
Article:
Massé, F. (2018) Topographies of security and the multiple spatialities of (conservation) power: Verticality, surveillance, and space-time compression in the bush. Political Geography, 67. pp. 56-64. ISSN 0962-6298

https://doi.org/10.1016/j.polgeo.2018.10.001

Topographies of Security and the Multiple Spatialities of (Conservation) Power: Verticality, Surveillance, and Space-Time Compression in the Bush

Francis Massé, f.masse@sheffield.ac.uk

Department of Politics, University of Sheffield

ABSTRACT

This article advances the analytic of topography to account for vertical and horizontal dimensions of space, power, and the ways in which they articulate with biophysical and political-ecological dynamics to (re)-shape socio-spatial and socio-natural relations. While commonly used to refer to the horizontal, vertical, and environmental features of a particular landscape, social scientists use the language of topography to understand the connections between spaces, processes, and power dynamics. I combine these literal and metaphorical understandings of topography to examine how multiple dimensions of space and power coalesce to protect certain bodies, police others, and secure the space within each move. In response to increases in commercial poaching, for example, conservation-security actors are increasingly going aerial to mobilise the vertical as a dimension of space and power to protect wildlife, neutralise those who threaten them, and ultimately secure conservation areas below. Verticality thus becomes important as both an empirical and analytical phenomenon that matters for understanding shifting power dynamics in contexts where actors seek to secure space and resources from perceived threats. But, the vertical does not exist on its own. It is in the interaction of the horizontal, vertical, and political-ecological dynamics of protected areas that conservation-related power-geometries are altered. A topographical analysis results in a nuanced understanding of how the workings of power and related security practices and technologies work to (re-)shape human environment and territorial relations.

Keywords: topography; power geometry; surveillance; anti-poaching; conservation; political ecology; security; green militarisation

INTRODUCTION

What I noticed sitting in the main camp of South Africa's Kruger National Park was how the whirring of helicopters flying overhead increasingly punctuated the silence and sounds of the bush I had become accustomed to. Conservation practitioners have long used aerial technologies like helicopters and planes for biological and ecological management purposes including monitoring, darting, and culling wildlife. And while their use intensified during my five years of researching conservation security in South Africa and Mozambique, the increase in going aerial, or using vertical space above the terrain of conservation landscapes, has not been for the biological and ecological management purposes mentioned above. Motivating the increasing use of helicopters and planes in conservation areas is the need to surveil people, space, and deploy rangers in response to the rise in commercial poaching of rhinos and elephants.

For most of my research I focused my senses and analytical lens across the horizontal plane of expansive spaces of conservation across which wildlife, rangers, and those looking to hunt rhino and elephant move. But as my time progressed in the Mozambican borderlands adjacent to Kruger where I spent approximately six months with an anti-poaching unit, I found myself increasingly looking upwards at planes and helicopters, or down from them, to understand anti-poaching and conservation security efforts. Altitude and aerial technologies have long provided opportunities and challenges for the governance of space, resources, and people (Moore, 2005; Scott, 2009), including in conservation (Lunstrum, 2014). In response to the escalation of commercial poaching of species like rhino and elephant, many protected areas, especially in Sub-Saharan Africa, are subject to intensified anti-poaching, policing, and security efforts (Büscher & Fletcher, 2018; Duffy, 2014; Lunstrum, 2014; Massé et al.,

2018). I examine how conservation-security actors increasingly mobilise the vertical as a dimension of space and power as part of these efforts. Their aim in doing so is to shift already uneven political-ecological and geographic dynamics in their favour to better secure conservation space and nonhuman life by pacifying threatening humans.

Beyond the empirical observation of anti-poaching personnel's increasing use of vertical technologies, how might the vertical offer a novel lens of analytical inquiry into understanding the nuanced, multiple, and changing spatialities of conservation practice and related processes of territorialisation? How does one make sense of the various and overlapping horizontal and vertical spatialities of protected areas and how might doing so help understand shifting notions, realities and power dynamics of conservation practice and space? How do they arise from and shape human-environment interactions?

The concept of topography helps answer these questions by explicitly tackling verticality as an empirical and analytical phenomenon that matters for the operation and understanding of power dynamics in conservation and other contexts where actors seek to secure space and resources from perceived threats. The language of topography commonly refers to the horizontal, vertical, and environmental features of a particular landscape. The familiar lines on a topographical map, referred to as contour lines, illustrate and describe intersections between the horizontal and vertical dimensions of an area. In human geography, topography similarly refers to the physical, environmental, and socio-political features of a place or landscape and the connections between them (Gregory et al., 2011, p. 396). Geographers and social scientists more broadly also use the language of topography as a spatial metaphor to highlight the connections between spaces, processes, and power dynamics (Ferguson, 2014; Gupta & Ferguson, 1997; Mountz, 2013; Murdoch & Pratt, 1997). Topography, as explained by Katz, is a way of uncovering the interplay and "theorizing the connectedness" between them (2001, pp. 1229-1230).

I draw on these insights to develop a topographical approach to analysing the multi-dimensionality of space and power in conservation. I argue that topography helps locate and understand the coalescing of multiple dimensions and spaces of power to protect certain bodies, police others, and secure the space within each moves. It does so by accounting for the integration of vertical and horizontal technologies, spaces, practices and their interaction with political-ecological dynamics. While I draw special attention to vertical space and aerial technologies, always accompanying the helicopters, planes, and even satellites are 4x4 trucks meandering through protected areas or racing along dirt tracks at a moment's notice. Rangers also patrol expansive spaces of conservation on foot while horizontally-focused technologies like camera traps monitor the landscape and movement of people and animals. Shaping the landscape of conservation security is thus a deep connection between and even blurring of the vertical and horizontal. What I demonstrate is that practices, efforts, and technologies to secure protected areas seek to mobilise and integrate the vertical and horizontal as dimensions of space and power to overcome nature's obstacles, but also to protect it and pacify those who threaten it. This can alter conservation power-geometries (Massey, 1993) in favour of anti-poaching and exacerbate already uneven power dynamics and territorial processes shaping human-environment relations. Thinking topographically promises to provide deeper insight into the uneven power dynamics that shape and are shaped by geographies characterised by contestations over space, resources, and mobility, and how such geographies changing, stabilised, and resisted.

In the next section I turn to critical social science literature that uses topography and related spatial metaphors to describe the variegated and interconnected dimensions of space, power, and socio-political and political-ecological processes. While my empirical case is conservation, I situate my analysis within the broader body of literature concerned with multiple dimensions of territory and ultimately power over bodies, circulations, and space. I

then use observational data from participant observation with an anti-poaching unit (APU) to examine how APUs mobilise the vertical as a dimension of space and power to secure protected areas and natures under threat. In the third section, I move beyond the vertical to analyse the topography of conservation security as constituted by the interconnectedness between the vertical and horizontal dimensions of space and power and their articulation with political-ecological dynamics in protected areas. I conclude by reflecting on what a topographical approach might offer for a broader understanding of power dynamics and their re-shaping of territorial and human-environment relations.

THINKING TOPOGRAPHICALLY (AND THROUGH OTHER SPATIAL METAPHORS)

Examining a series of paintings known as Dogs, Foucault reflected on the horizontal and vertical dimensions of space and power. He wrote: "In the world of prisons, as in the world of dogs ('lying down' and 'upright'), the vertical is not one of the dimensions of space, it is the dimension of power" (Foucault, 2007[1973], p. 170). Foucault then highlighted three elements in the paintings: the window, the bars, and the baton as metaphors for the integrated and interconnected embodiments of vertical and horizontal technologies of power. Foucault's attention to the multiple and integrated dimensions of power resonates strongly today. Even if not explicitly building on him, we find similar analyses in scholarship that uses the language of topography, among other spatial metaphors, to understand not only dimensions of power, but also the multiple dimensions of space, the relationship between the two, and how they are mobilised to control populations and resources.

Literally, a topographic map illustrates the connections, intersections, and relationships between the horizontal, vertical, physical, and socio-political features of a particular landscape (Gregory et al., 2011). Figuratively, and as used to understand socio-political and political-geographical processes, the contour lines of topography represent not

elevation, but the connections or relations between processes and space (Katz, 2001). It is in these connections that scholars locate the workings of power across space and scale. The language and concept of topography has indeed been used by social scientists to examine the multiplicity of power's spatialities, dimensions, and the articulations between them to conceptualise politics, culture, territory, security and how they operate (Ferguson, 2014; Gupta & Ferguson, 1997; Katz, 2001; Mountz, 2013; Murdoch & Pratt, 1997). What binds these analyses together is a focus on the productive interplay between different social, political, economic, geographical and environmental processes. "Topographies," writes Katz (2001, p. 1231), "are a means to elucidate the intersection of these processes." She perhaps best summarises thinking topographically, or doing topography as a critical social science approach, with the following:

> To do topography is to carry out a detailed examination of some part of the natural world, defined at any scale from the body to the global, in order to understand its salient features and their mutual and broader relationships. Because they routinely incorporate both "natural" and social features of a landscape, topographies embed a notion of process, of places made and natures produced (Katz, 2001, p. 1228).

Protected areas such as national parks and wildlife reserves are socio-natural productions whose "natural" and "social" features cannot be taken for granted (Adams, 1992; Neumann, 1998). From their physical infrastructure to the wildlife within them, and the animals and people not present, protected areas are human-envisioned and human-made, artificially separating and including certain species and activities. In Kruger National Park and the protected areas of the Mozambican borderlands where the empirical material for this article comes from, people and livestock were removed and fenced out while wildlife was moved in and confined alongside that which was already there (Carruthers, 1995; Massé, 2016). Protected areas are thus a process of territorialisation that concentrates biodiversity within a bounded space making it easier to appropriate, control, and secure while simultaneously

making transgressions easier to surveil (Bluwstein & Lund, 2018; Brockington, 2002; Fairhead et al., 2012; Neumann, 2001; Spierenburg & Wels, 2006).

Indeed, political ecologists and political geographers understand protected areas as enclosures and a process of "internal territorialisation" that is fundamentally about controlling human-environment relations (Vandergeest & Peluso, 1995). Territorialisation, here, refers to the process of "excluding or including people within particular geographic boundaries, and about controlling what people do and their access to natural resources within those boundaries" (Ibid, p. 388). Conservation territorialisation by state and non-state actors is motivated by a variety of reasons from protecting biodiversity and natural resources, to controlling peasant populations (Cavanagh & Himmelfarb, 2015), enclosing resources for economic gain (Benjaminsen & Bryceson, 2012; Corson, 2011; Kelly, 2011), and pacifying remote, rural areas (Massé & Lunstrum, 2016; Peluso & Vandergeest, 2011; Ybarra, 2012). These processes do not merely continue in Southern Africa and elsewhere, but they are intensifying in order to protect species like rhino and elephant from increases in illegal hunting (Lunstrum, 2014; 2016; Massé & Lunstrum, 2016).

Spatial metaphors offer important insights for conservation. Rocheleau and Roth (2007), for example, use the theory and spatial descriptor of networks to question how power works through multiple interconnections to shape the socio-ecological relations of conservation. In doing so, and paralleling the grounded empirical work of Katz and others, they call for understanding the complexity and multiple interconnections of hybrid landscapes, processes, and dynamics (Rocheleau & Roth, 2007, p. 433; also see Rocheleau, 2008). The empiricism these approaches call for is needed to "[see] multiple" and understand deeply entwined processes, spatialities, and even ecologies as part of "complex assemblages" (Rocheleau & Roth, 2007, p. 433). Both assemblage and network thinking are about conceptualising entities and processes as constituted by relations between parts that are not

always stable. Writing on policing and security, Orford (2014, xvii) thus argues that thinking in assemblages "avoids presenting a static model of power or force." Grounded, empirical analyses of how the vertical policing of conservation spaces interacts with their horizontal and political-ecological dynamics clarifies how topographies of conservation power that work to maintain artificial human-nature separations are assembled. Topography as an analytical device can thus help understand the production of particular spaces and the political-ecological relations that are constitutive of them and constituted by them.

Understanding the role of the ecological and biophysical is needed to account for the shape of topographies, networks, assemblages and their articulations with practices of spatial production and (non)state power. Attention to the material and biophysical reflects traditional notions of topography as "the detailed study and description of a place as much as to the materiality of its features or landforms more generally" (Gregory et al., 2011, p. 762). With respect to biodiversity conservation, Rocheleau and Roth (2007) highlight how the biophysical and ecological are part of the nodes in any network or web of political-/-socio-ecological relations. Accounting for these socio-material relations is thus essential to understanding the multiple spatialities of power dynamics in the context of conservation.

Analyses of the ways in which the materialities of nature shape and are shaped by processes of power and facilitate or complicate state control over people and resources is also increasingly common in political geography (Bridge, 2013; Elden, 2013; Gregory, 2016; Grundy-Warr et al., 2015; Steinberg & Peters, 2015; Sundberg, 2011). Without necessarily using the word itself, Scott (2009) speaks of topography in a quite literal sense drawing attention to how it matters for governance and the reach and effectiveness of state power, especially in rural areas. The combination of distance, lack of infrastructure, harsh landscapes and natural obstacles produce what he calls "friction of terrain" (2009, 41) that limits the ability of the state or other actors to project their power over space, people, and resources.

Here, Scott, among others, also demonstrates how marginalised populations are able to use the biophysical and topographical aspects of the terrain, including the verticality presented by mountainous regions, to tilt uneven power dynamics closer in their favour (Moore, 2005). Similar dynamics can be seen in the Mozambique-South African borderlands whereby hunting groups use the dense bush and mountains to evade surveillance and capture by anti-poaching and other security forces (also see Lunstrum, 2014). Together, this work draws attention to the ability of various actors from states to peasants to hunters to harness the socio-material realities and topographic features of space to their advantage, and more specifically to exercise and/or evade control.

As an analytical approach, topography helps make sense of the extension of state power and sovereignty over bodies, borders, and spaces, resulting in novel and more effective forms of territorialisation (Carmody, 2009; Massey, 2005; Mountz, 2013). The related analytic of assemblage is similarly used to make sense of vertical security and its politics and power dynamics (Adey et al., 2011; Crampton, 2015). What Crampton refers to as "assemblages of the vertical," for example, speaks to how vertical technologies and the spaces in which they operate do not exist on their own. Rather, they are integrated into a broader network of security and policing practices and technologies that usher in the use of vertical (and horizontal) space (Crampton, 2015; Crampton et al., 2014; Gregory, 2016). The vertical in these security and policing contexts is mobilised in part to overcome the obstacles of the natural and built environment (Adey, 2010; Adey et al., 2011; Gregory, 2016; Shaw, 2016). Taking the vertical in topography literally thus helps make sense not only of the specific processes and spatialities related to territory, security, and policing, but also of broader interconnected relations of power that they produce and reflect.

It is here where I turn to the notion of power geometries to complement the use of topography as a heuristic device to think through the connections between the production and

experience of space and the production of power. Power geometries are about power in relation to flows, mobility, and interconnections (Massey, 1993). Massey developed the concept of power geometry to explain how globalisation differently affects people and various social groups enabling some to increase their power relative to others. More specifically, power geometries are about how some groups have an increased capacity to see and understand flows and move and communicate across and through space. The latter amounts to "time-space compression" (Harvey, 1989). Like topography, power geometries are a metaphor to think through the dimensions of space and power and how they intersect. As Katz (2001, p. 1231) reminds us, doing topography entails examining "social processes in three-dimensional space." Understandings of territory are increasingly three or multi-dimensional encompassing and integrating multiple horizontal and vertical geographies (Baghel & Nüsser, 2015; Braun, 2000; Bridge, 2013; Elden, 2013b; Harris, 2015; Steinberg & Peters, 2015). Some of this work explicitly makes connections between the horizontal and vertical dimensions of territory and the biophysical resources that are found on, below, and above it (Braun, 2000; Grundy-Warr et al., 2015). Jessop (2016, p. 10), for example, highlights the manifold geophysical and spatial dimensions of territory that "provides the variable geophysical and socially appropriated 'raw material' or substratum for territorialisation as one mode of organizing space." Others examine the role altitude in mountian environments plays in shaping human-environment relations and their governance (Rudaz, 2011; Smethurst, 2000). Power and space across and above the land can thus be mobilised to territorialise in three-dimensions, thereby altering power-geometries of territorialisation itself.

Political-ecology and political-geography analyses of conservation are themselves rooted in understanding the uneven power dynamics that shape and are shaped by conservation practice as a territorial process. But, they fall short in thinking through and

accounting for the ways in which the vertical dimensions of space and power as that which exists above the terrain of conservation, especially as harnessed and made possible by technologies, might contribute to and exacerbate already existing unequal power dynamics. Explicitly addressing this gap promises to contribute to recent trends in political geography that mobilise ideas of topography, networks, assemblages, and power geometries to re-think cartographies of power, security, territorialisation, and the state (Carmody, 2009; Graham, 2004; Graham & Hewitt, 2013; Klauser, 2010; Klauser & Pedrozo, 2015; Mountz, 2013; Scott, 2008; Weizman, 2002).

This is not to say that the vertical overshadows or becomes more important than the horizontal. Summarising the work of topographies of power and sovereignty in helping to move beyond binary thinking to connections and overlaps, Mountz (2013, p. 833) points to the "productive blurring of onshore and offshore, internal and external, inside and outside in reconfigurations of sovereignty." She argues that attentiveness to this blurring and overlap is needed to understand the workings of power and the creation of exclusionary spatialities and/or topographies. In other words, a topographical analysis highlights how verticality comes to matter not necessarily on its own, but in how it articulates with existing analyses and modes of governing and policing space, resources, and people.

Protected areas are a form of state spatiality, are often an expression of state sovereignty, and have historically been used to extend and consolidate state power through exclusionary territorial means in rural and borderland areas. As I demonstrate below, a fully theorised and empirical accounting of the workings of conservation-power in the age of aerial technologies must attend to its three-dimensional and topographical configurations, or how the horizontal and vertical as dimensions of space and power in conservation security overlap and become productively blurred. It is here where we locate how security actors harness these

different dimensions to tilt power geometries in their favour and reinforce the extension of power over space, bodies, and their movement.

AERIAL TECHNOLOGIES AND GOING VERTICAL IN ANTI-POACHING

Much of the attention given to verticality in conservation focuses on the biological monitoring capabilities of aerial technologies like drones, helicopters, and planes (Arts et al., 2015; Christie et al., 2016). Mirroring dynamics in other security and policing contexts (Adey, 2010; Adey et al., 2011; Crampton, 2015; Graham, 2004; Graham & Hewitt, 2013; Pedrozo, 2017; Shaw, 2016), recent attention has turned to the use of aerial security and surveillance technologies to secure conservation territories and nature against the poaching threat (Linchant et al., 2015; Mulero-Pázmány et al., 2014; Olivares-Mendez et al., 2015; Snitch, 2015). The increasing turn to drones, helicopters, and satellites is in large part an attempt to increase the capacity of anti-poaching and other security actors to protect biodiversity, neutralise hunting groups, and ultimately secure conservation space in response to increases in commercial poaching, especially of charismatic megafauna like rhino and elephant. Keeping the nonhuman safe from threatening human circulations is the biopolitical imperative that underpins anti-poaching and is one that differentiates it from other contexts of war and policing. Building on a rich literature on conservation biopolitics (Bluwstein, 2018; Büscher & Fletcher, 2018), this is a multi-faceted imperative tied to the inherent valuing of nonhuman life (Biermann & Anderson, 2017), biodiversity as an economic asset (Cavanagh et al., 2015; Massé et al., 2018), and the framing of commercial poaching and the illegal wildlife trade (IWT) as a threat to national security (Duffy, 2014, 2016; Lunstrum, 2014; Massé et al., 2018). The latter two concern how IWT ostensibly undermines tourism and wildlife economies, has links to transnational organised crime and the putative, but unsubstantiated, links that certain forms of commercial poaching funds terrorist groups

(Duffy 2016; Kelly et al., 2018). Commercial poaching and the need to secure the nonhuman and the spaces in which it exists is being treated as security threat that attracts related resources that vitalise (state) power over people and nature (Büscher & Fletcher, 2018; Lunstrum, 2018; Marijnen, 2017).

A related political-ecological dynamic that is needed to understand the context in which the vertical comes to increasingly matter in conservation are the biophysical characteristics of many protected areas. While conservation does occur in urban contexts, this article focuses on rural protected areas and national parks. These protected areas are often characterised by harsh terrain, dense forest or bush, and enormous and varied landscapes that are bereft of infrastructure. For example, the rhino poaching hotspot of Kruger National Park, is just shy of 20,000 kms^2, and the Great Limpopo Transfrontier Conservation Area (GLTFCA) it is a part of, along with protected areas in Mozambique and Zimbabwe, is 100,000 kms^2. The Niassa National Reserve in northern Mozambique and the Selous Reserve in Tanzania, the most intense elephant poaching area in the world (Chase et al., 2016), are 42,000 km^2 and 54,000 kms^2, respectively.[1] These characteristics increase the "friction of terrain" and thus the difficulty of governing protected areas and the people and resources located within and moving through them. Protected areas are thus far from what Scott would call an "ideal state space" (2009, 41).

People who hunt illegally do use the environment and ecology to resist capture. Mirroring my own research insights, Lunstrum (2014) describes how rhino poachers in the South Africa-Mozambique borderlands use the biophysical characteristics of Kruger and the surrounding area to gain an upper hand over APUs. She describes Kruger National Park as

> a heavily forested landscape of mixed woodland and Mopani bushveld that is especially thick with vegetation in the rainy season. Much of the border also includes the

[1] Research for this paper consists of over 5 years of research into anti-poaching and conservation security in the Mozambique and South Africa parts of the GLTFCA as well as shorter periods of research in Niassa.

> undulating and rocky Lebombo Mountains, which makes for "ankle-breaking" patrols. These qualities together leave the park difficult to patrol, enabling rhino poaching teams to slip in and out of the park often undetected (Lunstrum, 2014, p. 824).

As I witnessed, the rocky ground of the Lebombo Mountains also makes tracking people nearly impossible without dogs who use their sense of smell.

Anti-poaching managers and rangers routinely extolled the knowledge and abilities of local hunters who use the landscape to cover their tracks and/or confuse rangers as to their direction of movement. Hunters use these tactics to avoid detection and capture in what is referred to as anti-tracking and counter-tracking. On several occasions, I bore witness to how hunting parties place rocks across dirt roads or tracks to step on them and avoid leaving a trace. The same individuals might also purposefully disturb an area or walk in circles to deceive rangers into thinking they went in one direction when they actually went in the opposite. This also works to confuse tracking dogs. On one occasion where this happened, the dog handler simply said, "we were outmaneuvered today."

As I demonstrate below, going aerial, or what Lunstrum (2014, p. 824) calls the turn to "technologically sophisticated vertical militarization" in protected areas like South Africa's Kruger National Park, may help overcome these challenges and tilt the power dynamics in the favour of APUs. The vertical in anti-poaching is increasingly mobilised as a dimension of power and space to police, protect, and pacify wanted and unwanted circulations below. Apart from a few studies (Duffy et al., 2015; Lunstrum, 2014; Sandbrook, 2015), however, there has been little critical analysis of the use of such technologies and verticality in conservation from a political-ecological or political geography perspective and what it means for broader debates. Explicitly incorporating the vertical into analyses of conservation-security and understanding what this might mean for conservation-related geographies and power-geometries and how we understand and study them is thus timely, if not overdue.

VERTICALITY ENABLED CHANGES IN CONSERVATION'S POWER GEOMETRIES

In developing the analytic of power-geometries, Massey (1993) draws attention to two primary ways in which certain groups are able to harness globalisation and technologies to increase their power relative to others. The first is concerned with how people come to know space and the relation between it with people and flows. The second is how some people or groups are able to experience space-time compression by taking advantage of the increased mobility of people, goods, and capital. Both dynamics increases their power relative to those who cannot do the same. Going aerial in anti-poaching and conservation policing harnesses each of these processes.

Seeing, Surveillance, and the Aerial Gaze

Surveilling the movement of people, wildlife, and the space of protected areas is the priority of anti-poaching and the foundation of the ranger patrol. Either on foot or in a truck, rangers can only surveil so much and cover so much distance. Going skywards and flying facilitates the mobility needed to surveil and monitor the enormous spaces that characterise most protected areas. At a reserve where I conducted ethnographic research into anti-poaching, the pilot did a flyover twice a day in a small-fixed wing plane. Achieving what foot and truck patrols in a 30,000 ha space cannot, these flyovers located the rhinos on the reserve, numbering anywhere from eight to twenty-five on a given day. The pilot then communicated the rhino locations to the APU so they could plot the locations in a mapping system and plan their daily operations. Adjacent to this reserve, another protected area owner flies his larger plane to locate charcoal camps and operations. The APU then uses this information to follow up and dismantle the charcoal operation in question. In the Niassa National Reserve (RNN),

management similarly uses a small Cessna plane to monitor elephant populations and locate illegal mining and logging operations in the over 40,000 km^2 protected area. As the monitoring manager explained, flying is the only way to even begin covering the area and is the only way to locate mining and logging camps and then plan operations accordingly. Moreover, flying to detect elephant populations is an important aspect of preventative anti-poaching as the information on elephant locations is used to strategise ranger deployments.

The "aerial gaze" (Adey et al., 2011, p. 175), or view from above, afforded by certain technologies complements and addresses the shortcomings of a horizontal gaze. While many cities may be "impossible to envision from the horizontal" (Adey, 2010, p. 54), the same is often true of expansive areas of conservation that are often dense in foliage or forests. Moreover, even when flat and relatively unobscured, many spaces are simply too big for the horizontal gaze to be effective. Even getting rangers on to a high point such as a hilltop for an observation post, a rather innocuous form of going vertical, is a common and effective way of surveilling the landscape in front and below.

Planes, drones, and satellites thus increase the panoptic surveillance reach of anti-poaching personnel. This is what motivates the increasing attention and resources given to drones for anti-poaching (Mulero-Pázmány et al., 2014; Olivares-Mendez et al., 2013; Olivares-Mendez et al., 2015). In each reserve I visited in Mozambique and South Africa, there were discussions about the use of drones with many having tested them, waiting for requisite legislation to allow them to further pursue their use. Going to even higher altitudes, the Anti-Poaching Engine (APE) project operating in Southern Africa uses a combination of "high resolution satellite imagery" and drones to help stop suspected poachers before they make a kill by surveilling the movements of rhinos, rangers, and potential poachers to more accurately deploy anti-poaching teams (Park et al., 2015; Snitch, 2015). Information on the movements and locations of animals and people collected from satellites and drones are fed

into algorithmic software to help predict the locations of each and prevent future poaching incidents. Similar predictive anti-poaching is used in Kruger (and to a lesser extent in the borderlands of Mozambique through partnerships with private reserves) (CSIR, 2015; also see Adams, 2018). Verticality also entails static forms of observation. In one reserve, for example, a team is developing an aerostat, a type of gas-filled balloon anchored to the ground. The idea is for the aerostat to sit high above the ground and be mounted with a camera to surveil the surrounding area, including a nearby lake adjacent to the reserve that rhino poachers use to by-pass anti-poaching rangers on patrol.

Whether by plane, drone, helicopter, or satellite, going aerial has the potential to increase the knowledge APUs have about the locations of elephants, rhinos, charcoal camps, and those who threaten them. When successful, this allows APUs to more effectively deploy rangers to that area to better protect the former and neutralise the latter. Mobility enabled increased surveillance to know where threatened animals are and then deploy rangers accordingly is one example of how changes in the way anti-poaching actors know what is in the protected area alters the ways in which they practice anti-poaching to gain an upper hand over human threats to wildlife.

Space-Time Compression in the Bush

The mobility enabled by vertical technologies also facilitates the movement and deployment of rangers and security forces. In the rainy season in many parts of Southern Africa, ground transportation in protected areas, other than walking, is simply not possible. Once the rain comes even the best 4x4s are grounded as it may take hours to move even a kilometre or two through the mud's relentless grasp. Getting above the water and mud is often the only viable option for deploying rangers and reacting to poaching incursions and incidents.

Such debilitating friction exists even in the best of conditions. In Kruger and the adjacent borderland protected areas in Mozambique, the Lebombo mountains that span the border are not only difficult obstacles for rangers, as also highlighted by Lunstrum (2014), but are nearly impossible for trucks in certain areas. If rangers detect gunshots, people, or their tracks in these areas, trucks must drop rangers where movement by vehicle is no longer possible. This can be close or can be several kilometres away. Some areas of the relatively small reserve where I conducted most of my fieldwork take upwards of an hour to get to in a truck. Walking another couple of kilometres from where the truck must stop can mean it takes an hour or two before even reaching the original spot where hunting groups may have been active or detected. Even if a carcass or suspected hunters are detected in real-time, with this delay the individuals are likely gone, perhaps even out of the protected area and free from the authority of the rangers. Following the insights of Scott (2009), in such contexts, distance is best measured not in kilometres or miles, but in the time to get from one spot to another. Reducing this temporal distance, or compressing space and time, is essential to effective anti-poaching and conservation security. As the following examples demonstrate, this is precisely what going aerial offers.

Like many days during fieldwork at a reserve in southern Mozambique, rangers detected a human entry on the fence line in mid-April of 2016. The rangers at the scene started tracking, and the newly acquired helicopter was dispatched to deploy a second team of rangers for re-enforcement. Within a matter of 15 minutes, the helicopter transported the new group of rangers to the area in what would take at minimum 45 minutes in the best of conditions by truck. The helicopter then rose up and dropped a group of rangers a few kilometres ahead to leapfrog and try to pick up the tracks further ahead to save time tracking. With the first tracking dog getting tired, the pilot went back to headquarters, loaded the second tracking dog into the helicopter, flew back to the scene, picked up the tired dog, and

deployed the new one to continue tracking. Each of these trips back and forth in a truck would be at least 45 minutes, and then a kilometre or two on foot to reach the tracking party.

In another incident, rangers in Kruger National Park were hot on the tracks of a group of people who had just killed a rhino. They communicated this to their Mozambican counterparts and a helicopter was dispatched with rangers to intercept the hunting party as they attempted to flee across the border. Using locational information gathered by ranger teams tracking on the ground, the helicopter reached the scene within minutes. The chopper landed and the Mozambican rangers proceeded to jump out and tackle the individuals in the reserve on the Mozambican side of the border leading to two arrests. Without the helicopter, it is likely that the hunting party would have successfully crossed the few kilometres needed to exit the reserve. In both these examples, the helicopter effectively overcame the friction posed by distance and terrain of the area resulting in the neutralisation of the hunting parties.

Aerial technology's ability to optimise horizontal movement across the landscapes of conservation areas reflects the "power-geometry of space-time compression" at work (Massey, 1993, p. 62). More specifically, while the friction of terrain of protected areas may "set up sharp, relatively inflexible limits to the effective reach" of the state or other actors (Scott, 2009, p. 43), the mobility, surveillance gaze, and space-time compression afforded by going vertical can help reduce such friction, and thus increase the reach of state and non-state conservation security and APUs over people, animals, and conservation space. Rather than a "distance-demolishing technology" (Scott, 2009), certain aerial technologies are friction-reducing technologies with going aerial a friction-reducing strategy. Reducing friction tilts conservation's power geometries in the favour of APUs who can more effectively know and control space, resources, bodies, and their movement. Verticality enabled space-time compression can facilitate more efficient deployment of rangers, canines, and therefore more effective tracking and responses. The advantage this produces can be so fundamental that in

protected areas where helicopters exist, APUs often keep a reaction team on stand-by to be deployed at a moment's notice instead of merely relying on rangers patrolling in the bush to react. Put another way, the potential shift in power geometries afforded by helicopters and going vertical has altered the very ways in which anti-poaching is practiced and conducted.

What also becomes clear in these cases is how aerial technologies in anti-poaching are not concerned with securing the vertical as a dimension of space for its own purposes. Rather, the vertical as a dimension of space and power is harnessed to surveil, secure, police, pacify, and ultimately know and exert control over (un)wanted circulations of people, space, and resources of an area below. This is conservation territorialisation from above.

TOPOGRAPHIES OF CONSERVATION SECURITY: INTEGRATING THE VERTICAL, HORIZONTAL, AND ECOLOGICAL

Moving beyond the vertical, a topographical analysis must interrogate the ways in which horizontal and vertical space, practices, and technologies of conservation and other socio-spatial and contexts are blurred. It is in the blurring that the actually-existing workings and coming together of multiple dimensions of space and power that reify protected areas as exclusionary territories emerge.

Bringing the Vertical and Horizontal Together

Proponents of technologies for anti-poaching and protected area management highlight how it is the integration of technologies that leads to more effective monitoring and surveillance as it produces scalability across time and space. As Marvin et al. argue, scalable and replicable models of protected area management, including anti-poaching, come from "combining patrol and remote sensing monitoring tools" (2016, p. 2720). Put another way, the aerial technologies of security and surveillance as manifested in a drone are part of an

assemblage of security, technologies, practices, and spatialities. It is in this integration that they become truly effective, and concerning.

The creator of APE explains the power and utility of aerial technologies his team uses, namely drones and satellite imagery:

> The real game changer is our use of unmanned aerial vehicles (UAVs) or drones, which we have been flying in Africa since May 2013. We've found that drones, combined with other more established technology tools, can greatly reduce poaching – but only in those areas where rangers on the ground are at the ready to use our data (Snitch, 2015, emphasis added).

The aerial technologies of drones are only useful in shifting power-geometries insofar as they are combined with technologies (old and new) and personnel on the ground.

Indeed, personnel on the ground are vital to securing conservation space. The bodies of the rangers, in combination with the monitored bodies of wildlife, reflect the "corporography" of anti-poaching. Writing on the Vietnam War, Gregory uses the term corporography as opposed to cartography to describe how even with all the technologies – including helicopters, aerial bombing, and surveillance by planes and satellites – the battlespace of Vietnam "depended on the bodies of soldiers" (Gregory, 2016, p. 4).[2] Corporography draws attention to the material importance of ground troops and their bodies and activities. Rangers who move horizontally across the ground are indeed the most important asset in anti-poaching and in protecting wildlife. Moreover, when they are not patrolling on foot, the majority of their movement is facilitated by ground transportation, not plane or helicopter. It is in the integration of vertical and horizontal technologies, spaces, and practices that the coalescing of multiple dimensions and spaces of power to protect the bodies of wildlife and the space in which they exist begins to emerge.

Low-tech interventions like dogs, another body in anti-poaching's corporography, also help rangers track more quickly and effectively across the ground. Fences, a rather

[2] He also focuses on how vertical and horizontal technologies and spaces were integrated.

innocuous barrier technology, are fundamental to anti-poaching's monitoring efforts. By forcing people to go above, through, or below fences, would-be hunters leave traces of their movement. These are the primary signs of an incursion detected by rangers on a daily basis. Other high-tech security and surveillance solutions are being sought that are themselves horizontal. These include cameras, and motion and seismic sensors around perimeters of protected areas (Arts et al., 2015; Hossain et al., 2016; van der Wal & Arts, 2015). Perhaps the best example of an effective and new horizontal technology comes from Kruger and is known as Meerkat. Meerkat is a mobile anti-poaching surveillance system that can be moved around Kruger and is placed on the ground. It includes a suite of surveillance technologies like radar, long-range electro-optic sensors, and night vision to detect, track, and surveil people within its boundaries and moving horizontally across the plane of Kruger's space (CSIR, 2016; PPF, 2017). The information gathered by Meerkat not only helps detect and surveil people, but much like drones, satellites and flyovers is also used to deploy rangers and reaction teams to neutralise them. Moreover, and representing the integration of multiple spatialities and dimensions of power to harness the three-dimensionality of conservation space, once Meerkat detects an individual or group of individuals the reaction team often deploys by helicopter to reduce the friction posed by distance and the harsh terrain below This helps compress space and time thereby altering the power-geometries in favour of the APU. Indeed, no topography is complete without an analysis of how the multiple horizontal and vertical dimensions of space and power articulate with the natural landscape and related political-ecological dynamics.

Bringing Nature In

Understanding the multiple spatialities of conservation security and the relationship between them entails paying adequate attention to their articulation with the (bio)physical

characteristics of space, environments, and resources (Bakker & Bridge, 2006; Sundberg, 2011). Here I more explicitly account for the ecological as an aspect of the topographies of conservation security and how it articulates with the vertical and the interplay between the vertical and horizontal. There are three points of articulation I wish to highlight.

First, which I have discussed at length, is that nature is an obstacle to overcome. Going vertical is a way to exert power and control over the natural environment and its obstacles to more effectively surveil and neutralise people who are deemed to pose a threat to nonhuman life. Put simply, power over nature made possible by exploiting and integrating vertical and horizontal technologies and spaces facilitates a governing and knowledge power over space and bodies moving through it.

Second, where conservation security differs from other contexts such as policing and contexts of war is that nature does not only enter the picture as an obstacle to be overcome or pacified, but as the object of biopolitical, or life sustaining, protection. This is rather self-evident as rangers and anti-poaching personnel seek to protect wildlife and other natures. However, while mobilising the multi-dimensionality of space and power serves to enhance the life-sustaining features of conservation spaces for the nonhuman, it can also strengthen the life-taking abilities of APUs and other security actors by increasing their capacity to neutralise transgressors, like rhino hunters. As such, harnessing and integrating the vertical and horizontal through various practices and technologies extends, enhances, and reproduces biopolitical and sovereign power and space in the defence of the nonhuman.

Third, non-human natures and landscapes do not passively accept power exerted over them by aerial or other means. They resist and enable resistance, contributing to the interplay between conservation's multiple spatialities. Harnessing the three-dimensionality of conservation space to territorialise the horizontal terrain of protected areas below has its limitations. This is the point of articulation that I elaborate here.

Nature resists and disrupts the grasp and gaze of aerial technologies. Thermal sensors on drones and aircraft mistake animals for people (Martin, 2017), the thick bush distorts acoustic sensors and gunshot location systems (Reuters, 2014), and wildlife and livestock trip seismic and motion sensors. Moreover, animals like rhinos and elephants that are monitored for protection purposes are also constantly on the move. They change locations and find cover under trees from the hot sun inadvertently hiding themselves from overhead surveillance. As I witnessed, this is particularly problematic in terms of surveilling white rhinos as they spend much of the sunny parts of the day hidden under trees and shrubs making them almost undetectable to aerial surveillance. Rangers must then be deployed on foot to find them, as was a regular occurrence during my fieldwork patrols. In addition, many conservationist managers acknowledge that most protected areas are simply too big for drones to be effective (Interviews 06/2016). Even when planes and helicopters are available, it is impossible for them to monitor everywhere every day, nor can one pierce through the foliage or see human tracks from the sky. Here too the physical presence of rangers and on the ground technologies are as vital as ever.

Despite the publicity surrounding them, drones are particularly vulnerable to nature's uncooperative temperament. After a year-long test phase for the use of drones in Kruger National Park, drones failed to detect a single hunting party. Authorities decided to not use drones as part of their anti-poaching tool-kit (Martin, 2017). Drones were cited as ineffective because they do not have the requisite payload needed for infra-red and thermal sensors or cameras that are necessary to see through the foliage to detect people. The testing of drones also failed in the RNN (Personal Communication, 06/2016). Even though they managed to get off the ground, the reserve is simply too big for drones to be of use because of their limited range. It is thus possible that drones lend themselves better to more compact urban environments than expansive rural areas, drawing attention to what are perhaps the limited

topographies of drone power and effectiveness. This might be used to inform a re-direction of resources away from drones in anti-poaching to more community-oriented conservation to complement existing law enforcement approaches.

Just like wildlife, hunters too resist aerial surveillance and they use the environment to do so. Rhino hunters in Kruger and southern Mozambique tend to move at night and spend most of the day bunkered down under trees or shrubs to avoid detection when the plane, drone, or helicopter may be flying. As the pilot for one reserve explained: flying the micro-lite plane is near useless when it comes to detecting people. All they must do is stay put under a tree or shrub and they remain undetected. The Mission Area Manager for Special Projects in Kruger, explains "our opponents are skillful, formidable people who know how to navigate in the thick of the night, taking cover under leaves and grass. You can't win this war with helicopters and drones, the bush is too dense" (Reuters, 2014). Like rhinos hidden under shrubs, the strategy in such cases is to send rangers on foot to sweep areas of concern. Sometimes they are accompanied by canine units to improve detection and force the suspected hunting party out of hiding. Technologies like Meerkat also come to assist by surveilling through a horizontal gaze.

The Kruger National Park and Sabie Game Park that are at the heart of disrupting rhino poaching also lie adjacent the lake created by the damming of the Sabié River that flows into Kruger National Park when the water is high. While liquid, this unique biophysical characteristic and spatiality poses a serious thorn in the side of the parks' anti-poaching efforts. The lake and its flow into Kruger acts as a major thoroughfare for poaching groups. Given that the body of water is not within the concession of Sabie or the jurisdiction of Kruger National Park, anti-poaching personnel cannot patrol or police it.[3] With boats allowed

[3] Drafts of a new Dam Management Plan and interviews with consultants working on the plan indicate anti-poaching patrols will be allowed on the water in the future.

on the water during fishing season, poachers disguise themselves as fishermen and stay on the lake until they are confident there are no rangers on the shoreline. They then approach the boundary of Kruger debarking on SGP's shore and proceed on foot. At night, many hunting parties use the cover of darkness and quietly row small boats from the opposite shoreline to SGP where they similarly proceed on foot under cover of darkness to Kruger or elsewhere in SGP. As SGP does not have the authority to patrol on the water, one technology that was under development during my fieldwork was an aerostat, a gas-filled balloon anchored to the ground and equipped with long-distance video cameras to surveil the water from above and send video back to the anti-poaching control room (Personal Communication, 08/2015). Even for terrestrial conservation, the spaces and materiality of water within, beyond, and flowing through protected areas become important and articulate with the horizontal and vertical dimensions of conservation space and power.

Topography and (conservation) power geometries

What a topographical approach brings to the fore is that while aerial technologies may be effective in certain ways, an overdetermined focus on the vertical (or the horizontal) in conservation security, or elsewhere, may partially blind us to the actually-existing workings of power and related security practices and technologies on-the-ground and how they work to (re-)shape human-environment interactions and (re-)produce protected areas as enclosures. Indeed, Meerkat, a non-aerial technology, has been much more successful in detecting suspected poachers in Kruger than the failed drone test phase (Mahlakoana, 2017). While this may exemplify the limitations of aerial technologies' effectiveness, this is not to say that verticality is not productive even when technologies like drones are less-than effective in exercising direct power over nature and people.

Thinking beyond a narrow idea of anti-poaching effectiveness, the productive elements of verticality in relation to political economies and geographical imaginaries are all too real. The mere promises of tilting power geometries that aerial technologies offer shores up conservation and territorialising power in in other ways. For one, the spectacular nature of aerial technologies and what they offer is productive in attracting funds for anti-poaching and related organisations that promote (para)militarised approaches to conservation (Duffy & Humphreys, 2014; Lunstrum, 2018). Drawing on Lunstrum (2018), the very partnerships with aerospace, technology, and military-security actors and the production of new political-economies in the pursuit of conservation-security enable the state and non-state actors to access capital and expertise that can serve to "vitalize" and consolidate state power over space and resources, even if the technology itself fails.

Second, Bluwstein and Lund (2018) draw attention to conservation's "double territorialisation – of landscape and of mind." They examine how even when territorial conservation interventions seeking to re-order socio-natural configurations fail on the ground, they remain productive in shaping conservation imaginaries thereby perpetuating the creation of particular types of (exclusionary) conservation spatialities. Following Massey's insights concerning knowledge-related power-geometries, research in other contexts suggests that geographical knowledge, and the promises of such knowledge, produced and enabled by aerial technologies do indeed work to re-shape how people envision and thus produce and govern space and socio-spatial relations (Pedrozo, 2017; Shaw, 2016; Shim, 2014). Do aerial technologies have the potential to have a similar double-territorialising effect whereby they might contribute to novel processes and dynamics of conservation territorialisation by facilitating a power over space, resources, and people, yet also influence how people think and envision conservation-security and anti-poaching in simplistic terms (see for e.g. Sandbrook, 2015), even when they fail? If so, what is it about them? And is there something

specific about their claim to verticality that enables this? Given the increasing turn to technological fixes for conservation and other securities, these questions merit further investigation.

CONCLUSION

I have argued that topography is a useful analytic to account for the vertical and horizontal dimensions of space, power, and the ways in which they articulate with ecologies, the natural and built environment, and their politics to (re)-shape socio-spatial and socio-natural relations. I apply this approach to analyse and understand the multi-dimensionality of space and power in conservation security. I examined how aerial technologies and the practices they enable help to extend state-sanctioned power vertically, but also horizontally, over the landscapes of protected areas to gain the upper hand over unwanted circulations and bodies below. This is achieved through reducing the friction of terrain and the limits of a horizontal gaze thereby increasing the mobility and surveillance capacities of anti-poaching and security forces. The result is a tilting in the power geometries to facilitate more effective control over space, resources, bodies, and their movement that reinforces and re-produces conservation territoriality from above.

However, a thorough understanding of the (changing) power geometries of conservation requires an engagement with empirical research and an analytical lens that focuses on the productive coming together of that which moves across and above the terrain of protected areas and its articulation with related political-ecological dynamics. This is the value in thinking topographically: ensuring that the focus is not on one dimension or dynamic over the other, but on the ways in which they interact. Not accounting for and understanding these multiple aspects of security and environmental politics risks losing sight of how security technologies and practices operate on-the-ground and are used in effective, but also

repressive and oppressive ways that strengthen and reify exclusionary territorial formations and relations. Indeed, while a focus on verticalisation may be intriguing, attention grabbing, and warranted, an overdetermined focus on verticality may miss the nuanced but nonetheless productive and problematic ways in which anti-poaching, conservation-power, and security more broadly operate and are resisted. Moreover, the "power" of aerial technologies may not lie necessarily in their ability to neutralise poaching, per se, but in the ways in which the vertical becomes enrolled in producing conservation-related political economies and geographical imaginaries that further contribute to an exclusionary shaping of human-environment and socio-spatial relations. More research on this topic is needed.

In this respect, thinking topographically to understand the multiple spatialities and dimensions through which conservation operates to secure nature and control certain people and activities is vital to locate the actually-existing dynamics of conservation-related power and how they are productive and constitutive of conservation and broader state space, power, and territory in the name of controlling human-environment interactions. This offers promising insights for others contexts characterised by contestations over space, resources, and mobility, especially where we see a turn to aerial and vertical technologies.

WORKS CITED

Adams, J. S. (1992). The myth of wild Africa: conservation without illusion. Berkely, CA: University of California Press.

Adams, W. M. (2018). Conservation by Algorithm. Oryx, 52(1), 1-2.

Adey, P. (2010). Vertical security in the megacity: legibility, mobility and aerial politics. Theory, culture & society, 27(6), 51-67.

Adey, P., Whitehead, M., & Williams, A. J. (2011). Introduction: Air-target: Distance, reach and the politics of verticality. Theory, culture & society, 28(7-8), 173-187.

Arts, K., van der Wal, R., & Adams, W. M. (2015). Digital technology and the conservation of nature. Ambio, 44(4), 661-673.

Bakker, K., & Bridge, G. (2006). Material worlds? Resource geographies and the matter of nature'. Progress in Human Geography, 30(1), 5-27.

Benjaminsen, T. A., & Bryceson, I. (2012). Conservation, green/blue grabbing and accumulation by dispossession in Tanzania. Journal of Peasant Studies, 39(2), 335-355.

Biermann, C., & Anderson, R. M. (2017). Conservation, biopolitics, and the governance of life and death. Geography Compass, 11(10).

Bluwstein, J. (2018). From colonial fortresses to neoliberal landscapes in Northern Tanzania: a biopolitical ecology of wildlife conservation. Journal of Political Ecology, 25(1), 144-168.

Bluwstein, J., & Lund, J. F. (2018). Territoriality by conservation in the Selous–Niassa corridor in Tanzania. World Development, 101, 453-465.

Braun, B. (2000). Producing vertical territory: geology and governmentality in late Victorian Canada. Cultural Geographies, 7(1), 7-46.

Bridge, G. (2013). Territory, now in 3D! Political Geography(34), 55-57.

Brockington, D. (2002). Fortress conservation: the preservation of the Mkomazi Game Reserve, Tanzania. Bloomington: Indiana University Press.

Büscher, B., & Fletcher, R. (2018). Under Pressure: Conceptualising Political Ecologies of Green Wars. Conservation and Society, 16(2), 105-113.

Carmody, P. (2009). Cruciform sovereignty, matrix governance and the scramble for Africa's oil: Insights from Chad and Sudan. Political Geography, 28(6), 353-361.

Carruthers, J. (1995). The Kruger National Park: a social and political history. Peitermaritzburg, South Africa: University of Natal Press.

Cavanagh, C. J., & Himmelfarb, D. (2014). "Much in Blood and Money": Necropolitical Ecology on the Margins of the Uganda Protectorate. Antipode, 47(1), 55-73.

Cavanagh, C. J., Vedeld, P. O., & Trædal, L. T. (2015). Securitizing REDD+? Problematizing the emerging illegal timber trade and forest carbon interface in East Africa. Geoforum, 60, 72-82.

Chase, M. J., Schlossberg, S., Griffin, C. R., Bouché, P. J. C., Djene, S. W., Elkan, P. W., . . . Sutcliffe, R. (2016). Continent-wide survey reveals massive decline in African savannah elephants. PeerJ, 4, e2354-2324.

Christie, K. S., Gilbert, S. L., Brown, C. L., Hatfield, M., & Hanson, L. (2016). Unmanned aircraft systems in wildlife research: current and future applications of a transformative technology. Frontiers in Ecology and the Environment, 14(5), 241-251.

Corson, C. (2011). Territorialization, enclosure and neoliberalism: non-state influence in struggles over Madagascar's forests. Journal of Peasant Studies, 38(4), 703-726.

Crampton, J. W. (2015). Assemblage of the vertical: commercial drones and algorithmic life. Geographica Helvetica, 71(2), 137-146.

Crampton, J. W., Roberts, S. M., & Poorthuis, A. (2014). The new political economy of geographical intelligence. Annals of the Association of American Geographers, 104(1), 196-214.

CSIR (Producer). (2015) Cmore supports counter-poaching operations in the Kruger National Park. Retrieved from http://cmore.co.za/site/index.php/archives/268

CSIR. (2016). Launch of Postcode Meerkat Surveillance System in Kruger National Park.

Duffy, R. (2014). Waging a war to save biodiversity: the rise of militarized conservation. International Affairs, 90(4), 819-834.

Duffy, R. (2016). War, by conservation. Geoforum, 69, 238-248.

Duffy, R., & Humphreys, J. (2014). Mapping Donors: Key Areas for Tackling Illegal Wildlife Trade (Africa and Asia). Evidence on Demand and the UK Department for International Development.

Duffy, R., St John, F., Büscher, B., & Brockington, D. (2015). The militarization of anti-poaching: undermining long term goals? Environmental Conservation, 42(04), 345-348.

Elden, S. (2013). Secure the volume: Vertical geopolitics and the depth of power. Political Geography, 34, 35-51.

Fairhead, J., Leach, M., & Scoones, I. (2012). Green Grabbing: a new appropriation of nature? Journal of Peasant Studies, 39(2), 237-261.

Ferguson, J. (2014). Transnational topographies of power: beyond" the State" and" civil society" in the study of African politics. Occasional paper(19), 45-71.

Fletcher, R. (2018). License to Kill: Contesting the Legitimacy of Green Violence. Conservation and Society, 16(2), 147-156.

Foucault, M. (2007[1973]). The force of flight. In J. W. Crampton & S. Elden (Eds.), Space, Power and Knowledge, 169-172. New York, NY: Picador.

Graham, S. (2004). Vertical geopolitics: Baghdad and after. Antipode, 36(1), 12-23.

Graham, S., & Hewitt, L. (2013). Getting off the ground: On the politics of urban verticality. Progress in Human Geography, 37(1), 72-92.

Gregory, D. (2016). The natures of war. Antipode, 48(1), 3-56.

Gregory, D., Johnston, R., Pratt, G., Watts, M., & Whatmore, S. (2011). The dictionary of human geography. West Sussex, UK: John Wiley & Sons.

Grundy-Warr, C., Sithirith, M., & Li, Y. M. (2015). Volumes, fluidity and flows: rethinking the 'nature'of political geography. Political Geography(45), 93-95.

Gupta, A., & Ferguson, J. (1997). Culture, power, place: Explorations in critical anthropology. Durham, North Carolina: Duke University press.

Harvey, D. (1989). The conditions of postmodernity: An enquiry into the origins of cultural change: Oxford, UK: Blackwell.

Hossain, A. N. M., Barlow, A., Barlow, C. G., Lynam, A. J., Chakma, S., & Savini, T. (2016). Assessing the efficacy of camera trapping as a tool for increasing detection rates of wildlife crime in tropical protected areas. Biological Conservation, 201, 314-319.

Jessop, B. (2016). Territory, politics, governance and multispatial metagovernance. Territory, Politics, Governance, 4(1), 8-32.

Katz, C. (2001). On the grounds of globalization: a topography for feminist political engagement. Signs: Journal of Women in Culture and Society, 26(4), 1213-1234.

Kelly, A. B. (2011). Conservation practice as primitive accumulation. Journal of Peasant Studies, 38(4), 683-701.

Pennaz, A. K., Ahmadou, M., Moritz, M., & Scholte, P. (2018). Not Seeing the Cattle for the

Elephants: The Implications of Discursive Linkages between Boko Haram and Wildlife Poaching in Waza National Park, Cameroon. Conservation and Society, 16(2), 125-135.

Klauser, F. (2010). Splintering spheres of security: Peter Sloterdijk and the contemporary fortress city. Environment and Planning D: Society and Space, 28(2), 326-340.

Klauser, F., & Pedrozo, S. (2015). Power and space in the drone age: a literature review and politico-geographical research agenda. Geographica Helvetica, 70(4), 285-293.

Linchant, J., Lisein, J., Semeki, J., Lejeune, P., & Vermeulen, C. (2015). Are unmanned aircraft systems (UASs) the future of wildlife monitoring? A review of accomplishments and challenges. Mammal Review, 45(4), 239-252.

Lunstrum, E. (2013). Articulated sovereignty: extending Mozambican state power through the Great Limpopo Transfrontier Park. Political Geography, 36, 1-11.

Lunstrum, E. (2014). Green Militarization: Anti-Poaching Efforts and the Spatial Contours of Kruger National Park. Annals of the Association of American Geographers, 104(4), 816-832.

Lunstrum, E. (2016). Green grabs, land grabs and the spatiality of displacement: eviction from Mozambique's Limpopo National Park. Area, 48(2), 142-152.

Lunstrum, E. (2018). Capitalism, Wealth, and Conservation in the Age of Security: The Vitalization of the State. Annals of the American Association of Geographers. 1-16.

Mahlakoana, T. (2017). Kruger Park Reclaims the Night From Poachers. iOL. Retrieved from http://www.iol.co.za/news/crime-courts/kruger-park-reclaims-the-night-from-poachers-8322673

Marijnen, E. (2017). The 'green militarisation' of development aid: the European Commission and the Virunga National Park, DR Congo. Third World Quarterly, 1-17.

Martin, G. (2017). No more drones for Kruger. Defenceweb. Retrieved from http://www.defenceweb.co.za/index.php?option=com_content&view=article&id=47259:no-more-drones-for-kruger&catid=35:Aerospace&Itemid=107

Marvin, D. C., Koh, L. P., Lynam, A. J., Wich, S., Davies, A. B., Krishnamurthy, R., . . . Asner, G. P. (2016). Integrating technologies for scalable ecology and conservation. Global Ecology and Conservation, 7, 262-275.

Massé, F. (2016). The Political Ecology of Human-Wildlife Conflict: Producing Wilderness, Insecurity, and Displacement in the Limpopo National Park. Conservation & Society, 14(2), 100-111.

Massé, F., & Lunstrum, E. (2016). Accumuation by securitization: Commercial poaching, neoliberal conservation, and the creation of new wildlife frontiers. Geoforum, 69, 227-237.

Massé, F., Lunstrum, E., & Holterman, D. (2018). Linking green militarization and critical military studies. Critical Military Studies, 4(2), 201-221.

Massey, D. (1993). Power-geometry and a progressive sense of place. Mapping the futures: Local cultures, global change, 1, 59-69.

Massey, D. (2005). For space. Thousand Oaks, CA: SAGE.

Moore, D. S. (2005). Suffering for territory: Race, place, and power in Zimbabwe: Cambridge, UK: Cambridge Univ Press.

Mountz, A. (2013). Political geography I: Reconfiguring geographies of sovereignty. Progress in Human Geography, 37(6), 829-841.

Mulero-Pázmány, M., Stolper, R., Van Essen, L., Negro, J. J., & Sassen, T. (2014). Remotely piloted aircraft systems as a rhinoceros anti-poaching tool in Africa. Plos One, 9(1), 1-10.

Murdoch, J., & Pratt, A. C. (1997). From the power of topography to the topography of power. Contested countryside cultures: otherness, marginalisation and rurality, Routledge, London, 51-69.

Neumann, R. (1998). Imposing wilderness: Struggles over livelihood and nature preservation in Africa. Berkeley: University of California Press.

Neumann, R. (2001). Africa's 'last wilderness' reordering space for political and economic control in colonial Tanzania. Africa, 71(4), 641-665.

Olivares-Mendez, M. A., Bissyandé, T. F., Somasundar, K., Klein, J., Voos, H., & Le Traon, Y. (2013). The NOAH project: Giving a chance to threatened species in Africa with UAVs. Paper presented at the International Conference on e-Infrastructure and e-Services for Developing Countries.

Olivares-Mendez, M. A., Fu, C., Ludivig, P., Bissyandé, T. F., Kannan, S., Zurad, M., . . . Campoy, P. (2015). Towards an Autonomous Vision-Based Unmanned Aerial System against Wildlife Poachers. Sensors, 15(12), 31362-31391.

Park, N., Serra, E., Snitch, T., & Subrahmanian, V. (2015). APE: A Data-Driven, Behavioral Model-Based Anti-Poaching Engine. IEEE Transactions on Computational Social Systems, 2(2), 15-37.

Pedrozo, S. (2017). Swiss military drones and the border space: a critical study of the surveillance exercised by border guards. Geographica Helvetica, 72(1), 97.

Peluso, N. L., & Vandergeest, P. (2011). Political Ecologies of War and Forests: Counterinsurgencies and the Making of National Natures. Annals of the Association of American Geographers, 101(3), 587-608.

PPF. (2017). No more 'hiding in the dark' for poachers netering Kruger National Park. Retrieved from http:///www.peaceparks.org/news.php?mid+1725&pid=1696.

Reuters. (2014). South Africa tries gunfie location system to catch rhino poachers. Defenceweb. Retrieved from http://www.defenceweb.co.za/index.php?option=com_content&view=article&id=36159:south-africa-tries-gunfire-location-system-to-catch-rhino-poachers&catid=87:border-security

Rocheleau, D. (2008). Political ecology in the key of policy: From chains of explanation to webs of relation. Geoforum, 39(2), 716-727.

Rocheleau, D., & Roth, R. (2007). Rooted networks, relational webs and powers of connection: Rethinking human and political ecologies. Geoforum, 38(3), 433-437.

Rudaz, G. (2011). The cause of mountains: the politics of promoting a global agenda. Global Environmental Politics, 11(4), 43-65.

Sandbrook, C. (2015). The social implications of using drones for biodiversity conservation. Ambio, 44(4), 636-647.

Scott, H. V. (2008). Colonialism, landscape and the subterranean. Geography Compass, 2(6), 1853-1869.

Scott, J. C. (2009). The art of not being governed: An anarchist history of upland Southeast Asia. New Haven, CT: Yale University Press.

Shaw, I. (2016). Scorched Atmospheres: The Violent Geographies of the Vietnam War and the Rise of Drone Warfare. Annals of the American Association of Geographers, 106(3), 688-704.

Shim, D. (2014). Remote sensing place: Satellite images as visual spatial imaginaries. Geoforum, 51, 152-160.

Smethurst, D. (2000). Mountain geography. Geographical Review, 90(1), 35-56.

Snitch, T. (2015). Satellites, mathematics and drones take down poachers in Africa. The Conversation. Retrieved from https://theconversation.com/satellites-mathematics-and-drones-take-down-poachers-in-africa-36638

Spierenburg, M., & Wels, H. (2006). " Securing Space" Mapping and Fencing in Transfrontier Conservation in Southern Africa. Space and Culture, 9(3), 294-312.

Steinberg, P., & Peters, K. (2015). Wet ontologies, fluid spaces: Giving depth to volume through oceanic thinking. Environment and Planning D: Society and Space, 33(2), 247-264.

Sundberg, J. (2011). Diabolic Caminos in the Desert and Cat Fights on the Rio: A Posthumanist Political Ecology of Boundary Enforcement in the United States-Mexico Borderlands. Annals of the Association of American Geographers, 101(2), 318-336.

van der Wal, R., & Arts, K. (2015). Digital conservation: An introduction. Ambio, 44(Suppl 4), 517.

Vandergeest, P., & Peluso, N. L. (1995). Territorialization and state power in Thailand. Theory and Society, 24(3), 385-426.

Weizman, E. (2002). The Politics of Verticality. Open Democracy. Retrieved from https://www.opendemocracy.net/ecology-politicsverticality/article_801.jsp.

Ybarra, M. (2012). Taming the jungle, saving the Maya Forest: sedimented counterinsurgency practices in contemporary Guatemalan conservation. Journal of Peasant Studies, 39(2), 479-502.