Human-wildlife conflict, interspecies disease, and justice in a wildlife-rich region of Kenya

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Abstract

Central Kenya's Laikipia district is known for its significant wildlife numbers and biological diversity. This is the result of the commitment of community residents to protect wildlife populations, including those on private land. Despite successes, tensions between humans and wildlife remain. Most research to date has focused on conflict between pastoralist herders, particularly Maasai, and two wildlife species: elephants and lions. It has also focused on conflict resulting from depredation, property damage, and human injury. This study explores another potential contributor to negative attitudes toward wildlife: interspecies disease, and particularly the perception that wildlife can transfer disease to pastoralists' domestic animals. Formal interviews were conducted with 64 Maasai pastoralists. Questions focused on experiences with disease in domestic animals, perceptions of wildlife contributions to domestic animal disease, and broader attitudes toward wildlife, and these issues are considered against the social, cultural, and historical background of the region. Interviews supported the commonly held belief that livestock disease places severe burdens on East African pastoralists. Different diseases were associated to varying degrees with wildlife; elephants, Cape buffalo, and zebra were most often cited as causing disease in domestic animals. Epidemiological studies confirm several associations that pastoralists made between wildlife and disease in domestic animals, and instances where assumptions and perceptions were not epidemiologically correct were still logically coherent. Persons who took part in this study did not list wildlife disease, or disease threats, as their greatest problem with wild species. However, responses also suggest that it would be a mistake to underestimate the impact that concerns about disease have on pastoralists' attitudes toward wildlife.

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Introduction

Laikipia's conservation narrative is powerful. In recent decades, this central Kenyan district has seen promising trends in both wildlife numbers and biological diversity. It has also seen the investment in conservation efforts of district residents and stakeholders—private landholders, pastoralist populations, and ranchers, among others. Today, Laikipia has the second highest concentration of wildlife in the nation; it is, moreover, one of the country's only rangeland districts where wildlife populations, including those of endangered species, are increasing. This trend has occurred simultaneously with wildlife declines of up to 50 percent across the rest of Kenya in the final decades of the twentieth century (Gadd, 2005; Georgiadis et al., 2007a; Reid et al., 2004; Sundaresan and Riginos, 2010; Thompson and Homewood, 2002). These quantitative measures indicate that Laikipia's conservation strategies are working.

Not surprisingly, however, human-wildlife conflict has the potential to erode support for wildlife, particularly among rural pastoral populations who arguably experience the greatest consequences and most tenuous gains from Kenya's wildlife conservation policies and practices. Significant research has been conducted, and much has been written, about interactions between Laikipia's wildlife and human residents; in recent years, pastoralists have been a key focus (see, e.g., Blair, 2008; Denney, 1972; Frank, 1998; Frank, 2011; Frank et al., 2005; Gadd, 2005; Graham et al., 2010; Ogada et al., 2003; Romañach et al., 2007; Romañach et al., 2011; Sundaresan and Riginos, 2010; Wambuguh, 2007; Woodroffe, 2001; Woodroffe and Frank, 2005; Woodroffe et al., 2005).

The existing work on human-wildlife conflict in the region nonetheless provides a window into broader issues of power, equity, and social justice, including Laikipia's history of marginalizing pastoralists. White Kenyans, ranchers, expatriates, nongovernmental

organizations, and even scholars hold disproportionate power in the district, particularly when it comes to wildlife conservation. Because lions and elephants are the charismatic megafauna that hold particular monetary and emotional value in the eyes of the conservation community, they have been the focus of both research and intervention efforts. These species no doubt have negative impacts on the lives and livelihoods of pastoralists, as demonstrated by records of domestic animal depredation, property damage, and human injury. However, official incident records also show that other animal species are often sources of human-wildlife conflict, and existing research has not pushed beyond these two megafauna (Blair, 2008).

In addition to focusing on only two species, research on conflict and efforts to enhance pastoralist support for wildlife have largely focused on the obvious sources of conflict noted above: herd depredation, property damage, and human injury. Seemingly insufficient consideration has been given to whether other issues, perhaps more subtle ones, may also be of concern to pastoralists and lead to human-wildlife conflict.

The way in which human-wildlife conflict has been addressed to date in both this district and the rest of the country thus leaves ample opportunity to fill some vital gaps. Toward this end, the research undertaken for this thesis explores what would seem a plausible contributor to tensions between humans and wildlife in the region: disease. It began with the question of whether interspecies disease, and particularly *perception of* interspecies disease, contributes to the ways in which Maasai pastoralists view wildlife in Laikipia. Pastoralists are encouraged to promote wildlife on the lands where they reside and raise their domestic animals. It would seem that the increased interface between domestic species and wildlife, combined with the already high prevalence of disease among cows, goats, and sheep, could reasonably lead pastoralists to conclude that wildlife play a role in the transmission of disease to domestic animals. This would

have implications for the success of current initiatives to ameliorate human-wildlife conflict and to promote sustained wildlife conservation.

In light of the way that human-wildlife conflict in Laikipia has been evaluated to date, this thesis made a concerted effort to avoid identifying the "problem"—in terms of both species and types of harm—and limiting, or even precluding, discussion beyond those issues. The interview process emphasized the current thinking, perceptions, and experiences of pastoralists who live in closest proximity to wildlife. With respect to diseases, pastoralists were asked how they make diagnoses, how they treat diseases, how they believe their animals acquire them, and during what seasons animals are most vulnerable. It builds upon these findings to analyze attitudes toward wildlife and to better understand the views of those interviewed toward wildlife in relation to their views toward disease.

It is important to note that this study was not medical in nature. From the standpoint of disease prevention and treatment, diagnosis and monitoring of disease are absolutely essential but sorely lacking on Laikipia's pastoral lands. Pastoralists' descriptions of symptoms and diagnoses of conditions *were* cross-checked with information in both conventional veterinary and ethnoveterinary guides. Veterinarians from the Kenya Wildlife Service (KWS), the state corporation mandated by an Act of Parliament to conserve and manage wildlife in Kenya, were consulted, as were livestock veterinary professionals from both the district government and the private sector. That being said, because this research focused on attitudes and perceptions and relied on a social science framework, the disease diagnoses made by interview participants were not confirmed.

This paper is divided into four sections. The first focuses on the events that brought wildlife conservation in Laikipia to where it is today. The region's current dynamics of species

richness, animal husbandry, and conservation achievements are the results of a complex history that blends cultural influences of European settlers and ranchers with more mobile pastoralist legacies from within East Africa. The second section hones in further on the research subject and is divided into two subsections. The first discusses the aforementioned existing (albeit limited) studies of human-wildlife conflict in Laikipia, with some references to broader studies in Kenya and East Africa. Existing gaps and their implications are discussed. The second subsection focuses on one of these gaps, which is also the focus of the thesis research: the contribution of disease to negative attitudes toward and even conflict with wildlife. Although little attention has been paid to the connection per se, a small body of literature offers a helpful foundation for inquiry into the role of disease in human-wildlife conflict.

The third section presents results from 64 formal interviews conducted with Maasai pastoralists living in two communities in Laikipia. These interviews illustrate the value of framing research in a way that accounts for interspecies disease in discussions of human-wildlife interactions. Finally, the fourth section ties together research findings with related recent work and makes suggestions for future research that moves beyond consideration of human-wildlife conflict, conservation biology, or conservation medicine as isolated issues, and into a realm that accounts for their important overlaps.

Section I
The Historical Context

Today, Laikipia is a mottled mix of forest reserves; government land; small- and large-scale farms; private, pro-wildlife ranches belonging largely to white Kenyans and expatriates; and "group ranches" belonging to pastoral communities, primarily Maasai and Samburu (Romañach et al., 2011; Sundaresan and Riginos, 2010). (See Figure 1.) Livestock husbandry and wildlife tourism, often practiced together, are currently the primary uses of land in non-agricultural areas of the district. Indeed, Living with Lions Project Director Laurence Frank (2011) recently asserted that "Laikipia district is unusual in many ways, but unique in one: it is the only place in the world where commercial ranchers actively conserve large predators and go to significant lengths to coexist with them" (p. 73).

Yet as Jones (2006) posits, "current wildlife, biodiversity, and habitat management approaches in Africa are best contextualized through the lens of history" (p. 483). This is certainly true in Laikipia, whose current physical landscapes and landholdings, economic drivers, and approach to conservation can be traced to past events and to the political and social dynamics that those events created.

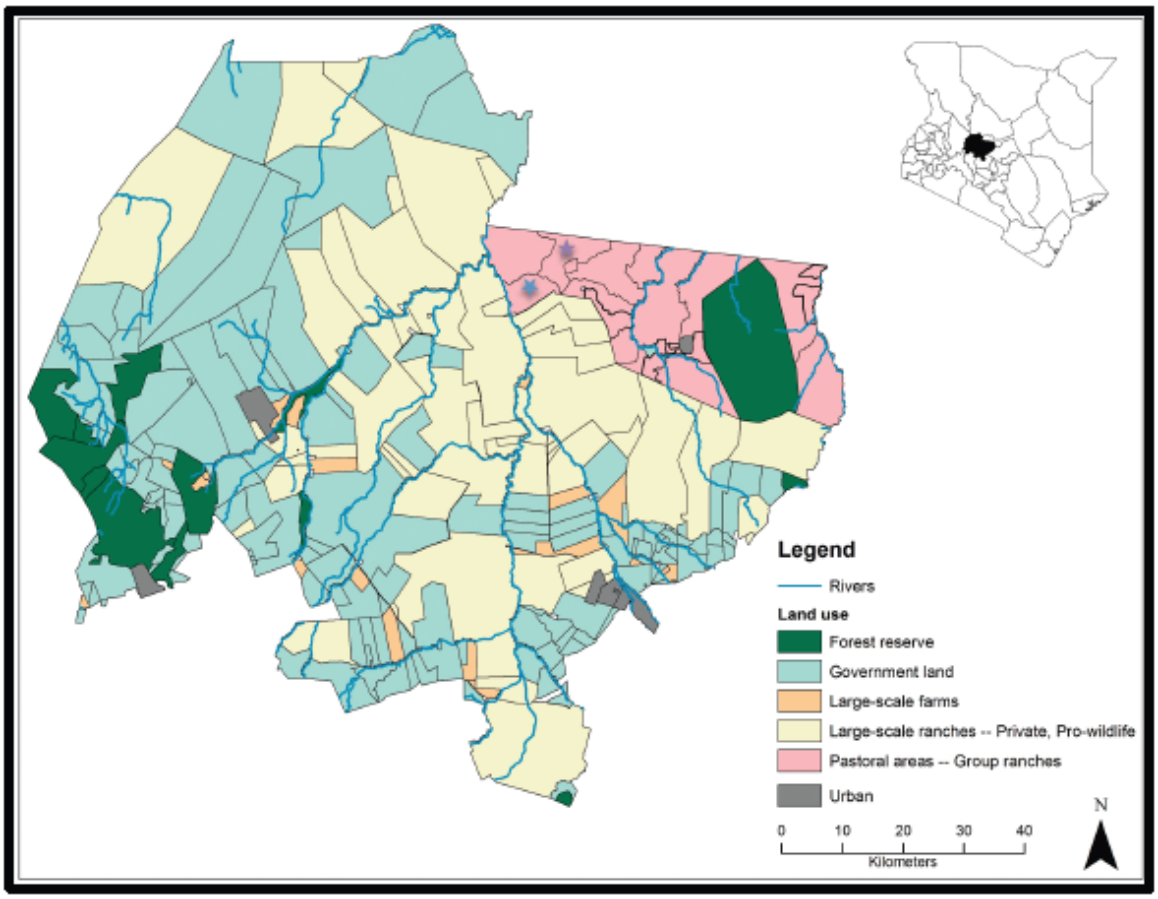

Figure 1: Map of Laikipia District with major land use types. Source: Sundaresan and Riginos (2010), based on property boundaries and land use data from Mpala Research Centre, Laikipia, Kenya. Blue and purple stars, respectively, denote Ilmotiok and Tiemamut group ranches, where interviews were conducted.

Pre-colonial pastoralism

The colonial and postcolonial history of Laikipia, like much of Kenya, is a mix of displacement and marginalization of pastoralists, privatization and physical divisions of land through fencing and boundaries, and clashes of livelihoods and identities. Many scholars have sought to untangle these trends in Laikipia, Kenya, and East Africa (see, e.g., Akama, 2008; Campbell, 2000; Cronk, 2002; DePuy, 2011; Fratkin and Mearns, 2003; Jones, 2006; Mwangi, and Ostrom 2009; Yurco, 2011).

By the eighteenth century, pastoral groups, including the Maasai and Turkana, dominated

semi-arid savannahs, which constitute the majority of the country's landscape (Spear, 1993, cited by Yurco, 2011). Indeed, the adaptation of Maasai pastoralists to high grasslands is said to have been "perfected" in Laikipia in this pre-colonial era, leading to the growth of the Laikipiak Maasai population (Sutton, 1993, p. 41, cited in DePuy, 2011).

These pastoralists' ability to raise cattle stemmed from successfully responding to significant climatic obstacles and unpredictability, including periods of extended drought, through engaging in what Mwangi and Ostrom (2009) describe as a "robust socio-ecological system" (p. 38). This included transhumance, the practice of moving livestock among grazing grounds in a seasonal cycle, and relying on "complex exchange networks" that permitted distribution of cattle across pasture areas and, as a result, distribution of risk (Yurco, 2011, citing Spear, 1993). Membership in fluid communities entitled individuals to resources necessary for livestock production, and elders held authority to allocate resource use and mediate outsiders' access to rangelands (Mwangi and Ostrom, 2009; Sobania, 1993).

Colonial and post-colonial emphases on privatization, agriculture and ranching

British colonial rule, which began in 1895 and ended with Kenya's Independence in 1963, drastically changed land use, land tenure, and mobility, with significant impacts on pastoralists throughout the region. These impacts extended into the postcolonial period. In all, Kenyan Maasai lost 60 percent of their rangelands to British settlers (Fratkin and Mearns, 2003). As Europeans took control of the most fertile agricultural lands, they restricted, or even prohibited, access to the prime water sources and grazing lands that were at the foundation of "pure" pastoralism. In doing so, they diminished the power of pastoral communities (Campbell, 2000; Fratkin and Mearns, 2003; Homewood, 2008).

Treaties in 1904 and 1911 moved Maasai, including those living in Laikipia, onto "unproductive" land in southern Kenya; the 1911 treaty forced Maasai to cede Laikipia (Broch-Due, 2005; Cronk, 2002; Fratkin and Mearns, 2003; Mungazi, 1999). Laikipia's land was subsequently divided into large landholdings leased to private colonial landholders, primarily for agriculture, large-scale livestock ranching, and sport hunting (Cronk, 2002; Sundaresan and Riginos, 2010).

The era following Kenya's Independence in 1963 brought continued displacement and relocation of pastoral populations, shifting land boundaries and uses, and even reshaping of ethnic identity. British landholdings in Laikipia, abandoned when Kenya gained independence, were resettled by both Europeans and Mukugodo, the latter at this point identifying themselves as Maasai (Sundaresan and Riginos, 2010; Yurco, 2011). Policies continued to allocate and divide land among European farmers and ranchers to be used for large-scale livestock and agricultural production, further diminishing land available for pastoral use. This impact is reflected in land ownership and use today: large-scale ranching by non-Africans comprises up to 70 percent of Laikipia's land; African ownership comprises less than eight percent (Wambuguh, 2007).

During this post-Independence period, international development agencies such as the World Bank and U.S. Agency for International Development (USAID) were actively involved in the nation's policymaking and governance processes (Fratkin, 2001). Pastoralists were arguably the most severely impacted by this third-party engagement, which was premised on the belief that pastoralists were "irrational, wasteful, and shortsighted" and served to "justify" development projects that "called for sweeping privatization of land and commercialization of livestock production" (Fratkin, 2001; Fratkin and Mearns, 2003, p. 114). This way of thinking, influenced

by Garret Hardin's (1968) contemporaneous "Tragedy of the Commons" theory, is one that would later be critically reexamined. At the time, however, the Kenyan government, with the prodding of international powers, was encouraged to "curtail pastoral livestock production on communally held lands and promote private ranching of beef and dairy resources, as private landowners were assumed to better conserve their resources" (BurnSilver and Mwangi, 2006; Fratkin, 2001, p. 6; Fratkin and Mearns, 2003). In Laikipia, this led to further subdivision of desirable, highly productive grazing lands for commercial agricultural or livestock husbandry (Sundaresan and Riginos, 2010).

The denigration of pastoralism also provided ample fodder to pass the Kenya Group Representative Act of 1968. This Act established pastoralists' legal, private title to and ownership and occupation of land and created the Maasai "group ranches" that are found today in northeast Laikipia.[1] Proponents of group ranches argued that they would improve pastoralists' earning capacity, prevent landlessness, and promote access to education, health care, veterinary care, and livestock husbandry modernization strategies (Fratkin and Roth, 2005; Homewood, 2008). Instead, group ranches and the associated processes of sedentarization and land privatization have limited pastoralists' access to the resources (namely grazing land and water) on which pastoral production depends and lessened their ability to move their animals to different pasturelands in accordance with the season (Homewood, 2008; Neumann, 2001). Without question, these constraints are felt more profoundly as residents grow in number; there was uniform agreement among pastoralists interviewed in this study that human populations on their respective group ranches have increased over the past decade.

[1] Group ranches were not designated exclusively for Maasai, and they are found in other areas of Kenya (Homewood, 2008; Ng'ethe, 1993).

The pendulum swings: a narrow emphasis on wildlife conservation

In addition to having significant human consequences, the years of colonization and post-Kenyan Independence were associated with diminished wildlife populations. In the early 1900s, predator populations were heavily suppressed by Laikipia's ranchers. Plains zebra were suppressed as well, because they were perceived to compete with cattle (Sundaresan and Riginos, 2010). In the decade after independence, Sundaresan and Riginos (2010) argue, remaining European ranchers "continued to manage their landholdings as they had during the colonial era, suppressing wildlife populations through hunting, often indiscriminately" (p. 18). Wildlife were also "effectively excluded" from smaller subdivisions of land distributed by the Kenyan government in the 1970s (Sundaresan and Riginos, 2010).

As time passed, both Laikipia and the country as a whole took halting steps toward a stronger conservation ethic, albeit one strongly driven by external influences and oriented toward the interests of white landowners. Pastoral groups were often peripheral to discussions, their populations having been "stabilized" by "land adjudication and grazing schemes" (Denney, 1972, p. 415). A "fortress conservation" mentality, imported from outside the country, drove the creation of national parks, and in 1977 the government instituted a policy that banned killing of wildlife anywhere in Kenya, be it on private, public, or protected lands (Homewood, 2008; Jones, 2006; Neumann, 2001). Exceptions were made neither for pastoralists nor hunter-gatherers (Akama, 2008).

Supported by many conservation and tourism advocates at the time, the ban was arguably driven by the notion that "indigenous resource use methods were destructive to wildlife and other natural resources," making it prudent to remove "wildlife-resource-user rights from rural peasants" (Akama, 2008, p. 73). The ban has since been widely critiqued and criticized, albeit

often not for its consequences to marginalized human populations, but rather for its failure to secure desired wildlife and economic benefits for Kenya (see, e.g., Akama, 2008; Lindsey et al., 2007; Norton-Griffiths, 2000; Sundaresan and Riginos, 2010).

Although the ban did not benefit wildlife nationwide, species rebounded on Laikipia's European-held ranches (Georgiadis et al., 2007a; Sundaresan and Riginos, 2010). As a result, in 1991, the one-year-old Kenya Wildlife Service selected Laikipia as one of five locations in which to experiment with hunting wild ungulates for a fee (Akama, 2008; Georgiadis, 2007b). Group ranches and pastoral populations were excluded from the policy's objectives and parameters (Akama, 2008).

This new approach to wildlife conservation was the driving force for Laikipia's private landholders to develop the Laikipia Wildlife Forum, which assumed an authoritative role in coordinating wildlife hunting and "cropping" (Sundaresan and Riginos, 2010). Twelve years later, in 2003, the government would suspend the wildlife harvesting policy, and as of this writing, it has not been reinstituted. However, the Forum continued, evolving into a powerful force not only for marketing Laikipia as a wildlife tourism destination but also for implementing conservation policies and standards outside the government realm—including pulling group ranches into the world of community conservation and wildlife tourism.

Conservation present: theoretical wildlife-human coexistence

This brings us to conservation in contemporary Laikipia and the foundation for this thesis research. The current conservation ethos emphasizes wildlife conservation on private and group lands, or what Didier et al. (2011) refer to as Laikipia's "landscape-scale approaches to conservation" (p. 106).

It has been posited that the past decade has focused on two key themes in African wildlife conservation: first, the need for habitat heterogeneity across multiple spatial scales, and second, the need for conservation of large mammalian fauna on non-protected lands (Augustine et al., 2011, citing Prins et al., 2000). If this is true, then Laikipia is a model for the "new" conservation. With only 2.1 percent of its land set aside exclusively for wildlife in private fenced conservancies, it could be argued that Laikipia reflects a sea change from the "fortress conservation" approach in which animals exist in a park or reserve in isolation from people (Didier et al., 2011; Georgiadis et al., 2007a; Homewood, 2008; Jones, 2006; Neumann, 2001; Sundaresan and Riginos, 2010; Wambuguh, 2007). The model acknowledges and reflects the large percentage of wildlife—up to 65 percent in the country as a whole—that lives outside formally protected areas, plus the value of providing suitable habitat and safety for these species in the human-occupied areas that they must share (Western et al., 2009).

Pastoral communities are recognized as necessary for optimal wildlife conservation outcomes, since their lands are both part of wildlife migration corridors and important to a large-scale, contiguous wildlife-friendly landscape (Georgiadis et al., 2007a). Ecotourism, and particularly wildlife tourism, have thus emerged as central to efforts to make wildlife conservation economically attractive to pastoralists. These ecotourism ventures often coincide with the designation of land for "conservation" (no human settlements and little-to-no livestock grazing) and the creation of conservancies spanning multiple group ranches (Blair, 2008).

Il Ngwesi Group Ranch, developed with support from USAID, is arguably the most famous of the district's community conservation and wildlife tourism initiatives (Manyara and Jones, 2007). However, it is far from the only one. All thirteen Maasai group ranches that constitute the Laikipia North District, or Mukogodo region, are currently involved in some

ecotourism-related venture, ranging from rustic campsites to luxury lodges to cultural museums (Blair, 2008). So, too, are Ilmotiok and Tiemamut, the two group ranches whose residents were interviewed for this study.

Non-pastoralists and non-residents have been actively engaged in the process of establishing conservation ventures on these ranches. Ol Gaboli Lodge on the Ilmotiok Group Ranch, founded as the only tourism facility owned and run entirely by pastoralist women, was built with funding from the European Union Community Development Trust Fund and Netherlands Development (Fennessy, 2009; Yurco, 2010). The Laikipia Wildlife Forum also provided both financial and logistical support, including submitting the application for European funds (Fennessy, 2009). An agreement between Ol Gaboli and a foreign-owned adventure and expedition company, Rift Valley Adventures, was reached with "guidance/support" from the Mpala Research Centre and the Laikipia Wildlife Forum (Fennessy, 2009, p. 12). Mpala, the Laikipia Wildlife Forum, and "other interested neighbors" together formed the Ol Gaboli Management Committee to provide "support in all areas of business and management" (Fennessy, 2009, p. 12).

Meanwhile, in exchange for Tiemamut's setting aside land for conservation and maintaining the land as ungrazed, the African Wildlife Foundation covers the cost for registered group ranch members' children to attend secondary school (Yurco, 2011). The ranch also receives compensation from a nearby luxury lodge, the Sanctuary at Ol Lentille, which uses Tiemamut's conservancy land for wildlife viewing. The conservancy continues to grow amidst exchanges of group ranch land for services; in February 2011, the Ol Lentille Trust reported that the Ol Lentille Conservancy added 5,500 acres by agreement with Tiemamut Group Ranch in exchange for support to the ranch's primary school and providing funds to employ four

Tiemamut residents as uniformed rangers in the conservancy (Ol Lentille Trust, 2011).

Sundaresan and Riginos (2010) argue that the community conservation model appears to be working, as measured by wildlife sightings in the conservancies compared to surrounding communal grazing lands. However, Laikipia's current conservation status, including but not limited to the role of pastoral communities, is extremely complex.

Beyond encouraging wildlife, conservancies should in theory provide economic benefits to communities, not only drawing in tourists, but also providing employment for group ranch residents in the form of security patrols and putting communities in a better position to attract funds for development (Blair, 2008). Yet Ilmotiok's conservation initiatives have been plagued by challenges. Its Ol Gaboli Lodge became partly operational in 2006, and the group ranch initially found steady income by leasing the lodge to Rift Valley Adventures. However, the agreement failed, a result attributed variously to the country's decline in tourism in 2008 and alleged contract breaches by both parties (Blair, 2008; Fennessy, 2009). Conversations with community residents during the course of research reveal a larger number of challenges from both within and outside the community: community disagreement about the objectives of the lodge, usurpation of control of the lodge from Ilmotiok by Rift Valley Adventures, and a corrupt Ilmotiok-born (male) lodge manager who stole income from both the lodge and the community. It is far from clear that the land Ilmotiok has set aside for its conservancy, and the animals that frequent it, have outweighed the community's sacrifices.

Recently, conflict has flared over creation of Laikipia National Park, Kenya's first new national park in 25 years. With support from international agencies advocating for indigenous rights, the district's Samburu pastoralist community initiated legal proceedings claiming ownership of the 17,000 acres by adverse possession (Banks, 2011; Cultural Survival, 2011).

Unbiased details about the history and transfer of the land are difficult to obtain. What *is* known, however, is that the transfer of land from private ownership to international NGOs, and subsequently to the Kenya Wildlife Service, gives rise to issues of land rights, human justice, and conservation. It also greatly complicates the district's longstanding identity as a region where wildlife can thrive through the commitment of landholders and without formally protected areas.

The sense among pastoral communities that rightful ownership to land has been lost extends well beyond the 17,000 acres being battled over in court. An attachment to land once belonging to their ancestors is felt even by youth living on Laikipia's Maasai group ranches today. One story that is commonly invoked is that British settlers, exploiting the illiteracy of Maasai, deceived them by adding a "9" to land use agreements so that Maasai unwittingly signed over prime grazing land to settlers not for 99 years, but for 999. This story was shared with DePuy (2011) by elders while he performed ethnographic research, as well as by Maasai youth during the course of this research. These stories, and particularly the sense of loss and injustice that these stories epitomize, are relatively common in historical accounts of Laikipia. However, they tend to be repressed in ecologically oriented discussions of and plans for wildlife conservation.

In a best-case scenario, community conservation and wildlife tourism would offset the economic losses associated with supporting large wildlife populations on pastoral lands. However, even this best-case scenario could not mitigate feelings of historic loss and injustice, nor could it address some of the more tangible consequences of greater human-wildlife interaction in present circumstances. Although this paper focuses on this latter issue, the "tangible" consequences of human-wildlife interface should not and cannot be looked at in isolation from the deep-seated historical issues that underlie conservation in Laikipia today.

Section II
Studies of Human-Wildlife Conflict

Conflict between humans and wildlife, often involving domesticated animals, has been addressed in studies across Kenya and East Africa. Laikipia is no stranger to such studies, nor to interventions promoting successful interspecies interactions and cohabitation.

Four decades ago, looking at Laikipia's significant wildlife declines associated with colonial and postcolonial shifts, Denney (1972) advocated directing attention to human-wildlife conflict in Laikipia: "Since the welfare of wildlife species depends so greatly on the attitudes of the ranchers toward them, and their resultant management policies, it is essential to maintain the tolerance of the ranchers who are tolerant, and to improve the attitudes of those who are not" (p. 419). In the intervening years, many of Laikipia's private ranches and ranchers have become decidedly pro-wildlife. Also, as noted in the previous section, pastoralists have over time become more widely recognized as an important part of the wildlife conservation equation—exemplified by, among other things, community conservation initiatives.

Even with increased attention to human-wildlife conflict and, more broadly, the human aspects of wildlife conservation, existing research reveals three significant gaps that relate to understanding the implications of human-wildlife conflict among pastoralist communities. First, with regard to conflict, scholars and conservation advocates working in Laikipia have tended to focus on limited species, namely elephants and lions, that do not necessarily reflect the concerns of pastoral populations. Second, research to date has tended to place insufficient weight on social and cultural factors that are part of human-wildlife relationships, and which a small body of research shows can be extremely important in "conflict" analysis. Third, existing research focuses on limited forms of conflict: depredation, crop raiding, infrastructure damage, and harm

to humans. Although these are dramatic causes for conflict, this list and mechanism for evaluating conflict ignores elements such as disease, which, while more insidious, could reasonably reduce support for wildlife and increase human-wildlife friction.

A Narrow Species Focus

Scholars and conservation advocates working in Laikipia have concentrated on a limited number of species, namely elephants and lions. While existing data suggests that elephant research is warranted, the justification for the pronounced focus on lions, particularly if it comes at the expense of attention to other species, is less clear.

Elephants. Elephants have been the focus of extensive research and intervention projects, both within Laikipia and in other areas of Kenya, and particularly near the borders of protected areas (Gadd, 2005; Graham et al., 2009a; Graham et al., 2009b; Graham et al., 2009c; Graham et al., 2010; Hemson, 2009; Kiiru, 1995; Maclennan et al., 2009; Madden, 2004; Obunde et al., 2005; Wambuguh, 2007).[2] There is little doubt that elephants have the capacity to cause tremendous damage. The probability of damage is heightened in Laikipia, which today has an estimated population of 5,400 elephants, the largest population known to be living outside protected areas (Douglas-Hamilton, 2005).

[2] The periphery of protected areas tends to be a location of significant human-wildlife conflict and research. Pastoral communities are often found around national parks and reserves, having been relocated when those lands were designated exclusively for wildlife. Until recently, Laikipia did not have any national parks or preserves, and the district's conservation narrative has relied heavily on this fact. Nonetheless, many of the district's private landholdings in essence function as protected areas due to their high concentrations of wildlife, and the nearby pastoral communities face many of the same challenges as their counterparts on the borders of "official" wildlife protection areas.

Elephants top the lists of human-wildlife conflict records kept by both the Kenya Wildlife Service's Laikipia office and the Ewaso Incident Reporting System, the latter a joint project of the Mpala Research Centre, Laikipia Wildlife Forum, Kenya Wildlife Service, and Save the Elephants. Kenya Wildlife Service records from June 2003 through May 2004 show that elephants were the cause of 502 incidents in Laikipia, followed by "other" animals, charged with only 75 incidents. Ewaso Incident Reporting System records show a more dramatic ratio: elephants were the cause of 1,158 incidents, followed by "other" species at 102 (Blair, 2008). To be sure, these reporting mechanisms have significant shortcomings (Blair, 2008). However, the preponderance of elephants in these databases does speak volumes.

Moreover, the types of damage that elephants cause are substantial. In studies and records of conflict, elephants are occasionally charged with killing livestock. Most assessments of human-elephant conflict in Laikipia, however, have focused on the animals' propensity to raid crops, damage infrastructure, and harm people (Gadd, 2005; Obunde et al., 2005; Thouless, 1994; Wambuguh, 2007). Indeed, a recent study found that over 90 percent of wildlife-caused injuries and deaths among Laikipian residents were attributed to elephants (Wambuguh, 2007).

Laikipia-based efforts to reduce conflict have emerged in the form of two UK-affiliated NGOs: the Laikipia Elephant Project and Space for Giants. The former, in association with the University of Cambridge and with funding from the British government's Darwin Initiative for the Survival of Species, Kenya Wildlife Service, and Laikipia Wildlife Forum, has published a number of working papers on human-elephant conflict (see, e.g., Graham et al., 2009a; Graham et al., 2009b; Graham et al., 2009c). They have specifically evaluated the efficacy of such interventions as mobile phone technology, electrified fences, farm-based deterrents (chili rope fences, early warning trip wire bicycle alarms, chili dung briquettes, loud homemade

noisemakers, watchtowers, and solar charged spotlights), and elephant-compatible livelihoods (beekeeping, chili farming, and elephant dung paper production). The organization's studies and associated working papers are outcome-oriented, addressing limitations and potential for the respective strategies to work. The latter organization, Space for Giants, has also produced several publications pertaining to human-elephant conflict, including patterns of crop-raiding and efficacy of different interventions, elephant movement across human-dominated lands, and the effectiveness of mobile phone communication in managing human-elephant conflict.

Large Predators. "The act of killing predators over livestock predation has been the principal cause of declining predator populations throughout Africa," Romañach et al. (2011, p. 85) argue. This claim is echoed in several other papers (Frank, 2011; Hazzah, 2006; Kolowki and Holekamp, 2006; Woodroffe, 2001; Woodroffe and Frank, 2005). However, large predators present a more complicated story in Laikipia, both in terms of which predator species are the greatest problems, and for whom.

Laikipia's large predators are generally considered to include lions, leopards, cheetahs, striped hyena, spotted hyena, and wild dogs (Frank, 1998; Ogada et al., 2003). Studies of and interventions to protect large predators in Laikipia, however, have been disproportionately focused on lions, even when they are presented as being about predators more broadly. This single-species orientation is no doubt shaped in part by the presence of the Laikipia Predator Project. The project is part of the Living with Lions program, a conservation research group, comprised of Kenyan (including Maasai) and international employees and scholars, working to save Kenya's remaining wild lions and other predators outside the country's national parks (LWL, 2012).

The emphasis on lions is certainly bolstered by findings that human persecution is the most important factor in observed declines of lions, of greater consequence than habitat conversion, declining natural prey populations, or commercial exploitation (Frank, 2005, citing Woodroffe, 2001). It is also strengthened by Living With Lions-affiliated research that has found the costs of "keeping" lions on one's property to be greater than the costs of "keeping" other predators, as measured by attacks on cattle and, in the case of Ogada et al. (2003), cattle, sheep, and goats combined (Frank, 1998; Romañach et al., 2011). Furthermore, the orientation toward lions seems warranted by Frank's (2011) argument that Laikipia's small-scale rural farmers and pastoralists tend to lack resources to protect livestock from predators, and "pastoralists have lost tolerance for predators; ready availability of cheap and effective poison poses a critical threat in Kenya outside of the largest national parks" (p. 73). Frank (2011) cites records of at least 52 lions being poisoned on Laikipia's communal lands since 2003. Hazzah et al. (2009) reiterate this claim in an article about Maasai killing of lions in a nearby district, noting that "Maasai people are spearing and poisoning lions at a rate that will ensure near term local extinction" and attributing this killing to "Maasai perception of livestock depredation, socio-economic factors, and the complex relationship between Maasai and conservation" (p. 2428). The emphasis on lions in the context of pastoralist-wildlife conflict is, however, somewhat baffling for both ecological and social reasons, the latter of which is discussed in the following subsection.

From an ecological perspective, many of the studies, and their assumptions, leave unanswered questions. The implication is that pastoralists' killing of lions has a disproportionately large effect on population numbers. However, much of the data, discussions of predators, and recommendations of ways to reduce human-wildlife conflict are based on

studies focused on commercial ranches due to allegedly low lion populations on community lands (Frank, 1998; Frank, 2011; Frank et al., 2005; Ogada et al., 2003). Frank (2011) provides a theory for these low numbers: "Overgrazing by domestic livestock has reduced wild ungulate numbers on group ranches, leaving superabundant goats and cattle as the most available and vulnerable prey for carnivores. Incoming lions kill livestock and then are then poisoned" (p. 75). The rarity of lions on Laikipia's group ranches is substantiated by data collected over some 14 years (Frank, 2011; Frank et al., 2005; Woodruff and Frank, 2005). It is also substantiated by camera trap sampling in Laikipia, which found that land use type had a greater impact on numbers of large carnivore species than it did on numbers of small (Kinnaird and O'Brien, 2012). In fact, Frank (2011) states that, due to the rarity of lions on communal lands, community conservation efforts among Laikipia pastoralists now concentrate on reducing losses to spotted hyenas. It is never made clear how, at least at present, pastoralists can have such substantial impacts on lion populations, and thus warrant such focus on conservation and conflict reduction, if this charismatic species is not found on the land where pastoralists reside.

One concern is that with a limited species focus, animals that peripheral research indicates might be highly problematic for pastoralists, such as spotted hyenas and leopards, are not being given sufficient attention. Data used to reach conclusions about the high cost of sustaining lions were heavily oriented toward cattle depredation (see Frank, 1998; Ogada et al., 2003; Romañach et al., 2011). When smaller livestock species such as goats and sheep, which tend to dominate on group ranches, are included in calculations of depredation and rankings of species impact, lions fall on the list of problem predators, and spotted hyenas and leopards move to the top (Frank, 1998; Romañach et al., 2011).[3] This trend has also been reported among

[3] Romañach et al. (2011) ask both community and commercial ranch respondents to rank

pastoralists residing elsewhere in Kenya and is confirmed by the research presented in this paper (Campbell, 2000; Kolowski and Holekamp, 2006; Maclennan, 2009). Moreover, there appears to be a level of animosity toward spotted hyenas on community lands as well as commercial ranches that is disproportionate to the species' perceived threat (Frank, 1998; Frank et al., 2005, citing Woodroffe, 2001; Romañach et al., 2011). The antipathy felt by pastoralists toward spotted hyenas has effects that extent beyond the species, interestingly, with poisoning intended for hyenas killing lions instead (Frank, 2011).

Implications. From the perspective of financial support for research, a focus on Laikipia's elephants and lions no doubt makes sense. From a conservation perspective, this single-species orientation may also be warranted. Certainly, many of the strategies researched and implemented to protect domestic animals from lions will also protect domestic animals from smaller, less charismatic, and (arguably) ultimately far more problematic species. Moreover, as mentioned above, Frank (2011) asserts that Living with Lions is now concentrating on hyenas in community conservation efforts. The fact remains, however, that the general focus of research remains lion-centric, and this raises some issues, not the least of which is whether the district's most vulnerable populations would benefit more if the species focus better represented the actual problems faced by pastoralists.

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different predators' severity for cattle attacks and for sheep/goat attacks. Thirty-five percent of community members reported spotted hyenas to be the worst for sheep and goat attacks, 27 percent reported leopards, and 2 percent reported lions. Frank (1998) calculates that the annual marginal cost of leopards per head of sheep and goat is more than three times that of lions (data was unavailable for spotted hyena). The same report assesses that the annual marginal cost of leopards on large-scale commercial ranches is more than three times that of lions and about twice that of spotted hyenas. It would be an error to translate this to depredation experiences on community ranches due to different husbandry practices and species densities and distributions; however, the general trend is notable.

Social and cultural considerations

As mentioned above, a sizeable portion of Living With Lions-associated data and discussions of predators are based on studies focused on commercial ranches (Frank, 1998; Frank et al., 2005; Frank, 2011; Ogada et al., 2003). This is allegedly due to low lion populations on community lands as substantiated by longitudinal lion radio collaring research conducted in Laikipia (Frank, 2011; Frank et al., 2005; Woodruff and Frank, 2005). Frank (1998) further notes that assessments of livestock and economic loss are easier on commercial ranches due to better record keeping.

Besides raising some questions about the actual contributions of pastoralists to lion population declines, at least at the present time, the relative lack of pastoralist voices in research promoting strategies for reducing conflict with and killing by pastoralists is problematic. If lions are crossing onto pastoral lands, and if pastoralists are killing lions through spearing and poisoning, then they should have a more substantial voice in studies and dialogue on the issue—particularly since one of the purported purposes of Living with Lions and the Laikipia Predator Project is to support the region's more vulnerable populations.

Recognizing the inevitability of depredation even with optimal animal husbandry, several papers recommend providing financial motivation for people to support predators through compensation for livestock loss, earnings from tourism, or payments for trophy hunting of lions and potentially lower-value leopards (Frank, 1998; Frank, 2011; Frank et al., 2005; Frank et al., 2006; Hazzah, 2006; Hazzah et al., 2009; Maclennan et al., 2009; Romañach et al., 2007; Romañach et al., 2011; Wambuguh, 2007). Frank (2011) speaks directly to the economic aspects as applied to pastoral populations: as "pastoralists increasingly engage in a cash

economy, they have lost their tolerance of predators and are likely to continue eliminating lions unless lions bring in financial benefits that outweigh costs" (p.81).

To a certain extent, this is a fair point. However, if pastoral lands contain few highly valued lions, then logically pastoralists would not reap significant compensation from trophy hunting. More fundamentally, this argument is based on the oft-used line of thinking that the way to promote human-wildlife coexistence and conserve wildlife is to make wildlife "pay" for its continued existence. There is some legitimacy to this ethically fraught argument. However, it perpetuates the notion that the only value of wildlife, particularly to pastoral communities, is economic, thereby ignoring the social and cultural significance of wildlife developed during centuries of cohabitation where economic benefits were nonexistent and yet wildlife populations remained steady.

The argument for financial benefits also rests on the idea that earnings are distributed fairly among those who suffer consequences from the presence of wildlife, and also that earnings are high enough to justify the consequences. Particularly in the context of ecotourism, profits have been shown time and again to be distributed unequally, not only between communities, but also within communities (see, e.g., Manyara and Jones, 2007; Mbaria, 2007; Reid et al., 2010). In short, ecotourism is not necessarily a panacea for wildlife conservation within highly complex social structures.

Just as the suggestions that wildlife conservation be based on the profit motive ignores differences among social structures, research to date on pastoralist-wildlife conflict also tends not to pay particular attention to the social and cultural differences that exist among human populations despite significant heterogeneity among and within pastoral communities. (Even the two communities whose residents were interviewed for this research differed in significant ways,

despite the fact that both were Maasai who shared both a common boundary and chief. Differences would no doubt have been more dramatic without these shared factors.)

Amy Dickman (2010) appears to be a relatively new breed of wildlife conservation and human-wildlife conflict expert who speaks directly to the "social" aspects of conservation. Acknowledging that "most mitigation studies investigate only the technical aspects of conflict reduction," she argues that "peoples' attitudes towards wildlife are complex, with social factors as diverse as religious affiliation, ethnicity, and cultural beliefs all shaping conflict intensity" (p. 458). The influence of these factors has been minimally explored in research in Laikipia, but could most certainly play a role in attitudes within and between communities and, as a result, warrant more nuanced strategies for reducing conflict.

Definitions of conflict

The third major gap is the way in which conflict is defined. It is viewed in narrow terms, particularly in Laikipia-oriented research. Elephant studies focus on destruction of crops and threats to people and physical buildings. Human-predator conflict studies focus on livestock depredation and occasionally threats to human life. These forms of conflict are the same as those reported in both the Ewaso Incident Reporting System and Kenya Wildlife Service incident records, which have categories for crop-raiding, livestock depredation, human fatality/injury, infrastructure damage, and "other." The first four categories are certainly the most obvious types of incidents and sources of conflict between humans and wildlife, a fact reflected in the relatively small number of incidents in the "other" category in both sets of records.

However, there are also possibilities for more subtle forms of conflict—or, at the very least, dynamics that could compromise support for sustaining large free-ranging wildlife

populations. One of these is resource competition between domestic and wild ungulates. Research on this subject in Laikipia is in its nascence, with most studies published in the past decade (see, e.g., Augustine et al., 2011; Georgiadis et al., 2007a; Georgiadis et al., 2007b; Odadi et al., 2007; Odadi et al., 2009; Young et al., 2005). These studies have focused primarily on ecology. Little attention has been given to the relationships between perceived resource competition and human attitudes toward wild ungulates, despite the fact that pastoralists' cattle, goats, and sheep often interface with various ungulate species, and 89 percent of small-scale Laikipian landowners interviewed in a study by Wambuguh (2007) reported encountering zebras on their property.

Disease is also a logical area for inquiry, and one that has been vastly underexplored. It is widely recognized that livestock disease can carry significant burden. Even four decades ago, Denney (1972) asserted that one-half of livestock tick control and veterinary costs faced by Laikipian ranchers were attributed to wildlife. Frank (1998; 2011) and Bedelian (2004) found that in studies of livestock losses in Kenya, disease and drought account for a much higher proportion of livestock mortality than do predators. Frank's (1998) calculations place disease as more than twice as costly as depredation for cattle, and nearly three times as costly as depredation for sheep. Yet despite "concerns that perceived risks of zoonotic disease may diminish public support for wildlife," Decker et al. (2010) note, "research has contributed little to enhance understanding of these perceptions and of resulting possible reactions" (p. 256). Attention to interspecies disease, including zoonoses (diseases passed from nonhumans to humans), seems a fundamental omission in general, and an even greater one in a region like Laikipia, where human population densities are increasing, land use and resource access are changing, and community conservation and close livestock-wildlife interface are supported. All

of these could in theory significantly exacerbate challenges with disease. Further discussion of this subject follows in the second half of this section.

Fanning the flames? Interspecies disease transmission

As noted above, limited scholarship has explored the connection between interspecies transmission of disease, including zoonoses, and support for wildlife. The small number of studies that *have* addressed how interspecies and zoonotic diseases factor into human-wildlife relations have tended to take place in the United States and Europe (see, e.g., Brook and MacLachlan, 2006; Decker et al., 2010; Peterson et al., 2006; Vaske et al., 2004). Few studies have addressed how communities in developing countries, much less in East Africa or Kenya, view wildlife in the context of disease. Those that do consider this issue tend to focus on knowledge of risk associated with butchering and consuming meat from wildlife, in contrast to the broader context of sharing land and resources with these species (see, e.g., LeBreton et al., 2006; Monroe and Willcox, 2006).

What *is* clear, however, is that disease has been widely cited as one of the major factors constraining pastoralist livestock production (see, e.g., Bengis et al., 2002; Homewood et al., 2006; Kock et al., 2002; Moonga and Chitambo, 2010; Nyariki et al., 2009). The diseases affecting Kenyan pastoralist livelihoods are extensive. Interest in interspecies disease emergence and epidemiology, as well as the consequences of disease to pastoralist livelihoods, has increased significantly in recent decades. So, too, has awareness of the anthropogenic factors contributing to emerging disease transmission from wildlife: human-assisted movement of animals and animal products, changing agricultural practices, environmental and climatic changes, institutional barriers, and land use changes and restrictions (Bedelian, 2004; Begis et al., 2004;

Homewood et al., 2006; Kock et al., 2002; Nyariki et al., 2009; Rhyan and Spraker, 2010). Even so, the role of wildlife in interspecies disease transfer is contentious, with different researchers and interests offering widely varying statements on which wildlife species do and do not contribute to disease in domestic animals (see, e.g., Bengis et al., 2002; Kock et al., 2002; Nyariki et al., 2009).

Although little has been published on these issues in Laikipia per se, studies elsewhere in Kenya and the East African region provide a valuable contextual framework for the question of how pastoralist perceptions and experiences of interspecies disease in Laikipia ultimately influence attitudes toward wildlife.

Pastoralist experiences of disease

Discussion of livestock disease in Kenya can be divided into three categories: export commercial, domestic commercial, and subsistence production. Although it would be appropriate to approach them as interconnected from epizootic and socio-cultural perspectives, work to date suggests that they are in fact addressed in relative isolation, particularly by government officials (see, e.g., Kock et al., 2002).

Research conducted on the third category reveals the extent to which vector-borne diseases, particularly those carried by ticks, limit subsistence pastoral production in Kenya (Bengis et al., 2002; Nyariki et al., 2009). Key vector-borne diseases include Rift Valley fever, East coast fever, anaplasmosis, babesiosis, and heartwater. Importantly, these tick-borne infections have only moderate or limited epizootic potential, contrasting with the highly contagious, notifiable viral diseases that tend to have more significant impacts on commercial and export livestock production (Bengis et al., 2002).

A limited number of studies have been conducted regarding pastoralists' perceptions and knowledge of specific diseases in East Africa. Although few of these studies make the jump to how perceptions of disease affect perceptions of wildlife, they do provide a foundation for inquiry into this issue.

Among the most comprehensive and inclusive studies on this subject is Bett et al.'s (2008) participatory investigation of animal health problems faced by Turkana pastoralists in northwest Kenya's Turkana South district. The study provides thoughtful consideration of pastoralists' perceptions of each disease's relative importance and incidence, assessment of factors that promote the illnesses' occurrence and persistence, and feelings about the impact of government interventions in disease control.

Livestock diseases and drought were identified as the major constraints to livestock production in Turkana South district, as in many others in Kenya (Bett et al., 2008). The study found that livestock movement, limited access to veterinary services, and sometimes insecurity were deemed the main factors contributing to high prevalence and persistence of livestock diseases. Goats suffered disproportionately from disease, showing an overall median morbidity rate of 69 percent in the study year—a significant problem given that goats, along with camels, were viewed as the most important species for a family's survival. Diseases perceived to be most prevalent among goats were mange, Peste des Petits Ruminants (PPR), Contagious Caprine Pleuropneumonia (CCPP), goat pox, worms, heartwater, foot rot, and anaplasmosis. Interestingly, mange was viewed as the most important disease, even in areas where incidence was low, due to the fact that it was difficult to treat and reduced the value of the goat. Dry season was viewed as facilitating contraction of CCPP, mange, and tick-borne infections because many *adakars*, loose cooperations of families who live and herd together for security, congregate

at the few available grazing and watering points. However, social gifts and livestock markets were also cited as a cause of disease transfer among pastoralists in this and other regions of Kenya (Bett et al., 2008, citing Wafula, 2006 and Fevre et al., 2006).

Participants in the research were acutely aware of the potential for interspecies transfer of several diseases, particularly between domestic animals and wildlife. Dry season brings not only more reliance on *adakars,* but also more contact with wildlife species as pastoralists seek places to water and graze their animals. This sometimes means bringing domestic animals near wildlife reserves. Study participants associated tick infestation and tick-borne infection with livestock coming into contact with wildlife, viewing the dry season tick-borne diseases as coming from ticks that had fallen off of wildlife. Respondents additionally viewed these ticks as having higher vectorial capacity than those encountered in the wet season. When asked to state the source of mange, viewed as the most serious infection of the community's most populous and important livestock species, goats, many study participants cited elephants. This stemmed from the fact that the skin of an affected goat thickened like that of an elephant, and the disease had therefore been named *lotome* after the elephant.

Although wildlife was certainly viewed as being a cause of illness in domestic species, Bett et al. (2008) do not suggest that this affected attitudes toward wildlife. Livestock-wildlife interface was depicted as an inevitability of the dry season. In fact, if anything, the report suggested that respondents viewed people who failed to treat their animals, thus creating disease reservoirs that could not be easily isolated, as most at fault for promoting illness.

Other studies of pastoralists' experiences of disease have tended to focus on specific infections rather than the broad spectrum of illness. Malignant Catarrhal Fever (MCF), a fatal cattle disease for which wildebeest serve as an unaffected reservoir, has been the focus of much

of this small cohort of literature (Bedelian, 2004; Bedelian et al., 2007; Cleveland at al., 2007; Ngotho et al., 1999a; Ngotho et al., 1999b). Indeed, studies have found that Maasai pastoralists in Kenya's Kajiado and Narok districts view MCF as ranking among the five most important problems facing pastoralists who live near wildebeest calving zones (Bedelian, 2004; Bedelian et al., 2007, citing Ngotho et al., 1999a; Ngotho et al., 1999b). Consequences of the disease include not only the death of cattle, but also both the need to lower prices for emergency sale of infected animals and the need to avoid prime wet-season grazing sites where wildebeest are present (Bedelian et al., 2007).

Studies with a political ecology orientation address issues that compound the consequences of MCF and attitudes that result from cattle death (Bedelian, 2004; Bedelian et al., 2007; Cleveland et al., 2001). Maasai believe that the problem has been ignored by the government and international donors in favor of wildlife conservation (Bedelian et al., 2007; Cleveland et al., 2001). They also resent the lack of research on methods for MCF control—a sentiment corroborated by a review of previous literature on the disease, which ignores the economic impact of MCF on pastoralists (Bedelian et al., 2007).

More broadly, research with a political ecology orientation offers insights into the substantial potential for pastoralists to contribute to discussions of interspecies disease and animal health. "Pastoralists have an intimate and extensive knowledge of their surroundings and are well aware of the diseases affecting their livestock," writes Bedelian (2004, p. 23), citing the fact that Maasai were the first people to suggest that wildebeest were associated with the epidemiology of MCF. More broadly, pastoralist community animal health workers have helped to strengthen disease surveillance systems in Tanzania and made unsolicited reports of serious notifiable diseases (Bett et al., 2008, citing Mariner et al., 2002 and Allport et al., 2005).

Moonga and Chitambo (2010), citing Holden (1999), call for the preservation and utilization of indigenous knowledge in livestock production, noting in particular that traditional systems add value to the formal livestock health care sector in part because "both the government and the private veterinary services, in certain cases, do not adequately meet the needs of the traditional livestock sector" (p. 3). Validation of pastoralists' inherent knowledge and value are, however, relatively rare in mainstream discussions of pastoralism, disease, and wildlife conservation.

Prevention and treatment of disease on pastoral lands

The fact that many of the most serious diseases limiting pastoral livestock production are vector-borne speaks to both the cost-effectiveness of and necessity for preventive care. Yet studies on the subject nearly uniformly reflect the challenges that pastoralists face in obtaining both preventive and curative veterinary care (Bailey, 1999; Bett et al., 2008; Nyariki et al., 2009).

Animal health facilities are inadequate in districts with significant pastoral production. When they *do* exist, they tend to be concentrated in urban and peri-urban areas (Nyariki et al., 2009). Government-sponsored preventive vaccination programs have declined in many of Kenya's rural districts (Bailey, 1999). A study of southern Kenya's Narok District found 127 "dip" structures, an efficient and effective way of fully covering livestock with acaricidal sprays to protect them from ticks and mites. However, only 50 were functioning (Nyariki et al., 2009). Meanwhile, private veterinary care is simultaneously unprofitable for veterinary professionals and unaffordable for pastoralists. Nyariki et al. (2009) write that in the pastoral communities near southern Kenya's Masai Marai National Reserve, most pastoralists now depend mainly on disease treatment rather than prevention because prevention is both difficult and expensive to

obtain. Veterinarians have taken advantage of pastoralists' reliance on treatments, the authors write, by cheating on diagnosis and medicines and charging exorbitantly for treatment.

Although cost and access are no doubt critical limiting factors to disease prevention in pastoral communities, a handful of studies points to the importance of cultural and ecological factors as well. Homewood et al. (2006) analyze the impacts of an East Coast Fever (ECF) vaccination program among northern Tanzanian Maasai pastoralists. The consequences of the disease in the study site are severe, with ECF-caused cattle mortality ranging from 30 to 60 percent. As such, it has a tremendous economic impact on human livelihoods.

Homewood et al. (2006) suggest that pastoralists from all economic backgrounds viewed the ECF vaccine positively. However, the authors found that the decision to vaccinate was strongly associated with a measure of wealth that includes livestock numbers and economic security: in one community, the proportion of calves vaccinated ranged from 30 percent among poorest households to over 90 percent in the wealthiest. The implication, the authors write, is that the current logistics and economics of access to the ECF vaccine could mean that instead of alleviating poverty across pastoral communities, it is driving socioeconomic differentiation.

An emergency effort to vaccinate against CCPP and treat mange among Turkana pastoralists in northern Kenya also had relatively low coverage (Bett et al., 2008). In contrast to the ECF vaccination campaign, however, this campaign offered free vaccination and treatment, meaning that economic standing of community members should not have directly impacted outcomes. It was ultimately determined that the low coverage of CCPP vaccination was the result of the campaign's timing: it was carried out during the dry season, over a short time period when many *adakars* had migrated out of traditional areas. In addition, there were significant cultural barriers, including traditional beliefs among some elders that prevented healthy animals

from being shown to strangers and thus vaccinated (Bett et al., 2008).

Bett et al.'s (2008) study of Turkana pastoralists also provides valuable insights into the way that diseases are treated in pastoral communities. The author noted that most participants in the study said they treated their own animals when they were sick, even when paraprofessional Turkana Community Animal Health Workers (CAHWs) were available to provide veterinary support. In this scenario, Bett et al. (2008) explain, most participants preferred to purchase the drugs from CAHWs and administer them personally. For treatment of CCPP, Bett et al. (2008) report, the antibiotic of choice was 20 percent Alamycin (oxytetracyclin), produced by Northern Ireland-founded Norbrook Laboratories and administered intramuscularly. The study found that the medication was given at quantities higher than recommended for adult goats. The authors added that most herders could not properly identify the recommended dosages or different concentrations of oxytetracyclines from the drug labels due to low levels of literacy. CAHWs in the region said that enhancing knowledge among pastoralists in regards to treatment was a priority, as was enhancing knowledge of and compliance with warnings regarding withdrawal periods that need to be observed for milk and meat consumption after antibiotic treatment.

These regional and national studies provide helpful background and context for understanding how issues of disease, wildlife-livestock interface, and perceptions of interspecies disease transfer play out among Maasai pastoralists living on two Laikipia district group ranches. The research conducted is discussed in Section III.

Section III
Research and Analysis

Following an overview of the research conducted, this section is divided into three distinct parts. The first discusses pastoralists' experiences of livestock disease; the second, disease and wildlife; and the third, broader-scope experiences with wildlife.

Research

Sixty-four interviews were conducted with residents of Ilmotiok and Tiemamut Group Ranches between May and August 2011. Forty-two interviews took place at the former group ranch, and 22 at the latter. These adjoining communities are in the northwest corner of Laikipia's pastoral lands; Ilmotiok shares a border with Mpala Research Centre as well. Ilmotiok and Tiemamut were selected because of their proximity to Mpala, but also because of their relatively close ties to the Research Centre.

At both Ilmotiok and Tiemamut, interviews were conducted with the support of an interpreter residing in the respective community. In total, two men and one woman served as translators. To ensure consistency in interview questions and structure, there was always a period of overlap before full responsibility for interviewing was assumed by the newer interpreter. Permission was obtained from both communities prior to conducting interviews: the ranches' chief was contacted for approval and, at Ilmotiok, a meeting was held with council members to explain the nature and purpose of the study.

Interview selection. The first people to take part in interviews at each ranch tended to be members of the interpreters' families or social networks. A snowball sampling method was also

used in the research; in several instances, a person being interviewed recommended a friend or family member whom he or she thought would be willing to participate. This non-random selection of interviewees most likely enhanced the proportion of people willing to participate in the study. It presumably also increased participants' trust in the interview and research process, and hopefully the forthrightness with which they responded to questions. Nonetheless, the close interpersonal relationships likely impacted the findings, as it is likely that family and friends have more similar experiences with and attitudes toward domestic animals, wildlife, and disease than would randomly selected individuals.

Survey instrument. The final survey consisted of 44 questions that addressed residents' livestock ownership, experiences with livestock disease, perceptions of the cause of disease, and experiences with wildlife (see Appendix A). The first seventeen interviews conducted at Ilmotiok over a period of six days used a "pilot" survey. During the course of conducting these interviews, shortcomings and gaps were identified in the questionnaire; five questions were added and marginal adjustments were made to the questions' order. Given the richness of peoples' responses early on in the survey process, however, answers to questions in the initial questionnaire were included in the analysis. Questions that were not asked of all 64 interviewees are noted.

The most significant change to the survey was the inclusion of a participatory rural appraisal ranking exercise. In trying to understand experience of livestock disease, it was critical to work out not only what diseases posed problems for pastoral communities, but also the relative severity of those diseases and their impacts on the welfare of both families and the animals themselves. With this goal in mind, Bedelian's (2004) participatory research model was

adapted for this study. Disease names were written in the language provided by the respondent on individual index cards, and the interpreters read these names out loud. The respondent was then given 20 beans and asked to distribute them in a way that represented the relative severity of each disease.

Given the nature of the research, findings are described qualitatively and with descriptive analyses.

Research findings

Tiemamut is the larger of the two communities, the home of an estimated 242 households, more than double Ilmotiok's estimated 105 (Yurco, 2011). Ilmotiok interviews were relatively evenly split between women and men, with 22 males and 20 females taking part. The community identified nine of the men as "youth," approximately 30 years of age or under, and the remaining 13 were "elders." Six female participants were in the youth class, 11 were elders, and three were of unknown age. Meanwhile, Tiemamut interviews were more heavily weighted toward females: 15 women and seven men took part. This was no doubt connected to the fact that the interpreter at Tiemamut was female. Eight women were elders, and seven were youth; all men were elders.[4]

[4] All men who were interviewed have lived in their respective community for their entire lives. This was not so for women. Among the 20 women currently residing at Ilmotiok, eight (40 percent) were lifelong residents. A larger proportion of women interviewed at Tiemamut—10 of 15, or 66.7 percent—were born in the community. The women who were not born in their respective community moved from a variety of locations: other Maasai group ranches, peri-urban communities in Laikipia (the towns of Dol Dol and Kilmanjo), and, in two instances, private ranches. Although a relatively large proportion of women interviewed were not lifelong residents of their present community, the majority of interviewees *are* lifelong residents of Laikipia district. A mere four of 35 women interviewed for the study (11.4 percent) were born outside Laikipia (in Nyeri, Isiolo, and Nakuru districts). The movement of women between Maasai communities is unsurprising from a cultural perspective. It is, however, potentially

The extent to which domestic animals shape the identity of Ilmotiok and Tiemamut residents cannot be underestimated. Interviews were conducted with a driver at Mpala on his day off, as well as with individuals involved in small businesses and cottage industries: weaving carpets for nearby tourist lodges, selling food staples, making jewelry, carving wooden animal figurines, and producing honey. Four interview participants at Ilmotiok had recently started gardens along the Ewaso N'giro River; one did so after her family lost all domestic animals to disease. Every respondent, including those with other sources of income and the woman with no remaining animals, claimed that their primary source of wage-income is "raising livestock" or "raising animals." The sense of responsibility for the well-being of one's domestic animals, and the reliance on these animals for not only well-being but also identity, is profound.

Goats dominated herds on both ranches. They were the most common livestock species in terms of both number of individual animals owned and number of persons who owned them (see Table 1).[5] At Tiemamut, each of the 22 persons interviewed owned goats; at Ilmotiok, 40 of 42 persons interviewed (95.2 percent) owned the animals. The median number of goats owned at Tiemamut and Ilmotiok was 10 and 20, respectively, a quantity many times that of any other species.

	Number of respondents who own species	**Median no. owned**	**Mean no. owned**	**Maximum no. owned**
Goats				
Ilmotiok	40/42 (95.2%)	20.0	29.6	100.0
Tiemamut	22/22 (100%)	10.0	18.6	100.0
Sheep				
Ilmotiok	19/42 (45.2%)	0.0	7.6	50.0
Tiemamut	21/22 (95.5%)	6.5	21.4	300.0
Cattle				

relevant from the standpoint of knowledge of and attitudes toward disease; spending one's formative years in another community could in theory impact responses and experiences regarding disease.

[5] "Ownership" is a term used loosely here, as men technically owned a family's livestock.

Ilmotiok	30/42 (71.4%)	2.0	4.2	20.0
Tiemamut	21/22 (95.5%)	2.0	6.1	50.0
Camel				
Ilmotiok	2/42 (4.8%)	0.0	0.2	6.0
Tiemamut	3/22 (13.7%)	0.0	0.8	14.0

Table 1: Domestic animal ownership among Group Ranch residents.

The proportion of interviewees who owned camels was comparatively low on both ranches, as were the numbers owned. It Ilmotiok, 4.8 percent of persons interviewed owned camels; at Tiemamut, it was 13.7 percent. The largest number of camels owned—14—belonged to a particularly wealthy resident of Tiemamut.

Whereas the two group ranches showed relatively similar trends in ownership of goats and camels, sheep and cattle numbers saw some notable variations by community. Sheep ownership was more than twice as high among those interviewed at Tiemamut (95.5 percent) as it was at Ilmotiok (45.2 percent). In each community sheep ownership was less that goat ownership and the median number of sheep owned by interviewees was less than the median number of goats that they owned.

At both ranches, respondents owned a median 2.0 cattle. However, less than three-quarters of Ilmotiok respondents owned this species, whereas at Tiemamut, all but one respondent had at least one in their herd.

In addition, those with large numbers of cattle tended to also own two, three, or four donkeys—a correlation that is unsurprising given that the financial resources required to purchase these two species is significantly higher than that required to purchase goats or sheep. Finally, several respondents owned chickens, and a significant proportion of individuals also kept dogs, although interestingly very few mentioned the latter species even though they were asked to name the numbers of animals, not only livestock, in their home.

Trends in livestock populations

Interviews revealed perceptions of shifting species compositions within both communities' domestic animal herds (see Table 2). This begins with the relatively recent trend of camel ownership on pastoral lands. Although both total numbers of camels and proportions of camel owners were comparatively low on both ranches, there was consensus that this species has increased in the last decade.[6] Several individuals commented that a decade ago their respective communities had no camels. This shift is attributable, at least in part, to environmental conditions. Several residents of both communities commented that people are beginning to view camels as a viable response to more droughts in the region, and they specifically cited the animals' capacity to provide milk long after the production capability of cattle, goats, and sheep has ceased. In this way, Maasai communities are beginning to incorporate into their herds a species that has long been a part of the Somali, Oromo Gabbra, Rendille, and Turkana communities living in Kenya's more arid northern and northeastern regions, as well as one that is increasingly being used for commercial milk production in Laikipia (Musinga et al., 2008).

Meanwhile, across both ranches, the overwhelming majority of individuals (57 of 64, or 89.1 percent) observed that cattle populations have *decreased* over the past decade. With the exception of one Ilmotiok resident (who currently owns no cattle) who claimed that his cattle numbers have decreased because the cost of food has necessitated selling animals, every person who provided a reason for decreasing numbers attributed it to drought. A small proportion of individuals (4 of 64, or 6.3 percent) believed that cattle numbers have increased; one Ilmotiok resident attributed this to greater access to medications and thus fewer deaths from disease.

[6] Participants in the first set of Ilmotiok interviews were not asked about camel populations.

Perceptions of goat and sheep populations are less clear-cut than for the other two species. During the course of interviews, participants were asked to describe their population trends as a unit. The majority of persons interviewed (47 of 64, or 73.4 percent, including all from Tiemamut) believed that the "shoat" population was lower than a decade prior, attributed variously to disease, drought, and the need to sell animals in order to purchase food staples such as maize, beans, and flour. At the same time, nearly one-quarter of Ilmotiok residents believed the population had increased; an additional seven residents from across the two ranches commented that trends differed for the two species. In most cases, they reported that goat numbers had increased, while sheep had diminished.

Cattle	**Ilmotiok**		**Tiemamut**	
	Less now	36	Less now	21
	More now	3	More now	1
	No answer	3	No answer	0
Camels	**Ilmotiok**		**Tiemamut**	
	Less now	0	Less now	0
	More now	25	More now	22
	No answer	0	No answer	0
Shoats	**Ilmotiok**		**Tiemamut**	
	Less now	29	Less now	18
	More now	10	More now	0
	No answer	3	No answer	4

Table 2: Populations trends of domestic animals over the past 10 years.

Greatest challenges

When asked about the greatest challenges with raising animals, residents from Ilmotiok and Tiemamut provided similar responses. Across both communities, drought was mentioned most often (51 times), followed by disease and/or ticks (33).[7] (See Figure 2.) Drought-related challenges were framed in a number of ways. A young female resident of Ilmotiok noted that during droughts "animals have less food and must run from wild animals." Other responses reflected the additional strain that drought places on the owner's time; as one male resident of Ilmotiok commented, "During the drought seasons, you have a lot to do and need to put in more effort to find grass for animals."

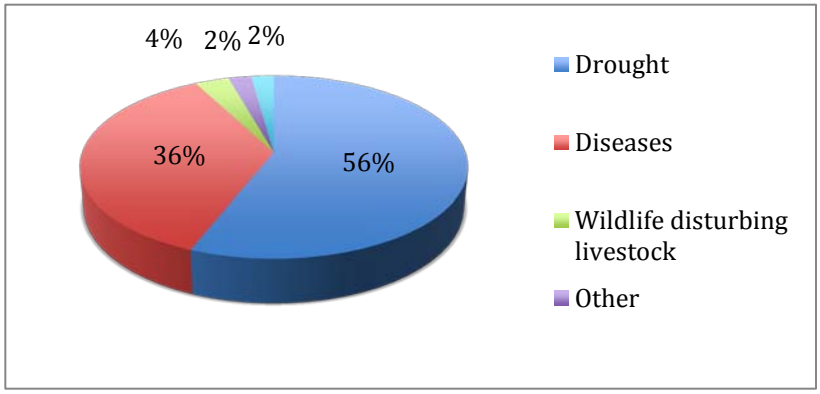

Figure 2: Greatest challenges to raising domestic animals (percent of respondents citing challenge).

Dry seasons also carry an economic cost and highlight the trade-offs that the communities experience, many of which are compounded by drought. Thirty-three of 64 (51.6 percent) of respondents reported that they sell more livestock during drought despite knowing that the animals will not garner as much money as during periods with more rain (see Figure 3).

[7] Several respondents listed more than one challenge, and consequently the total number of challenges cited (91) exceeds the number of persons interviewed. The results reported in Figure 4 are the percentages of the total number (91) of reported challenges.

Many cited the need for cash not only to pay for school fees and clothes, but also because, as one female youth resident of Ilmotiok explained, livestock are not producing milk and "people are hungry and need food." This sentiment was reflected in the answers of several respondents of both sexes and both ranches.

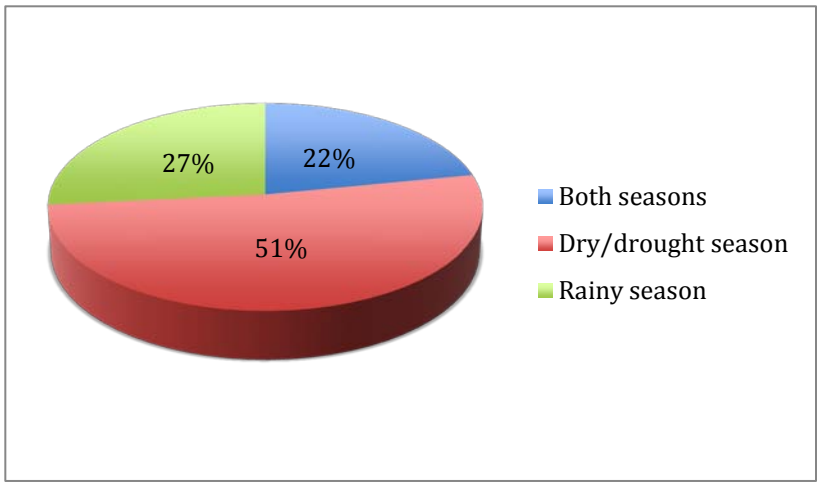

Figure 3: Primary season during which livestock is sold (percent of respondents reporting).

Comments by two men, both residents of Ilmotiok, also spoke to the relationship between the Mpala Research Centre and surrounding group ranches during dry periods. When there is insufficient food for animals on the group ranches, residents may pay to use Mpala's land to graze their animals. This arrangement tends to be used for cattle and, for those who own them, camels.[8] One youth pointed out that while he "ideally sells [goats] when they are healthy because you get more money and [thus] food; when they are weak you don't get as much money," he nonetheless "may sell goats [during drought] in order to get money to pay Mpala to

[8] Access to this abutting land comes at a cost, which is likely one reason why the option is used only for more valuable species. As of 2010, the fee was approximately 200 Kenyan shillings (KSH), or about USD $2.23 per animal, per month, significantly higher than the Ksh 10 (USD $0.11) per animal, per month charged by other private ranches (Yurco, 2011).

take care of cows." Another resident similarly spoke of selling livestock "for money to rent land for grazing cows and to buy food and clothing."

There is no doubt also a perceived correlation between drought and disease. When asked to name the season in which more animals die from disease, approximately two-thirds of respondents (31 of 47 people) believed that it is the dry, or drought, season.[9] In some instances, a causal correlation was made between disease and drought, with one female Ilmotiok resident proposing that goats and sheep get diseases during drought "because their bodies are weak due to lack of food." (An additional 9 of 47 respondents, or 19.2 percent, said that more animals die from disease during rainy season; the remainder said that death was equal in both seasons or did not respond.)

Experiences with domestic animal disease

Diagnosis of disease is made by community members themselves. Interviews and informal conversations with residents of both Ilmotiok and Tiemamut revealed that information about disease, diagnosis, and treatment is passed from elders to youth; when an individual is unsure about a medical ailment, he or she will consult more experienced or knowledgeable members of the community. The use of veterinary professionals is limited to government employees who provide subsidized vaccination against foot-and-mouth disease during outbreaks (see below) and the merchants and paraveterinarians who sell medications at markets and in market towns.

Residents of both Ilmotiok and Tiemamut reported broad ranges of disease in their domestic animals. In total, 15 distinct diseases and conditions were mentioned during the course

[9] This question was not asked in the pilot questionnaire.

of interviews and conversations. Quite frequently, respondents who otherwise spoke no English referred to "foot-and-mouth." This likely reflects the Kenyan government's emphasis on the disease. All other diseases and conditions were cited in Maasai and Samburu, a presumed result of interactions among members of the two pastoral communities at places such as livestock markets, as well as similarities in language origins.[10] (See figure 4.)[11]

Maasai (Samburu) Disease Names	**English Translation**
Olkuluk (Lkulup)[12]	Foot-and-mouth disease/Hoof-and-mouth disease

[10] Both Samburu and Maasai are Eastern Nilotic/Maa languages.

[11] Bedelian (2004), Bett et al. (2008), Biovision Foundation (2012), Intermediate Technology Kenya/International Institute for Rural Reconstruction (1996), and Practical Action (2012) have all conducted work on diseases in East Africa and provided translations from Maasai, Samburu, Turkana, and other languages into English. I relied extensively on these sources, as well as on the input of my interpreters and personal communication with veterinary professionals in Laikipia. Unfortunately, there was not consistency among all sources. I have extremely high levels of confidence for the translation of many diseases. I am less certain about blackquarter/symptomatic anthrax, East Coast fever (ECF), and enterotoxaemia. ECF is complicated by the fact that the Maasai name for Anaplasmosis, or "yellow fever," is the same as the Samburu name for ECF. In light of the fact that many persons used Maasai and Samburu names for diseases interchangeably, I differentiated reports of ECF from anaplasmosis based on key symptoms provided by individuals. *Empuruo* or *Umpururo* is the Samburu name for blackquarter/symptomatic anthrax; no Maasai name could be obtained (Bedelian, 2004; Intermediate Technology Kenya/International Institute for Rural Reconstruction, 1996). However, not all symptoms provided by respondents for the disease they called *Empururo* or *Umpururo* matched the defining symptoms of blackquarter. Further complicating translation, *Mporot* and *Mporoto* are Samburu names for anaplasmosis (Biovision Foundation, 2012; Intermediate Technology Kenya/International Institute for Rural Reconstruction, 1996; Practical Action, 2012). Consequently, these three diseases should be viewed as best guesses, and not as definitive translations. Rift Valley fever and babesiosis are two additional diseases, both common among livestock and with the potential to infect humans, that several studies have found to be common in the region. It is possible that these infections are present in domestic animals on pastoral lands in Laikipia, but were identified as something else by respondents. The symptoms of these infections overlap with symptoms of several others.

[12] The first name(s) is Maasai. Text in parentheses refers to Samburu-language disease names.

Oltikana, Ltikana (Lipis)	East Coast fever (ECF)
(Empuruo/Umpururo)	Blackquarter/Symptomatic anthrax
Olkipei, Olkipiei (*Lkipei)*	Contagious Caprine Pleuropneumonia (CCPP)[13]
Olmonkoi, Erirei (Naririi, Lmonkoi)	Lumpy skin disease (cattle), contagious skin necrosis (camel)
Olmilo, Ormilo (Nangarangar)	Heartwater/Theileriosis[14]
Lipis (Ndiss)	Anaplasmosis ("yellow fever")
Lotome	Mange
Imbiruli (*Mberurui)*	Bloat
Olbus	Enterotoxaemia ("pulpy kidney")
Olodo kurum (Ngorotit, Nkiriato)	Diarrhea (non-specific cause)
Oldua/Olodua (Lodwa, Lodua)	Rinderpest
Ndominanta	Unknown, translated as "red intestine"
Nado Tolit	Unknown
Osaara	Unknown

Figure 4: Diseases and conditions reported in domestic animals in Ilmotiok and Tiemamut Group Ranches.

Disease trends

In addition to naming a broad range of diseases that can afflict livestock, residents of Ilmotiok and Tiemamut both overwhelmingly reported (43 of 47 respondents, or 91.5 percent) that their livestock suffer more from disease now than they did ten years prior.[15] (See Table 3.) When asked why they believed this to be the case, most respondents offered one of two explanations. Nineteen of the 43 respondents (44.2 percent) who believed that there has been an

[13] *Olkipei* also refers to Contagious Bovine Pleuropneumonia, or CBPP (Bedelian, 2004; Biovision Foundation, 2012). Laikipia has been successful in preventing CBPP in commercial animals through use of quarantine, vaccination, and double-testing of all cattle entering the district (personal communication, Giles Prettejohn, Ol Pejeta Conservancy, July 31, 2011). Only one interview participant stated that his cattle contracted *Olkipei*. For the purposes of this paper, *Olkipei* is used in reference to CCPP among goats.

[14] The acute form of heartwater is known to resemble babesiosis, anaplasmosis, cerebral trypanosomiasis, or theileriosis, among other infections (World Organisation for Animal Health 2009). *Olmilo* and variants are alternately translated as heartwater (Intermediate Technology Kenya/International Institute for Rural Reconstruction, 1996), and as both heartwater and bovine cerebral theileriosis (Bedelian, 2004).

[15] This question was not included in the pilot survey.

increase had a very literal explanation for the trend: the arrival of new pathogens or increased prevalence of longstanding diseases. Heartwater/theilerioisis and CCPP were mentioned most often, by nine and four people, respectively.

Livestock Disease - Perceived change over 10 years			
Ilmotiok		**Tiemamut**	
Less now	3	Less now	1
More now	22	More now	21
No answer	0	No answer	0
Total	25	Total	22

Table 3: Perceptions of changes in livestock diseases over the past decade

The other common explanation was associative. Twelve of the 43 respondents (27.9 percent) attributed it to an increased presence of wildlife in their community, and particularly increased interactions between domestic animals and wildlife.

- *Wildlife are abundant and nearby. They step in water that livestock drink, and livestock get sick.* (Female, age unknown, Ilmotiok)
- *Livestock mix with wildlife during grazing and watering. This may bring diseases.* (Female, youth, Ilmotiok)
- *Wildlife are many, and they bring the disease.* (Female elder, Tiemamut)
- *[There are] larger numbers of wildlife, and they spend more time with livestock and drink from the same place.* (Female youth, Tiemamut)
- *Wildlife are more now, so disease has increased as well.* (Female elder, Tiemamut)

Four individuals believed that disease has decreased, which they attributed to the greater availability of medication—a potential reflection of the tendency among respondents to equate

preventive and curative interventions. Finally, 11 individuals offered no details on shifting trends.

Most severe diseases

To gauge the relative impact of different illnesses on the well-being of domestic animals and the families that rely on them, the men and women who took part in interviews were asked to list the five animal diseases that have had the greatest impact on their family over the past decade. Once this list was complete, they were asked to distribute up to 20 beans to show the comparative impacts of the diseases on livestock.

In total, 43 persons completed this ranking activity.[16] Residents of both communities overwhelmingly cited the significance of CCPP, followed by anaplasmosis (see Table 4). Lumpy skin disease, enterotoxaemia, and heartwater/theileriosis were also mentioned multiple times on both ranches as being among the top three diseases for severity, and a handful of respondents even viewed them as the most severe disease that has affected their family in the past ten years. However, the importance of these infections paled in comparison to that of CCPP and anaplasmosis.

[16] Four persons declined to complete the ranking exercise. Seventeen people completed the pilot survey, which asked them to name the "most worrying" animal diseases and captured neither the relative breadth nor severity of conditions.

Disease severity ranking	Contag-ious Caprine Pleuro-pneumonia	Anaplas-mosis	Lumpy Skin Disease	Heart-water	Diar-rhea	Entero-toxaemia	*Ndominata* ("Red intestine," disease unknown)	Foot-and-Mouth	East Coast Fever	*Nado tolit* (disease unknown)	Black-quarter /Sympto-matic Anthrax
Frequency of mention on group ranches combined											
#1	30	6	4	3	2	1	1	0	1	0	--
#2	10	17	3	6	2	8	1	1	1	0	--
#3	2	9	4	4	2	8	1	3	1	2	5
Total	42	32	11	13	6	17	3	4	3	2	5
Frequency of mention at Ilmotiok											
#1	16	3	1	--	2	1	1	--	--	--	--
#2	5	5	--	2	1	4	1	1	--	--	--
#3	--	4	1	--	2	4	1	--	--	2	3
Frequency of mention at Tiemamut											
#1	14	3	3	3	--	--	--	--	1	--	--
#2	5	12	3	4	1	4	--	--	1	--	--
#3	2	5	3	4	--	4	--	3	1	--	2

Table 4: Diseases with the greatest impact on Ilmotiok and Tiemamut families over the past 10 years.

Contagious Caprine Pleuropneumonia. Across both communities, the perceived severity and impact of *Olkipei*, or CCPP, is acute; 30 out of 43 individuals (69.8 percent) who completed the exercise ranked it as having the first, second, or third greatest impact on their family over the past 10 years.[17] The most commonly reported symptom was severe coughing among infected goats; individuals also noted that goats with CCPP will not move, and that lung damage is visible upon slaughter. Respondents also emphasized the large proportion of a herd that will die from the disease, as well as the speed with which mortality occurs.

The experiences of Tiemamut and Ilmotiok residents with CCPP align with disease descriptions in veterinary literature. A highly contagious infectious bacterial infection of goats (causal agents are *Mycoplamsa mycoides capri* and *Mycoplasma F38*), CCPP causes inflammation of the lungs and accumulation of fluid in the chest cavity. Damaged lung tissue will often adhere to the chest wall. The goat ultimately dies from lack of oxygen, and mortality rates range from 60 to 100 percent (Herenda et al., 2000; Merck, 2005; MSU, 2012).

There was relative consensus about the way in which goats contract CCPP. Thirty-nine of the 42 people who ranked CCPP as one of the three most consequential diseases spoke of the disease's level of contagion between goats or from other livestock to goats. Many described the disease as airborne; several described its transmission between goats that share water, grazing areas, or salt licks. A small handful suggested that CCPP can be contracted if one goat drinks the water in which another goat has urinated. A sizeable proportion of persons who ranked CCPP as having a high impact (11 of 39, or 28.2 percent) noted its transmission among goats and simultaneously viewed it as coming from a place that is "outside" of, or "other " than, their own:

[17] In some instances, individuals ranked diseases as equally severe. In such a case, they were recorded as having the same ranking. Only three diseases in total were recorded per person. E.g., if someone gave each of CCPP and ECF seven (7) beans and enterotoxaemia six (6) beans, CCPP and ECF would each be ranked as having #1 severity, and enterotoxaemia as #3.

- *It comes from far away from other goats.* (Male youth, Ilmotiok)
- *Contagious among animals, will come from other homes.* (Male youth, Ilmotiok)
- *A goat is purchased from market and transfers disease to other animals.* (Female elder, Tiemamut)
- *Transported by air from goats purchased from far away, like [the town of] Nyeri.* (Male elder, Tiemamut)
- *Comes from far away places, transferred by other livestock.* (Female youth, Tiemamut)

There is truth to this perception. While it is possible that it stems in part from the view that one's own animals are healthy and do not present a risk to the community, disease outbreaks *are* related to animal movement and migrations. When asked where they purchased new animals, all residents were amendable to purchasing from other communities if the price was low and the animal appeared healthy. Markets, which draw together residents of multiple communities, facilitate this exchange.

In addition, although one intent of group ranches was to promote sedentarization of pastoralists, many residents still do migrate with some of their animals during drought. The movement, oftentimes to private ranches, may involve travel through multiple communities and a greater likelihood of disease transmission. Indeed, spread of disease has been noted as one of the main risks of migration (Kabubo-Mariara 2003). This vulnerability is no doubt exacerbated by environmental conditions and constraints of current land tenure in the region.

Only two people suggested that CCPP can be transferred by animals other than fellow domestic species. A male member of the youth set suggested that goats contract CCPP when "wildlife mix with domestic, [and] graze and drink water." A female (youth) resident of

Tiemamut stated that while the CCPP is transmitted "by air" and other goats, and it can also be contracted when goats drink water shared by wildlife.

Observations about how CCPP is contracted were largely consistent with epidemiological explanations. It is widely reported to be spread through inhalation of airborne droplets from coughing or sneezing animals, and direct contact between goats is required for transfer (Herenda et al., 2000; Merck, 2005; MSU, 2012). A literature review uncovered no reports of wildlife infection in East Africa.[18]

Anaplasmosis. Anaplasmosis, viewed overall as the second most significant livestock disease affecting families in the two communities, is a Rickettsial infection caused by multiple species of *Anaplasma* bacteria (Merck, 2005). In combination, the different strains can infect a variety of animal species, both domestic and wild (particularly wild ruminants) in tropical and subtropical regions across the globe (Brown, 2012). *Boophilus* ticks (including the Blue, or cattle, tick) are the major vector in Africa, although other species of ticks, biting flies, and even oxpecker birds are also known to transmit infection (Merck, 2005; Practical Action, 2012). Anaplasmosis is not transmittable through direct contact; however, domestic or wild animals that have contracted the disease become reservoirs of the pathogen.

Tiemamut and Ilmotiok residents had extraordinarily similar experiences in terms of the species that have been affected by anaplasmosis. Combined, they reported that cattle fall victim most often, with a frequency nearly three times that of sheep and ten times that of goats (see Figure 5). These experiences are consistent with findings from other regions of the country and

[18] There has, however, been confirmation of a CCPP outbreak in wild goat, Nubian ibex, Laristan mouflon, and gerenuk in a wildlife preserve in Qatar (a confined environment), meaning that wildlife infection *can* occur (Arif et al., 2007). Of these aforementioned species, the gerenuk is present in Kenya.

world; anaplasmosis is recognized as causing particularly severe economic impacts due to losses among cattle; goats and sheep tend to have less severe, even asymptomatic, infection (Tucker, 2001; Whittier et al., 2009).

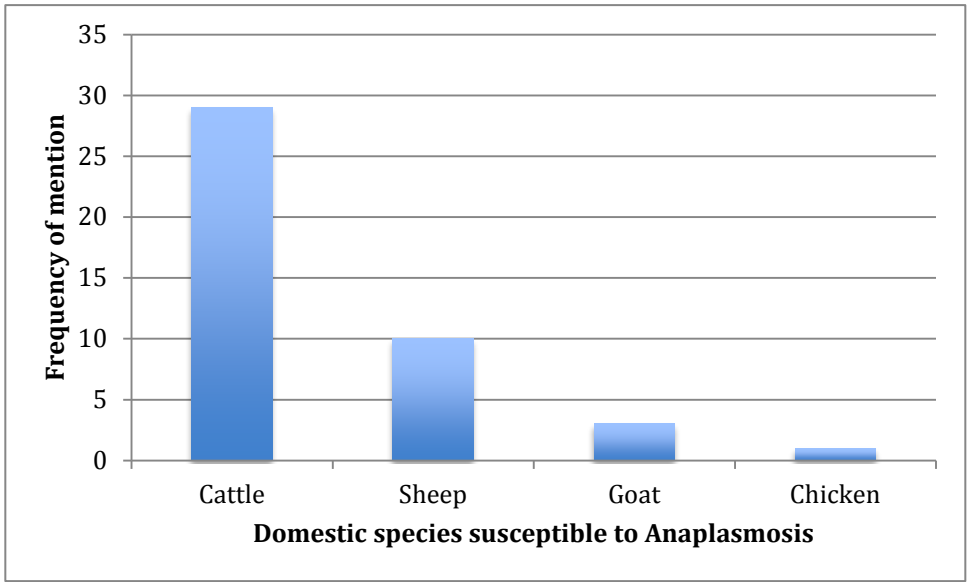

Figure 5: Domestic animal species reported by Ilmotiok and Tiemamut residents as being susceptible to anaplasmosis.

Community residents' beliefs about the causes and sources of anaplasmosis were quite varied, particularly when compared to the virtual consensus about the transmission of CCPP (see Table 5).

	Frequency of mention		
	Ilmotiok	**Tiemamut**	**Group Ranch total**
Rainy seasons/affects "healthy" cows	9	9	18
Wildlife	2	4	6
Migration	4	2	6
Contagious among domestic animals	--	3	3
Other	1	1	2

Table 5: Numbers of group ranch residents attributing anaplasmosis in domestic animals to different sources.

The most common explanation, mentioned by over half of respondents (18/35), was that the disease is associated with or caused by the rainy season and/or when animals, particularly cattle, are healthy:[19]

- *When there is enough grass and cows are healthy.* (Female elder, Tiemamut)
- *Green grass during the rainy season, and the cow is healthy.* (Male elder, Ilmotiok)
- *During the rainy season, cattle eat a lot and get lipis.* (Male youth, Ilmotiok)
- *It is a function of the rainy season, when the cow is healthy.* (Male youth, Ilmotiok)
- *Animals are healthy, have enough grass, are in one place.* (Female youth, Tiemamut)
- *When animals are healthy they get sick from eating small shrubs.* (Male elder, Tiemamut)

Six of 35 respondents (17.1 percent) spoke about the perceived role of wildlife in transmitting illness. Shared use of grazing land between livestock and wildlife, particularly during rainy seasons, was mentioned, as was the perception that wildlife carry ticks:

- *When Lipis was present there were many wildlife: buffalo, elephant, rhino. An elephant steps in grasses, and livestock eat and get disease. Buffalo, elephant, rhino are in water more than other animals, and are strong.* (Female elder, Ilmotiok)
- *Ticks from wildlife, especially buffalos and zebras.* (Male elder, Tiemamut)
- *Zebra bring through ticks because there are many of them [zebra], and they come from Mpala.* (Male elder, Tiemamut)
- *Can come from wild animals to domestic* (Female elder, Tiemamut)
- *Ticks cause disease from wild animals like zebras.* (Female elder, Tiemamut)

[19] Some people associated Anaplasmosis with more than one cause – e.g., it comes during the rainy season and is transmitted between domestic animals – and where placed in both categories – hence the total adding up to more than the number of people interviewed.

An additional six respondents spoke specifically about the role of migration in contracting Anaplasmosis:

- *If animals move during drought to another place with black cotton [soil], they will return with Lipis.* (Female youth, Ilmotiok)
- *Cows moving from place to place bring Lipis, especially in cool areas.* (Female youth, Ilmotiok)
- *If cattle and goats move to other places, they can get Lipis.* (Male elder, Ilmotiok)
- *Cows migrate and bring Lipis in both dry and rainy [seasons]*. (Female unknown age, Tiemamut)

These explanations are consistent with veterinary and epidemiological literature. Migration does foster disease spread, as does exposure to ticks, whether sourced from wildlife or other domestic species.

The seasonality of tick abundance and tick-borne diseases vary based on tick species, geographic region, and landscape (Swai, 2005). While literature is lacking on *Boophilus spp* and anaplasmosis in Laikipia *per se*, a study conducted in western Kenya found that anaplasmosis seroprevalence in cattle was higher in rural areas during the rainy season (Okuthe and Buyu, 2006). This supports the Ilmotiok and Tiemamut residents' suggestion of a cruel irony: when animals are nourished and "healthy," having survived seasonal drought, they become susceptible to another disease threat.

Respondents who associated anaplasmosis with wildlife specifically mentioned buffalo, zebra, elephant, and rhinoceros. The conclusion that anaplasmosis in livestock co-varies with presence in buffalo and zebra is substantiated by veterinary and epidemiological literature. A recent study conducted in areas of Kenya with significant spatial overlap between domestic and

wild animals found *Anaplasma* antibodies in several wildlife species; plains zebra seroprevalence was 72.7 percent (*n*=11) (Ngeranwa et al., 2008). In addition to being a member of the same family as cattle (Bovidae), Cape buffalo have been found to host extremely large numbers and species of ticks. Although studies in Laikipia and Kenya are lacking, research on buffalo in neighboring Tanzania found that buffalo had the highest tick burden of multiple wildlife species evaluated, and that several of the tick species taken from buffalo tested positive for *A. marginale*, which causes bovine (cattle) anaplasmosis (Fyumagwa et al., 2007; Fyumagwa et al., 2009). A literature review revealed no known cases of anaplasmosis in elephants or black rhinoceros, although research in Tanzania found very low and moderate tick burden, respectively, for the two species (Fyumagwa et al. 2007; Fyumagwa et al., 2009).

Prevention and Treatment

Interview participants were asked to speak about their strategies and options to prevent and treat disease in domestic animals. This, of course, impacts the number of animals to get sick, the number of animals to die, and the overall consequences of disease on lives and livelihoods.[20]

A handful of respondents of both sexes, residences, and age groups mentioned use of traditional treatments for specific illnesses. One female youth living in Ilmotiok mentioned use of ashes to treat foot-and-mouth disease. Treatment for blackquarter entailed boiling tobacco or leaves of *raparrot* or *lodua poro* trees in water, and then giving the resulting mixture to the

[20] Although domestic animals belong to the husband in a household, every interview participant was asked this question. Answers revealed that women were not only familiar with disease names and symptoms, but also the medications and dosages used. This suggests that women take an active role in this aspect of animal care, and means that responses were not gender-specific.

animal orally or intranasally. Two respondents mentioned treating lumpy skin disease with milk from the *Poponi* tree; another mentioned burning skin lesions and infections with hot metal, a treatment whose scars were seen on multiple cattle (see Figure 6). Nearly every respondent reported treating CCPP and anaplasmosis, the two most consequential diseases, with purchased drugs.

Figure 6: Skin lesions on cows and scars associated with use of hot metal.

Everyone, including those who mentioned using traditional medicines, also reported using commercial drugs to prevent or treat illness. These commercial products fell into four main categories: antibiotics (penicillin and oxytetracycline), acaricidal "stock spray," fluke and worm drenches, and vitamin injections. A small handful of individuals additionally mentioned use of copper sulfate to treat animals with foot-and-mouth disease.

There are mixed indications about how appropriately these medications are used. Nearly uniformly, respondents treat CCPP with oxytetracycline. Despite high mortality rates even *with* treatment, this is appropriate antibiotic to use for the bacterial infection (Herenda et al., 2000; Merck, 2005; MSU, 2012). It was not clear that other consequential infections were treated with appropriate medications. Even with CCPP, however, there was substantial inconsistency in dosing. Respondents reported treating sick goats with oxytetracycline dosages ranging from two or three 5cc injections; to one, two, three, or four 10cc injections; to two 15cc injections. Age and size of the goat accounted for only a small portion of this variability.

The challenges with prevention and treatment run deeper than treatment selection and dose, however. Access, shaped by both economics and geography, is a tremendous barrier. Conversations with residents of Ilmotiok and Tiemamut suggest that the availability of preventive and curative treatments has increased in the past decade. Even so, there are limitations. Antibiotics requiring refrigeration are neither available nor practical. Medications are expensive, even more so at rural markets and market towns, sometimes requiring sale of another animal to purchase.[21] As a result, treatment may be delayed for the time that it takes to

[21] Prices of medications and treatments were recorded at Dol Dol and Kilmanjo markets during summer 2011. Adamycin 10% (active ingredient Oxytetracycline Hydrochloride) cost between Ksh 200 and Ksh 300 (USD $2.23–$3.34) for 100 ml, depending on the brand and seller. Penstrep 20/20 (active ingredient Benzylpenicillin) sold for approximately Ksh 300 (USD $3.34). Acaricidal "stock sprays," commonly referred to as "dips," used to control ticks, lice,

obtain money to buy the treatment. For many infections, the likelihood of survival drops as treatment is delayed, making access an issue of significant concern.

Prevention of disease is in many ways closely linked to access. Use of acaricidal sprays on livestock to prevent ticks and mites is widely used, with the cost of chemicals borne by owners. A study in a heavily pastoral district in southern Kenya, discussed in the previous section, found that only 50 of 127 acaricidal "dip" structures were functioning (Nyariki et al., 2009). Neither Ilmotiok nor Tiemamut appeared to have any dip structures, functional or not, which means that owners would spray the acaricide on the animals by hand—a process that is time-consuming, costly, and of questionable efficacy—as evidenced by the number of tick-borne diseases reported. Moreover, interviews revealed that the frequency of use varies from weekly to bi-weekly to once per month, likely a function of purchasing capacity and likely contributing to drug resistance among the targeted pests (see Swai, 2005).

Although several of the infections cited by respondents have associated vaccines, actual vaccination on the group ranches is limited to foot-and-mouth disease, conducted by the government and provided at a cost of Ksh 2 for sheep and goats and Ksh 10 for cattle, with the added perk of free medications and acaricidal sprays (personal communication, Patrick Apollo Miliko, Ilmotiok Group Ranch, July 15, 2011). When this service is provided, the response on ranches is positive, with people lining up the afternoon before. The draw could, of course, be the medications more than the vaccination per se. The response nonetheless suggests that the

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and mange mites on livestock sold for KSH 1200, or USD $13.37, for 1 liter. Wormcid (active ingredient Levamisole Hydrochloride 1.5%), used to treat gastrointestinal roundworms, lungworms, eyeworms, and stomach and intestinal strongyles, sold for Ksh 150 (USD $1.67) for 500ml. Nilzan Plus (active ingredients Levamisole Hydrochloride 1.5%, Oxychlonanide 3.0%, and Cobalt Sulphate 0.382%), a broad-spectrum dewormer used to treat fluke, roundworm, and bowel tapeworms in cattle, sheep, and goats, sold for Ksh 1200/USD $13.37 for 1 liter, a significantly higher cost than Wormcid, and more than half the going rate to purchase a goat at the time interviews took place.

minimal use of vaccines at these ranches is based on economics, rather than on cultural or social resistance.

Disease Significance by Domestic Animal Species

Without question, if residents had been asked to name the most consequential diseases for each of the domestic species in their herds, the list and rankings would have likely differed quite dramatically by species. It is reasonable to conclude that CCPP's ranking is related to its virulence, but also to the prominence of goats on community lands. Consequently, for many families, losing most goats is equivalent to losing most of the herd.

Maasai have a long history and tradition of cattle ownership. Indeed, more than once residents of Ilmotiok and Tiemamut described themselves and other community members as "cattle people." This would seem to help explain why, despite the capacity of certain diseases to significantly constrain cattle production, residents of the community lands continue to strive to include cattle in their herds.

CCPP is a different story altogether. The devastation that it causes raises the question of why, if the disease is both so significant and exclusive to goats, goats dominate these community lands. Answers to other survey questions, combined with less structured conversations, provide a few plausible explanations. First, goats are observed to fare better than both sheep and cows in drought, which some persons described as by itself being the most severe "disease" in terms of its toll on animals. Goats are better able than other domestic animals both to withstand constrained water and food intake and to escape disease during dry seasons. Consequently, it is reasonable to assume that while large numbers of goats can be quickly eliminated by CCPP, from the perspective of vulnerability to drought, they are a wise choice.

Goats also present a lower investment and thus lower risk. The amount of capital invested in each goat is significantly less than that invested in other species. During a relatively dry stretch on northwest Laikipia's pastoral lands, healthy female cows were selling at market for upwards of 40,000Ksh, or approximately US$445. Sheep were being sold for between 5,000 and 6,000Ksh, or in the US$55 to $66 range. Goats were about one-third that price, selling in the range of 2000Ksh, or US$22 (personal communication, Nicholas Piyiet, July 5, 2011). Not only are they the most affordable species to populate a herd at this time and place, but they also represent a much smaller economic loss if and when the animal dies. With drought and disease posing both major and, it seems, increasingly unpredictable threats to pastoral production in this region, investing less in each animal seems to make good economic sense. In fact, what has been titled a "small stock strategy," particularly among poorer pastoral households and within the constraints of changing socioeconomic and environmental conditions, has been cited in literature about other pastoral communities, particularly those perpetually vulnerable to severe drought (see, e.g., Hary, 1999; Mworia and Kinyamario, 2008).

Disease and wildlife

Several questions were asked to gauge how Ilmotiok and Tiemamut residents view the relationships between wildlife and livestock disease. As discussed above, the most severe disease, particularly among goat herders, CCPP, was not attributed to wildlife. Instead, interviewees accurately viewed it as primarily the result of infection in other domestic goats. Opinions on the cause of anaplasmosis were mixed; several respondents attributed it to wildlife, including the ticks carried by wild species. However, this was not the dominant explanation; the disease was most often attributed to the rainy season and periods when animals, particularly

cows, are "healthy." If parameters are expanded beyond the most consequential diseases, however, wildlife appears more prominently in peoples' understandings and beliefs. Across both ranches, 87.5 percent of respondents believed that wildlife play a role in livestock disease.

Anaplasmosis and symptomatic anthrax were the diseases most commonly listed as having origins in wildlife, with more individuals associating anaplasmosis with wildlife in response to a question about diseases caused by wildlife than when asked more generally to name the cause of the illness (see Table 6).[22]

	Frequency of mention		
	Ilmotiok	**Tiemamut**	**Group ranches combined**
Blackquarter/Symptomatic anthrax	16	7	23
Anaplasmosis	9	11	20
Lumpy skin disease	3	4	7
Tick-borne diseases (general)	4	--	4
Enterotoxaemia	1	1	2
Foot-and-mouth disease	1	1	2
CCPP	3	--	3
Rinderpest	2	--	2
Diarrhea	2	--	2
Heartwater/Theileriosis	--	1	1
East Coast fever	--	1	1
Mange	1	--	1
Unknown (*Osaara*)	1	--	1
Unknown *(Nado Tolit)*	--	1	1

[22] Anaplasmosis was mentioned in association with wildlife in participant responses to two pairs of questions. First, respondents were asked to name "the five animal diseases that have had the biggest impact on your family in the past 10 years" and to cite how they thought animals "get sick from these diseases." Further into the interview, they were asked to answer the question "Do you think that wildlife ever make your animals sick?" and, "If yes, what diseases do you think that wildlife give your animals?" More people stated that wildlife cause disease in response to the second question pair than the first. Specifically, six individuals did not name wildlife as the cause for anaplasmosis in the first question pair but mentioned anaplasmosis as a disease caused by wildlife in the second pair. There are several possible explanations for this disparity. Individuals may have viewed other factors as more significant causes of anaplasmosis, but nonetheless still believe that wildlife have a role—hence naming anaplasmosis in response to only the second questions. Although the survey was crafted to avoid "lead-in questions" and bias, it is also possible that respondents felt that the survey and/or interviewer wanted them to provide a particular answer, and that they responded accordingly.

Table 6: Diseases and medical conditions attributed to wildlife.

Elephants, Cape buffalo, and zebra were most often cited as being culpable for the transmission of disease to domestic livestock, followed by gazelle and rats.[23] Elephants were mentioned by 28 respondents as causing livestock illness; zebra, by 19 respondents, and buffalo, by 18. Gazelle and rats were mentioned six times each (see Table 7). Interestingly, the major species held accountable for transferring disease were proportionally quite different on the two ranches. Greater percentages of Ilmotiok residents charged both elephants and Cape buffalo with causing livestock illness, while a greater proportion of Tiemamut residents saw zebra as the offending species. There were also some variations in proportions of animals associated with specific diseases. Most notably, relative to other species and other diseases, zebra were very often cited as causing anaplasmosis—a reasonable association given that zebra were also associated with ticks (see below).

	Frequency of mention		
	Ilmotiok	**Tiemamut**	**Total**
Elephant	22	6	28
Zebra (non-species-specific)	10	9	19
Buffalo	14	4	18
Gazelle	3	3	6
Rat	5	1	6
Wild dog	3	--	3
Eland	2	1	3
All wildlife	3	--	3
Giraffe	2	--	2
Rhino	2	--	2
Hyena	1	--	1
Waterbuck	1	--	1

[23] Plains zebra and Grevy's zebra are both common to Laikipia and seen on group ranches. However, for the purpose of this question, residents were not asked to specify zebra species. The minimal number of people who *did* name a species attributed disease to plains zebra. The same is true for gazelle; Grant's gazelle and Thomson's gazelle are both present in the communities, but residents did not specify whether one species is more at fault for transferring disease.

Tortoise	--	1	1
Hare	--	1	1

Table 7: Wildlife species reported to cause disease in domestic animals

Elephants. Across both communities, elephants were associated with a variety of domestic animal illnesses, including blackquarter, anaplasmosis, lumpy skin disease, mange, (bloody) diarrhea, and the unknown disease *osaara*. Reasons given for the associations were similarly numerous. Several individuals from both communities associated disease with elephants' ubiquity on group ranch lands. Some people noted not only their current population numbers, but also the fact that their populations have increased the most of any animal in the area (discussed below). (See Table 8.)

Means of disease transfer	Frequency of mention
Contaminate water that domestic animals drink. Methods of contamination cited: urine, feces, stepping in, spending time in, lying in.	10
Contaminate grass that domestic animals consume. Methods of contamination cited: urine, feces, stepping on.	7
Graze with and/or come into close contact with domestic animals. Includes destroying trees consumed by goats.	5
Large populations. Higher numbers of animals yields a higher potential for disease transfer.	5
Close contact with domestic animals for reasons other than grazing; includes destroying trees that goats consume.	4
Carry ticks. Ticks transfer disease to domestic animals.	3
Migrate long distances. Bring disease through migration.	1
Use trees for scratching. Scratching leaves Lumpy Skin Disease for domestic to contract.	1

Table 8: Explanations for citing elephants as causing disease in domestic animals.[24]

[24] The frequency denotes the number of individuals who cited a given cause for disease transfer, and several persons listed more than one reason for citing elephants as causing disease. Consequently, frequency of mentions is greater than the total number of respondents who listed elephants as causing disease.

The main modes of transmission cited were water and grasses, with most respondents providing explanations that revolved around these two resources. The animals' connection to water was seen as a primary source of risk due to the fact that elephants, often due to their affinity for mud, were considered "dirty" animals who also produce highly acidic urine. Elephants were seen as contaminating water resources with urine and, to a lesser extent, feces. This ability to contaminate water was compounded by the quantity of time spent in water; as one elder female resident of Ilmotiok stated, elephants "like to play in water and spend a lot of time there." Most likely, the perception that there are many elephants, mentioned by five individuals, is viewed as compounding the consequences of the species' capacity to contaminate water.

The theme of urine extended to resources besides water. Urine was also seen as posing a threat to livestock in grazing areas. Seven respondents mentioned that elephants' urine contaminates grass that livestock consume. The perceived consequences of urine and contamination of grasses are exacerbated by the fact that elephants graze in close proximity to domestic animals, a response reported by five individuals.

While water and grass were mostly commonly seen as mechanisms of disease transmission by virtue of bodily fluid transfer, several other viewpoints were also offered. One person commented that elephants go to "far away places" and bring back diseases. Goats also eat from the same trees that elephants consume and "destroy," and they are perceived to contract disease through this shared food source. This relationship, whereby elephants knock down trees whose leaves goats later browse, was mentioned frequently, in some cases for its disease potential, and in many more as an example of the broader damage that elephants cause on group ranch lands.

A small number of people cited ways in which elephants transfer individual diseases to livestock. In particular, respondents noted that elephants spend significant amounts of times scratching or rubbing against trees. They posited that when cattle scratch those same trees, they can contract lumpy skin disease. In addition, an elder woman from Tiemamut recounted the story of when, during a "very dry season, elephants had *olbus* [entertoxaemia] and died everywhere, every day for 3 months. Elephants would come to a watering hole and then die; livestock would drink from the watering hole and get sick."

Cape buffalo. Cape buffalo were viewed as capable of transmitting a wide variety of diseases, including anaplasmosis, blackquarter, contagious caprine pleuropneumonia, rinderpest, and lumpy skin disease. This is in part because, like zebra and, to a lesser extent gazelle, buffalo are viewed as significant carriers of ticks. One person reported that buffalos in particular carry "big" ticks. Ticks, in turn, are widely understood to bite livestock, "exchange blood," and transmit disease—hence the use of acaricidal sprays. This association separates both buffalo and zebra from elephants; only three people viewed the latter species as carrying ticks.

Although ticks were mentioned frequently in association with buffalo, they were by no means the only reason provided for why cape buffalo pose a risk to livestock. As with elephants, buffalo were viewed as spending more time in water than other species. Respondents variously reported that buffalo sleep, urinate, and defecate in the same "stagnant" water that livestock must drink, and as such they make water "dirty." Others simply called buffalo "dirty" animals, the description also used for elephants. Buffalo were also commonly viewed as having highly acidic urine, more so than that of other species, which contaminates grass as well as water. Buffalos' act of urinating in grass consumed by livestock was commonly noted as a cause of disease

transmission. Further similarities between buffalo and elephant include the fact that buffalo are perceived to migrate long distances and "go wherever they want," oftentimes bringing back diseases, and that they are very "strong" animals. Moreover, buffalo are viewed as coming closer to domestic livestock than other wildlife species, a behavioral characteristic mentioned by multiple respondents. In describing why the species transfers rinderpest, an elder female additionally mentioned that buffalo, along with eland, are in the same family as cattle.

Zebra. With one exception, every person who mentioned zebra associated the species with causing blackquarter and anaplasmosis, or a broader range of tick-borne diseases. Although a higher proportion of Tiemamut residents than Ilmotiok cited zebra as causing disease (40.9 percent versus 23.9 percent, respectively), there was no notable difference between communities in why residents believed that zebra are culpable.

Several reasons provided for viewing zebras as the source of disease overlap with the reasons given for the prior two species. As is the case for buffalo, zebra are perceived to attract ticks. "Ticks like zebras," one person commented, and the animals "drop" those ticks in the grass to be picked up by domestic animals. Like elephants, zebra populations were widely reported to have increased, and the ungulates are often seen in large herds. Numbers, concentrations, and population increase are all reasonably viewed as posing an increased threat to livestock. Like elephant and buffalo, they are viewed as migrating long distances and both grazing and sharing water with livestock. Though not emphasized to the same extent as with elephant and buffalo, zebras' urination in water sources for domestic animals was, indeed, mentioned.

Gazelle. Gazelle were mentioned six times as causing disease in domestic animals. One person noted that gazelle die in the "bush" and speculated that disease was the cause of death; she extrapolated that if they are dying of disease, then the fatal condition can be transmitted to domestic animals. With this one exception, however, everyone associated gazelles with transferring ticks to livestock, particularly because they are also reported to overlap significantly with domestic species when grazing.

Rats. Like gazelle, rats were mentioned six times as causing disease, albeit more commonly by Ilmotiok residents. Their urine was uniformly viewed as the cause of disease in domestic animals; it was particularly associated with blackquarter. As with buffalo and elephant, rat urine is viewed as acidic, and the animal as dirty; in fact, rats were never listed singly, but rather in addition to these two species and, in some cases, to zebra. As one individual noted, the "urine of these animals has lots of acid; they are dirty animals. Wildlife and livestock consume the same water." Two individuals additionally noted that if livestock are near rat feces, than they will contract blackquarter.

Predators. Predators were, interestingly, largely absent from the list of species known to cause disease in livestock, and entirely omitted from Tiemamut residents' list of perpetrators. Hyenas received only one mention; the species was listed with elephants as "making water dirty," and it was named because the respondent, a resident of Ilmotiok, has seen both species entering water. Wild dogs, mentioned three times, were seen as transferring disease because they "like to spend time" near water shared by livestock. Lion, leopard, cheetah, and jackal were entirely absent from the list.

Disease transfer from domestic animals to wildlife

When asked if disease can be transmitted from domestic animals to wildlife, the level of certainty regarding interspecies transmission dropped substantially, to three of 64 respondents (4.7 percent), all from Ilmotiok, and all of whom *also* believed that wildlife have the capacity to transmit disease to livestock. An elder male believed that "*Oldua* [rinderpest] is the only disease that is spread in both directions." The other two respondents, both young men, believed that the CCPP can be transmitted from livestock to wildlife. One man suggested that if a goat with CCPP grazes and drinks water with wildlife, the domestic animal can make wildlife sick; the other viewed urination "in the bush or grass" as the means of transmission, and dik-dik and gazelle as more susceptible because they "feed in one place" with domestic animals. The importance of urine was also posited by another Ilmotiok youth who was unsure about disease transmission from domestic to wild animals. He suggested that disease transfer *could* occur "if no one is taking care of domestic animals and they get out and urinate." One male elder from Ilmotiok noted that while he did not know about disease per se, he did believe that ticks could be transferred in both directions between domestic and wild species.

Remaining respondents stated either that no, disease transmission could not take place from livestock to wildlife, or that they did not know. Explanations for believing the former revolved around the care provided livestock as distinct from wildlife. One elder male from Ilmotiok suggested that wildlife make livestock sick because "there is no person to look after wild animals"; an elder male from Tiemamut focused on why domestic animals are *not* culpable: "domestic animals are washed with dips and given medicine so that they cannot make wildlife sick." Those who did not give a definitive answer generally stated that they do not have a close enough relationship with wildlife to answer the question definitively:

- *I do not care for wildlife—how would I know?* (Female youth, Ilmotiok)
- *It is difficult to see wildlife. How would [disease] get transmitted?* (Female elder, Ilmotiok)
- *When a wild animal has died, you don't know from what disease because no one is taking care of them. You therefore cannot identify the specific disease or cause.* (Male elder, Ilmotiok).
- *I have not seen evidence.* (Male elder, Ilmotiok)
- *Wildlife are in the bush, and I cannot see diseases* (Female youth, Ilmotiok).

Perceptions versus scientific evidence

Many of the diseases mentioned by pastoralists are indeed ones that have been formally diagnosed in both domestic and wild animals. Anaplasmosis infection and subclinical infection have been detected in a wide variety of wildlife species, including but not limited to Cape buffalo, plains zebra, Thomson's and Grant's gazelles, eland, and impala (Ngeranwa et al. 2008). A recent study found *Anaplasma* antibodies in many of these species, as well as domestic animals (cattle, sheep and goat) in areas of Kenya that have significant interface between wildlife and domestic species; as mentioned above, plains zebra were found to have an extremely high seroprevalence, at 72.7 percent (Ngeranwa et al. 2008). Although the infection itself is vector-borne, there is little question that close interaction of wildlife and livestock can aid in transmission of the pathogen.

Blackquarter is known to be most common to cattle relative to other domestic species; it is believed to be contracted orally when animals consume spores from contaminated pastures (Bagge et al., 2009; Merck, 2005). There is limited information on the disease and the causative

pathogen, *Clostridium chauvoei*, particularly in the context of rural Kenya. What is known is that in one area of neighboring Uganda, where a national park was surrounded by cattle ranches, endemic blackquarter was found to infect cattle, impala, and eland (Ocaido, 1996). Consequently, while blackquarter is not a directly transmittable disease, it cannot be ruled out that spillover occurs between wildlife and domesticated taxa.

Several of the less oft-mentioned diseases are also associated with wildlife. Although questions remain about wildlife species as maintenance hosts of lumpy skin disease, it is indeed caused by a virus that has been found to infect buffalo, impala, and giraffe (Hunter and Wallace, 2001). Foot-and-mouth has been found to infect at least 70 species of wild animals, including many of the species found in Laikipia (Aftosa, 2007).[25] Cape buffalo are a confirmed maintenance host (Thomson, 1995). African elephants are not considered susceptible under natural conditions, although they *have* been infected in zoos, meaning that there is potential for them to play a role in transmission (Aftosa, 2007). Heartwater and East Coast fever have been widely recognized as having both domestic and wild animal hosts, as have several other tick-borne diseases found in the region (Peter et al., 2002; Wambwa, 2005).

When considering attitudes toward both domestic and wild species, however, there is a strong argument to be made that the "actual" epidemiology and pathology of disease matters less than what is observed. And what is observed on the community ranches, and the conclusions that are reached from those observations, tend to make intuitive sense. Interviews with members

[25] It is important to note that while foot-and-mouth disease has been identified in at least 70 species, including wildlife found in Laikipia, this does *not* mean that all species are epidemiologically important in disease maintenance or transmission to other wild or domestic species. In the discussion of pastoralists' perceptions of disease, the breadth of species susceptible to foot-and-mouth infection is primarily important insofar as if a person sees a wild animal with foot-and-mouth symptoms, he or she might assume that the species is capable of infecting domestic animals.

of these two communities suggest that wildlife species' perceived attractiveness to ticks contributes to whether a particular species is perceived to transmit disease to domestic animals. Research conducted in the region indicates that zebra and Cape buffalo most definitely carry large numbers of ticks compared to fellow wildlife species. This is not necessarily the case for other species seen by pastoralists to have a high tick burden. Gazelles have been found actually to have a relatively low tick burden in studies in Kenya and Tanzania (see Fyumagwa, 2007; Olubayo, 1993). However, respondents reported them to come into contact most with domestic animals (see below). If domestic animals show signs of disease after grazing with gazelles, it is not unreasonable to assume, by process of elimination, that gazelle are carriers of ticks. Indeed, respondents made this claim a handful of times.

Perceptions of disease transferred from elephants have less biological substantiation. To be sure, elephants in Kenya have been found to carry parasites, which domestic animals could contract (McLean et al., 2012; Obanda, 2011). However, it appears that more often than not, attribution of disease to elephants is based more on reasonable associations than epidemiological data. Historically, both Ilmotiok and Tiemamut residents have relied for water for their domestic animals on the Ewaso Ng'iro River. If domestic animals (and humans) suffer health consequences and consume river water daily, and if elephants in particular are found not only to spend a lot of time in the river, but also to urinate and defecate in it, it is reasonable to associate this species with disease. If elephants' urine and feces are viewed to cause problems in water, it stands to reason that they would cause problems in grass and grazing areas as well.

Association of elephants with skin diseases, including lumpy skin disease and mange, may be at least in part explained by the fact that elephants *do* frequently come into physical contact with trees. In addition, a study in a nearby district in Kenya found that respondents

named mange *lotome*, after the elephant, because the skin of a mange-infected goat thickened like that of an elephant (Bett et al., 2008). It appears as though this is also true for the resident of Laikipia who described *lotome* to be a skin disease caused by cattle scratching against trees shared by elephants.

Although many explanations of disease are substantiated by veterinary literature or can be explained by very reasonable and rational associations, there is aversion to certain species, particularly elephants, but also zebra, that is not attributable to disease but which may contribute to these species being blamed for causing illness among domestic animals. Particularly for the former species, it is reasonable to assume that more general problems contribute to assertions about the animals' disease threat. This is described further below and discussed in the conclusion.

Experiences with wildlife

Beyond gauging perceptions of wildlife disease, interviews were designed to explore the place of wildlife disease in the context of human-wildlife interactions or, at the very least, reasons for attitudes toward wildlife. Questions therefore explored wildlife population trends, experiences with wildlife, and thoughts about living in a community where wildlife and livestock come into regular contact.

Wildlife trends

Wildlife populations. An overwhelming number of respondents (59 of 64, or 92.2 percent) reported that numbers of wildlife have increased on their land. When asked which species has gone up most in number, the answer was overwhelmingly the elephant in both

communities (see Figure 7). This species was mentioned by 83.0 percent (39 of 47) of individuals asked to name the species that had increased, including 19 residents of Ilmotiok and 20 of Tiemamut.[26] The next most often mentioned animal was the zebra, specified as plains zebra by one individual, which was mentioned by eight of 47 respondents (17.0 percent).[27] Additional species mentioned as having increased in population include the wild dog (one Tiemamut resident), hyena (one Tiemamut resident), gazelle (two Ilmotiok residents), and dik-dik (one Ilmotiok resident). Six of 47 persons (12.8 percent) declined to provide an answer or stated that they did not know. A small handful of individuals also offered unsolicited insights about species that have been lost on the community ranches, including lions ("lions are no longer in the area"), rhinoceros, greater kudu, oryx, Jackson's hartebeest, and waterbuck, and giraffe. Giraffe in particular were said to have "gone to far places" within the district, away from community ranches.

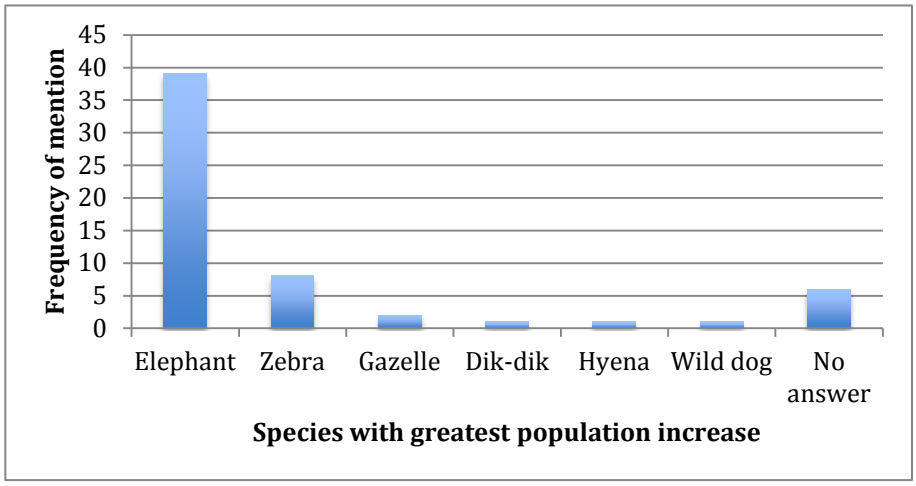

Figure 7: Wildlife species viewed as having the greatest populations on group ranch lands.

[26] The question was not asked of individuals during the first interview set at Ilmotiok. Consequently, N=47.

[27] Some individuals named both elephant and zebra as increasing in number. Consequently, the total number of animals named exceeds the number of respondents.

Explanations for wildlife increases were exceptionally wide-ranging. Though respondents were not specifically asked *why* they thought wildlife populations were increasing, many gave unsolicited answers. Several made comments similar to that of one Ilmotiok resident: her community is now "keeping wildlife like they're keeping livestock." Other residents mentioned increases associated with the communities' relatively recent wildlife conservancies, with one elder female additionally noting that these conservancies have "employed some people from communities to look for wildlife so that you cannot try to kill one." A decrease or elimination of hunting and consuming wildlife was also often mentioned; one person, a male elder from Ilmotiok, expressly viewed this shift as changing populations of elephant: "You can now get an elephant with three children, whereas before you would only have an elephant with one offspring because people would kill and eat wildlife." Several individuals from both Ilmotiok and Tiemamut additionally noted that hunting made wildlife "fear" group ranches; once hunting decreased, wild animals began to return.

Contact between domestic animals and wildlife. During the course of the interviews, residents of the two group ranches were asked the related question of whether their animals spend more, less, or the same amount of time near wildlife now in comparison to 10 years ago. Examples included, but were not limited to, sharing water, grazing, and predation. Thirty-nine of 64 respondents (76.6 percent) stated that their animals presently spend more time with wildlife than a decade prior; the responses were proportionally similar across the two group ranches. Twelve of 64 respondents (18.8 percent) felt that their animals spend less time near wildlife today, with a higher proportion of Tiemamut than Ilmotiok residents choosing this answer (22.8

percent and 16.7 percent, respectively). Three respondents (4.7 percent) felt that amount of wildlife-domestic animal contact has remained the same.

The explanations for increases in contact between wildlife and domestic animals mirrored the reasons given for absolute increases in wildlife numbers. References to historic practices of hunting and eating animals were common; they were contrasted with the present use of wildlife for tourism. An elder male member of the Ilmotiok community stated that "Ten years ago people killed wildlife for food, but now we are trying to conserve them for tourism, so wildlife have now almost come to be friends." Additional residents framed the reduction in hunting as a result of the consequences if caught:

- *People used to hunt and eat wild animals, [but they] no longer do this because of KWS and conservancies; they would get into trouble.* (Female elder, Ilmotiok)
- *More now because killing no longer happens. The government will jail people for killing and because they are keeping wild animals for tourism.* (Male youth, Ilmotiok)

As with the previous question about absolute changes in numbers, reductions in the fear that wildlife have of people was mentioned, as was the role of conservancies in attracting animals.

There was some discrepancy in respondents' perceptions of the amount of time their animals spent in proximity to wildlife (76.6 percent reporting an increase) and their perceptions of the increase in numbers of wildlife on the community lands, where fully 92.2 percent have observed an increase. Even as conservancy land draws animals onto the ranches, respondents also indicated that it may be drawing wildlife away from some of the land areas used for domestic animals and grazing. Among those individuals who explained why they thought time their domestic and wild animals spent together had decreased, a number attributed the decrease to the surrounding conservancies, with one person mentioning the fact that salt licks in the

ranches' conservancies are used to attract animals, which draws them away from grazing lands. Following the reasonable assumption that wildlife prefer conservancies, and therefore that conservancy land shifts the distribution dynamics of wildlife on group ranch lands, it is quite possible that a person's particular location within a group ranch could affect his or her contact with wildlife, with those persons who live and herd animals closer to conservancy land or on migration corridors having different experiences with wildlife than their counterparts in other areas of the community.

Even if conservancies are perhaps influencing wildlife distribution, and therefore contact between domestic animals and wildlife, there is no question that absolute measures of contact between wildlife and domestic animals are high. The majority of respondents (55/64, 86.0 percent) said that their domestic animals come into contact with wildlife on a daily basis; as a group of three women from Tiemamut commented, this is because "we now keep wild animals like cows." Several other respondents offered further details on why they gave this answer. Six of 64 respondents (9.4 percent) mentioned variability, often related to the season. In fact, the majority of respondents (41 of 64, or 61.4 percent) asserted that contact between wildlife and livestock is at its highest during the rainy months, primarily because wildlife spend more time on community lands.

When residents of group ranches were asked the species of wildlife with which their domestic animals most often come into contact, gazelle and elephant topped the list with 30 and 23 mentions, respectively. These species were followed by zebra, cited by 16 respondents, and dik-diks, with half as many mentions (see Table 9). In nearly all instances, respondents identified these wildlife species through seeing them graze with their own animals. Rationales for naming elephant aligned with answers to several other questions. The dynamic exclusive to

elephants and goats, wherein “goats run to eat from broken trees that elephants knock down,” as one female resident of Ilmotiok explained, was reiterated by several individuals and formed the basis for the claim that the elephant is the wild species that most often comes into contact with their own animals. Another young female resident of Ilmotiok explained that contact is mostly between livestock and elephant because elephants are “big, brave, strong, not afraid of livestock, and will go wherever they want.”

The most striking species on the list, however, is gazelle. Not only were they mentioned by the most people as most frequently coming into contact with livestock, but unlike elephant and zebra, they had not had a prominent place in answers to other questions. Whereas elephants and zebra were mentioned often in responses to questions about disease transfer and “problem” wildlife (discussed below), gazelles were mentioned infrequently, particularly compared to fellow wildlife species.

In this same vein, the total absence of buffalo on this list was striking, a result inconsistent with the fact that the species was widely referenced across both communities as a cause of disease. No respondents mentioned it as a species with which their domestic animals spent the most time; it was also not among species cited as increasing in number or frequency of interaction with domestic animals on group lands; and it was mentioned only infrequently as an animal that causes the most problems for residents of the group ranches. This points to the fact that this species is found relatively infrequently in pastoral communities, something corroborated by two interpreters for the study, but leaves unexplained the stated perceptions of disease causation.

	Frequency of mention							
	Gazelle	**Elephant**	**Zebra**	**Dik-dik**	**Hare**	**Giraffe**	**Jackal**	**Small WL**
Ilmotiok	15	17	10	5	2	1	--	1

Tiemamut	15	6	6	3	2	--	1	--

Table 9: Wildlife species that come into contact most with domestic animals

Predation

Predators are notably absent from responses to questions about both disease and contact between domestic animals and wildlife. When asked specifically about carnivores, however, respondents had significant insight into the species and seasonality of predation.[28]

Hyenas were cited most frequently, 35 times, as killers of livestock (see Table 10). Leopards were mentioned 17 times, followed by wild dogs, mentioned by seven individuals.

More than with other questions, striking themes emerged when respondents discussed predation of their domestic animals. First, variations between ranches were more obvious in the answers to this question than in the answers to others. Whereas 14 of the 25 Ilmotiok residents (56.0 percent) who answered this question mentioned leopards as a frequent killer, only three of 22 Tiemamut residents (13.6 percent) said the same. Wild dogs also resulted in significantly different responses at the two ranches. Only one Ilmotiok resident mentioned this species (2.4 percent of respondents), in contrast to six of 22 Tiemamut residents (27.3 percent). While it is possible that the rate of leopard and wild dog predation varies drastically between the two communities, it seems likely that communication among residents of group ranch villages may also contribute to perceptions of which wildlife is most destructive. Among the six residents of Tiemamut who mentioned kills by wild dogs, only one person, an elder female, indicated that she had actually seen a kill: “wild dogs try to chase gazelles and then come into boma and take domestic animals.” Everyone else commented that they see and hear the animals nearby, but

[28] This question was not asked of the first cohort of interviewees at Ilmotiok.

they did not report incidents in which the presence of wild dogs actually translated to kills of domestic animals.

Lions were virtually absent in reports of predation. Only one resident, a young male from Ilmotiok, mentioned the species. He mentioned lions alongside leopards and cheetah, giving a relatively vague reference to their killing of livestock: he "identifies animals through sight; if the animal has killed and run away, they will see the tracks." This aligns with lion conservationists' arguments that lions spend little time on group ranch lands.

	Frequency of mention						
	Hyena	**Leopard**	**Wild dog**	**Cheetah**	**Jackal**	**Lion**	**Elephant**
Ilmotiok	20	14	1	1	2	1	1
Tiemamut	15	3	6	2	1	--	--
Total	**35**	**17**	**7**	**3**	**3**	**1**	**1**

Table 10: Predators that kill the most livestock

Reasons for avoiding wildlife

Respondents were asked if they avoid wildlife due to fear of disease.[29] The majority of respondents (29/47, or 61.2 percent, divided almost equally between residents of Ilmotiok and Tiemamut, at 15 and 14, respectively), said that they do not avoid and will allow livestock to mix, graze, and drink water with wildlife. Many peoples' answers reflected a concession to the reality of raising livestock. Several people, residents of both group ranches, mentioned that they allow livestock to eat and drink with wildlife because "wherever you go, you'll find wildlife" and "wildlife are everywhere." A resident of Tiemamut specifically noted that this was the case at the dam, a key location for obtaining water. One young woman, a resident of Ilmotiok, simply said that "you cannot fear; you just go and need to be prepared." One person, an elder female from Tiemamut, specifically noted the benefits of going "where elephants have been" because

[29] The question was not asked of the first cohort of respondents.

"they knock down trees and create food for livestock," particularly goats (browsers). This relationship between elephants and goats was mentioned at many points throughout interviews, in both positive (elephants give goats access to food that they otherwise would not be able to reach) and negative (elephants destroy trees, *even though* they make food accessible to goats) contexts.

An additional ten individuals (21.3 percent), also relatively evenly divided between ranches, stated that they will avoid only elephants, a behavior connected in one instance to the belief that elephants "carry disease" (elder male Tiemamut resident), but in most instances to recognition that elephants can endanger and kill both humans and domestic animals. Many of the individuals who said that they avoid elephants specifically noted that they will allow their animals to graze with gazelle, zebra, and other ungulates.

Six individuals, all residents of Ilmotiok and equally divided between genders, said that they do take active measures to avoid wildlife. Three individuals specifically noted avoidance of places with both water and wildlife; a member of the male youth set noted that this is because the "watering place…is more dangerous than the feeding place." One woman noted that she "will change direction because you feel scared." Again, this avoidance seems more a function of fear of bodily harm than of disease.

Problems with wildlife

When asked to name problems with wildlife, elephants topped the list. Over 70 percent of respondents (45 of 64) mentioned the species. Their damage to, even complete destruction of, trees and bushes was mentioned often (17 times). So, too, was their capacity to transmit disease to domestic animals and, in one instance, people, oftentimes by virtue of contaminating water

(12 mentions). This is an unsurprising response in light of respondents' answers to aforementioned disease-specific questions. The potential for disease transmission, however, pales in comparison to the most dominant theme: the fear that elephants instill in people, and the extent to which elephants disrupt critical daily activities. Indeed, fear was referenced by 35 of the 45 individuals who included elephants in their discussions of problems with wildlife, prompted by the fact that, as one female elder from Ilmotiok stated, "If you take animals to the bush, you run into elephants."

The likelihood of bodily injury and even death was the main cause of fear that people cited; "fear" of the species was never attributed to disease. "They come in large numbers and inevitably kill people and even livestock," explained one elder male resident of Tiemamut. Two residents provided specifics about frequency. An elder female from Ilmotiok proposed that elephants "bring fear because people do not want to walk in their presence. They also kill people about once per year. They move north in October and return in March [or] April and kill people." An elder female from Tiemamut suggested that the "frequency of killing [by elephants] varies—in some years, people will be killed; in others, they will not."

Fear of coming into contact with elephants was mentioned as having particular impact on the ability to collect firewood and water, as well as to graze livestock. A handful of people noted that the presence of elephants leads people to leave their livestock alone in the bush: "Livestock are alone in the bush because people fear elephants," one male elder from Ilmotiok commented; a youth from the same community stated that "Elephants chase people and prevent owners from watching over their livestock." Lack of close supervision no doubt increases the likelihood of livestock being hunted by predators. The effect extends to the youngest generation, one person

commented, as “children do not go to school because of the elephants.” Another added that elephants “come to chase children when they are fetching water.”

Although elephants were cited as the major cause of both fear and more general wildlife oriented problems, other species most definitely made it onto lists of problem animals; 21 of the 64 respondents (32.8 percent) mentioned species other than elephant. Buffalo were put in a similar category as elephants in terms of threatening people with bodily harm, a trend that is borne out in statistics about human fatalities in the area. Nonetheless, they were mentioned only three times as problem animals, and one person explicitly said that “elephants scare people more than buffalo”; this can perhaps be attributed to the fact, as noted above, that buffalo spend relatively little time on community lands, particularly as compared to nearby private ranches.

Hyenas were mentioned as “problem” animals six times, five by Ilmotiok residents and once by a resident of Tiemamut, due to their killing of domestic animals, and particularly goats, while lions were also mentioned six times. The parity between hyenas and lions is interesting, given that hyenas were identified 35 times more frequently as the species that killed the greatest number of pastoralists’ animals. It is possible that lions were mentioned as “problem” animals because of a history among Maasai males of hunting lions as part of initiation into manhood—a tradition that was mentioned a handful of times during the course of interviews and conversations with both Ilmotiok and Tiemamut residents—or because of the aura that surrounds them as killers of humans as well as domestic animals, a perception explicitly noted by two respondents.

General damage of resources was mentioned by 25 of 64 respondents (39.1 percent). Most often this was associated with elephants damaging trees, mentioned by 18 people, including every one of the nine Tiemamut residents who mentioned destruction of resources.

This category also included, however, mentions of dirtying water consumed by both livestock and humans and of elephants and zebra consuming grass and trees that might otherwise be consumed by livestock such that "livestock don't have enough food."

Disease and health were mentioned by 15 of 64 individuals (23.4 percent). Specifics were the same as those provided in questions oriented specifically toward disease: wildlife, particularly elephants, contaminate water by stepping in, urinating in, and generally making it "dirty"; wildlife transmit disease through close proximity during grazing and "because animals are nearby now"; and wildlife spread ticks to domestic animals.

Finally, eight people, seven of whom were residents of Tiemamut, mentioned having no major problems with wildlife.

Is it good or bad to keep wildlife with livestock?[30]

Eight residents of Ilmotiok, and six from Tiemamut, were unequivocally and vocally opposed to the current state of free-roaming wildlife in community ranches. The majority of these individuals viewed fencing, particularly of "dangerous" animals, as an acceptable solution:

- *Fence animals so that people can go where they want*. (Female, age unknown, Ilmotiok)
- *Fencing dangerous animals is okay.* (Female youth, Ilmotiok)
- *Ilmotiok has created a conservancy; it would be good to put the animals inside a fence.* (Female elder, Ilmotiok)
- *Fence animals to reduce diseases and keep them from destroying trees.* (Male elder, Tiemamut)

[30] Those who took part in the pilot survey were not asked this question.

An additional 26 individuals, including 10 from Ilmotiok and 16 from Tiemamut, provided answers that suggested resignation about the current situation with wildlife, be it because of the group ranches' efforts to draw in wildlife or because of the repercussions of killing them. Although a higher proportion of Tiemamut residents expressed this sentiment of resignation, the explanations provided were similar among residents of both group ranches:

- *There is fear, but you cannot do anything. Consequently, you allow [wildlife and domestic animals] to stay together*. (Male youth, Ilmotiok)
- *I feel bad but cannot do anything because [wildlife] are bringing money to the community*. (Male youth, Ilmotiok)
- *I cannot say anything because Ilmotiok has the responsibility to look after all animals*. (Male youth, Ilmotiok)
- *[We] cannot do anything about wildlife at Tiemamut so allow them to stay together with livestock*. (Female youth, Tiemamut)
- *No alternatives. If you kill animals you get in trouble, so you allow animals to mix*. (Female youth, Tiemamut)
- *Cannot do anything. Wildlife are more important than people because they create jobs*. (Male elder, Tiemamut)
- *No alternatives. You keep wildlife for tourists*. (Female elder, Tiemamut)

Meanwhile, six individuals, all from Ilmotiok, provided answers that seemed to reflect some degree of positive sentiment about "keeping" wildlife, without reference to their absence of choice or agency about the issue, or to the consequences that would befall them if they were discovered taking action against wildlife. All responses revolved around the economic returns of wildlife and included:

- *[We] keep them in order to gain profits from ecotourism.* (Female elder, Ilmotiok).
- *[Keeping wildlife] is good because it brings tourists and money to the community*. (Male elder, Ilmotiok).
- *[We] look after wildlife because conservation areas bring money to people*. (male elder, Ilmotiok).
- *With conservancies, wildlife go everywhere. This is good, because it brings tourists*. (female youth, Ilmotiok).
- *I do not fear disease, so it is okay to have wildlife mixed [with livestock] because both bring money*. (Male elder, Ilmotiok).

These sentiments revolve around the economic benefits of wildlife generated by tourism. Given the potential adverse impacts of wildlife, it is not at all surprising that no one expressed the desire to keep wildlife on their land without any return for doings so. This places immense pressure on ecotourism to deliver the anticipated economic benefits, particularly if the wildlife being conserved are viewed as causing economic consequences in addition to disruptions of residents' daily lives.

Section IV
Conclusion

This research sought to understand the extent to which, and ways in which, interspecies disease, and particularly *perceptions of* interspecies disease, contribute to conflict between Maasai pastoralists and wildlife residing in Laikipia. Gauging this relationship required understanding pastoralists' experiences with disease among their domestic animals, experiences with human-wildlife conflict, and broader perspectives regarding wildlife on their land. These questions were considered against the social, cultural, and historical background of the region.

There seems to be relative consensus that Laikipia's large-scale and commercial ranchers accept, and even support, having wildlife on their lands. This tends to leave pastoral communities as the focus of studies about human-wildlife conflict in the region, and too often pastoralist communities are portrayed as fundamentally antagonistic toward wildlife. This is problematic. Fratkin (2001) offers an extensive list of the challenges facing East African pastoralist societies today: population growth; loss of former herding lands to farmers, ranchers, game reserves, and urban growth; increased commoditization of the livestock economy; out-migration by poor pastoralists; drought and famine; and privatization of resources.[31] All of these factors contribute to challenges with wildlife and affect pastoral livelihoods, security, and welfare. Although history and context do not pre-ordain the outcome of human-wildlife conflicts, they are important to take into account, and they are considerations that are not always recognized in ecologically oriented studies of such conflict.

[31] Regarding game reserves, Laikipia is poised to be the location of Kenya's newest national park.

Experiences with disease

Interviews with Ilmotiok and Tiemamut residents supported the commonly held belief that livestock disease places severe burdens on East African pastoralists. Their challenges in dealing with disease are compounded by imperfect knowledge and lack of access to preventive and curative measures.

Interviews revealed that knowledge and treatment strategies varied by disease. The consistency with which respondents viewed CCPP as transferred by goats, for example, as well as the uniformity with which they chose oxytetracycline to treat the infection (albeit at varying dosages), is striking. There was, however, much less consistency with other diseases and conditions.

Options for the use of preventive measures contribute to the challenges that face pastoralists. Foot-and-mouth, reported to be the only disease for which the government provides subsidized vaccination, is *not* viewed as severe. This could be because periodic vaccination campaigns convey some degree of herd immunity, but it could also be the result of the government and pastoralists having different priorities regarding animal health and disease. More broadly, however, disease prevention is undermined by limited physical access to vaccines and financial resources, and perhaps, to some extent, by pastoralists' knowledge and priorities. Even though investments in vaccines have been found to be returned many times over, if they are unavailable at markets, require cold-chain storage, or require a substantial up-front investment, their use is likely to be severely curtailed (Homewood et al., 2006).

The fact that several of the diseases affecting pastoralists are vector-borne is worth noting. Acaricidal dips seem to have had a limited effect in reducing the perceived impact of tick-borne diseases (including anaplasmosis, East coast fever, and heartwater). Particularly with

anaplasmosis, this could be because the Blue tick most associated with carrying the disease also tends to be the first to develop resistance to acaricides (Biovision Foundation, 2012). A broader explanation may be that acaricides are not applied with the same frequency among group ranch residents, or as often as at private ranches, or by using the same body-drenching, fuel-powered sprays used at "dip" structures on private ranches.[32] Irregular use or use of under-strength acaricides by pastoralists has been noted elsewhere in Kenya, with particular issues noted in the wet season (Onieke, 1999).

The fact that many individuals did *not* view anaplasmosis, one of the most consequential diseases, as being tick-borne could also support an argument that lack of familiarity contributes to suboptimal use of acaricides. In this case, however, such an argument seems unfounded. The use of acaricides is widespread among group ranch residents, demonstrated by the fact that nearly every person referred to it as a method of preventing and/or treating disease. There *is* a commitment to the practice; the glitch seems to be the frequency and efficacy with which the practice is conducted. Here, access and cost again appear as key issues.

Disease and wildlife

CCPP was the most consequential disease seen in domestic animals, namely goats, but wildlife were not viewed as a cause. In contrast, respondents did not view blackquarter as particularly consequential as a disease, but they overwhelmingly associated it with wildlife. Anaplasmosis, followed by lumpy skin disease, were two infections of relatively high

[32] It is worth noting that frequent, regular, and body-drenching use of acaricides is not uniformly viewed as the best option to reduce deaths from tick-borne diseases. At least one high-end ranch in Laikipia practices less frequent dipping based on the rationale that less dipping allows young animals to build up immunity to vector-borne infections (Loisaba, 2012).

consequence that many respondents also saw as having origins in wild animals. General tick-borne diseases were also noted as having wildlife origins.

Epidemiological studies confirm several associations that pastoralists made between wildlife and livestock disease. The claim that Cape buffalo carry a heavy tick burden, for example, is supported by such studies. Even instances where assumptions and perceptions were not epidemiologically correct were still logically coherent. For example, although elephants and gazelles were incorrectly blamed for disease transmission, elephants do spend a lot of time in communities' water, and although gazelles are not known to carry a heavy tick burden, they are regularly in close contact with domestic animals.

The one major claim without a clear explanation or attribution is the frequent association of certain diseases and species with urine, and particularly with acidic urine. This is curious on two counts: first, what aspect of acidic urine is viewed as causing disease, and second, why acidic urine is associated with a certain species cohort. This said, Kenya has seen at least one zoonotic disease, leptospirosis, that is transmitted through animal urine, specifically that of rodents, which six respondents mentioned as a carrier of disease (Nally, 2011). Pastoralists' knowledge or observations of leptospirosis could potentially explain the interview responses.

The Ilmotiok and Tiemamut residents who took part in this study did not list wildlife disease, or disease threats, as the greatest problem that they have with wild species, nor did they indicate that they avoid wildlife because of fear of disease exposure. In fact, few individuals reported taking active measures to avoid wildlife; those in the minority tended to only avoid animals that presented immediate physical danger.

However, it would be a mistake to underestimate the impact, both overt and more subtle, that concerns about disease have on pastoralists' attitudes toward wildlife. Moreover, it is

reasonable to assume that associations between wildlife and the illnesses suffered by domestic animals may increase if both disease prevalence and wildlife numbers continue on upward trends.

This argument is based on the significant overlap between certain wildlife species viewed as having increased most over the past decade (elephant and zebra); wildlife species viewed as coming into contact most with domestic animals (gazelle, elephant, zebra); wildlife species viewed as transmitting the most diseases to domestic animals (elephant, buffalo, and zebra); and wildlife listed as "problem species" for reasons that do not have any clear relation to disease (elephant and zebra). There is reason to believe that, at some level, concerns about disease may foster or justify more general antipathy toward a species, and more broad-based dislike of a species may foster or justify claims that it is a disease threat. This is certainly true of elephants, which are viewed as a major cause of disease and also widely maligned for destruction of trees, the danger and fear they cause people, and their disruption of necessary activities for day-to-day survival. This is also true, to a lesser extent, of zebra.[33]

Broader issues with wildlife

Efforts and investments to ameliorate conflict between humans and carnivores would indicate that depredation is a significant cause of conflict. It may be true that humans' lethal

[33] Interestingly, Cape buffalo do not fit this pattern. They are viewed as causing disease in domestic animals, yet they are not widely viewed as a "problem species." In fact, they are not said to have much of a role in the lives of Ilmotiok and Tiemamut residents. It may be assumed that residents have inherited knowledge from elders or ancestors who had more contact with buffalo, or from peers in areas where buffalo *are* present in abundant numbers. In neighboring Mpala, for example, Cape buffalo are common, and there is significant movement between and communication between the group ranches and research center, in part due to employment of group ranch residents as herders of Mpala's domestic animals. It is possible that experiences with buffalo and disease there, where buffalo are both common and have proven deadly, are helping to foster beliefs across the Ewaso N'giro River at the group ranches.

actions pose the greatest challenges to predator populations, as several scholars argue. However, predators' lethal actions posed a relatively minimal challenge to human and domestic populations, at least as perceived by residents of Ilmotiok and Tiemamut. Relative to the effects of drought and disease, "wildlife disturbing livestock" was virtually absent from the list of the "greatest challenges with raising [domestic] animals." When asked to list "the biggest problems you and your family have with wildlife," pastoralists mentioned the effects of predators on domestic animals 15 times. This frequency is noteworthy, but it paled in comparison to elephants, which 45 people mentioned as causing problems. This finding from interviews does not discount the impacts of predators on Ilmotiok and Tiemamut residents and their domestic animals—indeed, studies by Living with Lions and associated scholars show that depredation has significant economic consequences, no doubt felt more acutely by pastoralists than commercial ranchers. Moreover, protection of domestic animals from predators requires both diligence and resources. However, feedback provided by residents of Ilmotiok and Tiemamut suggest that in these communities, and at this time, focusing on pastoralists' protection from and resilience to predators at the expense of protection from and resilience to elephants and, of course, disease and drought, may be misguided.

The predator *species* focus also deserves attention. As discussed in Section II, lions are the focus of predator research in Laikipia. Interviews with Ilmotiok and Tiemamut residents suggest that something may be said for the "legend" of certain species, namely lions. Lions were mentioned only once when pastoralists were asked about species that most often kill their domestic animals, and significantly more often in response to the broader question about "problems with wildlife." Whether or not lions carry a certain aura, however, hyenas were mentioned most often as the species that actually kills livestock, with respondents frequently

saying that they see hyena in the *boma* and attacking their domestic animals.[34] The prevalence of hyenas warrants further attention to this species and to interventions that specifically target hyena depredation.

Meanwhile, elephants dominated lists of problems with wildlife. In some instances, pastoralists' negative attitudes toward elephants seemed to emerge from associations between elephants and disease among domestic animals. However, the challenges with elephants are fundamentally so extensive and substantial that even if elephants were no longer seen as causing disease, or if prevention and treatment were such that disease was not associated so extensively with morbidity and mortality of domestic animals, elephants would still present the greatest challenge to be overcome.

Attitudes, conflict, and wildlife conservation

To a certain extent, pastoralists conveyed a sense of powerlessness regarding the wildlife on their land, with a common explanation being that little can be done about wildlife because of the government ban on hunting and the communities' wildlife conservancies.[35] Most people stated that they had no way to respond when faced with challenges from wildlife. A few said that they take preventive measures (e.g., fencing bomas and keeping dogs to alert them of predators at their home), a few others that they notify the Kenya Wildlife Service of problems or, when possible, chase wildlife away. Even accounting for the strong likelihood that more wildlife

[34] Respondents were not asked to specify whether spotted or striped hyenas did the killing. Based on findings from multiple prior studies, it is presumed that individuals were referring to spotted hyenas.

[35] This may not be entirely accurate. There is a ban on killing wildlife in Kenya, with no exceptions made for pastoralists, hunter-gatherers, or subsistence hunting (Akama, 2008; Homewood, 2008; Jones, 2006; Neumann, 2001). However, predators may be killed legally in order to protect the lives of humans or domestic animals (Ogada et al., 2003).

are killed in defense of human or domestic animal life (or for consumption or general retribution) than was revealed to this American researcher, the dominant view was that challenges posed by wildlife are inevitable on pastoral lands.

At the same time, a cohort of respondents articulated acquiescence in, if not enthusiasm for, the "keeping" of wildlife for tourism and tourist dollars. This raises concerns. Particularly in recent decades, the "carrot" used with communities for supporting wildlife on their lands has been economic, and Ilmotiok and Tiemamut have bought in. Not only have they set aside land reserved for wildlife, but one of Ilmotiok's four villages, Lorobai Village, relocated entirely so that the group ranch could establish conservancy land and the Ol Gaboli Lodge. Placement of the conservancy and lodge alongside the Ewaso N'giro River meant not only constricting land available for livestock grazing, but also reducing access points to the river that serves as a major source of water for both the community's domestic animals and human residents.

At present, it appears that ecotourism has not provided a return on investment for these two pastoral communities. This seems to place the conservation initiatives in a position to disintegrate, *particularly* if wildlife populations, and their adverse impacts on the community, continue to increase as a result of the conservancy.

Future directions

Interviews with residents of Ilmotiok and Tiemamut group ranches suggest possible benefits to expanding the species focus of human-wildlife conflict in Laikipia. They also suggest possible benefits to addressing human-wildlife conflict in broader terms, and to considering causes of conflict that are *not* as obvious as those currently tracked by the Kenya Wildlife Service and Ewaso Incident Reporting System, or evaluated in scholarly works. Disease is

certainly one such issue. While it is neither as obvious nor as immediate as physical threats from elephants or depredation by hyena, it does seem to factor into attitudes toward specific wildlife species.

There is no guarantee that identifying and addressing more subtle causes of conflict would lead to solutions. Human-wildlife conflict and wildlife conservation are complex, often intractable, and shaped by the interests of a large and diverse set of stakeholders. However, it was troubling that the only rationale that respondents conveyed for "keeping" wildlife was tourism and economic returns, and it is reasonable to think that this has to do with the way in which wildlife conservation has been presented to these Maasai communities. Greater awareness and acknowledgement of communities' nuanced interests and concerns might enhance trust that the broader conservation community is concerned about Maasai people as much as about the wildlife with whom they share land, even if tangible improvements take time to be realized.

Further inquiry into the geographic aspects of human-wildlife contact and conflict on group ranches also warrant more attention. In combination, community lands tend to have comparatively high human population densities and relatively challenging conditions for raising domestic animals. There are nonetheless major variations between, and even within, group ranches. It is likely that residents' experiences with, and potentially attitudes toward, certain wildlife species are shaped by the specific places in which they spend most time, including their proximity to water, conservancy land, and surrounding private and group ranches. Further attention to community-specific interactions between humans and wildlife could potentially allow for better approaches to reducing conflict.

The interviews also spoke to the ethical, economic, and epidemiological aspects of expanding access to preventive and curative veterinary care on pastoral lands. To be sure, there

is recognition among scholars, non-governmental organizations, and both Kenyan and international government officials that veterinary care for Kenya's pastoral communities needs improvement. There are also some reasonable questions about the costs and benefits of investing in veterinary provision in rural regions, as well as the social and cultural implications. At the same time, some of the attitudes and approaches to pastoralism in Kenya, particularly as it relates to disease prevention and wildlife, are problematic and need revision.

Related to disease, there is also reason to press further on knowledge about different diseases. Interviews confirmed that nearly every person treats his or her livestock him or herself, relying on members of the community, and particularly community elders, for guidance. But even within this framework for knowledge transfer, there are significant variations seen among diseases. At some point, use of acaricides to try to prevent certain vector-borne diseases became standard among pastoral communities, even if the frequency and method of application did not. Given the cost of acaricides and financial struggles of many members of the community, this was not an insignificant shift. The nearly uniform and epidemiologically accurate explanation of how goats contract CCPP was notable, as was the uniform choice of oxytetracycline to treat animals with CCPP symptoms. Even with CCPP, treatment methods were inconsistent, a fact even more true for other diseases, including ones with significant consequences such as anaplasmosis. A better understanding of how knowledge and understanding is initially acquired and subsequently shared, and what factors explain different knowledge and attitudes, could aid in addressing disease in a community- and culturally sensitive manner. The potential benefits of wildlife tourism have been illusory for a number of pastoralist communities; it may be that those concerned about reducing conflicts between pastoralists and wildlife could address resources and expertise to issue that are of greater concern to those communities. It is a hope that over time,

this could help ensure that wildlife are not incorrectly viewed as contributing to suffering of both domestic animals and the people who care for and rely on them.

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Appendix A: Interview Questions

Location (village, ranch):
Sex:
Age:

1. Have you lived in Ilmotiok/Tiemamut since your birth? If you came from another community, which one was it?

2. What are your sources of wage-income?

3. If you keep animals, what type of animals?

4. What do you consider to be the greatest challenges with raising your animals?

5. When animals die during dry seasons, what are the causes of death? What do you think kills the most animals?

6. If animals die during rainy seasons, what are the causes of death? What do you think kills the most animals?

7. Is there a time of year when more of your animals die from disease? Is this the same for all species that you keep?

8. Are there seasons when you sell or give away many animals?

9. Are there seasons when you buy more animals? Do the animals you buy come from inside or outside Ilmotiok/Tiemamut?

10. Is there a time of year when wild animals kill more of your livestock? Why do you think this is?

11. What wild animals kill livestock most often? How do you identify that a species has done the killing?

12. What are the five animal diseases that have had the biggest impact on your family in the past 10 years?

13. Did these sicknesses make all of your animals sick, or only certain species?

14. How did you recognize these diseases? What were the symptoms?

15. With 20 beans, can you assign beans to the different diseases to show how much they currently affect your livestock relative to each other? For example, if each disease had an equal effect, you would give each disease 4 beans. But if one disease is much more important than all the others, then you would give it more than 4 beans, and another

disease less than 4 beans. Can you use the beans to show disease importance 10 years ago?

16. Why did you choose this order?

17. How much of your herd dies from the diseases you have mentioned?

18. How do you think your animals get sick from these diseases?

19. Do more animals get sick with these diseases during dry or rainy seasons?

20. How many times per week do your animals come close to wildlife? (This could mean sharing water, grazing, predation, or anything else that brings your animals and wildlife close together).

21. Which wildlife species do your animals come into contact with most? How do you identify the wildlife species with which your animals come into contact (for example, through animal observation, footprints, dung)?

22. Does fear of disease ever make you change where your animals go to eat food and drink water?

23. Do your animals spend more, less, or the same amount of time near wildlife than they did 10 years ago? (This could be sharing water, grazing, predation, or anything else that makes shoats/cattle and wildlife close together.)

24. In what seasons do your animals spend most time near wildlife?

25. Where do they come into contact most often (for example, the bush, the river, when animals are in the boma)?

26. Do you think that there are more, less, or the same amount of shoats now versus 10 years ago at Ilmotiok/Tiemamut?

27. Do you think that there are more, less, or the same amount of cattle now versus 10 years ago at Ilmotiok/Tiemamut?

28. Do you think that there are more, less, or the same amount of camels now versus 10 years ago at Ilmotiok/Tiemamut?

29. How many animals do you own currently?

30. Do you think that there are more, less, or the same amount of wildlife now versus 10 years ago at Ilmotiok/Tiemamut? What species do you think have changed most in terms of their numbers?

31. Do you think there are more, less, or the same amount of diseases in your herds now versus 10 years ago?

32. About how many families live at Ilmotiok/Tiemamut today? About how many lived at Ilmotiok/Tiemamut 10 years ago?

33. What do you do when your animals are sick?

Sickness/Symptom	Response

34. What has helped you to prevent disease in your animals?

35. When one of your animals is sick, is there anybody that you speak to about the sickness? If yes, who?

36. If you care for animals yourself when they are sick, how have you gained your knowledge about sicknesses?

37. Do you think that wildlife ever make your animals sick?
    a. If yes, what diseases do you think that wildlife give your animals?
    b. If yes, what wildlife species are most likely to make your animals sick? Why do you name these species?
    c. If no, why not?

38. Do you think that domestic animals ever make wildlife sick? If yes, with what? How do they make wildlife sick? If no, why not?

39. Can you list the biggest problems you and your family have with wildlife?

40. How do you respond to these problems?

41. Do you think that animals can make people sick?

42. If yes, what animals do you think make people sick? What sicknesses do they cause?

43. Does disease, or fear of disease, affect how you feel about having wildlife at Ilmotiok/Tiemamut?

44. How do you think that livestock disease could be reduced in Ilmotiok/Tiemamut and Laikipia?