described by Harold Conklin (1954) in his ethnoecological approach to examine shifting cultivation practices in the Philippines. Shifting agriculture, also known as slash-and-burn or swiddens, are often used in tropical areas. Much like indigenous veterinary medicine,

this practice is still not well understood by westerners and often receives unwarranted criticism. It has long been seen as a poor use of resources, resulting in a loss of valuable timber (Conklin, 1954). Western policy-makers often attribute these practices to native ignorance, assuming that western efficiency standards could be attained, and more interestingly, *are desired*, by swidden farmers.

Ethnoecology considers local variables such as available land, population density, climate, and native agricultural knowledge (Conklin, 1954). Through ethnographic data collection, Conklin was able to present local concepts of ecology and methods of swidden farming using an emic, rather than etic perspective.

Conklin notes that the farmers often have greater understanding of the interrelations between culture and natural phenomena than suggested by ethnocentric westerners (Conklin, 1954). In fact, the farmers have detailed knowledge of small differences in plants and a highly detailed categorization system. Ethnoveterinary systems have similarly specific knowledge, especially in regards to plants and locally endemic diseases.

Below, some of the studies that have been conducted on ethnoveterinary knowledge are presented.

Case study 1: Tzotzil Maya

The first case study concerns the Tzotzil Maya in the Mexican highlands (Perezgrovas, 1996). The author notes that anthropologists who have conducted research with the Tzotzil Maya have ignored animal husbandry, while those who studied the animals have not considered the role of culture. This case study has been selected due to its ethnographic similarities to the Wayuu, the indigenous group that participated in the present study.

The Tzotzil Mayan women have their own management system (breeding and healthcare) for the *chiapas* (a breed of sheep particularly bred for this area) (Perezgrovas, 1996). Their health approach stems from the traditional Mayan approach, while their herding practices are derived from the early Spanish practices. A great example of their management system is illustrated via their proactive response to liverfluke. Because liverfluke is a parasite found in wet vegetation, the herdowners keep the sheep away from the dewy pastures, muzzle them when herding through these pastures, and provide water for them from containers rather than local streams. Because of 1) the inability of sheep to develop resistance to liverfluke and 2) the propensity for liverfluke to develop in environments like that of the Tzotzil, the author concluded that the animal husbandry and healthcare practices of the Tzotzil have reduced the burden of liverfluke.

Case study 2: Maasai

Ethnoveterinary studies were also conducted with the Maasai, including one by Jacob and colleagues (2004). The purpose of this study was to consider the potential benefits of a non-scientific approach, such as the examination of indigenous knowledge, for increasing livestock health, nutrition, and efficiency.

For example, Malignant Catarrhal Fever (MCF), a disease spread through the nasal secretions of wildebeest, is endemic to Maasai territory. To reduce MCF exposures, the Maasai keep their cattle away from the wildebeest pastures during the calving season (Cleaveland et al., 2001). A participatory epidemiological study found that one Maasai herdowner also provided minerals such as salt to his herd to keep the cattle away from grazing on salt-rich, yet potentially infected pastures (Cleaveland et al., 2001).

Western veterinary medicine seems to be having a noticeable impact on Maasai practices (Jacob et al., 2004). They have welcomed antibiotics such as terramycin; however, its introduction is an excellent example of the difficulties that can arise when introducing a new drug to a traditional system. In this case, the dosages were being given as if they were an herbal treatment, rather than as prescribed. Eventually, this led to the development of terramycin-resistant organisms (Jacob et al., 2004). Additionally, terramycin was reportedly being used to treat children. This can easily be understood because most traditional medicine treatments are equally applicable to both humans and animals.

The introduction of a modern veterinary system has also led to the centralization of herds (Jacob et al., 2004). In an effort to prevent the annihilation of an entire herd from disease, the Maasai have been known to decentralize their herds, sending some animals to other pastures, thus creating a seed stock in the event of a loss of their principal herd. However, with the advent of western veterinary treatments, such decentralization has declined, resulting in overstocking of herds, increased disease risk, soil erosion, and environmental degradation.

A Success Story: Rinderpest

A striking example of the efficacy of combining traditional ethnoveterinary knowledge with western veterinary knowledge was in the eradication of rinderpest from remote areas in Africa, specifically Uganda, Ethiopia, Sudan, Kenya, and Somalia (Charles, 2012). The eradication was accomplished in several stages. Initially, a thermostable vaccine with the capacity to be stored unrefrigerated for a duration of 30 days was developed at a western veterinary medical institution (Mariner et al., 2012). The development of this vaccine allowed veterinarians to travel to rural areas and administer the vaccine. However, because rinderpest

outbreaks in rural areas often went unreported by government officials, veterinarians were unable to identify communities that were still being affected by the disease. Although western veterinarians had the resources and tools necessary to eradicate the disease (e.g. a thermostable vaccine), they were lacking cultural knowledge and local insight. Therefore, to identify outbreak locations, they partnered with local community members and taught them how to administer the vaccines. The local community members then traveled to the affected areas to distribute the vaccine. This allowed for rural communities to implement vaccination programs and eradicate rinderpest (Mariner et al., 2012). The eradication of rinderpest via collaboration between local community members and veterinarians supports the continued conversation between ethnoveterinary medicine and western veterinary medicine. It also suggests that the “veterinary anthropologist”, acting as a liaison between the two, would be able to facilitate knowledge transmission.

Revitalization & New Application

Unfortunately, the use of ethnoveterinary knowledge to understand human-animal health conditions never really gained momentum within anthropology, and most certainly not within medical anthropology. I have come across studies, such as the one on the Maasai, by academics outside of anthropology, but (unlike the emphasis, for example, on ethnomedicine in medical anthropology) it seems to have been dismissed by the discipline in which it originally got its start. In the face of increasing emerging diseases, a revitalization of this approach is necessary. Understanding local veterinary knowledge and practices will undoubtedly shed light on zoonotic disease transmission. These systems not only determine animal health, but also affect both perceived and actual risk of human contraction of zoonotic diseases. The method is simple, but it

can have a huge impact. It would help in developing “sensitive, cost-effective, bottom-up interventions” and “solutions that are culturally acceptable, technically comprehensible, ecologically sound, and socioculturally, economically, and even politically feasible” (McCorkle, 1989, p. 224). Many current public health initiatives to address zoonotic diseases, such as cull and kill, demonstrate a lack of cultural understanding. More productive initiatives could be achieved through collaboration between anthropology and veterinary medicine, in addition to the other disciplines working on this issue. Together they have the necessary cultural, biological, and medical skill-based training, to effectively address the global issue of zoonoses from the bottom up.

Introduction to Case Study

Zoonotic diseases are of particular concern in Latin America where livestock are a significant part of local economy and culture. Public health control and surveillance initiatives for zoonotic diseases, particularly bovine tuberculosis, are already implemented in many Latin American countries. A report published based on a Latin American Zoonoses workshop sponsored by the World Organization for Animal Health states that several countries in Latin America have already achieved eradication of bovine TB (de Kantor et al., 2008). However, these countries, Cuba, Costa Rica, Panama, and Uruguay, have generally had success in implementing standard health protocols, therefore, eradication of such diseases is not unexpected. This circumstance raises the question of whether eradication is not being seen as quickly in other developing countries due to a mismatch between the framework of western public health tactics and the cultural contexts and traditional health frameworks.

The report states that certain actions are required in order for eradication campaigns to be successful (de Kantor et al., 2008). Such actions include the implementation of herd cleaning and depopulation, and legally obligating farmers to report confirmation or even suspicion of the disease in their herd to authorities (de Kantor et al., 2008). These two public policy recommendations are inherently counterproductive. Farmers will understandably be less likely to report instances of the disease in their cattle herds if the next known step will be to then kill portions of the herd, which for some may represent a significant segment of their livelihood.

It is through these perspectives that we can begin to understand why standard public health initiatives have been less successful in developing regions. A lack of cultural understanding with regard to economic, nutritional, and symbolic value of the livestock by the public health sector becomes evident through such recommendations. To this end, more productive initiatives can easily be envisioned through the joint collaboration of anthropology and veterinary medicine.

These collaborative initiatives are particularly relevant to the Wayuu, a transnational community native to the Colombian-Venezuelan border, and the non-Wayuu residing in La Guajira, Colombia. These communities provide an ideal case study because of the complex biocultural landscape of this region. It is a region that is superficially divided by political, cultural, and species boundaries. That is, there is the national border, both indigenous and non-indigenous communities, and their corresponding animal herds. And, one of these communities, the Wayuu, has dual citizenship in both countries and so can freely move over that border, while the other is bound by its single citizenship. During an average year, this region is considered to be remarkably arid, but at the time of the study, it was actually plagued by what they considered to be a severe drought. Additionally, not only is there a zoonotic disease prevalent in the

population, but anthrax is in fact endemic to the local environment. In light of these locale-specific factors, it is apparent that standard public health approaches to any adverse health condition, but particularly zoonoses, in the region would prove inefficient, making La Guajira an ideal case study for a biocultural anthropological approach to zoonotic disease mitigation.

Based on these factors, the research questions I will address are: How does animal movement influence human-animal vulnerability to anthrax during drought periods in La Guajira, Colombia? Does vulnerability vary cross-culturally within La Guajira?

CHAPTER 2

CONTEXT

Overview

Because I argue that we must understand local contexts before implementing zoonotic disease protocols, such as those under OneHealth, I use an adapted version of the Triangle of Human Ecology (Meade and Emch, 2010) to compartmentalize the context of this study. See Figure 1. According to this framework, the context is divided into three vertices: population, environment, and behavior. Each vertex influences the other two vertices and all are used to understand the factors contributing to a particular state of health, in this case anthrax. Broadly, the population vertex takes into account gender, age, and genetics. The environment vertex focuses on the natural, built, and social environment. Lastly, the behavioral vertex encompasses beliefs, social organization, and technology.

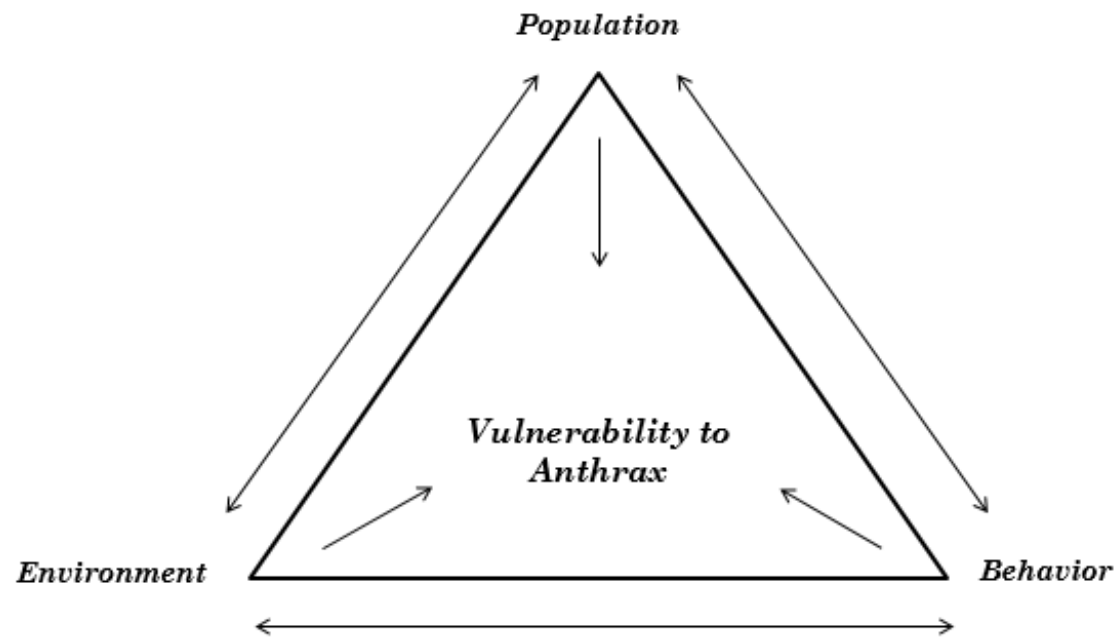


Figure 1. Triangle of Human Ecology (Adapted from Meade (1977) and Carrel and Emch (2013))

Population

The northern most region of the Colombian-Venezuelan border is home to both an indigenous and non-indigenous population. Their history, economy, and other cultural circumstances, as well as their geographical location, provide an ideal setting to examine a number of the key areas of research in re-emerging infectious disease.

As the primary vessels of disease, human and animal populations need to be evaluated in terms of their unique, locally-specific characteristics. When considering the Triangle of Human Ecology (Meade and Emch, 2010), these descriptive factors are included in the Population vertex. This vertex often includes data on sex, gender, age, genetics, nutrition, and health of the said population. Here, the focus will be on the history of the human and animal populations, size of the populations, diet and nutrition, and prevalent diseases.

Population Statistics (History, Peopling of the Land, Size)

People and animals of La Guajira. In 1960, La Guajira had 60,000 inhabitants (Aschmann, 1960). At the time of this study, Aschmann (1960) suggests that this population density could not be adequately supported by the environment, even during years of sufficient rainfall. The current population of La Guajira now includes over 900,000 people. Of these, 300,000 are Wayuu (also, Goajiro or Guajiro). This Amerindian indigenous group is the largest indigenous group in Colombia and Venezuela (Cook, 2001).

Between 1770 and 1773, the Spanish implemented a project to Christianize, reduce, and permanently settle the natives (Aschmann, 1960). They provided them with small stock as incentive. However, drought drove them to disperse over the landscape in order to find water

sources for the stock. Because of the increasingly aggressive terrain, goats and sheep soon became the primary animals.

History of Colombian-Venezuelan border. The Guajira peninsula is 70 miles long and 50 miles wide (Llambi, 1989). See Figure 2. Colombia's border with Venezuela spans La Guajira and has been in existence since the demarcation treaty of 1941. Following the demarcation, both countries began to regulate the border more strictly, requiring the Wayuu to obtain formal documentation of citizenship in both Colombia and Venezuela. Prior to this, the Wayuu traversed the border freely. In the 1960s and 1970s, as a consequence of the Venezuelan oil boom, Maicao² became an important trade site, connecting Colombian and Venezuelan markets. At this time, the Wayuu took on a significant role in carrying goods across the border. The economic and political crises of the 1980s, characterized by increased drug trafficking, enhanced conflicts between the Wayuu and law enforcement on the Venezuelan side. Given the precarity of the traditional Wayuu subsistence strategies, these illegal trade circuits provided important economic opportunities for many Wayuu.

² Maicao is a municipality in La Guajira, Colombia, located near the border with Venezuela.



Figure 2. Map of La Guajira, Colombia (Google Maps, 2016). The white line which begins at Castilletes and continues along the eastern part of the region represents the Colombian-Venezuelan border.

Diet and Nutrition

The nutritional status of the Wayuu ethnic group has received some attention from public health sources. Wayuu children, in particular, were the focus of one nutritional study (Villalobos-Colina et al., 2012). Using anthropometric and dietary data, Villalobos-Colina and colleagues (2012) demonstrated that 32% of 100 Wayuu children (Venezuelan residents) were malnourished, consuming primarily pasta, rice, maize flour, sugar, bananas, oil, eggs, and dairy products. A significant finding of the study was that approximately half of their sample of children consumed no fruits or vegetables. The authors suggested that these results could be directly attributed to the socioeconomic status of the population, as 82% of families were of low socioeconomic status. They also note that malnutrition in the region is significantly related to food insecurity. The authors suggest that the Wayuu as evidenced through food consumption may have changed as a result of sustained contact with the non-Wayuu culture. Long-term effects of malnutrition may make the Wayuu more vulnerable to diseases already present in their environment.

Prevalent Zoonotic Diseases in La Guajira

Anthrax. *Bacillus anthracis*, commonly known as anthrax, is one of many zoonotic diseases transmissible to humans from livestock. It is caused by a Gram-positive, aerobic bacterium that forms spores when environmental conditions inhibit growth (Turnbull, 2002). The spores are extremely hardy and resistant to variability in external conditions. However, oxygen is a requisite for sporulation³ to occur. Temperature, pH, and sunlight can also affect germination⁴.

³ Sporulation is the process by which spores are produced. This process allows bacterial cells to enter a dormant state when exposed to harsh environmental conditions.

⁴ Germination refers to the period of spore growth and occurs when environmental conditions are favorable.

Anthrax is described as a seasonal disease (Turnbull, 2002), with drought and rainfall being key factors in the transmission process. It is usually spread by an infected carcass, which sheds vegetative spores (Turnbull, 2002). Once the spores leave the host, they become activated by oxygen and can infect other organisms. Therefore, the soil surrounding, and particularly beneath, an infected carcass poses a great risk to humans and other animals. Turnbull (2002) points out that the site of an infected carcass can remain contaminated for years, even after enduring changes in rainfall, temperature, and wind. Turnbull (2002) states:

Climate probably acts directly or indirectly by influencing the way in which an animal comes into contact with the spores (for example, grazing closer to the soil in dry periods when grass is short or sparse, or movement of herds to restricted sites when water becomes scarce) and/or by affecting the general state of health of the hosts and, thereby, their level of resistance to infection from the stress which results from meteorological conditions lead to diminished food and water sources, crowding around the remaining sources, heat, high concentrations of insects and hormonal changes heralding the onset of the rutting season. (p. 10)

Turnbull's argument provides support for the likelihood that inhaling or ingesting spores is happening during browsing and grazing, especially during dry seasons.

Modes of transmission. Anthrax is transmitted through indirect or direct contact with infected animals (WHO, 2013). There are three modes of transmission: cutaneous, aerosol, and alimentary. That is, the disease can be transmitted through contact with skin lesions, inhalation of the spores, or ingestion of the spores through consumption of infected meat. In developing countries, 95% of cases are attributable to the cutaneous form (Turnbull, 2002; WHO, 2013). See Figure 3 for a diagram of the complete cycle of infection. Because humans are most likely to

contract anthrax via direct or indirect contact with animals, an understanding of the prevalence of the disease within a given animal population can be used as a proxy for estimating prevalence in the corresponding human population (Turnbull, 2002).

Symptoms. Clinical symptoms vary depending on type of infection. Onset of symptoms are usually sudden in animals and quickly result in death (Turnbull, 2002). Fever, disorientation, sudden collapse, and convulsions are all signs of anthrax infection in animals. Indicators of death due to infection include bloody excretions from the nose, mouth, or anus (Turnbull, 2002). In humans, clinical symptoms vary in accordance with mode of infection. Infection with cutaneous anthrax results in the presence of a papule on the skin within the first three to five days. During the following two to three days, the papule will ulcerate. It will then become dry, black, and have a scabbed-over appearance with noticeable vesicles (Turnbull, 2002). Infection with alimentary anthrax can persist in both the alimentary tract and intestines. Symptoms of infection include sore throat, fever, nausea, vomiting, bloody diarrhea, shock, and sudden death. Lastly, contraction of inhalational anthrax will produce fever, nausea, cough, collapse, and sudden death. Abnormal chest X-rays are also suggestive of inhalational anthrax (Turnbull, 2002).

Vaccines and treatment. Live attenuated anthrax vaccines have been known to be effective in protecting herds against anthrax (Friedlander et al., 2002). Similar vaccines exist for humans, but are only recommended for those at increased risk of exposure due to occupational hazards of working with livestock or military service. The literature suggests that the efficacy of the human vaccine warrants further study (Friedlander et al., 2002).

Postexposure prophylaxes are used to treat exposed patients (Bell et al., 2002; Sweeney et al., 2011). Treatment with a multidrug regimen is usually recommended. The most commonly

prescribed prophylaxes include oral dosages of ciprofloxacin, doxycycline, and penicillin for a duration of 60 days (Sweeney et al., 2011).

Locale-specific history of anthrax. According to the World Health Organization (WHO), the prevalence of anthrax in Latin America remains uncertain due to underreporting (WHO, 2008). It is confirmed enzootic to Bolivia, Argentina, and Peru. The data from Colombia are considered unreliable by WHO due to ongoing civil unrest.

However, a report published by the Ministry of Social Protection (2010) epidemiologically evaluates an anthrax outbreak of 2010 in La Gaujira, Colombia. The primary focus is on patients in the community of Parenska. Animal-to-human transmission is believed to have resulted from contact with goats. The report was based on data collected from 748 people and 90 corrals, located in 12 *rancherías*⁵ in the municipalities of Manaure and Riohacha. They found that 8.3% of the people (total of 62 cases) reported having had symptoms of cutaneous anthrax since November 2009. However, the majority of them occurred during April 2010. They found there to be greater prevalence among those who handled infected animals, than among those who consumed the animals. Cases were primarily associated with goats and sheep that died on their own, but then later had been slaughtered. Shepherding, cooking, and consuming the dead animals were considered to be the primary risk factors. At the time of the study, 35 people had clinical symptoms of anthrax. The report does suggest that the climatic conditions at the time influenced the onset and severity of the outbreak. The effects of El Niño were particularly noteworthy, resulting in a severe drought during the latter part of 2009 and early part of 2010. The drought led to reduced vegetation, and therefore fewer available food resources for the livestock. This likely influenced the livestock grazing patterns and techniques. In order to find

⁵ The *ranchería* consists of a group of dwellings. The community and household structure of the *ranchería* will be described in the following section.

sufficient food, the livestock were forced to dig further into the soil to obtain vegetation, in turn exposing them to anthrax spores. These spores had likely been residing in deeper levels of soil due to previously poor practices in the disposal of infected carcasses.

Human and animal cases were reported in Riohacha and Manaure (Ministry of Social Protection, 2010). There were a total of 111 reported cases, one of which was respiratory and 110 were cutaneous. The report describes the two fatal cases. One case was a woman from the Parenska Ranchería in Manaure. She was 71 years old and had previously been in contact with animal blood. At first, only swelling was visible, but she later developed skin lesions. She was treated with antibiotics at the hospital, but died within the week (four days after authorities were contacted). The other case was a 55 year old woman. She was also from Manaure (Paneracal Ranchería). She was experiencing pain, rash, and a purulent substance was excreting from her hand. She was diagnosed with septicemia and treated with an antibiotic. She died three days after authorities were contacted.

According to this particular history of the outbreak, a veterinarian was informed of possible cases in Parenska on April 28, 2010. The institutions that became involved include: Colombian Agricultural Institute (ICA), the National Institute of Food and Drug Monitoring (INVIMA), the National Institute of Health (INS), and the National Focal Point (CNE). They collaborated with the Secretary of Health of La Guajira and the Secretaries of Health of the Municipalities of Manaure and Riohacha. The interviews conducted for this study indicated that some people had handled animals that died on their own (14% of respondents) and some had consumed the meat of those animals (23.9% of respondents). The report states that the majority of cases were 10-24 and 35-39 years old. It highlights that those under the age of nine also made up a significant number of cases. This likely coincides with the age at which the Wayuu youth

begin to partake in pastoral activities. According to this report, Riohacha and Manaure had the greatest number of cases, with Riohacha having slightly more cases. However, the *rancherías* with the greatest number of cases were located in Manaure.

The report did give attention to the importance of the connection between infection with the disease and human-animal contact. Students, household caretakers, and herders were found to be the most affected. The report identifies three forms of human-animal interaction. The majority of those handling animals were involved in slaughtering, followed by cooking, and herding. A total of 67% of the 90 observed corrals (from 17 *rancherías*) had reported animal fatalities associated with the outbreak. Of these, 32% had consumed the meat from these animals, while 7% had sold the meat. A variety of practices for disposing of the infected animals had been reported with some burning the carcasses and the majority burying them or disposing them in open-air spaces. The report suggests that vaccinating animals in the affected areas and medically treating the people exhibiting clinical symptoms is necessary to prevent animal-to-human transmission.

A brief news article was posted on May 30, 2012, publicly reporting anthrax cases in northern Colombia, close to the Venezuelan border (Westwood, 2012). According to this article, one person reported having skin lesions and 16 animals died. The indigenous population was affected and informed of the protocol for disposing the infected animals. The article states that vaccinations were being distributed and some animals were being quarantined. It also mentions an outbreak which occurred in 2011. This article provides evidence of anthrax exposures after the last major outbreak (2010), indicating that anthrax is ever-present in La Guajira and continues to affect both people and animals, even if on a small scale.

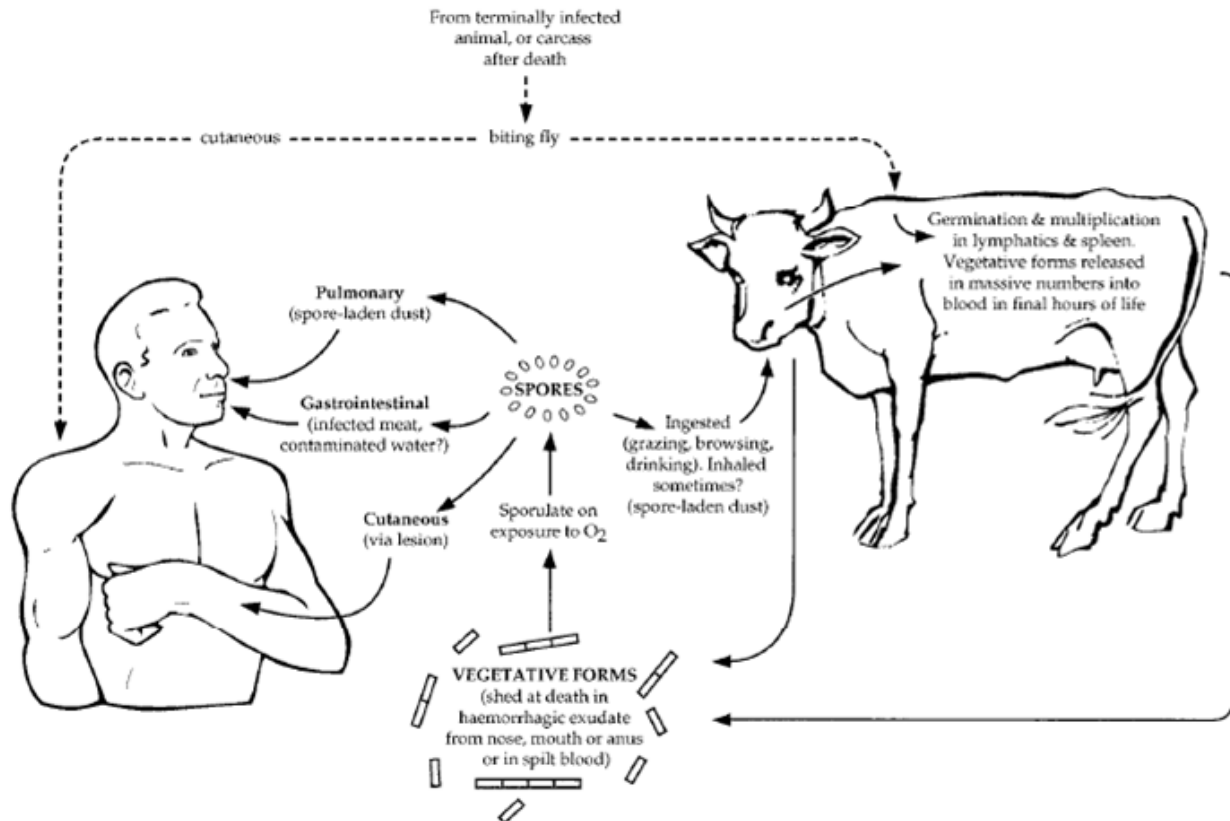


Figure 3. Cycle of Anthrax Infection (Turnbull, 2002)

Venezuelan Equine Encephalitis. Venezuelan equine encephalitis (VEE) is a re-emerging zoonotic infectious disease endemic and enzootic to the Guajira Peninsula, and has previously had devastating effects on both the animal and human populations in Colombia and Venezuela. It is transmitted from equine species, primarily donkeys, to people via mosquito vectors. Epidemiological data demonstrate that these outbreaks occur every 15-20 years (Rivas et al., 1997), with the last significant outbreak occurring in 1995 (Rivas et al., 1997; Weaver et al., 1996). This outbreak emerged in Venezuela and following unusually heavy rainfall and flooding, moved over the border into Colombia. Rivas et al. (1997) suggest that:

It is likely that native Wayuu people and their animals, traveling from epidemic areas in Venezuela across La Guajira peninsula, brought the virus to the Caribbean coast, where it spread southward. (p. 831)

Although studies such as Rivas et al. (1997) claim that this phenomena is likely, the relationship between cross-border movement and disease transmission has not been the focus of health research in the region. Social science research evaluating Wayuu dual citizenship and therefore movement of people and animals and its influence on human and animal health in the region is certainly warranted.

Rivas and colleagues (1997) also note the importance of culturally-specific medical and funeral practices and their potential to lead to underestimates in confirmed cases of VEE among the Wayuu in La Guajira. At the time of this study, the Wayuu living on rural *rancherías* did not often make visits to health clinics and likely did not report deaths in the community, as they had private funerals (Rivas et al., 1997). Similar caution should be taken when considering the confirmed cases of other diseases, specifically anthrax, endemic to these populations.

Environment

An understanding of the environmental context of La Guajira is essential to understanding the spread of zoonotic disease in the region. The natural, built, and social environment are all part of the environment vertex of the Triangle of Human Ecology (Meade and Emch, 2010), which serves as the key theoretical framework in setting the stage for the analysis of human-animal vulnerability to anthrax in La Guajira. Meade and Emch (2010) define habitat as:

that part of the environment within which people live — that which directly affects them.

Houses and workplaces, settlement patterns, naturally occurring biotic and physical phenomena, health care services, transportation systems, schools and governments are parts of the habitat. (p. 30)

Here, the focus will be on climate, geographical features, natural resources, access to electricity, transportation and water infrastructure, waste disposal, construction of the *ranchería*, sociopolitical organization, and healthcare.

Natural Environment

La Guajira is located on the Caribbean coast and spans the Colombian-Venezuelan border. La Guajira consists of three recognized sectors: Baja (lower), Media (middle), and Alta (upper) Guajira (Vásquez and Correa, 1992). Each sector has its own microenvironment to which the Wayuu have had to adapt. The Alta Guajira is located at the tip of the peninsula and is the most arid of the three regions and the lowest in altitude. It is Wayuu ancestral land and home to several sacred landmarks, including Cabo de la Vela, now an increasingly popular tourist draw (Vásquez and Correa, 1992). The Media Guajira is semi-arid and also part of Wayuu ancestral

land. The major urban centers, including Riohacha, Manaure, and Maicao, are located in this central region. The Baja Guajira maintains the least arid climate with significantly more vegetation accessible for grazing and is at a considerably higher elevation (~6,562 ft.). This area consists of predominately non-Wayuu farms. Although they do not make up the majority, some people from the Wayuu and Arawak indigenous groups also reside in this area.

Animals, including cattle, goats, sheep, horses, pigs, donkeys, and poultry, have a major presence in this region and are uniquely adapted to the extreme climate (Cook, 2001-2).

Although now a significant part of the natural environment of La Guajira, as well as a fundamental part of Wayuu culture, the livestock are not native to this region. They were introduced in the 16th and 17th centuries when the Spanish arrived (Guerra, n.d.; Pérez, 2004).

Although cattle are highly valued among the Wayuu, the severity of the environment prevents them from being raised throughout all of the peninsula (Perrin, 1987). Therefore, sheep and goats constitute the majority of Wayuu herds.

Climate. La Guajira is considered the most arid region in Colombia, with a relatively flat landscape characterized by sand dunes, and shrub vegetation (Ramírez and del Valle, 2011). Precipitation is highly seasonal in the region, with a wet season lasting from September to November and the remaining months being extremely dry (Ramírez and del Valle, 2011). Average rainfall is approximately 397 mm (15.6 in), while the yearly average temperature in La Guajira is 28.8 °C (83.84 °F) (Ramírez and del Valle, 2011) with highs of 42 °C (107.6) (fieldnotes, 2014). Climatic changes leading to increasingly severe drought periods caused by a significant rise in annual temperatures and dramatic decreases in rainfall are predicted for the region by several sources (Ramírez and del Valle, 2011; IDEAM, MAVDT & PNUD, 2008; Solomon et al., 2007). These changes will likely have a negative impact on the growth of

vegetation, which is of high ecological and cultural value in La Guajira. The severe drought of 2013-2014 marked by little to no rainfall is discussed in great detail in the results and discussion.

Wind is also a significant feature of the Guajiro landscape as it can dictate both daily and seasonal activities. The Wayuu recognize eight types of winds (Guerra, 2004). These winds play a role in how the Wayuu mythologically explain climatic shifts. For example, the wind called *Joutai* comes from the east and brings the harsh, hot clouds of dust common to the summer season (Guerra, 2004). However, Wayuu mythology also describes a more paternal wind that balances the harshness of summer. This wind, called *Jepirachi*, brings nourishing rains and cooler weather (Guerra, 2004).

Geographic features and natural resources.

Sea. The Caribbean coastal sea is also considered to be part of Wayuu territory. It is, in a sense, an extension of the pastureland in which the turtles are the cows, lobsters are poultry, and fish are goats and sheep (Guerra, personal communication, 2014). The fishermen, or *apaalanchi*, are considered herdsmen of the sea (Banco de la Republica, 2001).

Salt. La Guajira has long been a site of small and large-scale commercial salt production. The salt production sites in Manaure are a notable feature of both the local economy and the landscape (Rangel-Buitrago and Anfuso, 2009).

Natural gas. La Guajira is an energy resource-rich land. In recent years, energy development has flourished on the peninsula, with two-thirds of the natural gas utilized by Colombia being extracted from offshore drilling sites in La Guajira (Guerra, n.d.). The extraction of gas originally began with these offshore platforms, but international private companies are now seeking drilling rights on Wayuu land (fieldnotes, 2014). During my fieldwork, I encountered a wide range of Wayuu perspectives on this new development of extraction on their

lands. For some Wayuu, the prospect of receiving monetary compensation in exchange for allowing international private companies to drill on their territory presents a new window of opportunity, hope for a more financially-secure future, and the perception, albeit skewed, of shared economic collaboration between the Wayuu and these companies. These perceptions are further encouraged by regular donations brought by the companies to individual communities. During one such donation, I witnessed a truck carrying water, milk, toys and clothing for the children arrive in the community (fieldnotes, 2014). The goods were unloaded and the members of the community ran with gleaming faces to pick them up. However, other Wayuu are more skeptical of the company's intentions and remain resistant to granting what would almost certainly become permanent access to ancestral land.

Coal mining. The local coal mine, *El Cerrejon*, is run by a multinational corporation, with an overwhelming social, economic, and physical presence in the region (Szegedy-Maszák, 2008). Its role is highly socially contested. Both Wayuu and non-Wayuu Guajiros are nominally grateful for the economic benefits of the mine, including employment and philanthropic activity, but it is primarily viewed as an external entity that extracts value from their land and then exports it for the benefit of other Colombian departments and countries. It is a source of growing frustration as people become more aware of the difference in economic status between themselves and the corporation.

Flora. Although a semi-desert/desert landscape, certain plants can be found in abundance in La Guajira and have a significant role in Wayuu culture and human and animal health. Some of these plants include *malambo*, bark that is used as a general digestive curative, an anti-malarial, and anti-inflammatory, and *culebrilla*, which is used in animals to help expel the placenta (fieldnotes, 2014; Tiles Ipuana, 2011). *Dividivi* is another plant found in La Guajira,

which is frequently used as a disinfectant for skin lesions and wounds (fieldnotes, 2014; Tiles Ipuana, 2011). However, the ongoing drought has resulted in the significant loss of plants that were once in abundance, leading to animal starvation and potentially reduced use of traditional medicinal practices.

Cultural landmarks. The Wayuu cultural attachment to the land is illustrated by the frequent references to certain cultural landmarks (fieldnotes, 2014). Rio Ranchería was once a significant fresh water resource for the Wayuu and remains an important cultural landmark. Prior to the establishment of wells and reservoirs, it supplied many communities within trekking distance with water for human and animal drinking, laundry, and other household necessities. Female informants recalled making daily trips to the river with their donkeys and hauling water back to their *rancherías* (fieldnotes, 2014).

Built Environment

Rancherías. The Wayuu reside on *rancherías* or groups of dwellings. Individual *rancherías* consist of a dwelling structure, called *miichi* or *piichi*, which is typically constructed of mud, and a dried heart-of-cactus roof (Guerra, n.d.). More recently, roofs are made from corrugated metal or composite materials. However, the materials used for construction of the house are largely dependent on available resources in particular areas of La Guajira (Guerra, n.d.). This is especially pertinent to the construction of the kitchen, which can vary widely depending on access to electricity. At one extreme, one might find a semi-open-air kitchen in which food is cooked over a wood fire built on a cement slab. At the other extreme, it is common to see an electric stove and refrigerator in an enclosed cement structure. Located close to the house, there is a covered area called an *enramada* (Guerra, n.d.). The *enramada* is where the

family receives guests. It is also common for the *enramada* to be used as a resting space in the afternoon. Unless uncomfortably windy, the Wayuu hang *chinchurros* (woven hammocks) under the *enramada* to escape the heat characteristic of afternoons in La Guajira. It is also a place where intergroup conflicts are discussed and resolved. Corrals of varying sizes are also a significant part of the *ranchería*. Small ruminants (goats and sheep) are usually corralled together, while cattle and horses each have their own distinct corrals. In some areas of the peninsula, land may be designated as a cultivation area. However, this depends on the reliability and accessibility of the water source in that community, and I witnessed only one concerted attempt at cultivation during my field research.

Waste disposal. Because the Wayuu do not have access to waste collection services, the disposal of garbage is handled in a variety of ways in rural settings. One of three practices is usually chosen as the primary waste disposal procedure for each *ranchería* (fieldnotes, 2014). That is, they bury the household garbage, conduct a controlled burn, or toss it into the *monte*, or scrubland. Unfortunately, this last practice happens with some frequency, as is evidenced by the high concentration of loose refuse across the regional landscape, visible from both main roads and unpaved byways. Accountability for the abundance of refuse in the region is highly socially contested. During my fieldwork, my Wayuu informants often tended to attribute the responsibility for the refuse to the *alijunas*, or non-Wayuu, stating it either blew in from the city or that the government should be making an effort to collect waste on the *rancherías*.

Electricity. Access to electricity varies significantly throughout Wayuu territory (fieldnotes, 2014). Some *rancherías* in La Guajira have regular access to electricity, with the electrical units having been installed by private companies. It is also common to find some communities that have gained access to electricity by splicing the wires and running live wires

from open-air access points through the *monte* to their homes. There are still some *rancherías* that do not have either form of electricity. In one community, electricity had once been delivered to a number of subcommunities. However, the lines from the main transformer had been removed and not replaced. There are a number of explanations to which different Wayuu families attribute this event. The members of that particular community state that the wires were stolen because of an ongoing inter-clan conflict between their clan and a neighboring one. However, others state that the end to their electricity was due to the fact that members of that community were not able to pay the utility bill. While it is difficult to know how exactly the situation developed, it is clear that the lack of electricity in this particular community has had a negative impact on their overall quality of life. They have reduced access to news media and other sources of information and the lack of electricity has contributed to their inability to maintain a well-stocked and functional community health clinic.

Transportation infrastructure. One major public road spans the Media Guajira. The Wayuu refer to this road as *la carretera negra*, or the black road, as it is one of the few paved roads that run through their territory (fieldnotes, 2014). The roads that lead to and connect individual *rancherías* are unpaved, often uneven, quite sandy, and in some cases, only accessible by motorcycle. In fact, many Wayuu use motorcycles as their primary mode of distance transportation. Wayuu men, in particular, utilize the motorcycle as both a form of transportation and as a source of income as taxi drivers. *Colectivos*, or privately-owned taxis, run between different cities in La Guajira, and are also a common means of transportation for Wayuu traveling to other parts of La Guajira or to the markets located in the urban centers. During the wet season, the unpaved roads to the *rancherías* easily flood and some become impassable. The

rancherías are transformed into island-like communities, making access to resources such as food and medical services very difficult.

Water infrastructure. The water infrastructure also varies widely between communities, even between neighboring *rancherías* (fieldnotes, 2014). The various types of water systems include wells of varying depth, in which water is brought to the surface by a windmill, maintained in a cement enclosure, and released through a spigot-like structure. Other wells, while also constructed with cement, require manually drawing water to the surface one bucket at a time. A third type of well was also observed during fieldwork. This well is constructed by one family and only utilized by that family and their herd. It consists of digging until water is reached. When these hand-dug wells run dry, they may opt to dig deeper or begin a new well in another nearby location (fieldnotes, 2014). Although wells are the most common water source, some *rancherías* only have access to reservoirs that fill during the rainy season. These reservoirs are constructed and shared by surrounding communities and are utilized for all water necessities. Ongoing drought in the region has severely impacted the reservoirs, completely drying some and leaving those communities without a regular water source at which they can bathe, draw water for household chores, and provide water for their animals.

Social Environment

Non-Wayuu sociopolitical organization. Political corruption and general instability at the departmental level in La Guajira has been detrimental to the health and livelihoods of Wayuu and non-Wayuu community members for decades. During the last year, the governor's seat has seen several turnovers, due to what one informant simply described as elected officials "being in bed with the paramilitaries" (Roberto, personal communication, July 2014). Because there had

been several short-term interim governors, La Guajira's fiscal budget had been placed on hold. This hold severely, and negatively, impacted the department once the unexpected drought began to plague the region. The Wayuu and non-Wayuu were unable to seek government resources, such as pasture for the animals and additional water pumps, to help alleviate the effects of the drought.

Additionally, the fiscal organization of the Colombian state itself makes it difficult for resources to reach the Wayuu. Historically, indigenous peoples have not been well-represented in government, and although this is in the process of changing (fieldnotes, 2014), the Wayuu remain underrepresented. Wayuu sociopolitical organization is more diffuse than many other indigenous groups and it is therefore a more complex matter for the Wayuu to "speak with one voice" about needs that may vary by region or clan (fieldnotes, 2014). Even when needs are accurately identified, the fact that local governments must seek the resources for their budgets from the national government in Bogotá can cause Wayuu needs to become a low priority at the local and regional levels.

State of terrorism in Colombia. The current state of terrorism in Colombia grew out of revolutionary movements (Bibes, 2001). These movements began to seek funding via illicit drug trade. Involvement in the drug trade led to increased violence and terrorist activities; Colombia was soon labeled as a global hotspot for narco-terrorism (Bibes, 2001).

Three major terrorist groups occupy Colombia (Sullivan and Beittel, 2014). These include the two leftist guerilla groups: 1) the FARC (the Revolutionary Armed Forces of Colombia) and 2) ELN (the National Liberation Army). The United Self-Defense Forces of Colombia (AUC), more commonly known as the paramilitaries, is recognized as the third group and is the only rightist group of the three. The FARC is the largest of these groups and has been

involved in a diversity of criminal activities, including kidnapping, drug trafficking, and extortion. Sullivan and Beittel (2014) note that terrorist attacks by the FARC and ELN have decreased in recent years. However, attacks on infrastructure, such as roads, bridges, oil pipelines, and military/police stations, have seen an increase. The Colombian government began peace talks with the FARC in 2012, and more recently with the ELN. The FARC and the Colombian government have agreed upon several of the initial agenda items, specifically on land development issues, participation in the political process, and the production and trafficking of illegal drugs (Sullivan and Beittel, 2014). However, further work is necessary on the other agenda items (i.e. disarmament of the groups). The authors also note that both the FARC and the ELN have a presence in Venezuela, with likely support from the Venezuelan government.

Wayuu sociopolitical organization. Traditionally the Wayuu sociopolitical system has been characterized as having three fundamental leadership positions for each extended family (Premauer, 2013). These include the *palabrero*, the chief, and the community leader (fieldwork 2014; Guerra, 2002). The *palabrero* acts as a lawyer or mediator between Wayuu individuals and families, helping to negotiate marriage settlements and resolve multigenerational conflicts between clans. Each matrilineal clan also has a chief, or *alaüla*. The chief is usually a maternal uncle and is recognized by the clan as central to maintaining order through familial ties. He acts as a spokesperson for the clan, and a military leader during inter-clan conflict. He also holds cultural and historical knowledge, particularly in reference to clan territory (Premauer, 2013). Depending on size of families and settlement patterns, family clusters of *rancherías* may have sub-clan chiefs, who speak for the extended families. This role, representing a type of leadership, is distinct from that of the community leader.

The role of a community leader is becoming increasingly significant in Wayuu culture as the society has become more urbanized. He or she speaks both Spanish and Wayuunaiki and is usually formally educated. He or she is therefore able to represent the needs and interests of the community to external institutions, particularly government representatives at the local and regional levels (fieldnotes, 2014; Premauer, 2013). For example, the community leaders support members in obtaining government subsidized health insurance and national identity papers (fieldnotes, 2014). In one observed community, one of these leaders is collaborating with state officials to gather data on childhood nutrition and general health. She hopes this will lead to greater medical resources being dedicated to the community (fieldnotes, 2014).

In fact, the community leader can have a significant role in the health of both humans and animals in their community. This was exemplified during the anthrax outbreak of 2010 in one particular community in Manaure (community leader, personal communication, August 2014). During the outbreak, the community leader (as opposed to the head of the extended family) made initial contact with the Secretary of Health of Manaure and the Colombian Agricultural Institute (ICA) to report the sudden and devastating number of deaths of livestock in their community as well as to seek help for people exhibiting unusual clinical symptoms. Initially, his concerns were dismissed by some officials as the principal person exhibiting symptoms was elderly and had other health conditions that complicated the initial diagnosis. Because of his local knowledge, social capital, and leadership abilities, he was able to persist and eventually gain the attention necessary to begin an initial investigation and receive resources to prevent further spread of the disease.

Healthcare. There are two different means by which healthcare is obtained by Wayuu and non-Wayuu in La Guajira, Colombia. Healthcare provided by individual employers is

available for those whose work offers it. Subsidized healthcare, delivered through privately contracted Health Maintenance Organizations (HMOs) is available and used by most Wayuu living in the region (fieldnotes, 2014). The Indigenous Health Providing Institutions (IPSI) is the national provider of indigenous health insurance, and distributed by such HMOs as Anas Wayuu and Ayuuleepala. In speaking to informants, they identified a third group of people who are without any type of health insurance (fieldnotes, 2014). This group represents the most socially and geographically isolated, those considered to be the most vulnerable from a public health standpoint.

Behavior

In this section of the context, I will focus on key behavioral practices in La Guajira which are of relevance to the current study. For the purposes of the Triangle of Human Ecology, Mead and Emch (2010) define behavior as:

the observable aspect of culture. It springs from cultural precepts, economic constraints, social norms, and individual psychology. It includes mobility, roles, cultural practices, and technological interventions. (p. 30)

Here, Wayuu social structure, geographic movement, history of contraband trade, drought relief efforts, and participation in the health insurance system will be discussed.

Human-Animal Interactions

The most significant behavioral practice as it pertains to this project is variability in human-animal interactions. The Wayuu human-animal interactions are driven by symbolic, cultural, and economic factors, while the non-Wayuu interactions are driven primarily by

economic factors. These interactions will be discussed in great detail in both the results and discussion.

Social Structure

An atypical social structure is a distinguishing factor of Wayuu life, not often seen in most pastoral groups. It is characterized by matrilineal descent (Cook, 2001) and a matrilocal residency pattern. The Wayuu are divided into about 30 matrilineal clans in which women hold significant roles in the decision-making processes, especially with regard to subsistence activities (Jamieson, 2007). Because men are often absent for long periods of time with more urban economic pursuits, the women tend to the pastoral activities, which involve typical animal husbandry practices, ethnoveterinary practices, and finding lost or stolen animals (Cook, 2001). As such, the social structure of the Wayuu will contribute to the understanding and prediction of the risk of contracting zoonoses in this region, particularly among the Wayuu, as it dictates the patterns of human-animal relations.

Geographical Movement

Some studies have also documented an increasing movement toward the acquisition of urban jobs among the Wayuu (Saler, 1988, p. 42-48, as cited in Cook, 2001), leading to increased movement between the rural setting of the peninsula and the city of Maracaibo. Because they have dual citizenship in Colombia and Venezuela, the Wayuu can move with great fluidity between the two countries. According to Cook (2001), for all intents and purposes the political boundary between Colombia and Venezuela does not exist to them. The significance of the political boundary does not resonate with them as they consider their territory to be the entire

Guajira Peninsula and not just the portion that belongs to either Colombia or Venezuela. Adding to the increased movement over this landscape is the passing through this territory of non-Wayuu Venezuelans and Colombians en route to major cities (Cook, 2001).

History of Contraband Trade

Contraband trade has always had a significant presence within Wayuu culture, made particularly attractive by the opportunity to trade over the barren and historically unregulated Colombian-Venezuelan border. Wayuu women, in particular, have been known to act as mules, smuggling goods under their *mantas*, or traditional dresses (Aschmann, 1960). Acuña (2005) suggests that contraband trade created a space for inter-ethnic cultural and economic exchange and therefore a certain amount of hybridization. In the early to mid-1600s, there was a great deal of competition among colonial European powers, including England, France, and the Netherlands, to attempt to take possession of Spanish territories, trade routes, and valuables (Acuña, 2005). During this time, the Dutch succeeded in occupying Aruba, Bonaire, and Curaçao. By 1655, Britain had taken control of a number of islands including Jamaica. Jamaica and Curaçao became launching points for Dutch and English sea and land pirateering (Acuña, 2005). As such, La Guajira ultimately became contested territory, where the English and Dutch collaborated with the local Wayuu to circumvent the Spanish in order to sell their goods at local markets. Specifically, they sought out the most powerful *apūshis*, or matrilineal kinship groups, to arrange for illegal trade of their goods (Acuña, 2005). It was through this contraband trade that the Wayuu obtained firearms. Social inequality among the Wayuu stems from this period. During this period, more powerful *apūshis* were able to gain leverage over others, creating further socioeconomic stratification among family groups. Although it is unclear from the

historical record precisely how many African slaves were owned by the Wayuu, it is very clear that they were actively involved in the slave trade itself (Acuña, 2005). Contraband activities increased each time authorities attempted to control it. The contraband networks extended to Lima, Peru and Quito, Ecuador, where goods were traded for gold and silver. The impact of contraband for the Wayuu was not solely economic. It created shifts in political power among the Wayuu, within and between *apüshis*, and, at the same time, defines and solidifies the core elements of the Wayuu ethnicity that are still recognizable in Wayuu culture today.

Drought Relief Efforts

Selling stock during periods of drought is common (Aschmann, 1960). They also frequently divide the herd into smaller groups so that they may more easily seek water sources. Projects at the national level have been developed to alleviate stress during times of drought (Aschmann, 1960). These include the salt evaporation program, intended to provide steady employment, and various projects aimed at increasing and improving available water sources to both feed and water the herds. Aschmann (1960) suggests that projects aimed at supporting herds are not ultimately sustainable due to the population density of animals in La Guajira. However, because animal ownership is the ultimate source of social status for the Wayuu, they would prefer to maintain their pastoral livelihoods even under severe environmental conditions.

Participation in Health Insurance System

The Wayuu have shown some reluctance to participate in the universal health insurance system that was enacted in 1993 in Colombia (Buttorff et al., 2013). Buttorff and colleagues (2013) sought to better understand this issue by taking into consideration the perceptions of the

system among the rural population of La Guajira. The current healthcare system is comprised of two tiers. One is for those who are employed, while the other serves low-income populations. In spite of the benefits of this program, about 9% of Colombians and 15% of the Atlantic region are still uninsured. Although from a policy perspective, the contributions and/or copayments are relatively low and are based on income levels, there is a general perception in Colombia overall, and particularly among the uninsured, that the cost would still be prohibitively expensive. However, in La Guajira, 88% of those uninsured claimed it was due to difficulty enrolling without administrative support. Additionally, 24% responded that premiums are too high and 24% also responded that they lack political connections. Respondents said they would be incentivized to enroll if a family plan were made available. This situation is of particular concern in La Guajira, where there is high prevalence of respiratory issues.

Other Culturally-Specific Behaviors

Here, I will describe several Wayuu practices and terms that are mentioned later in the text.

Burial practices. The Wayuu funeral and burial processes are multi-step procedures that carry high social and symbolic meaning. They can also be interpreted as active means by which to avoid disease and contamination when handling deceased loved ones. When a community member passes on, two distinct funeral and burial practices occur (Nájera and Lozano, 2009). The body is first buried soon after death. After the body has decomposed (after approximately 5 years), family members exhume it and begin preparations for the second burial. To do so, one woman is responsible for removing the flesh and cleaning the bones, while others standby and support her. She wears a headscarf, facemask, and gloves while handling the flesh. Everyone

surrounds the woman during this process to help protect her. She is then sprinkled with *chiririnchí*, a Wayuu alcoholic beverage imbibed only by men. She uses scraps of fabric and small branches to remove the flesh (Nájera and Lozano, 2009). The bones are then wrapped in cloth and buried in the clan's cemetery.

Chichamaya. The *chichamaya*, or the *yonna* is a traditional Wayuu dance. Community members will dance the *chichamaya* at important celebrations, such as when a girl has completed the puberty ritual (fieldwork, 2014).

Piachi. Wayuu *piachis* are spiritual healers, or shamans, who rely on their relationships with supernatural beings to cure illness (Rosado and Moreno, 2015).

CHAPTER 3

METHODS

Ethnographic Interviews

Open-ended discussions were initially conducted with Wayuu, and non-Wayuu herdowners, and a *curandero*, or traditional healer. Once a greater understanding of the most significant zoonotic disease threats in La Guajira was obtained, I began to conduct focused, semi-structured interviews which honed in on topics most pertinent to community members. Fourteen interviews were conducted with the following 15 stakeholders:

- 1) Wayuu herdowners (9)
- 2) Non-Wayuu herdowners (2)
- 3) Veterinarians and veterinary technicians (3)
- 4) Representative from the Office of the Secretary of Health of Manaure (1)

Interviews with some participants required a community member to translate between Wayuunaiki and Spanish. All other interviews were conducted in Spanish.

Topics covered during the interviews included purposes and frequency of movement and exchange of livestock, distance traveled by livestock for food and water, effect of drought on humans and livestock, human consumption of livestock and dairy practices, threat of anthrax, most recent anthrax outbreak, vaccination practices, and human and animal indigenous versus western, medical practices.

Although both Wayuu and non-Wayuu interview sample sizes are relatively small, I argue that they are representative of the respective populations. This assertion is based on 3 months of continuous direct and participant observation. Detailed fieldnotes based on informal conversations with approximately 35-40 residents of La Guajira also support this claim.

See appendix B for interview templates.

Direct Observations

Direct observation of human-animal activities on Wayuu *rancherías* and non-Wayuu cattle production farms was conducted on a total of approximately 15 *rancherías* and 3 farms. Observed activities included the daily grazing of livestock, the movement of livestock by herdowners in response to the ongoing and severe drought in the region, the monitoring of this movement by the Colombian Agricultural Institute (ICA), the use of livestock in cultural practices (i.e. the *piachi's chichamaya*, puberty ritual), the exchange of livestock as payment, and the medicinal practices used on non-Wayuu livestock. Human-animal interactions were also observed at the local market. Observation of the slaughtering and processing of Wayuu and non-Wayuu livestock was conducted.

Additional data were collected during the duration of this study. These include cattle hair samples, vaccine distribution data provided by ICA, and data on the Cannexion livestock improvement project in Colombia. Because the information gained via these methods did not directly inform the research question, they are explained in appendix A.

CHAPTER 4

RESULTS

All names presented in the following sections have been replaced with pseudonyms to protect the identities of the participants.

Ethnographic Interviews

Characteristics of Participants

A total of 14 semi-structured interviews were conducted with 15 people residing in La Guajira, Colombia during the months of May through August 2014 (Table 1). Interviews were conducted with nine Wayuu herdowners, including one community leader (W-H3). Two interviews were conducted with non-Wayuu ranchers. However, it is important to note that one of the non-Wayuu ranchers (NW-R2) identified as mestizo. For the purposes of this analysis, he will be considered part of the non-Wayuu group due to the operational structure of his farm and animal husbandry practices on the farm. Two of the 15 were non-Wayuu employees of the Colombian Agricultural Institute (ICA). One was a veterinarian and the other was a veterinary technician (NW-VT, NW-ICAV). Another interviewee (W-VT) was a Wayuu veterinary technician who formerly worked for *Servicio Nacional de Aprendizaje* (SENA), a Colombian institution focused on applied research. One interviewee was a representative from the Office of the Secretary of Health of Manaure (NW-PHO). She previously held a position with regard to transmissible vector-borne diseases and Tuberculosis. She is now responsible for matters concerning social promotion and participation in health initiatives. Of the 15 individuals who participated in the semi-structured interviews, 10 were male and six were female. The Wayuu participants belonged to the Ipuana (4), Epinayu (3), Uliana (1), and Aapushana (1) clans and were from the following *rancherías*: Parenska (7), Pishushimana (1), Jariraigka (1) and Arenosa

(1). These *rancherías* are located in the municipalities of Manaure, Riohacha, and Maicao, all of which are in the Media Guajira. The non-Wayuu ranchers had farms located in Dibulla in the Baja Guajira and in Manaure in the Media Guajira.

Table 1. Characteristics of Participants

Code	Status	Ethnic Identification	Sex	Herdowner	Municipality	Ranchería	Clan
Wayuu Herdowner 1 (W-H1)	Herdowner	Wayuu	M	Yes	Manaure	Parenska	Ipuana
Wayuu Herdowner 2 (W-H2)	Herdowner	Wayuu	F	Yes	Manaure	Parenska	Ipuana
Wayuu Herdowner 3 (W-H3)	Herdowner; Community leader	Wayuu	M	Yes	Manaure	Parenska	Ipuana
Wayuu Herdowner 4 (W-H4)	Herdowner	Wayuu	F	Yes	Manaure	Parenska	Uliana
Wayuu Herdowner 5 (W-H5)	Herdowner	Wayuu	F	Yes	Manaure	Parenska	Epinayu
Wayuu Herdowners 6,7 (W-H6,7)	Herdowners (mom, son pair)	Wayuu	F, M	Yes	Manaure	Parenska	Epinayu
Wayuu Herdowner 8 (W-H8)	Herdowner	Wayuu	F	Yes	Manaure	Pishushimana	Ipuana
Wayuu Herdowner 9 (W-H9)	Herdowner	Wayuu	M	Yes	Manaure	Jariraigka	Aapushana
Wayuu Veterinary Technician (W-VT)	Veterinary technician ⁶	Wayuu	M	Yes	Maicao	Arenosa	Ipuana
Non-Wayuu Rancher 1 (NW-R1)	Rancher	Non-Wayuu	M	Yes	Dibulla	N/A	N/A
Non-Wayuu Rancher 2 (NW-R2)	Rancher	Non-Wayuu	M	Yes	Manaure	N/A	Uliana (mestizo)
Non-Wayuu Veterinary Technician (NW-VT)	Veterinary technician; new employee of ICA	Non-Wayuu	M	No	Riohacha	N/A	N/A

⁶ previous employee at SENA; docent; animal production and reproduction scientist; ethnobotany specialist

Table 1. Characteristics of Participants (continued)

Code	Status	Ethnic Identification	Sex	Herdowner	Municipality	Ranchería	Clan
ICA Veterinarian (NW-ICAV)	Veterinarian at ICA of Riohacha, Cattle Division	Non-Wayuu	M	No	Riohacha	N/A	N/A
Public Health Official (NW-PHO)	Employee at the Office of the Secretary of Health of Manaure ⁷	Non-Wayuu	F	No	Manaure	N/A	N/A

⁷ Previously held position concerning vector-transmitted diseases and zoonotic Tuberculosis; Currently holds a position regarding social promotion and participation in health initiatives

Herdowner Responses to Interview Questions

Question 1 (Q1). When was the last time you received an animal? Gave an animal away? How many? Which species? From and to where did they go? What was the purpose of the move? How often would you say this occurs?

Wayuu responses (Q1). Wayuu herdowners' responses ranged from frequently loaning and borrowing small ruminants to never having had such an experience. Three of the 10 Wayuu reported no involvement in changing herd composition. One herdowner (W-H2) loaned/borrowed two animals in the recent past and expected to be paid with two goats in the future. Another herdowner (W-H3) reported giving away a goat within the previous 24 hours. Still another herdowner (W-H8) received two new sheep during the last two months. They were received as gifts due to family conflict. The owner claimed that this was not a frequent occurrence. However, one of the two sheep died shortly thereafter. Lastly, one herdowner (W-H9) shared that his sister was planning on giving away bulls or exchanging them for cows to help balance the herd. He said that transactions occurred within a radius of one and five kilometers of herdowners' *rancherías*. Generally, the Wayuu herdowners reported engaging in a variety of livestock transactions for the purposes of payment/repayment for wrongdoings and family conflicts, wedding gifts, and herd augmentation.

The Wayuu veterinary technician (W-VT) shared his knowledge of the types of animal movement present in the region. He stated that animals are gifted by the offending party approximately three times to resolve any particular family conflict. They are given to a bride's family for marriage purposes. Conflict regarding contraband also results in the movement of animals over large distances. Additionally, the Wayuu are paid to bring animals across the Colombian-Venezuelan border to the market. Cattle traffickers prefer to use the Wayuu to move

animals due to their dual citizenship status. The interviewee also commented on the health risk this poses to animals in the region, particularly in terms of Foot-and-Mouth Disease, which is still present in Venezuela, yet has been eradicated in Colombia.

Non-Wayuu responses (Q1). One rancher (NW-R1) reported purchasing a bull from Antioquia, a distant Colombian department, approximately three years ago. He sold several cattle two months ago. Additionally, he bought and sold two small ruminants five months ago. Another non-Wayuu rancher (NW-R2) last bought cattle six years ago. He also sold three cattle two months ago and two small ruminants five months ago.

Summary (Q1). Ten Wayuu and two non-Wayuu shared their experiences with buying, selling, gifting, and receiving animals. This total includes a mother-son pair (W-H6,7) jointly responding to questions and a Wayuu authoritative figure (W-VT) responding based on his own personal experience and that which he observed through his veterinary and ethnobotanical work. Most Wayuu move a few animals at any given time. Although only several animals are moved at one time, they report that this movement occurs with some regularity throughout the year. The primary purposes of this movement is payment for accrued debt due to family conflict, marriage gifts, and to provide financial assistance to other family members. In comparison to the Wayuu responses to this particular question, the non-Wayuu responses were limited in number. However, based on my direct observations, they are representative of the frequency of animal movement that characterizes non-Wayuu animal establishments (i.e. farms, ranches). That is, the non-Wayuu ranchers purchase and sell primarily cattle and do so in response to personal needs. This movement may occur every few months to every few years.

Question 2 (Q2). How far do your animals go for water? How far for food? How far did they used to go before the drought? How much has climate change affected this movement?

Wayuu responses (Q2). Most Wayuu herdowners reported that animals were now traveling farther due to lack of nearby vegetation induced by the ongoing drought. According to one herdowner (W-H1), his animals stayed close to the *ranchería* before onset of the drought. They now travel two kilometers and back to find sufficient food sources. They also travel in two different directions, presumably to meet their food intake needs. Another herdowner (W-H2) shared that his animals traveled one kilometer or less before the drought. They now travel four to five kilometers in each direction for food. As for water sources, they have access to a nearby canal. Herdowner W-H3 stated that before the drought, his animals only traveled less than one kilometer. They now travel three to five kilometers (in one direction). The herd actually ventures to the other side of the *carretera negra*, or local paved highway, to find food. This particular herd has access to water at the *ranchería*. The herd of one individual (W-H4) traveled a similar distance (3 km), but went in a different direction than the animals from Parenska II, a neighboring *ranchería*. She also mentioned that when there are mosquitoes, they stay here, at the *ranchería*, because there are more mosquitoes in the woods.

Herdowner W-H5 explained that before the drought his animals remained close to the *ranchería* throughout the day. They now travel so far that they are unable to come back before dusk, and so venture back in the morning. A female herdowner and her son (W-H6,7) were in agreement with the other Wayuu herdowners. They also explained that their animals once fed nearby, but are now forced to travel approximately three kilometers. Herdowner W-H8 shared a similar experience. His animals once stayed close to home as well; they now travel two kilometers in one direction to find edible vegetation. Lastly, herdowner W-H9 shared that prior to the drought, his animals traveled six kilometers or less, three kilometers there and three kilometers back. His animals now travel 12 kilometers total, six kilometers there and six

kilometers back. The Wayuu veterinary technician (W-VT) supported the herdowners' responses. The drought is affecting animal nutrition which in turn is increasing animal movement.

Non-Wayuu responses (Q2). One non-Wayuu rancher (NW-R1) shared that prior to the drought, his animals went to pasture. Now, he helps the herd; they are provisioned. He needs to maintain a “hotel” for the animals consisting of shade, water, and food. The other non-Wayuu rancher (NW-R2) explained that his animals do not travel far. There is a tank on his property into which water is pumped. The animals have regular access to this tank. In response to the drought, he has also begun to grow his own pasture, in hopes to soon provide for his herd.

Summary (Q2). Nine Wayuu and two non-Wayuu shared their experiences with regard to changes in animal movement, particularly in terms of distance traveled prior to and during the drought. All of the Wayuu respondents agreed that their animals were now traveling approximately twice the distance they had been traveling prior to drought conditions. The herds once fed on vegetation near to their respective *rancherías*. Most now travel about six kilometers, with one herd traveling as far as 12 kilometers to obtain sufficient food sources. As stated in the results for Q1, the non-Wayuu responses are limited, but certainly exemplify non-Wayuu experiences. Because the non-Wayuu animals graze on a defined and restricted pasture, they are unable to increase their movement in order to find additional vegetation. Instead, the owners are providing the necessary food and water.

Question 3 (Q3). Do you feel the introduced animals tend to be healthier, less healthy, or the same as yours?

Wayuu responses (Q3). One Wayuu herdowner (W-H8) responded that the animals arrive healthy. She noted that it is a question of change in environment, water, and food. She

referred to these factors as the microclimate. Another herdowner (W-H9) stated that there have been times when the new animals arrived and they were not healthy. This particular herdowner also mentioned that they are more likely to take in sick animals from family members due to familial obligations.

Non-Wayuu response (Q3). One non-Wayuu rancher (NW-R1) explained that the new animals tend to be healthier because if they are not, he will not buy them. The point of buying them is to augment the herd.

Summary (Q3). One non-Wayuu rancher and two Wayuu herdowners responded to the relative health of introduced animals as compared to previously existent animals in one's herd. The Wayuu herdowners noted two significant points. The first was that although an animal may appear healthy when the herdowner first receives it, the change in microclimate may negatively impact the animal's health. The second notable detail was that the Wayuu are sometimes obligated to help other family members. This dynamic may result in the herdowner taking in an unhealthy animal, or an animal that they may not have otherwise deemed a good fit with their existing space and herd. However, the non-Wayuu experience is markedly different. That is, the purpose of seeking out a new animal is to augment the herd. A non-Wayuu rancher would not intentionally take an unhealthy animal as it would be unlikely for them to feel such an obligation.

Question 4 (Q4). How is the drought affecting you?

Wayuu responses (Q4). Responses varied slightly among respondents. One herdowner (W-H1) responded by stating that the drought is solely affecting the animals. Some explained (i.e. W-H2) that it is affecting the Wayuu through obvious means, primarily through the role it has played in negatively impacting the health of the animals. Another herdowner (W-H3) supported this claim, explaining that the animals are now producing much less milk. Usually the

Wayuu are able to give milk to the children, but they are currently unable to do so. The animals also do not have as much meat and so cannot be used for consumption. W-H6,7 shared that there is a severe loss of water for the animals. There is a well at their particular *ranchería* for the animals. However, when the animals are in the *monte*, or woods, and are looking for food, they do not have access to much water. Others (i.e. W-H8) said that the animals are now worth less. The Wayuu are unable to sell the animals because they are too skinny. In return, they are unable to purchase food. Also, due to the limited supply, the prices of meat and cheese are rising. The Wayuu veterinary technician explained that there is no food or water. The animals are dying. They cannot feed their young because they are not producing milk. He (W-VT) provided a rather detailed response. He felt that the loss of animals is the principal loss. However, he emphasized that it is a symbolic and social loss. When a cow dies, the Wayuu talk about how many children she had, and what a good cow she was during her lifetime. They mourn the animal's death, as they would do during a human funeral. They do not see a price when they see the animal. He added that the value of the herd reflects the herdowner's personal value, and the value of the family. In the case of a flood, they would save the children and the animals at the same time and leave everything else. He also shared that he had told his mom to sell some of her older animals to reduce the size of the herd when he thought the drought was coming. She refused.

Non-Wayuu responses (Q4). A non-Wayuu rancher (NW-R1) shared his thoughts on the matter. He explained that the drought does not only affect food and pasture. It also affects nature. It damages the fruit and leaves. The drought affects all life forms. Another rancher (NW-R2) stated that animals do not have protection from the sun when vegetation is sparse. There is also a lack of hydration.

Summary (Q4). Nine Wayuu herdowners and two non-Wayuu ranchers shared their opinions on the impact of the drought. This included the Wayuu veterinary technician (W-VT) responding based on his own personal experience and that which he observed through his veterinary and ethnobotanical work. Most Wayuu explained that the primary impact of the drought is seen in its devastating effects on their herds. Because the animals hold significant cultural, familial, and financial value, the loss of the animals due to the drought severely negatively impacts several aspects of their lives. In comparison to the Wayuu, the non-Wayuu ranchers seemed to have experienced the devastation as less of a personal and symbolic loss, but more of a financial and environmental loss.

Question 5 (Q5). On what occasions or for what purpose do you exchange animals? When do you exchange for consumption?

Wayuu responses (Q5). According to one Wayuu herdowner (W-H3), the Wayuu often exchange animals for personal or family damages or in the context of funerals. Other herdowners (W-H6,7) supported this by explaining that when a *falta*, or offense, occurs, the groups of people involved must meet and the offending individual or family must provide animals to the other family to resolve the conflict. Another herdowner (W-H8) shared a different occasion in which animal exchange regularly occurs. Often Wayuu herdowners might exchange one species for another. For instance, one may have a horse that they do not utilize, but would like a male goat to augment their herd. In this case, they may barter with a neighbor or family member and exchange for the desired animal.

Summary (Q5). Four Wayuu responded to this question and provided insight into the purposes of animal exchange within the Wayuu community. They shared that animals are

exchanged to resolve conflicts that have arisen due to personal or familial offenses, and also to augment one's herd.

Health Authority Responses to Interview Questions

The following questions were addressed by Wayuu and non-Wayuu authoritative figures with expertise in veterinary medicine, agricultural science, indigenous plant use, and public health.

Question 6 (Q6). What are the factors that most increase zoonotic disease risk in La Guajira?

The veterinary technician (NW-VT) explained that risk exists in the control of animals across the border. The animals entering from Venezuela, where there is poor sanitation and a lack of vaccine enforcement, present the greatest risk. This movement across the border is driven by the market for Venezuelan meat in Colombia due to its low cost. According to the veterinarian at the Colombian Agricultural Institute (NW-ICAV), zoonotic disease risk is largely driven by the environment. However, the environmental conditions that increase risk are disease-specific. He provided two examples: 1) rain augments Venezuelan Equine Encephalitis because it increases mosquito breeding, and 2) anthrax is increased during drought periods because animals dig into the soil for food.

Summary (Q6). Both respondents were non-Wayuu. They attributed zoonotic disease risk to cross-border animal movement from Venezuela and changing environmental conditions (e.g. drought in the case of anthrax).

Question 7 (Q7). From your perspective, does the movement of animals present a risk (for example, among indigenous people, at the market, or in terms of border crossing)?

The non-Wayuu veterinary technician (NW-VT) stated that crossing the border is a risk.

Colombia is dedicating more resources to the control of this movement. For instance, the Colombian Agricultural Institute (ICA) recently opened two new employment positions as a part of these efforts. The police and army are now enforcing inspection of animals crossing the border and confiscating those animals without corresponding permits. The Wayuu veterinary technician (W-VT) provided a very insightful response. He described a particular type of movement, which he called "micromovement". If an animal moves three kilometers in one direction, there may be little to no environmental change. If it moves three kilometers in the other direction, it may enter a completely different climate. For example, although located in neighboring municipalities and within relatively close proximity to one another, Cucurumana (*ranchería* in Riohacha) and Parenska (*ranchería* in Manaure) have very distinct microclimates. This concept is particularly useful when considering anthrax. For instance, anthrax is more common in La Sierra. Therefore, if there is animal movement in and out of this region, anthrax transmission will be more likely. He explained that there is a *choque de habitas*, or crash in ways of living, in La Guajira and a need to adapt. Movement created by cultural practices encourages an exchange of pathogens between microclimates. The microclimates do not necessarily need to be far away from one another, they just need to be sufficiently distinct.

Summary (Q7). One Wayuu and one non-Wayuu veterinary technician responded to the above question. They both agreed that the movement of animals does, in fact, present a disease risk. However, they each offered a different supporting argument for increased risk. The Wayuu veterinary technician (W-VT) felt that the "micromovement" of animals increases disease risk. That is, Wayuu animals are responding to cultural practices and therefore can and do travel between distinct environments, increasing opportunities for contact with novel pathogens. The non-Wayuu veterinary technician offered a different perspective. He referred to the difficulties

that are present at the Colombian-Venezuelan border in terms of the illegal movement of animals and implied that previously there was a lack of law enforcement in the control of animals without appropriate documents.

Question 8 (Q8). From your perspective, can climate change or the drought increase risk of zoonotic diseases such as anthrax?

The ICA veterinarian (NW-ICAV) explained that drought increases risk of anthrax. Most people would say that the winter rain increases exposure, but during a drought animals dig for food in the ground and activate spores. The non-Wayuu veterinary technician (NW-VT) shared a different perspective. Without food and water, the animals are hungry. When they are hungry, their immune systems are weakened and they are unable to defend against exposures. There have been more deaths due to viruses and diseases this summer than in previous years. He stated that there have been 7,000 deaths since the beginning of the drought (approximately two years ago). The representative from the Office of the Secretary of Health in Manaure (NW-PHO) held an opposing viewpoint. She claimed that there were actually fewer cases of anthrax during the drought period.

Summary (Q8). Both the non-Wayuu veterinarian (NW-ICAV) and the non-Wayuu veterinary technician (NW-VT) asserted that drought and anthrax are positively associated with one another. While the veterinarian (NW-ICAV) attributed this to animal feeding behavior, that is, digging deep into the soil for food and thus exposing anthrax spores, the veterinary technician (NW-VT) attributed it to decreased immunity brought on by nutritional stresses. The representative from the Office of the Secretary of Health in Manaure (NW-PHO) stated that there was a negative association between drought and anthrax.

Other Comments

The following information was shared by respondents during interviews, but not in response to particular questions. Please note that the comments are presented here in a language and style similar to the way in which they were originally expressed by the respondents. I provide response summaries below each themed section of commentary.

Animal movement.

NW-VT: The Wayuu, *alijuna* (local term used to refer to non-indigenous people), guerillas, paramilitaries, Colombians and Venezuelans are all trafficking. Officially, the Wayuu need permission to bring animals across the border in trucks, but because they have access to the *monte*, they can pass on foot. At the control points, the police are not really looking for gas and food. They are looking for animals. The control of contraband and the control of disease work hand-in-hand. The Venezuelan government protects the traffickers. The border is well-maintained. Colombia tries to protect its side from the Venezuelan movement of goods, animals and diseases (e.g. Foot-and-Mouth disease). Classical Swine Fever is well controlled at the border. ICA verifies that the animal is not infected. The animal gets an ear tag to confirm its disease-free status. The animal can then be slaughtered.

NW-ICAV: It would be hard to stop the movement of animals infected with anthrax over the border because they appear healthy.

W-VT: Giving animals for a woman (during matrimonial practices) symbolizes the alliance between the families. The woman mixes with the family. That family's animals mix with their herd. It is an exchange of patrimony. W-VT also mentioned that the people in the Alta Guajira have saved their lifestyle from the era of narcotrafficking and so goods easily move from Venezuela into the Alta Guajira.

Summary (Animal movement). The non-Wayuu veterinary technician (NW-VT) noted the importance of the border as a means by which to control disease transmission. He emphasized the use of uncontrolled, open space in indigenous territory to facilitate the trafficking of illegal goods, particularly animals. The non-Wayuu veterinarian from ICA (NW-ICAV) points out that in practice it is actually rather difficult to prevent the movement of animals infected with anthrax due to late onset of clinical symptoms. That is, the animals will initially appear healthy and then experience sudden onset of fatal symptoms. The Wayuu veterinary technician (W-VT) provides an alternative example of the movement of animals in the region. He shares that herd redistribution commonly occurs during matrimony, when the bride's family receives livestock from the husband's family. He also briefly mentions the ongoing movement of goods in the northernmost part of La Guajira, a remnant of a time when narcotrafficking was prominent in the region. This suggests that the Alta Guajira may be a potential hotspot for anthrax transmission.

Drought

NW-R1: Climate change is destroying nature. There are no more trees. The rain is not being reabsorbed in the same place. It is running off. It is not going back into the system. [The Wayuu] are continuing to dig wells deeper and deeper. They once only dug wells that were 15m deep. They are now 50m deep. It is not an unlimited supply of water. NW-R1 also mentioned that the drought is leading to the devastation of dung beetle populations in the region.

W-VT: The climate crisis is causing cultural exchange. The political and environmental crises are causing contamination through direct contact with western culture. These syndemic crises are economically precarious and precarious for the culture. There are not many options. Every option has its advantages and disadvantages. We can change and lose our culture or not change and struggle with food and health.

W-VT: The *agropecuario* group (ranchers, plant harvesters, *alijuna*, and Wayuu) met with the governor of La Guajira to discuss the drought situation. He said there are currently no resources. Kiko Gomez, the previous governor, was involved with the paramilitaries. The people took him out of office at the end of 2012. There is an interim governor. The *ley de garantias* says that [the municipality] cannot make future plans during this period. The budget is on hold. The politicians cannot make promises to get elected. The political phenomenon augmented the environmental phenomenon, making it a crisis. The state resources all come from the national level. Under the law, some things are still set – money is sent to schools, etc. However, such things as salaries need to be negotiated. The law was no longer in effect starting the day of the election (July 2014). They are now making requests from the national level. He explained that it is going to take time to receive support and resources. The governor (now Jose Maria Ballestros) went to Bogotá to request money from the President. The President still has not responded. The mayor made his own budget and sent it to the governor. There is no councilman to check the mayor because he was outed for corruption. The national government should respond in approximately 30 to 40 days because it is a crisis. There is a request for more wells – one well for five farms. Two wells of 500 meters would supply all of Riohacha. People asked the mayor for one after seeing that one was constructed near Camarones. The indigenous communities want wells like the one in Riohacha (or to connect to the one in Riohacha), he explained, and a solar-powered pump to have a strong enough watering system to cultivate food for the animals. The short term plan would be to bring food from other parts of the country to provide immediate relief. To his knowledge, no plan is in place to do this.

Summary (Drought). One non-Wayuu rancher (NW-R1) expressed concern for the changing environment, particularly in terms of limited water availability. The Wayuu veterinary

technician (W-VT) relayed the concern the larger community has about losing their culture as a direct result of the environmental crisis. To survive during such precarious times, they are compelled to incorporate western, or non-indigenous practices, into their everyday lives. He also spoke extensively on the political instability at that time and its resulting influence on environmental recovery. Because the local political structure was in flux, funding for drought relief efforts could not be accessed locally and national funding requests did not receive immediate attention.

Anthrax

W-H3: Prior to the outbreak in 2010, there had not been an anthrax outbreak in approximately 30 to 35 years. During the outbreak of 2010, case zero was at Parenska ranchería (of which he is the community leader). He states that his grandmother died of anthrax. When his grandmother was sick, [the community] went to the Secretary of Health. They said it was nothing. She had a bad cut on her hand and then cut meat from a dead goat and got infected. W-H3 worked with a veterinarian to send information to the national level. The animals continued to contract anthrax from other herds. There was a drought. Then there was one rainfall. Animals were looking for food deeper in the ground and further in the woods. Animals began to contract anthrax. Some kids had wounds on their arms. They looked like burns. An animal and its baby died in the reservoir. When it rained, water entered the reservoir. Other animals came to drink from the reservoir and contracted anthrax.

NW-R1: *Carbón bacteridiano*⁸ and *ántrax*⁹ are not the same. *Carbón* comes from the temperature. *Ántrax* comes when the animals are hungry, thirsty or hot. They cannot defend against it. [Herdowners] are trying to build up [animal] immune systems now because when the

⁸ *Carbón bacteridiano*, or *carbunco*, is used to refer to anthrax.

⁹ *Ántrax* also translates to anthrax.

rain comes, there will be potential exposures to anthrax. They usually vaccinate in June in preparation for the rain in August.

NW-ICAV: Vaccines are free now. It is usually less than 300 pesos per vaccine. There is a lot of potential for zoonoses among the Wayuu. They are predisposed because of the environment and poverty. Poverty leads to malnutrition for people and they are more susceptible to disease. The Wayuu do not view vaccines as necessary. ICA wants every herdowner to make a minimal investment in vaccines. The argument is that it will be included in their “patrimony”. Each herdowner will have his/her own program. When NW-ICAV went to vaccinate the Wayuu animals, the Wayuu blamed him for damaging the animals with oversized needles. They wanted him to pay them. If an animal got sick after being vaccinated, the Wayuu came and said it was his fault. Before the outbreak, the Wayuu used a mix of spiritual healers and *curanderos*, or traditional healers. They thought they would die in the hospital. Now they are more willing to go to the hospital and get treated, especially if they have symptoms of anthrax. When working with the Wayuu, things have to be self-evidently useful (i.e. very simple pamphlets about anthrax). The anthrax vaccine is only good for one year. The Wayuu closest to Riohacha are more susceptible to anthrax. They experience the worst effects of urbanization. In the past, it was not important for the Wayuu to claim territory. If the area was infected with anthrax, they would pick up and move. Now, they have windmills/wells, jobs in Riohacha, kids in school, and are selling *mochilas*, or bags, in the urban center. Now it is more populated and there is less land. They do not want to pick up and move. They lost their nomadic ways. Access to Riohacha is more important to them. There are now more exposures to anthrax.

He also mentioned that [the Wayuu] call anthrax *araña*, or spider, because it leaves spider-like scars on the skin. ICA went to look for people with these scars to find out about their

historical cultural practices. They learned that the Wayuu were once semi-nomadic. He also shared that ICA has to seek funds from other organizations to go out and vaccinate. Their goals are therefore hampered as national money is the only way to cover the cost of vaccines.

W-VT: In the Alta Guajira, they bring live animals around and ask how much of the meat individuals would like to purchase. The Wayuu there will not buy meat without first seeing the alive animals. This prevents against anthrax contamination. Also, they do not bring animals in from the *monte* every night. They only go back to the *ranchería* once a week.

Summary (Anthrax). The community leader at Parenska (W-H3) recounted his experience during the previous anthrax outbreak (2010). Anthrax transmission initially occurred cutaneously via contact with an infected goat during slaughter processing. As the community leader, he sought help from the local public health institution, the Office of the Secretary of Health in Manaure. The institution dismissed his concerns as the patient exhibiting symptoms was elderly. He also gave particular attention to the weather conditions prior to the outbreak. The region had experienced a period of severe drought, immediately followed by heavy rainfall. The response of one non-Wayuu rancher (NW-R1) suggests that there is some ambiguity about causal factors of anthrax and its distinguishable characteristics. The veterinarian at ICA shared his experience working with the Wayuu and the difficulties he often faces in terms of medical practices and perceptions of vaccines. According to the Wayuu veterinary technician, behavioral practices surrounding meat consumption are slightly different in the Alta Guajira, decreasing the propensity for anthrax exposures.

Direct Observations

Key Informants

Roberto. I met Roberto on the first day I arrived in La Guajira. He happened to be the owner of the hotel at which I planned to stay for the next few days until I had the opportunity to meet with Dr. Pablo García, the local anthropologist. Two days after arriving in Riohacha, I was already spending my evenings talking with Roberto *en confianza* at a table in his closed restaurant. We made an immediate connection and it soon became obvious that he would likely be playing a key role in my establishing a social network in La Guajira.

During our first conversation at the table in his closed restaurant, Roberto expressed his concerns about his own cattle herd. He explained that the pastoral industry in La Guajira was not supported by the government. It had now been over a year without any rain and it is affecting his cattle. By pumping water out to the field, he has begun to grow his own feed, primarily corn, to supplement the pasture. Traditionally, the cattle just graze on the land and he provides a small amount of hay. However, it is now what he would consider to be a severe crisis. They are technically in the rainy season, but there has not been any rain. He said that climate change has had such a great effect on all those who raise livestock. It is forcing the people to choose between selling the cattle before they die or allowing them to die of starvation. This situation can be detrimental to those with few cattle he explained.

In this first conversation, he also shared information about local disease risks. He explained that Hoof-and-Mouth Disease is a huge issue. This is because Colombians vaccinate against it, yet it is not controlled in Venezuela. He said that everything is subsidized on the Venezuelan side of the border. Venezuelans can buy something for \$5 and sell it for \$10 in

Colombia. For Colombians, such prices are still more economical than if they were to buy the same product through the Colombian market. He shared that this is especially true when selling and purchasing cattle because of the trying environmental conditions. That is, Colombian herdowners are experiencing financial difficulties because of the arid conditions and their resulting impact on cattle starvation. The illegal market provides them with an opportunity to conduct more favorable business transactions. Roberto summarized his thoughts by saying that this process and its impact on health can easily be understood in terms of the following: climate change is leading to animal trafficking which, in turn, is leading to pathogen transmission across the border.

During one conversation on his farm, Roberto explained that there was once a formal meat processing center in La Guajira. *El matador* had national certifications, but the slaughterhouse was eventually closed due to failure to comply with sanitary regulations. Roberto feels that the *ganaderos*, or ranchers, need to unite as they would be more successful if they pooled their resources to obtain processing certifications. This would enable them to enter the national market.

Dr. Pablo García. Dr. Pablo García is a cultural anthropologist, a highly revered member of the Wayuu community, and was my initial contact in the field. He currently holds a position with *El Banco de la Republica* in Riohacha. Our meetings were very formal. I would remain in the lobby until his secretary welcomed me into his office. During our first meeting, we conversed over coffee and he shared information on the complexity of human-animal relations within the Wayuu community. He spoke of the differences between symbolically and economically important animals. He explained that Wayuu livestock corrals are “dynamic spaces”, which allow for the separation of economically purposed animals from the others. He

said that these “others” are utilized during matrimonial and funeral celebrations. Human-livestock relations within the Wayuu community is one context in which Wayuu material and spiritual realities are naturally articulated.

He shared another context in which these material and spiritual realities are entangled. He explained that processing the human body after death is a complex process that can be used to understand health risks. The women who process and are in direct contact with the corpse are not permitted to consume the animal meat served during that time. He went into further detail on the process, explaining that there are two separate burials. Following a period of time after the first burial, the corpse is retrieved. Two women, assisted by two additional women, remove the remaining flesh from the bones. They are required to remain awake for 72 hours. The role of the assisting women is to ensure the primary women do not fall asleep during this time. During each burial, animals are sacrificed and consumed. The women are fed in order to avoid contamination. He repeatedly stated that this ritual exemplifies the entanglement of the sacred and the profane.

Dr. Jorge Días. I met Dr. Jorge Días through Roberto during the partnership meeting described in the following section. He is a veterinarian with a research position at SENA. His current research focuses on genetics and animal production. During my visit to Yaris’ *ranchería*, he shared with me that he had contracted toxoplasmosis, a zoonotic disease, while treating an infected cow. He was not wearing protective eyewear and so blood from the animal splashed in his eye. He is now blind in that eye. After contracting it, he focused his attention on understanding the risk of contraction among several groups of people including butchers and consumers.

Key Issue

There was consistent disagreement among interview participants and those with whom I spoke with via informal conversation about the meaning of *carbón*¹⁰. Some Guajiros were certain that this was another term for anthrax. Others, such as the non-indigenous wife of a Wayuu man at the Cucuramana Ranchería, explained that this word translated to brucellosis. After learning of this translation, I sought Roberto's opinion. He explained that *carbón* is not brucellosis. It is simply a high fever, or a generic sickness. Some Wayuu herdowners qualitatively described *carbón* according to their personal experiences. Several herdowners described *carbón* as a disease that very suddenly affects their animals and one they cannot prevent or treat. Many said that their animals would be beautiful and fat one moment and the next time they saw the animal it was dead. According to these herdowners, this was typical of *carbón*. To add to the multitude of interpretations, there was also another disease present in La Guajira with a similar name. *Carbon sintomático* was another disease against which the animals were vaccinated, further complicating discussions of anthrax transmission in the region.

Key Events

Relocation of cattle on non-traditional Wayuu farm. Lorde's non-traditional Wayuu farm was located in Maicao, a town close to the Colombian-Venezuelan border. Although Wayuu, Lorde considered herself to be a rancher and ran what she called a "technical business". She did not partake in traditional Wayuu pastoral practices. For instance, she provided her cattle with a defined and bounded space in which to graze and also supplied them with additional provisions. She then sold the meat on a national scale. Because of the drought, she decided to

¹⁰ According to the local health institutions and scientific community, *carbón* is anthrax.

move her cattle from her acreage near Maicao to a farm located at a higher elevation, in a more mountainous region south of Maicao and beyond Wayuu territory. She noted that this was the first summer in which relocation was necessary. She explained that the cattle would remain at this location until the rain returns to La Guajira. A representative from ICA arrived at the farm as the owners began to prepare the cattle for transport. The representative shared that he was there to verify the health of the animals. Because Maicao is a border town and Venezuela is not effectively controlling for such diseases as Foot-and-Mouth Disease, ICA oversees all legal animal movement in the region. However, it soon became clear that Lorde was unhappy with the ICA representative. She complained that he was late and costing her time. When he asked for proof of birthplace for some of the animals, she became further enraged about his tardiness and began yelling quite intensely at the man for reasons that did not seem justified.

After about two hours, the cattle were loaded onto two trucks, the representative from ICA fastened ties to the back doors to prevent the addition or removal of any cattle, and the journey began. Soon after we left Maicao and began our ascent, the environment changed dramatically. We left the arid desert behind and were entering what seemed like an oasis in comparison. Each side of the road was filled with green, luscious vegetation and the skeletons of grazing animals were no longer visible. Distracted by the sudden change in environment, it took me a few minutes to realize we were pulling off the road. The police had stopped the trucks carrying the animals. Lorde and her brother remained silent in the front seat of our pick-up truck as the truck driver handed over the requested documentation to the officers who were noticeably armed with automatic weapons. The documents contained the animals' vaccination records, all prior locations of the animals (including place of birth), branding codes, and confirmation that the animals had been checked by ICA. While stopped on the side of the road, Lorde explained

that Venezuelans are receiving help from the government to offset the negative impacts of the drought. She said that goods are subsidized in Venezuela. Many Wayuu living near the border are moving to Maracaibo. There are now entire herds living in the city. While in the car, I asked her questions regarding diseases, vaccines, and the process of moving the cattle. In response, she spoke quickly, and replied with yes/no answers and indiscernible mumbles. We were soon given confirmation by the police to continue on our way. Once we arrived at the farm, they began to unload the first truck holding 25 head of cattle. One cow arrived dead. It is likely he was trampled by the other cattle during the trip and suffocated. There was another cow down, unable to gain enough strength to stand. While the cattle were unloaded, Lorde continued to yell about the difficulties she had with ICA and how late they were in arriving that morning. Without much discussion, we got back in the pick-up truck, the dead cow was loaded into the bed of the truck, and we headed back toward Maicao. We stopped at a man's house on the way to drop off the dead cow. There the cow would be processed and the meat would be sold. The man expressed no concern that the cow arrived dead. Without any notice or warning, Lorde got out of the car to catch the bus back to Maicao, making her disinterest or perhaps even disapproval of my presence rather clear.

While waiting with Lorde's sister to find my own way back to Maicao, I observed what is considered a common occurrence in this area. As trucks carrying containers upon containers of gasoline passed by, their drivers threw money out the window in the direction of young boys. Lorde's sister explained that this was a typical trafficking system. The truck drivers were paying the young boys to verify that the road ahead was clear from police or military who would disrupt the transport of Venezuelan gasoline into Colombia.

Sudden fatality on non-Wayuu farm. Roberto's farm is located in Dibulla, a municipality in La Baja Guajira and beyond Wayuu territory. Like Lorde, he owns a fixed plot of land and grazes his cattle on that land. During one visit to his farm, a young bull quickly became the focus of everyone's attention. After not seeing Roberto for a few hours, I decided to head out and explore the farm. I soon came upon Roberto standing in a pasture hovering over a down bull. As I approached them, I realized that the young bull was convulsing. Every 30 seconds or so his legs went back into an overextended, flexed position and his eyes opened wide and remained fixed. His head arched back and his heartrate quickened. Nasal discharge was noticeable. It appeared as though he was straining. The farm manager used a glove to arm the bull to see if he was having difficulties defecating. He removed some feces. Roberto went to the store and purchased medicine to facilitate bowel movement. The farm manager administered it as an intramuscular injection. The young bull died within 30-40 minutes. All those who were present said that they had never before seen these symptoms. However, all symptoms clearly suggested anthrax infection.

The farm manager returned the next day to bury the carcass. While he dug the hole, other cows as well as dogs approached the carcass. Once he was finished digging the hole, the manager left and returned with a machete. Concerned about his intentions, I asked how he was going to bury the carcass. He said that he was going to disassemble the appendages so that it would be easier to bury. Because opening the carcass of an animal potentially infected with anthrax was generally not advisable, I made a conscious decision to intervene. I expressed my concerns to the group, including Roberto and the manager, and their immediate response was to laugh. However, after some thought, they decided to bury it whole, but did not wear gloves or any comparable protection. After the incident, Roberto shared that this bull was new to the herd.

He had purchased it from another farm along with two other bulls. Roberto also stated that other ranchers in his position would have likely sold the meat of an animal that died suddenly.

Partnership between Cannexion, SENA, Ministry of Agriculture, and Wayuu herdowner. Cannexion, a Canadian trade and agricultural consulting service for Latin America, partnered with SENA, the government-funded National Service of Learning, and the Colombian Ministry of Agriculture and Rural Development to strengthen the small ruminant industry in Colombia. A significant part of this project included partnership with Wayuu herdowners in particular. With this partnership goal in mind, Cannexion set up a meeting with a local herdowner to evaluate the potential mutual benefits and opportunities that may be available.

Roberto learned of the activities taking place with Cannexion and SENA through his friend, Dr. Días, a veterinarian who works at SENA, and invited me to join. Without much information about the purpose of the trip, I eagerly accepted. We left Riohacha and headed in the direction of the open desert. Shortly after leaving the urban center, the surrounding landscape changed. It was suddenly quite barren and cattle, goats, and sheep roamed freely on the side of the road. We soon made a left off the main highway and followed a dirt road for a couple of kilometers, passing several housing structures on the way. Once we arrived, I was introduced to Dr. Días, the team leader, sheep breeder, and gender researcher of Cannexion, their translator, and Yaris, a female Wayuu herdowner. We were served iced tea and the Canadians were given hats. Yaris then took us on a tour of the *ranchería*. First, we stopped at a haystack, where she explained that they had to feed the animals due to lack of sufficient grass for them to graze. We then entered the first corral, where she pointed out a few newly born goats. We walked through the corral to a water pump. She explained that she wanted to tap into water deep in the ground. She would like to provide the animals with water for drinking and also create an irrigation

system to facilitate the growth of grass during periods of drier weather. Yaris criticized the government and their lack of assistance during such a difficult time. Esteban Adan Vasquez, who holds a position at the Colombian Ministry of Agriculture, responded by saying that they need to know what the Wayuu need in order to help them. All those involved, including Yaris and the Cannexion team, spoke of the importance of such partnerships. One of the men from Cannexion described the project as an opportunity for the Wayuu to export meat to North America. However, the indigenous goat breeds are not considered to be of high value. Therefore, he shared that the goal is to crossbreed Wayuu goats with North American goats to create stock that have more meat and produce more milk.

After we ate lunch, Yaris brought us into the second corral. Two young Wayuu men showed the men from Cannexion two male goats and one sheep. Immediately, one of the Canadians recognized that one of the male goats was infected with chlamydia and could transmit it to the ewes. Yaris was very interested to learn this as her newly born animals had been dying. She said that she had a total of 50 die in the recent past. She then loudly stated that this is exactly what she wants; she wants to learn from the partnership with Cannexion. The sheep breeder from Cannexion said that the goats would have automatically gone to the cull list in the United States. The testes on the male goats were not right; they need to remain low in such hot conditions in order to produce healthy, viable semen. They suggested adding penicillin or tetracycline to the water to rid them of venereal diseases.

Political strike in La Guajira. The continued severity of the drought and the lack of government aid prompted the organization of a strike in La Guajira in August of 2014. The strike was organized by the *Paro Cívico Departamental por la Dignidad de La Guajira*, (County Civic Strike for the Dignity of La Guajira) and largely supported by the National Federation of Cattle

Ranchers (FEDEGAN), as they were one of the most severely affected groups. In the two years in which rain did not fall in La Guajira, thousands of animals, primarily cattle, perished.

Although the initial intention was for the strike to remain a peaceful protest involving mostly school and business closures as well as road blockades, it escalated to burning buses on the *carretera negra*, or main highway that traverses the Media Guajira. Both the indigenous and non-indigenous community participated in the strike. The strike did successfully call President Santos' attention to the region as was evidenced by his unplanned visit to La Guajira within days after the strike commenced.

Details of the strike were published in "*La Guajira Al Día*", the local newspaper. In an article published on July 11, 2014, the secretary of the ranchers' committee announced the prospective union strike, reporting that it was being organized in response to the lack of government support received to address the crisis created by the drought. They threatened to blockade roads to prevent travel within La Guajira as well as access to neighboring states and Venezuela. The national government had promised they would provide the ranchers with both food and water for the livestock. However, these promises were yet to be fulfilled, even as the gravity of the environmental circumstances and livestock health became more severe.

On August 12, 2014, a recap of the event was published in the same paper. It highlighted the slogan and underlying driver of the event, "*Por la dignidad de La Guajira*", for the dignity of La Guajira. This slogan made clear their message. They were suffering and refused to be overlooked due to their geographical isolation from the rest of the country. The natural resources found in abundance on their land, including gas, coal, salt, and wind power, have been and continue to be accessed and exploited by external stakeholders and yet they are so easily forsaken during a period of multi-faceted precarity.

Cattle trafficking reported in the local paper. On August 8, 2014, an article in the local newspaper reported the illicit movement of stolen cattle. The police and military seized 106 young bulls in Albania¹¹, after receiving information from ranchers located near the border. They sought leads from these herdowners in order to apprehend the cattle smugglers. The bulls were believed to have been stolen from Venezuela based on their markings.

Many of the articles published prior to and during this time illustrated local concern for the re-introduction of Hoof-and-Mouth disease to Colombia, where prior mitigation efforts had successfully eradicated the disease from Colombian herds. Because the Venezuelan agricultural and health industries were not controlling for the disease, it seriously threatened Colombian financial and health investments.

Military protection on cattle ranch. When visiting Roberto's ranch in Dibulla, we were accompanied by two young men. After spending a few hours on the farm and still not being formally introduced to them, I decided to engage them in conversation over dinner. When asked about their interests in the farm and intended duration of their stay, they replied that it depended on how long I intended to stay as they were there for my protection. Confused by their response, I inquired further. In support of their initial claim, they stated that they were part of the military and lifted their shirts, revealing their concealed pistols. Surprised by what I had learned, I went to Roberto for confirmation. He explained that although he did not perceive the current situation to be one of high risk, it is the responsibility of the military to protect the group of *ganaderos* (a total of 12 ranchers in this area). He said that there had not been a kidnapping in about three years, but the ranchers and their cattle had previously been a target in this area. This interaction demonstrates 1) the high social status of ranchers in this area, and 2) the perceived risk of cattle

¹¹ Albania is a municipality located in La Baja Guajira.

smuggling. Because of the farm's relatively close proximity to the border, it also implies risk of trafficking.

CHAPTER 5

DISCUSSION

Overview

Because zoonoses emerge and re-emerge over biocultural landscapes, where human-environment and specifically human-animal interactions are socially constructed, an in-depth understanding of the local context is essential to the understanding of disease transmission processes. This is exemplified through the present case study: human-animal vulnerability to anthrax among the Wayuu and non-Wayuu in La Guajira, Colombia. In this case, the sociopolitical drivers of livestock movement and their variability within a given geographical region and between culturally distinct ethnic groups are a significant component of the biocultural landscape and are likely to be contributing factors to anthrax exposures. Although the central focus of this study is on livestock movement, the results highlight the importance of understanding the differences between Wayuu and non-Wayuu attitudes toward western veterinary practices and local versus governmental perceptions of disease causation. An understanding of these broader issues is critical to a holistic approach to anthrax mitigation in La Guajira. Furthermore, the severity of the drought at the time of the study revealed far-reaching implications of ongoing political unrest, further exacerbating local human-animal health burdens. This analysis draws on direct observations of human-animal interactions, and semi-structured interviews with local herdowners and government officials in La Guajira.

The preliminary qualitative data gathered during the three month pilot study elucidate a significant disjuncture between theoretical, western-driven health mandates and on-the-ground behavioral animal health practices. This is particularly relevant when considering the impact of the OneHealth mandate put forth by western veterinary institutions. The mandate is founded on

the idea that human, animal, and environmental health are inseparable entities. It is most frequently utilized to evaluate and mitigate the risk of emerging zoonotic diseases in a global context. Although the holistic principal upon which it was founded is vital to mitigation efforts and has driven them forward, its implementation in culturally and environmentally distinct contexts needs further refinement.

Drought

Global temperatures have increased by 0.74°C since 1906 and are expected to increase another 1.8°C to 4.0°C over the next 90 years (Patz et al., 2008). With these changes will come changes in the hydrologic cycle, leading to increased floods and drought (Patz et al., 2008). It is climatic changes such as these that influence patterns of disease emergence (Patz et al., 2008). However, while the drought may superficially seem like the main driver of anthrax transmission in La Guajira and was certainly a severe burden to all participants, it actually served to bring to the fore the more fundamental issues centered on human-animal-environment interactions. That is, the drought-anthrax relationship was mediated by several high-impact factors, including cultural drivers of large and small-scale livestock movement, heterogeneity of animal establishments, medical pluralism, political instability, and community-institution relationships.

I was initially skeptical of alternate climate change arguments such as Lafferty's (2009), which presents a theoretical idea that contradicts most other infectious disease research. Citing Epstein, a well-known zoonotic disease expert, Lafferty (2009, p. 88) states that "conventional wisdom" claims that global climate change will increase tropical diseases. However, Lafferty (2009) argues that rather than *increase* geographic range of infectious agents, climate change is more likely to only *shift* geographic ranges, as it is not the sole factor contributing to infectious

disease transmission. Other factors, including accessibility to health resources, socioeconomic status, migration, drug and pesticide resistance, vaccination, nutrition, and education, play a significant, yet not easily quantifiable role in disease patterns. Therefore, the spread of infectious disease is really context dependent and a linear relationship with climate change cannot be suggested (Lafferty, 2009). The results presented in this study support such arguments. That is, although drought provided the requisite environmental conditions for anthrax exposure in La Guajira, a one-to-one relationship between human-animal vulnerability to anthrax and ongoing drought in the region cannot be suggested. This is due to the presence of several high-impact biocultural factors, namely culturally-driven animal movement and structural heterogeneity in livestock establishments, which are acting as both facilitators and inhibitors of this relationship.

Comparisons can also be drawn to McCabe's 1987 work on drought and recovery among the Ngisonyoka Turkana. The pastoral Turkana and the Wayuu both reside in arid regions, where drought has substantial implications for traditional systems. McCabe (1987) notes the different effects drought has on large versus small ruminants, concluding that drought most severely affects Turkana cattle. Drought similarly impacts Wayuu herds, as the Wayuu lost significantly more cattle than small ruminants due to the devastating effects of the drought, primarily starvation.

An additional comparison can be made in terms of the presence of contagious bovine pleuropneumonia (CBPP) in the Turkana cattle herds. The presence of CBPP in an animal population affected by drought stress suggests that nutritional stressors are leading to immunosuppression. This example further validates the likelihood of increased vulnerability to disease during drought periods in La Guajira. This argument is also supported by Kock (2005), who cites Anderson (1982) in explaining that drought has played a role in livestock/wildlife

disease epidemics. Because drought results in increased contact between animals, it has the potential to facilitate the spread of pathogens. Additionally, Kock notes the importance of immune status in determining susceptibility to disease. Nutritional stress caused by resource limitation during drought periods will lead to suppressed immune systems and create a dynamic in which animals are even more susceptible to disease (Bengis et al., 2002; Kock, 2005).

Heterogeneity of Livestock Establishments and Veterinary Practices

Farms and *rancherías* of varied size, function, and purpose were observed, a notable example of the highly variable character of the animal establishments that exists within the department of La Guajira. For the purposes of this analysis, they were classified into 3 distinct categories: 1) non-Wayuu farms (consisting primarily of cattle), 2) traditional Wayuu *rancherías* (consisting primarily of goats, sheep, and cattle), and 3) non-traditional Wayuu farms (consisting primarily of cattle). Although initially these distinctions were not obvious and certainly did not appear to be significant, an evaluation of the systemic function of the region has encouraged such categorization.

For instance, the type of animal establishment determined how each individual human-animal community responded to the ongoing drought. Veterinary and animal husbandry practices also varied by type of establishment. Animal movement was observed to be both limited and driven by culturally-appropriate physical boundaries. Because of existing variability in micro-environments and micro-cultures, each human-animal community may be most vulnerable to a specific disease. Vulnerability to anthrax at each site will be evaluated.

Two non-traditional Wayuu farms were observed during the study. The first resembled that of a traditional *ranchería*, in that it contained the traditional Wayuu housing and corral

structures and traditional Wayuu customs were clearly maintained. It was located within close proximity to Riohacha, the major urban center in La Guajira. Goats were the primary livestock being raised, although sheep and a few cattle were present. At the time of observation, a meeting between a Canadian agricultural company, Cannexion, and the female herdowner, Yaris, was taking place. The purpose of this meeting was to foster a partnership between the international company and the local herdowner with potential prospects for each partner, although the equality of the partnership was not clear from the data collected. The Canadian agricultural company hoped to introduce Canadian goat breeds recognized for their genetic strengths into the Wayuu goat population. The representatives from Cannexion seemed to have identified a potential market, although they seemed concerned about the health of the local goat population, local veterinary practices, and the severity of the climate in the region.

The introduction of western medical practices was evidenced during this event. In examining the herd, one of the Canadian entrepreneurs identified a male goat with chlamydia and proceeded to explain to Yaris the potential implications for the herd, particularly in terms of transmitting the infection to the female goats and consequently jeopardizing successful reproduction. Although surrounded by local veterinarians, he recommended the herd be treated with tetracycline, a broad-spectrum antibiotic. This event marked the initial transmission of western medical practices to this particular Wayuu herd. If Yaris hoped to create a more robust herd with greater potential for meat and milk production, then she must accept the introduction of new practices. Whether or not treating for chlamydia was the appropriate measure to be taken, it still evokes a critical analysis of such partnerships which may inadvertently place Wayuu herdowners in a vulnerable position, particularly those with aspirations for entering the global market. In order to establish such partnerships which have the potential to augment the genetic

strengths of the herd, they are faced with the reality of abandoning the use of local medicinal knowledge, a significant part of their cultural tradition and even patrimony. There seemed to be an acknowledged tradeoff between western and indigenous practices. That is, there is the potential to gain healthier herds (although this idea is contested due to the need for the livestock to adapt to the extreme climate conditions in the region), and to increase monetary income, but it is at the cost of sacrificing cultural identity and traditions.

Additionally, the potential impact of introducing broad-spectrum antibiotics into an indigenous medical system needs to be thoughtfully considered in terms of unintentionally creating risk for antibiotic resistance. Other studies (Jacob et al., 2004) have reported that it is not uncommon for antibiotics to be incorrectly administered according to traditional or indigenous medical standards. That is, traditional or natural remedies are often used to treat symptoms on an as-needed basis. However, the misguided perception that such a change is merely a substitution of antibiotics for traditional medicines within an existing and viable medical system is unsustainable. Rather, this imposed change to local medical practices requires that communities like the Wayuu intentionally move from a familiar, intuitive, and culturally-grounded system to a medical structure that is fixed, pre-determined, and based upon unfamiliar knowledge systems. The complexity of this shift needs to be thoughtfully considered by organizations like Cannexion which hope to establish long-term, successful partnerships with indigenous herdowners.

The risk of anthrax transmission present on *rancherías* undergoing traditional to western medical transitions is rather complicated. Because their medical systems are in flux, it is difficult to quantify risk associated with each dynamic establishment. However, it may be likely that such farms are at greater risk because they must relinquish some control over the well-being of their

herds. Additionally, they may assume that if vaccines are being administered, their animals are protected against anthrax spores.

Other establishments such as those that belong to the non-Wayuu also present unexpectedly complicated risks. In one sense, they may be seen as less vulnerable to anthrax exposures than their Wayuu counterparts. This is supported by the fact that their animals graze in bounded spaces and do not traverse distinct microenvironments. Additionally, the majority of the non-Wayuu farms are located in the Baja Guajira, where anthrax spores historically have not been known to be present in abundance. However, the one anthrax case observed during the time of the study was in fact on a non-Wayuu farm in La Baja Guajira.

Risk of anthrax on traditional Wayuu *rancherías* is also not as clear cut as it may seem. At first, it may appear as though they are at greater risk of exposure due to the unstructured grazing patterns of their livestock. Their livestock certainly travel a greater distance than non-Wayuu livestock and therefore interact with a variety of microenvironments. However, we must also consider their extensive knowledge of their land, which is their cultural patrimony. They are people who are deeply connected to their land, a land that they have always shared with these pathogens. Only recently have they changed the way they interact with their land, moving from semi-nomadism to permanent settlements and thus creating greater vulnerability to anthrax. However, the lived experience of the Wayuu over the last four years has once again encouraged another shift in their interactions. This behavioral shift came about after the devastation they experienced during the anthrax outbreak of 2010. These behavioral changes include 1) only purchasing the meat of livestock that they have witnessed alive, and 2) greater acceptance of vaccines distributed by ICA.

Animal versus Human Public Health Sector

The interview processes with the veterinarian representing the Colombian Institute of Agriculture and the representative from the Office of the Secretary of Health of Manaure were starkly different. From the onset of the conversation, the veterinarian was eager to engage and provide information on a number of topics. He shared his experiences working with both the Wayuu and non-Wayuu and their animals in La Guajira. He willingly shared his perceptions of the current environmental and health burdens in the region and provided insightful analyses of disease risk based on his profound, although not unbiased, understanding of local cultural beliefs and practices. He quite clearly articulated large-scale political and cross-border public health surveillance issues as well as helped shed light on vaccine perception and animal exchange at a community level. Although he did express his own frustration about reoccurring difficulties in working with the Wayuu, he made great effort to understand their experiences, perceptions, and belief systems and their resulting influence on human-animal health. He was also eager to share vaccine data that were collected during and after the anthrax outbreak of 2010 as well as pamphlets and other educational outreach materials that were designed as a step toward culturally-specific mitigation efforts.

On the contrary, my experience interviewing the representative focused on social promotion and participation in health initiatives at the Office of the Secretary of Health of Manaure involved far less detail. When asked about anthrax in the region, she shared the relatively small number of cases that were reported and confirmed by the institution over the last few years. Because it was a relatively small number in comparison to other morbidities, she claimed that it was not of great concern. However, underreporting of anthrax cases was not discussed. Unlike most other participants, in response to Q8 she stated that there were fewer

cases of anthrax during drought periods. There seems to be a concerning disjuncture between perceptions of the disease, even among health authorities in La Guajira. The institution's interactions with the Wayuu were also demonstrated in the comments WH3 shared during his interview. He had reported his grandmother's case to the public health institution and was dismissed. His concerns were not taken seriously and it eventually led to his grandmother's passing.

Ironically, the institution focused primarily on animal health (ICA) had a far greater understanding of the local cultural differences present in La Guajira and how these varying belief systems influence human-animal interactions and therefore shared health. While these institutions claim to jointly work to address health burdens in the region, it was apparent that they approached community health from two very different perspectives. In considering the impact this may have on anthrax transmission, treatment, and mitigation efforts in La Guajira, it is clear that the Colombian Agricultural Institute is better suited to more effectively protect both human and animal communities.

Animal Movement and Anthrax

The results of the exploratory data collection during the three months of fieldwork demonstrate the variability of animal movement during periods of drought. The heterogeneity of these patterns may pertain to varying forms of farm and ranch establishments in La Guajira as determined by cultural identities and practices. In response to questions regarding quantity, originating location, frequency, and purpose of animal movement, Wayuu and non-Wayuu herdowners and health authorities responded quite differently.

As illustrated via the responses to Q1, the drivers of livestock movement in La Guajira are highly culturally dependent. That is, they are determined or strongly influenced by one's own ethnic identity. As detailed in Chapter 4, the non-Wayuu engage in livestock movement in the form of buying and selling cattle both within and external to the state of La Guajira a few times within any given year. The purpose of these cattle transactions is to augment their herd, a strictly capital investment. One herdowner even referred to his herd as a savings account for his retirement. In contrast to the non-Wayuu, livestock movement within the Wayuu community is driven by the symbolic and social value of the animals. Movement is specifically attributed to resolutions for family or clan conflict, payment for accrued debt and personal offenses, loan repayment, marriage gifts to a bride's family, and other familial obligations such as lending or trading an animal to help augment a family member's herd.

To evaluate human-animal vulnerability to anthrax within each ethnic group, thoughtful consideration of livestock movement drivers is necessary even for the most rudimentary risk analysis. Because most of the Wayuu are moving livestock due to cultural and clan obligations, this suggests that the animals are moved from one microenvironment to another within Wayuu territory and likely even within one subsection of La Guajira (e.g. Media Guajira). Because anthrax is endemic to the broader environment of La Guajira, it is reasonable to suggest that the frequent gifting and trade of livestock, particularly goats, may increase human-animal exposures to anthrax spores. According to this argument, the non-Wayuu movement of livestock, particularly cattle, may be seen as less of a global health risk. This is explained by their limited cultural obligations with regard to animals. Because the non-Wayuu only move cattle for business transactions that will result in herd augmentation, they engage in fewer overall movements. Additionally, it is likely a non-Wayuu herdowner would actually purchase a new

animal from another state, beyond the limits of anthrax endemic land, further reducing human-animal vulnerability to anthrax. Lastly, because they are primarily moving cattle and not small ruminants, it is less likely the animals will expose the spores lying dormant in the soil. On the contrary, the Wayuu primarily move small ruminants, especially goats, which likely puts them at greater risk of exposure. The Wayuu say this is due to the ease with which goats can manipulate the soil and surrounding vegetation to gain access to additional food sources in times of scarcity, inadvertently tilling the soil and exposing and potentially ingesting spores.

To gain a more profound understanding of human-animal vulnerability to anthrax at the time of the study, it is crucial to evaluate the implications of the extreme environmental conditions plaguing the region at that time. As evidenced by herdowners' responses to Q2, the severity of the drought led to unprecedented malnourishment in both Wayuu and non-Wayuu livestock. Tens of thousands of animal fatalities were reported by local media sources during that two year period in which there was little to no rainfall in La Guajira. Although this was a shared burden among both Wayuu and non-Wayuu herdowners and their animals, the responses and coping mechanisms employed by each ethnic group were markedly different. That is, the drought altered herdowner and animal behavior in starkly different ways. Each group was driven to do what was necessary for the well-being of their animals and the livelihood of their families, but did so within the constraints of their own culture.

For the non-Wayuu, this meant that the herdowners were pushed to provision their cattle, a substantial economic undertaking. Because non-Wayuu cattle graze on fixed, privately-owned land with defined boundaries, the owners had to find ways to cultivate their own pasture and pump water into large troughs to ensure the maintenance of their herd. For the Wayuu, this resulted in their herds traveling twice the distance they once did in order to find sufficient

quantities of food and, in some cases, water. Because Wayuu *rancherías* are not bounded spaces, the animals move freely through neighboring *rancherías*, the *monte*, across *la carretera negra*, and into varying micro-environments.

Because the Wayuu animals are traversing more land than non-Wayuu animals, it further suggests that they may be at greater risk for more frequent exposures to anthrax spores. This risk is further exacerbated by the ongoing drought, as it doubles the range of Wayuu animal movement and therefore land area coverage. As exemplified by responses to Q8 and described in the Animal Movement section of the Other Comments, the desperation experienced by the animals during this period also changed their feeding behavior. Prior to the drought, the animals, particularly goats, obtained food by selecting vegetation that was easily accessible. Because of the scarcity of easily accessible vegetation during the drought, the goats were seen digging into the soil to uproot any available vegetation that may be located just below the surface. In the process, they ingested soil and likely came into contact with dormant anthrax spores. This behavioral change provides further evidence of increased human-animal vulnerability among the Wayuu.

While Wayuu and non-Wayuu herdowners' responses elucidated the impact of small-scale animal movement on anthrax transmission at a local level, other data provided by health officials and community members with specialized knowledge or practices demonstrated the importance of large-scale animal movement. Both Wayuu and non-Wayuu veterinarians and veterinary technicians explained the significance of the transnational movement of animals across political boundaries, although greater emphasis was made by the non-Wayuu health officials. Via their responses to Q6, Q7, and additional comments, they provide concrete support for the argument that large-scale animal movement may be influencing human-animal

vulnerability to anthrax. They claim that this risk is attributable to several factors: 1) difficulty in detecting anthrax-infected animals due to late onset of clinical symptoms, 2) ability of Wayuu to move animals through uncontrolled border areas, 3) inconsistencies in national veterinary protocols and disease surveillance and control in Venezuela, and 4) economic desirability of Venezuelan products in Colombian markets.

The relevance of large-scale animal movement as it pertains to disease transmission is made clear through the events that occurred on both Lorde and Roberto's farms. The relocation of Lorde's cattle exemplified one way in which drought may increase the macromovement of livestock in La Guajira and, in turn, increase exposure, transmission, and movement of pathogens. Additionally, Lorde's hostile interactions with the ICA representative during the transportation process suggested that although Colombian officials claim to have control over livestock movement and disease, it is not uncommon for there to be "oversights". That is, I later learned that Lorde's cattle were indeed born in Venezuela. The event on Roberto's farm was also suggestive of the potential risks that may be associated with moving cattle from one state to another. As presented in the results, he purchased his young bull in Antioquia and had not yet vaccinated it. The death of this bull, which was likely due to anthrax, and the resulting animal handling process provide further support for the complexities of human-animal vulnerability within but a single region.

Other studies have considered the influence animal movement practices have on pathogen exposure and transmission. For example, Cleaveland and colleagues (2001) explain that the presence of Malignant Catarrhal Fever (MCF) in Eastern Africa has led to human-driven restrictions on livestock movement, so as to avoid wildebeest territory. However, this restriction, in turn, led to the herds contracting tick-borne and helminth diseases.

Additionally, studies such as Fèvre et al. (2006) give particular attention to the unregulated movement of animals over political and cultural borders as a zoonotic disease risk factor. Although they seem to idealize legally constraining animal movement, they acknowledge that doing so would encourage more illicit trade, further complicating mitigation efforts. With that in mind, I argue that gleaning local insight prior to implementing zoonotic disease mitigation protocols will help us to understand the movement of *transboundary* pathogens (Cleaveland et al., 2001) over political, cultural, and biological boundaries.

CHAPTER 6

CONCLUSION

The present study can be seen as 1) an explicit response to the call for social scientists to actively contribute to the OneHealth movement (Zinnstag et al., 2011), 2) an extension of the ethnoveterinary foundation laid by anthropologist, McCorkle (1989; 1995), and 3) exemplifies a syndemic approach to understanding zoonotic disease emergence and re-emergence (Rock et al., 2009; Singer, 2009; Singer and Clair, 2003). The central finding of this study is that drought conditions in La Guajira reveal a rather complex biocultural landscape which acts as the underlying driver of human-animal vulnerability to anthrax. More specifically, the findings reveal that the drought-anthrax relationship is most significantly influenced by large and small-scale livestock movement. Because the Wayuu herd primarily small ruminants and engage in a greater variety of human-livestock interactions than do the non-Wayuu, they are likely more vulnerable to anthrax exposures.

The implications of these findings are threefold. First, it demonstrates the importance of anthropological approaches for not only understanding human-animal relations, but also for human and animal health. It does so by expanding our understanding of the lived experience of those that share their lives with livestock, giving particular attention to their medical knowledge and practice systems. Second, it demonstrates how better understanding of local practices, including how western technologies are locally interpreted, has the potential to improve efficacy of treatments, and avoid problems such as antibiotic resistance. Local knowledge can also be an extremely cost-effective, low-intensity way to control a known pathogen. Third, it demonstrates how in communities like the Wayuu and non-Wayuu movements of people and animals create a fluid environment in which diseases can easily become transnational phenomena. Finally, these

anthropological insights have great relevance for the ongoing reframing of international public health into a more holistic global health practice.

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APPENDIX A

Additional Methods

Hair Sample Collection

A total of 94 cattle hair samples were collected from three geographically and culturally distinct regions in La Guajira, Colombia. Thirty-four samples were collected from nine Wayuu *rancherías* in the sector of Riohacha, located in the mid-western region of La Guajira. Thirty samples were collected from a Wayuu-owned cattle production farm in Maicao, in the mid-eastern region of La Guajira. Thirty samples were collected from a non-Wayuu cattle production farm in Dibulla, located in the southwestern region of La Guajira.

Hair samples were retrieved from the tail of each animal due to length of hair in this region. In some instances, herdowners assisted with sample collection. In instances where I retrieved the samples, the hair was cut. The hair samples were then placed in individual envelopes and labeled with GPS coordinates, date, estimate of total herd size, and name of *ranchería*/farm.

The hair samples were initially cleaned with soap and water to remove any anthrax spores they may have been harboring. A USDA Animal and Plant Health Inspection Service (APHIS) approved deactivation treatment was used on the cattle hair samples to render them non-infectious for Foot-and-Mouth Disease (FMD). The samples were exposed to vinegar, which has a pH of less than 5.5, for a duration of 30 minutes. Personal protective equipment (PPE) was utilized during these processes. The PPE included gloves and an N-95 mask.

Colombian Agricultural Institute (ICA)

Quantitative data on the monitoring and treatment of cattle, goat, sheep, horses, and pigs during and after an anthrax outbreak in 2010 were provided by the Colombian Agricultural Institute (ICA). These data describe the activities ICA conducted including surveillance, recording any associated/discarded suspicion of presence of disease in animals and humans, focal diagnostics, vaccination, and re-vaccination. Details on the precise location of each activity are given. These include the name of the owner, entry road, community name, municipality, and GPS coordinates of the *ranchería*/farm. Herd size for each species (cattle, goats, sheep, horses, and pigs) is listed as well as corresponding number of fatalities.

Laboratory results from blood samples taken from deceased livestock were also provided by ICA. These data detail the species from which the samples were taken, and the owner, *ranchería*, and municipality where that animal had been found.

Additionally, ICA provided the official contingency plans for combating the 2010 outbreak, describing the types of activities that they partook in and promoted to reduce risk of zoonotic transmission. These included giving specific attention to suspected cases, epidemiological surveillance, vaccination, risk communication, controlling the mobilization of animals via road checkpoints, and reviewing and improving diagnostic protocols. They also raised awareness of anthrax transmission processes through community outreach, workshops, and stylized pamphlets.

Included in the data provided by ICA is a contingency plan developed by the Secretary of Health, detailing the steps they took during the outbreak to manage human risk of anthrax infection. Many of the steps were similar to those taken by ICA, but also included others, such as

managing risk due to consumption of meat and coordinating inter-institutional initiatives (such as those between ICA and the Secretary of Health).

Secretary of Health of Manaure – Epidemiological Data

The Secretary of Health of Manaure provided data collected during the 2010 outbreak, detailing the human modes of anthrax transmission. The data lists the number of confirmed human cases in the municipality of Manaure, the name of the community, the clinical symptoms, and the entity that reported the case (e.g. IPSI). A second report, also provided by the Secretary of Health, focuses more specifically on the two communities in Manaure with patients exhibiting symptoms of anthrax. The report provides information on their type of health insurance, and describes exhibited symptoms.

Cannexion – “Evaluation of the Colombian Ovine/caprine Industry, its Needs and Mutual Benefits and Opportunities for Canada and Colombia”

Cannexion, an organization whose mission is to improve the small ruminant industry in both Colombia and Canada, conducted assessments of the Colombian ovine and caprine industry (Cannexion, 2014). The project had several regional focuses in Colombia, one of which was Riohacha, the capital of La Guajira. According to the assessment, the objectives of this project included evaluating the needs of the local industry, while also identifying the potential opportunities that may be available there, and the resulting mutual benefits for both Canada and Colombia. They provided Colombian authorities with information regarding Canadian sanitary regulations for international food trade. They also evaluated the sanitary conditions of the food animal production chain in Colombia. Additionally, Cannexion provided Colombians with

information on the small ruminant industry in Canada and the genetic quality of their small ruminants. Finally, data on the role of gender in decision-making as it pertains to livestock production and care were collected to inform the project. A report summarizing the project and data collected during that period were provided.

APPENDIX B

Interview Templates**Herdowner Interview Template**

Name:

Clan:

Date:

1. When was the last time you received an animal? Gave an animal away? How many?
Which species? To and from where did they go? What was the purpose of the move?
How often would you say this occurs?
2. Do you feel the new animals tend to be healthier, less healthy, or the same as yours?
3. How far do your animals go for water? How far for food? How far did they go before the drought? How much has climate change affected this movement?
4. How is the drought affecting you?
5. How is the loss of animals affecting you?
6. On which occasions or for what purposes do you exchange animals? When do you exchange for consumption?
7. What do you do with the animals that die on their own?
8. Generally do you slaughter and consume your own animals?
9. Do you drink milk? How often? How is it prepared?
10. When was the last time you or someone you know had anthrax in their herd?
 - a. Who?
 - b. How close to here?

- c. How many animals were affected?
 - d. Did any humans contract it? How many?
 - e. What were the human symptoms? How were they treated?
 - f. Were there any human fatalities?
 - g. Was the meat consumed?
 - h. To your knowledge, were the animals vaccinated prior to contraction?
 - i. To your knowledge, are they vaccinated against anthrax now? Against any other disease?
 - j. How did ICA and other authorities respond?
11. Do you vaccinate your herd against anthrax? Who does the vaccinations? How much does it cost?
12. Do you have any experience with ICA? Explain.
13. Apart from vaccination, do you seek western veterinary care? If yes, explain.
14. Are there any conditions that you always treat with plants? Which?
15. When you or your family members are sick, do you use traditional practices to treat, go to a *curandero*, or seek western medicine at a clinic?
16. Are there any conditions in humans that you always treat with plants? Which?
17. In your opinion, has there been a decline in indigenous medicinal practices among the Wayuu? If so, to what do you attribute this?
18. Do you have health insurance? What does it cover? Where can you use it?
19. Do all Wayuu have the same health insurance plan? Explain variability.

ICA Interview Template

Name:

Affiliation:

Qualifications:

Date:

1. What are the mission and objectives of ICA?
2. From your perspective, what is the most severe animal health risk in La Guajira?
3. From your perspective, what is the most severe zoonotic disease risk in La Guajira?
4. Which factors increase zoonotic disease risk in La Guajira?
5. From your perspective, is the movement of animals a risk factor?
6. From your perspective, can climate change or drought increase risk of zoonotic diseases such as anthrax?
7. When was the last time an anthrax case was reported in either the human or animal community?
 - a. Where was it?
 - b. How many animals/people were affected?
 - c. Were there any human fatalities?
 - d. How did ICA respond?
 - e. What is the protocol that ICA follows when there is an outbreak?
 - f. Are the outbreaks as common among the non-Wayuu communities as in the Wayuu communities?
8. Can you describe the outbreak of 2010? Which communities were most affected?

- a. Is ICA still working with these communities?
 - b. How long after the first case were the animals vaccinated?
 - c. How did the people respond to the vaccination protocol? Were there any issues with participation?
9. From your perspective, might there still be a risk of another outbreak? Why or why not?
10. What is ICA's role in the drought crisis?

Wayuu Expert Interview Template

Name:

Title:

Expertise:

Affiliation:

Date:

1. How often do the Wayuu move their animals? For what reasons? Does this differ from non-Wayuu *ganaderos*?
2. Do you feel this has any relation to the health of the animals and/or zoonotic disease transmission? If yes, explain.
3. Do you believe climate change has affected this movement?
4. How is drought affecting the animals?
5. How is drought affecting the people?
6. Do the Wayuu or non-Wayuu sell and/or consume meat from animals that have died?
7. Do the Wayuu slaughter and consume their own animals?
8. Do the Wayuu drink the milk? How often? How is it prepared?
9. When was the last time there was an outbreak of anthrax in an animal herd?
 - a. Who?
 - b. Where?
 - c. How many animals were affected?
 - d. Did any humans contract it? How many?
 - e. What were the human symptoms? How were they treated?

- f. Were there any human fatalities?
 - g. Was the meat consumed?
 - h. To your knowledge, were the animals vaccinated prior to contraction?
 - i. To your knowledge, are they vaccinated against anthrax now? Against any other disease?
 - j. How did ICA and other authorities respond?
10. Do Wayuu/non-Wayuu vaccinate herds against anthrax? Who does the vaccinations? How much do they cost?
11. Do you have any experience with ICA? Explain its role in the community. What are its objectives?
12. Apart from vaccination, do the Wayuu seek western veterinary care? If yes, explain.
13. Are there any conditions which are always treated with plants? Which?
14. Do most Wayuu use traditional practices to treat, go to a *curandero*, or seek western medicine at a clinic?
15. Are there any conditions in humans that are always treated with plants? Which?
16. In your opinion, has there been a decline in indigenous medicinal practices? What do you attribute this to?
17. Do the Wayuu have health insurance? What does it cover? Where can you use it?
18. Do all Wayuu have the same health insurance plan? Explain variability.