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The Emotional Dimensions of Animal Disease Management: A Political Ecology Perspective for a Time of Heightened Biosecurity

Kathleen Epstein[1]*, *Erica von Essen*[2] and *Hailey Wilmer*[3]

[1] Resources and Communities Research Group, Department of Earth Sciences, Montana State University, Bozeman, MT, United States, [2] Department of Social Anthropology, Stockholm University, Stockholm, Sweden, [3] United States Department of Agriculture-Forest Service, Pacific Northwest Research Station, Northwest Climate Hub, Olympia, WA, United States

The ongoing devastation of the Covid-19 pandemic has brought new urgency to questions surrounding the origins, management, and complex dynamics of infectious diseases. In this mini review, we use growing international concern over the pandemic potential of emerging infectious diseases as motivation for outlining a research approach to study the emotional dimensions of animal disease management. We sketch out this important analytical terrain by first locating opportunities for literature on the biosecurization of nature to intersect with the emerging field of emotional political ecology. Second, we describe three biosecurity contexts and environmental conflicts at the wildlife-livestock interface: African swine fever in wild boar, brucellosis in elk, and pneumonia in bighorn and domestic sheep. We argue that in these "contact zones," a focus on emotions can add a new layer of explanation for analyzing the manifestations, implications, and varied experiences of biosecurity.

Keywords: African swine fever, bighorn sheep, brucellosis, elk, emotion, wild boar, wildlife-livestock interface

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***Correspondence:**
Kathleen Epstein
kathleenepstein@montana.edu

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INTRODUCTION

The ongoing devastation of the Covid-19 pandemic has brought new urgency to question surrounding the complex dynamics of infectious disease dynamics and, in particular, those with the potential to spillover between animal and human populations (Dobson et al., 2020; Laborde et al., 2020). Measures to control or limit the spread of infectious diseases, policies and practices often referred to collectively as biosecurity, increasingly target the wildlife-livestock interface and agricultural landscapes where rural livelihoods revolve around human-animal relations and risks of disease transmission between species are high (Jones et al., 2013; Wiethoelter et al., 2015). In these focal geographies of animal disease management, biosecurity projects require the participation of rural peoples (Barker, 2010; Hinchliffe et al., 2013). Yet, this work can be a source of conflict for ranchers, hunters, farmers, and herders, along with their families and communities (Massey et al., 2011; Johansson et al., 2020). As such, there is an urgent need to consider how emotions influence animal disease management, and vice versa, in line with current trends in political ecology to emphasize how "emotions matter" in environmental conflicts and struggles over issues of resource management (Sultana, 2011, p. 163; González-Hidalgo and Zografos, 2020).

This mini review calls attention to the emotional dimensions of animal disease management as important analytical terrain in a time of heightened biosecurity and growing international concern over the pandemic potential of emerging infectious diseases. To sketch out potentials for future work, we first identify opportunities for an emotional political ecology approach to biosecurity. Second, we describe three animal disease management contexts with conflicts related to biosecurity. In these "contact zones" (Haraway, 2013), a focus on emotions adds a new layer of explanation for understanding and analyzing the manifestations, implications, and varied experiences of biosecurity.

AN EMOTIONAL POLITICAL ECOLOGY APPROACH TO BIOSECURITY

Though battles between humans and disease are as old as time immemorial (Zinsser, 1935), efforts to "secure life" from infectious disease have formalized in recent decades as part of a shift in environmental governance toward security and "security thinking" (Ingram, 2010; Hinchliffe et al., 2013, p. 532). In rural areas, this era of biosecurity manifests as increased awareness of animal diseases and increased surveillance, containment, and control of lands, animal bodies, and other unruly life (Enticott and Franklin, 2009; Hawkins and Paxton, 2019).

Bringing attention to the varied dimensions of managing animal diseases is an emerging canon of critical social sciences. This literature recognizes biosecurity as a political project, or an example of *biopolitics* (Foucault, 1995), as institutions responsible for public health and environmental safety are increasingly taking up activities that valorize or legitimize the death of some life to sustain others in the name of infectious disease management (Vint, 2010; Woods, 2017). As a form of spatial control (Enticott, 2014), biosecurity practices can delineate landscapes and bodies as "clean" or "diseased," efforts often articulated through a moral geography where "concepts of purity and contamination relate to spatial flows of animals, goods, and services" (Shortall and Brown, 2020, p. 3). Further, everyday activities of biosecurity can intersect with a broader political economy to contribute to a consequential "differentiation of the countryside" (Enticott and Franklin, 2009) and reshaping of social relations, for example, among regulators (e.g., veterinarians), their regulatees (e.g., dairy farmers), and the broader public (Enticott, 2014).

While the emotional dimensions of biosecurity regimes are not frequently interrogated (for important exceptions see Convery et al., 2005; Crimes and Enticott, 2019), multiple studies argue that participation in disease management agendas and fears over the ability to manage and adapt to associated regulations induces stress for those enrolled in what Barker (2010) calls biosecurity citizenship—governance projects that compel individuals and communities to enact disease control measures (Delgado et al., 2012; Johansson et al., 2020). Interventions and regulations often divide "good" rural participants from those "not doing enough" (Nerlich and Wright, 2006, p. 452), while new practices and routines can fracture rural identities and livelihoods and challenge local understanding of human-environment relations (Enticott, 2014; Shortall et al., 2016; Kowalewska, 2019; Urner et al., 2020). In turn, emotional responses from rural communities can challenge the effectiveness of the interventions themselves. The imposition of a biosecurity regime, hence, suggests a consequential relationship between disease measures and emotions, a complicated dynamic primed for further examination.

Critical perspectives on emotions have long been the domain of feminist scholars whose work marks the role of emotions in deconstructing dualisms, constructing knowledge (Lorde, 1981; Jaggar, 1988), and shaping social and socio-environmental relations (Plumwood, 2002; Norgaard, 2019). More recently, political ecologists have drawn these insights in line with literature on the geography of emotions (Davidson and Milligan, 2004; Pile, 2010; Nightingale, 2012), to frame struggles over access to and control over resources as not only social, political, and economic but also emotional experiences (Sultana, 2011, 2015).

To elucidate the role of emotions in conflicts such as those presented in biosecurity contexts, scholars emphasize a need to examine governance processes alongside individual and collective emotional experiences (González-Hidalgo and Zografos, 2020). This entails both addressing the role of what Nightingale (2018) calls the "socioenvironmental state" and questioning "*how* political authority emerges" within biosecurity regimes (Nightingale, 2018, p.689), as well as grounding investigations of biosecurity in the emotional conditions of everyday disease management practices and experiences (Sultana, 2011).

In the next section, we describe three disease contexts from our ongoing research into animal disease management at the wildlife-livestock interface related to African swine fever, brucellosis, and pneumonia. While these diseases have a global presence (Seleem et al., 2010), we articulate our cases through set of emotional geographies in rural landscapes in the American West and Europe where disease management regimes rely on the work of hunters, cattle ranchers, sheep producers, and public resource managers to take up biosecurity practices and adhere to biosecurity regulations. In sharing but a slice of the complexity endemic to each case, our goal is to identify ways that emotions intersect with the policies and practices of animal disease management.

FOCAL GEOGRAPHIES OF ANIMAL DISEASE MANAGEMENT: THREE CASES OF BIOSECURITY AT THE WILDLIFE-LIVESTOCK INTERFACE

African Swine Fever and Conflicted Hunters: Controlling Wild Boars in Europe

A species known for carrying multiple diseases, the wild boar (*Sus scrofa*) of Europe holds current notoriety for its connection to African swine fever (ASF). A key concern related to ASF in wild boar is the potential for spillover to the continent's domestic pig populations. Research notes that even small ASF outbreak

events in pork supply chains can result in significant economic losses and threaten agricultural livelihoods (Niemi, 2020). In response to the disease's recent expansion, some European Union (EU) countries are taking protectionist approaches. Denmark, for example, has erected an 80 km border fence to Germany and several countries have plans to follow suit (Mysterud and Rolandsen, 2019). However, wild boar hunters are the interest group most implicated in ASF containment on the ground.

EU legislation requires hunters to become "trained persons" (Regulation EC, No. 853/2004:51); hunters must identify and assess diseased animals in the field, skills typically required of veterinary professionals (Benedito et al., 2019). The convergence of veterinary and hunting practice in the name of biosecurity has proven problematic, however. Hunters have resisted perceptions of hunting as a form of clinical slaughter and instead emphasized the care, compassion, and ethics that hunting requires (Giacomelli et al., 2018; von Essen, 2019)—emotional qualities that hunters feel set them apart from butchers in the abattoir (Marvin, 2006; von Essen, 2018). The increasing threat of ASF has also made requisite new practices for hunters such as rigorous inventories of boar sightings and interactions, burdensome tasks that add to the challenges of traditional hunting practices (Urner et al., 2020). Research on hunting cultures in the Netherlands and Sweden notes that the additional administrivia has spurred some hunters to feel resentment at being the "garbage collectors of society" (Dahles, 1993, p. 178), unappreciated and overworked (von Essen and Tickle, 2020). Other hunters report costly, cumbersome, physically demanding, and lonesome hunts (often at night) and injuries and scars from wild boar skirmishes (Massey et al., 2011). Where hunters view regulating wild boar populations in agricultural landscapes as "someone else's problem," friction between farmers and hunters over wild boar culling has surfaced in debates about disease management (Keuling et al., 2016).

The emotional stakes of combating the spread of ASF have become particularly high amidst debates over the future of Europe's wildlife and wild lands (Lorimer and Driessen, 2016). For their part, some hunters feel like they are first port of call for controlling the outbreak where failure to provide security against the disease may threaten their status as stewards of wild populations—a label many see as essential to hunter identity and public legitimacy. At the same time, in Estonia, the proposition that biosecurity tasks such as boar culling might otherwise befall state appointed personnel (e.g., professional sharpshooters) has been met with animosity by hunters who feel that inviting army or police branches to cull wild boars would amount to "massacre and genocide" (Urner et al., 2020, p. 6). Elsewhere, other hunters have formed unlikely alliances with animal rights activists in opposing mass culls of wild boars and the use of live-capture traps. This research emphasizes how ASF management requires hunters to navigate a conflicting set of emotional identities, as ruthless murderers, compassionate cullers, and irresponsible sportsmen. In turn, biosecurity efforts appear to become as much about negotiating the public perception of hunting and hunters as they are managing infectious disease (von Essen and Tickle, 2020).

Unruly Elk and Worried Ranchers: Managing Brucellosis in the Greater Yellowstone, USA

Affecting multiple animal species and humans, brucellosis is a highly infectious bacterial disease that causes abortions or stillbirths in wild and domesticated ungulates (hoofed mammals). The disease is considered a significant threat to agricultural supply chains and international trade and has been a target of major eradication efforts in the US since 1934 (Seleem et al., 2010; USDA-APHIS, 2020). The nation's primary and current source of brucellosis transmission risk involves the co-mingling of elk (*Cervus canadensis)* with cattle and calves on ranchland properties in the Greater Yellowstone Ecosystem (GYE). One of the world's most iconic conservation areas, the GYE is also a touchstone for debates over wildlife management in context of amenity-driven land use transitions (Epstein et al., 2018; Haggerty et al., 2018a).

Federal and state-level biosecurity interventions for brucellosis target a mosaic of public and private lands surrounding the GYE where the risk of transmission across species is highest. Within this region, cattle ranchers are subject to increased herd testing and vaccinations; infection detection results in a cascade of management protocols such as removing, quarantining, or in some cases the forced culling of entire herds of cattle. As these interventions can cost ranches upwards of $150,000 (Boroff et al., 2016), some ranchers feel that the discovery of an infected animal could compound with existing livelihood challenges to effectively end their operation (Schumaker et al., 2012; Tilt, 2020). Simultaneously, infected herds can dramatically impact neighboring ranchers, who may also incur infection, increased regulation, or price discounts for their products based on proximity to disease (Rhyan et al., 2013; Boroff et al., 2016). Alongside the multiple challenges facing agricultural operations in the region—rising land values, changing climate regimes, and growing conflicts over human-wildlife interactions—cases of transmission can send "shockwaves" through ranching communities (French, 2015; Haggerty et al., 2018a; Mannix and Allison, 2018; Western Landowners Alliance, 2019). Thus, managing brucellosis presents both an actual and anticipated threat and one that looms over not only individual operators but the livestock industry more generally.

As such, it is the GYE's expanding elk populations and their increasing rate of bacterial prevalence that "keep ranchers awake at night" (Brennan et al., 2017; Tilt, 2020, p. 14). Because elk are quick to respond to shifts in land management (Proffitt et al., 2013), wildlife and disease experts argue that additional biosecurity measures such as defensive land use changes that separate elk and cattle or increasing hunting pressure on private lands would reduce the risk of disease transmission. However, the adoption of these measures by producers has been largely uneven (National Academies of Sciences, 2017), leaving state and federal agencies to debate how to best engage the GYE's livestock community in more comprehensive brucellosis interventions. At the same time, some livestock industry advocates contest additional biosecurity regulations and

question the ability of wildlife agencies to manage diseased elk effectively (Miller, 1997; Schumaker et al., 2012; Bonser, 2019). Policy responses aiming to ameliorate burdens for producers have honed in on the administrative and financial outcomes of the disease (Tilt, 2020); however, shifting elk populations, the politics of wildlife management, and the pursuit of livestock-based livelihoods in conservation landscapes seem to also produce particular emotions and emotional experiences. These dynamics raise questions about the co-production of psychosocial outcomes and resource governance, or how individual and collective stresses and anxieties both emerge from and ultimately implicate the practices of brucellosis management.

Trophy Sheep and Contested Land Uses: Preventing Spill Back of Pneumonia in the Western US

Whereas ranchers in the GYE worry about disease spilling from wildlife to livestock, the spread of pneumonia from domestic small ruminants to wild bighorn sheep is a major concern for public land sheep herders, hunters, and resource managers across the American West. A culturally and ecologically important herbivore that once ranged across all western North America, bighorn sheep suffered steep die-offs following EuroAmerican settlement. This "strictly wilderness animal" has low tolerance for human activity and relies on remote alpine or desert areas for summer range (Buechner, 1960), a geography largely managed by US federal land agencies. Bighorns' iconic status and the low number of tags available for conventional hunts makes makes the pursuit of the species a "once in a lifetime" hunt for resident hunters.

Pneumonia has hindered bighorn conservation efforts for decades (Cassirer et al., 2018; Pils and Wilder, 2018). The polymicrobial infection leads to high initial mortality rates in the wild sheep, especially lambs, and may be carried by individuals for years (Besser et al., 2017; Plowright et al., 2017; Dekelaita et al., 2020). Wildlife managers widely recognize that any close contact between bighorn and domestic sheep puts bighorn at risk for an all-age die-off, even as domestic sheep remain healthy (Gunn et al., 2008; Cassirer et al., 2018). While public lands sheep ranching is not as widespread as it once was, sheep grazing remains an important source of regional economic, cultural, and ecological benefits (Feuz and Kim, 2019). Importantly, many sheep ranching traditions have deep ties to Basque, Indigenous, and non-White working-class peoples—communities who have faced racial, ethnic, and class-based discrimination in the agriculture industry (Weisiger, 2011; Sayre, 2018). Whether and how sheep producers can secure access to public lands, however, has become increasingly uncertain amidst growing fears of pneumonia infections. As state wildlife officials continue to use selective culling and hunting tags to contain the threat of disease spread between species, resentment from impassioned bighorn advocates toward domestic sheep and their people builds in what has become a standoff "sheep vs. sheep" (Hoffman, 2007).

Thus, an expansion of pneumonia's threat around the American West and now northward into Canada and Alaska has fueled conflict among conservation, hunting, and ranching communities over which species of sheep (wild or domestic) get to graze where (Rovani et al., 2019). That these conflicts persist, despite years of collaborative, science-based planning efforts, reveals the recalcitrant struggles of public land management interests and the deeper tensions surrounding public lands access and grazing issues. Hence, preventing the spread of pneumonia presents not only as an issue of biosecurity, but one of wildlife conservation and land management and their varied and historied politics (Brugger et al., 2019). This patterns aligns the emotional dimensions of animal disease management with other assessments of environmental conflict where emotion-fueled debates about resource management become refracted through older and deeper struggles over identity, livelihood, and place (Martin et al., 2019; Martin, 2020).

TOWARD AN EMOTIONAL POLITICAL ECOLOGY OF ANIMAL DISEASE MANAGEMENT

Our cases highlight a set of complex dynamics at wildlife-livestock-human interfaces in the American West and Europe, a reminder that infectious diseases are global, not only in spread but origin (Jones et al., 2008; Lloyd-Smith et al., 2009; Hinchliffe et al., 2013). At the same time, efforts to manage and mitigate disease spread involve the actions, efforts, and coordination of individuals and collectives "on the ground." Here, conflicts related to animal disease management are *felt* experiences for those invested in the processes and outcomes of biosecurity measures. Hunters are asked to cull, ranchers to test, vaccinate, and monitor, while sheep ranchers risk losing access to forage resources. These activities raise questions about the implications of disease management for not only rural life and livelihoods but socionatural relations (Buller, 2016).

When emotional experiences shape participation in biosecurity efforts, as they appear to do for wild boar hunters, emotions may influence the ability for government-led interventions to manage disease (Van Bavel et al., 2020). But biosecuritization is also just one aspect of modernization influencing rural places (Marsden, 2016; von Essen, 2019). The emotions accompanying disease outbreaks like brucellosis, for example, may emerge amidst a host of resource management challenges or regional anxieties to compound with other stressors related to rural and agricultural life (Edelman, 2019; Martin et al., 2019). This signals a need to understand animal disease management, and rural peoples' participation in it, as a potential driver of rural stress and a dimension of public health. Simultaneously, much like the land use conflicts associated with bighorn and domestic sheep suggest, disease management protocols may amplify or activate latent grievances related to emotional regimes, memories of lives and livelihoods lost, or other populist sentiments (Dillon et al., 2019; Carolan, 2020). These circumstances highlight an opportunity to chart out new analytical terrain in studies of human-wildlife disease dynamics by addressing the potential for emotions to reflect aspects of rural well-being (Haggerty et al., 2018b), shape identities and

subjectivities (Nightingale, 2011, 2013), and catalyze action around biosecurity initiatives (González-Hidalgo and Zografos, 2017; Nightingale, 2018).

Our three cases locate a place for emotional political ecology in studies of animal disease management, and in particular, where cases of infectious diseases are emerging alongside agricultural intensification and environmental change, shifting politics of wildlife conservation, and an ongoing negotiation of rural livelihoods (Jones et al., 2013). Future work addressing the emotional dimensions of animal disease management would do well to interrogate how the structural context and social histories of rural economies and societies influence trajectories of biosecurity, factors that are hinted at but not fully explored in our case descriptions. Such approaches are well-developed in the political ecology lineage and, in combination with greater attention to emotions, respond to the increasing need for multidisciplinary perspectives on human-environment-disease relations (Hinchliffe, 2015; Martin et al., 2019).

Lastly, our mini review suggests a need to do more than uncover and navigate these emotions, but to actively engage with and care for them. This point is made even more relevant in the context of the Covid-19 pandemic, as other accounts in this Special Issue and elsewhere so compellingly demonstrate (cf Plagg et al., 2020). That emotions are also linked with individual and community well-being provides an opportunity and imperative for disease experts, resource managers, and the rural peoples they collaborate with to privilege care as means to generate more just and effective disease management plans and actions (Noddings, 2015; Wilmer et al., 2019).

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KE conceived the study. All authors reviewed literature, prepared case studies, and drafted discussion comments.

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