

The Precariousness of the Non-Human Other: Situating Lyme Disease Within a Multispecies Framework.

by
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Authors Declaration

I hereby declare that I am the sole author of this thesis. This is the true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

Abstract

Lyme disease, the fastest growing vector-borne infection, can be found at the convergence of human-animal-environmental health. The spread of the bacterium is accompanied by various factors, such as ecological changes brought about by human activity (i.e. climate change, hunting & deforestation), tick lifecycles, deer, mice, and bird populations, political designs, economic strategies, built environments, and toxic myths that turn practices of care into conditions for disease communicability. Lyme disease highlights how when multiple species are present, how they interact and relate with each other shapes their respective realities and changes the contours of interspecies encounters. Drawing on methods and scholarship from both critical medical anthropology and multispecies ethnography, this thesis seeks to understand the factors involved in people's understanding of their companion animals, the environment, and disease transmission.

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CHAPTER 1

SITUATING ZONOTIC INFECTIONS WITHIN MEDICAL ANTHROPOLOGY'S NOTIONS OF PUBLICS

For some time now, medical anthropology has been interested in the ways that individual and social bodies are implicated in the formulation of health and well-being (Porter 2019; Brown & Nading 2019; Nading 2012; Kelly & Lezaun 2014; Brown & Kelly 2014). As such, well-being is both an individual and social process that tends to focus on bodies and their interaction with the world around them. In this manner, human lives are not separate from other species but rather “from the level of the physical space we coinhabit to the movement of pathogens across and through the landscapes and bodily boundaries, to the social, economic, and political structures we navigate while interacting with others, we are never alone” (Fuentes 2019, 3). By looking at zoonotic diseases one can see these entanglements; they are not simply one-off events, but rather a reflection of ongoing and recursive interactions, mediated by forms of contemporary governmentality, land degradation, the vector's lifecycle, the movement of humans, animals, and microbes, and the short-term management of acute outbreaks (Brown & Nading 2019). Therefore, we need to investigate what it means for people, microbes, animals and things to all live well together. These notions around human-animal health revived questions about responsibility while disturbing the boundaries between political, economic, and ontological dimensions of life (Brown & Nading 2019).

A multispecies perspective focuses on the ways in which bodies, and bodily difference, are perceived and the affect each has on particular material and social contexts (Porter 2019; Brown & Nading 2019; Kirksey & Helmreich 2010; Singer 2014). What distinguishes this orientation is the attention to the ways in which species difference provokes “unfolding, often incidental attachments and affinities, antagonisms and animosities that bring people, nonhuman animals, and materials into each other's world” (Nading 2012, 572). There has never been a purely human space as animals have always occupied a role in our everyday lives, whether as pets, wildlife, or livestock. They are thoroughly embedded in our work: as parts of development, conquest, or imperialism; or in practices of cultivation, consumption, or co-habitation (Coulter 2016; Brown & Nading 2019). By paying attention to our differences we can begin to unsettle

our long-held, anthropocentric notions of well-being by looking at what it means for nonhuman others to have freedom and autonomy. In other words, our differences can show the unequal relationships that underlie our ability to live and feel well alongside other species (Porter 2019).

1.1 Defining a Public: Who or What is a Public?

Medical Anthropology generally treats illness as a human problem, focusing on how ill-health is distributed across populations due to inequality and injustice, among other factors (Rock 2017). Within Medical Anthropology, it seems the dominant way of thinking about a public is as entities that have “reason and are bound together by their minds, whereas populations are ideally composed of masses of ordered bodies and crowds are unreasonable, unruly, and even dangerous” (Rock 2017, 316). When thinking about publics and public issues through an interspecies perspective, there needs to be an expansion on the definition of what and who is allowed to make up a public. Human illness cannot be fully understood without taking non-humans into consideration; nonhumans are essential to both the formation of the illness and remedy for it (Rock et al. 2017). The transmission of Lyme disease is predicated on the use of multiple different bodies, throughout which if one was not available the cycle of infection could be broken. Therefore, there needs to be a reconceptualization of publics in order to grasp the complex and myriad relations that inhabit the public health sphere and influence the health of others. Therefore, promoting health and well-being is not merely a human endeavour as it inevitably has effects across species boundaries. A public should not be thought of like a bound entity brought together by rational thought, but rather as a multi-species entanglement that has formed in relation to a specific event, policy, etc (Rock et al. 2017). Lyme disease brings together interactions between people, nonhuman hosts, ticks, and microbes, thus giving rise to a social structure that is multi-species in composition. Looking at a multi-species public entails incorporating all of the actors inherent in the disease process in order to fully understand disease communicability.

1.2 Publication

The intended publication venue for Chapter Two of this thesis is *Anthropologica*. This journal is published by the Canadian Anthropology Society and reflects the range of research being done by both Canadian Anglophone and Francophone anthropologists. This Journal

provides a representation of Canadian anthropologists' contribution to the scholarship, which encompasses anywhere from global to Canadian issues.

CHAPTER 2

THE PRECARIOUSNESS OF THE NON-HUMAN OTHER: SITUATING LYME DISEASE WITHIN A MULTISPECIES FRAMEWORK

2.1 Introduction

Ticks are one of the most important disease vectors in North America. These arachnids are able to transmit a wide variety of pathogens, including viruses, fungi, bacteria, and protozoa, with new tick-borne pathogens being discovered regularly (Fuente 2003; Singer & Bulled 2016; Farnsworth 2013). According to the fossil record, ticks originated somewhere between 65 to 146 million years ago and as such have been present throughout human history. Although their impact on human health in prehistoric times is unknown, the earliest references to the arachnid and its resulting illnesses can be attributed to Homer, when he mentioned ticks on Ulysses' dog, and on an Egyptian papyrus scroll referring to tick fever (Fuente 2003; Singer & Bulled 2016). Despite this early recognition of the arachnid and the illnesses it carries, even today the magnitude of tick-borne illnesses on human health is not fully recognized; there is still so much we do not know about the arachnid or its pathogens (Fuente 2003; Farnsworth 2013).

Humanity's continued incursion into natural environments is bringing them into closer contact with ticks and the diseases they carry. In Canada, the occurrence of Lyme disease has been gradually increasing over the last few years. In 2009 there were only 114 confirmed cases; however, by 2016 there were 992 Lyme cases, with a huge jump in 2017 to 2025 cases (Government of Canada 2018). There has been a marked increase in the occurrence of Lyme disease in Ontario, specifically in the eastern portions of the province. The number of probable or confirmed cases of Lyme disease in Ontario in 2017 was 959, which is three times higher than the province's 5-year average of 313 (Nelder et al. 2018). Over the past few years, climate change and land degradation have exacerbated the conditions of Lyme transmission within Canada (Singer & Bulled 2016, 446; Kilpatrick & Randolph 2012; Ogden et al. 2013a; Ogden et al. 2013b; Ogden et al. 2014). One way this occurs is by impacting the arachnid vector's movements, reproduction, and ability to establish new populations throughout much of the country, since the regions that have previously been uninhabitable due to the severe and brutal winters are now warming up (Ogden et al. 2013a; Ogden et al. 2014; Scott et al. 2012; Singer &

Bulled 2016; Farnsworth 2013). More importantly, land degradation, particularly habitat fragmentation resulting in farm land and other important ecosystems being converted to housing or shopping centers, places people in close proximity to the ticks and their nonhuman hosts (Ogden et al. 2013a; Ogden et al. 2014; Singer & Bulled 2016; Farnsworth 2013).

This thesis attempts to reconcile insights from both critical medical anthropology and multispecies ethnography. By exploring issues such as human-animal contact and cohabitation, I hope to show how a syndemic approach can be applied to interspecies relations by focusing on how the environment plays a role in disease communicability (Singer 2014; Singer & Bulled 2016; Brown & Nading 2019). Multispecies approaches can expand on zoonotic narratives by going beyond the human experience to explore how people understand the landscape through their everyday interactions, as well as what animals and other entities' bodies and behaviours can tell us about changing disease ecologies (Sodikoff 2019; Fuentes 2019; Friese & Latimer 2019; Lorimer 2019; Blanchette 2019; Brown & Nading 2019; Nading 2014; Brown & Kelly 2014; Singer 2014; Singer & Bulled 2016; Kirksey & Helmreich 2010). Critical medical anthropology, when looking at interspecies interactions, can highlight the ways in which different species interact within a given space and how that influences one another's development. For instance, it can highlight the ways behavioural changes happen over time due to repeated interactions with multiple other species (Sodikoff 2019; Sharp 2019a). By focusing on the interactions between people, animals, arachnids, and microbes, this thesis shows how zoonotic infections are changing over time, with a central focus on Lyme disease.

Different bodies are affected by Lyme disease (*Borrelia burgdorferi*) and implicated in its spread and transmission. Humans and ticks have propelled *B. burgdorferi* into Canada, and one way of tracking the infection is by using dogs (Weese 2011; Herrin et al. 2017; Backer et al. 2001). Animal studies can show how dogs are susceptible to Lyme disease just as much as humans are. Although dogs are not a source of human infection, both species get the disease through the same mechanisms and therefore infection in one can indicate the potential for infection in the other. Essentially, outside of endemic regions, the risk of infection is generally low to non-existent but if the infection rate increases by 5% or more in dogs then the incidence rate for human infection increases as well (Weese 2011). By exploring the convergence of human, animal, and environmental health my thesis begins by briefly exploring an interspecies perspective within medical anthropology. I then describe the virology of Lyme disease by

highlighting the human-environmental interactions that led to people coming into contact with the arachnid vector, along with the forms of contact between humans and the various animal hosts. By using a syndemic approach, I begin to explore the contours of these interactions.

2.2 Methodology

The main objective of my thesis is to investigate the syndemic interactions that are found in our interactions with our companion animals, the environment, and disease transmission. In order to generate my findings, I reviewed the relevant archival-historical, epidemiological, and social science literature concerning Lyme disease, multispecies ethnography, and syndemic theory. These resources allowed me to gain insight not only into the myriad ways we conceptualize animals but also how we view and understand our positioning in relation to the non-human world. My review was further supported by analysis of the anthropological, entomological, and public health research. On top of this, I conducted unstructured interviews and phone conversations throughout the period from May 2018 to March 2019. In total, I interviewed 10 participants, 7 in person and 3 over the phone. The phone conversations, along with the interviews, lasted anywhere between 30 – 60 minutes. I audio recorded all interviews and transcribed them manually. I paid attention to themes around public health and how people talked about the healthcare of their dogs. All dog owners will be identified by their dog's name.

2.3 Multispecies Ethnography

Anthropology has always been interested in the relationship between people, plants, animals, and things. Some of the early work done in the discipline was looking at taxonomies of social difference, however, these seminal pieces were focused on a materialistic perspective of multispecies relations (Ogden, Hall, & Tanita 2013; Leeds & Vayda 1965). For instance, Evans-Pritchard's classic work on how cattle play an integral role in almost every social institution among the Nuer, along with geographers mapping the spatial distribution of animals¹ in the 1930s (Ogden, Hall & Tanita 2013). This allowed for the study of relational distributions of animals, thus creating an opportunity to begin theorizing the humanity of nature, with much of this work focusing on the ways natural environments reverberate cultural significance (Ogden, Hall, & Tanita 2013; Williams 1980; Cronon 1996; Latour 1993, 2004; Ingold 1995, 2000,

¹ This gave rise to the exploration of human influences on animal distributions in the 1950 and 1960s.

2011). Thus, the multispecies scholarship has come out of several decades of research that has problematized the essentialism of nature (Ogden, Hall & Tanita 2013).

Nature, then, becomes an archive of social identity, cultural memory, mythology, and as sites of production and reproduction. Coming out of this, feminist ecology has investigated how proprietorships, global conservation discourses, and ecological claims intersect with and impact local populations and their livelihoods (Ogden, Hall, & Tanita 2013). Thus, nature is no longer seen as apolitical, but rather as a hybrid system of socionatural assemblages (Ogden, Hall, & Tanita 2013; Heynen et al. 2006; Whatmore 2002; Braun 2002; Castree & Braun 2001). This view of the world and its inhabitants has long been documented in Indigenous worldviews. A. Irving Hallowell, a scholar of Ojibwa “culture, warned against “projecting” Western conceptions of subjectivity on other societies, compellingly illustrating the myriad ways ‘entities other than human beings’ have personhood in Ojibwa social life” (Ogden, Hall, & Tanita 2013, 12-13). There needs to be an appreciation of how nature influences people’s understanding of the world we share, along with an understanding within the discipline of the ontological relativism that multispecies ethnographies can reveal (Ogden, Hall & Tanita 2013).

Therefore, multispecies ethnography seeks to understand the world as multicultural and multinatured, emergent, materially real, and partially knowable through the relations of multiple beings. Encompassing the liveliness of plants, bacteria, animals, and other beings, the nonhuman world is understood as possessing its own rules and logic that exists within and beyond the human world (Ogden, Hall, & Tanita 2013; Ingold 1993). This reconceptualization of the human represents an epistemic shift within the discipline and beyond in the humanities and social sciences. Traditionally the discipline relied on a standardized human as a point of analysis, generally a Euro-male, and employed various categories such as ethnicity, race, gender, sexuality, culture, and class in order to theorize and account for human variation (Ogden, Hall, & Tanita 2013). This scholarship is attempting to move beyond these categories and bring the human out of its isolation from other entities and beings. Rather than only looking at human difference within these categories, multispecies ethnographers are investigating how the world and the distinctiveness inherent within it emerges through shifting, often asymmetrical, relations with other agentive beings (Ogden, Hall, & Tanita 2013). Accordingly, multispecies ethnographers are making theoretical contributions to the reconsideration of what it means to be human.

2.3.1 Politics, Health, & the Nonhuman World²

Humans have lived in close proximity, and in some cases in symbiosis, with other animals for the entire history of our species (White & Candea 2018). According to Coulter (2016) animals have been integral for the formation of human civilization and are key components for most modes of production (K. Anderson 1997; Childe 1928). Therefore, within the last 13,000 years, humans have domesticated various wild animals, such as cows, goats, donkeys, and llamas, in order to use their bodies and abilities to further human development. However,

at the same time, by altering animals' existence and changing the natural environment everywhere we went, unintended human-animal interactions began or were exacerbated. The number and frequency of mosquitoes and mosquito-borne illnesses grew alongside the pools of water and piles of excrement that accompanied agriculture, for example, human settlements attracted more rodents and scavengers. Close living and working with animals meant an increased intermingling of living and dead bodies, bodily fluids, and micro organisms. People also began shaping not only animals' lives, but also their biological futures and genetic makeup through selective breeding and other practices that continue today. Overall, the number of species and individual animals whose futures were wedded to human beings is astounding. From the smallest insects, birds, and mice, to the massive whales, and elephants, no animal or species were unaffected by humans and their work (Coulter 2016, 6).

Human and animal fates have been economically and symbolically connected by global capitalism and as the anthropological record shows, our health has been entwined for decades. Therefore, there needs to be a more socially engaged approach to the fate of human and animals (Nading 2013). As the above quote highlights, there needs to be an integration of ecological models of disease exposure into household dynamics, social models of market, and labour in order to change the way social scientists study disease (Nading 2013). Thus a multispecies approach brings the creatures, objects, and landscapes that previously appeared on the margin of the discipline into the foreground; now the smallest organisms and those seemingly least like us are being brought into the realm of study (Kirksey & Helmreich 2010; Singer 2014).

Political ecology has been able to show how nature becomes politicized; rain, temperate forests, clouds, savannas, polar expanses, and oceans are all sites of capitalist expansion,

² See Keck (2018) for a history of animal diseases in social anthropology.

resource wars, colonial and postcolonial displacements, and development schemes and contests (Ogden, Hall, & Tanita 2013). Political ecology is interested in the mechanisms people utilize in order to exert control over landscapes, and the ramifications of such an endeavor on people and the environment in their search of material and ideological advancement (Ogden, Hall, & Tanita 2013; Singer 2010). This scholarship has produced significant analyses into “the symbolic and material absorption of other beings within capitalism and other arenas of socioeconomic power – including through discursive regimes, practices of governance, and contests over resources and the equitable distribution of environmental risk” (Ogden, Hall, & Tanita 2013, 15). Some interesting work in multispecies ethnography has come out of this scholarship, seeking to appreciate how various creatures, small and big, enter into the political realm (Ogden, Hall, & Tanita 2013). For example, Kosek (2006) examines the material and discursive ways that the forests of New Mexico play into Hispano struggles over rights, identity, and access to the forestland. Another way to look at it is by investigating how certain species are politically deployed in order to reinforce security and safety measures. For example, Paxson (2008), by using Vermont’s raw milk cheese industry as a model, was able to show how microbes and microorganisms found in milk protein are becoming utilized as integral parts of public debate and regulatory concern.

By looking at these multispecies relationships we can begin to understand how much and how many people are influenced by animals (Coulter 2016). In a health context, animals often only appear in the role of the disease vector and the fact that the majority of “animal vectors are insects makes them easier, perhaps, to treat as Others, objects of cultural scorn and as subjects of detached strategies of technological control, as indeed they have been since scientists began associating infectious disease with insect vectors at the end of the nineteenth century” (Nading 2013, 61). Our collective life should be understood as a dynamic, ongoing process of symbolic and material relationships among humans, other life forms, and the environment. Indeed, even infectious and zoonotic diseases depend on the transmission of nonhuman components such as bacteria, viruses, fungi, and other microscopic life forms (Nading 2013). With industrialization settlements were constructed and allowed for the intensification of animal husbandry, exposing populations to disease vectors, like mosquitoes, and to pathogens that used animals as reservoirs, like influenza (Nading 2013). The intimacy urbanization created between people and animals lead to the introduction of major epidemics that would plague the next several centuries.

However, this also contributed to the creation and refinement of species categories, as people were starting to influence animal lives on a far greater scale (Nading 2013). Ranging from the mass culling of animals for biosecurity reasons to the genetic change brought about through selective breeding, humans have been influencing animals' lives, and subsequently the environment, for centuries (Coulter 2016; Nading 2013).

Medical anthropologists began analyzing the political economy of health during the latter half of the 20th century. This approach looked at how economic policies, planning initiatives, and land degradation have led to human suffering. For example, studies of malaria and dengue demonstrated how humans attempt to deploy ecological knowledge in order to disrupt the lifecycles of insects with chemicals, which tend to have unintentional social and environmental consequences as often as not (Brown & Nading 2019; Dauphinais 2017 unpublished manuscript). Since medical anthropology was developed on the fringes between nature and culture it is concerned with the interactions between multiple life forms (Latour 1993; Singer 2014). By focusing on such things as vectors, pathogens, using animals as therapeutic agents and extracting medicine from plants, etc., medical anthropology's focus on other species has always been driven by a concern for the consequences for the human (Singer 2014). Medical anthropology has long recognized the dangers zoonotic infections pose to human health by studying the interactions between pathogens, intermediate hosts, and the environment. However, this model has always privileged the human by trying to break off the cycle of transmission to prevent further human infection (Sharp 2019a). By applying a multispecies lens to medical anthropology, we can begin to change established modes of representation, thought, and action. An interspecies approach exposes a newly productive, multidirectional entanglement that foregrounds how humans, animals, pathogens, and parasites are all enmeshed in our collective sickness, suffering, treatment, care, and death (Sharp 2019a).

The emergence of Lyme disease as a zoonotic infection in North America presents an exemplary case of the blurring of species boundaries. The emergence of zoonotic infections has a fundamental role in shaping public health. Reconstruction of the evolutionary history of *Borellia burgdorferi* shows evidence of the bacterium in North America 60,000 years ago. The diversity of this bacteria is geographically widespread and pre-dates the recent emergence of Lyme disease (Walter et al. 2017). This suggests that the current epidemic of Lyme is due to ecological, rather than evolutionary, changes. For instance, human activity such as increasing

deforestation, hunting, and climate change has influenced the movement of bird and mammal hosts enabling a drastic expansion in the range of Lyme (Walter et al. 2017). Recognition of this emergent disease began in the 1970s with the appearance of 32 initial cases showing the distinctive Erythema Migrans rash and arthritis, with the numbers growing exponentially from there (Weintraub 2013). There are various connected biological, sociocultural, and environmental factors that are critical to the spread of Lyme disease to humans. First, black-legged ticks (*Ixodes scapularis*), or deer ticks, were found to be infected with Lyme disease (*Borrelia burgdorferi*) which previously had not been found in humans. Second, due to climate change and other consequences of human activities (such as the production-driven ethic that underlies capitalism) there has been a reduction in the availability of primary hosts. Third, the creation of suburbs (and other such developments) increase habitat fragmentation which leads to greater contact between humans and the tick's terrestrial hosts, contributing to a viral amplification cycle. Fourth, nearly 4 billion birds make their way to Canada for spring migration, with more coming in the fall. Due to climate change, the ticks brought up during migration have a greater chance of creating new populations and passing the infection along in potentially new regions. Fifth, a cultural shift placing emphasis on outdoor recreation which further increases the frequency of ticks and humans interacting. Finally, medical ignorance dominates much of the world of Lyme disease, ranging from doctors insisting it is a rare illness, thus not knowing when to suspect a Lyme infection, to those who actually claim that Lyme doesn't exist in Canada, despite the mountain of evidence to the contrary (Singer 2014; Singer & Bulled 2016; Ogden et al. 2014; Ogden et al. 2013; Ogden et al. 2008; Scott et al. 2012; Farnworth 2013; "itslyme" 2017; personal unpublished data).

As the above suggests, there are various factors that need to be considered when investigating the spread and magnitude of Lyme disease. Ethnographic studies on the behaviours and interactions between multiple species (ticks, deer, mice, birds, humans, and bacteria), assessment of the impact humans have on the environment, and the identification of the specific political and economic drivers of these changes, in addition to epidemiological and virologic data, are all needed to understand Lyme disease and inform preventative measures (Singer 2014; Singer & Bulled 2016). In addition to, or in conjunction with, climate change and land degradation, there are many other anthropogenic factors that contribute to the increasing number of zoonotic infections, including deforestation, overpopulation, inadequate food and water

supplies, disruptions due to military actions, migration to urban centers and the subsequent overcrowding in resource limited areas, and the mass migrations of populations due to disasters (Singer 2014). Moreover, the clearing of new land for food cultivation or other uses for the newly cleared land are also exposing people to new animal populations, disease vectors, pathogens, and the inevitable zoonotic disease transmission. Thus, zoonotic infections become situated at the convergence of political designs, economic strategies, land degradation, the vector's lifecycle, the movement of humans, animals, and microbes, affective complexities inherent in outdoor recreation, the short-term management of acute outbreaks, along with practices of care that exacerbate disease communicability (Brown & Nading 2019; Brown & Kelly 2014). The evident convergence inherent in human and animal diseases reinforces the need for a multispecies perspective of environmental health within medical anthropology (Singer 2014).

An interspecies approach focuses on the biological, sociopolitical, and environmental phenomena inherent to disease interaction by paying attention to the experiences, characteristics, behaviours, and social life of all the species involved in health and well-being (Singer 2014). A multispecies approach in medical anthropology raises critical questions, including how many species there are to consider (e.g., interaction between Lyme disease and other pathogens, and between other tick-borne infections; interaction between Lyme disease and gut microbiome of various host species), how much environment to consider (e.g., does capitalistic land degradation need to be considered; do the few poultry species who eat ticks need to be considered), and with what expertise (e.g., are medical anthropologists trained or have the resources and capacity to undertake the study of humans, multiple other animals, plants, and diverse pathogens, and multiple species interactions)? According to Singer, multispecies ethnography becomes “an extension of an existing holistic tradition that moves us from studying humans in physical and social contexts to unpacking and studying contexts in which humans are important but not the only players, and in which the agencies, cognitions, and experiences of other species matter” (2014, 1303). A fully developed multispecies approach can begin to clarify our embeddedness in a world of intertwined, mutually causal processes and relationships and the ramifications of this for the health of humans and nonhumans alike (Singer 2014).

2.4 (Eco)Syndemics

One attempt at broadening the lens of medical anthropology is through the biosociocultural concept of the syndemic (Singer 2014; Singer & Bulled 2016). By looking at the interface between two or more infections, this approach considers the intersections and blurred species boundaries of a disease encounter. According to Singer and Bulled (2016), a syndemic is the interaction between two or more diseases or adverse health conditions within a given population, and the detrimental consequences on people's health due to social inequality and the unjust use of power. Thinking about the interplay of exchanges between various levels of biological and social interaction relates to the theoretical framework of political ecology as well as critical medical anthropology. These connections are even more evident for zoonotic infections: "zoonotic infections pose syndemic threats not solely because of a microbe's inherent properties, but because of the opportunities afforded to microbes and their evolutionary trajectories by social and environmental conditions" (Rock et al. 2009, 992; Singer 2014). Syndemics, then, become the consequence of adverse social conditions and are borne out of the traumas of structural violence. These include things like the weakening of bodies, the disruption and inaccessibility of health care, the inevitable clustering of disease, the failing of social support, and the degrading of immune systems can all be found at the convergence of these forces. However, they are not the only social factors to have damaging effects on healthcare and disease communicability, especially when investigating infectious diseases transmitted by ticks. Other less known social factors need to be considered, such as climate change, environmentally mediated class bounds and division, and the collapse and distinction of eco-social systems (Singer & Bulled 2016).

A subtype of syndemic that is of importance to this paper is an ecosyndemic. This concept is borne out of the recognition that various anthropogenic changes to the physical environment have serious implications for the clustering and adverse outcomes of, among others, zoonotic infections (Singer 2014; Singer & Bulled 2016). Despite the magnitude of tick-borne infections, there are still considerable gaps in our understanding and knowledge of them. To date, there are 12 known tick-borne infections, with the potential for more to be discovered. On top of that, ticks have the ability to harbour multiple pathogens simultaneously and can even pass along multiple infections with a single bite (Singer & Bulled 2016; Esteve-Gassent et al. 2016; Weintraub 2013; Farnsworth 2013). Tick coinfections are invariably present with a Lyme disease infection and the interaction between the multiple tick-borne infections could be a source of the

complexities that have been encountered with this disease (Singer & Bulled 2016). However, when conducting fieldwork in Southern Ontario it was difficult to ascertain any data on tick-borne infections outside of Lyme disease. Lyme is the only reportable tick-borne illness in the province. Therefore, in Ontario there is no data on any other tick-borne infection.

Looking at the human-impacted environment allows for a reconceptualization of the bio-social interactions that increase the total burden of tick-borne infections (Singer & Bulled 2016). Urban populations have been swelling in the modern era. The number of Canadians fleeing for either calmer existences on small acreages or cottages nestled in the woods or towards affluent suburbs that sprawl over land that had previously been “untouched” is increasing (Farnsworth 2013). This expansion contributes to habitat fragmentation as these subdivisions are breaking up environments, like broad-leafed woodlands, farmland, wetlands, grassy plains, etc. These developments are placing the tick’s terrestrial hosts, such as deer and mice which are abundant in these habitats, in people’s backyards. A cultural shift toward outdoor recreation and exercise has further increased the opportunities for ticks and humans to interact. This has turned mundane interactions into possible sites of infection (Singer & Bulled 2016; Farnsworth 2013). Another cause for concern is the reduction in overall biodiversity. There has been a dramatic decrease in the number of predators, like wolves and mountain lions, which have traditionally kept deer populations under control. Concurrently, a reduction in fox populations, usually in areas with an increased coyote presence, has created a surge in rodent populations. This has created an increase in the likelihood of Lyme transmission, as the diseases that are present in both hosts are now much more likely to infect humans (Farnsworth 2013). However, the way that we look at, study, and conceptualize Lyme disease comes with an implicit erasure of the terrestrial host species in the role they play in disease transmission. Most people do not notice the deer and mice that surround their homes or outdoor recreation as potential sites of infection (Personal unpublished data).

Nature is often evoked to express a desirable social position. For instance, nature tourism gained prominence in North America and Western Europe, which began with the romanticization of grand tours of environmental landmarks, such as the Alps, to the fetishization and quasi-religious acclamation to the wilderness that led to the creation of national parks (Singer & Bulled 2016). These representations of nature held the dual belief that nature should be both enjoyed and protected. Therefore, nature becomes both something experienced through participatory

engagement and something to be protected from prolonged human contact³ (Singer & Bulled 2016). Much of the environmental movement emerged from this work, bringing with it the anti-urban and ethnic attitudes that accompanied the earlier endeavor of creating national parks and other green spaces. Therefore, most of the scholarship looking at environmental activism and/or conflict does not take into consideration the socio-economic power relations inherent in people's interactions with nature (Singer & Bulled 2016; Koensler & Papa 2013). This is evident within certain sectors of the environmental movement as there is not an adequate acknowledgement of the impact the human-nature dichotomy has, especially its ability to change societal attitudes about nature (Ortner 1974). Environmentalism started as a movement so people could privilege and preserve the outdoors for their own recreation and amusement. Thus, "historically, white middle and upper class Americans have constituted the strongest base for conservation and environmental organizations" (Pyramid Communications assessment, as cited by Singer & Bulled 2016, 449). This can be felt in North America, as the overwhelming whiteness of the green movement influences the neglect around certain issues, such as environmental injustice and racism (Singer & Bulled 2016).

Due to climate change, zoonotic infections have become one of the biggest threats to human health. There is distressing epidemiological and public health scholarship that shows how practices, for instance, within the industrialized agriculture sector and the live animal trade, put people, the environment, and the animals' health in danger (Coulter 2016). Many of the risks involved include antibiotic and microbial resistance, increased greenhouse gas production, and water, air, and soil pollution (Coulter 2016). Climate change is important for understanding the interspecies consequences of disease transmission for these reasons:

"on the bio side, climate change has the potential to impact tick vectors and the microbial agents they transmit in ways that promote syndemic interactions. On the social side, the dominant force in contemporary climate change is human activity, including a socioeconomic interest-driven commitment to fossil fuel use and resulting greenhouse gas emissions" (Singer & Bulled 2016, 445).

³ This also applied to the Indigenous peoples living on the land. Most were deemed unable to appreciate the beauty before them; therefore, they had no right to be on the land. This became a dominant theme within conservation: the rationalized removal of Indigenous peoples from designated areas and the introduction of exclusionary practices for recreational use by the dominant population to keep them off the land (Singer & Bulled 2016; Jacoby 2006; Wakefield 1994, 1995; Harper 2002)

The production-driven ethic that underlies capitalism has a far broader impact on the environment than any other social system. The division of nature that is inherent to capitalism reduces the physical world down to its components and their exchange value. Therefore, global warming is not simply anthropogenic but is a system predicated on a precise mechanism for production, accompanied by particular patterns of consumption along with environmental degradation (Singer & Bulled 2016, 446).

Indeed, southern portions of Canada are warming up, allowing for ticks to slowly creep northward (Ogden et al. 2014; Ogden et al. 2013a; Ogden et al. 2013b; Farnsworth 2013). Just a few decades ago, adventitious ticks would turn up in portions of the country they had never been seen in before but more often than not they would succumb to the brutal winter temperatures before they could establish a permanent population. Nowadays that is no longer the case as an increasing number of populations are being established as these adventitious ticks are not only surviving the cold but are breeding (Farnsworth 2013). As a result, they are creating populations in territories that just a few years ago would have been unthinkable – tick species known to harbour and transmit Lyme disease has been found alive and well as far north as the Yukon (Farnsworth 2013; Scott et al. 2012). Due to this, it is estimated that *Ixodes scapularis* ticks will have expanded their territory so rapidly that within the next decade three-quarters of Canadians will be living in areas with established tick populations capable of carrying the Lyme bacteria (Farnsworth 2013). If ticks capable of carrying *Borrelia burgdorferi* have been found in the Yukon, it is safe to say that they can be found anywhere in this country (Farnsworth 2013).

Up until 1997, there was only one known endemic region in Canada, which was Long Point, Ontario. However, since then the number has grown from 1 to 13 official and 38 unofficial Lyme-endemic regions (Ogden et al. 2008). Perhaps then, if the host densities, temperature, and habitat were suitable, these adventitious ticks could at times have the numbers needed to establish new populations. In addition, increasing temperatures due to climate change led to faster developmental rates among ticks' larvae, nymphs, and adults (Singer & Bulled 2016). Of these recent introductions, many have occurred via migratory birds rather than their terrestrial hosts (i.e deer and mice). Geographically, the Great Lakes and the Appalachians pose significant barriers for the introduction of Lyme by its terrestrial hosts from the US into regions from the Maritimes to Western Ontario in Canada (Ogden et al. 2013a). However, 3 to 4.5 billion songbirds migrate into Canada every spring with more arriving for fall migration (Farnsworth

2013; Scott et al. 2012; Ogden et al. 2008). It has been estimated that these little birds could be carrying anywhere up to 175 million *Ixodes scapularis* ticks. Indeed, “a surprisingly high proportion of birds carried ticks of at least one of the seven species, and *I. scapularis*, the Lyme disease vector, was the second most common” (Ogden et al. 2008, 1786). This could have major implications for public health since *Ixodes* ticks are the second most common migrating into the country. As areas that were originally thought too cold to sustain them are warming up, these adventitious ticks are increasingly more likely to survive and ultimately attach to humans or animals and possibly infect them with a tick-borne infection.

2.4.1 Tick-Borne Syndemics⁴

Simultaneous coinfections or sequential infections with the various tick-borne illnesses can have the potential to modify transmission dynamics and to influence the severity of the illness. The impacts of these syndemic interactions include such things as the efficiency of transmission, obscure disease diagnosis due to symptom overlap, increasing the duration and severity of the diseases, and complicate the kinds of treatments available (Singer & Bulled 2016; Farnsworth 2013; Weintraub 2013; Thompson et al. 2001; Belongia et al. 1999; Alekseev et al. 2003; Krause et al. 1996). In addition, multiple pathogens within a coinfecting tick have the potential to influence the tick’s behaviour and thus affect the tick’s survival and the transmission of the pathogens (Singer & Bulled 2016; Ginsburg 2008; Esteve-Gassent et al. 2016). During any life stage of the tick, when one feeds off an infected host it can take up one or more pathogens from the host. The microbes can even be acquired during subsequent blood meals through the various life stages of the tick. This process, called transstadial transmission, becomes a temporal interaction between the ticks and the pathogens which occurs when a pathogen remains within the tick from one life stage to the next, thus allowing for an interaction between pathogenic agents (Singer & Bulled 2016).

In Lyme endemic regions there seems to be the highest prevalence of coinfecting ticks. According to Singer and Bulled (2016), in North America there is evidence that shows coinfections with multiple pathogens occur for *Ixodes* species, the ticks that carry Lyme disease

⁴ Interestingly, there is a growing body of literature questioning if the tick vector *Ixodes*, is the only vector for the disease with the possibility that other blood-feeding insects could have the potential to carry the bacteria (Melaun et al. 2016; Raelle et al. 2018; Losik-Bogacka et al. 2007).

(Swanson et al. 2006). Due to the potential presence of two or more microbes in these ticks, humans are placed at a far greater risk of contracting multiple infections with several tick-borne illnesses from a single bite. It was found that within Lyme endemic regions of the United States, between 4 to 45% of patients suffering from Lyme disease had a coinfection with another ailment, either babesiosis or anaplasmosis (Singer & Bullied 2016; Swanson et al. 2006). Therefore, Lyme disease needs to start being associated with multiple infections and the persistent symptoms which seem to appear with a Lyme infection need to be associated with the possible coinfections present and not with a singular, isolated infection of only Lyme (Singer & Bullied 2016; Weintraub 2013; Farnsworth 2013; “itslyme” 2017).

Therefore, there needs to be an understanding of the myriad ways individuals, populations, and environments interact in order to understand what led to an outbreak: “it is not a means of prospectively or retrospectively specifying the factors that might lead (or have led) to transmission, but a way of altering us to the radical and contingent relationality through which outbreaks emerge” (Brown & Kelly 2014, 292). One way to analyze the adverse syndemic interactions among tick-borne infection is by utilizing animal studies. One such study, the Canadian Canine Lifetime (Lyme) Study, uses data collected from heartworm testing⁵ by veterinarians to track the spread of Lyme disease throughout Canada. And even the dog owners, when asked about volunteering for such a study, were all open to the idea, with one saying “I believe that data needs to be collected in order to start creating effective mitigation measures as well as to start to analyze what the current population looks like for ticks, what the current percentage of Lyme is, etc. I would see no issue with aiding in that type of research and data collection.”

Lyme disease, caused by the bacteria *Borrelia burgdorferi*, is maintained in a tick – rodent, deer – tick cycle primarily involving *Ixodes* sp. ticks. Humans and other mammal species are accidental hosts. The early symptoms of Lyme resemble flu-like symptoms, such as chills, fever, headache, muscle and joint aches, and the distinctive EM rash. However, if left untreated more severe symptoms can occur, such as arthritis, facial paralysis, and neurological disorders (“Lyme Disease” 2018). The geographical range of Lyme disease has historically included Europe, North America, and Australia, but currently the pathogen can be found in over 80

⁵In Canada, for the last 10 years vets have been testing a range of infectious diseases when they test your dog for heartworm.

countries and on every continent (“Lyme” 2013; Schmid 1985). The particular relationship that domestic dogs share with humans makes them well suited to act as sentinels or indicators of infectious diseases that are possible risks to their owners. Both dogs and humans suffer similar illnesses when subjected to the same risk factors (when both species are vulnerable), which makes it easier to monitor the health of the pet dog in order to identify the occurrence of certain diseases and/or exposure to contaminants in humans (Backer et al. 2001). Since companion animals share the same environment with their owners, they can be particularly valuable as sentinel animals. Pets may be even more sensitive to certain contaminants, like soil or house dust, than their owners (Backer et al. 2001).

Dogs are good sentinels for Lyme disease since they can acquire the same infection through similar pathogenic mechanisms. The ease and convenience with which the tick can attach to dogs in their search for a blood-meal make them a desirable sentinel, as dogs would be exposed to higher levels of infection compared to humans (Halliday et al. 2007). As such, there are multiple roles that companion animals can take part in, and Canu and Titan are good examples of how animals are utilized as sentinels. A sentinel animal that is sick or dying shows an obvious response to a pathogen and can provide a reliable signal for that pathogen within a particular ecosystem. Now an apparently healthy sentinel that develops subclinical responses can be more useful at times for investigating the transmission and maintenance patterns of a pathogen (Halliday et al. 2007). Even though Titan never developed Lyme disease or filled the role of the sick or dying sentinel, he and the ticks pulled off of him were tested for Lyme, contributing to the gathering of information on the disease for the region. He was, for that moment, placed into the role of a sentinel animal contributing to data collection on detection and identification of Lyme disease. The detection of sick or dying animals to a pathogen can show the potential onset of human cases within a certain duration of time. This spatial analysis can identify a timeframe between the risk of human infection and elevated levels of sick or dying sentinel animals – this can be used to detect human risk early enough to implement targeted responses to vector control and changes to human behavior in avoidance of the pathogen (Halliday et al. 2007). Canu, on the other hand, does fill the role of the latter. He has a tick-borne infection but does not show any symptoms. Canu’s position highlights the temporal characteristics of sentinel – pathogen reaction. He is an apparently healthy sentinel who has subclinical responses and therefore he would be helpful in tracking the transmission and

maintenance of tick-borne infections (Halliday et al. 2007). This type of sentinel can be an indication for the presence of the pathogen within the human population and it can be tested for sensitivity and specificity to Lyme disease. On the other hand, the serological data collected from these sentinels can provide a good indication of occurrence patterns of Lyme disease within their population but also within prey species (animals from lower trophic levels). For instance, fox populations could be utilized in order to observe incidence patterns of Lyme within the mice populations known to harbor the bacteria (Halliday et al. 2007).

Through a critical medical anthropology perspective dogs can be viewed as integral to the sentinel role, which is bolstered by their position as companion animals. Therefore dogs are not simply companion animals or sentinels but rather they begin to inhabit a range of roles and functions, inscribed with passions, emotions, and feelings of love, compassion, helplessness, and gratitude. The many roles that dogs portray seem to be layered on top of one another, thus revealing the animals' unpredictable and contested nature of affective complexities (Street 2012). Moreover, dogs have become a favoured species in the home, on the farm, and in the field. However, within science, dogs have become more complicated as they are simultaneously prized experimental subjects and the motivation for reforming said experimental projects (Sharp 2019b). In other words, certain species are effective at occupying both registers, such as dogs, who have long been favoured as research subjects and household pets and who bear significant moral weight. Dogs not only facilitate a discussion on how animals are transformed into valuable lab subjects, but they are also among the few species that are regularly transformed back into companion species (Sharp 2019b). Sadie & Gracie's owner represents this sentiment perfectly:

“I kind of worry about that when you kind of hand your dog over to a person for a day and you don't see them for a while. If it is a friendly study, I would totally sign off for that. Especially if it helps people, kinda like you would do research on things like that, to help future dog owners and future dogs ... I would definitely be into that.”

Tucker's owner also shares this position: “I'm all for research for the betterment of other dogs. Especially if it's nonintrusive, what do we have to lose?” These dogs hold two different identities: they are companion animals who are loved completely by their owner but they are also sentinels, or proxies, for humans and hopefully their contributions can help further human and canine health.

2.5 Conclusion

In my thesis, I sought to explore the intersections between animals, people, and the environment in order to illustrate how tick-borne infections play out within social, political, and economic relations found at these junctions. By situating an interspecies perspective within medical anthropology, this thesis was able to look at the affective, social, and biological differences between people and their dogs in their attempt to live well together. By showing how these processes are embedded in our relationships, we began to understand how people view their dogs, along with the world around them. Thus Lyme disease becomes situated at the convergence of political designs, economic strategies, land degradation, affective complexities inherent in cohabitation, and practices of care that exacerbate conditions for disease communicability (Brown & Kelly 2014). By utilizing a medical anthropology framework, this thesis was able to critically evaluate the threat of environmental degradation on the emergence of zoonotic infections. Highlighting these issues, it can show how people's everyday interactions with the landscape can have dire consequences for their health as, for instance, their backyards become possible sites of infection. With the rate of Lyme disease in Canada increasing, we need to start taking our disregard for the environment seriously and start holding institutions and governments accountable for upholding social and economic systems that predicate themselves on the degradation of the environment.

When utilizing an interspecies approach, the attentiveness to the human-other interface becomes a moral project. Our responsibilities are not limited to our actions, but rather what happens when we expand our theoretical frameworks to include, recognize, and privilege humans, animals, and things (Sharp 2019a). The interspecies scholarship has come a long way; however, the work itself is still plagued by an insurmountable challenge. Particularly, the people writing within a multispecies framework, no matter how self-conscious they are, are always going to struggle to overcome the species hierarchy (Sharp 2019a). This demands a continuous reorientation that moves beyond the individual human toward a collective more-than-human subjectivity and agency, not only in the ways we think about and conceptualize non-humans, but in the way we write and theorize about them (Pacini-Ketchabaw, Taylor & Blaise 2016). Thus, the multispecies trend should entail a relearning of "how to do research without the tools of human exceptionalism" (Pacini-Ketchabaw, Taylor & Blaise 2016, 2). Multispecies work should become a collective and compositional practice that accounts for all the other species that make

up our lives and our acknowledgment of the dynamic, often entangled relations that create our common worlds and bring them together (Pacini-Ketchabaw, Taylor & Blaise 2016).

Multispecies practitioners should become both participants and observers. Indeed, as we learn from other species, we can see ourselves becoming entwined in the threads that weave our common worlds together, such as those small chance encounters between people and ticks on their passageway through life (Tsing 2013; Pacini-Ketchabaw, Taylor & Blaise 2016).

Humans and animals make up “two interacting populations, both form social groups, and are guided in political-economic decision-making, which takes the other into account, by very different sets of goals and values” (Ingold 1974, as quoted in Ingold 2013, 6). Humans want economic growth and prosperity⁶; non-humans want security and reproduction. Even though disease vector insects and/or arachnids are often times consequences of human-environment manipulation, most are searching out a blood-meal for reproduction and are dependent on humans. As tick-borne illness show, human-made changes to the environment are enabling ticks to move into parts of North America that they have never had access to before. Therefore it should be a social enterprise to care for both beings of your own kind, as well as beings of a different kind. In order to accomplish this we need to begin to shed the exceptional nature we have given to human beings and begin to see the world as a composition of various different entities:

“For anthropology is distinguished not by its object, as if it shone a spotlight on human beings while leaving all else in the shadows, but by its way of working, which is to learn through participation in other lives. Thus in anthropology we do not make studies *of* people, or indeed *of* animals. We study *with* them. The aim of such study is not to seek a retrospective account, looking back on what has come to pass. It is rather to move forward, in real time, along with the multiple and heterogeneous becoming’s with which we share our world, in an active and ongoing exploration of the possibilities that our common life can open up. And just as in life, becoming continually overtakes being, so in scholarship the scope of anthropology must forever exceed the threshold of humanity” (Ingold 2013, 21).

If medical anthropology is to care for themes around death, disease, care and well-being, then being aware of positionality becomes both an essential and moral enterprise (Sharp 2019a). Indeed, as long as science continues to pursue pharmaceuticals, and humans eat meat, the need

⁶ From a capitalistic/economic perspective.

for cattle, pigs, rats, and the array of other animals will remain secondary to that of the needs of people. And when thinking about disease processes, human life will always be privileged over that of the pathogen or the vector (Sharp 2019a).

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