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Law enforcement technologies and the government of conservation from international conferences to Indonesian protected areas

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Abstract

Places dedicated to the protection of wildlife have not escaped the spread of monitoring and surveillance technologies. Systems enabling the collection and analysis of data to support the enforcement of conservation regulations have become commonplace in protected areas over the last ten years. Yet the influence these technologies have on the processes of government of protected areas and vice versa have been relatively little analysed and documented. This thesis explores these relationships.

I adopted a qualitative multi-sited approach to follow conservation technologies from the non-governmental organisations and international conferences where they are designed and promoted to some of the protected areas and conservation organisations where they are used in North and Eastern Sumatra, Indonesia.

This research highlights three important dimensions of the relationship between surveillance technologies and the government of protected areas. Firstly, I analyse the relationships between international non-governmental organisations, donors and states which structure the mainstream conservation sector and the government of protected areas. I argue that these relationships shape the choice of hardware and software deployed for conservation in biodiversity-rich regions. Secondly, I found that, through the tasks associated with their use and the enhanced staff oversight they enable, surveillance technologies affect the work of field conservation staff. Thirdly, I focus how what goes on in protected areas is framed and documented through surveillance technologies. I show that this knowledge feeds into both technocratic and policing-inspired approaches to protected areas management. Finally, I suggest that some of the ways in which these systems are currently used present under-acknowledged risks for in-situ conservation of endangered wildlife.

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List of Acronyms

AI	Artificial Intelligence
ASEAN	Association of Southeast Asian Nations
AWS	Amazon Web Services
BAPENAS	Indonesian Ministry of National Development Planning
BKSDA	Indonesian Offices for the Conservation of Natural Resources
CI	Conservation International
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
FFI	Fauna and Flora International
GAFA	Google, Apple, Facebook and Amazon
GAKKUM	Indonesian Ministry of Environment and Forestry's Direction for Law Enforcement
GIS	Geographic Information System
GPS	Global Positioning System
GSM	Global System for Mobile Communications
INGO	International Non-Governmental Organisation
INTERPOL	International Criminal Police Organization
IOT	Internet Of Things
IUCN	International Union for the Protection of Nature
IUU	Illegal, unreported and unregulated fishing
KKP	Indonesian Ministry of Maritime Affairs and Fisheries
KLHK	Indonesian Ministry of Environment and Forestry
KSDAE	Indonesian Ministry of Environment and Forestry's Direction for the Conservation of Natural Resources and Ecosystems
METT	Management Effectiveness Tracking Tool
M-STrIPES	Monitoring System for Tigers - Intensive Protection and Ecological Status

NGO	Non-governmental Organisation
PAWS	Protection Assistant for Wildlife Security
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SIMONTANA	National Forest Monitoring System
SIGN-SMART	National Greenhouse Gas Inventory System
SMART	Spatial Monitoring and Reporting Tool
SMART-RBM	Spatial Monitoring and Reporting Tool – Resort Based Management
UAV	Unmanned Aerial Vehicles
UGM	Universitas Gadjah Mada
UK	United Kingdom
UNDP	United Nations Development Programme
UNEP	United Nation Environment Programme
UNEP-WCMC	United Nation Environment Programme - World Conservation Monitoring Centre
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNODC	United Nations Office on Drugs and Crime
US	United States of America
USAID	United States Agency for International Development
VOC	Dutch / United East India Company
WCS	Wildlife Conservation Society
WWF	World Wildlife Fund
ZSL	Zoological Society of London

Introduction

This thesis explores the relationship between conservation law enforcement technologies and the governance and management of protected areas in Indonesia. Through an analysis of the design, implementation and use of surveillance technologies for wildlife conservation in Indonesia, I make an important contribution to debates in conservation social science. I bring new insights to discussions on the social, ethical and political aspects of surveillance systems used by those in charge of protecting the environment.

Over the last ten years, technologies which emerged from military research and have long had civil and commercial applications have increasingly been experimented with and adopted in conservation practice. International conservation non-governmental organisations (INGOs) and national wildlife protection agencies have taken an interest in tools such as data and analysis management software, artificial intelligence applications, unmanned aerial vehicles (UAVs or drones) and satellite detection systems. These tools can be considered as surveillance tools. They are used to gather and analyse information about protected ecosystems, animals and plants but also about people who might threaten them. The aim is to produce comprehensive and timely insights into the state of biodiversity as well as to help quell illicit activities such as poaching and logging that endanger it. Indeed, these technical investments accompany a turn of many conservation institutions towards a focus on preventing and countering activities defined as wildlife crime, starting with training and equipping conservation officials on the ground as law enforcement agents.

Law enforcement technologies are designed to help curb illicit activities by people transgressing the rules of protected areas, but I shift the focus away from the behaviour of those at odds with the law. I give emphasis to the perspectives of and interactions between conservation professionals involved in the development, implementation and use of monitoring technologies. Indeed, the overall question I set out to address in this thesis is: **in what ways do the development and use of surveillance systems and the management of protected areas mutually influence each other**? I was interested in finding out more about how law enforcement technologies are shaped by the way the many stakeholders making decisions about protected areas such as INGOs, donors, states, protected area managers and employees work and interact. I was also looking to uncover how in turn technologies influence conservation professionals' practices and interactions. In order to shed light on these issues, I ask and answer three intermediary questions:

a) How do the power relationships structuring the conservation sector relate to the design and acquisition of technologies that are deployed in protected areas? I examine this aspect in Chapter 3, 4 and 5.
b) Secondly, how do monitoring and surveillance systems influence the work practices of conservation staff and what is expected of them? This is the topic of Chapter 6 and 7.
c) Finally, what knowledge and visibilities do surveillance tools produce about the threats faced by wildlife and responses to these threats? Chapter 8 provides answers to this question.

My argument is built on a case study of one particular system, the Spatial Monitoring and Reporting Tool (SMART). I follow SMART from the INGOs and international workshops where it is developed to protected areas and conservation offices in Sumatra, Indonesia, where it is implemented. Along the way, I also learn from examples of other technologies used for conservation law enforcement in Indonesia as well as from other contexts where SMART has been implemented.

Theoretically speaking, I consider the governance and management of protected areas as a form of government. This approach is inspired by the work of Foucault and those who have interpreted his writing and applied his theories to understand people's relationship to the environment (Agrawal, 2005; Rutherford, 2007; Fletcher and Cortes-Vazquez, 2020). Indeed, as I explain in more detail in Chapter 1, decisions and activities relating to protected areas can be considered as government, a series of 'techniques and procedures for directing human behaviour' (Rose, O'Malley and Valverde, 2006:83). Framing the process of administering protected areas as a form of government enables me to break down this phenomenon into the components of government identified by Foucault such as practices, knowledge, visibilities, identities. Using these concepts allows me to explore both what empirical implications of using monitoring and surveillance technologies have but also the vision of what should be done to protect wildlife that is associated with the development and use of these systems.

To complement this framework, I also draw on the political ecology of conservation and scholarship on surveillance and socio-technical systems. The governmentality framework brings an understanding of the processes that managing protected areas entail but not a historically and empirically informed view of the different groups and organisations involved and how they relate to each other. This is what the political ecology of conservation provides and why I also draw on this body of literature. Finally, neither political ecology nor Foucault-inspired studies of environmental issues have developed concepts that facilitate an understanding of the specificities of digital technologies such as those increasingly deployed in protected areas. This is why I also take inspiration from scholarship relating to technological surveillance and socio-technical systems.

In the next pages I expand on the broader context for this research. I then outline the significance of my work and its contribution to the literature. Finally, I introduce and summarise the eight chapters that make up this thesis.

Background and rationale to the research

Conservation is a multi-faceted endeavour to 'establish, improve or maintain good relations with nature' (Sandbrook, 2015b). This umbrella term covers a wide variety of practices ranging from organic and multi-crop farming to fishing quotas, encompassing the breeding of endangered species in zoos as well as the culling of undesirable animals.[1] My research focuses on one specific manifestation of conservation: 'mainstream conservation' (Brockington, Duffy and Igoe, 2008: 9). Mainstream conservation is practised by transnational non-governmental organisations (NGOs) based in the Global North such as the World Wildlife Fund (WWF) or the Wildlife Conservation Society (WCS) in alliance with states and businesses. Should their interests align, mainstream conservation alliances can in some cases include rural populations. In other instances, these networks can be in conflict with indigenous and local communities over the way land should be used and natural resources accessed. Mainstream conservation networks and institutions strive to protect wildlife without directly or fundamentally challenging the patterns of profit generation, industrial production and mass consumption that imperil species and ecosystems (*idem*: 5). In these ways, this form of conservation differs from other environmental movements such as what has been termed 'the environmentalism of the poor' or the protests of poor and largely rural communities against industrial developments and waste disposal operations to protect their homes, health and livelihoods (Guha and Martinez-Allier, 1997).

Mainstream conservation organisations fund and manage a wide array of projects to preserve the wildlife and ecosystems of biodiversity-rich countries in situ. They often push for the creation of and partner with national parks and other forms of protected areas, i.e. clearly delineated spaces dedicated to the conservation of nature. One of the issues these NGOs work to counter in these areas and beyond is the illegal harvesting and trading of wildlife, including timber and plants, that particularly affects the survival of some species such as tigers (Goodrich *et al.*, 2015; UNODC, 2020: 81-89), the scented resin-producing aquilaria trees (IUCN Asian Regional Workshop, 1998) or hornbill birds (Beastall *et al.*, 2016). Given the importance of NGOs, states and businesses in shaping conservation policies and biodiversity protection measures generally, it was

[1] For an overview of the breadth of conservation actions see Conservation Evidence Action Database. Available on: https://www.conservationevidence.com/ [Last Accessed: 11/11/2020]

important for me to include them in my research and understand their position and role in relation to the spread of technologies.

Conservation and the scientific research that underpins it has a history of technological innovation and experimentation with newly developed tools. In the late 19th century, photography was still in its infancy when George Shiras III experimented with remotely triggered cameras to document the wildlife of North America (Wender, 2015; Wearn and Glover-Kapfer, 2017). This set up was improved throughout the following decades thanks to developments in camera technology from compact film and infrared flash to digital. Statistical models were developed to estimate wildlife distribution and abundance based on the images collected. In the 1990s, camera trapping became, and still is, the bread and butter of wildlife ecology research and monitoring for conservation (Trolliet *et al.*, 2014; Wearn and Glover-Kapfer, 2017). Similarly, during the 1960s, groups of wildlife biologists piggybacked off technical advances made during World War Two and the Cold War and developed radio tags and collars that could be attached to animals to transmit their location over radio. This method took off during the 1980s and became an indispensable instrument to learn about and manage wildlife (Benson, 2010).

Given this history of interest in incorporating technological innovations, it is perhaps unsurprising that the last decade has seen a fresh wave of interest in the opportunities afforded to conservation by increasingly cheap and accessible technologies (Jones, Pearlstine and Percival, 2006; Pimm *et al.*, 2015; Rose *et al.*, 2015; Berger-Tal and Lahoz-Monfort, 2018). As tools such as drones, geolocation data management software, internet of things or connected sensors and satellite imagery have become more available and affordable, they have been included in conservation trials and practice. Tools such these have indeed become common sights in protected areas and regular features of optimistic conservation news stories (Rogers, 2017; Ives, 2019; Criddle, 2020; Geib, 2020).

In parallel, the issue of the illegal wildlife trade has risen on the agenda of high-profile policy makers and international organisations who have expressed a preference towards forceful and security-oriented actions to tackle it. Poaching and illegal logging are increasingly being categorised as 'serious crimes', and their connection with other security issues such as armed conflicts, terrorism and human trafficking is emphasised (Douglas and Alie, 2014; Haenlein and Smith, 2016). Mainstream conservation actors are turning to policing, intelligence and military operations for inspiration on how to tackle these issues, providing funding and assistance to implement crime-oriented approaches and partnering with armies and private security firms (Duffy *et al.*, 2019; Massé *et al.*, 2020). Bodies such as the International Criminal Police Organization

(INTERPOL) and the United Nations Office on Drugs and Crime (UNODC) have made 'wildlife crime' a domain of interest and recommended better support and training for law enforcement agents to deal with the issue (UNODC, 2012; Nellemann *et al.*, 2014).

Monitoring and surveillance technologies are mobilised to bolster the capacity of law enforcers on the ground. Given that protected areas can be several thousand square kilometres large and are notoriously understaffed (Leverington *et al.*, 2010), new tools can be the eyes and ears of the management authorities in remote corners and help make strategic decisions. For instance, drones, cameras as well as heat and sound detectors are deployed to keep protected areas under surveillance. They can be used to detect when someone enters the area unauthorised. Cameras and sound sensors can send alerts when someone bearing or using loud hunting or logging equipment is nearby. This information is transmitted to the authorities in charge of guarding the protected areas who can launch in hot pursuit or prepare an ambush and arrest. Images collected can later provide evidence for the prosecution of law-breakers. Lastly, and of central interest to my research, mobile applications and computer software can assist in the standardised collection, storage and analysis of information about outlawed activities. Such bespoke systems allow protected areas employees to record and review the when, where, what, who and how of logging, hunting, mining or other incidents. This can help detect patterns and plan the next patrol or decide on other relevant actions.

My analysis centres around one specific, comprehensive and prevalent system: the Spatial Monitoring and Reporting Tool (SMART). Designed for protected areas, this system facilitates the collection, storage and review of relevant geo-located information. At the time of writing this tool used in over 765 other protected areas around the world, making it the most widespread of its kind (SMART Partnership, 2018: 6). In the words of its promoters, SMART has become 'the global standard for protected area monitoring' and is 'helping to revolutionize the practice of conservation' (*idem*: 5-6). I describe SMART in more details in Chapter 2. In the course of my analysis, I occasionally draw on examples of complementary or similar but less common technologies.

The digital tools included in this research go by various collective designations: 'law enforcement technologies', 'monitoring systems' or 'surveillance tools' depending on the speaker and the functionality of these devices they want to put emphasis on. The people I interviewed and promotional materials for conservation technologies tend to use the terms 'monitoring' or 'detection' rather than 'surveillance.' Tools such as databases and analysis software, cameras and drones are versatile, they are used for various purposes and with various intentions. Some of these

purposes are correctly described by the word 'monitoring', others are more accurately represented by the term 'surveillance.' In some cases, the aim is indeed to monitor i.e. to observe and keep a continuous record, of wildlife present in the area or of patterns of human activity. In other instances, and as described above, the data collected is used to guide policing interventions. I unpick this distinction between monitoring and surveillance further in Chapter 1.

The increasing use of technologies deployed to secure protected areas raises several novel practical questions. The adaptability of devices to new and often challenging environments, their efficiency, or lack thereof, are starting to be documented in peer-reviewed literature. Many of the papers discussing law enforcement technologies for conservation concerns their suitability, efficiency and accuracy. This has taken the form of accounts of trials for new systems (Fang *et al.*, 2016; Bondi *et al.*, 2018; Haas and Ferreira, 2018) or assessments of the ability of data collection systems to deliver on their promise to improve the detection and deterrence of illegal activities (Jachmann, 2008; Stokes, 2010; Hossain *et al.*, 2016).

Social, ethical and political aspects of conservation technologies adoption have been less studied, however. Practical changes to the work of conservationists brought about by the use of monitoring and surveillance technologies both in terms of what these professionals do and how they understand the issues facing the wildlife they aim to protect have been considered in general and speculative terms rather than through in-depth analysis of these technologies' implementation in a particular context (Arts, van der Wal, and Adams 2015; Adams 2017). It has been highlighted that surveillance technologies risk undermining long-term conservation goals as they can contribute to deteriorating the relationship between conservationists and communities living closest to the environment under protection. Tools such as drones and camera traps can scare and antagonise local populations (Sandbrook, 2015a; Sandbrook, Luque-Lora and Adams, 2018). Data collection and analysis instruments can also shut communities with limited technology literacy out of decision making processes concerning the protected areas they live in or around (Shrestha and Lapeyre, 2018). This still leaves many aspects of the question understudied. For example: how and why do specific technologies come to be used in certain places? Do other types of unexpected difficulties or opportunities arise in the deployment of these tools? What are the opinions and reactions of field conservation staff to these new systems meant to facilitate their work? Interest in the matter is just emerging (Mehtta, 2019; Simlai, forthcoming; Kuiper *et al.*, 2020; Lin, 2020). My thesis aims to contribute to this debate through original and empirically grounded material.

Significance and contributions to knowledge

There are three main and distinct ways in which my thesis contributes to existing scholarship. First, I add to existing social science research on conservation and studies of surveillance. I provide new empirical insights on the impact of technologies that over the last ten years have gone from small-scale experiments to ubiquitous elements of conservation practice. SMART and similar systems are now in use in conserved areas around the world and their growth shows no sign of slowing. Yet, as I have mentioned above, the social and political aspects of this development in the conservation sector have been relatively little studied this far. Because I give prominence to the experience of conservationists and protected areas employees, I am also able to contribute knowledge on how the conservation sector functions as an industry and how protected areas operate as a workplace. Indeed, I highlight how monitoring systems mediate relationships between those involved in the management of protected areas at a macro level such as INGOs, donors and states and those in charge of the day to day micro-level running of these places such as rangers, administrators and their hierarchical superiors. Finally, I add to surveillance studies which have long examined the implications of technologies similar to those I focus in this thesis. In this body of literature, inquiries about rural settings and environmental conservation contexts have been exceptions (Braverman, 2014, 2015).

On a theoretical level, I consider conservation through protected areas as a form of government, meaning 'modes of action, more or less considered or calculated, which were destined to act upon the possibilities of action of other people' (Foucault, 1982: 790) to protect wildlife. Therefore, I mobilise the governmentality framework inspired by the writings of Foucault. I use this approach to analyse the experiences of those doing the governing. This angle is present in the writing Dean who has interpreted Foucault's work and asks 'what statuses, capacities, attributes and orientations are assumed of <u>those who exercise authority</u>[2] […] and those who are to be governed […]? What forms of conduct are expected of them? What duties and rights do they have?' (Dean, 2010:43). However, this focus on those exercising authority has not yet been applied in studies of environmental issues. Indeed, the 'environmentality' literature which draws on Foucault's work to analyse responses to environmental change and the management of natural resources mostly centres the impact of government programmes on the populations and communities they target (Agrawal, 2005; Rutherford, 2007; Fletcher and Cortes-Vazquez, 2020). By contrast, I use it to look at how the different actors involved in the governance of protected

[2] My emphasis

areas constrain each other's possibility of action through the deployment and use of surveillance technologies.

Methodologically speaking, I give equal time and importance to the different groups and spaces, or scales, involved in shaping the technologies I studied. For this purpose, I conducted interviews and observations with people involved in funding, developing, implementing and using monitoring and surveillance technologies in a range of interconnected settings. A large proportion of political ecology of conservation studies tends to focus on a particular location and the individuals, groups and institutions present there. Oftentimes, this literature draws connection to national or global processes or the situation on the ground is compared to a dominant discourse in the conservation or development sector. I took a different approach by fully including the perspectives of participants from international NGOs, donors and the Indonesian central government in my approach. The usefulness of multi-sited methodologies such as the one I adopted, has been recognised as a way to understand how discourses and policies emerging in some places relate to conservation actions and outcomes in others (Barua, 2014; Corson, 2018). However, despite their growing popularity in social science since the late 1990s (Bryman, 2016), multi-sited methodologies have been relatively little used in political ecology.

Structure of the dissertation

My analysis of the relationship between law enforcement technologies and the government of protected areas unfolds over eight chapters. In Chapter 1, I introduce the bodies of academic literature that have framed my research. I clarify the relevance of Foucault's ideas on government and governmentality to the issue at hand. I demonstrate that drawing on the political ecology of conservation as well as on scholarship on socio-technical systems and surveillance is a good way to complement the governmentality literature to understand the social and political implications of technologies aimed at supporting law enforcement in protected areas. I show how combining these strands of research allows me to apply the governmentality framework differently and contribute new insights to knowledge about protected areas as workplaces and the use of technology in this context.

Chapter 2 details how the methodological and research design choices I made to deliver the contributions to knowledge outlined in Chapter 1. Therefore, the second chapter sets out how I have structured my inquiry across sites and scales. I justify why I chose Indonesia and two provinces of Sumatra as a case study to examine the implementation and use of law enforcement technologies. I explain the challenges I faced while collecting data and provide an overview of the background of the participants I interviewed and interacted with despite these difficulties.

Chapter 3 constitutes my first empirical contribution to the issue of law enforcement technologies. I explain how a community of interest has coalesced around a range of technologies and hailed such tools as a positive and necessary development to halt the destruction of ecosystems and the illicit harvest of endangered plants and animals. This community includes technology experts and companies but is dominated by INGOs and donors who have long been influential in funding and shaping conservation action around the world. I argue that together, these organisations are setting agendas and defining of models for the development and adoption of technologies for conservation that largely follow neo-colonial patterns.

In Chapter 4, I trace back the development of conservation regulations and enforcement in Indonesia to the colonial era. Indeed, to delve into the relationship between surveillance systems and law enforcement activities in my region of interest, it is important first to understand what law enforcement means in this context. I explain here that legal definitions of forests and principles regarding access to natural resources and land ownership which emerged in the 19th century still have an impact in 2020. They have resulted in the concentration of decision-making power over land use into the hands of the central government to the detriment of rural populations. This situation has resulted in natural resources exploitation patterns and conflicts which impede conservation efforts to this day. I highlight that, since the early 2000s, mapping, monitoring and surveillance technologies have come to play a growing role in these conflicts.

The Indonesian central government, whose role in forest and wildlife conservation I introduced in Chapter 4 is also the focus of Chapter 5. Here I look at the country's trajectory to adopting SMART and other monitoring and surveillance systems. I argue that principles of national sovereignty, in particular as they translate to issues of data storage and ownership, can clash with the plans the organisations presented in Chapter 3 have for systems deployed in protected areas. I show that this opposition shapes and constrains the expansion of digital technologies for conservation law enforcement.

From Chapter 6 onwards, I use the governmentality roadmap to analyse how the internationally-defined norms and ideas analysed in Chapter 3 have translated into practices at ground-level wildlife and forest protection workplaces in Indonesia and beyond. I focus on the practices necessary to set up and operate monitoring and surveillance systems and show how much human labour is involved in introducing more sophisticated technological systems in the running of protected areas.

In the next chapter, I continue my analysis of the interaction between the work practices of those in charge of governing protected areas and the technologies designed to support their

tasks. Indeed, in Chapter 7 I draw on the Foucauldian concepts of practices and identities to argue that law enforcement technologies can be used to push rangers to conform to certain norms and expectations surrounding on-the-ground conservation work. I explain that these specific ways of using conservation technologies can lead to resistance and conflicts that are counterproductive to the protection of species and ecosystems.

Finally, in Chapter 8, I examine how the data created through technologies are creating new visibilities and shifting the body of knowledge that conservation workers rely on to make decisions and enforce laws in protected areas. I demonstrate that this shift is happening towards modes of reasoning inspired by criminology and urban policing and towards the automation of knowledge production.

Throughout the thesis, I highlight future directions and contrast the vision provided by the promoters of monitoring and surveillance technologies with actually existing practices and uptake of these tools. Indeed, there are positive ideas of progress linked to being able to collect comprehensive data sets on conservation issues. Conservation monitoring and surveillance technologies such as SMART or drones are highly versatile and have been adopted and adapted for diverse purposes by a range of actors, from state protected areas to environmental activists as I highlight in Chapter 4 and 8. Systems like SMART have facilitated record keeping and centralisation of information in a way that provides unprecedented perspective. These tools can support historical and geographical comparison, increasing transparency about of what is being done for conservation and what results these actions might have.

Still, the negative potential of ubiquitous surveillance and automated conservation decision-making associated with the technologies cannot be ignored. I show that when used in support of securitised and wildlife crime-focused conservation approaches, these technologies carry risks and can be counterproductive for the protection of species and ecosystems. Indeed, I point out that the use of surveillance technologies can create tensions between the different actors involved in the management of protected areas such as states and INGOs or protected area employees and their managers rather than facilitating communication and collaboration between them. I also highlight that turning attention and resources towards developing and using technologies to support specific law enforcement activities such as patrols narrows the focus of those in charge to the detriment of other activities which contribute positively to the protection of wildlife.

Chapter 1: Theoretical framework: understanding the government of technologically sophisticated conservation areas

Conservation law enforcement data collection and analysis tools such as Spatial Monitoring and Reporting Tool (SMART) enable the gathering of information about animals and plants, indications of wildlife crime and data relating to conservation work. As such these tools combine the surveillance of wildlife, human activity and labour. These databases gather and juxtapose previously scattered elements of reality concerning a tract of land, the wildlife that inhabits it and the human activities taking place there. These systems encompass the actions of people visiting or infringing the rules of protected areas as well as the steps taken by those working there. Thanks to algorithmic computing, the software then turns these elements into information that should be applicable to improve the protection of endangered species and ecosystems. In that sense, these databases represent a new way of collecting and analysing information that might lead to a change in priorities and allocation of resources in conservation. Simultaneously, the data collection and analysis processes these systems call for also constitute a change in what conservation actors at different levels are meant to be doing. As such technologies can be considered a tool of government. Government is the word used by Foucault to refer to 'the thousand and one different modalities and possible ways that exist for guiding men, directing their conduct, constraining their action and reaction and so on' (Foucault, 2008: 1-2). As Foucault's work is a key building block of this research I will use this term throughout.

Considering conservation technologies as a tool of government leads to the following research question: In what ways does the development of digital tools and the government of protected areas mutually influence each other? To answer this question, I draw together three main strands of the literature: governmentality, the political ecology of conservation as well as perspectives on socio-technical systems and electronic surveillance. In doing so, I provide a governmentality approach of the role of technologies in conservation law enforcement work.

As conservation monitoring and surveillance technologies can be considered tools of government, I rely on governmentality, Michel Foucault's understanding of what government is and how it operates, to frame my research. In this chapter, I demonstrate the relevance of governmentality studies inspired by Foucault's work to analyse the role of digital technologies in the government of conservation. I underline how it can be used as a roadmap to understand the processes by which people's conducts are directed and constrained. I then chart its application to

environmental matters by post structural political ecologists, notably through the concept of 'environmentality.' This theoretical body conveniently allows to ask both: 'how is the environment conceptualised and construed as a domain of government' and 'how is environmental governance accomplished in practical and technical terms' (Lövbrand and Stripple, 2011:112) and is therefore a fruitful approach for the study of law enforcement technologies.

However, key dimensions of the deployment of law enforcement technologies for conservation are difficult to apprehend through the environmentality framework as it has been developed so far. Indeed, the governmentality and environmentality frameworks have engaged little with the ways government programmes affect those tasked with implementing them or who these people are. It focuses instead on targeted populations external to groups holding decision-making and administrative powers. My thesis shows this is an oversight. Despite relying on words such as 'technique' and 'technologies' to describe how government operates, the framework also has little insights to offer on the specificity of digital tools. In other words, it does not tell us how digital technologies differ from other instruments destined to generate knowledge about environmental issues and direct people's actions.

To fill these gaps, I argue that four complementary components are necessary: an understanding of technologies in their social context, a view of conservation as a professional sector and protected areas as workplaces, as well as an appreciation for the surveillance of these workplaces. I show that a sociotechnical perspective and literature on the electronic surveillance of work can be productively combined with Foucauldian approaches to the environment to understand the relationship between the government of protected areas and technologies.

I start this chapter by introducing the overall aim of the thesis and the questions it addresses. I then lay out Foucault's heritage and governmentality studies, I detail how these have been applied to conservation interventions. I then highlight their shortcomings when it comes to analysing the interplay between digital technologies and conservation work. I introduce scholarship on socio-technical systems and electronic surveillance in the workplace as a way to make up for these shortcomings. In a final section, I outline this thesis' contributions to knowledge.

A governmentality approach to the role of technologies in conservation law enforcement work

In this thesis, I argue that although law enforcement technologies are designed primarily to direct interactions between people and protected nature, they also constrain the actions and relationships of those in charge of conservation. Law enforcement technologies are meant to assist with law enforcement: to help detect, prevent and punish outlawed activities such as poaching or illegal logging. I show that they are also deeply linked to the way conservation professionals at different levels interact and that in turn technologies shape these professionals' practices and interactions. I contend that these dynamics are as much a factor as technical performance in influencing the outcome of technology implementations in conservation programmes. In other terms, technologies contribution to conservation does not only rest on how accurately they can detect poaching for instance. What technologies do or do not contribute to efforts in conserving protected areas is related to the way the conservation sector operates and shapes these technologies.

In order to demonstrate this, I weave the governmentality with scholarship on socio-technical and surveillance systems as well as conservation studies. This combination allows me to analyse the interaction between technology and wildlife conservation work from the ground up. I do so by answering the overall question: In what ways do the development and use of digital tools and the government of protected areas mutually influence each other?

a) What is the relationship between established practices of conservation actors and the political economy surrounding the acquisition and use of these technologies?
b) How do monitoring and surveillance systems influence the work practices of conservation staff and what is expected of them?
c) What knowledge's and visibilities do these tools produce?

In the rest of the chapter I review the elements of chosen bodies of literature which enabled me to frame and answer these questions. I start by presenting Foucault's work on governmentality and highlighting the aspects of this work that are relevant to my thesis.

Foucault's heritage and governmentality studies

I consider conservation, and in particular conservation focused on protected areas, a form of government. Michel Foucault's work on governmentality provides useful concepts to understand what this entails and how it can be analysed. Foucault first used the term 'governmentality' in his series of lectures at the College de France in 1977-8 and 1978-79 to articulate his analysis of the

evolution of political power. Since Foucault's reflexions on government and governmentality have mainly been passed down as transcriptions of lectures and much of the material has not been formalised in published writings by the man himself (Gordon, 1991; Dean, 2010), interpretations and applications of his ideas by social science scholars are diverse and divergent. This first section provides an overview of the different definitions of government and governmentality present in Foucault's work and clarifies that which my research operationalises.

In the context of Foucault's 1977-1979 lectures, government refers mostly to 'the government of men as it appears in the exercise of political sovereignty' (Foucault, 2009: 2) or 'the legitimately constituted forms of political or economic subjection' (Foucault, 1982: 790). Governmentality is a neologism formed to explain a historically specific development of government. Foucault uses it in his lectures to trace the process, starting in the 18th century, through which political power became interested in administrating and regulating populations (Foucault, 1991: 102-103). He shows how populations have become constituted as an object with its own characteristics and the focus of government, through bodies of knowledge like political economy. Enhancing the population's health and wealth became a rationale for governmental intervention alongside the reinforcement of the state and its land base. This leads Joseph (2009) to argue that the main criteria for using a governmentality driven analysis is that the object of study must concern an action targeted at the level of a population.

However, for Foucault, government and power also have a broader meaning as 'the thousand and one different modalities and possible ways that exist for guiding men, directing their conduct, constraining their action and reaction and so on' (Foucault, 2008: 1-2). Put differently, government refers to the 'modes of action, more or less considered or calculated, which were destined to act upon the possibilities of action of other people' (Foucault, 1982: 790). Foucault was very interested in the links between the political or national government and more micro occurrences of government. He repeatedly sought to show interconnections between these different levels and demonstrate that the same analytical logic can be applied to all (Foucault, 2008: 19). In *Discipline and Punish* (Foucault, 1995: 200-06) for instance, he explores how architectural constructs and surveillance measures constrain individuals to internalise norms and adopt socially desirable behaviours in a range of contexts from prisons to schools.

Conservation can therefore be considered as a form of government. Indeed, it consists in a range of actions intended to 'establish, improve or maintain good relations with nature' (Sandbrook, 2015b: 565) . In other words, conservation seeks to define the range of possible interactions people can have with their environment. Signposting and trail grooming to orient

tourists in nature reserves, patrolling protected areas, arresting and evicting people violating environmental regulations within their boundaries are examples of conservation practice. These examples are all ways to constrain the conduct of people which are thought to be contributing to protecting biodiversity. In that sense, governmentality can also take a broader meaning as 'the reasoned way of governing best and, at the same time, [the] reflection on the best possible way of governing' (Foucault, 2008: 2) and can be applied to conservation.

It is this broader definition and the way it has been formalised by followers, which this research utilises. Governmentality can now broadly be understood as an analytical approach, a series of questions to understand 'techniques and procedures for directing human behaviour' (Rose, O'Malley and Valverde, 2006:83). As Nikolas Rose et al (2006:84) put it: an analysis of governmentalities, is one that seeks to identify the different styles of thought that power operates through, 'their conditions of formation, the principles and knowledges that they borrow from and generate, the practices that they consist of, how they are carried out, their contestations and alliances with other arts of governing.'

Importantly, the study of governmentality also supposes an interest in conducts that do not fit, or go against the objectives and expectations of those in power i.e. forms of resistance or 'counter conducts' (Foucault, 2009: 194-195, 201). Indeed, according to Foucault, government is not a unilateral imposition of practices on those governed (Foucault, 2008: 12). The social theorist conceptualises it more as 'a practice that fixes the definition and respective position of governed and governors facing each other and in relation to each other' (*ibid*). This process involves a series of conflicts, agreements and reciprocal concessions (*ibid*).

Dean (2010: 33) provides a useful grid of further dimensions to consider when applying a governmentality framework: visibilities, knowledge, techniques and practices, identities and subjectivities. Rather than a framework formalised by Foucault himself during his 1977-79 lectures, this guide combines and draws attention to key aspects of Foucault's work over the course of his career (Darier, 1999a).

Indeed, the concern for visibilities can be traced back to *Discipline and Punish* (Foucault, 1995). There, Foucault points out that as social phenomena become the focus of government, parts of these phenomena get highlighted and others get ignored or concealed. This is linked to the establishment of norms, which practices and behaviours are encouraged by governments and which ones are discouraged. For the researcher applying a governmentality framework this opens up a set of questions: what kind of objects and issues are being brought to attention? Which ones are obscured and hidden? (Dean, 2010:41).

Foucault's interest for techniques and practices as well as knowledge is recurring. The author makes the focus on practices a central element of his approach in his College de France lectures (Foucault, 2008: 2-4). It his way of picking apart, rather than taking for granted, institutions and broad political concepts such as the state (Foucault, 1991). Foucault prefers the term 'regime of practice' to emphasise how repeated concrete actions of government coalesce into a coherent, rational whole. This construct is stabilised at one point in time but not immutable. This leads to the following questioning: 'By what instruments, procedures and technologies is rule accomplished?' (Oels, 2005:189).

Foucault's interest in knowledge or as he often puts it the articulation 'power/knowledge', can be traced throughout his work. In *The Birth of the Clinique* (Foucault, 1989) for instance, Foucault traces the development of modern medicine based on individual diagnosis. *The History of Sexuality volume 1* (Foucault, 1978) includes an outline of the development of a scientific vocabulary and expertise about sex. The College de France lectures are also dotted with reflections around the intellectual developments in political economy and statistics (Foucault, 1991: 99) that enabled the constitution of populations as objects of government (Foucault, 2009: 52-55). To Foucault, a key issue is the way in which representation and conceptualisation of social problems enable various ways of shaping the realm of possibilities for other's action. Hence the line of enquiry: 'which forms of thought arise from and inform the activity of governing?' (Oels, 2005: 189).

Finally, 'identities' and 'subjectivities' are concepts which appear in Foucault's later work as found mostly in *The History of Sexuality* (Foucault, 1986). The philosopher had become interested in the connections between government and qualities expected of individuals as well as the way individuals perceive themselves. One could sum it up as: 'what statuses, capacities, attributes and orientations are assumed of those who exercise authority […] and those who are to be governed […]? What forms of conduct are expected of them? What duties and rights do they have?' (Dean, 2010:43). These identities which exist in the minds and plans of governing actors are not to be confused with subjectivities, the attitudes, capacities and attributes that come to actually be constituted as a result of government practices (*ibid*).

These five areas of inquiry (practices, knowledge, visibilities, identities and subjectivities) have been taken up to various degrees by those who have come to be called post structural political ecologists. The following section traces the adoption of governmentality by environmental scholars and demonstrate its advantages to grapple with conservation issues.

Environmentality: an adaptation of governmentality studies to environmental issues

Foucault's own work contain few reflections about the human-nature relationships (Darier, 1999b; Winkel, 2012). His reflections around power and government have nevertheless inspired number of scholars working on environmental issues from the 1990s onwards. In the edited book *Discourses of the Environment*, Darier and colleagues (Darier, 1999a) propose to map the relevance of Foucauldian concepts for scholars interested in environmental issues. Since then, Foucault's work has been a source of inspiration for studies pertaining to forest administration (Baldwin, 2003; Agrawal, 2005; Benson, 2010; Winkel, 2012; Astuti and McGregor, 2015; Asiyanbi, 2016), climate policy (Oels, 2005; Lövbrand and Stripple, 2011) and wildlife management (Youatt, 2008; Youdelis, 2013; Bluwstein, 2017; Lorimer, 2017). This section presents specific manifestations of the trend that this research builds on: the development of a post-structuralist political ecology and the concept of environmentality.

Political ecology is a diverse body of academic inquiries characterised by a common concern for the environment and people who live in it. It seeks to highlight how power relations and inequalities interact with environmental change and attempts to protect nature (Robbins, 2012: 19-20). Typical research questions include: what are the causes of environmental change? Which social groups benefit or lose from specific environmental interventions? A trend partly inspired by Foucault and auto designated as 'postructuralist' (Escobar, 1996) has developed within this broad scholarly field. This branch insists on a political ecology that also pays particular attention to 'the discourses and practices through which nature is historically produced and known' (*ibid*: 325) and engages with 'the different ways in which "nature" is perceived, studied, and presented by different social groups' (Goldman and Turner, 2011: 5).

This post-structuralist strand develops two lines of argument that support and reinforce the conception of conservation as government: that the materiality of nature is inseparable from human representations of it (Castree, 2014) and that all nature can in fact be understood as socionature. Animals, minerals and organic materials are shaped by, and in turn influence human interventions (Peluso, 2012). Human structures and ideas are deeply intertwined with natural processes. Indeed, 'the production process of socionature embodies both material processes and the proliferating discursive and symbolic representations of nature' (Swyngedouw, 1999: 447). Protected areas, sometimes considered as the epitome of wilderness, are no exception (Cronon, 1996a; Adams, 2004). National parks are associated with aesthetic ideals, conceptions of rarity and national pride (Carruthers, 1995; Cronon, 1996a; Patin, 1999; Adams, 2004). These areas are often fenced and human activities within their boundaries policed. Culls are an accepted method to

regulate species populations, controlled fire is used to regenerate vegetation and tracks and paths crisscross the landscape. In this context, it is important to understand how frames of thoughts, human-made and organic materialities interact to create various socio-natures. The ways in which we understand our environment and shape the possible realm of actions towards it, is an inherent part of this process.

Within this branch of political ecology literature, the governmentality framework has therefore been taken up and adapted in various ways. One has been the concept of environmentality. The term environmentality was coined by the political scientist Luke (1999). Exemplifying the difficulties posed by the constant reinterpretation of Foucauldian ideas, Luke (1999) does not clearly expose his understanding of governmentality. Nevertheless, his take on the concept seems closer to the first definition oriented towards national government presented earlier in this chapter. He takes inspiration from governmentality and applies it on a very macro level to the government understood as state institutions and elected politicians. Luke shows how making the global environment a theme of 'political operation, economic interventions and ideological campaigns' (*ibid*: 122) has become the new tactic for the American government to guarantee national security and economic growth after the Cold War.

Agrawal (2005) borrows the neologism 'environmentality' but imbues it with a different meaning closer to the second, more general, definition presented in the previous section. In his monograph of the government of North Indian forest communities, he examines the interconnected aspects of knowledges, politics, institutions and subjectivities to provide an explanation of how villagers of the Kumaon region had come to adopt protective attitudes towards the local forests (*ibid*: 202). He shows how interconnected processes have come to transform people's subjective perceptions and practices towards forests. The geo-historically specific combination of scientific forestry presenting forests as separate from people and threatened by human action, the decentralization of forests regulation and the enforcement of these regulations at the village level all played a role according to Agrawal.

Building on Agrawal's work and in the wake of a new translation of Michel Foucault's lectures in 2008, Robert Fletcher (Fletcher, 2010) proposed yet another interpretation of the concept and identified multiple types of environmentalities. In his ideal-typical framework, Fletcher distinguishes four series of mechanisms that enable the direction of people's attitudes and practices towards natural resources. Neoliberalism provides incentives for people so that desired behaviours aligns with their self-interest. Disciplinary mechanisms push people interiorise norms and act according to them for fear of punishment. Sovereignty operates through direct threats of

punishment. Finally, government according to truth operates according to the claim that its 'prescriptions accord with the fundamental nature of life and the universe' (Fletcher, 2010:176).

Like governmentality before it, environmentality has come to take a number of meanings. For the purpose of this research, I will retain Agrawal's understanding which is the closest to the broad Foucauldian definition presented in the first section of this chapter. Cepek (2011) is critical of Agrawal's linking of knowledge, institutions and subjectivities to explain communities' relationship to their environment however. According to him, governmentality in general assumes a deterministic, linear relation between programmes of government, practices and subjectivity. He is a fortiori critical of Agrawal's (2005) approach that emphasises the unconditional appropriation of environmental messages and practices by the communities of Kumaon. Cepek (2011) takes the counter-example of an indigenous community living in the Ecuadorian Amazon. He points out that it is not because they participate in scientific inventory activities encouraged by an American conservation organisation that they uncritically accept its vision of the environment. On the contrary, the community views 'their participation in relation to their political aspirations and cultural background rather than the aims and rationales' (*ibid*: 502) of the conservation organisation.

Cepek's argument concerning Agrawal's work does not call into question the whole governmentality framework and its relevance to study conservation. As exposed above, Foucault himself was interested in counter-conducts, behaviours and opinions that do not fit governing authorities' plans. Keeping this dimension as a focus of the analysis is a way to avoid assuming 'governmental power as the substance and cause of what researchers see' (Cepek, 2011:504). Adopting in-depth qualitative methods is another way to avoid the deterministic interpretations Cepek associates with governmentality. It is a way to pay attention to the 'social relations through which technologies of control are formed, exercised, contested and critiqued' (Cepek, 2011: 504-505). This has been also argued for by Foucault-inspired political ecologists.

Despite theoretical divergence on the application of governmentality, political ecologists inspired by Foucault have tended to adopt a common method. They have embraced detailed, situated ethnographic approaches (see for instance Agrawal, 2005; Murray Li, 2007; Youdelis, 2013; Astuti and McGregor, 2015) which encompass not only the rationale and strategies of various authorities but also 'what happens when those interventions become entangled with the processes they would regulate and improve' (Murray Li, 2007). This makes their approach much more embodied and empirically grounded. This may in some ways clash with Foucault's own methodological considerations. As the philosopher explains in an interview, he is mostly interested

in studying programmes or 'sets of calculated, reasoned prescriptions in terms of which institutions are meant to be reorganised, spaces arranged, behaviours regulated' (Foucault, 1991: 80). He does not seek to address the real functioning of institutions once a tangle of programmes takes effect (*ibid*: 80-81).

In my opinion the most relevant approach in the case of wildlife law enforcement technologies is to add considerations for 'what happened' to an initial questioning around 'what authorities of various sorts wanted to happen, in relation to problems defined how, in pursuit of what objectives, through what strategies and techniques' (Rose, 1999: 20). Indeed, this technology is the manifestation of a strategy of government, a prescription on the right way to police a protected area, but its usage in specific contexts also has the potential to provide inspiration for new government programmes. In practice, the governmental rationality expressed through conservation technologies may become enmeshed with local social and political priorities and dynamics.

Despite the multiplication of governmentality-inspired research and associated expansion of the theory, key dimensions are missing which prevent the field from offering a full picture of contemporary conservation issues.

Multi-scales of the Conservation Sector and Digital Technologies: missing aspects of the environmentality literature

The governmentality of conservation professionals themselves, the translation of governmentality across scales, and the role of new technologies of surveillance in informing and enacting these governance mechanisms are still little explored in the political ecology of conservation and conservation studies more broadly.

Empirically, governmentality frameworks have largely been used to examine the governance of various communities' use of natural resources and their attitudes towards different forms of management (Hanson, 2007; Murray Li, 2007; Youdelis, 2013; Adams, 2015). However, governmentality approaches have not been used to study the mechanisms through which mainstream conservation actors themselves are encouraged to act in desired ways. This was however of concern to interpreters of Foucault's theories as Dean asks 'what statuses, capacities, attributes and orientations are assumed of those who exercise authority […]?' (2010:43). Scholarship about on-the ground conservation staff tends instead to look at their divided identities and allegiances as well as the stresses they face (Sodikoff, 2009; Poppe, 2012; Moreto, 2016; Kiik, 2018). Yet, in the age of log frames and monitoring and evaluation, governance mechanisms are also turned on the ones that are meant to govern. In the rest of the thesis, I look at the ways in

which the conservation actors, govern each other and in particular those closest to the ground, in protected areas.

In order to examine the government of protected areas, it is important to consider how they fit into mainstream conservation, recognise that actors at different scales are involved and acknowledge the power relations between these actors. Wildlife conservation is a field heavily influenced by international regulations, funding and organisations. Therefore, it is crucial to understand how knowledge about local socio-environmental phenomena is understood and mobilised at different levels of the conservation governance networks: from funding to on the ground every day work, from park management and local non-governmental (NGO) offices to NGO headquarters and national ministries. Foucault-influenced political ecology is a key inspiration here because it is in the discipline's DNA to provide detailed, historically and empirically grounded accounts of the various actors involved in conservation issues as well as the power imbalances between these actors, including those linked to colonial legacies and global political economic trends.

However, as noted by Fletcher (2017:314) there is currently a lack of understanding of 'how different forms of governance operate and interconnect across levels and scales, and the negotiations among them.' Indeed, political ecology scholars have become renowned for presenting rich empirical data from local field sites in the Global South (Winkel, 2012). A number of studies focus on rural communities and demonstrate the impact that forms of government such as colonialism and development/conservation programmes have had on their livelihoods (Peluso, 1992; Neumann, 1998; Brockington, 2002; West, 2006; Ybarra, 2017). Sometimes the analysis includes an examination of the functioning of local and national administrations as well as NGOs based in country (Bryant, 2002; Wilson, 2006; Corson, 2016; Kiik, 2018; Margulies, 2018). Ethnographies of conservation NGOs, policy and aid organisations in the Global North evidencing their decision-making and planning practices have been rare (Corson, 2016; Corson *et al.*, 2019). Although the links between political institutions or economic structures at different scales are considered an intrinsic element of political ecology scholarship (Rocheleau, 2008), they are often not explicitly addressed in the research design. Data collection tends to focus on one level while connections to other spheres of practice are underlined at the writing up phase. The different lenses are rarely combined in a single study. The case of law enforcement technology is relevant to remediate this gap. Indeed, I show in this thesis that a range of actors at different scales, from international NGO headquarters to protected areas around the globe, interact with these technologies and influence their uses by others.

Protected areas have only marginally been looked at as organisations and workplaces. Indeed, there is a growing body of research focusing on those designated by the internationally-accepted term 'rangers.' The International Ranger Federation[3] defines rangers as people who work in protected and conserved areas and endorse a variety of outdoor and outwards-facing tasks including, but not limited to, protecting and restoring landscapes, enforcing relevant laws, engaging in a dialogue and collaborating with local stakeholders as well as monitoring and researching biodiversity. The status and role of rangers can differ widely according to national context, place of work and the type of organisation employing them. Publications that are dedicated to rangers have highlighted the dangerous and stressful nature of their work (Gibson, 1999; Oliver and Meier, 2006; Eliason, 2006; Eliason, 2011; Moreto, 2016) as well as the lack of support and benefits associated with the profession (Sodikoff, 2009; Spira, Kirkby and Plumptre, 2019). Central points of interest in existing publications are rangers' job satisfaction and motivation with an eye on how to improve these as they may relate to productivity, staff recruitment and retention (S. Eliason, 2006; Moreto, Lemieux and Nobles, 2016; Eliason, 2017; Moreto *et al.*, 2017). A recent global survey of rangers orchestrated and published by WWF has further been instrumental in shedding light on rangers' perceptions of their working conditions and their views on the inadequacy of the training, equipment and employment benefits they have access to (Belecky, Singh, and Moreto 2018). Massé (2019) has conducted ethnographic research on anti-poaching ranger forces in Mozambique and examined how they exercise their authority and use of violence to punish alleged poachers as well as the broader context which enables them to do so.

However, organisational dynamics and the relationship between rangers, administrators and their supervisors are often only implicit or addressed in passing in research on protected area staff. So is the equipment or technology they have at their disposal. For instance, both Palmer and Bryant (1985, p. 133) and Eliason (2006, p. 12) identify light touch supervision as a source of job satisfaction of conservation officers in the American South but do not examine in details what that implies in practice. Not much is known about the relationship between rangers and their hierarchical superiors, protected areas managers, or between field staff and administrators. Yet, workplace dynamics and available tools could indeed be key dimensions in rangers feeling supported, their job satisfaction and motivation. One notable exception, is the research conducted by Sherbolm et al. (2002) at the Maine game warden service in the US. They examined the transformation of the warden service into more of a bureaucratic agency with a stronger emphasis on law enforcement beyond fish and wildlife offences and a more diverse recruitment. They

[3] International Ranger Federation (2020) Ranger Code of Conduct

showed that this transformation was accompanied by new expectations towards game wardens and new management techniques such as a closer monitoring of the numbers of warnings and summons to appear in court they issued. According to the authors, this change caused tension and conflict in the organisation as well as employee departures. In Chapters 5 and 6 of this thesis, I follow Sherblom et al.'s (2002) lead and articulate the interactions between protected area staff's workplace dynamics and new digital technologies.

A focus on digital technology also represents an addition to the existing literature, Indeed, social science approaches to the environment in general, and political ecology in particular, have engaged relatively little with digital technologies compared to the role they now play in gathering knowledge about the environment and supporting conservation decision-making. As shown in the first section of this chapter, the strong dimension of knowledge and the representation of social issues associated with government was an important dimension of Foucault's original work. This concern for knowledge is present in Agrawal (2005) and Scott's (1998) work for instance, but their research was of a historical nature, examining the emergence of scientific forestry. The proliferation of new technologies of data collection, processing and visualisation directed towards wildlife, landscape and conservation practitioners' activities calls for a reinvestigation of this knowledge dimension of governance.

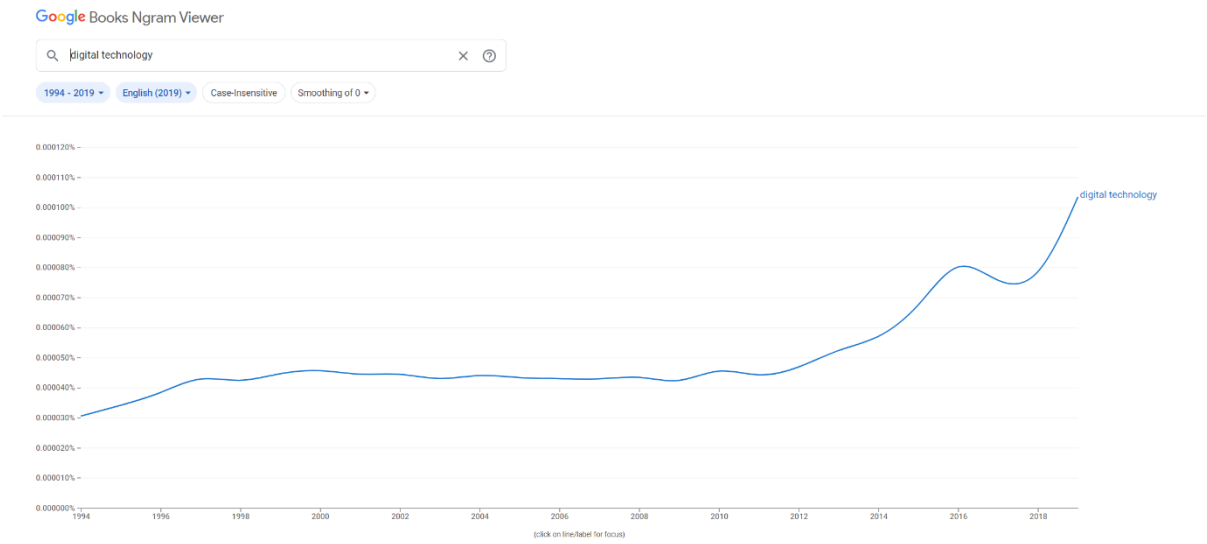

Figure 1: Frequency of the term 'digital technologies' in books referenced in Google Books and published between 1994 and 2019

Figure 1 which represents searches for the term digital technologies in Google Books reveals a steady rise of interest in digital technologies in academic literature. The same keyword in key political ecology journals such as the Journal of Political Ecology (JPE) and Conservation and

Society (C&S) only returns two results in each. The much broader terms 'technology/technologies' call forward forty-two papers in JPE and eleven in C&S since they first started publishing in 1994 and 2003 respectively. This suggests that there has yet been little interest for digital monitoring technologies in the discipline. A few recent and notable exceptions in political ecology and neighbouring fields include work on satellite imagery in the governance of desertification (Goldman, Nadasdy and Turner, 2011), climate change (Jasanoff, 2017) and other environmental risks (Rothe, 2017), the proliferation of radio and satellite tracking, cameras, and audio surveillance in wildlife conservation (Benson, 2010; Verma, van der Wal and Fischer, 2016; Adams, 2017) and the exclusion of local communities from conservation partnership through the use of technologies (Shrestha and Lapeyre, 2018). These piecemeal contributions point to importance of those technologies in the production of new socionatures and ways to govern them and indicate the need for further research. In other words, how do digital technologies differ from other instruments destined to generate knowledge about environmental issues and limit people's possibility of action?

Socio-technical interaction networks

A sociotechnical approach is particularly helpful in giving centre stage to technologies as it acknowledges that social context is as significant as technical and material properties to understand the origin and role of technologies. This brand of thinking developed in opposition to 'technological determinism' which holds that technological progress is the motor of history and that technologies cause societal changes. The sociotechnical perspective broadly holds that people and technology mutually influence each other. It has been taken up by many subfields of social sciences, from social construction of technology (Pinch and Bijker, 1984) to actor network theory (Latour and Woolgar, 1979; Latour, 2005). All of these schools of thought agree that both social context and technological affordances matter in understanding how and why technologies are conceived, adopted and used as well as their role in social change (Meyer, 2014). Yet, each grouping gives a varying importance to each of these poles in their explanations.

In particular, I take inspiration from the branch of socio-technical thinking to which Kling, McKim and Kings's (2003) and their concept of socio-technical interaction networks (STINs) belong. Through this idea of STINs, Kling et al. (*idem*) provide useful analytical points of reference to scholars analysing the social life of technologies. According to them, the lens of STINs serves to 'identify key relationships between different technologies, social actors, resources (including money flows) and legal regulations (*idem*: 48).' They further define the scope of enquiry by breaking down the key dimensions of such networks: social actors who have direct or indirect relationships

with the technology, resource flows (i.e. funding), excluded actors and undesired interactions (i.e. ways in which people do not want the technology to be used) as well as architectural choice points (i.e. technical features or social arrangements chosen by the designer at critical junctures).

The framework of STINs is well-suited to my enquiries into the interplay between digital technologies and the conservation sector and complements the Foucauldian approach well for two reasons. First, this approach places an equal emphasis on exploring both the social context of technologies and the intrinsic properties of artefacts and software. This framework is also holistic and takes into account broader power relationships that surround technologies, not just direct social actors that directly interact with the device or software.

Amongst the spectrum of socio-technical approaches, STINs strikes a unique balance regarding the relative importance it gives to technological features and social dynamics when analysing the interplay between the two (Meyer, 2014). Indeed, STINs sit between technological determinist and perspectives such as Actor Network Theory (ANT) as well as more constructivist approaches. ANT contends that artefacts have an agency of their own (Latour, 2005). Some social constructivists hold that technologies are eminently flexible and could theoretically be repurposed endlessly by social inventiveness and discourse (Woolgar and Grint, 1991).

ANT has been effectively used to generate insights about the adoption and role of scientific and technological tools for conservation (Goldman, Nadasdy and Turner, 2011; Jepson, Barua and Buckingham, 2011; Rothe, 2017). However, ANT does not have strong affinities with a political ecology-infused Foucauldian framework, the rationale for which I explained in sections 2 and 3 of this chapter. In this thesis I focus on the relations of power and resistance that play out through and around the design, use and deployment of technology. Adopting an ANT lens would have led me to centre symbiotic horizontal relationships between actors such as individuals, institutions, wildlife, devices and databases used in protected areas, all contributing to an evolving state of play. The ANT concept of translation (Callon, 1984) is relevant for analysing the adoption of law enforcement technologies by a range of conservation professionals. Indeed, translation is a concept which helps break down and analyse the process of definition, negotiation and mobilisation that leads to notions or tools to become embedded in a network of actors. However, by putting many types of actors on an equal footing, ANT can sideline the role and importance of broader socio-historical contexts and obscure patterns of inequality and domination (Whittle and Spicer, 2008). Therefore, I do not use ANT in the course of this research in order to maintain the focus on political ecologies of power relations.

STINs are more compatible with the Foucauldian framework I adopted. There are part of an approach which acknowledges that artefacts take meaning through social interactions but also gives consideration to technological features and parameters. This is explained by one of STINs creators, Kling (1992: 362) who writes: 'physical objects like guns and roses have some capabilities that are not only arbitrarily derived from the talk about them. It is much harder to kill a platoon of soldiers with a dozen roses than with well-placed high-speed bullets.' I subscribe to this idea. Indeed, as I examine in Chapter 7 and 8, data management systems can have a range of applications and these applications differ according to local context and interpretation. However, these systems' intrinsic features also matter and limit what social actors can and can't make of the technology. This is the case in particular of geolocation and cloud-connectivity functionalities. As I will explore in Chapters 5 and 7, these technical parameters are at the heart of differing appraisals of data systems but also genuinely enable tasks previously thought impossible.

The second advantage of an STIN framework is that it helps focus the scope of analysis while taking a broad view of the social relationships which are relevant to understanding a technology. It takes into account both macro and micro level interactions between the social and the technological. Kling et al. (2003:54) manage this through including in the network both what they call 'resource dependency' or direct relationships as well as 'account taking' or indirect relationships. Direct relationships can hinge on money but also other types of mutual interests or obligations. The authors further define 'account taking' as*:* 'using other examples as reference points when making or defending decisions or proposing services. Account taking frequently takes the form of imitation […] but can also take the form of differentiation […] or working around (i.e., trying to avoid a previous system failure)' (*idem*: 54). Kling et al. (2003) also acknowledge that participants in the network 'are embedded in multiple, overlapping, and non-technologically mediated social relationships, and therefore may have multiple, often conflicting, commitments' (idem: 57). Because of this, their framework is compatible with and invites analyses that pay attention to the political economy of technologies and the power dynamics that surround them. This is why an STIN approach is a good counterpart to Foucault and followers' theorisation of government.

Electronic surveillance in the workplace

I examine the relationship between digital technologies and conservation, in particular I focus on their interaction with conservation professionals and protected areas as a place of work. Therefore, there is one further body of work that completes the ones I have introduced so far and speaks to the specificity of the expansion of digital technologies in workplaces. Research on the surveillance

or monitoring of workers is an important point of reference on this matter. I provide an overview of relevant research now and build on it in Chapter 7 particularly. Surveillance can be defined as a 'social ordering process' which 'comprises the collection, usually (but not always) followed by analysis and application of information within a given domain of social, environmental, economic or political governance' (Ball, Haggerty and Lyon, 2012: 1) In the context of workplaces, this tends to refer to the observation of and collection of information on the way workers' carry out their tasks with a view to improve work processes and productivity as well as to dissuade undesirable behaviours. Researchers concerned with the political and power implications of technology tend to use the term 'surveillance.' Those from psychology and management, who consider it as a common tool of the contemporary workplace and look at it from a cost-benefit point of view, tend to write about 'monitoring' (Ball, 2010:88). Both groups of scholars have made valuable understanding of these issues. However, for the sake of clarity, and as explained in the Introduction, I will use the term 'surveillance' to analyse instances where technologies are used to gather information about people with the intention to correct and direct their behaviour. I use 'monitoring' in cases where technologies are used to build a record of human activity and environmental patterns. will use these phrases interchangeably as they refer to similar practices and both groups of scholars have made valuable contributions to our understanding of these issues.

The observation and assessment of workers has been a feature of workplaces since the Industrial Revolution at least (Ball, 2010:89) and is integral to capitalism as it is a way to control their time and extract profit from it (Marx, 2013: 160-206). However, it has acquired a new scope and garnered renewed interest with the spread of computing, mobile and geo-location technologies. Reams of paper have been produced on this issue in the context of sectors such as customer support call centres (Bain and Taylor, 2000; Ball and Wilson, 2000), clerical work, retail (Joshi, 2005; Sobreperez, Ferneley and Wilson, 2005; Johnson *et al.*, 2014; Evans and Kitchin, 2018) and manufacturing (Sewell and Wilkinson, 1992; Bernstein, 2012) . Yet very little has been written on the topic in the context of protected areas. I aim to put this dimension of the interplay between technologies and the day to day of conservation on the map.

Some have raised unmitigated concerns about the expansion of electronic surveillance (Attewell, 1987; Baldry, Bain and Taylor, 1998; Fernie and Metcalf, 1998) which they have heralded as instrumental to turning offices into 'satanic mills' designed to wring out all energy out of employees, leaving them no space for respite. However, the main takeaway from the debates on the legitimacy and impacts of surveillance at work is that they are more nuances and the outcomes are highly contextual (Bain and Taylor, 2000). One technology and worker surveillance approach can galvanise workers in certain cases but spark uneasiness and resistance in others.

Some studies have concluded that the surveillance of employees can indeed enhance productivity through motivating employees (Nebeker and Tatum, 1993; Stanton and Julian, 2002) and deterring unauthorised behaviours such as theft (Pierce, Snow and McAfee, 2015) and absenteeism (Duflo, Hanna and Ryan, 2012). Others have raised concerns about the effects of surveillance. Bernstein (2012) has for instance argued that close monitoring stifles the necessary innovation and creativity while Anteby and Chan (2018) have shown that constant surveillance can be perceived as oppressive by employees who will adopt behaviours to avoid it such as taking longer breaks. The use of workplace monitoring technologies has also been noted to have a detrimental effect on employees' health and well-being as well as inter-personal relations in the workplace. Electronic monitoring has for instance been linked to higher levels of stress theoretically (Amick and Smith, 1992) and as reported by employees (Smith *et al.*, 1992; Aiello and Kolb, 1995). Computer mediated surveillance has also been shown to cause mistrust towards (Westin, 1992) or conflict with management (Johnson *et al.*, 2014).

Faced with such diametrically opposed conclusions, it is key to look at what causal mechanisms scholars have identified as leading to these different outcomes. One key aspect relates to the type of task being monitored and whether the dimensions measured and evaluated accurately reflect employees' responsibilities and job description. Ranganathan and Beson (2017) and Aiello and Svec (1993) thus noted that on simple tasks this monitoring system did improve productivity but on more complex jobs it decreased it. In a complementary way, Evans and Kitchin (2018) and Grant, Higgins et al.(1988) found that scanning and computer systems could only assess the quantitative aspects of jobs leaving the more time consuming but just as key qualitative aspects such as customer service out of the equation. This was perceived as unfair, affected the quality of service and led to employees to be dissatisfied.

The ways in which the devices are set up, developed and introduced also are relevant in determine the outcomes of surveillance at work. In practice, Westin (1992) and Amick and Smith (1992) have underlined the importance of employees' participation in the design of the tool while Tomczak, Lanzo et al. (2017) have remarked that the system is less likely to encounter opposition if management is transparent about its existence and about the use of data collected. Attitudes towards technology-mediated surveillance are indeed linked to the type of management policies associated with it. Workplace surveillance tends to lead to more positive results when it is used as a starting-point for training and skills development rather than sanction (Zubroff, 1988; Amick and Smith, 1992; Alder and Ambrose, 2005). The way the tool itself is set up also matters for mitigating negative effects associated with work surveillance. For instance, employees seem more amenable to being monitored at team level with the data presented in an aggregated format

(Stanton, 2000). Similarly, workers seem more accepting of monitoring tools they can control or turn on and off (Aiello and Svec, 1993; Stanton, 2000).

It is not my aim to uncover new causal explanations for the positive or negative repercussions of workplace surveillance beyond those reviewed here. I agree with Chalykoff and Kochan (1989) and Zubroff (1988) who highlight that although technologies have the potential to provide managers with new abilities for evaluating and controlling their employees, it is the social arrangements of specific workplaces that determines their impact. This is why, in Chapter 7, I detail the ways in which the surveillance of conservation workers takes place through technology and highlight the extent to which these existing findings map onto my empirical focus.

Contributions to the literature

Building on the bodies of literature reviewed above, my research looks at wildlife and forestry law enforcement databases as a technology that acts both as an instrument of knowledge to conduct in-situ conservation and as a technique for the government of conservation actors. I aim to analyse the novel ways in which it does so. My research therefore makes an original contribution to the current state of the literature along four main directions.

Firstly, I turn the governmentality framework on its head. A number of studies using this framework focus on how populations living within the jurisdiction of conservation programmes are governed and affected (Agrawal, 2005; Murray Li, 2007; Fletcher, 2017; Fletcher and Cortes-Vazquez, 2020). I draw attention to the ways in which tools of government influence the practices, rationales and the expectations placed on those in charge of governing themselves. Moreover, accessing the population that law enforcement technology users attempt to govern, the perpetrators of wildlife crimes, would be methodologically and ethically difficult. In Chapters 3 and 5 to 8, I explore instead the interplay between technologies and the government of governors themselves, their rationales, practices and the knowledge they draw on.

Secondly, I borrow from the socio-technical perspective an attention to the technical parameters of these technologies as well as to the broader social context and political economy. With this in mind, I explore how digital technologies, their nuts, bolts, and code, interact with the ways in which conservation professionals plan and practice their activities. In doing this, I build on and expand social science research already published on 'technology for conservation' (Arts, van der Wal and Adams, 2015), 'conservation by algorithms' (Adams, 2017) and 'AI in the wild' (Dauvergne, 2020).

Thirdly, by bringing in insights from the literature on the surveillance of workplaces, I add an analysis of the ways in which law enforcement databases are used to monitor conservation staff. Very little has yet been written about this particular topic either in case studies of conservation technologies or in sociological and organisation studies publications on protected areas as workplaces.

Finally, I add a multi-scales dimension to the environmentality approach. Political ecology, the home discipline of much environmentality research, is attuned to the connections between localised conservation interventions, local manifestations of environmental change, national and global processes. There are political ecology studies choosing government departments, international conservation NGOs and donors as their main focus. Yet, there are not many studies giving equal attention to both localised interventions and to actors based elsewhere who weigh in on these interventions through funding, policy making or project design. I spent an equal amount of time conducting observations and interviews with actors influential at different scales be it local, national or international. This enables me to unpack how different forms of governments and actors at different levels cooperate or clash around one type of instrument, i.e. law enforcement databases.

Conclusions

Foucault's reflections on government have opened up the field of political studies beyond political institutions traditionally understood as the government. Scholars have later formalised his reflexions in a grid of enquiries to better understand how practices, knowledge and identities shape and are shaped by attempts to guide people's conduct. This approach has been productively adopted by political ecologists to examine environmental, and in particular conservation, issues under the concept of environmentality. Political ecology offers a view of nature as an intertwining of human ingenuity and natural materials and a vision of conservation as a form of government. Conservation is indeed, a series of human interventions designed according to expertise, shaping landscapes and behaviours in order to attain the best possible result, in this case the preservation of habitats and species. I borrow from Foucault's approach and its conservation study followers an understanding of how the notion of government translates to conservation issues as well as four concepts highlighting the processes by which government operates: practices, knowledge, visibilities and identities.

In Foucault's writing power, government and resistance can be something of a disembodied phenomenon. Drawing on the political ecology of conservation literature enables me to give an historically and empirically-informed account of who holds power when it comes to the

management of protected areas and what tensions exist between different groups around this issue. I notably introduce the institutions and actors relevant to my research in Chapter 2, 3 and 4.

Although Foucault and followers use the terms 'techniques' and 'technologies' to refer to the different ways in which government operate, this has little to do with machines, wires and software. Political ecology has not engaged much with the digital either. This is why I introduced the literature on socio-technical systems and electronic surveillance in the workplace. Indeed, these help understand how the nuts and bolts of digital technologies shape and are shaped by government processes and power relations in the conservation sector.

Through combining governmentality, the political ecology of conservation as well as research on socio-technical and surveillance systems approaches I develop a governmentality approach to the role of technologies in conservation law enforcement work across scales. In the next chapter, I justify the framing of my empirical inquiries linking protected areas in Sumatra, Indonesia to international decision-making spaces and I detail the methods I used to conduct this research.

Chapter 2: Methodology

The diversification and spread of monitoring and surveillance technologies for wildlife and forest conservation is a relatively new phenomenon. Its social, political and economic ramifications are still little documented in the academic literature. As such, there is much to learn from the experiences and understandings of people who interact with and make decisions about these technologies which is why I chose an in-depth qualitative approach to examine this topic. My choice of qualitative methods fits within an established take on the application of a Foucauldian framework to conservation issues (see for instance Agrawal, 2005; Murray Li 2007; Asiyanbi, 2016). My qualitative outlook also builds on recent contributions on critical study of digital technologies, big data and algorithms (Bates, Lin and Goodale, 2016; Seaver, 2017).

I focused on a specific case study and intensively researched a 'relatively bounded phenomenon' (Gerring, 2004: 341). I looked at technologies which support law enforcement. These technologies are used to monitor and keep track of intrusions into protected areas and breaches of environmental laws. They can support policing responses to these incidents. The Spatial Monitoring and Reporting Tool (SMART) has been at the centre of my inquiries. I followed it from the networks of developers, international NGO and donor organisation employees who initiated it and supported its deployment across the world, down to the civil servants and conservationists who controlled its implementation in Indonesia and across relevant authorities in two provinces of the island of Sumatra. In doing so, I adopted a multi-sited approach, 'tracing cultural formation across and within multiple sites of activities' (Marcus, 1995: 96). This perspective was called for as one my research's contributions is to add a cross-level lens to the environmentality framework.

In this chapter, I justify my case study selection and give some context to each of its components: law enforcement technologies (SMART in particular), international conservation policy and funding circles, Indonesia as well as the provinces of North Sumatra and Riau. I then explain how my research was shaped by the challenges I faced in accessing the places and people I had identified as relevant. Finally, I detail the methods I used to gather information, the steps I took to treat participants with respect and how I analysed the material collected. Throughout the chapter, I highlight how the various facets of my identity, i.e. my positionality, came into play during the research process.

Case selection and components

This research is a multi-sited illustrative case study of a technology used for conservation law enforcement, SMART. In this section, I explain the characteristics and benefits of multi-sited case study research. I then explain why SMART is a relevant case to focus on and why I chose Indonesia, North Sumatra and Riau as sites or sub-units to pay particular attention to.

A number of landmark peer-reviewed articles on the social and political implications of conservation technologies rely on reviews of secondary material (Arts, van der Wal and Adams, 2015; Sandbrook, 2015a; Adams, 2017) and large-scale surveys (Sandbrook, Luque-Lora and Adams, 2018). However, as Flyvbjerg (2006) argues, there is also heuristic value in placing oneself in a context and delving into the concrete detail of a single example. Original and informative knowledge can be produced through this approach and illuminate broader, more abstract ideas. This approach is often called a case study. Much has been written in attempt to categorise case studies, often using terminology from quantitative approaches such as populations and samples to do so (Gerring 2004) or starting from the assumption that extreme, critical or common cases should be strategically chosen in order to test hypotheses (Flyvbjerg, 2006; Yin, 2018). The way I have structured my research is not a direct implementation of these models as they were not suitable to answering the what and how questions I introduced in Chapter 1. Instead, I adapted my research design to suit the specificities of my topic, the use of law enforcement technologies in wildlife conservation, and to the Indonesian context. Nevertheless, careful consideration has gone into selecting the different elements of my case study, reflecting on how they fit together and weighing their wider significance as I explain in the rest of this section.

I used SMART as a guiding thread for my research across different sites. SMART is a technology developed by a consortium of international conservation NGOs to tackle the illegal killing and trading of endangered species. It aims to bridge a perceived gap between the capacity of those enforcing anti-poaching and logging laws, in particular in protected areas, and the sophistication of those involved in breaching these laws (SMART Partnership, no date b). At its core, SMART is an open source software combining data categorisation and storage, mapping and graph-making functionalities. It borrows, and claims to democratise, features from Excel and geographic information systems such as ArcGIS and OpenGIS. Geo-tagged data is collected 'in the field' thanks to mobile GPS-enabled devices such as handheld GPS units used in tandem with analogue notebooks or phone and tablets with the SMART application. The information is then input into the software, either automatically or manually, and visual representations of the area and activities of interest can be created. This includes information such as the wildlife and spoors observed, the

communities visited by rangers for awareness raising and development projects, signs of illegalactivities such as poaching, illegal logging and mining or land clearing for agriculture as well as the nature and number of confiscated tools used for these activities. The objective is to support strategic planning of conservation action by protected area managers and help conservation NGOs report on their projects.

When I started this project SMART was in used in 300 protected areas worldwide. At the time of writing, it has been adopted by over 765 sites across 60 countries, mostly across tropical regions (SMART Partnership, 2016, 2018). It is therefore the most widespread system of its kind. There are a number of other surveillance systems that gather and analyse information about the going-ons inside protected areas, either through devices carried by rangers or through sensors attached to animals or dissimulated in the landscape. Prominent applications in this vein include the EarthRanger software (previously called Domain Awareness System) developed by Vulcan, the philanthropic organisation of Microsoft's co-founder Paul Allen, the Zoological Society of London's Instant Detect, Wildlife Protection Solutions' wpsWatch, Cisco Group connected conservation initiative and Smart Parks' communication networks. None of these are in operation across as many sites and countries as SMART.

Furthermore, SMART is maintained and promoted by a consortium of some of the largest, most influential and well-funded conservation non-governmental organisations (Chapin, 2004; Brockington, Duffy and Igoe, 2008; Brockington and Scholfield, 2010). The likes of the Wildlife Conservation Society, World Wildlife Fund and Peace Park Foundation have come together around this project. In fact, SMART is often presented as a rare example of successful collaboration between NGOs in the sector.[4] Major donors such as the World Bank, the European Union and the United States Agency for International Development, the US Fish and Wildlife Service are also listed as associates of the partnership. SMART therefore occupies a unique and privileged position in the current conservation landscape. Because of its breadth and the number of actors it involves, SMART can be considered as an object of study 'that cannot be accounted for ethnographically by remaining focused on a single site of intensive investigation' (Marcus, 1995: 96). As such, it lends itself well to a multi-sited approach that broadens the field of enquiry beyond a single site of intensive investigation. In the case study literature, this approach is also called an embedded case study meaning that the case involved units of analysis at different levels (Yin, 2018: 87). I followed SMART from the individuals and organisations involved in the consortium, the

[4] World Bank Global Wildlife Program Webinar 'SMART Improving the effectiveness of protected areas globally' on 22/05/2019

spaces where they meet and advertise, down to the civil servants and conservationists who controlled its implementation in Indonesia and on across the jurisdiction of the forest and wildlife authorities of the North Sumatra and Riau provinces.

I have chosen to focus on SMART's implementation on the island of Sumatra, Indonesia. Asia is the region were SMART was implemented the most at the time I started my project: almost half of SMART sites were then located on the continent (SMART Partnership, 2016). Indeed, South East Asia is the region where SMART's direct ancestor, the MIST software was first experimented with on a large scale (Stokes, 2010). Indonesia is a particularly interesting case as it is one of the few places where the technology has been in operation from 2011, when the first version of SMART was launched (SMART Partnership, 2015).[5] Participants are therefore likely to have more hindsight and experience of the technology than in places where it has been implemented more recently.

More broadly, the country has made official commitments to address environmental issues such as deforestation, and the illegal wildlife trade. Indonesia subscribed to the 2014 London Declaration on the Illegal Wildlife Trade which highlights the need for governments to 'criminalise poaching and wildlife trafficking', 'strengthen the legal framework and facilitate law enforcement.' In terms of deforestation and as part of international agreements on climate change, Indonesia has committed to reduce its greenhouse gas emissions by 29% between 2020 to 2030, with the forestry sector leading the way. The government has issued a moratorium on the use of primary forests and peatland since 2011. Following several episodes of devastating and highly polluting forest fires, Indonesia signed the ASEAN Agreement on Transboundary Haze pollution with the president Joko Widodo more recently specifying that law enforcement and early warning systems had a key role to play in implementing the Agreement's framework and addressing the issue (Ministry of Environment and Forestry Indonesia, 2018).

The main institution in charge of upholding these commitments is the Ministry of Environment and Forestry (*Kementerian Lingkungan Hidup dan Kehutanan - KLHK*). The Ministry has responsibility for forest and wildlife throughout the country. It manages national parks and other categories of nature reserves as well as the other legal classes of forests (protected and productive) beyond their boundaries. Each of these administrative categories is handled by a different department or directorate general (*dirjen*) within the Ministry. Most of these divisions have relays

[5] See also interviews 3.01 and 3.07

in each provincial capital as well as smaller outposts spread across the countryside, in the districts with more or less autonomy given to the local level depending on the issue.

The provinces I focused on, that of North Sumatra and Riau are located on the island of the same name. Sumatra has been listed as a 'biodiversity hotspot', a region with high rates of species found nowhere else and rapid habitat loss (Myers *et al.*, 2000). Although the biodiversity hotspot model has been questioned (Bonn, Rodrigues and Gaston, 2002; Orme *et al.*, 2005), it effectively acts as a strategy to target conservation action and attract funding (Myers, 2003). Indonesia is also a source country for illegal wood and animal products with Sumatra acting as one of the departure point for international trade routes (Ward and Mabrey, 2013). This region therefore attracts significant conservation resources and attention. Keeping to the broad geographical designation of North Sumatra and Riau in this chapter allows me protect the anonymity of the specific locations I conducted fieldwork in.

Generalisation or the applicability of findings and proposals beyond the case studied has been a major concern of the literature on case studies (Gerring, 2004; Flyvbjerg, 2006; Lund, 2014). A lot of emphasis is put on formalising links between case studies design and the conclusions that can be inferred from findings. Although SMART and Indonesia are at the heart of this research I also collected information about other similar technologies and from individuals supporting their implementation in other countries or continents. These represent what Gerring (2004: 344) calls 'informal units' or elements that are brought to the analysis in a less structured manner than the main case study and have been more superficially studied. I used this material to understand the specificities of my case study and it helped me identify which of the dynamics I observed may, in Lund's words (2014) resonate with, or be representative of, broader trends.

In short, I have taken a qualitative in-depth case study approach to a topic which had previously mostly been examined on the basis of secondary data or surveys. The particularities of the case I chose led me to adopt a multi-sited or embedded cases approach and selected sites which are significant amongst existing technologies and conservation intervention locations. In the next section I describe the practical challenges I faced when moving from research design to data collection.

Official permits and entry points: the challenges of researching technologies for conservation in Indonesia

Reaching out to and being accepted by people who have first-hand experience of the research topic is the make or break first step of a research project. This requires 'strategic planning, hard work and dumb luck' as Van Maanen and Kolb (1985: 11) put it. Planning, work and luck have

all played a part in the development of this research. In 2017, when I started my PhD, 10 protected areas on Sumatra were implementing SMART according to the Partnership's website. All 10 of them were potentially suitable as smaller units of inquiry within the case study. I therefore organised Skype conversations with other researchers and conservationists to identify which of these parks would be most appropriate and accessible for research. In April 2018, I spent a month in Indonesia between Jakarta, the country's capital and Yogyakarta, an important centre for culture and education, for informal meetings and to assess ways of reaching relevant participants and sites. I started learning *Bahasa Indonesia* (the national language) and met with representatives of organisations, including representatives of the large international conservation NGOs providing technical support and funding to protected areas in the region. Seven months later, in December 2018, I travelled to Indonesia again and spent six months staying in turn in the provinces of North Sumatra and Riau, in Jakarta and in Yogyakarta where the *Universitas Gadjah Mada*, which I was affiliated with, is located. In between these two trips, several access challenges presented themselves.

Gatekeeping and access to local level interviewees

From speaking to other researchers who had done research on protected areas in Indonesia and elsewhere, I had envisaged that international NGOs and multilateral donors might a good first point of call. Academic colleagues had relied on these organisations' material resources and clout to approach protected areas and local level wildlife authorities. After my pilot trip, it became clear that it would not be the case for my project. I approached the main international organisations involved in the promotion of SMART in the country who also had links to on-the ground projects. Some initially refused to meet, others were happy to answer general questions about their projects but became very vague and non-committal when the discussion turned to facilitating a research stay at their field offices or stations.

I attribute these organisations' hesitations to two main issues: the cost and risk of supporting independent researchers as well as the present state of relations between national authorities and international NGOs in Indonesia. As I will detail further on in this chapter, Indonesia has strong regulations in place regarding non-national researchers. This means that organisations are wary of welcoming researchers as this represents an additional administrative workload and time spent helping said researchers settle down and facilitating their work. Indeed, public transportation and hotels are often lacking in rural areas and non-nationals are not allowed to wander around protected areas unaccompanied. The perspective of spending limited resources on supporting an unknown independent researcher is therefore not appealing.

Facilitating independent research by an academic who is not already in these organisations' networks is an even less attractive proposal as the findings published will not necessarily be in line with their official messaging. This could throw a wrench into their relationship with national administrations authorising their collaboration with protected areas. NGOs were even more protective of their reputation as I conducted my research at a time when the relationship of some of them with the government was becoming more strained. I also approached organisations with the idea to focus on SMART which had been the object of much back and forth between conservation organisations and national authorities in previous years. I unpack the relationship between NGOs and the Indonesian government and examine their discussions around conservation technology in more details in Chapter 5.

I dealt with these challenges by broadening my focus and the range of participants I approached. I did not only mention SMART in my interview requests anymore but described my interest through phrases such as 'monitoring and mapping technologies used in wildlife and forest conservation such as satellite imagery, GPS databases and drones.' Learning Bahasa Indonesia was also an important asset to my research. It not only allowed me to navigate day to day life in Indonesia and to conduct interviews but also enabled me to meet and establish a rapport with other gatekeepers. It was at the language school that I met people who put me in touch with the managers of a protected area I spent a month conducting interviews and observations at. My conversational knowledge of Indonesian also proved useful in another situation. In October 2018, I attended the London Conference on the Illegal Wildlife Trade with my colleagues from the Biodiversity and Security research project. This international event gathered official representatives from at least 46 countries, including Indonesia. I was able to make connections with the Indonesian delegation composed of NGO staff and government representatives more easily thanks to my language skills. People I met then introduced me to provincial wildlife authority representatives and opened many doors when I later returned to Indonesia.

One last element that facilitated my access to interviewees was my affiliation to the Department of Politics and Government at *Universitas Gadjah Mada* (UGM). This university is one of the oldest higher-education institutions in the country. It has instant name recognition and many senior civil servants have graduated from it. Carrying a letter of introduction from my academic sponsors at UGM and using the university's name in my introduction messages helped my interlocutors situate me and, in some cases, legitimised my presence and enquiries. More broadly, letters of introduction and permits of all kinds played a crucial role in conducting research in Indonesia which added another layer of practical complexity to my work.

Official research permits and administrative surveillance

Foreign researchers in Indonesia have to follow a strict visa and permit protocol. Complying with these regulations was time consuming and an integral part of my research project. I filled in an online application to the Ministry of Research and Higher Education which included a research proposal, guaranties from my academic sponsor and the Indonesian Embassy in the UK as well as a list of all localities I would conduct research in. Over a month later, I received a positive response from the Ministry. I then visited the Indonesia embassy in London to collect my stamped passport. When I arrived in Jakarta, I had to report to and collect paperwork at no less than four government offices: the Ministry of Research, the Ministry of Interior, the Immigration Office and the Police headquarters. Each time I travelled to a new province or district, I had to show my permits and register with the police and the 'Unity and Politics Agency'[6] locally.

Administrative supervision did not completely stop after the initial registrations. At one particular location, I was met with much suspicion by the local officer in charge of foreigners. He visited all the addresses I had indicated on my forms and questioned me at length about my purpose in the locality. Despite my official permits bearing the title of my research and my academic affiliations, the officer had trouble believing I was indeed conducting research for a PhD. Part of this was due to my age as he expected that people undertaking such a degree would be older. My gender perhaps also played a part although this was not explicitly mentioned. The officer demanded to witness an exchange with a research participant before he was convinced I was a legitimate student. He also initially floated the idea of having one of his staff accompany me at all times: I had to do my best to tactfully explain how problematic it would be to have a local government authority attend interviews and the organisation which hosted me had to provide a schedule of activities for my visit and formally take responsibility for me. In the end, I promised to send the officer a picture of my location each day and to produce a written report at the end of my stay. I ensured that these pictures only showed buildings and landscapes and not participants. These dynamics meant that, for part of my fieldwork, I was under surveillance myself as I was researching technologies in the conservation context.

These restrictions and demands for guarantees from international scientists are justified by predatory scientific practices past and present.[7] Indonesia has a history of colonial plunder and

[6] Badan Kesatuan Bangsa dan Politik (Kesbangpol)

[7] In 2019, however the Indonesian parliament has passed changes to the laws regulating foreign researchers which worry both international and Indonesia researchers who, at the same time, are encouraged to build international collaborations to raise the profile of their institutions. Violation of research permits are now liable of fines and prison

decades of foreign researchers briefly visiting and stealing ideas and resources from the country. Controversies surrounding such 'helicopter research' continue to this day (Misany and Fiantis, 2018). As recently as 2012, there was a notorious case in which two Northern researchers published a paper describing a new species of giant wasp (Rochmyaningsih, 2019). They did so without acknowledging the role of Indonesian scientists who collected the specimen and suggested a name for the species. To add insult to injury, the article's authors named the wasp after the mythical bird-like Garuda, a religious and national symbol. At a time where authorship of peer-reviewed papers is used as a measure the worth of researchers, such practices are highly damageable. In 2018 another study created controversy in Indonesia. The researcher in question was a PhD student who examined the link between genetics and Central Sulawesi's Bajau people's ability to stay under water for long amount of time. She was accused of not obtaining local ethical consent and taking DNA samples out of the country without the necessary authorisations (Rochmyaningsih, 2018). My research is nowhere near as sensitive as these examples but my status as a white, middle-class, European researcher as well as the shortness of my stay did produce some uncomfortable dynamics. These aspects were on my mind during the length of my project and I analyse them as part of the account of my data collection methods.

Data collection methods

I used three qualitative methods to complete this research: interviews, observation and document analysis. I used these approaches in an iterative and complementary way so that they reinforced each other and enabled triangulation or cross-checking of the information obtained. For instance, I used document analysis and observation to identify potential interviewees and devise interview questions while interviewees sometimes pointed me to further documents to read. In this section, I detail how I mobilised these methods and the on-going challenges I encountered.

In-depth qualitative studies combining observations, interviews and document analysis which result in a detailed account of the research process and findings are often called ethnographies (Adler and Adler, 2008; Bryman, 2016: 424) but I will not claim this appellation. A number of scholars who have used various blends of these methods to examine conservation interventions (see for instance Moreto *et al.*, 2017; Kiik, 2018; Massé, 2019) or shed light on the interplay between social relationships and technologies (Seaver, 2017; Dourish and Gó Mez Cruz, 2018) qualify their work of ethnography. However, opinions are divided as to what exactly constitutes an ethnography. Emerson (1987) and Wolcott (1990) for instance regret that studies

sentences (The Jakarta Post, 2019). The lack of clarity around the implementation of these new measures is source of concern. The government has been suspected to use this law as a form of political censorship (Rochmyaningsih, 2020).

now called ethnography often entail a less prolonged and intense immersion in social settings than used to be the case. My approach is much closer to what Seaver (2017: 6-8) calls a 'scavenging ethnography' or what Wolcott (1990) dubs 'mini-ethnographies.' Indeed, I sought any point of entry I could into my topic of interest across several sites and types of sources. I spent a maximum of one month actually embedded in any given social setting. Interviews, not participant observation, were my main source of information. Because of the ambiguities surrounding what constitutes an ethnography, I will continue to designate my research as an in-depth qualitative study as I describe how I conducted my research.

Interviews

I completed my data collection through a seven-months fieldwork period in Indonesia. In Jakarta, I was able to interview representatives of national authorities such as the Ministry of Environment and Forestry but also employees of donors and civil society organisations. I also spent time conducting interviews and observations in the province of Riau, at two protected areas in the province of North Sumatra as well as within the relevant district and provincial government authorities. From June 2018 to July 2019, I also conducted interviews over video and phone calls and participated in international conservation conferences and workshops such as the London International Conference on Illegal Wildlife Crime in October 2018. I used these channels to reach representatives of NGOs based in the Global North and businesses involved in developing and promoting technologies to support conservation law enforcement. Overall, I conducted 73 interview sessions, some one-to one and some involving two or three participants at a time.

I devised a protocol for these interviews with in mind ethical considerations such as confidentiality, informed consent and data security as well as more diffuse principles such as respect and care for participant and partners. The workshop on 'Research in Developing Countries' organised by the University of Sheffield's Research Ethics Committee has informed my approach which has also been assessed and approved by the Politics and International Department Ethics Committee. However, balancing ethical considerations did not stop there and was an on-going part of the research process, as illustrated by my dealings with local security officials detailed above. In Indonesia, participants and passer-bys alike were curious about my presence and often snapped pictures of me which they then posted on social media. This was hard to reconcile with my commitment to keep locations and people involved in the research anonymous. On a couple of occasions, when pictures were taken during interviews, I intervened and asked for them to be deleted or kept offline but in most instances, I resigned myself to it. My reasoning was that most people in the networks where the pictures would circulate were already aware of my whereabouts

and that I had already declared the specific locations I would be carrying fieldwork in to the immigration and research authorities.

Once I finished conducting interviews and started writing about participant's opinions and experiences, I continued to take into account my commitment to keep them anonymous. In order to keep their identity confidential, I have labelled each interview with a number and am using this number to cite them. With each quote, I only give as much context on the identity and background of each interviewee as I think is necessary to understand the significance of their remarks.

I recruited interviewees through cold emailing following online research, convenience sampling and snowball sampling. In the lead up to interviews I would send documents detailing the aims of my research project as well as consent forms outlining the uses I would make of interviews and guarantees of confidentiality. When it was not possible to send these documents ahead of time or not appropriate to give paper copies, I started the conversation by running through this information verbally. I used semi-structured interviews, supported by an interview guide of six to seven questions adapted to each group of participants leaving time and space for follow up questions and digressions. In the lead-up to a scheduled interview I would also check that the guide was relevant to the individual participant and their organisation and do additional background research. I asked open questions starting with prompts about the interviewer's role and their involvement with specific technologies to put them at ease, give context to the rest of the discussion and adapt my questions on the spot if need be. I left the topics I judged more sensitive such as potential 'pushback' against technologies and financial matters to the end of the conversation. I also took to ending the interviews with asking whether the interviewee felt there were important dimensions to the topic we had not covered to give participant a space to take the lead and reflect.

In keeping with my multi-sited approach, the research participants I interviewed were spread across various geographical locations. As Figure 2 below shows, almost three quarters of my interviewees were based or worked in Indonesia. The United-Kingdom and United-States were the other most represented locations. This is principally due to the fact that large conservation NGOs are headquartered there and the contractors and consultants collaborating with them also often operate out of these countries. The 'Other' category in Figure 2 encompasses places across the Americas, Europe, Africa and Asia and mostly relates to employees of INGOs working in different countries. As I mentioned above, I used these 'Other' interviews to understand the specificities of the Indonesian context and it helped me identify which of the dynamics I observed

there might relate to, or be representative of, broader trends. The US and 'Other' interviews mostly took place over video calling applications Skype and WhatsApp. In Indonesia and in the UK, I privileged interviewing people face to face in cafes or at their places of work. This last setting provided additional layers of information as I observed the maps and pictured displayed (or not) in corridors and meeting rooms as well as the IT equipment present in offices or lack thereof.

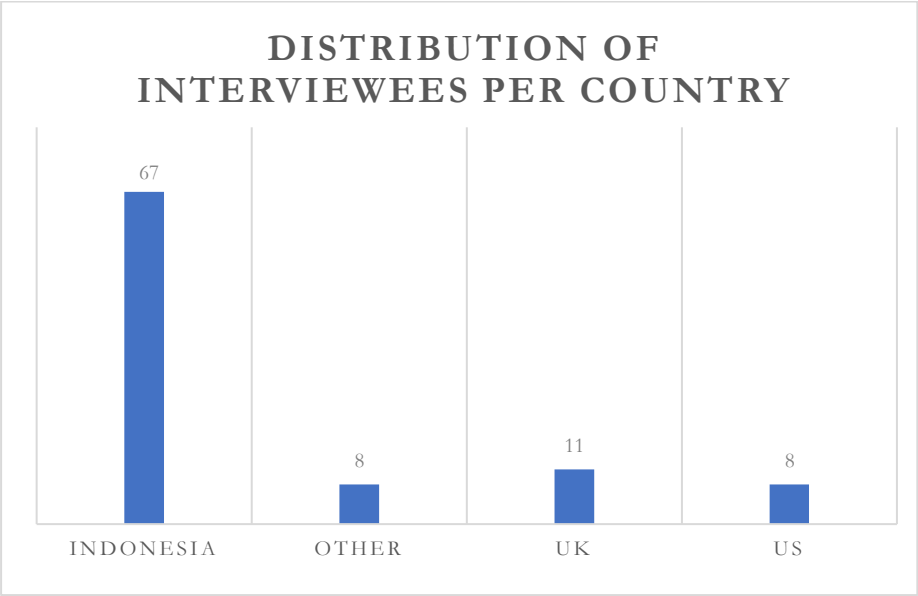

Figure 2: Distribution of interviewees according to the country they are based and work in

With the permission of participants, I made an audio recording of the vast majority of interviews. I later transcribed these recordings either myself, with the help of a professional service or with the help of a research assistant, an Indonesian forestry student, who contributed to nine interviews. The recordings were helpful in more ways than one: it meant that I could give my undivided attention to the flow of the conversation and it enabled me to capture meaningful nuances of the conversation such as the precise turn of phrase used, laughter or hesitations.

Ideally, interviews provide a space where interviewees and researcher can build a rapport thanks to shared characteristics or despite the lack thereof and feel comfortable enough to actively engage in this slightly unusual form of interaction and information-sharing (Davies, 2008: 110-115). The basis for mutual trust and openness naturally varied with each interviewee. Curiosity for the topic discussed and showing an interest for the interviewee's experience and expertise were ways to create common ground. Nationality and common language sometimes also influenced interviewees' enthusiasm and the length of the interview. I carried out interviews in English, French (my native language) and Indonesian. When I could use the interviewee's first language, I felt that this helped put them at ease and sometimes led to appreciative comments.

Drawing on the multi-sited approach, I sought to reach and interview people involved in the different stages of building and using technologies for conservation and from different professional backgrounds. I spoke with people working for organisations developing technologies, those coding, designing, prototyping, advising on maintenance and selling tech products. In Figure 3 below, these people are split between the 'Academic/Research', 'Private Sector/Industry' and 'International NGO (INGO) Headquarters' categories. We discussed how they came to work on conservation-related projects, their understanding of conservation issues, salient tech features, the 'business model' behind applications for conservation and the challenges they encountered in developing 'products' for the wildlife conservation sector.

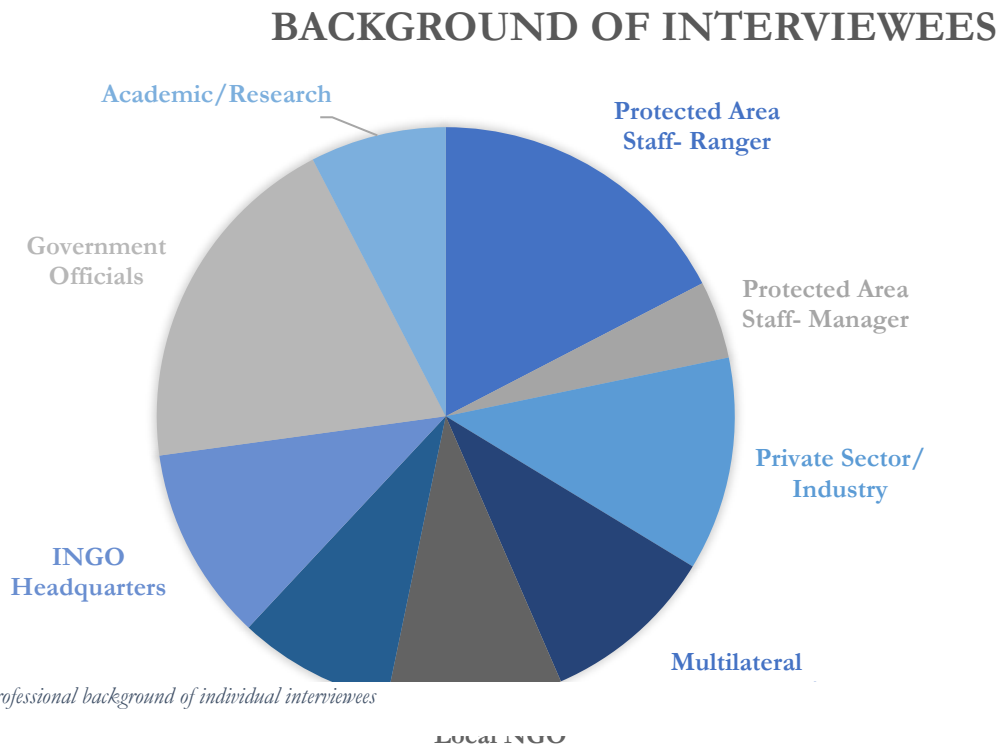

Figure 3: Professional background of individual interviewees

I contacted representatives of donor and multilateral organisations backing the use of law enforcement technologies through financial and/or technical assistance. I asked them about the programmes they contribute to which included surveillance technologies, how and why they supported specific tools. I also spoke to INGO staff in country and at headquarters as well as local conservation NGOs and consultants (included in Figure 3's 'Private Sector' category) who are helping to set up new technological systems at conservation sites or directly using these systems

in their law enforcement activities. I elicited descriptions of their approach to deploying innovative technologies in new locations, of what they believed these tools were useful for and of the challenges or pushback they encountered. The interviews were an occasion for them to reflect on the role of technology as part of their mission to protect species and ecosystems.

I asked Indonesian government officials at national level about their investment in various systems to support law enforcement and their interest in and use for data produced through technologies in the provinces. At protected areas, district and provincial wildlife and forest authorities, I spoke with government officials, rangers, office staff in charge of administration and data management[8] as well as managers. In the context of my research, the term rangers refers to three categories of civil servants employed in state-sanctioned protected areas: forest police (*polisi hutan*) specialised in law enforcement, forest ecosystem controllers (*pengendali ekosistem hutan – PEH*) dedicated to biodiversity monitoring and community liaison officers (*penyuluh kehutanan*). Although each of these groups have a different specialism and focus, they often work in mixed teams and interact with monitoring and surveillance technologies. I wanted to understand rangers and other government employees' perception of what SMART and technologies were useful for, how they used those to collect, compile and review information, what data was prioritised and how technologies fitted within the broader range of tasks and activities that make up their job description.

Lastly, the Private Sector/ Industry category in Figure 3 also includes representatives of the agro-commodities and forestry sector in Indonesia who are under increasing pressure to consider biodiversity and set aside tracts of their plantations for conservation. Although, their experiences are not at the heart of my argument, some are now using similar systems to traditional protected areas. They also provided valuable insights about legal and scientific aspects of wildlife and forest conservation in the Indonesian context.

Participant Observations

I used participant observation as a way to get a richer first-person understanding of the activities and group dynamics I was researching as well as to get an appreciation of the atmosphere of the places concerned. Observations were also a way to assess and reflect on statements gathered during interviews. Finally, they served as inspiration for further questions. My observations covered a range of activities as diverse as participating in webinars and workshops on the margins

[8] Rangers carrying out enforcement patrols, biodiversity monitoring or community outreach as well as protected area administration staff are all included in Figure 2 under 'Protected Area Staff –Ranger' due to the similar nature of their status.

of international conferences, watching people use or demonstrate the functionalities of technologies, accompanying rangers and wildlife officers on various outdoor tasks and spending time with research participants during meals and breaks. As such I could be qualified of what Bryman (2015: 436-7) calls a 'partially participating observer.' At conferences and workshops I was often delivering presentations and chatting with other delegates. As such, I was fully complying with what is expected of an event attendee. In other settings such as protected areas, I was continuously interacting with participants but was only invited to join certain activities and did not take on roles other than that of researcher.

In all observation situations, I made it clear that I was a researcher and that this was the source of my interest in the activities I was taking part in. After seeking permission and if it was appropriate, I would make handwritten notes during the activity and later write a summary and some reflexions. If the activity took place outdoors or in more informal contexts, I would type or record a voice memo of everything I could remember in the evenings.

Observations were the situations where I was the most accurately aware of tensions relating to my positionality, in part due to the events and spaces I could access, was invited to even, and those I could not. I was invited to policy and practitioners-oriented workshops. I was not invited to patrols requiring overnight stays in the forest, no-matter how many times I asked.[9] Indeed, acknowledging the similarities and differences between who I am and who my interviewees were matters for two reasons: it clarifies what aspects of my topic I was able to gather information about or not and what dynamics may have been at play during interviews and observations beyond questions and answers. It also brings to light imbalances of power and is a way of dealing with the tensions they create.

The binary insider/outsider has been used as a way to think through and relate the identity of researcher and participants but I agree with Mullings (1999) and Acker (2001) that it is too simplistic. Race, class, gender, age, nationality, academic and professional backgrounds combine and interact in more ways than one. First of all, given the range of people I interacted with for this research, I was not either an insider or an outsider throughout my project. Secondly, because I have multiple overlapping characteristics and can be labelled in many different ways, I was not always clear which of these was the most salient to participants and which way the power balance tipped. In the instance of my interactions with Indonesian protected area or wildlife authorities' employees for example, several characteristics associated with power and status came into play so that the resulting balance was not clear cut. I am a white European, with more academic and

[9] A combination of factors was possibly at play here, including timing and resources.

economic opportunities than my participants but my interviewees tended to be in more secure jobs, imbued with official state authority, and, for most of them, older men in a patriarchal society. In terms of interacting with international NGOs staff, we had in common higher education, an international outlook and/or lifestyle but we differed in terms of sector of employment, career stage and, more often than not, gender. Which of these dimensions mattered the most and facilitated or hindered interaction cannot be ascertained once and for all. These issues were less stark but no less important in relation to document analysis.

Document analysis

In the first instance, I used document analysis as a source of information to develop interview guides. I also critically examined documents such as tech-developing organisations' and funding bodies' annual reports, videos, brochures and social media promoting technologies as well as training materials. Most of documents I analysed are freely available online, either well signposted on organisations' website and social media channels or accessible through a 'doctype:pdf' search on Google. Some reports and brochures I collected at events. Other documents such as training manuals were given to me by interviewees. While keeping in mind that a lot of curation work and negotiations go into the production of such documents, I considered them as a reflection of the official rationale for law enforcement technologies. I found documents could be read as one, but far from the only, expression of the hopes surrounding the technologies I studied and the expectations the authors placed on potential users.

I had initially considered drawing on archival research looking at past reports produced by protected areas and probing the data collected through various technologies. Although I have seen what this data looks like, was shown reports produced with the help of SMART and made notes about their broad content and structure, more in-depth access to such material was too sensitive. When I introduced myself and my research, a few of participants from Indonesian wildlife and forest authorities would immediately start arguing that access to data was very sensitive and that I would have to write additional letters to justify that the purpose of my research was in line with the aims and interests of their organisation. As soon as I mentioned that all I was after was an interview, they immediately relaxed and were amenable to answering my questions. I reflected on these incidents around access as an integral element of my research and they have notably informed the arguments I make in Chapter 5.

Data analysis and Nvivo coding

The process of making sense of the data started as I collected it. I made notes on striking quotes as well as recurring or emerging topics after interviews and during transcription. This was a way to further adapt my interview guides and interviewees recruitment strategy but was also a form of preliminary coding. This developed into an iterative process of coding my observation notes, documents and interview transcripts with the support of the qualitative data analysis software Nvivo.

I used a combination of three coding approaches. This enabled me to apply the theoretical lenses presented in Chapter 1 and answer my research questions while being attentive to participants' own perceptions of the issues and keeping an open mind to new ideas. As my first research question relates to the political economy of technology acquisitions and uses, I used versus coding (Saldaña, 2009: 93-96). This approach enabled me to uncover areas of tension between different group of participants and to find out how each group perceived the others. Through this coding technique, I was able to ensure that the views of all were represented in my dataset and I could highlight power dynamics. I also employed a combination of descriptive and structural coding (Saldaña, 2009: 66-70). I used short phrases to summarise topics discussed by interviewees and was able to identify recurring and important elements I had not thought about from the onset. This included issues surrounding digital sovereignty and data security which ended up forming the backbone of Chapter 5 or interrogations surrounding the sustainability of funding and distribution models behind law enforcement technologies which became a key element in Chapter 3. I also structured my coding by relating participants' words and the processes they described to my research questions and the conceptual framework of governmentality. This allowed me to map abstract concepts such as 'knowledge' or 'practices' onto events I observed or which were described by participants such as 'uses of data' or 'implementation process.'

After having read and coded most of my interview transcripts, notes and documents, I examined similarly coded sections, grouped them into overarching themes and analysed how they related to one another. This was far from being a neat and linear process. I relabelled some codes after coding a few transcripts and documents to specify their meaning, I combined codes that kept overlapping and when came the time of writing I left some codes aside which did not end up being very significant. This process merged with the writing as I started developing the main themes I had identified into extended arguments and kept going back to transcripts, observation notes and documents throughout the redaction of the Chapters 3 and 5 to 8. This process of grouping and

refining codes allowed me to synthesize insights generated through applying codes based on my pre-fieldwork questions and insights emerging form codes that stuck more closely to the data.

Conclusions

In this chapter, I explained why I designed a qualitative multi-sited case study of conservation law enforcement technologies. I chose qualitative methods to understand the interactions between different groups of participants revolving around the SMART system and a limited number of other technologies. Because these interactions unfold across a number of places and settings I adopted a multi-sited approach. I followed technologies across the places and sectors where they were conceived, promoted and implemented. In particular, I looked at the deployment and use of these technologies, often developed in the Global North, in the biodiversity-rich country of Indonesia. Inspired by the work of political ecologists and critical research on digital technologies, I chose to adopt three complementary qualitative methods: interviews, participant observation and document analysis. Through this approach, I was able to produce a rich, detailed empirical account about relatively new tools in the conservation sector which few have published about in this way.

I detailed above the combination of work, persistence and luck involved in carrying out this research and reflected on the practical challenges and ethical issues I faced. Despite initial administrative and access setbacks, I succeeded in conducting three quarters of my interviews in Indonesia and in carrying out observations at sites in Riau and North Sumatra. My research period in Indonesia was preceded and followed by data collection time about the organisations, individuals, events and documents setting out aspirations for technologies in the UK, US and elsewhere.

Finally, I highlighted how my positionality might have affected my access to and interpretation of materials collected. My interpretation is the foundation of the following chapters exploring the relationship between technologies and the government of conservation. In Chapter 3, I start by introducing how already influential actors of the international conservation sector have embraced and shaped technological developments.

Chapter 3: Conservation's technological transition, an international agenda setting

The international conservation sector has embraced digital technology as a necessary and positive component of the future of conservation. Scientists, non-governmental organisation (NGO) practitioners, engineers and programmers have partnered to produce innovative and bespoke devices and protocols to monitor the health of habitats and animal populations as well as to support wildlife law enforcement. They have made digital tools and monitoring hardware an area of collaboration and information sharing as they seek to orient and regulate their development.

This chapter is a first step towards fully understanding how the interactions between conservation professionals influence the development of law enforcement technologies and are in turn shaped by the use of these technologies. I bring two important pieces of this puzzle here. First I introduce the international conservation sector and the technology companies that have become involved in it. This allows me to establish how the vision these organisations have of what constitutes suitable tools for government of protected areas shapes what technology gets developed. I also begin to explore the relationship of these organisations with other conservation actors, namely those managing and working in protected areas in the Global South. I highlight how their interactions are in turn shaped by the dissemination of technologies.

In fact, I demonstrate in the next pages that technology dissemination follows the same neo-colonial patterns of influence that have been highlighted for conservation more generally. Admittedly, new actors have taken an interest in protecting biodiversity through the prism of technology, and traditional conservation players have had to adapt and engage with these but they have also maintained their prominence. Through more or less institutionalised networks, NGOs as well as mostly North America and Europe-based companies and government departments are shaping what a good 'technology for conservation' is, driving its implementation, and collectively identifying areas for improvement. These conversations around technology reflect norms and expectations around how protected areas should be managed, species conserved and wildlife laws enforced.

I first show how already influential actors in the field of international conservation have engaged with technological developments and technology experts. I describe how they have carved spaces to showcase and fund interventions resting on computing or scientific innovation. I explain that the phrase 'technology for conservation' does not refer to a well-defined set of material

technological features. Rather, it encompasses a range of tools that have been deemed innovative and useful in international conservation fora. Finally, I demonstrate that the implementation of technological tools for conservation largely follows neo-colonial patterns as conservationists and tech start-ups based in Europe and North America identify countries of the Global South as more in need of the technical investment and support they can offer.

Technology brings the Silicon Valley to conservation

Like the mining or the food and drinks industry before them, technology companies are keen to contribute, and more importantly be seen to contribute, to 'saving nature and wildlife.' Unlike other industries before them however, it is not just their money or commitment that can help conservation work but also the products and expertise they have to offer. Technology companies and individuals with the expertise and networks to set up dedicated consulting firms have come to back and direct a number of conservation activities.

Google, Apple, Facebook and Amazon (often referred to as GAFA) and other tech giants have become involved in wildlife conservation. Some, like Apple have donated funds to environmental organisations and projects.[10] Facebook, Amazon and others such as the Chinese online retailer Alibaba and search engine Baidu have become more directly involved. These internet businesses have joined forces with conservation organisations in the Coalition to End Wildlife Trafficking Online (2020) to stop the sale of illegal wildlife products on their platforms. Microsoft has set up a division called AI for Earth[11] dedicated to providing technical support, data storage capacity and funding to teams developing artificial intelligence applications related to environmental sustainability and conservation. Similarly, Google is making funding and tools that help code, train and test machine learning models available to organisations working on conservation technology. Rainforest Connection, a not-for-profit repurposing mobile phones into chainsaw listening devices, is one of Google beneficiaries.[12] The tech giant is also getting involved in projects such as Wildlife Insights, a soon-to-be-launched platform for sharing and automatically

[10] Apple (2018; April 19) Apple adds Earth Day donations to trade-in and recycling program. Retrieved from:https://www.apple.com/newsroom/2018/04/apple-adds-earth-day-donations-to-trade-in-and-recycling-program/ ; Apple (2016, November 14) Apple and The Conservation Fund advance forest protection efforts. Retrieved from: https://www.apple.com/newsroom/2016/11/apple-and-the-conservation-fund-advance-forest-protection-efforts/ [Last Accessed: 19/05/2020]

[11] Microsoft. AI for Earth Partners. Retrieved from: https://www.microsoft.com/en-us/ai/ai-for-earth-partners?activetab=pivot1%3aprimaryr2 [Last Accessed: 19/05/2020]

[12] White, T (2018, March 21) The fight against illegal deforestation with TensorFlow. *Google Blog*. Retrieved from: https://www.blog.google/technology/ai/fight-against-illegal-deforestation-tensorflow/ ; Ives, M (2019, October 15) Using Old Cellphones to Listen for Illegal Loggers. The New York Times. Retrieved from: https://www.nytimes.com/2019/10/15/climate/indonesia-logging-deforestation.html?utm_source=twitter&utm_medium=worldresources&utm_campaign=socialmedia [Last Accessed: 19/05/2020]

analysing camera trap images, and hosted a symposium on the topic at its headquarters in 2019. Leading microprocessors designer and manufacturer, Arm, has had a long standing partnership with Fauna and Flora International, granting it funding and lending engineers to help on specific projects. The list goes on.

But it is not only the tech giants that are involved, smaller start-up-like organisations have also been created to bring technological innovation to the field of conservation. For example, Wildlife Protection Solution, Smart Parks and Rainforest Connection produce and deploy movement, audio and video sensor devices and surveillance applications to keep watch in protected areas and identify intruders. In a similar vein, Conservation X Labs is an organisation which holds events and provides an online platform to support the design, incubation and distribution of technologies aiming to address environmental challenges. These are organisations which emerged in the 2010s and are entirely devoted to putting technologies and innovation at the service of wildlife and ecosystems conservation.

An array of organisations of all sizes are now providing technological applications for conservation purposes, and have even made this niche the core of their business in certain cases. Taking stock of this situation is important to understand who those involved in the development of monitoring and surveillance technologies are before we turn to understanding their relationships. However, the involvement of technology companies has not fundamentally shifted what the international conservation sector looks like. On the contrary, traditional heavy weights are partnering with these newer organisations and including more technology-focused activities in their own portfolio as I explain the next section.

Technology, the talk of the conservation town

If at first, traditional conservation organisations were unsure about how to integrate emerging technologies to their activities, they have by no means been unseated by the newcomers introduced in the previous section. Indeed, traditional conservation actors such as large NGOs and foreign assistance donors have embraced technological innovation, how they are, as an interviewee put it,'fitting it into their work[13] and setting out to collaborate with new players.

Technology for conservation is surrounded by hype, seen alternatively as both the future of conservation and a useful and more positive outlet for products tainted by commercial exploitation and data ethics controversies. The Conservation X Labs website for instance reads that their

[13] See interview 3.03

'technology- and innovation-focused, market- and scale-driven, and interdisciplinary approach to conservation […] is the future of conservation, what we call Conservation 3.0.'[14] This optimistic outlook is shared by representatives of the United Nations Programme for the Environment (UNEP) who reviewed the use of digital technologies for environmental monitoring and wrote: 'A future that leverages the digital revolution for the planet is ours to imagine and create' (Campbell and Jensen, 2019).

The way this technology has been discussed in recent international conservation conferences illustrates the trendy status it holds in the sector. The 2018 London Illegal Wildlife Trade Conference, a gathering of government representatives, not-for-profit staff and other interested parties was preceded by the launch of a horizon-scan report (The Royal Society, 2018) as well as no less than three advisory workshops dedicated to technology.[15] Under the auspices of the British Foreign and Commonwealth Office, these workshops put conservation practitioners and technology experts in the same room in the hope of generating new ideas and lasting collaborations. Participants represented organisations of all sizes but leading ones such as Amazon Web Services, Microsoft or the satellite imagery provider Planet were actively involved. Presentations outlining the problems associated to the illegal wildlife trade and describing successful innovations used on conservation projects, the latest commercial technologies as well as resources that could be made available to charities from the private sector were on the agenda. During the main event, an entire panel was dedicated to the topic in the largest room of the venue. Mark Field, then Minister of State from the British Foreign and Commonwealth Office started off this session by announcing that '*[the conference organisers] are confident that technology holds the key and what [they] want to is inspire nothing less than a revolution in conservation and technology has a critical part to play in that*.' In the meantime, several organisations were advertising products they developed at a stall in the conference venue. When British Crown heir Prince William attended the event, he was ushered to this booth for questions and a photo operation. This reflects the current star and trendy status of technology in the conservation aid sector.

[14] Conservation X Lab. Our Mission is to End Human-Induced Extinction. Retrieved from: https://conservationxlabs.com/mission [last accessed: 19/05/2020]

[15] Royal Society Workshop on the illegal wildlife trade, London, UK on 26th June 2018
'Technology for Conservation: Protecting Animals in the Wild' held at the Royal Aeronautical Society, London, UK on 27-28th September 2018
'Machine Learning and Data Sharing to Combat the Illegal Wildlife Trade' held at ZSL London Zoo, London, UK on 3rd October 2018

Similarly, the CITES 18th Conference of Parties in August 2019 held two sessions[16] to discuss the development of an electronic registry for trading permits in endangered species as well as a digital listed species traceability system. Technology was also one of the six key themes of the 9th World Ranger Congress which took place in November 2019.[17] Talks were held on the tools that exist to support rangers' work, in particular anti-poaching activities, and organisations are invited to advertise their applications and devices at dedicated stalls. Technology has indeed been granted a place of honour at large meetings destined to showcase the achievements of the conservation sector.

Behind the scenes, expert groups are emerging in conservation learned societies and policy organisations. These groups are actively looking for ways to weave new technologies into the sector's agenda as expressed by an international NGO employee involved in one such network:

' […] *in the past we had tech companies come to us and saying 'we've got this neat solution' and it's like 'ok, where can we fit this into our work' rather than it being 'this is our problem, here are the definite needs from the field, design something specifically for that and then let's take the scale*.' – Interview 3.03

This quote illustrates the willingness of conservationists to increase control over technology development so that it is relevant to their work and objectives. The Society for Conservation Biology for instance has a Conservation Technology Working Group which has very similar goals to those described by this interviewee. The Group sets out to 'push the technology agenda in conservation', support the development of new tools, evaluate the usefulness of existing ones and disseminate related research.[18] Peer-reviewed papers laying out a strategy and making recommendations for conservation technology have emerged out of this network which I comment on later in this chapter (Berger-Tal and Lahoz-Monfort, 2018; Lahoz-Monfort *et al.*, 2019).

The largest conservation NGOs are also individually keen to show that they are on-board with and up to speed with these developments. This is reflected in the annual reporting and planning documents of the largest and best funded amongst them. In its 2020 strategy, The Wildlife Conservation Society (WCS) states that by that year, it aims to have achieved 'sector-wide leadership in applying technology to enhance [its] strategies' and will 'expand [its] systems and

[16] CITES (2019) Provisional agenda and working documents - Eighteenth meeting of the Conference of the Parties Retrieved from: https://cites.org/eng/cop/18/doc/index.php [Last Accessed: 11/05/2020]
[17] 9th Ranger Congress (2019) Retrieved from: https://rangercongress.org/ [Last Accessed: 11/05/2020]
[18] Society for Conservation Biology. Conservation Technology Working Group. Retrieved from: https://conbio.org/groups/working-groups/conservation-technology-working-group [Last Accessed 11/05/2020]

methods of data collection, analysis and management.'[19] WCS also signals its intention to 'build its SMART partnership to strengthen the management of protected areas.' Similarly, in the World Wildlife Fund US-branch's 2018 annual report, its Board Chairman and CEO assert that they 'believe technology can help save nature' (WWF-US, 2018: 21). The 30-pages document also contains three editorial pages on the merits of technology and four case studies where big data analysis, blockchain, satellite imagery and forensics methods have been used to keep track of elusive species or act on wildlife crime. In its 2018 report, Fauna and Flora International (FFI) states that one of its main objectives is to 'empower individuals and organisations to lead innovative conservation action' through 'harnessing the potential of new technology' (FFI, 2018: 14). In its evaluation document for the same year, Conservation International (CI) details its involvement in Wildlife Insight, an online sharing and analysis platform for camera trap images boasting that its application of big data will 'revolutionise wildlife monitoring.' Last but not least, the Zoological Society of London (ZSL), which has its own in-house Technology for Conservation Unit, features similar case studies in its Annual Report and Accounts 2018-19. The ZSL report also includes announcements for updates on their citizen science mobile application and on the surveillance camera network that the organisation will roll out in 2020.

A final sign of technologies' fashionable status in conservation circles is that new tools and systems also attracts dedicated pots of funding. In the words of an international NGO employee interviewee:

'*There's been a bit of a rush into conservation technology, let's say, partly driven by the fact that for a number of donors they do put a premium on technology and technological solutions being quick fixes to more inherent problems of systems and personnel and human resource management at sites.*' - 3.71

This is confirmed by a hardware developer:

'*Well, as it turns out with donors, technology is sort of a popular effort for them to support so you know the development is pretty well funded, we don't have a problem with that.*' - 3.22

Traditional grants from biodiversity conservation and development donors as well as philanthropic donations from tech companies are therefore allocated to technologies. But more unusual resources for the sector are also mobilised. Competition and hackathon prizes aimed at jump-starting the development of 'technological solutions' are multiplying. Hackathons are gatherings of programmers or other groups with technical expertise who meet for a limited amount of time,

[19] Wildlife Conservation Society. 2020 Strategy. Retrieved from: https://www.wcs.org/our-work/2020-strategy [Last Accessed: 11/05/2020]

a few days at most, to focus on developing a product or addressing a specific issue through technological innovation. There can be competitive elements to these meetings. Participants who produce a satisfactory prototype might leave the room with a new job or some funding to develop their product further. Hackathons emerged in the late 1990s with the rise of the dot-com bubble as a way for scattered proponents of free software to collaborate in person for short periods of time (Coleman, 2013). The format has also been taken up by tech companies as a way to recruit and foster innovation within their ranks (Leckart, 2012; Thornham and Gómez Cruz, 2016). It has since spread as a way to support civic or charitable causes (Irani, 2015), including conservations issues. Indeed, organisations entirely based on the definition of briefs that can be answered through technological innovation and focusing on the organisations of competitions and hackathons have recently been founded or have entered the field of conservation. This is for instance the case of Odyssey Hackathon[20] or the previously-mentioned Washington DC-based Conservation X Labs.

Established biodiversity conservation funders have also decided to invest in this area and adapt their funding mechanisms. In November 2019, the US State Department relied on its diplomatic service to co-organise 'Zoohackathons', hackathons focused on wildlife trafficking, in 16 cities around the world.[21] As for competitions and grants, in 2016, the United States Agency for International Development (USAID) awarded more than $900,000 as part of its Wildlife Crime Tech Challenge.[22] Four projects were selected out of 300 applications tasked with finding ways to detect, investigate and stop wildlife trafficking. These projects received money and support to fully develop and disseminate their innovations. The National Geographic Society[23] also has a number of grants specifically focused on technology. It is one of the areas in which the Society is encouraging those interested in their Exploration Grants to put an application together for. At the time of writing, the National Geographic Society also had a call for proposals related to creating and implementing 'open source trained models, algorithms, and datasets to support species discovery'[24] in partnership with Microsoft AI for Earth Division. Caveats to this grant include the fact that grant recipients must make their code available for publication on the AI for Earth website

[20] Odyssey (2020) Hackathon Challenge Protecting Marine Biodiversity. Retrieved from: https://www.odyssey.org/hackathon-2020-challenge-iucn-icel-protecting-marine-biodiversity/ [Last Accessed: 21/05/2020]

[21] US State Department (2019) Combatting Wildlife Trafficking through Innovation and Technology. Retrieved from: https://www.state.gov/zoohackathon-2019-combating-wildlife-trafficking-through-innovation-and-technology/ [Last Accessed: 30/06/2020]

[22] USAID. WildlifeCrime Tech Challenge. Retrieved from: https://wildlifecrimetech.org/about [Last Accessed: 30/06/2020]

[23] National Geographic. Grant Program. Retrieved from: https://www.nationalgeographic.org/funding-opportunities/grants/what-we-fund/ [Last Accessed: 30/06/2020]

[24] National Georgaphic. Artifical Intelligence Funding Opportunities. Retrieved from: https://www.nationalgeographic.org/funding-opportunities/grants/what-we-fund/artificial-intelligence/ [Last Accessed: 30/06/2020]

through a designated open source license, make the training data for their algorithms publicly available in a standard digital format and implement their applications on Microsoft's cloud computing service, Azure. This example demonstrates that the conditions and assessment criteria attached to these sources of funding shape what is considered a suitable innovation in terms of technical components, intellectual property and business arrangements underpinning it. This affects who can and will apply, who is included in the 'technology for conservation' networks.

The examples presented in this section show that donors, INGOs and policy circles traditionally influential in the conservation sector have taken an interest in technology. They have developed funding streams and other activities that enable them to weigh in on what technologies are built. The next section explores in more detail how the sector defines technologies for conservation and what these should look like.

'Technology for conservation': less about technology more about community-defined norms and expectations

Despite attracting attention and funds, it is not entirely clear what 'technology for conservation' is exactly. The commonalities reside less in technological features than in the community involved in sharing lessons learnt and defining expectations for it.

'Technology for conservation' is a potpourri that might not make a lot of sense to an engineer or IT specialist. The phrase encompasses everything from cutting edge camera traps to satellite imagery analysis platforms, from plant-cell fuelled batteries to sensors that will send an alert when a vehicle passes by and of course drones. Forensics and DNA analysis methods are also sometimes included. These are tools that rest on a very diverse set of technical expertise and which have been created to serve different purposes. Some are meant to help count animals and learn about their behaviours, others are designed to watch people and stop them from engaging in activities deemed to harm wildlife. Yet, all of these tools and devices have been grouped together by the international conservation community through activities such as conference panels and grants. Labels and language also contribute to this unification with the widely used phrases 'technology for conservation' or 'wildtech' and the social media hashtag #tech4wildlife.

Norms and strategic directions are being created by an active group of practitioners under this banner of technology for conservation. This process is visible through discussions happening under the auspices of WILDLABS.NET, an online forum and in-person network created by a coalition of international conservation NGOs and the UK's Royal Foundation. The network emerged as a conscious realisation of the opportunities offered to conservation by technology and

the inadequacy of leaving these investments to the sole good-will of philanthropic technology companies.

Through online discussion threads and in-person socials on the fringe of well-established conservation events, practitioners therefore express the difficulties they face, answer each other's technical queries and define what 'good' and fit for purpose technology for conservation should look like. The protagonists mentioned above make a conscious effort to evaluate and articulate a vision and goals for the development of conservation technology. This process highlights and prioritise common concerns but also serves to side-line other issues.

There are several documents and events that crystallise the normative work carried out by the international conservation sector. Key topics of interest to the international conservation community were for instance distilled succinctly and repeatedly as the 'five principles for success' at workshops leading to the 2018 London Conference on the Illegal Wildlife Trade. Representatives of WILDLABS.NET and ZSL told participants to these workshops that to succeed and be scaled up, technology for conservation applications had to be affordable and hardened to field conditions. Conservationists should also have access to equipment, digital platforms and services in a financially sustainable way and the data generated had to be shared within the conservation sector to enhance tools. Finally, innovation and implementation should be accelerated which should include education, training and capacity building around existing tools. Similar themes have been highlighted in reports (United Nations Environment Programme (UNEP), 2014; Hodgkinson and Young, 2016; The Royal Society, 2018; WILDLABS.NET, 2019), scientific journal contributions (Pimm *et al.*, 2015; Marvin *et al.*, 2016; Berger-Tal and Lahoz-Monfort, 2018; Hill *et al.*, 2019; Lahoz-Monfort *et al.*, 2019) and blogs (Campbell and Jensen, 2019) by well-networked individuals with a recognised interest in the intersection of conservation practice and technology development

Descriptions and advertisements for conservation technologies often include comments on their adequacy to the rugged and remote environments conservation projects can take place in. They also emphasize how user friendly the tools are, although these claims are loaded with assumptions regarding who the users are and what their skills might be. These assumptions are crisply summarised by Pimm et al. (2015: 4) in their review of emerging technologies for conservation which describes potential users as 'poorly educated, but locally wise individuals with low technical capacity and minimal infrastructure.' Thus, the English-language Spatial Monitoring and Reporting Tool (SMART) brochures addressed to donors and protected area managers make a point of mentioning its 'user-friendly features' as well as the existence of extensive training

documents, practical guidelines and technical support (SMART Partnership, no date a, no date b). The compatibility of the system with a set of pre-existing databases such as CITES' Monitoring the Illegal Killing of Elephants as well as a range of mobile and GPS devices is also mentioned as a selling point. Similar elements are highlighted in a blog written to draw attention to the second iteration of ZSL's protected area intrusion alert system, Instant Detect (Seccombe, 2019). The application is advertised as 'easy to use, set-up and maintain by even the most untechnical conservationists' and developed 'specifically for the needs of conservationists, following a user-led design process.' The piece specifies that the system will undergo a 'hardening' and testing phase in 'real field sites.' In the same vein, Smart Parks, an organisation devising real-time surveillance systems for protected areas, also prides itself in presenting data through an 'easy-to-use web application.'[25]

Beside 'fitness for purpose' and 'user friendliness', another principle and path to affordability features high on the agenda: the idea of open source technology and open data (Turner *et al.*, 2015; The Royal Society, 2018; Hill *et al.*, 2019). The idea is that conservation is a sector operating on limited resources for the public good and therefore innovations should be widely shared for the benefit of all. Yet, open source is a slippery concept and not necessarily the key to dissemination and widespread adoption. 'Open source' refers to a piece of equipment or software that is non-proprietary. It can be modified, improved and shared at will because the design files or code are publicly available for free. It supposes a group of individuals willing and able to get involved in the two-pronged process of using and refining the technology (O'Mahony, 2007; Coleman, 2013). There is therefore a large amount of human labour and expertise hidden behind the promise of cheaper and more efficient technology (see also Chapter 6). Conservation biologists and ecologists might have the expertise to get involved in these processes but not necessarily of wildlife law enforcers and civil servants.

SMART is a telling example of the ambiguity surrounding open source principles for law enforcement technologies and the difficulty for these norms to trickle down to practical conservation environments. Indeed, the software's source code is available on the online repository Assembla. The software is also promoted as open-source on the marketing brochures and can be downloaded for free on the SMART website. Yet, there has been one single company contracted by WCS for the past eight years to update the software. The code itself, written and added to over almost a decade, has been judged tortuous to decipher by experienced developers.[26]

[25] Smart Parks. Our Work. https://www.smartparks.org/work/ [Last Accessed 19.11.2019]
[26] Interview 3.73

As an interviewee working in developing technology applications for conservation highlighted, there is not a decentralised community of programmers actively working on improving the code:

'*You know open source, it's one of those things where people like to throw the word around but if you look at SMART, in theory or maybe in practice SMART is 'open source' but they'll tell you themselves that they haven't really build a community of people developing software around and adding software to SMART and you know there's reasons to that.*' - Interview 3.19

Therefore, SMART only demonstrates some of the characteristics of open source software but not others. This is a strategic financial choice as revealed by an interview with one of the initiators of this application published on opensource.com stating that developing the tool following non-proprietary principles was 'attractive to donors and that was most likely to work for all future funding scenarios.' (Wike Huger, 2013).

Through communities of practice such as WILDLABS.NET or the SMART Consortium and within these spaces of discussion, narratives around the flipside of strategic ideals and norms are also emerging. One of these challenges is indeed that of funding and 'business model.' The combination of private actors entering the field and the specific nature of technological investments is calling in question the adequacy of donor grants that are otherwise heavily relied upon to support biodiversity conservation

No overall study has been conducted on the extent to which various sources of funding contribute to conservation activities according to countries. It is not clear what proportion of national budgets for protected areas or other environmental government departments rely on foreign aid and NGO technical support. Yet, it is fair to say that grants from Global North donors widely support NGOs intervening in protected areas, wildlife management and environmental policy reform in the Global South and that these NGOs have a broad reach. Duffy and Humphreys (2014) provided a snapshot of the international organisations, governments and philanthropies involved in funding action against the illegal wildlife trade drawing attention to the World Bank, the European Union and the United Nation Environment Programme Global Environmental Fund. In terms of national bodies, USAID and the US Fish and Wildlife Service have granted billions of dollars to biodiversity conservation over the past 15 years, although the type of activities funded and their geographical distribution has evolved (Massé and Margulies, 2020). Existing research also indicates that these funds are unequally distributed and overwhelmingly go to behemoths of the sector such as WWF, WCS and Conservation International (CI) (Chapin 2004, Brockington and Scholfield 2010). Large NGO reports reveal their geographical reach and the portion of their budget that comes from aid grants. WCS' 2019 annual report highlights for

instance that the organisation operates across 60 countries and derives 43% of its revenue from gifts and grants. Similarly, in 2018 trusts and foundations funding made up 57% of FFI's income while another 23% came from government and multilateral donors to support the organisation's activities across 50 countries or so. Meanwhile, CI derived of 29% its budget from foundations and 19% from public funding, NGOs and multilateral donors. These revenues supported offices in 27 countries and commitments in a number of others.

However central they are to conservation biodiversity worldwide; these donor grants come with an end date and are attached to specific and often pre-agreed upon activities. Interviewees working in organisations providing surveillance and communication technologies to protected areas have complained that such grants are not adapted to the development and provision of technologies.[27] These interviewees, who are not conservationists by training, highlighted the need for a 'business model' and alternative funding mechanisms to adequately and durably cover the costs of post-implementation support: keeping software systems updated and hardware in working condition, responding to queries and troubleshooting. One complained that the reliance on donor funding skewed the market and obscured the true cost of providing these services. NGO representatives have also talked about the constraints of working on technological products under funding grants agreements:

'*Everything has to be modular so that when something new does come along or some part is replaced you don't have to do a complete redesign because as we are not a company we don't have funding, we're all donor-funded, our money is... it's absolutely critical that we spend it super wisely and make everything modular*.' - 3.16

Besides money, the security of information related to criminal matters and the whereabouts of highly endangered species is another challenge well identified by the conservation community (Pimm *et al.*, 2015; Cooke *et al.*, 2017; Frey, Hardjono, *et al.*, 2017; Frey, Miller, *et al.*, 2017; Tulloch *et al.*, 2018). Alongside the ambition of data sharing to improve the technologies available and train algorithms, runs an acute awareness that some of the data involved is sensitive and needs to be kept securely. To try and address this issue, in 2019 the UK government funded a feasibility study for data trusts, legal arrangements pertaining to the creation, custodianship and use of data (Samson *et al.*, 2019). One of these data trusts would aim to pool and store images of illegal wildlife products to train algorithms which could help customs to identify these products in the future. The other would serve to gather data from audio and visual sensors to train algorithms to send real-time alerts about incidents involving wildlife.

[27] Interviews 3.18, 3.19

While highlighting priority areas such as data security, the normative and agenda setting work conducted by the international conservation community is also relegating other issues as secondary matters. This is the case of human ethics and privacy concerns associated with surveillance technologies. Instead of being embedded in technology design from the get-go, these preoccupations often remain a footnote. Scholars (Arts, van der Wal and Adams, 2015; Sandbrook, 2015a; Adams, 2017; Sandbrook, Luque-Lora and Adams, 2018) have articulated the privacy risks associated with conservation monitoring and surveillance technologies such as drones and camera traps. These researchers have provided examples of the distrust or fear these technologies could instil in populations living where they are deployed. During the course of my PhD studies, I have been invited at two sector events[28] to give presentations about the 'responsible-use of technology' or 'human-side of technology' so there is an interest in and awareness of these concerns. Yet, they are not widely championed and awareness does not necessarily translate to mitigation measures. At a tech-focused preparatory workshop leading to the London Illegal Wildlife Trade Conference, during a breakout group discussion about 'human monitoring' technologies, a participant from a wildlife philanthropic organisation remarked 'let's do what we need to do and then we can worry about putting a filter on it [to sift through data relating to people].' This offhand comment illustrates the regard privacy and ethical concerns are held in by sections of the conservation community.

Nevertheless, conservation projects using technologies personally identifiable information would gain from better accounting of privacy and ethics issue. As Sandbrook et al. (2018) show in their survey of camera trap users, the lack of a privacy contingency plans is costing conservation money and goodwill as unhappy passers-by destroy and tamper with the devices as well as engage in protest behaviours in full range of the lens. The use of drones raises similar ethics and privacy concerns. Although not always successful, drones have found a number of applications in conservation: counting animals such as elephants (Vermeulen *et al.*, 2013) or spider monkeys (Spaan *et al.*, 2019), assessing forest coverage (Koh and Wich, 2012) or supporting law enforcement by deterring or detecting intruders in open environments (BBC News, 2017; Bondi *et al.*, 2018). Some drone applications are therefore capturing images of people for policing purposes, other, intentionally or not fly past inhabited or much-frequented areas. Yet, these devices have been

[28] 'Technology for Conservation: Protecting Animals in the Wild' held at the Royal Aeronautical Society, London, UK on 27-28th September 2018
'Machine Learning and Data Sharing to Combat the Illegal Wildlife Trade' held at ZSL London Zoo, London, UK on 3rd October 2018

shown to tie into some local populations' fears, beliefs and resentment against conservation projects and affect their well-being (Sandbrook, 2015a).

Attention to privacy issues on conservation projects is not helped by the fact that a number of biodiversity-rich countries INGOs are working in, such as Indonesia, Mozambique, have vague legal definitions of sensitive personal data and limited enforcement mechanisms for their privacy and data protection regulations (DLA Piper, 2017). This means that there is limited recourse if data enabling the identification of individuals is collected and stored unlawfully. Furthermore, issues of privacy and ethics as well as strategies to mitigate them are only tangentially touched upon in the technology reviews and best practices guides devised for and shared amongst conservation practitioners (Hodgkinson and Young, 2016; Wearn and Glover-Kapfer, 2017).[29] One branch of conservation technology that has been better at integrating privacy concerns and could serve as a model is that of audio monitoring and surveillance. This is both for ethical and technical reasons. Indeed, the recording and storage of sound is power hungry which means that devices recording continuously would need powerful, large and expensive batteries or regular replacements. This one of the reasons why the designers of devices such as the audio recorders Audiomoth (Prince *et al.*, 2019) or Rainforest Connection (Earthrise, 2017; Ives, 2019) have developed inbuilt algorithms that pick up on the signature of particular sounds and would only launch a recording upon catching these unique wavelengths. This could be the noise of a gunshot, bats or birds' calls. The devices set up in this way would not record human conversations or going-ons that are not of interest to law enforcement and would therefore be in line with one of the fundamental principles of data protection: collecting data for a specified, explicit and legitimate purpose. These ideas are yet to make it on top of the priority list for the international conservation community contrary to issues of affordability, funding, user friendliness and openness.

I have shown here that debates setting out what technology for conservation is and what characteristics these tools should present are happening within the international conservation sector. This process prioritises certain concerns such as the cost or sturdiness of devices and casts aside other issues such as concerns around privacy protection. The orientations set by the sector influence what hardware and software options are selected. This is because these organisations also provide funds and access to protected areas around the world where technologies can be tested or deployed. In the next and last section, I highlight the fact that this technology

[29] See also *Drones for conservation: best practices*, a Google Doc collectively written by members of the online WILDLABS.NET community.

development and deployment model perpetuates neo-colonial relationships between the various actors involved in the government of protected areas.

Decision-making and funding in the Global North for projects in the Global South

In this chapter, I have repeatedly used the phrase 'international conservation sector' or 'community' but these are perhaps misleading expressions. Indeed, these international circles are not comprised of a college of representatives of all nations on an equal footing. The bulk of gatherings which I attended or studied and where technology is celebrated bring together NGO representatives, employees in the private sector and scholars based in the US or the UK. Further, much of the cutting-edge technology for conservation promoted by NGOs and in sector gatherings are developed in the Global North to be used in the Global South following a neo-colonial pattern. By neo-colonial I mean that the funding, development and implementation of technology for conservation replicates and reinforce international imbalances of power in the field of conservation. While this allows resources to flow towards regions and conservation projects where they are needed, it means that the economic and decision-making power in this field is concentrated in the hands of actors based in current or ex-imperial entities and build on, or replicate, colonial patterns. It is a trend that has already been identified in the context of many aid and development projects revolving around technology and the digital (Wade, 2002; Kleine and Unwin, 2009; Heeks, 2010; Anonymous, 2016; Madianou, 2019). This means that only a specific and limited set of norms, interests and views on what conservation is and how it should be done gets embedded in the design of these technologies. This can lead to resistance against conservation projects involving technology as well as the development of inappropriate tools, leading to a waste of resources (see Chapters 6 and 7).

It has been observed that a lot of power and money for conservation projects worldwide comes from the Global North. Philanthropic and government donors fund organisations largely headquartered in Europe and the United-States which were founded in the late 19th-early 20th century, often by keen safari hunters concerned about the long term availability of game (Adams, 2004; Brockington and Scholfield, 2010). These organisations continue to operate in countries with a colonial history, sometimes directly perpetuating this legacy (Mbaria and Ogada, 2017). Similar trends can be observed for organisations producing and promoting technology for wildlife conservation, partly because the same organisations are concerned and partly because newcomers replicate these patterns.

The opening of a research and development laboratory for conservation technology in 2019 encapsulates this trend well. Through WILDLABS.NET, the Royal Foundation and FFI have supported the opening of a technology lab at the Ol-Pejeta conservancy in Central Kenya otherwise geared towards tourism. The project has received funding from UK-based Arm but also from the pan-African telecommunications infrastructure and services firm Liquid Telecom. The make-up of actors involved in this project give Kenya, a country with the charismatic wildlife these technologies will be pointed on, more of a central role. Yet, it is impossible to ignore that Ol-Pejeta bears a heavy colonial legacy as it used to be a settler cattle ranch during the British rule over the region. It was reconverted towards wildlife tourism in the 1980s and was then called the Sweetwaters Game Reserve (Bersaglio, 2017: 157). The conservancy was established through the support of UK-based FFI, an organisation which until the early 1980s was called the 'Society for the Preservation of the Wild Fauna of the Empire.' This NGO purchased land to establish the conservancy in 2004 thanks to a philanthropic grant from American billionaire, John Stryker, through its Arcus Foundation. It is now an area protected by a labyrinth of electric fencing, armed guards and police dogs. Ol-Pejeta conservancy is also situated in the heart of Lakipia county, a region where the establishment of conservancies fuelled inter-ethnic conflicts in the 2000s (Greiner, 2012) and has been used strategically by white settlers and NGOs as a way to reinforce their hold on land (Bersaglio, 2017; Mbaria and Ogada, 2017). To this day, some pastoralist groups contest the boundaries of settlers' land reserved for wildlife conservation and tourism leading to violence confrontations with conservancy owners and staff (Mbaria and Ogada, 2017; Bersaglio, 2018). Small-scale farmers also protest the impact wildlife tourism has on their livelihoods (Bersaglio, 2017: 132-133, 234-236). In 2015 for instance, the demonstration of a such a group of farmers made Kenyan headlines. They marched on the gates of Ol-Pejeta conservancy to ask compensation for the threats they face living and farming in the vicinity of the reserve's large mammals (*idem*).

Cases such as that of the Ol-Pejeta innovation lab illustrate that neo-colonial patterns which persist in the conservation sector also influence the dissemination of conservation technology. However, this picture needs to be nuanced. The overall situation is not just a simple case of an imposition of technology from the North to the South. Some interviewees insist that they consider and include in the development process the national authorities and national park managers in the countries where their tools are deployed:

'*We also, as I said, worked with a lot of partners including partners on the ground and the folks, so the folks would actually use it. We actually sat with them and really thought of them as partners and I think this a really important point in terms of thinking about appropriate technology adoption […] you really need to understand what the*

operational realities are on the ground in places that you want to put the technology, whether that's Africa, Asia, South America or even North America for that matter but you have to understand how the people work' - 3.19, representative of a technology development organisation

'[…] *The clients and our partners, and I like to call them partners because if we don't do this as a collaborative or partnership then it will fail, because if I turn up and there is no roof on the building then I have to go home, right? So, we really have to work together on that* […]' - 3.18, representative of a technology-providing company

These quotes show that there is a recognition amongst some conservation technology actors based in the Global North of the value of involving direct users in the design and deployment of their products.

The Spatial Monitoring and Reporting Tool is also less of a top-down project than first meets the eye. As previously mentioned, SMART is managed by a consortium of nine large NGOs led by WCS and including the likes of WWF, the Peace Park Foundation and ZSL. But this partnership has established an elaborate system of thematic committees and feeding back mechanisms. It notably has a 'user council' where representatives of each of the partner organisations, working across a range of regions, sit. These committee members are meant to liaise with in-country staff in their organisations and feedback the needs and requests of direct users. The committee is therefore in touch with the rangers, the park managers, the environmental administrations but also the local civil society organisations and community associations which have come to adopt the software for data collection, storage and analysis purposes.[30] This is a channel through which local dynamics and interests can influence international decision making in a bottom-up fashion. The feedback from SMART adopters around the world can for instance relate to ensuring that the promotional brochures are culturally appropriate, e.g. not displaying pictures of armed rangers in countries where this is not permitted by the law, asking for new functionalities or improving the navigation settings and display of the desktop application. It is important to note that, apart from a handful of notable exceptions, these in-country staff making the link between and Global North organisations and on-the ground conservation sites in the Global South are not from as diverse a background as the users they represent. Indeed, at the time of writing, the majority of these representatives were men and expatriates from countries where the partnership's INGOs are headquartered or have spent formative education years there.

Despite these nuancing elements, the fact of the matter remains that the development of these technologies for conservation remains largely driven and mediated by actors of the Global

[30] The adoption of SMART by local NGOs and community groups was discussed in interviews 3.43, 3.49 and 3.53.

North. When I pointed out to an interviewee involved in the SMART partnership that the countries of implementation were concentrated in the equatorial regions I was told:

'*The national park service in the United-States already has systems in place for monitoring what is going on so they don't really need SMART, the same probably in Europe so it's not really a tool that designed for... even though it certainly could be used in the West, the need isn't there hence the pattern of adoption.*' Interview 3.4 – NGO representative

This narrative is misleading as Australia, European and North American countries also face important biodiversity declines, issues of illegal natural resources harvesting and pollution as well as under resourced conservation authorities.

In the UK for instance, the State for Nature Partnership (Hayhow *et al.*, 2019) reports that 15% of species present in Great Britain are threatened with extinction and that the country will not meet its international biodiversity commitments for 2020. The Wildlife Trusts[31], also raise awareness of the diversity of wildlife crimes persisting in the UK, from hare coursing, bats and badger persecution to the theft and disturbance of wild birds and their nests. The illegal shooting and poisoning of birds of prey particularly affects hen harriers, a species which had become extinct on the UK in 1900.[32] Hen harriers slowly started breeding in the UK again but are once more threatened because of illegal hunting. 72% of the hen harriers that were satellite tagged in 2007 for a government study had been killed by 2017 (RSPB 2018: 3). Meanwhile, national parks in England have seen important cuts in public funding and job losses between 2010 and 2015 (Campaign for National Parks, 2015). This led a number of parks to abandon some landscape management and outreach activities. Although, the amount of public funding awarded in 2019/2020 was £4m higher than in 2015 but remained under the 2010/2011 figure. The parks were further encouraged to draw on commercial and philanthropic fundraising to secure their own funding in a review published by the Ministry in charge, the Department for Environment, Food and Rural Affairs (Glover, 2019). In this context, national parks may not have been equipped with state-of-the-art monitoring and surveillance equipment.

As for the United-States conservation authorities have identified and are attempting to address rising threats to the biodiversity in their care. The last five year have for instance seen a rise in illegal removal and trafficking of native succulent and cacti species such as the Saguaro

[31] The Wildlife Trusts. Wildlife Crime. Retrieved from: https://www.wildlifetrusts.org/wildlife-crime [Last Accessed: 13/11/2019]

[32] Royal Society for the Protection of Birds. Hen Harrier LIFE Project. Retrieved from: https://ww2.rspb.org.uk/our-work/conservation/henharrierlife/ [Last Accessed 13/11/2019]

found in Arizona on the Mexico border (Phippen, 2016; Goodyear, 2019; McGivney, 2019). National parks services have trialled sophisticated technologies such as tracking chips (Associated Press, 2019) to deal with this issue. However, in the meantime, and similarly to their UK counterparts,they are facing severe resources cuts which might affect their ability to continue doing so. Indeed, the Trump administration has cut the national parks service budget which affects staff numbers as well as range of visitor services, trainings and conservation activities they can run (US Department of the Interior, 2018, 2019).

National parks authorities in Global North countries do not necessarily benefit from a higher budget in absolute terms than equivalent authorities in the Global South. As an example, in 2017, the US provided its national park service with a budget of $4,339,244 (£3,361,092) (US Department of the Interior, 2017) while Indonesian Wildlife Authorities operated on a budget of IDR 1,657,940,101,759 (£91,154,070) during the same year (Bambang Danono, 2017). Unfortunately, the information presented above does not directly address the question of the IT and monitoring equipment available in US and UK protected areas as this has not, to my knowledge, been a topic of interest in academic writing and publicly available institutional reviews. However, considering in details the state of environmental and national parks authorities in the Global North does demonstrate that a gap in technical support and resources may also exist there. Some national authorities in the Global South are also able and willing to invest in technology and infrastructure to monitor their biodiversity and protected areas. I detail Indonesia's and India's ways and reasons for doing so in Chapter 5.

Neo-colonial patterns are not only manifest in the concentration of economic and decision-making power in the hands of a few Global North-based organisations. These patterns are also exemplified by the material dependencies that the deployment of law enforcement technologies contributes to in many cases. The need for expensive parts such as lithium batteries mean that some technological projects simply are not sustainable in many local contexts because replacing such batteries entails a need for continuous external support and funding to keep the project running. External labour and expertise from expatriate conservationists is also part of this picture as I explore in more details in Chapter 6 and 8. This dependency to external support is a feature of many technology-for-conservation deployments and feeds into the neo-colonial aspect of conservation where Global South conservation actors are continuously encouraged into dependency on Global North resources.

I have just shown that the unequal relationships between Global North based conservation organisations and actors managing protected areas in the Global South are reproduced through

the development and use of technologies. This trend also constrains the contribution that technologies can make to the conservation in protected areas. Indeed, as foreign aid and technical expertise is instrumental to their dissemination and maintenance, there is a risk that these technologies could not be relied upon in the long term if this aid stopped.

Conclusions

Monitoring and surveillance hardware, satellite imagery and machine learning for pattern recognition have brought new actors to the conservation sector. Specialised start-ups have emerged. Big Tech money is being spent. The constraints of conservation environments are also leading to innovations in low energy design and limited signal communications. In concert with the new entrants in the sector, traditionally involved international non-governmental organisations, multilateral organisations and governments have keenly promoted and driven the development of technologies for conservation, in particular for wildlife and forest law enforcement. By doing so they embed a specific set of ideas about how to address outlawed activities that threaten wildlife into devices and they formulate norms around their intended use and ways of governing protected areas.

The interests, concerns and expectations of NGOs, companies, donors and government departments assembled in a community of practice and professional networks are influencing what is considered good 'technology for conservation.' Through conferences, workshops, informal meetings, online forums and reports, a narrative concerning the state of technology for wildlife emerges. This narrative highlights the need for low energy, weatherproof devices and data security features. It singles out Global South countries' protected areas and agencies as requiring support and technical expertise. Material dependency follows as foreign assistance is relied upon for maintenance support, repair pieces and on-going funding. The development and spread of conservation technologies therefore follows similar top-down Global-North driven patterns as pre-existing wildlife conservation projects.

This chapter has shown how the political economy of conservation technology development and implementation interacts with established dynamics of international conservation funding and assistance. It has established that the relationships between the international conservation sector and protected areas in the Global South is a crucial element shaping what technologies for conservation look like and what they can do. In turn these relationships are also affected by technology as deploying and maintaining them are added to the list of interactions between these two groups of actors.

This chapter has provided a detailed and embodied introduction of the various organisations making up the international conservation sector. However, in order to unpack and explain further interactions between different groups of conservation professionals and technologies, I must introduce the actors involved in conservation in Indonesia with the same level of detail. This is the subject of the next chapter.

Chapter 4: Regulating and enforcing: an historical overview of conservation in Indonesia

In this chapter I provide an overview of the long history of forest and wildlife conservation in Indonesia. Whenever possible I especially focus on the island of Sumatra and the provinces of North Sumatra and Riau where I conducted fieldwork in 2019. In particular, I delve into the questions of land ownership, forest legal definition and management. These issues are central to understanding contemporary conservation interventions and the difficulties they face. I highlight the origins and significance of relevant laws and detail the way they have been enforced, or not, over time. I introduce the main actors and institutions involved. Finally, I present the various ways in which digital technologies have come to mediate their relationships in recent years. This context colours the way monitoring and surveillance technologies were used and implemented in Indonesia when I carried out this research and informs the analysis I conducted in Chapter 5 to 8.

The day to day conservation activities I observed during my research build on a legacy of struggles over the definition of who owns land, forest and wildlife, who has access to these resources and how they can be used. This is where historically and empirically grounded political ecology work comes in. This literature allows me to retrace here the history of the government of forest and wildlife in Indonesia and in Sumatra. Political ecology enables me to highlight what realities are covered by the term 'law enforcement.' This phrase is often used in an abstract way by the international conservation organisations I discussed in the previous chapter but as I show here it glosses over imbalances of power between specific social groups that have been enshrined into law. Presenting who governs forest, wildlife and protected areas in Indonesia and how this situation emerged historically sets the stage for the rest of the thesis where I analyse the role of digital technologies in this process.

In order to explain what conservation law enforcement encompasses in Indonesia, I start by retracing the emergence of forestry and hunting regulations under Dutch colonisation. These were developed on a utilitarian basis as land and forests were seen as profit-yielding resources. In time, certain forms of environmental change came to be considered damaging to forestry and agriculture and therefore became a topic for legislation and administration. In a second section, I explain the legacy of colonial rule on post-independence natural resources management and highlight the complex overlap of claims to forest land left behind by the Dutch. I show that the issue of competing claims over forest land and hunger for economic development led to conflicts that

affect conservation interventions to this day. Finally, I give an overview of the biodiversity and ecosystems that internationally-backed conservation initiatives are currently concerned with, I describe who now carries out conservation law enforcement, what they do and give an overview of the range of technologies involved.

The making of forest and wildlife legislation under Dutch colonialism

The colonial period has deeply shaped the regulations and practices that apply to forest and wildlife conservation in Indonesia today. During this time, the foundations were laid for a centralisation of control over forests and land, the first conservationist legislations emerged and unequal access to natural resources along lines of wealth and race was entrenched into law. The Forest Law and Wildlife regulations enacted in 1999 and currently in application for instance still largely follows the principles laid out in the Agrarian Law established by the Dutch colonial government in 1870. The government systems applying to land and forests in particular were initially developed as a way to seize and maintain control of profitable natural resources, largely to the detriment of local communities. These laws and the way they are implemented have evolved over time to include ideas and provisions that we would recognise as conservation i.e. the preservation of habitats and species against man-made damages. Although scientists and conservation advocates petitioned the government, the justification for conservationist measures was largely utilitarian at first: it was about ensuring profits from forestry and agriculture in the long run. The process of legislation about and taking possession of forests directly illustrates why conservation can be considered a form of government in the sense of Foucault as suggested in Chapter 1. Indeed, the history of conservation in Indonesia is one of plans and policies constraining many the archipelago's rural populations' access to natural resources.

Figure 4: Map of Indonesia from Hellwig & Tagliacozzo (2009) The Indonesian Reader

The 17,000 or so islands that make up Indonesia today are represented on Figure 4 above. These islands have been subjected to various degrees of invasion and control and were not unified as one political entity before the Indonesian independence from Dutch colonialism in 1947. One could argue they were not even fully unified then as a strong independence movement was active in the northernmost province of Aceh until the early 2000s and one remains in Papua to this day. Although medieval-era kingdoms such as Srivijaya and Majapahit came to control most of modern day Indonesia, it was and still is a culturally, religiously and politically diverse area. The Portuguese, the Spanish and the English were the first European empires to establish trading counters in the spices-producing islands east of the archipelago but the Dutch came to be a dominant force in the region between the 17th and 20th century. With the Dutch administrative and political centre firmly rooted on Java, their hold over other islands such as Sumatra, Borneo or Bali and their capacity to implement policies there was met with resistance and varied over time. On Sumatra, the Dutch were able to carve out rubber, palm oil and tobacco plantations all along the coast of the Strait of Malacca from the 1860s onwards through alliances with four sultan dynasties. However, they were met with protracted violent opposition from Batak people westward and from the Achenese northward until the very beginning of the 20th century (Stoler, 1995; Reid, 2014).

In 1602, the United East India Company (or *Vereenigde Oostindische Compagnie,* VOC) was founded to organise merchants, shipping and trading in Asia-produced goods. In particular, it was granted a monopoly over the Dutch spice trade, a large part of which originated from the East of

the archipelago, in present day Maluku. A hard to define beast, the VOC was at once a trading company, the first publically listed one, and a quasi-governmental military enterprise. If at first it did not directly intervene in the production of the goods it traded, the VOC gradually became more and more involved in local politics and established a territorial base centred on Java through war and alliances. In 1743, it seized direct control over the teak growing regions of North Java (Peluso and Vandergeest, 2001: 774). The move highlights the strategic and economic importance of forests which yielded the raw material for ships and infrastructure. It also set the tone for future land policies.

At turn of the 19th century emerges what Peluso and Vandergeest (2001) call 'political forests': the idea of a state's sovereignty over land it declares as forests. Thereby forests become an object of government and become political. Through government techniques such as the compiling of knowledge, the production of visibilities and administration practices, access to these lands and the resources they offer becomes regulated. This regulation process favours certain categories of the population, to the exclusion of others. This process is at the root of exclusionary land politics which still underpin conservation in Indonesia today.

In the early 1800s, the VOC faced bankruptcy and the Dutch government dissolved it and took over its assets. Shortly after, as the Dutch faced political turmoil in Europe, the British took charge of Java and brought with them the legal notion of considering land as 'state property' to legitimise a taxation system based on land ownership (*ibid*: 774). From 1815, with the end of the Napoleonic Wars that had shaken the Netherlands, the colonial government reinstated control over the region now dubbed the Netherlands East Indies. The idea of taxation based on property remained however and formed one of the principal tenets of the 1870 Agrarian Law. According to the 1870 Law land which was uncultivated and did not have a registered private owner was declared state domain (this only applied to Java and Madura initially). The state in theory controlled who the land could be allocated to and what for, it could lease it to entrepreneurs for timber exploitation or plantation development or, from the 1910s on, set it aside for conservation. These entrepreneurs were most often Dutch settlers or of Dutch descent, therefore a racial division was created between those whose access to land titles and private ownership was facilitated and those who saw their access to land legally impeded.

Through the 1870 Agrarian Law, the rights of indigenous communities to access land and natural resources was severely curtailed. Although there was a recognition that some land was the customary (or *adat*) property of village communities, the village boundaries were legally reduced to the meanest share as more and more land was sold or brought under direct control of the state

and in particular, the Forest Service (*ibid*: 775-776). This was in opposition to the customary authority structures and land allocation systems as well as to the practices of rural populations (Nasution, 2018: 75-83). Indeed, although the colonial government incorporated some village level institutions in the lower rungs of its administration system, it much reduced the areas of land these institutions had official authority over by designating uncultivated land as state forest land. Although so-called forest land was not necessarily under permanent cultivation, villagers did access it to gather firewood, collect edible or medicinal plants and building materials or cultivate tracts of land further away from habitations, using swidden agriculture in some regions including North Sumatra and Riau (Stoler, 1995; Potter and Badcock, 2004).

The official exclusion of village communities from forested land was reinforced by the means that the Dutch colonial government used to delineate, manage and secure the forests it extracted timber and other products from. In practice colonial administrative on-the-ground presence was mostly concentrated on Java. It is only in the early 20th century that Dutch regulations and government officials began to spread to other islands such as Sumatra (McCarthy, 2002). Nevertheless, a Forestry Service modelled on military bureaucracy and training was established in 1865 to manage tree planting and harvests on plantations but also to patrol and police forest areas (Peluso, 1993). One of the regulations the Service were tasked with enforcing from the late 19th century was the need for a permit to hunt, graze cattle or open new areas for cultivation in state forests (Peluso, 1994; Cribb, 2007; Murray Li, 2007). From 1927, forest clearing and cultivation was banned in areas administered by the Forest Service and punishable by jail (Peluso and Vandergeest 2001). But rural populations resisted and in many instances continued to use forest land and resources (Peluso 1994).

Strictly protected rather than productive forest reserves were only created on paper fourteen years after the Agrarian Law. Once more, it was in large part concerns about crops and profits which drove this development. Indeed, the deforestation of mountain slopes was found to cause droughts and flooding affecting plantation estates (Boomgaard, 1999: 262). All tree felling was therefore prohibited in these mountainous areas. However, it was only in the 1910s that legislative provisions were made to create natural reserves for scientific interest, to preserve areas of outstanding beauty or, from 1932, to protect wildlife. A hundred and twenty of these nature and wildlife reserves were created before the Dutch recognised the independence of Indonesia in 1949 (Boomgaard, 1999; Jepson and Whittaker, 2002). In 1940, the island of Sumatra nominally had the largest area protected as nature and wildlife reserves compared to other regions of the archipelago. Vast reserves created on the island between 1932 and 1949 still exist and have since been bestowed the status of national parks. Way Kambas, Kerinci Seblat or UNESCO-listed

Gunung Leuser are amongst these (Boomgaard 1999: 271, 275). Indeed, the regulations enacted in the 1930s and 1940s still form the backbone of Indonesia's conservation framework today. Although the activities of rural populations were also criminalized in reserves, government presence and capacity was often not sufficient for the new designations to materialise and be enforced locally as McCarthy (2002) describes in the case of the Leuser reserve.

Finally, hunting and species conservation laws also emerged from concerns about maintaining profits from plantations. Hunting laws reflected and reinforced social and racial hierarchies in a similar way to forestry regulations. Protecting game for wealthy Europeans hunters was not the primary driver for regulation as it was in the British Empire during the 19th and early 20th century (Peluso, 1993; Rangarajan, 2001; Mbaria and Ogada, 2017). The first ordinance from the Dutch colonial government focusing on hunting explicitly lists species that can and should be hunted on the basis that they are pests harmful to people and agriculture (Cribb 2007). Species that could generate profits through trade, such as elephants for their tusks or bird of paradise for their pelts, could be exempted from protection locally. It is only with the Hunting Ordinance of 1924 that legislation started to look like current conservation treaties and laws. In the 1924 text, protected species are the ones listed in detail. As was the case with forest control measures, the Dutch colonial hunting regulations were discriminatory and reinforced social inequalities. Whoever wanted to hunt with a firearm had to apply and buy a licence. The licences to shoot species deemed undesirable were free but when it came to other categories of game, the bigger the animal, the more expensive the permit. Prices could be prohibitive for anyone other than members of the elite or the middle class such as plantation and business owners or civil servants who were often of European descent or Chinese background (Boomgaard 1999; Cribb 2007). Thereby hunting licences drew on and perpetuated economic and racial inequalities.

Therefore, early regulations and enforcement practices pertaining to the wildlife and landscapes of the archipelago were built on a centralisation of political power and the appropriation of land by colonial State institutions. This process produced and reinforced racial and economic hierarchies, sometimes explicitly, sometimes more subtly. These hierarchies fed into the attempts to control people's relationship to their land and environment which is one of the ways in which government operates according to the framework presented in Chapter 1. As shown in this section, most early regulations relating to forests and wildlife in the region stemmed from economic concerns but later included more conservation-oriented measures. Competing state and local claims over forest land endured after the end of the colonial period with important consequences for conservation. Similarly, the tension between the economic exploitation of

natural resources and their protection remained in decades following the declaration independence as I explain next.

Post-colonial administration of natural resources

In this section, I show that key developments in politics, land and forest policies unfolding between Indonesia's independence in 1945 and the late 1990s have shaped what conservation and the enforcement of forest and wildlife legislations look like today. I explain that the principles of state control over land and natural resources established in the colonial era endured post-independence. I highlight the political and legal dynamics that have led to blurred concepts of legality/illegality when it comes to Indonesian forest and wildlife. Indeed, the corruption of state officials and an overlap of sometimes competing sources of authority have reinforced the gap between the letter of national law and locally accepted practices. Conservation programmes in the 2000s are still navigating this legacy in their attempts to protect species and ecosystems from overexploitation.

On the 17th August 1945, the proclamation of Indonesian Independence was read publicly. This marked the start of a two-year conflict before the Republic of Indonesia was officially recognised by the Netherlands. Given that 1930s Indonesian pro-independence figures saw conservation as a 'ploy of the Dutch to keep Indonesian people from using the natural resources that were their birth right', what legacy did the Dutch conservationist laws have in newly independent Indonesia? (Boomgaard, 1999). Two key pieces of legislation for forest conservation and management were passed soon after independence which carried on the legacy of the colonial model: article 33 of the 1945 Constitution and the Forest Law of 1967. Article 33 of the Constitution reaffirms the principle of state domain by stating that 'the land, the waters and the natural resources within shall be under the power of the State and shall be used to the greatest benefit of the people.' In 1967, the Indonesian Parliament passed the Basic Forest Law which confirmed the forest status of 75% of national territory. This gave central government the authority to allocate natural resources exploitation licences all over this area. Forests were placed under the control of the Ministry of Agriculture until the creation of the Ministry of Forestry in the early 1980s.

The law enforcement apparatus was also expanded and consolidated in the 1960s and 70s. In 1962, the forest police were granted permissions to bear lightweight firearms for self-defence which put them on par with the military and police as civilians are not allowed to carry guns (Peluso 1993: 212). The training of forest agents also started incorporating police tactics, military and paramilitary exercises. These methods were put in application to protect timber-producing forests in particular

(*idem*: 212-213). These practices are an element of government and precursory to those adopted by contemporary forest police using some of the systems analysed in the rest of this thesis.

Despite the colonial legacy of state domain, there had been moves towards distributing land rights to a larger number of rural people in the early days of the Indonesian Republic. Indeed, the Basic Agrarian Law decided under President Sukarno in 1960 provided for some recognition of customary land claims, a land-titling programme and restrictions on business interests access to land (Barr *et al.*, 2006; Safitri, 2016). The Law, which is still in application today, has been unevenly interpreted and implemented in the course of its existence (Lucas and Warren, 2013: 16-38). In the 1960s, the Communist Party and the Indonesian Peasant Front pushed for the reform and a speedy application. They organised rural people to unilaterally occupy the lands of large private landowners and demand that the Law be put in application (Peluso, Afiff and Rachlan, 2008; Vickers, 2012: 158).

Promises to improve the welfare of the rural poor and embryonic agrarian reforms aside, forests were seen as a crucial source of income both the newly independent country and its political and military leaders. Commercial logging was a key piece of the national development plan formulated in 1960 by Sukarno's government to promote economic growth (Barr *et al.*, 2006). However, from War of Independence (1945-1949) and onwards to the early days of the Republic, forests were also a source of personal wealth. The government, particularly the military and high-ranking army officials, funded themselves through officially prohibited activities such as trading illegal substances and illegally exploiting natural resources (Aspinall and Van Klinken, 2011: 4, 43; Vickers, 2012: 137, 165).

This pattern of using state resources for the personal enrichment of military, state officials, their supporters and relatives became the hallmark of President Suharto's New Order regime (1966-1998). This regime was born out of the military-backed massacre of half a billion people affiliated with or alleged sympathisers of the Communist party and other left-wing organisations (Farid, 2005; Vickers, 2012; Bevins, 2020). In particular, the army sanctioned violent retaliation against the organisations and individuals who had organised land occupations and the squatting of plantations in the early 1960s. Around 40,000 people were killed in the plantation regions of Sumatra and a fifth of all killings took place on the island (Vickers, 2012: 162). Land was retaken by former private owners or distributed to local army officers. This bloody repression paved the way for a centralisation of control over economic decision-making, development projects and natural resources exploitation revenues in the hands of Suharto and his associates (Farid, 2005).

The ensuing 32-years period was characterised by an omnipresence of the military in public spaces and the use of violence to crush political pluralism and dissent (Vickers, 2012: 174-187).

Under the New Order, timber remained a key contributing sector to government revenue. So much so that wood-based industries became the second biggest contributing factor to the country's gross national income after oil (Barr et al. 2006). The forestry sector was also a source of personal wealth for high-ranking military dignitaries and close associates of the president. Indeed, large timber concessions were distributed to close relations of Suharto creating a conflation between state resources and personal interest and wealth. These concessions sometimes overlapped with protected areas and licence holders, in cahoots with the authorities, be they national or local, also often logged beyond the volume and area allocated to them into protected forests and national parks. This created a precedent for the disregard of forest protection laws. Logging was so extensive that it is estimated that the country's forest cover decreased from 74% to 56% of the national territory between the 1970s and 1990s (Tacconi, Rodrigues and Maryudi, 2019).

Strong central government authority over Indonesian forests has therefore not guaranteed their conservation. But this was not only due to lack of capacity or resources allocated to law enforcement, although this was a contributing factor. Deforestation and environmental degradation had everything to do with how the state and other forms of authority operated in practice. In Indonesia like elsewhere 'the state' is not a monolithic whole but a label encompassing a number of institutions, hierarchical levels and individuals with potentially conflicting responsibilities and interests (Jessop, 2016: 42-44). This is especially stark in the case of Indonesian forests as the Ministry of Forestry is in charge of both their exploitation and preservation.

Intra-state lack of consistency and corruption in relation to forests are illustrated by McCarthy's research (2002, 2006) on the edge of Gunung Leuser National Park in Northern Sumatra. McCarthy details how timber businessmen, field forest guards, local forestry officials, local elites, customary leaders and villagers interacted to sustain a logging economy of dubious legality. Indeed, logging widely encroached on protected forests and the park demarcated in 1982 by the central government petitioned by international conservation groups. Field forest guards and local forestry officials played a key role in the logging economy by either becoming actively involved, only administrating minimal fines when catching loggers during patrols or regularly turning a blind eye on the tree cutting and road building in exchange for payments that complemented their small government salaries. Peluso (1994) describes similar dynamics in relation to logging and poaching in Javanese forests. Both Peluso and McCarthy highlight the

relative impunity of officials caught in illegal dealings under the Suharto regime. These historical insights give substance to concerns of corruptions that play into the use and design of surveillance technologies today as I will explore in more details in Chapter 7.

In addition to contradictory injunctions emanating from various branches of government, the *adat* or customary institutions also remained a source of authority and legitimacy. Although they were constrained and challenged under colonialism, *adat* authorities' word on access and use of land continued to be regarded as more legitimate than that of the Republic's government in some cases. This in effect created a situation of legal pluralism, parallel and sometimes conflicting sets of rules as official systems did not provide for customary land us practices and property rights (McCarthy, 2011: 95-97). Because of this, villagers clearing and cultivating land on the basis of *adat* were, and still are, at the mercy of state authorities. However, they were and are often assertive in the affirmation of their claims and employ a range of resistance techniques, including land occupations, against central government authorities and corporate expansion (Peluso, 1994; Hall, Hirsch and Murray Li, 2011).

Accommodation and tacit understandings between local forest officials and communities allowed laws and policies devised in Jakarta by central government to be disregarded in favour of local interests and customs. For instance, such local arrangements gave villagers leeway to open and farm land in areas defined as state forest including in protected areas. However, should there be a political U-turn and a change in the local balance of powers affecting the alignment of *adat* and state institutions, local communities and their small scale livelihood activities are the first affected. In such situation the full force of the law has been brought down on villagers who found themselves violently evicted from their plots located in officially protected forests (McCarthy 2002; 2011). The police and army have in some instances been called in to carry out these evictions and support or bypass local forestry officials (*idem*).

Civil society movements opposing state-backed appropriation of land for large scale exploitation and clientelist networks contributed to the fall of the Suharto regime in 1998 (Hall, Hirsch and Murray Li, 2011: 222). A period of political reforms, called *Reformasi,* ensued which saw a larger portion of natural resources revenues and some aspects of authority over forests devolved to districts.[33] Districts are a very local echelon of government headed by an elected official (the *bupati*). The *Reformasi* laws also provided for the creation of new districts. Unfortunately, this decentralisation process has not been sufficient to achieve the desired outcomes of a) improved

[33] Also called regencies in the literature, the Indonesian term is *kabupaten*

local accountability and democratized access to natural resources (Affandi, 2005) and b) reduced deforestation. On the contrary, local elites made the most of these new devolved powers to distribute forest and other natural resources licences to the business networks they already had connections to, including within protected forests under the preview of Jakarta (Barr *et al.*, 2006; Ribot, Agrawal and Larson, 2006). Deforestation rates increased in the early 2000s in the wake of *Reformasi* and the Asian financial crisis (Burgess *et al.*, 2012; Tsujino *et al.*, 2016). So much so that Jakarta then cracked down on local authorities issuing licences in state forests and seized back control over forest licence allocations (Ribot et al. 2006; Barr et al. 2006: 103).

As part of the decentralization movement, there has also been steps towards a greater involvement of communities in natural resources management and an acknowledgement of customary collective rights over land, in particular for indigenous people. Through a 1999 revision of forestry law, the government recognised the right of communities to manage forests but this did not yield concrete change. In 2013, the Constitutional Court was called upon to confirm this right and the fact that indigenous forests should be distinct from state forests. It is only in 2016 that the government followed through and for the first time granted forests to nine indigenous communities (Safitri, 2016). In 2007-2008, the Ministry of Forestry launched three schemes opening more opportunities for rural populations to secure tenure over land, regardless of their ethnic background: community forestry licences, people plantation forests and village forests.

Yet, many argue these measures do not go far enough (Affandi, 2018; Nasution, 2018; Diantoro, 2020). Critics point out that new community-oriented land regulations do not solve the issue of overlapping land claims as only partial rights are granted through these programmes and the application process is lengthy, complex and off-putting (Nasution 2018: 29-30; Safitri 2016). Application for indigenous land rights and community forestry licences involve communities unifying to put in a claim, producing highly-detailed maps of the area and obtaining approval from several levels of government.

Nevertheless, technologies similar to those used by state and international non-governmental conservation actors for surveillance purposes have been used by local residents and indigenous groups to secure land rights, challenge land grabs and report environmental violations by government agencies and corporations. For instance, using GPS/GIS for participatory mapping has been instrumental as a way for indigenous communities to apply for customary land tenure (Rye and Kurniawan, 2017; Tilley, 2020). GIS mapping and drone imagery have also been used by civil society groups to document and develop legal action against illicit and environmentally destructive industrial expansion (Radjawali, Pye and Flitner, 2017; Meridian *et al.*, 2018; Hasyim *et*

al., 2020). These activities sometimes take place with the support of INGOs or donors. Given that the boundaries of my field sites and of some protected areas discussed in interviews are contested, and encroached upon, it is entirely possible that local groups there have applied monitoring and mapping technologies to back their claims in these areas. Different identities, knowledge and practices are certainly associated with these community-based uses of mapping and monitoring technologies. I have chosen not to focus on these as part of this research: during its design stage, I realised it may be methodologically and ethically challenging to gain the trust, interview and observe both community groups and the state officials with whom they can have tense relationships.

In summary, several political dynamics affecting present conservation interventions crystallised between 1945 and the early 2000s. This period left a legacy of overlapping and conflicting claims over land and natural resources. Central government, businesses, local officials, customary authorities, rural and indigenous communities: all have an interest in how forested lands are used. These interests do not necessarily align amongst themselves, let alone with conservation approaches and on-the ground projects. Furthermore, a variety of local understandings of what is acceptable as well as a history of government officials' involvement in illegal activities have left national land and environment laws with little legitimacy. This is especially the case as enforcement of national forest laws swings back and forth between tolerance of local practices to violent repression of deviations. I now highlight the enduring influence of these trends and examine more recent developments in the conservation landscape in Indonesia.

Conservation in Indonesia today: key issues and actors

In this section, I start by introducing the main actors involved in conservation in more details and the environmental issues they set out to tackle, in particular as they affect the region of Sumatra. I then explain the enduring legacy of the Suharto era and recent evolutions in enforcement and legislation. Finally, I highlight the growing and varied role of technology in mediating relationships between various actors with a claim over wildlife and forests.

Today, 63% of Indonesia's landmass[34] is still under the control of the Ministry of Forestry, or as it is called since 2015, the Ministry of Environment and Forestry (*Kementerian Lingkungan Hidup dan Kehutanan - KLHK*) including the 12,17% of the country designated as terrestrial protected areas.[35] It is important to remember that although this territory is labelled as state

[34] Direktorat Jeneral Konservasi Sumber Daya Alam dan Ekosistem (2018) *Statistik 2017*
[35] According to the UNEP-WCMC Protected Planet Database

'forests', not all of it covered in lush forests. A large portion has long since been logged as I showed in the previous section. This is the reason for the gap between the surface officially designated as forests, 63% of the territory, and that which external observers consider forested, 50%.[36] This figures of 50% is still high and contributes to making Indonesia one of the planet's most important haven for biodiversity. State forests are divided in three main categories: production, protection and conserved forests which include nature reserves and national parks. The country now counts733 terrestrial and marine protected areas, as illustrated by Figure 5 below, 49 of which are national parks (UNEP-WCMC 2020).

The Ministry divisions in charge of protected areas and endangered wildlife throughout the country are of prime concern to this study. National Park Head Offices and the Offices for the Conservation of Natural Resources (*Balai Konservasi Sumber Daya Alam BKSDA*) spread across the provinces answer to the Direction for the Conservation of Natural Resources and Ecosystems (*Konservasi Sumber Daya Alam KSDAE*) in Jakarta. The BKSDA are responsible for nature and wildlife reserves as well as all protected fauna and flora outside of these areas. When it comes to law enforcement and investigations into wildlife crimes these institution coordinate with another Ministry division with local relays across the country: the Direction for Law Enforcement (*Dirgen Penegakan Hukum – GAKKUM*).

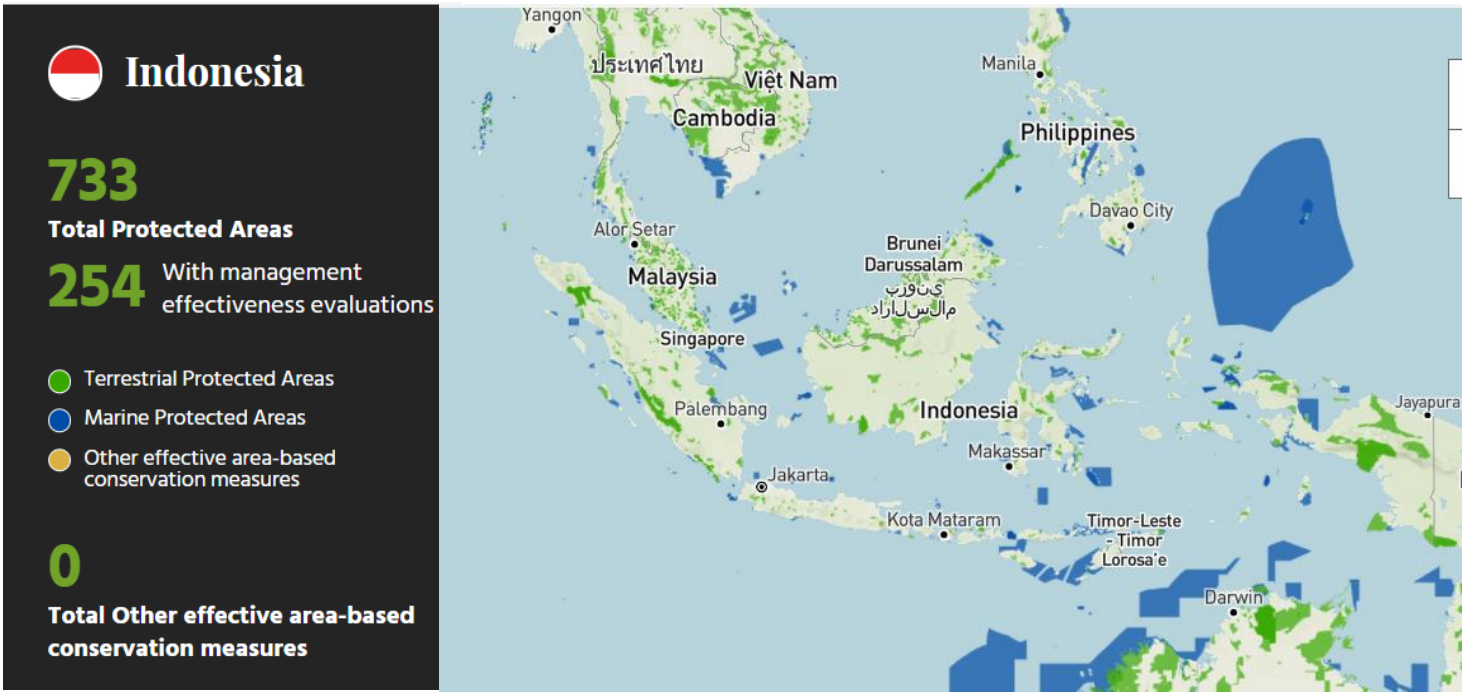

Figure 5: Protected areas of Indonesia. Source: UNEP-WCMC

[36] According to the Food and Agriculture Organisation which defines a forest area as 'land under natural or planted stands of trees of at least 5 meters in situ, whether productive or not, and excludes tree stands in agricultural production systems.'

In dialogue with KLHK, large international NGOs (INGOs) and national civil society organisation advocate for the protection of the country's wildlife and manage on-the-ground projects to this effect. INGOs have been operating in the country since the 1980s. Indeed, Indonesia consistently ranks high in the indicators and trends that these organisations look at to prioritise their interventions. The country still boasts the third largest expanse of old growth tropical forest in the world. Unfortunately between 2000 and 2012, Indonesia also had one of the highest and fastest-increasing deforestation rate globally, with Sumatra being the worst affected region (Hansen *et al.*, 2013; Margono *et al.*, 2014).[37] No matter the concepts used, the archipelago consistently features as a crucial region for biodiversity globally. It is a megadiverse country and is part of the small club of 17 countries harbouring most of the earth's biodiversity (UNEP-WCMC, 2014). It is also at the heart of a biodiversity hotspot (Myers, 2003; Orme *et al.*, 2005) meaning it has an exceptional concentration of species that exist nowhere else in the world and that these species are exceptionally threatened. These are qualities that attract conservation INGOs: from WWF to WCS and CI to FFI and more, all are present in the country. Indeed, the database ngoexplorer.org reveals that as many as 117 NGOs registered in the UK alone are active on environmental, conservation and heritage issues in Indonesia.

These INGOs are influential actors in natural resources politics. Some international donors involved in technical assistance at the national level i.e. in shaping regulations and policies in Jakarta even have dedicated office space in Ministry buildings. In the 1990s, INGOs and donors provided fifty percent of Indonesia's conservation funding (Murray Li, 2007: 124-125). Although I could not find a recent overall figure, it is clear that these organisations continue to yield large budgets, sometimes larger than the annual revenues of the districts they operate in (Nasution 2018).

INGOs' attention is not misplaced as Indonesia's biodiversity and ecosystems face many interlinked pressures. Forests are under the combined threat of timber exploitation and commercial agriculture expansion, infrastructure development and recurring large-scale fires (Austin *et al.*, 2019). The disappearance of forests has a knock on effect on the species that inhabit them. Wildlife is also vulnerable to poaching and trade with Indonesia being both a source and demand country for live animals and wildlife products as well as a hub for wildlife trafficking (Krishnasamy and Zavagli, 2020). Sumatra is also home to charismatic but critically endangered mammals that capture the attention of donors and the public: Sumatran tigers, elephants,

[37] This is a figure must be taken with caution as deforestation rates, forest cover figures and methodologies to calculate these are at the centre of a heated debate in the academic community as well as between the Indonesian government and international observers. See for instance: Sari and Samadhi (2014); Sloan (2014) Jong (2020). Indonesia's deforestation rates have also been decreasing since 2016 (Wijaya, Samadhi and Juliane 2019).

rhinoceroses and two subspecies of orang-utans to name but a few. Other creatures such as the Sunda pangolin, helmeted hornbill and a wide range of songbirds have also more recently become a focus of protection efforts due to the extent to which they are traded (DEFRA, 2019; UNODC, 2020). Indonesia being an archipelago country, marine species and ecosystems are also an important part of the picture. Indeed, the country encompasses a maritime area one and a half times larger than its land mass (Ariansyach, 2018). Poaching of protected sharks, horseshoe crabs and corals as well as illegal, unreported and unregulated (IUU) fishing are notably problematic.

Enforcement of conservation regulations alone is unlikely to resolve these environmental issues with deep political and economic ramifications. Yet, a great deal of attention has gone to it. International statements and treaties signed by Indonesia such as the 2014 London Declaration on the Illegal Wildlife Trade or the Forest Law Enforcement, Governance and Trade Partnership Agreement with the EU[38] have focused on the need for legal reforms and enhanced law enforcement. Reports (Ward and Mabrey, 2013; Krishnasamy and Zavagli, 2020) and papers co-authored by INGO staff (Zafir *et al.*, 2011; Linkie *et al.*, 2014; Risdianto *et al.*, 2016) have also highlighted the need for and benefits of an enforcement approach to forest and wildlife conservation including better dissuasion and detection of illegal activities through patrols, prosecution and stricter penalties. This discursive attention has been matched by legal reforms and on-the-ground interventions. As early as 2003, WCS set up an undercover wildlife criminal investigations programme to look into the killing and trafficking of Sumatra's tigers and elephants as early as 2008.[39] This is but one of a flurry of NGO-backed patrol and investigations teams as FFI[40], ZSL[41] and others smaller organisations[42] have followed suit.

The government has in some ways tightened its conservation regulations and enforcement. Since 2014 the administration has forcibly cracked down on IUU fishing by foreign-flagged vessels. A high-level taskforce was established to deal with the issue including representatives from Ministry of Maritime Affairs and Fisheries (KKP), the navy, the marine police and the government's legal counsel. The most visible policy in this area has been the increased and more violent penalties against IUU fishing. Indeed, ships caught fishing illegally are being seized and

[38] EUFLEGT Facility. The Indonesia-EU Voluntary Partnership Agreement. Retrieved from: http://euflegt.efi.int/background-indonesia [Last Accessed: 22/09/2020]
[39]Wildlife Conservation Society. Wildlife Response Unit. Retrieved from: https://indonesia.wcs.org/Initiatives/Wildlife-Response-Unit.aspx [Last Accessed: 22/09/2020]
[40] Fauna & Flora International, Conserving Sumatran tigers in Kerinci Seblat National Park, Retreived from: https://www.fauna-flora.org/projects/conserving-sumatran-tigers-kerinci-seblat-national-park [Last Accessed: 22/09/2020]
[41]The Zoological Society of London, Sumatran Tigers in Berbak. Retrieved from: https://www.zsl.org/conservation/regions/asia/sumatran-tigers-in-berbak [Last Accessed: 22/09/2020]
[42] These include Wildlife Asia, Flight, The Leuser Conservation Forum

dynamited. 488 boats were destroyed in this way between 2014 and 2018, the majority of which were sailing under non-Indonesian flags (Parameswaran, 2015; de Rivaz *et al.*, 2019). Forest and wildlife conservation authorities also have long-standing links with other more powerful law enforcement bodies. The Forest Law of 1999 confirmed the right of forest guards (*polisi hutan*) to bear arms in self-defence keeping them on par with the police and the army. They are indeed all encouraged to collaborate through joint exercises such as annual joint patrols or arrests operations.

International commitments and agreements have played a key role in the development of Indonesia's conservation policies under the New Order. The country joined the Convention on Biological Diversity in 1994 and has more recently set up a Biodiversity Strategy and Action plan for 2015-2020 to translate the latest Conference of Parties commitments. In terms of protected areas, Indonesia is a member of the UNESCO's Man and the Biosphere programme since 1977, a party to the UNESCO's Convention Concerning the Protection of the World's Cultural and Natural Heritage since 1989 as well as a signatory of the Ramsar Convention on Wetlands since 1992. A total of eleven protected areas have been recognised as Biosphere Reserves, seven as Ramsar sites and four as World Heritage Sites. This means that resources have been and still are directed to these sites so that they can be managed in accordance with these internationally recognised standards. These sites are also subject to enhanced international scrutiny.

Since the early 2000s, Indonesia has sought to present itself as a model in terms of environmental efforts and responded to growing international pressures about its forest clearing and management ways. Negotiations with the European Union about an overhaul of the timber licencing and traceability system started in 2007, culminating with the signature of the Forest Law Enforcement, Governance and Trade agreement in 2013. This agreement entails the development of a licencing system to certify that Indonesian timber destined for exportation comes from legal sources and has been processed in compliance with the law. The negotiation process for this deal also brought about reforms in forestry law towards greater sharing of information and scrutiny by non-governmental groups. Through the Agreement on Transboundary Haze Pollution, the country's regional partners of the ASEAN have also pushed Indonesia on its forest management practices. Indeed, yearly episodes of forest and peat fires in Sumatra and Kalimantan create a thick haze which causes pollution and health issues as far as neighbouring countries. The Agreement therefore requires that signatories improve enforcement to prevent fires, develop early fire warning and firefighting systems and provides for regional cooperation and assistance on these issues (Heilmann, 2015).

Indonesia's climate commitments are also highly relevant to forest conservation issues. Indeed, the forestry sector and land use changes are the main source of Indonesia's greenhouse gases emissions through the destruction of tree and the loss of their storage carbon potential. The protection of forests has therefore been made into a cornerstone of Indonesia's climate action strategy. It is a key element in implementing the commitment the country made to reduce its emissions by 29% between 2020 and 2030 in application of the Paris Climate Agreement. Norway has been a great champion of Indonesia's climate action since the two countries entered in a Reduced Emission from Deforestation and Forest Degradation (REDD+) partnership in 2010. The Nordic country has since spent millions of dollars in technical assistance. The funding includes a large reward payment for deforestation avoided in 2017 (Jong, 2020). This money has also notably gone into the development of a forest cover and emissions monitoring methodology and databases (Ministry of Environment and Forestry Indonesia, 2018: 14-15, 60-65).

Not all domestic regulations and policies concerning forest and wildlife have evolved in line with international commitments. For instance, Indonesia is an early signatory of the Convention on International Trade of Endangered Species (CITES) since 1979, six years after it was opened for signatures. The laws listing nationally protected species and laying out dispositions for their preservation date back from 1990 and 1999. Although the list of protected species was extended in 2018, the sanctions for wildlife offences have not been amended.[43] This is despite the fact that the government has subscribed to strengthening penalties when it signed the 2014 London Declaration on the Illegal Wildlife Trade. Many conservation advocates consider current sanctions too low and point out that those who break wildlife laws are rarely charged, let alone given the maximum penalties (Risdianto *et al.*, 2016; Nijman, 2017; Gomez and Shepherd, 2019; Krishnasamy and Zavagli, 2020). Things are different when it comes to forests. In 2011, the government did issue a moratorium banning all new primary and peatland forest clearance for wood-products or plantation concessions. This ban has since been made permanent by President Joko Widodo. However, observers have noted that the moratorium is not effective because of loopholes and flexibility and lack of transparency on areas covered by the ban (Sloan, 2014; Jong, 2019).

Technologies have been seen by international observers and funders as key way to deliver on these international environmental commitments. As early as 2006, the World Bank envisaged to invest in remote sensing and geographical information systems tools and training to support

[43] According to Law 5/1990 Art 40 paragraph 3: the maximum sentence for harvesting, storing or selling a protected plant, capturing, killing, keeping or trading a protected animal is maximum 5 years of prison and a fine of maximum IDR 100,000,000 (USD 6,746).

forest monitoring and law enforcement in the country (The World Bank, 2006: 35). In fulfilment of Indonesia's anti-illegal logging, anti-deforestation and climate commitments, foreign aid and government funding have gone into the improvement and development of a number of separate but related data repositories and analysis systems (Ministry of Environment and Forestry Indonesia, 2018).[44] The National Forest Monitoring System (*Sistem Monitoring Hutan Nasional* SIMONTANA) a database hosting all forest cover maps since 1990 helps to track deforestation from one year to the next. The National Greenhouse Gas Inventory System (*Sistem Inventarisasi Gas Rumah* – SIGN-SMART) is an online tool to calculate greenhouse gases emissions. Finally, three different databases are mobilised to evidence the legality and sustainability of traded timber.[45] There are therefore numerous technological systems contributing to the government of Indonesia's forests. Although I have focused on the ones supporting the deterrence, detection and sanction of those violating conservation regulations, these examples show that monitoring technologies play many other roles.

Yet, the political and economic drivers of deforestation and poaching are not fully addressed by regulations, enforcement policies and technological instruments. Since the early days of the reformation era, local governments and other branches of central government have continued to act in opposition to national conservation regulations. Despite decentralization reforms, local governments such as district authorities still resent the grip of central government on natural resources and forests in particular. Districts try to claw back influence and benefits from these sectors. Some continue to allocate logging permits even if it is no longer legal for them to do so. In other cases, district elected officials back the building of infrastructure in national parks as well as encourage and protect voters clearing land for agriculture in conserved state forests (Bettinger, 2015: 258). Indeed, local elections are at the centre of this process as business permits and protection are used by successful candidates to reward their voters and campaign funders (Widoyoko, 2014; Berenschot, 2018).

When it comes to area-based conservation, the insufficient recognition of customary institutions and local claims over forest land also continues to plague conservation efforts to this day. Indeed, it is one of the key reasons that national parks established in the early 2000s are still controversial (Diantoro, 2011; Nasution, 2018) and that both newer parks and more established parks and reserves are threatened by logging and agricultural expansion (Potter and Badcock, 2001; Li, 2007; Yonariza and Webb, 2007; Bettinger, 2015). Villagers continue to occupy, clear and

[44] See also interviews 3.25 and 3.63
[45] Interview 3.57

cultivate or mine land they feel entitled to, whether it is in a protected area or not, and official avenues for recourse or conflict arbitration are still limited. The police and army are sometimes called in reinforcement to carry out eviction operations (Bettinger 2015: 258-259; Wulan et al. 2004).

A further technological solution is however expected to ease land conflicts. Through the One Map policy, Indonesia's government has sought to combine and standardise land use maps across the country and branches of government (Shahab, 2016). The aim of this process which began in 2010 is to get an overview of all land conflicts across the country and, where possible make a judgement on overlapping claims and allocations. The Map is to act as a reference for all administrations when granting licences and permits as well as when enforcing existing regulations. The One Map[46] was published through an online portal in December 2018 and detailed geographic information made was made accessible to carefully-selected password holders. Yet, at the time of this launch the controversial thematic maps relating to forest boundaries, including protected areas, had not been uploaded.[47] This confirmed that having a centralised and standardised representation of land conflicts is a necessary step towards addressing them but it is still a highly sensitive and unresolved issue.

Before moving to my findings on contemporary conservation technologies, it is important to state that, since the early 2000s, technology has come to play a central role in mediating competing claims over land and attempts to enforce forest laws. Throughout this section and the previous one, I have mentioned uses and investments in digital technologies: the National Forest Surveillance System (SIMONTANA), the REDD+ emissions calculation database, the forest and peatland fire warning systems (which rely on satellite imagery), the digital maps created by indigenous communities to apply for land rights, the government's One Map aiming to reduce land conflict. Forestry and agro commodities corporations also use satellite imagery to monitor their concessions and ensure they meet the environmental targets set out by sustainability certification bodies.[48] All of these examples provide a glimpse the diversity of settings in which mapping and monitoring technologies have come to play a role and serve as a reminder that the narrow focus of this thesis fits into a bigger picture. These instances also show that data collection and analysis technologies have come to be seen as a key aspects of policies attempting to direct, or govern, relationships between people and forests.

[46] Badan Informasi Geospasial. One Map. Retrieved from: https://portal.ina-sdi.or.id/ [Last Accessed: 17/10/2020]
[47] Interview 3.25
[48] Interviews 3. 05, 3.28, 3.56 3.64, 3.65

In short, the Indonesian government's environmental discourse and commitments have become more ambitious in the last two decades, in no small part due to international negotiations and support. Despite the introduction of decentralisation measures and some pathways for communities to access more rights over land, conflicts persist. Law enforcement can be violent and repressive when it comes to forest land disputes, much less so in cases of wildlife capture and trafficking. Monitoring and mapping technologies have come to play a growing role in mediating many of these interactions, a subset of which I examine in Chapter 5 to 8.

Conclusions

In this chapter, I retraced the long history of regulations pertaining to Indonesia's environment and the way these have been enforced. I showed how Dutch colonial authorities placed land under government control in order to be able to licence it away to plantation and timber entrepreneurs. This vision of forests as a source of wealth continued post-independence as the Indonesian state confirmed the status of 75% of the territory as state domain, the majority of which to be exploited for growth, national development and personal enrichment. This edict did not leave much space for other ambitions and acceptations of land rights and ownership. Local informal arrangements between representatives of Jakarta and local sources of authority made up for this gap in places but did not prevent violent conflicts over land rights and land use. These are issues that conservation staff contend with to this day. Digitally-produced maps, satellite images and other data sources have come to play a central role in mediating these conflicts. This is for two reasons. Information produced through these tools provide evidence for different visions of who land belongs to and support various narratives around what forests are and should be used for. These systems have also become key instruments of conservation affecting how this work is carried out.

Land conflicts and corruption have not played in favour of environmental conservation with Indonesia displaying one of the highest rates of deforestation in the world in the early 2000s-2010s. This is despite laws that emerged at the end of the colonial era with the aim to protect certain species and conserve designed areas remaining part of the Republic's legal framework. Since the 1980s, international conservation NGOs have risen as powerful actors pushing for the strengthening of these environmental regulations, their application and enforcement. This is due to the budgets, access to central government and international exposure they yield. These INGOs play a key role in shaping how natural resources and protected areas are governed as well as what tools, including digital technologies, and practices conservation authorities in the country should adopt.

Now that I have established who the different groups and authorities in charge of conservation law enforcement are and how they have been exercising this role, I will explain how recently developed and implemented data collection and monitoring systems fit in this picture. The rest of the thesis demonstrates that these new systems come into play in two ways: by shaping what the work of conservation professionals is expected to look like and does look like as well as by constraining the relationship of the various actors involved in the government of Sumatran protected areas.

In the following four chapters, I focus on the experiences and practices of local and international NGO employees as well as that of conservation officials, mainly those affiliated to the Ministry of Forestry. This chapter has highlighted the wider dynamics they are part of and have to contend with. I have introduced many other actors such as locally elected officials, customary authorities, indigenous communities, rural dwellers, the police and the military who all contribute to governing and driving environmental change in the country. Although their activities and viewpoints are not at the centre of my research, they matter to the people I interviewed and were brought up in our discussions.

Chapter 5: Technology for conservation and digital sovereignty

In this chapter I delve further into the political economy of technology for conservation. I show that some States do not unconditionally accept the tools developed and promoted by the international conservation sector as seen in Chapter 3. Some refuse to deploy these products or demand adaptations before implementing the technology. This opposition equally shapes the adoption of technological tools around wildlife conservation projects and these tools in turn influence what the sociotechnical systems behind the government of protected areas can look like. This is therefore a second and intermediary set of relationships between conservation actors involved in the government of protected areas which influences the development and implementation of monitoring and surveillance technologies.

Drawing on the case of Indonesia, I explain why certain national administrations might reject the technologies promoted by international actors and donors. I argue that conservation issues have become one of the terrain of struggle for digital sovereignty, a movement concerned with the control and ownership of digital information and tools. These tensions pit key players in the government of protected areas against each other: national authorities are raising doubts over tools of government proposed by the international conservation sector. Indeed, states such as Indonesia balance conservation action with other concerns such as the handling and ownership of data, in particular data relating to government affairs. It is the highly contextual result of a compromise between national administrations concerned with (digital) sovereignty and the international conservation sector which influences what tools conservation employees are being provided with on a local level.

I start by reframing elements introduced in Chapter 4 to contextualise forest and wildlife issues as issues of national interest in Indonesia and I outline the existing restriction weighing on international actors who wish to intervene on these issues within Indonesia's borders. These are socio-historical elements that might lead to mistrust towards non-governmental organisations-backed conservation technologies. I then detail the blend of political economy and technical reasons that can feed into reservations about conservation technologies developed and promoted by NGOs or businesses and I relate these developments to the concept of digital sovereignty. Finally, I show how Indonesian government representatives have embraced some of the ideas linked to wildtech as it is promoted in international fora but have also sought to negotiate their own national trajectory where these technologies are concerned.

Forests, Wildlife State-Building and Nationalism

The defiance of a number of States towards conservation technology developed in the Global North and promoted by large environmental NGOs has to be contextualised first and foremost within the long history of the strategic and symbolic importance of particular species and ecosystems in these countries. These countries' relationship with external organisations wishing to become involved in conservation matters within their borders is also a crucial and related aspect. All of these dimensions bear on how technologies for conservation are chosen and implemented today.

In Indonesia, the regional focus of my research, forests and specific species play an important symbolic and strategic role nationally. The cultural importance of certain animals or plants can begin to be perceived even as a tourist, visiting museums displaying celebration costumes adorned with tiger skins or passing through airports decorated with hundreds of orchids. An avid reader of environmental news might get a sense of the entanglement of conservation and nationalism through the saga of attempts to breed the fast disappearing Sumatran rhino in captivity. This species of rhinoceros is only found in Sumatra and Borneo, Indonesia and until, 2019 captive individuals remained in Sabah, Malaysia. Sumatran rhinos are now extinct in Sabah but cooperation on captive breeding Malaysia, which holds rhino eggs from a now deceased female, and Indonesia, which has male individuals in captivity, has repeatedly fallen through.[49] Some commentators from the conservation community feel indeed that this failure is due to nationalistic 'bureaucratic quibbling' between the two countries (Geraldine, 2019; Gokkon, 2019a, 2019b). The rhino diplomacy story is therefore an example of the emblematic importance of certain charismatic species of conservation interest.

As for the strategic role of forest and wildlife in the history of state building and the national economic development, it is not as obviously visible but it is fundamental to an understanding of what legacies are at play in current conservation interventions. Forest resources in particular have been at the core of political and economic power in Indonesia for centuries. During the 19th and early 20th century, the definition of forests and the attempt to control these spaces were key to the development of a colonial state on the Indonesian archipelago. Forest products played a central role as raw materials for a range of economic activities that generated profit for Dutch colonisers. Forests were the fuel and building materials that enabled the

[49] See Borneo Rhino Alliance's website for more information. At the time of writing Sumatran rhinoceroses captive breeding efforts have taken another hit due to the termination of the working agreement between WWF, one of the implementing partners on the project, and the Indonesian government (Gokkon, 2020). More on this below.

processing and transportation of agricultural and mining commodities. The profitability of trading in teak and ramin wood as well as luxury species such as sandalwood led the Dutch colonisers to develop regulations, taxing systems, land rights regimes, management techniques and military-inspired policing forces to define, assert control over and exploit these resources (Peluso, 1992, 1993; Peluso and Vandergeest, 2001). In particular, large tracts of forested land, including land that had in the past been cultivated but had laid fallow for three years or more, came to be defined as state property in 1870 (Peluso, 1993). The reach of the bureaucracy and law enforcement developed earlier and was stronger on the island of Java but was uneven across the neighbouring islands. Of course, the influence of state institutions was also contested as competing claims over land both within the administration and in opposition to the state emerged (idem: 775-777). Nevertheless, what came to be officially designated as forests was a most important element in the creation and growth of state institutions.

From the 1880s, the commercial exploitation of timber and other forest products became intertwined with what we would now call 'sustainable management' or conservation efforts with attempts by the colonial government to ensure the long-term preservation of forests and the water cycle through the creation of reserves (Boomgaard, 1999).

During the fight for independence in the aftermath of World War II, forested areas in some regions such as North East Sumatra provided refuge for civilians fleeing violent clashes between the Allied forces, the Dutch and Indonesian nationalists (Vickers, 2012: 103; Steedly, 2013: 61-62, 242). Indeed, in the early days of the conflict, the nationalists favoured a scorched earth policy to oppose the colonial power and its supporters and they encouraged civilians to leave the affected areas. Forests could also serve as strategic rearward base for pro-independence fighters (Steedly 2013: 212, 280). Hence forests played a role in the making of a new independent nation as has also been the case in other contexts (Thomas and Curless, 2017).

Post-independence, forest products have remained key sources of revenue for the state and associated elites. Large scale extraction of a wider variety of tree species took off after World War II (Peluso, Vandergeest and Potter, 1995). More recently, under the regime of authoritarian leader Suharto (1967-1998), the allocation of monopoles over timber concessions was a way to create wealth for political allies (Aspinall and Van Klinken, 2011: 50-51). Illegal logging and timber smuggling by companies linked to the army at large have also been tolerated if not implicitly encouraged well into the 2000s as a way for the national armed forces to generate revenue since the budget allocation from the central government was inferior to half of its funding (Rieffel and

Pramodhawardani, 2007: 7, 48-49, 82). Forests and timber therefore continue to be a prized resource for powerful components of the Indonesian state.

It is important to note that although it is principally the exploitation of forests and production of timber that has been associated with the development of state institutions and their funding, the wildlife living in Indonesian rainforests have also been a source of income and employment in the region since the 18th century. Indeed, plant resins, colourful bird plumages and feline skins were collected and traded abroad, and in particular exported to the West as luxury commodities. The colonial state eventually also did intervene to regulate the hunting and harvest of these species and create reserves dedicated to wildlife (Boomgaard, Colombijn and Henley, 1997; Boomgaard, 1999; Cribb, 2007).

Nowadays, as explained in Chapter 4, the main institution in charge of forest and wildlife and heir to this legislative legacy is the Ministry of Environment and Forestry (*Kementerian Lingkungan Hidup dan Kehutanan - KLHK*). On paper, this institution still has under its control around 63% of Indonesia's land mass or about 120,63 million hectares.[50] Forests are still a factor of political and economic influence. Since the fusion of the Ministry of Forestry and that of Environment in 2015, KLHK has the responsibility to strike an awkward balance between the exploitation of forest resources and their conservation. The Ministry is currently in charge of national parks and other categories of nature reserves but also of timber licencing and timber trade monitoring. Each category of forest is handled by a different department within the Ministry, from the most strongly protected such as national parks and nature reserves to areas designated for sustainable timber extraction (*Hutan Produksi – HP*). There are two key divisions (*Dirjen*) within the Ministry when considering wildlife and illegal wildlife trade issues specifically. One is the General Direction for the Conservation of Natural Resources and Ecosystems (*Konservasi Sumber Daya Alam KSDAE*) which has all national parks and reserves under its care as well as all wildlife. The division has relays in each provincial capital, the Offices for the Conservation of Natural Resources (*Balai Konservasi Sumber Daya Alam BKSDA*), as well as smaller outposts spread across the more rural areas. The other key department is the Directorate General for Environment and Forest Law Enforcement (*Ditjen Penegakan Hukum Kementerian Lingkungan Hidup dan Kehutanan* GAKKUM) which, as its name indicates, is responsible for criminal investigations and arrest operations. According to the latest available figures, the KSDAE department employs 6,440 people across Indonesia. That represents one person for about 4,090 hectares[51] of protected land

[50] Direktorat Jeneral Konservasi Sumber Daya Alam dan Ekosistem (2018) *Statistik 2017*
[51]Idem

on average but the density greatly varies according to regions. Some of these 6,440 employees are also responsible for endangered species and conflicts involving animals outside of conserved areas.

The persisting clout of the Ministry is a good indication of the continued importance of forest and wildlife in national affairs. KLHK's influence is such that an interviewee nicknamed it 'The Kingdom of Manggala', after the maze-like campus where it is headquartered in Jakarta (Figure 6). It is also colloquially known as a *'kementerian bahsa'*, literally a 'wet ministry', one that has the power to capture and redistribute wealth, in particular through its forestry arm and the timber licence attribution system. As of December 2018, the Ministry employed 16,506 people in Jakarta and across the country (KLHK, 2019). Given the land mass it has legal authority over and the human resources it can muster, The Ministry of Environment and Forestry emerges as a force to be reckoned with.

Figure 6: The Ministry of Environment and Forestry's campus in Jakarta

Beyond forest matters, Indonesia has a long track record of defiance towards external interference in national affairs. This is exemplified by the anti-imperial rhetoric of its first head of state, Sukarno. During his presidency, in 1955, Indonesia hosted the Bandung Conference which was instrumental in the rise of the non-aligned movement. During the Cold War, this group was a point of reference on the international stage for states of the Global South promoting non-interference in domestic affairs as well as respect for other states' national sovereignty and territorial integrity.

This history and state of affairs contributes to explaining why foreign researchers as well as external donors and NGOs interventions and on-the-ground projects in Indonesia are strongly regulated. I have touched on the string of visa and administrative procedures faced by foreign researchers in Chapter 2. For their part, international NGOs are required to negotiate stringent

Memoranda of Understandings with the Ministries concerned by their sector of activity. These documents lay out the terms of their operations in the country. It can be and is used as a lever for sanctions. In November 2019, the government has threatened to strip WWF Indonesia from its authorisation to conduct on the ground forest conservation projects (Hicks, 2020) and in January 2020 KLHK put that threat to execution and terminated the group's forest activities (H. N. Jong, 2020; Widianto, 2020). Multi- and bilateral donors are also made to adhere to and support the governmental agenda. Those who operate through loans rather than grants can only lend funds through answering calls for priority projects.[52] It is the Ministry of National Development Planning (*Badan Perencanaan Pembangunan Nasional - BAPENAS*) that sets out this list of priority investments every five years. That being said, donors and NGOs may well shape the national agenda through privileged access to high-level figures and agreed upon consultancy missions within administrations. Yet, eventually the government has an important degree of control over these interventions, including those involving the implementation of new technological systems, and is able to hold them back or shut them down, should they not fit their aims.

The idea that such historical and political factors strongly shape the conservation interventions of today, including the use of technology, holds beyond Indonesia of course. India is one of the starkest example in that regard in terms of the importance of species like tigers (Aiyadurai, 2016) and rhinoceros (Barbora, 2017) to its federal or to regional identities like that of the north eastern state of Assam. Forests and their preservation have also been an important object of the development of the country's state apparatus and legislative body (Guha, 1983; Sivaramakrishnan, 1999; Beinart and Hughes, 2009). Foreign conservation NGOs and researchers working in the country are often met with suspicion by governmental authorities and subject to tight controls (Lewis, 2005; Margulies, 2018). India, incidentally is one of the countries that has keenly adopted a range of home-grown surveillance technologies for the protection of its charismatic species. The government has specifically commissioned programmes such as the Android application M-STrIPES (Monitoring System to Tigers, Intensive Protection and Ecological Status) used by field rangers to record all information related to the big cats (Ramkumar, 2018; The Times of India, 2019). It is also adopting tools developed by Indian researchers such as the Extract Compare software that can recognise the stripe patterns of individual tigers from photographs taken in the wild. If need be, these patterns can be compared with that of skins found in the possession of poachers (Ravindran, 2014).

[52] 3.27

The cases of India and Indonesia I have just presented are good reminders that there are political, economic and historical factors that might lead states to be suspicious of external interventions on forestry and wildlife issues. Before examining how these elements affect the uptake of technology for conservation law enforcement in Indonesia, I explain how the technologies' suppliers, affordances and parameters also influence States' willingness to adopt them.

National Resistance to Conservation Technology and the Political Economy of Data

Beside States' pre-existing relationships with external conservation actors, other factors may lead them to avoid ready-made, NGO-developed technologies in the running of their national conservation administrations. Another set of issues lies with the technological features themselves. The perceived security risks associated with characteristics such as cloud storage or technologies which rely on national telecom infrastructure are a cause of reluctance.

Technologies that offer to transmit information from the ground to central protected area offices in near real time through the cellular network infrastructure or through cloud technologies have indeed encountered some resistance from national authorities. An operator who developed sensors that can transmit data back to protected area law enforcement posts using the former method commented:

'*I mean there's also very important considerations in addition to that and it's mostly regulatory and by that I mean the spectrum used by GSM [Global System for Mobile Communications] is typically leased out to telecoms and it's simply not legal without explicit permission in some of these countries to use the spectrum for the purpose of private GSM. Now, that's actually a very important consideration and we didn't fully appreciate what it took to get that permission. In many countries it's out of the question, Malaysia, Indonesia you know, India certainly, those countries it's a none starter, you will not get permission to use the spectrum. […] There's that process at the early stages whereby, obviously a new technology and the government is naturally and understandably cautious about how that's going to interfere with any other technology which they have, and any other systems. What frequency does it emit that might disrupt other police and military signals, et cetera? That's just part of any tech.*' - Interview 3.22

This quote illustrates that national authorities are balancing the use of their technological infrastructure for conservation with other priorities and have authority to constrain how external organisations can set up monitoring systems for wildlife.

Technologies relying on cloud-computing such as Vulcan's EarthRanger or the cloud-enabled version of SMART, SMART Connect, have also encountered suspicion from national authorities. The cloud functionality that is relevant here is that it enables storage of data in a way

that feels dematerialised and seamless to the individual user. Indeed, instead of sitting on a localised object such as a CD, a memory sticks or a hard drive, the data is sent through computers or mobile devices to many, often faraway, servers. The information to store is multiplied so that, in case one of the hosting servers encounters an issue, this data is always available to users as they log onto to the internet and the storage platform. This means that the treatment of conservation-related information through applications like EarthRanger and SMART Connect much resembles that of a shared Google Docs file. As rangers based in local stations across protected landscapes input information onto the software from devices connected to the internet, this data is sent to storage servers. When protected area headquarters employees or national wildlife authorities' members of staff that have the software downloaded onto their computer and the right access authorisations open the application and connect to the internet, the information is retrieved from the servers and sent to the application so that they can also see this data that may have been collected several hundred kilometres away. To NGOs and donor staff this is an attractive way of replacing endless red tape and circulating information from remote landscape to decision makers in a time frame that enables a response to issues on the ground as they unfold.

Yet, States like Tanzania[53] have refused to adopt such technologies nationally stating as a reason that they run on the cloud. This technical arrangement is often not considered safe or suitable for data relating to conservation issues. Interviewees involved in the SMART Connect development themselves admit that:

'[…] security is more of an issue with Connect. But again, it's as secure as any other online platform, you know we recommend that people use an established Cloud service like Amazon or Google Cloud or Microsoft and those all have enterprise-rate security built into them so there's that barrier then the software itself is also protected and so on so it's something that we are aware of and cognisant of but it's not necessarily, in reality I don't think it's a main threat.' - 3.04

Yet the implementers of SMART in some countries seem to disagree about the (non) existence of a cloud-related security threat as exemplified by the interview extract below:

'**Interviewer**: *And so you were saying there's a problem with the server, is it because the data goes in a server in [country name] rather than in the cloud?*

Interviewee: *Yes, they decided that they want their own server, just because of security reasons and also that ... well they said 'ok we have the engineer, we have the capacity, we just want to do it that way' and that's I guess one*

[53] 3.73

of the... I mean it is good for them but I guess it's easier if we took the other platform, which is ok but yes, it's more minor technical processes that we need to solve' - 3.14

It is not just the risk that ill-intentioned individuals might break into the database and steal sensitive information that is at stake here. The central concern relates to the material infrastructure and geopolitics underlying cloud technology as these quotes from NGO representatives discussing SMART Connect and an equivalent system called Cmore highlight:

'*[…] Also one limitation, going back to your question a little bit about data security, is that they require for it to be hosted on their servers in South Africa which is a barrier for a lot of national governments to have their data stored on another government's server.*' - 3.04

'*[…] The only pushback is the one I mentioned I have had at the high level for Connect for the moment because that poses a security risk for their... I mean any illegal activity data that's recorded is really confidential, its nothing to do with anybody in the US or whatever and if SMART Connect's server is based in the US, anybody along that chain had access to this information so that's the security risk for them. So that's the only resistance.*' - 3.24

Indeed, the leading cloud services providers worldwide, Microsoft Azure, Google Cloud and Amazon Web Services (AWS) are headquarters in the United-States and are subject to American legislation. As alluded to in the quotes above, AWS is associated to the SMART coalition and Microsoft is a partner on both EarthRanger and SMART. The servers these companies rely on are distributed in a very limited number of places around the globe. In the case of Microsoft, business clients' cloud data from South America can end up on servers located in the United-States, the information coming from the Asia Pacific region is stored in Hong Kong and Singapore and documents coming from most African countries get distributed between servers in Ireland and the Netherlands.[54] Why does this matter? Because the physical locations of this infrastructure have legal and hence data security implications. Of course, Microsoft Azure promises their business customers that they '*will not disclose customer data hosted in Azure to a government or law enforcement except as you direct or where required by law. Microsoft does not give any third party, including law enforcement and government entities, direct or unfettered access to customer data*'[55]. Similarly, AWS guarantees that their customers can '*build on the most secure global infrastructure, knowing you always control your data, including the ability to encrypt it, move it, and manage retention at any time.*'[56] Yet, certain countries are

[54] Microsoft. Where your Microsoft 365 customer data is stored. Retrieved from: https://products.office.com/en-us/where-is-your-data-located [Last Accessed: 10/12/2019]
[55]Microsoft. Where your data is located. Retrieved from : https://www.microsoft.com/en-us/trust-center/privacy/data-location p.22-24
[56] Amazon Web Services. Global Infrastructure. Retrieved from: https://aws.amazon.com/about-aws/global-infrastructure/ [Last Accessed: 22.05.2020]

notoriously persistent and intrusive when it comes to demands for information placed on digital communications companies. Chief amongst these, the US. It was revealed in 2013 that its National Security Agency was able to directly access Microsoft and Google customers' communications data worldwide through its PRISM mass surveillance programme (Arthur, 2013; The Economist, 2013). 2018 represented a step further in this direction as American lawmakers enacted a piece of legislation entitled the Cloud Act. This bill enables the US law enforcement authorities, and that of countries it has entered in agreements with, to seize data held by 'US-based global providers' anywhere in the world for the purpose of criminal investigations (U.S. Department of Justice, 2019). This law represents a complete upheaval of online privacy protections internationally as it is no longer the location of data and local laws and courts that conditions law enforcement authorities' access to it but simply whether the company that holds the data is US-based and falls under US jurisdiction.[57]

The drive to digitise and share sensitive wildlife and forest-related information is therefore taking place in a context where there are well-founded concerns that this data could be accessed by third parties and foreign governments. Within these circumstances, it is no wonder some states are looking to establish their own infrastructure and reduce their dependence on foreign entities, in particular commercial actors, in the management of their national affairs. This is part of a global intellectual and policy movement called 'digital sovereignty.' This movement denounces the dominance of the American, and increasingly also Chinese, private sector over tech infrastructure, design and related policy making (Pinto, 2018). This state of affairs is cause for concern as it opens the door to political interference through digital applications and poses a risk of discontinuation of essential public services because the technologies these services run on are no longer profitable to providers or because the supplying company has had to comply with political pressure. Digital sovereignty has therefore become a rallying cry for the few communities, regions and nations attempting to restore control and ownership over their data and the digital systems used in the provision of public services. This can entail regulating emerging technologies through law, funding technological research and development (Berthier and Kempf, 2016), running government computers on home-grown operative systems, using free open source software and hardware (Abraham, 2013) as well as investing in network and storage infrastructure (Nugraha and Sastrosubroto, 2015; Hicks, 2019). The interview excerpts presented above illustrate that wildlife conservation has become another terrain for the struggle and expression of digital sovereignty.

[57] Fischer, C (2018, February 8) The CLOUD Act: A Dangerous Expansion of Police Snooping on Cross-Border Data. Electronic Frontier Foundation. Retrieved from: https://www.eff.org/deeplinks/2018/02/cloud-act-dangerous-expansion-police-snooping-cross-border-data [Last accessed: 22/05/2020]

This section detailed some of the techno-political motivations for states to reject NGO-made conservation technologies to gather and store data relating to their law enforcement efforts. I will now delve into the case of Indonesia and the effort of national authorities there to develop their own systems and digital infrastructure. However, developing such an infrastructure costs money, space, energy and skills at a scale that can be hard to match as the endeavours of Indonesia presented in the next section demonstrates.

A National Indonesian Digital Infrastructure for Conservation?

Despite objections to cloud applications, states are still attracted by what technology has to offer and the surveillance potential it affords. Some are therefore pushing for their digital law enforcement infrastructure to be developed and set up on their own terms. Three cases from Indonesia are telling in that regard. The first is the controversy that surrounded the adoption of data management systems such as SMART in protected areas. The second relates to the Ministry of Environment and Forestry's law enforcement division (GAKKUM) which is building up its digital investigations arsenal. The third concerns the establishment of a surveillance system to crack down on illegal, unregulated and unreported fishing.

The SMART adoption process in Indonesia is an interesting example of a tussle over conservation technology between the state and INGOs. There has initially been a reluctance by high ranking authorities towards the adoption of SMART, a foreign technology. For instance, the Ministry of Environment and Forestry only mentions Alas Purwo National Park's similar but locally developed data management system in its 2018 State of Indonesian Forests report. In other protected areas, although the SMART software has been used by partner NGOs, these organisations have had difficulty to convince the managers to adopt the system for the whole area and shift the administration of the programme in-house.[58]

One interviewee directly linked these hesitations to nationalism.[59] The words of other participants also suggest that past collaborations between the national administration and international NGOs have also created a climate of mistrust:

'*At that time, [an international NGO] helped train us then set up the application according to our needs in the field but they built the application and then they left [...] Then we had to manage and given our limited IT knowledge and how busy we are, it was hard to master the application*.' 3.46 – Representative of a conservation management authority

[58] Interview 3.01
[59] See Interview 3.30

'*You just need to be careful with the government, you can't keep introducing new acronyms or new additions because you know they would just be 'ok you asked us to do this, we did this but then we say we need to do this, but now you say we need to do this' so it's all step by step.'* - 3.01 NGO representative

However, the Ministry of Environment and Forestry has also eventually set up a taskforce of conservationists to develop a national data model for SMART that could be used throughout Indonesia. That is, this group of experts agreed on the definition categories and subcategories of key wildlife species and environmental issues to be recorded across the country. The Ministry then issued training packages to staff on flash drives and have experts of the software on hand at the headquarters.[60]

A balance seems to have been struck in November 2018 when an official letter on the 'effective management of conservation areas was issued' by the General Directorate for the Conservation of Natural Resources and Ecosystems (*Dirjen KSDAE*). They recommend all offices in charge adopt a system of information management and lay out that those that do not yet have one are expected to adopt SMART which they call SMART-RBM. Which implies that in the next few years around over 130 administrative units[61] will have to get on board.

The second example pointing to an emerging national conservation digital infrastructure in Indonesia relates to the law enforcement division (GAKKUM) of the Ministry of Environment and Forestry. This department has been setting up an 'intelligence centre' or 'situation room' ('sitroom') from 2016-2017.[62] This centre consists in an assemblage of several tools including mobile applications, one to track and communicate with enforcers on the ground, one to gather crime reports from the community. This can be related to issues such as wildlife and timber trafficking, forest clearing and fires or illegal waste dumping and chemical pollution. Official documents and the cases and investigations management system are also being digitised. A press and social media crawler has been set up to follow topics of interest and pick up on keywords. Added to this, a mapping tool to keep track of sea vessels which might be trafficking wood or polluting waters through satellite-enabled surveillance of their radio signals. These systems can be used from a large semi-circular multi-screen room, said 'sitroom', at the heart of the Ministry's maze-like headquarters in central Jakarta. Key GAKKUM provincial offices such as that of Pontianak, West Kalimantan Province and Palembang, South Sumatra, were in the process of being equipped with similar infrastructure at the time I conducted interviews.

[60] See WP3.38, SMART-RBM Modul Aplikasi, SMART-RBM Indonesia file
[61] 48 national parks, 26 BKSDA according to Wiratno (2019) *The ten (new) ways*
[62] WP3.66, 3.67

Figure 7: GAKKUM's Intelligence Centre at the Ministry of Environment and Forestry Headquarters.

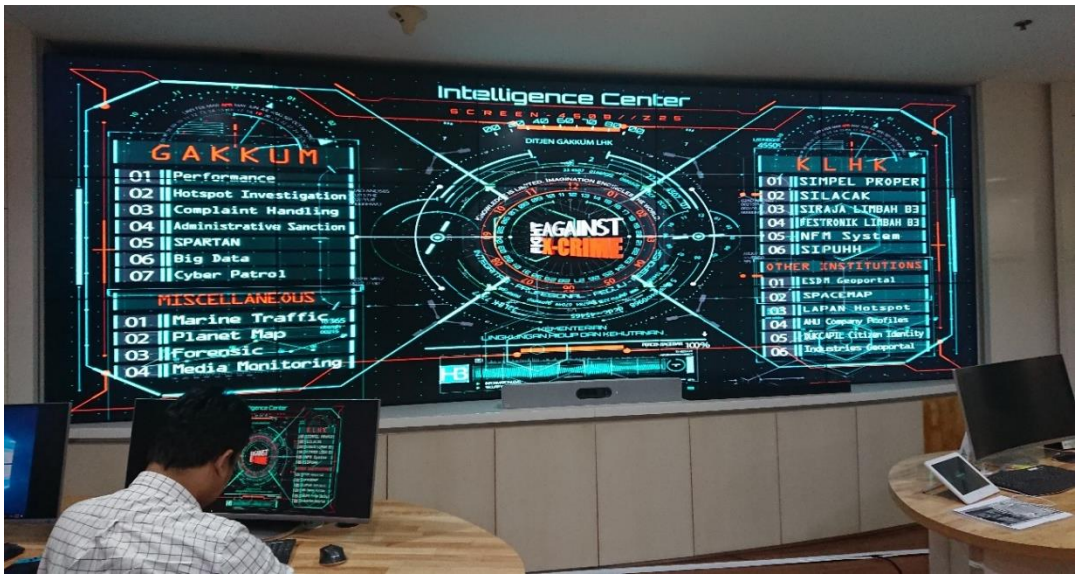

Figure 8: The home screen of GAKKUM's Intelligence Centre

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Admittedly, the digitalisation of documents and filing system is service provided by US-based computing company and one of the data streams is supplied by foreign companies on a subscription basis. The intelligence centre also benefits from funding from The United Nations Development Programme (UNDP), Norway and Australia in addition to governmental funds.[63] However, the mobile application for field officers and the social media crawler have been developed by Indonesian vendors. Most importantly, the server supporting these applications is

[63] This was mentioned in interview 3.67

located in the situation room itself. To my questions about reporting to donors and what data these institutions could access, interviewees were keen to highlight that:

'But of course regarding our data, although they are the donors, we keep our data to ourselves, that's why we have our own server' 3.67

Describing how they shared information with their officers in the provinces they also warned that:

'*There is also an external security element because these data are extremely confidential.'* 3.67

These quotes illustrate the division's will to keep control and ownership of data which is the hallmark of digital sovereignty. Furthermore, employees of GAKKUM credit the initiative for the intelligence centre and related applications to their head:

'*The Director General, that's it, it's our leader who has the inspiration. The vision for this is our leader's, we only put it in application, and indeed he has ways to remove specific obstacles such as human resources, outreach and moving towards technology'* 3.66

The department's ambition was to eventually lessen their reliance on subscriptions to external data provision services, another element of data sovereignty, and to reinforce data sharing between Ministries as demonstrated by the case of information related to ship identification and routes:

'*Actually, in the future there's a strong possibility we won't use it anymore because we will be working with the Transportation Ministry […] They have their own data on this. They have data on vessels. But we still need to see how much they have, whether it can replace Marine Traffic or whether we can use both*' 3.67

Data sharing between ministerial directorates and between governmental institutions in Indonesia is also fraught with territorial feelings and bureaucratic complications. Agreements between administrations rely on joint working agreement or request for information letters and only categories of information and projects explicitly mentioned in these documents will be shared. Despite this, the difficulties, cross government department information sharing is deemed a desirable aim by the government official quoted and more broadly, as part of the OneMap project initiated by the President's office which aims to integrate all of the country's thematic maps relating to natural resources and infrastructure developments. Information and data processing assistance also often happens informally through alumni and professional networks.[64]

Despite a possible divergence of views from the large NGOs on how technologies for environmental law enforcement should be implemented, some government officials interviewed

[64] 3.61

did also subscribe to the associated techno-optimism and rejoiced in the extension of surveillance enabled by this new digital arsenal. The layout and decoration of GAKKUM's 'intelligence centre' room (see Figures 7 and 8 above) are revealing of the modernity and efficiency imaginary tied to the battery of software that the division is investing in. This is particularly true of the home screen (Figure 8) with its futuristic layout and shiny dials. This home screen would not be out of place in a video game or a cinematographic rendering of an espionage station and may not be as readily associated with an under-development data filing and analysis system at a Ministry in charge of environmental issues. This spy movie feeling is also indicative of another dimension of law enforcement technologies that both large international NGOs and high-ranking government officials appreciate: the extension of surveillance powers. As a GAKKUM employee told me about the new press crawler which sorts through hundreds of news stories for cases which might fall under the jurisdiction of the department:

'*There's limitations with our staff which is only 800 people, it's not possible to cover all of Indonesia which is almost 170 million hectares, so our eyes and ears on the ground are the journalists which are in the field, good journalists which are independent, which will certainly write what they saw. Never mind if that story is false or true but it will become input data for us to follow up on.*' - 3.66

A centralisation of disparate information as well as an extension of the data available for the state administration to act on was therefore seen as desirable by this interviewee. Another area where some central government conservation officials interviewed have shown appreciation for increased personal information collection is the monitoring and surveillance of field agents which I will expand on in Chapter 7.

Similar efforts to increase surveillance for law enforcement purposes have taken place in relation to the Ministry of Marine Affairs and Fisheries' (*KKP - Kementerian Kelautan dan Perikanan*) portfolio. Cracking down on illegal, unreported and unregulated fishing, in particular that carried out by foreign commercial actors, has been a top governmental priority since President Joko Widodo's first mandate (2014-2019) and was aggressively pursued under Minister Susi Pudjiastuti, to the point where confiscated fishing vessels were set on fire and sunk (Kaye, 2015). A bilateral development donor for instance financed a satellite data alert system to flag up suspicious fishing vessels to national marine patrol teams as part of a larger ocean conservation and research project. The project funded the building of a national observation and analysis station and the training of expert staff. High definition satellite data was supplied to this station through a subscription, its employees routinely cross-examined this satellite imagery with other records such as vessel monitoring systems (VMS) data or bought data related to a specific location on demand from the

authorities. The station then passed on details about the vessels potentially in infraction to KKP law enforcers within the day to help focus their patrolling and arrest efforts at sea.[65]

But technological experimentations by state institutions in charge of natural resources management have encountered uneven success. Indeed, in the marine enforcement project described above, at the time I conducted my research the protocol to acquire satellite data had been set aside by KKP at the end of the donor's period of involvement as they estimated the cost of the data was too high and they could possibly get similar information through cheaper or free platforms.[66] Some of the difficulties encountered by technological projects in state institutions therefore have to do with core concerns of the data sovereignty movement: the cost of outsourced services and that of hardware able to store and withstand traffic of the volumes of data corresponding to the activities of state administration. This was clearly corroborated by two interviewees working for KLHK:

'We have got our own server. But the concern is that when we have more data we will need the server even more. And that's an expensive investment. And the maintenance is also expensive, as well as the management. The problem in Indonesia is that there's [the governmental regulation] PP 82/2012 about electronic transactions which states that the server for banks and government institutions must physically be in Indonesia. Yes. […] How much does it cost? Initially we – this initial one, this one was two M [Indonesian rupiah] wasn't it, the initial one? Two M? The initial one two to three milliard. But now we have already added six milliards for a new slot because our RAM was too limited. Because we had less RAM previously. So we just added some this year.' - 3.97

This quote articulates the implications of national data protection law for conservation data management and highlights the financial implications of this for the Ministry of Environment and Forestry. The quote below draws attention to similar concerns:

***'Interviewee**: But with the data what's important is that we all store it properly. We have a few places. And I wish we had a big enough cloud so that we could store all data in that cloud. […]*

***Interviewer:** Is this also a budget issue?*

***Interviewee:** Budget, yes […] Maybe this is a problem in all middle-income countries. We are required to work well, but we don't have enough resources to support us. Like this [points to phone and computer]. This and all-everything, this is mine'* - 3.62

[65] 3.27
[66] Idem; Project evaluation summary (2019)

These quotes concretely illustrate the problems of the cost of technological infrastructure highlighted by the digital sovereignty literature and very much confirm that they affect forest and wildlife management in Indonesia, even as the institutions in charge attempt to develop nationally-owned systems to support their work. But interviews also reveal another set of obstacles integral to the political economy of increasing reliance on digital technologies in the running of national affairs. Here they are summarised in the words of a multilateral donor representative based in Indonesia who described the components of an on-going project to set up a natural resources database with a number of Indonesian governmental agencies:

'*Yes, right from the methodology to the data protocols, the data infrastructures, all those elements are part of the programme of support and there's intense capacity building and training all the way along so that once our support ends on one, they replicate and they keep doing the same.*' 3.63

This quote hints at the fact that the human resources and labour implications of technology development and adoption are indeed often underestimated although they are a key dimension of the sociotechnical systems behind the government of protected areas that are affected. I will lay out this issue more thoroughly in the next chapter.

What the ups and downs of the conservation technology projects presented in this section show is that despite a strong will from the Indonesian State to assert oversight and proprietorship over systems used by its departments, it is limited in its ability to do so by costs and human resources. Yet, some members within government conservation agencies have embraced the possibilities offered by surveillance technologies. This leads to the development of mixed systems where government-led innovation and investments co-exist with systems favoured by or offered by international donors, NGOs and private sector.

Conclusions

A historical approach and the more novel lens of digital sovereignty applied to the case of Indonesia revealed the ways in which the political economy surrounding the acquisition of conservation law enforcement technologies by state institutions shapes what technology gets developed, provided to local practitioners and used to govern protected areas. This is a second set of relationships between conservation actors which influence the development of monitoring and surveillance technologies.

In Indonesia, the state, a central actor of the conservation of wildlife and forest, is negotiating the available offer of technologies promoted by international organisations with a stake in the country's sustainable development. The historical importance of forests and wildlife as a

source of revenue and as a key domain of state administration, defiance towards foreign interventions in national affairs combined to concerns that technologies might open a breach for external actors to profit from the country's data and public purse. Indonesian state agencies and ministries in charge of wildlife, forest and marine resources have sought to ensure that they have a certain level of control and ownership over the technologies they rely on for biodiversity monitoring and law enforcement. This has led to the establishment of hybrid systems; partly relying on state owned technology and partly operating thanks to commercial services, international funding and NGO expertise.

These concerns regarding technologies used for what is considered national affairs are valid beyond the Indonesian context as similar patterns and issues have been expressed interviewees working in other Asian countries, Latin America and East Africa. The compromise between the different stakeholders will vary in each context. These compromises however show that established governing practices of forestry wildlife agencies and digital technologies mutually shape one another.

Through Chapter 3, 4 and 5, I have examined combined influence of enthusiastic international promoters and national institutions in search of digital sovereignty on the characteristics of technologies for conservation. In the following three chapters I return to the four aspects of government I highlighted in Chapter 1 i.e. practices, visibilities, knowledge and identities. This enables me to examine how the relationships laid out in this chapter and the previous two affect how technological tools contribute to the day to day government of protected areas.

Chapter 6: The labour implications of implementing law enforcement technologies

Law enforcement technologies are expected to perform conservation tasks 'quickly', 'faster', 'easily' and 'automatically' (United Nations Environment Programme (UNEP), 2014; The Royal Society, 2018). But to what extent do they actually speed up and automate the work of conservation staff in the field? Authors such as Pimm et colleagues (2015) have enthused that tools such as mobile devices, databases assorted to GIS functions, camera traps and drones could help make conservation law enforcement more efficient by accelerating information collection, transmission and analysis. Protected areas or other wildlife conservation authorities could stop poachers, illegal loggers and traffickers in their tracks by getting real-time information or at least richer and more relevant insights. Adams (2017: 7-9) goes further in highlighting that conservation is moving towards an automation of data collection, processing and decision making. He writes: 'Conservation applications are therefore quickly following models that eerily copy the automated military kill chain' (*idem*, 9). The rapid development of tools such as connected cameras sending signals when they detect a human presence as well as audio recognition devices which dispatch an alert for chainsaws and motorcycles noises indicate that this is indeed the direction of travel. However, it is not yet a reality in most contexts.

Operating and maintaining systems used for conservation law enforcement in the long term, does not necessarily fit this ideal of ease, speed and automation. Much time and labour is required to integrate these technologies in conservation work routines and to keep them running. Human labour, that of rangers for instance, is still relied upon to produce large amounts of data, make sense of it and take relevant action based on the insight provided. I show that with this work come new expectations procedures, activities and techniques for the collection and analysis of information relevant to protected area management. I therefore relate this process to the Foucauldian concepts of 'practices', one of the five categories from the framework I presented in Chapter 1. As I explained in Chapter 1, practices are key modalities of the process of government, they participate in shaping the conduct of people, in this case conservation professionals working in protected areas. Indeed, through the labour associated with the deployment and use of technologies, it is the possibilities of action of conservation practitioners themselves which are affected and not only that of the populations living in and around protected areas.

In this chapter I examine the practical implications of law enforcement technologies implementation and use locally. I start with a reminder of theoretical debates relating to technologies and the qualitative nature of work, in particular the notion of 'human infrastructure' a specific form of the socio-technical networks I introduced in Chapter 1. I then build on these ideas to analyse the efforts, or practices, deployed to set up new conservation technologies and use them day to day. If automated 'conservation by algorithm' is quickly drawing closer, I have not directly encountered its manifestations. The widespread technological applications I studied in 2017-2019 still heavily relied on a human infrastructure to integrate them and produce results. Finally, I show that this process of deploying and using new technologies is not seamless and straightforward: some tools are not intensively used or even end up being ignored. I argue that these difficulties in adopting new tools are related to the way they are designed and deployed.

Human infrastructure: the people behind the machines

The impact of new machines, computers included, on work and employment has long been an object of concern and wild fantasies. Two questions in particular have led to much ink to flow: 'will technologies steal jobs from people and cause mass unemployment?' and 'how does work change when it is done in tandem with a machine?' In 1930, John Maynard Keynes already (1963) weighed the pros and cons of a future in which automation freed time for people to focus on intellectual and creative pursuits. More recently, the maturation of artificial intelligence (AI) technologies has led to a resurgence of the debate over the technological disruption of job markets (Akst, 2013; Mitchell and Brynjolfsson, 2017; Ojanperä, O'Clery and Graham, 2018). The idea that technological innovations do not lead to overall mass unemployment currently holds the upper hand. While new technological tools will certainly render some occupations obsolete, they may also create employment through enhancing productivity, reducing prices and thus increasing demand for products and services (Autor, 2015). New systems may create positions that are specific to their use and maintenance as well (Autor, 2015; Pianta, 2018). A recurring conclusion on this of work on technological change therefore relates to the need to adapt the training and education systems to fill these positions and keep people in employment (Autor, Levy and Murnane, 2003; Brynjolfsson and McAfee, 2016).

I have not sought to quantify the overall number of jobs that will be lost or gained as protected areas adopt more and more data collection and management systems. However, I can speak to the qualitative changes associated with these new systems. Which brings us back to the second question: 'how does work change when it done it tandem with a machine?' In understanding this process, the concept of socio-technical networks presented in Chapter 1 as well

as the idea of human infrastructure are especially helpful. The socio-technical framework is a holistic one which holds that to understand a technology, the social relationships coalescing around it are as important as its technological parameters. Meyer (2007) has effectively used this framework to examine a conservation context and explore how the switch from film to digital photography affected the work of scientists monitoring sea mammals. He noticed that although digital photography was a more accurate and efficient way to capture images of dolphins and whales at sea, it also produced more work when back in the laboratory scientists had to store, parse through and analyse unprecedented quantities of images.

The concept of human infrastructure plays on the same ideas but is more evocative. Elish and Mateescu (2019: 13-14) define 'human infrastructure' as 'the integral human component of a socio-technical system without which the system cannot properly function.' 'Properly function' is a mark of the concept's origin in the design and engineering literature (Liker and Majchrzak, 1994) which aimed to uncover ways in which the humans' way of working and the machines way of working could be synchronised and harmonised for optimal results. 'Properly' suggests that there is a way in which the technologies are expected to function, one that is correct and desirable. I do not subscribe to this normative approach although I do highlight and recognise that developers of conservation technologies expect and wish their creations to work in a certain way. This is exemplified in the brochures, sales pitch, webinars and presentation they offer.

The normative component set aside, the term 'human infrastructure' nicely sums up the idea that for technologies to work in the way developers hope and expect, or indeed to do anything at all, human labour is required. A range of norms, behaviours, information and resources are required to produce and maintain the conditions for the technologies' operating (Sambasivan and Smyth, 2010; Tang, Chen and Roberson, 2015). Because of this, the integration of new technologies in a working environment often entails a shift in daily routines and skill sets. Elish and Mateescu (*ibid: 45-47*) describe for instance how self-checkout machines made workers out of customers and transformed cashiers into assistants watching over, encouraging and helping shoppers to use the machines.

The existing English-language literature on the relationship between technological change and the qualitative nature of work focuses on manufacturing (Adler, 1992), agriculture (Mateescu and Elish, 2019) as well as state and commercial services delivery (Yeuk-Mui, 2001; Marler and Liang, 2012; Gough, Ballardie and Brewer, 2014; Evans and Kitchin, 2018) in a Global North context. With the notable exception of Meyer (2007), there has been little attempt to apply this line of questioning to the adoption of new technologies in biodiversity conservation work.

Yet, my research shows that similar processes are at play in conserved areas adopting new technological tools to help with the recording of information about illegal activities and apprehension of suspects. Human labour is required to make them fit into protected area management work and this reshapes the skills and tasks expected of employees. It is the nature and implications of this labour for rangers that are the focus of this chapter. As biodiversity conservation institutions adopt big data, artificial intelligence and Internet of Things (IoT) applications, understanding whether technological innovation has similar consequences there as it has had in other sectors may yield valuable insights about related shifts in power dynamics in the workplace and in labour markets, that is workers' autonomy and bargaining power.

The labour involved in transitioning to a new technology set up

Setting up law enforcement technologies in new conservation locations heavily relies on tasks, know-how and collaborations that can both be qualified of human infrastructure and labelled as 'practices' as part of an analysis of government. Technology for conservation adoption is often NGO or private sector-driven and, in the cases I have researched, follows a standardised project management framework starting with an implementation and training phase. This initial introduction period can be quite time consuming. The example of the Spatial Monitoring and Reporting Tool (SMART) is telling in this regard. My interviewees employed or contracted by member NGOs of the SMART consortium have described the steps necessary to implement this system, starting from convincing local and national partners with authority over the conservation site's administration that managing their protected area data through this platform is a worthwhile thing to do. This negotiation can entail organising and facilitating meetings to demonstrate the technologies' functions and setting up localised trials amongst other things. In the case of Indonesia, six years of deliberations went by between the time the first protected area official received a SMART training from the international NGO partnership and the year the Ministry of Environment and Forestry officially embraced it. It was only in 2018 that the Ministry officially declared SMART or similar data management systems a requirement in all the protected areas and wildlife management offices under its authority and made the tool a component of the national ranger curriculum.[67]

[67] 3.01, 3.10

Once it has been agreed that the system should be implemented, comes a phase of discussions over the data categories that should be included in SMART at particular sites. An NGO employee based in Sumatra explains this process:

'Actually we have to do that, the same thing that I have done at [the protected area], we've done it at the regional conservation agency, at the district agency and at the Forest Management Units, we discuss what they want. What data they need, what data they have from the forest, because it will be different. [The protected area] is different from the regional conservation agency' – 3.43

The version of SMART that can be downloaded from the partnership's website already contains a large number of information categories relevant to protected area management. Yet, introducing SMART to a new area often implies stock taking to adapt these categories to the local context and priorities. This entails a broader reflection around the key fauna, flora and natural features of value, the ins and outs of issues that the protected area faces e.g. mining, logging, land clearing and/or poaching. The detail of the equipment available (e.g. cars, boats, arms) and activities regularly undertaken by rangers (e.g. visiting local communities) also need to be taken into consideration. This process can be very laborious and time consuming, taking up to a year.[68]

User manuals and mobile data collection applications have to be translated into a language that users can understand. Local conservation organisations and conservationists produce and share videos explaining how to collect information in the field and navigate the SMART input and report-making functions.[69] Some key protected areas staff are trained through off-site workshops in order to later train their colleagues but protected areas rangers are also coached on the job in using GPS or other data collection devices and guided in navigating the standardised data collection procedure. Administration and monitoring officers learn about analysing and reporting on the results. Due to frequent turnover of protected area staff and the limited availability of training courses, many rangers learn from their peers who have previously been trained by external actors or are self-taught through information available online such as manuals and tutorial videos.

At a protected area I conducted research in in Sumatra, SMART had been in operation for four years and was considered a success by the management and the NGO staff who had introduced the system yet many employees still had only a vague idea of what the software was

[68] 3.11

[69] See for instance Laurio Leonald's Youtube channel. Available on:https://www.youtube.com/channel/UCG86RxnDnPS9DosQ0EwsT9Q/videos [Last Accessed: 08/06/2020] and People Resources and Conservation Foundation Indonesia's *Penjelasan Lengkap SMART PATROL oleh Specialist Program Conservation* https://www.youtube.com/watch?v=8Qet1nlSrUg [last accessed: 08/06/2020]

and could do.[70] This was revealed in meetings where I introduced myself, presented my research questions and later, an early understanding of the situation. At the first meeting, attended by a large majority of the staff, my presentation sparked a debate about the state of SMART adoption in the protected area. There was a raised hand vote put to attendees about who had already collected data: 15 attendees out of 30 or so. Who had already entered data in the software? 5 people. Run a query? 2 people. During the second meeting I asked about the use of queries – the search function that enables the creation of thematic maps and tables within SMART – and some attendees asked what they were.

Many interviewees reported that this implementation process was indeed iterative and open-ended. As protected areas staff changes, analysis skills can be built up as databases become populated and the organisation's staff and management become more familiar with the system. As one interviewee with expertise on the SMART system put it:

'[...] Any implementation is always a process, it's not something that you go in for a week and then you train people and then it's finished, it's often you know a year-plus long process of consultation and training and refining the system before it's really providing what's necessary for the people who are doing work on the ground.' – 3.04

This interviewee refers to two lengths of time, a week and over a year. The contrast between the two represents the gap between the length of officially organised training courses and the amount of work necessary to make SMART operational in their experience. This quote also highlights the fact that SMART and similar technologies are not readily completing conservation tasks as soon as the software is downloaded and rangers are equipped with GPS devices. A similar idea was summarised sharply by another research participant who said:

'*SMART is a process, it's not like if I'm selling you a washing machine, I can just direct deliver the washing machine to your house, demonstrate once how it works, give you the user manual and then I can forget about it.'* – 3.08

The two quotes above effectively draw attention to the skills and workflow adjustments called for by a new piece of conservation technology as well as the time required to make those adjustments. However, iterative and open-ended ways of working go against the logic of grant funding so many conservation projects rely on and which last for as little as a year and rarely longer than 3 to 5 years. The limited and time-restricted nature of the funding available affects the time and manpower that can be devoted to working with and around new technological tools.

[70] 3.30, 3.43, 3.60

Promoting and implementing technologies on conservation projects does not only require time but also requires numbers. People are recruited to facilitate collaborations that could lead to the development of new technological tools, coordinate the deployment of existing tools in new locations, liaise with national authorities, gather feedback from direct users at conservation sites, ensure maintenance or respond to troubleshooting enquiries. In international conservation NGOs, this leads to the emergence or repurposing of roles with titles such as technical advisor, community manager, tech lead, monitoring specialist, director of technology, chief technologist or chief technology officer. All nine SMART consortium member NGOS have designated representatives who devote some of their working time to sitting on the user council. This group gathers feedback from users in the field and meets to discuss how to best use and improve the tools' functionalities. These nine NGOs often also have one or two staff in charge of coordinating SMART implementation at their national country offices.[71]

As mentioned in Chapter 5, in Indonesia, the Ministry of Environment and Forestry (*Kementerian Lingkungan Hidup dan Kehutanan - KLHK*) has for instance granted its support to a taskforce of conservationists in order to develop a national data model for SMART that could be used throughout the country. This group of twenty-one experts agreed on the definition of categories and subcategories of key wildlife and related issues to be recorded by all users.[72] The Ministry then issued step by step user guide packages put together by the taskforce to protected areas staff across the country on flash drives. SMART software specialists are on hand at the Ministry headquarters to answer queries from the protected areas database officers and support them with advanced data manipulation procedures.[73] Indeed, long term support is required for such databases to be adopted and used.

Because certain tasks or practices are required to integrate systems like SMART in the work of local conservation staff, I argue that these systems have an effect on the practices of those who govern protected areas. But it is not the only way such technological tools impact the practices of conservation practitioners. These tools also have an impact on government practices in the long term as I explain in the next section.

[71] 3.01, 3.14, 3.24, 3.43
[72] SMART Taskforce. 2016. *Pedoman Implementasi SMART Di Kawasan Konservasi* (*Guidelines for the implementation of SMART in protected areas)*
[73] 3.28

The labour involved in day to day use of monitoring and surveillance systems

Durable technology adoption in conservation organisations is not only a matter of an initial push, one year of focused attention. Technological systems continuously rely on human infrastructure and are associated with a range of repeated practices. Labour and time are required to keep them running day to day over, generate insights from the data collected and act on the information provided. This is the case across the board. It applies to ranger-based data collection systems like SMART, which, as the name indicates, requires rangers to collect the data. But as an international funder working in Indonesia pointed out this stage can be problematic: '*the problem is not so much technology, the problem is funding for the people going out.*'[74] The deputy director of a Sumatran protected area concurred: '*if the NGOs don't have money, SMART doesn't function*.'[75] Data collection is only the first of several steps. The SMART data also needs to be entered and cleaned, most often manually, in the software, searched through queries and interpreted through reports to line managers, donors or higher government bodies. A protected area technical advisor I interviewed expressed this by saying: *'I think people sort of underestimate the amount of effort involved to keep this beast running.'* [76]

The same goes for poacher and loggers-detecting drones. A trained pilot has to fly the device, especially in the case of the plane-looking fixed-wings drones which can stay in the air longer but require more technical expertise to operate. To detect relevant activities, someone has to monitor the video feed, although more and more machine learning applications are being developed to automate this step. Should the drone detect a suspicious presence on the ground, what then? Someone with authority to act has to cover the, often long, distance between their office and the location in question in order to intervene. As a wildlife crime consultant eloquently summed it up: '*the camera doesn't make an arrest, the drone doesn't make an arrest, the fence doesn't make an arrest [...] if you don't have a response capability then it's completely pointless as well. And that's a big thing.*'[77]

Indeed, similar patterns are noticeable in the case of systems that aggregate real-time information from sensors and communications devices dotted over the protected area to alert of human movements and coordinate protected area staff. The Zoological Society of London's Instant Detect, Cisco and Dimension Data's virtual fence line or Vulcan's EarthRanger fit into this category. They aggregate information from a combination of sensors such as cameras, motion sensors, wildlife satellite tags or vehicle or ranger radios, all of which must be placed in the field

[74] 3.61
[75] 3.30. Other Indonesian protected area staff testimonies on this in 3.47
[76] 3.15
[77] 3.06

and maintained. In the words of an interviewee supporting the implementation of such a tool, to be of any use '*you need to make sure that the person that is getting any data coming in knows what it means and knows how to react to it. There's no point saying 'oh look, I've got a picture of a poacher, what should we all do now?*'[78] Indeed, at least one person is needed to continuously look at a screen and direct efforts of staff in the field. A team ready to respond to technical issues and work on updates is also essential. The above quote also indicates that, beyond the bodies necessary to operate them, monitoring and surveillance technologies come with a set of expectations around what working in and managing a protected area involves.

The rise of the figure of the data officer or monitoring and evaluation officer is a prime example of this shift in expectations towards certain protected area members of staff with the arrival of new computer systems. As key participants involved in the SMART partnership argued: '*you need someone to be thinking critically about the structure of the data you are collecting and managing the data you are collecting.*'[79] This quote reveals that having one or more employees responsible for sorting and making sense of data generated by SMART or other monitoring and surveillance technologies is key to their operating. Where there was already an administrator in charge of collating the protected area's records, the advent of technologies enabling more and different types of data to be generated supposes that they acquire new skills and take on new responsibilities. This is a common situation as indicated by an advisor working for a large international NGO: '*In 99% of the parks where we work, I would say they don't have to recruit a new person. We help a person within the park to do this job because they normally have somebody to do the documentation. The problem is the documentation is happening in a very age-old system like most of the parks we work with [...], they are still using those old file folders but I mean the person is there.*'[80]

To support protected areas in moving from these 'age old' filing systems to computerised data management, the SMART partnership has put together a course specifically addressed to this staff category who will administer the database.[81] In Indonesia, using SMART has become part of the conservation staff training agencies' curriculum.[82] But not all employees concerned manage to get a place on these courses and many are self-taught or learnt on the job from colleagues. This was the case of two of the six employees officially responsible for inputting and handling data at

[78] 3.16
[79] 3.04
[80] 3.08
[81] 3.09
[82] 3.01

the Sumatran protected area previously mentioned.[83] One of them explained the learning process he went through when taking over from his predecessor:

'*He didn't teach me. So, eventually I taught myself. Everyone was busy with their own tasks and I didn't feel comfortable disturbing them and taking up their time, so I taught myself as much as I could. […] From YouTube, Google, other people's blogs.*' - Interview 3.38

Whatever their level of confidence, data officers end up being responsible for not only entering data and circulating information to colleagues but also debriefing and feeding back to rangers after their patrols and, in some cases, calculating the best locations for monitoring or surveillance sensors on the basis of the information available. Skills they are expected to master include: querying the database, using the mapping software ArcGIS and Quantum GIS, writing reports, and, in some places, an understanding of the basics of criminology to support their data analysis (more on this in Chapter 8).

However, the documentation employees in question do not always seamlessly grow into the roles that are expected of them. The assistant director of a protected area which uses SMART for instance recounted:

'***Interviewee***: *But you saw yesterday that we don't have a lot of analysis done already. We just query or use data we already have. But if employees were a bit more creative or had more time then more of them would get into analysis.*
Interviewer: *But they are really busy?*
Interviewee: *Yes, because these are a lot of work and not all of them are familiar with the application. Maybe they are computer literate but they can only use Microsoft word and create presentations.'* – 3.30

This interview excerpt sums up some of the reasons why this transition might be difficult. Conservation staff do not necessarily have much time to dedicate to new tasks in addition to their other duties[84] and the new tasks may be quite different from what they have learned during their initial training.[85] Another reason cited by interviewees was that the outcome of the new tasks was sometimes not valued by data officers the park and agencies' hierarchy.[86] This state of things has led to the absence of employees devoted to analysis tasks occasionally being sorely felt. A wildlife crime analyst stressed that *'[...] more importantly, without an analytical capacity in house it also just becomes*

[83] 3.32, 3.33a, 3.34, 3.35, 3.38, 3.39, 3.42
[84] 3.14
[85] 3.15, 3.04
[86] 3.04, 3.06, 3.09, 3.11, 3.24, 3.71

a data collection exercise that never turns into anything worthwhile.' [87] This testimony foregrounds once more the tasks, information and relationships necessary to support the actualization of the software's functionalities.

Patrolling is the second example of a role that has been affected by the spread of data collection and analysis technologies. It is activity that features on rangers' basic job descriptions. Yet, this task did not used to be considered a central source of information. *Earthscan's Protected Area Management - A Global Guide* (Lockwood et al. 2006: 262-275) published over a decade ago recommends gathering information through pre-existing reference materials, geological, biological, community and visitor surveys, interviews, experiments and case studies. This manual encourages protected area managers to resort to volunteers, community groups, consultants and external researchers to generate knowledge. The *Guide* does not give any indications about law enforcement or illicit activities-related data. Yet, with SMART, ranger patrolling has become a central source of data and much of the details recorded will relate to illicit activities. SMART in some ways reshapes what being a ranger means.

The methods and expectations associated with expeditions to keep watch over protected areas are changing with the emphasis on patrolling as a central source of information. SMART-related procedures are to be followed when the patrol team comes across significant elements of the landscape. GPS coordinates are to be recorded, pictures taken, detailed and standardised notes written down to describe what is observed in a way that is compatible with the software database and enables comparison with similar past incidents. The recording of wildlife tracks in a South East Asian case of SMART application is a good illustration of this phenomenon:

'*They have a protocol to record ungulate tracks so for instance, if they walk along a path where an ungulate, say a wild boar has been, they're not going to record every footprint because they'll be one every step so as they are following the track they'll just record one footprint of each species every 30 minutes [...] but if it is an elephant or a tiger footprint, it will be recorded on the spot, for all other species they record one GPS dot every 30 minute*s' – 3.24 International NGO consultant

Adjusting to this evolution of patrolling and shift in information gathering is not always straightforward as illustrated by this excerpt of an interview with an international NGO employee: '*You see before it works smoothly, before your guys get good at data collection…it's a lot of time, a lot of investment and, at the beginning you could quickly give up and think that the technology isn't much help really.'* - 3.11

[87] 3.06

This is exactly what initially happened in a privately conserved area in Sumatra as related by its manager: '*At the beginning we used SMART a bit but then they* [the field staff] *have had glitches and they stopped.'* 3.28

The sources of tension for patrollers are similar to those faced by data management officers: time required to conduct the tasks as well as to build up confidence in using the tool. Indeed, in the protected areas I visited, the data management officers are also often rangers who occasionally patrol.

In short, a number of monitoring and surveillance systems, and SMART chief amongst them, require regular human input. These systems have the potential to influence on protected area's staff practices, what they do concretely to manage the area in the long run. However, it cannot be said that practices associated with technologies seamlessly coalesce into a coherent whole or 'regime of practice' with other procedures and techniques. In fact, practices associated with technologies or at least the view developers and promoters have of how these technologies should be used are not always compatible with other work routines. This limits the impact technologies have on conservation outcomes, the interactions between people and wildlife. In the next section I link this issue to the international conservation sector's hold on technology development which I first presented in Chapter 3.

Labour, innovation and diffusion of technologies for conservation law enforcement

The difficulties patrollers and data officers have to take on new tasks associated with technologies can be attributed to inoffensive teething problems. This is the explanation given by a number of interviewees.[88] However, these difficulties also reflect the drawbacks of a technology diffusion model that has more to do with deployment than integration. In Chapter 3, I have explained how international non-profit organisations and businesses based in Europe and North America drive the production and promotion of technology for conservation. These organisations take the initiative of developing 'solutions' to address a specific set of issues. Through interviews and meetings, consultants or in-house technology developers and electronics engineers will assess the needs of conservation practitioners and develop a business proposal. Once developers and engineers have made sufficient progress, conservation practitioners will test and implement the new tool in the field. This is has definitely been the case in Indonesia as explained by a conservation consultant: '*as I understand of all the areas where SMART has been introduced to Indonesia it often follows a*

[88] Discussed for instance in 3.01, 3.08, 3.09

very similar process where you get one of the large NGOs which will partner with a national park or otherwise.'[89] As I have highlighted in Chapter 3, international NGO staff, particularly expatriates working in biodiversity-rich regions, are privileged interlocutors in this process. However, on-the-ground professionals, those who would directly use the new tools day to day are sometimes left out of such initial conversations. Indeed, this is how an interviewee involved in the development of a law enforcement tool describes the process:

'***Interviewee**: The first phase anyways was to do a series of conference calls […] to talk to some of the key conservationists about the different functionality that's required for the project […] So they have... they have spent years in different countries in Africa or Asia managing sites and doing their own research so yes, so that was one thing. […] then we would have another business analysis interview with the same type of people but probably different individuals to learn all about the patrols that rangers do […].*
***Interviewer:** And so did you get to speak to rangers as well or not directly?*
***Interviewee:** I don't know that we ever have.*' – 3.12

In this case, the rangers' own accounts and experiences were not part of the business analysis even though this tool centres around their work. Important aspects of their tasks, workplace culture and concerns may have been lost in translation as only the interpretations of these realities by expatriates offering technical assistance were considered. This is an important drawback of the deployment model prevalent in the conservation law enforcement technology sector.

It is not only the development process but also the funding models that do not give much weight to the human infrastructure as explained by an international NGO employee working in a South-East Asian country:

'*What's often not appreciated even in grants or when perhaps organizations or governments are applying for funding with a certain technology, they say that the cost of the unit is one thing and then the cost of the training and then the salaries for the personnel to be managing it is something completely different, and then the rest of the systems.*' - 3.71.

As explained in this chapter, trainings, salaries and management costs are essential dimensions of using law enforcement technologies which are not easily covered by short-term grants.

Hackathon are also a format that conservation funders have encouraged to help generate new ideas and products to support conservation work. Hackathon organisers usually gather in the same room people with relevant expertise for a few hours or a few days. Participants are

[89] 3.60

encouraged to work on a brief or 'challenge statement' detailing the specific problem to address. In 2019, the United States Agency for International Development (USAID) for instance encouraged the participants to its Zoohackathon Philippines to either 'create educational and interactive digital content and tools that will encourage the public to learn more about highly endangered and trafficked species' or to 'develop a technology-based solution to help rangers receive messages […] that alert them to threats of wildlife poaching and trafficking.'[90] A prize or support to develop their idea into a marketable product is sometimes offered to participants with the proposal judged most convincing and advanced. The rest of the contestants take part out of pocket. The question remains of whether this sum is sufficient to cover the cost of further work on their prototypes, invest time liaising with potential customers and providing those with maintenance support. Again, only select perspectives will be included: that of those invited to these events as experts to frame conservation issues and that of those who can afford to travel to these competitions to code and design for no or limited pay.

The issues that can emerge from such innovation and diffusion models are well illustrated by an exchange I had with technical advisor working for an NGO developing a protected area surveillance technology:

'**Interviewee***: Well the first thing was finding out why the system wasn't being used and what was wrong with it?*

Interviewer*: Oh, it wasn't being used?*

Interviewee*: Well, why people had said that we can't keep using the system because it is taking up too much of our time to maintain it and stuff* '- 3.16

In this instance, the system had therefore been set aside by its intended users. I had a similar conversation with a monitoring and evaluation officer at a provincial branch of the Indonesian Natural Resources Conservation Agency (BKSDA):

'*At that time [a large international NGO] helped train us and adapt the application to our needs in the field but they set up the application and then they left [...] after that we needed to manage it but with our limited IT knowledge and how busy we are, it was hard to administer that application.*'- 3.46

The system was then left unused until another NGO partnered with the institution and supported another phase of implementation. These conversations speak to the pitfalls of a technology diffusion model that rests on short-term funding and follows a pattern of deploying i.e. introducing

[90] US State Department and USAID. Zoohackathon Philippines. Retrieved from: http://zoohackathon.com/philippines/ [Last Accessed: 16/06/2020]

a fully developed new tool rather than integrating it by focusing on the specific people who will use it, their existing norms and practices.

Conclusions

An examination of the human infrastructure supporting technology for conservation confirms that technology has too often been presented as a quick and easy solution to conservation issues, in particular illegal logging and poaching problems. 'Solution' is indeed the word practitioners in the technology industry often use to describe their products. Yet, this term of solution and the hopes of speed and efficiency associated with it obscure the human infrastructure essential to the set-up, use and maintenance of these products. These applications imply changes in the job descriptions of conservation practitioners. But, as Sambasivan and Smyth write (2010) 'we only become aware of infrastructures when they break down.' Indeed, where time, resources and capacity are not available and dedicated to implementing them, the new tools are soon left aside or ignored. One thing is for sure, technology adoption on conservation projects is not something that begins and ends with a frantic caffeine-fuelled weekend of hackathon coding.

This examination of the human infrastructure behind technologies for conservation related to the broader question of the relationship between technologies and the government of conservation in two ways. Indeed, this chapter shows that there are specific practices, professional identities and know-how associated with the use of new technologies. Some conservationists providing technical assistance to conservation projects are now specialising in software set up, training and technological support. Protected areas field staff are expected to be confident users of GPS units and computer software. Systematically collecting and inputting data as well as using this information to document the state of the area under their responsibility has become integral to their job description. These practices, identities and skills eventually aim at documenting, constraining and guiding the interactions between people and their environment within officially conserved areas. Indeed, the information aggregated through surveillance systems is meant to guide wildlife authorities in their engagement with local communities and strategy towards those who break environmental regulations. Secondly, through the expectations of developers and the work needed to operate these systems, it is the actions of conservation practitioners themselves which are governed i.e. directed and constrained. In the next chapter, I explore this dimension further by focusing on how law enforcement technologies are used to evaluate the performance of rangers.

Chapter 7: Systematised data collection in protected areas: supporting or surveilling field conservation staff?

Figure 9 : A ranger manually inputting data in the SMART software.

A khaki-clad forest police officer sits in front of a laptop in a small, AC-cooled office at a protected area in North Sumatra (Figure 9). He opens a file of GPS coordinates and the SMART data management software which takes a few minutes to load. The officer enters his name and that of his colleague he went on a patrol with the week before. They set off to identify areas prone to supporting herbivores and found deer snares to remove. The officer then proceeds to deciphering the hand-written notes he took during the outing and entering the information and their location in the software. As he annotates the location points with names of plants favoured by deer and boar as well as indications of paw prints, a red track appears on the screen highlighting their itinerary and all the stops they made, time stamps included. This procedure has become a key aspect of daily work in protected areas as conservation projects transition from pen, paper and Excel records to comprehensive digital information collection and record keeping. Sequences of tasks of this kind are now performed in conserved areas the world over.

Research has shown how profoundly various economic sectors have been affected by the increased production and reliance on digital data, in terms of productivity, changing nature of work and last but not least, the surveillance of employees (Zubroff, 1988; Adler, 1992; Brynjolfsson and McAfee, 2016; Ojanperä, O'Clery and Graham, 2018). Yet, few have investigated the impact of such systems on conservation projects as a place of work. In the last chapter, I showed that law

enforcement technologies are inseparable from work routines. In this chapter, I argue that these technologies, in particular SMART, also allow unprecedented oversight over the work of on-the-ground protected area staff. As such, they are a tool of government to influence the conduct of conservation agents, make their work more visible, reflects the expectations held towards rangers and encourage them to conform to these identities. I contend that with such uses of conservation technologies comes a risks of alienating employees on the ground.

I start by highlighting that SMART and similar technologies collect information about staff performance as well as about natural features and threats to local fauna and flora. I explain that there is a gap between the identities of rangers as imagined by proponents of the system and what they believe represents effective conservation work. I show how the software is sometimes mobilised to encourage such valued professional conducts. Finally, I demonstrate that this increased oversight can lead to resistance on the part of on-the-ground staff which is counter-productive for conservation action.

SMART, a human resources management tool

What information does SMART contain and what is it used for? Going back to the vignette opening this chapter, the ranger made notes about and input three kinds of information into the software: observations of plants and animal spoor, encounters with snares but also details of the patrol and members of staff involved. Because of this, SMART is also often used as a staff management tool for a decentralised and mobile workforce.[91] Indeed, qualitative interviews and promotional materials confirm that SMART can facilitate record keeping, historical comparisons and reporting on three issues: wildlife, illegal activities and conservation effort.

Wildlife is at the heart of protected area's mission and can be the target of illegal activities, it is therefore crucial to keep track of it. Interviewees were quite clear that information collected during patrols is not of the same standard as scientist-led ecological surveys. Yet, as patrols are usually more frequent and less costly than surveys, they have been found a good way to get an idea of wildlife presence and movements in protected areas. The SMART database categories as adapted by the Indonesian government for use across the country includes items such as tracks, animals met face to face, carcasses, invasive species and plants. Ecological survey results such as orang-utan nests or bird counts can also be entered into SMART (Kholis *et al.*, 2017; 25-30). Rangers are mindful of any spoor encountered and as detailed in Chapter 6, they will often have

[91] See interviews 3.01, 3.4, 3.11, 3.14, 3.15

been trained on standard ways to record these observations. They are instructed to note down species, number, size and age of the tracks, potential uses of plants etc.

SMART can be used to gauge the severity and distribution of illegal activities. This functionality is largely documented. A number of conservation science studies have looked at the implementation of SMART, or similar software that preceded it, focusing on the data generated through the tool to estimate illegal activities and the most efficient course of action to tackle these. Risdianto et al. (2016) have for instance studied the seasonal evolution of poaching and its link to enforcement efforts. Others (Jachmann, 2008a; Hötte *et al.*, 2016a) have measured the system's effectiveness in supporting the recovery of key species. Finally, Critchlow et al. (2017) devised ways to use this information to plan patrols that will detect more illegal activities. Using SMART data to plot the areas that rangers will be sent to work in does not only impact poachers' activities and habits, it brings SMART into the realm of staff management. Yet, these papers only touch upon limited aspects of what the SMART system can do, namely support the reduction of illegal activities that affect wildlife. Its last function, the surveillance and evaluation of rangers' work, has not been thoroughly discussed in the literature. Existing reports use the term 'monitoring' and present this activity as a way to motivate rangers through feedback (Stokes, 2010; Spira, Kirkby and Plumptre, 2019). This chapter aims to nuance this argument.

SMART can indeed also be used as a human management tool due to the geographical and individual data it can compile. The first step when recording information collected on patrol is to input the names of the team members and leader involved, the mode of transportation they used, whether they were armed as well as the aims of the patrol in question (Sadikin *et al.*, 2016). As the teams have travelled the protected area with a GPS, a track of their itinerary, its length and the amount of time they took to complete it is available on record. The location and duration of any breaks taken, overnight camps and whether the team has split in two or more groups following different routes can also be registered. This information combined with the wildlife and illegal activities categories enables the software to calculate metrics and ratios such as the number of kilometres travelled by a team during a patrol or over a month or the number of snares detected per kilometres travelled. The SMART Profile add-on released in 2018 has provided a further opportunity to compile information about protected areas employees as explained by an NGO representative:

'*Then you fill this profile. It's a bit like a Facebook profile almost. You can have it for whatever you want and use it for whatever case that you want. You have that and then you attach records to it, and then you can link entities to each other. For instance, you can use it as a human resource tool. We use it for our patrollers, so each patroller*

has its own entity. Then we have records of commendation, or a disciplinary action could be attached to the profile like that […] If you want to know, essentially, just generate a guy's CV based on either the number of training events he's been on or led or the number of operations he's been on or led, then you can do that on a touch of a button.' – Interview 3.71

This quote reveals that there is on-going appetite for further digitisation and centralisation of rangers' personal data. Although these functionalities have not been much documented in peer-reviewed research, the promoters of the system do not seek to hide them. For instance, Figure 10, an abstract of a brochure edited by the SMART partnership for protected areas managers, is clear about the fact that the data collected through this system can be used to evaluate rangers' work.

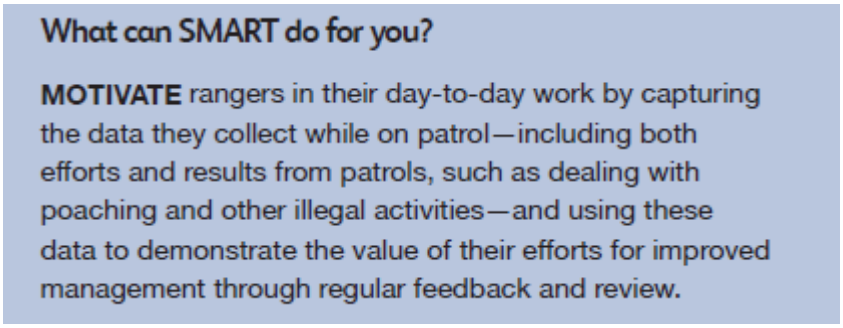

Figure 10: Capture of the SMART Partnership Brochure 'Get the SMART solution for your protected area'

Staff surveillance therefore is not a function creep whereby SMART would be used for something completely different than its intended purpose. This was part of the developers' thinking from the onset. That being said, SMART is not the only conservation technology that offers staff surveillance functionalities. The Indonesian government's own mobile phone application for GAKKUM, the wildlife police outside of protected areas offers similar options. This application called 'On Duty' has equivalent capabilities according to a civil servant working in this division:

'*On Duty is our application to detect and supervise our team who carry out tasks. We have an assignment '[…] please go there' something like that. And then we can monitor where they have gone*' -3.66

The application therefore enables supervisors to communicate with field teams in real-time and check whether they have completed their assignments.

In short, this section shows that there is yet another reasons to characterise law enforcement technologies as tools of government turned on those responsible for conservation in that they make certain aspects of the work of rangers visible. Next I explore why these particular aspects of rangers' work are in the spotlight and I analyse the role of staff surveillance functions in this context.

Good ranger v. bad ranger: two largely imagined identities

The interest in embedding employee surveillance in conservation technologies and making specific aspects of field's staff work more visible stems from concerns, real or imagined, regarding their integrity and work ethics. Related to this are more or less implicit norms surrounding rangers' behaviours and what is expected of them i.e. identities in the Foucauldian sense.

Interviews with employees of large international NGOs and Indonesian forest administration officials revealed a persisting concern with ensuring rangers did the work they were paid to do and highlighted how challenging this was over the vast distances protected areas usually encompass. The protected area mentioned in the introduction to this chapter for instance spreads over almost 73.000 hectares and is administered from a central office with three sub offices located between 30 minutes and hour-drive away.[92] The area's official boundary is an hour and a half away from the headquarters on winding mountain roads susceptible to landslide destruction in the rainy season. This is not an exception. In Indonesia and elsewhere, protected areas can be as large as small countries and in many cases have very little transport and communication infrastructure due to their protected status. UNESCO World Heritage Site Lorentz National Park in the Indonesia province of Papua is almost the size of Belgium for example. As a result, field agents are often away from the central office and high-level supervisors. They are also expected to be mobile and gather up-to-date information on the state of the area. This presents a challenge in terms of supervision despite many national park services' being modelled on police or military structures which have top-down hierarchical organisation (Lunstrum, 2015; Mabele, 2017; Pennaz, 2017; Dutta, 2020).[93]

In this context, interviewees expressed concerns about the work ethic and productivity of field staff. The figure of the 'coffee shop forester' and the idea that many rangers are not doing as much as they should was brought up by a number of interviewees working in Indonesia and other Global South countries.[94] A representative of a bilateral donor agency for instance rejoiced over email that *'through the GPS tracks the manager can also monitor if the patrols have been out in the field (knowing that in the past there have been cases of so called 'coffee shop foresters ;)'! who filled out their inventory sheets in the coffee shops).*' – 3.61. Moreto (2016: 650) identified similar perceptions amongst supervisors at the Queen Elizabeth National Park in Uganda: some were anxious that rangers were not performing duties

[92] Indonesian Ministry of Environment and Forestry - General Directorate for the conservation of natural resources and ecosystems (2017) *Statistics report*
[93] See also 3.15
[94] Interview 3.61, 3.06 3.09, 3.11, 3.01, 3.04

and going to the field. An NGO employee I interviewed regretted the apathy of protected area authorities more generally:

'*You know in some places the governments don't really want to change or individual park managers don't really want to change, they want a... they just want to do what they were doing before which is... which is not much […] And so in some cases there has been resistance to SMART. There's been resistance to introducing it, people say it's too much work or it's extra work or they want to get paid extra money, they don't want to be forced to... So that's happened in some cases.*' – Interview 3.09

While this perception of protected area staff, and rangers in particular, as work avoiders may be informed by lived incidents, it also has colonial undertones. This narrative is reminiscent of the assumptions that colonised populations were indolent or lazy. Such assumptions that have been pulled apart and critiqued in the late 1970s by Syed Hussein Alatas (1977). Hussein Alatas explains that the notion that South East Asian populations were lazy was cultivated by colonial powers and served to justify forced and exploitative labour practices. Similarly, regardless of its veracity, the idea that some rangers are work-shy is used to justify increased oversight and additional demands.

Negative stereotypes also surround the status of civil servants which rangers qualify as in Indonesia. Contacts working in the conservation administration pointed out that the civil service status provided perverse incentives. Forest officers (*polisi hutan*) are recruited through a test which most people apply to as they graduate from school or university. If they pass, they become civil servants. Because of this, little disciplining actions are available to sanction ranger units directed by protected area authorities. Staff are paid a living wage whatever their degree of industriousness and cannot be fired from this corps except if they break the law. Their wages can only be reduced if they are regularly absent from the office without justification. In the words of a protected area supervisor:

'*They only have the general regulations for direction. If they want to become a specialist in something it is up to their own personal choice. But because of the comfortable circumstances in government offices, I mean a fixed wage, no one gets fired, they are guaranteed a pension, most people just work a standard minimum and receive everything [...] There is no differentiation between how hard you work. The people who work harder don't get a bigger remuneration.*' -3.30 part 1

This interviewee lamented the lack of monetary incentives for his staff to go above and beyond despite the existence of a rank and promotion system whereby civil servants can apply for advancement on the basis of their achievements. Additionally, few penalties are applicable if employees are not up to date in their professional development trainings and only a limited number

of tasks are considered mandatory job requirements.[95] Explaining why the number of employees reporting to the Conservation of Natural Resources and Ecosystems Direction has been declining since 2014, an Environment Ministry official told me:

'Because some are retired and there is a zero growth policy for government officers in the Government of Indonesia. Because so far many employees may actually not have the qualifications to work well enough. So it must be cleaned up first, then we will recruit new ones later.' - 3.62 part 1 p.2

Judgements on the productivity and capacity of Indonesian civil servants therefore add to narratives around ranger's willingness to work. These two discourses produce a vision of a 'bad ranger' and of attitudes and practices which are undesirable and ineffective.

Figure 11: A ranger working 'in the field':

An ideal of a 'good ranger' can be discerned in contrast to the 'bad' coffee shop ranger. These two contrasting identities emerge from the materials analysed with the idea of a 'good ranger' implying one who is present in the field as depicted on Figure 11. Such a ranger regularly, thoroughly and strategically patrols the area he is affected to, reports information and acts swiftly. Indeed,

[95]Interview 3.30 part 2 p.6-8, off the record conversations, notebook p.116, 151 and 237

increased and frequent patrol effort is seen as an important element of a law enforcement-focused approach to curbing the illegal wildlife trade which has been adopted by some national park services and large international NGOs involved in wildlife and protected area management (Linkie *et al.*, 2015; Duangchantrasiri *et al.*, 2016; Risdianto *et al.*, 2016). Yet, Leverington et al. (2010) observed that only 40% of the over 3,000 protected areas worldwide they assessed showed 'significant deficiency across many management effectiveness indicators.' Amongst the indicators commented on by the authors, some relate to law enforcement capacity and whether the rules of the protected area can be enforced well enough. SMART can provide managers with the tracks of their staff's itinerary, the times they put in, the number of kilometres they travelled. Because of this, this system and similar application are considered as a direct or indirect solution to remedy some of these management shortcomings. These technologies are marketed as a way to effectively supervise a scattered workforce and to provide 'accountability'[96] on the management of parks i.e. evidence for costs incurred and return on investment.

Beyond perceptions of laziness, there are risks associated with a mobile and decentralised workforce conducting law enforcement which may justify increased oversight. The first one is the risk of corruption. Field conservation staff sometimes collude with poachers, turning a blind eye to their activities, accepting bribes to facilitate their hunt by sharing the itinerary of planned patrols as well as putting in touch poachers and potential clients or killing wildlife and transporting products themselves (Moreto, Brunson and Braga, 2015; Van Uhm and Moreto, 2018; Wyatt *et al.*, 2018). The second risk is safety. Without communications and localisations technologies it is difficult to send help to lone workers who have had accidents or have run into a dangerous situation. Indeed, the Thin Green Line Foundation and International Ranger Federation have reported that 107 rangers died at work between July 2017 and 2018 (Belecky, Singh and Moreto, 2018). In the face of these risks, real time positioning systems can help localise and keep in contact with rangers on patrol as well as send reinforcements if need be. SMART which helps analyse time and geographical data after patrols have taken place can help give feedback to rangers on ways to keep themselves safe as explained by a protected area management consultant I interviewed:

'*We could see where the guys had been and sometimes…I'll give you an actual example, the guys went to camp along the river, which of course is super easy, they have access to water right away but in the river bed, with their little campfire they were super visible from all the poachers who could cross the river during the night. Whereas one kilometre away there's a little hill overlooking the river where the guys could have camped and set up an observation post for the night and there they could have seen any torch, any campfire a few kilometres away from the river bed*

[96] Interview 3.01

[…] So that's a concrete example, we would tell the guys 'you shouldn't camp in the river bed, you're much too visible' – 3.11

Implied in this citation is the idea that the use of geo-localised data collected through SMART can help make rangers safer and more effective.

I have now established the expectations of active patrolling, field work and accurate documentation surrounding rangers' behaviours. This allows me to turn to the role of technology in encouraging compliance with these norms.

The making of a 'good ranger' through technology

Through and alongside the SMART technology, there are several techniques that park managers and NGO operators use to direct and improve rangers' conduct in line with this vision of their identity i.e. the idea of what 'a good ranger' is. This can be done indirectly, through encouraging field staff to use the tool, and directly, through setting targets based on the information collected on past patrols.

SMART or similar data collection and management systems can be an indirect tool to push rangers to conform to the norm of active, on-the-ground presence and therefore manifest identities expected of them. Indeed, the use of SMART implies managers expect geo-localised data from the area under their responsibility to be available and feature in reports. Forest officers have to actually leave their office and collect this data. This implies many do not leave the office, or not enough in the eyes of the national hierarchy.[97] This incentive to leave the office is being fully capitalised on by the Indonesian protected areas management authorities with the adoption of a new governance principle called 'resort-based management' (RBM), hailed as a component of a 'new paradigm for conservation area management.' This catch phrase amounts to encouraging staff closest to the field to be active and responsive on the ground[98] 'in order to restore back the spirit and 'marwah' (dignity) of the forest management authority' as the general director of the government department responsible for the conservation of natural resources and ecosystems puts it.[99] In November 2018, an official letter was issued by the central administration making it mandatory for conservation areas to adopt information management systems, in particular

[97] Interview 3.08

[98] Ministry of Environment and Forestry (2018) *The State of Indonesia's Forests*
Interview 3.46

[99] Wiratno (2019) *The Ten (New) Ways* p.15 & 19

SMART if they are not already using another tool, in the context of RBM.[100] The stated aim is to produce and make available regular, systematic and accurate information about local sites.

In the Sumatran protected area mentioned above, analogue bureaucratic incentives are in place to ensure the software is used and tasks are conducted up to a standard. Foresters are assigned to specific tasks through letters of activities signed by their superior. These letters authorise the spending of budget on the task and specify the order of mission. Monetary incentives also come into play with the pay for some activities handed out in two times: 70 to 80% first and the rest once the data concerning the activity has been entered into SMART and a report written. Since 2014, Indonesian rangers also have to send a portfolio evidencing their activities for the last year or two in order to gain points and apply for promotion. Once they have reached 500 points, they will progress through the ranks and access a higher status and pay grade. Performing data analysis such as allowed by SMART, writing reports, creating maps and training others is worth more points than going on patrol which is considered one of the basic job requirements.[101] This is a further incentive for local staff to become familiar with the software and actively make use of it. SMART data can also be used as evidence in the portfolio (Kholis *et al.*, 2016: 13).

SMART and similar tools can also more directly be used to direct on-the-ground employee's work and encourage certain conducts that conform with desired identities. The chairman of the international conservation NGOs coalition that supports the development and spread of SMART remarked during a World Bank-organised webinar[102] that the tool could help evaluate the performance of protected areas as whole, individual rangers' teams and down to individual rangers. Indeed, in many countries including Indonesia, central authorities ask the protected areas to frequently relay certain detailed information and metrics collated through digital platforms to assess how well they are doing.[103] This is the way in which an official from the Indonesian General Direction for the Conservation of Natural Resources and Ecosystems described the benefits of their digitalised central data collection system, SIDAK which can include information collected through SMART:

'*We are able to know. That's it. Actually, seeing the profile of the conservation area within SIDAK is good enough. For example, Laura saw earlier, look at the data in [this protected area]. And there is empty data in the middle.*

[100]General Directorate for the Conservation of Natural Resources and Ecosystems, Ministry of the Environment and Forestry (2018) Surat Edaran S.14/KSDAE/KK/KSA.1/11/2018.

[101] Conversation about the List of Proposed Credit Points (*Daftar Usulan Penetapan Angka Kredit DUPAK*) with interviewees 3.30 and 3.32 notebook p151 + 3.62 part 2

[102] World Bank Global Wildlife Program. *Using SMART at scale for effective wildlife protection* webinar. 22/05/2019

[103] See also 3.09, 3.14, 3.24 and World Bank Global Wildlife Progam Webinar 'SMART Improving the effectiveness of protected areas globally' on 22/05/2019

So then we can quickly find out that, "They don't have a group design system to carry out patrols." They don't have an annual patrol visit. They only make incidental patrols, without being properly planned. We can see that from the data.' -3.62 part 2 p. 25

The interviewee referred to a map of a site which we had just looked at where we could see that patrols had not thoroughly and regularly crisscrossed the territory of the protected area in question. This was a failure in his opinion and would have to be brought up with local supervisors. Patrol data can therefore serve to detect and call out unsatisfactory work at a macro level.

At a local level, the number of days on patrol or distance covered have in some cases been used to evaluate individual rangers' performance and push for longer, further reaching excursions with a broader coverage. The assumption is that distance, frequency and reach of patrols are indicative of their quality which an INGO interviewee described in the following way:

'*Yes, so patrol quality. So in the time that the inspectors are out there, walking or driving, conducting patrols, they are encountering more signs of illegal activity, they're encountering poachers more often and so for the time that they are putting out there, they are getting better results so that's the quality*.' – 3.09

In order to reach this aim, several incentives, feedback and disciplining mechanisms are used to increase the patrol effort in the first place. Protected area technical advisors[104] told me they drew on SMART indicators such as the number of days in the field or the number of arrests per team to reward hard-working rangers with prizes or to spark competition between patrolling teams. Itinerary tracks are used to ensure rangers are covering most of the protected area at one point or another regardless of how difficult the terrain is. An Indonesian national park ranger explained at one of the research sites this process:

'*In terms of the targets, if the national park is carrying out the patrol task, there is no clear target. If the partner NGO is in charge, we must do so many kilometres. There is a track, there is a grid.*' -3.47[105]

The geographical and individualised information available through SMART brings within reach an unprecedented degree of hierarchical oversight and targeted management to conservation sites. The way the SMART information is mobilised in some cases encourages a specific set of behaviours, namely meticulous data input and patrolling throughout the protected areas. Some protected areas have long had a paramilitary working culture with strong lines of commands and

[104] Interviews 3.11, 3.15

[105] Although the practices of comparing and creating competition between patrol teams as well as setting quantitative targets were discussed in interviews 3.11 and 3.15, and in 3.47 in the Indonesian context, interview 3.33 suggested that it was not used in the main research site in Sumatra.

hierarchical structure but contrary to other workplaces (Ball, 2010, 89) conservation areas do not have a long tradition of close, direct employee surveillance (Sherblom, Keränen and Withers, 2002) and concerns that employees are avoiding their duties remain. This shift towards increased surveillance has been met with mixed reactions.

Mixed reactions to increased oversight and unintended consequences

SMART is marketed in part as a tool to motivate rangers (SMART Partnership, n.d.; Stokes 2010). The promotion brochures available on the SMART website boast that because the data collected demonstrates the value of rangers' work and enables regular feedback and review, it will encourage them in their tasks. However, rangers' long-term reactions to the tool vary according to the site of implementation and the management techniques the tool is associated with in practice. In several locations, the system has encountered resistance. Rangers have not conformed with the aspirations regarding their attributes and duties i.e. their identities in the Foucauldian form. This resistance is linked by interviewees to the unwillingness to be closely monitored:

'*I mean probably the most common pushback that you receive is from rangers on the ground who feel like this system is being put in place to track them and whatever spy on them. Which in reality it is. But one person calling it spying is another person calling it managing them.*' - 3.04 [106]

To express their resistance, rangers have developed a range of bypass strategies such as intermittently turning off the GPS devices tracking their route, forgetting to charge or misplacing GPS devices or not collecting information thoroughly.[107] A law enforcement consultant I interviewed who has worked in a number of sites describes this process:

'***Interviewer**: Yes, and so what happens when they don't like it? **Interviewee**: Well, it depends, either they just don't use it or... I think that's pretty much the biggest thing, they just won't use it if they don't like it. If it's too technologically difficult, if they see it ... There's also plenty of ways to use the system and just not collect valid data right? You could find a carcass on patrol but if you don't put it in your system then it didn't exist, right? So that's the other ways, you can keep it on and show where you've patrolled but you can also very easily not include data, if you want.*' - 3.06

The strategies the interviewee described coincide with observations recorded in research on workplace surveillance in other contexts. This research has found that continuous surveillance tends to be considered less acceptable by employees than intermittent monitoring (Aiello and Svec,

[106] See also interviews 3.08, 3.11, 3.15.

[107] See interviews 3.04, 3.06, 3.11, 3.24 as well as Warchol & Kapla (2012) p.96

1993; Stanton, 2000). Elsewhere work surveillance has been shown to create mistrust between employees and management (Westin, 1992; Johnson *et al.*, 2014) and lead to resistance, either through open confrontation (Sprague, 2007) or more mundane rule-bending and avoidance practices (Bain and Taylor, 2000; Fleming and Sewell, 2002; Sobreperez, Ferneley and Wilson, 2005; Clawson and Clawson, 2017). Putting emphasis on a limited set of quantitative targets to direct the work of rangers can also provoke counterproductive effects. For instance, encouraging more substantial patrols through pushing for a higher number of kilometres walked or travelled can be in opposition to the end goal of decreasing illicit activities in the area. This metric can be easily subverted as a protected area consultant found out:

' This was an example of something that was quite funny : we realised that when we told the guys – because you could see that some of them were really not walking a lot – and so when there was a bit of a competition on the amount of kilometres, we realised that you had teams that were walking like crazy but actually their only aim was to say 'we're going to walk as many kilometres as possible' and they didn't take the time of looking for illegal activities anymore and so you had an increase of the number of kilometres walked but also at the same time, a real decrease of the number of illegal activities detected' – 3.11

The end result of this strategy to push for longer patrols was in direct opposition to the idea of collecting accurate and timely analysis to support anti-poaching or other law enforcement planning. When it comes to numbers of infractions and incidents detected, what do users of the SMART software anticipate is evidence of good work? It turns out some users are worried about the consequences of reporting the true extent of threats to wildlife in their area for their career, the reputation of the protected area or the budget they have allocated. This leads some to under-report the number of incidents taking place in their area. This is what an INGO representative working in South East Asia noted:

'Some parks do not record all of the data because they are afraid of getting told off by the director or because the director doesn't want to have issues' – 3.24

This under-reporting also goes against the aim of transparency and increased visibility promoted by SMART's proponents.

In other places, SMART indeed has had the advertised motivating effect on rangers. This increased motivation has been linked by conservation NGOs staff interviewed to a sense of pride and a feeling that records and visualisations of their efforts reassured protected area field staff that their job mattered despite their hard working conditions and limited employment benefits as

highlighted in the SMART advertising brochure and by several NGO interviewees.[108] This is reminiscent of the Hawthorne effect uncovered by Mayo and colleagues (1946) during experiments at the Western Electric company where they found that observing workers could make them more productive as they felt valued. More recent studies have also noted heightened productivity in highly skilled workers following monitoring as they saw it as a way to prove their value to the organisation (Aiello and Kolb, 1995; Tomczak, Lanzo and Aguinis, 2017).

The data compiled through SMART could also directly empower rangers, providing them with information to adapt their work and negotiate with their hierarchy. This is also a potential benefit highlighted by professionals involved in the system's promotion such as this INGO employee I interviewed:[109]

'*If your message is "we are not trying to monitor you, we are giving you the information that can help you to defend you own patrol". So for example if poaching happens, the first thing park management says is "oh you guys will go on patrol" and the rangers have no evidence that actually they have been on patrol. With the help of SMART, they can show evidence: "yes we were on patrol and, yes poaching happened but we were out on patrol". So if you sell it in that way that you know... Let's say the park manager likes one person and he gives him a promotion, he gives him incentive but doesn't give to other because he says that this person is doing good. The other ranger doesn't have evidence to say that he has done the equal amount of patrols and even more patrols. Now with the help of SMART it's all very transparent, it brings the accountability to everybody.*' 3.08

In contentious cases, the location data could therefore serve to absolve ranger teams of being involved in poaching incidents. SMART data could also be used by rangers to evidence the issues they face should they ask their management for more resources or to demonstrate their efforts to claim advancement. Although the benefits described by this interviewee are hopeful and speculative, they suppose that rangers do have bargaining power with their superiors and are likely to speak up. This is not necessarily the case. However, rangers have also found ways to co-opt the software and make the tool work for them in ways that were perhaps unanticipated by its developers. Rangers and data administration interviewees expressed appreciation for some of the tools functions such as how easy it is to use outdoors compared to previous systems, how comprehensive the application is and the usefulness of having spatial data easily accessible to follow up on incidents in the field.[110] One for instance rejoiced that the data collated in SMART can provide useful information in planning field outings as it is a record of what effort and time

[108] SMART Partnership (n.d) Get the SMART Solution for your protected area
[109] See also interview 3.06
[110] This topic comes up in interviews 3.32, 3.07, 3.46, 3.35

was needed to reach specific places as well as keep locations that were suitable for breaks on record.[111]

There are indications that rangers make judgement calls and demonstrate flexibility in both their enforcement of protected area regulations, in recording violations to these rules and in their approach of local residents who may be at fault. To understand this, it is important to remember that rangers constantly interact and have close links with people living on the edge of the protected areas I researched. This is especially the case at one of the research sites where rangers are themselves based in rural areas where communities are small and tightknit. In the course of my research I have for instance accompanied protected area staff on courtesy visits to houses and farms of residents who are supportive of their work and occasionally participate in field tasks or encountered protected area employees at weddings hosted by relations of my host family.

The interdependency of protected area staff and local communities was also reflected in interviews at this site. Employees shared how aware they are of the fact that intractable issues such as land clearing by small holders within the protected area are driven by contestation of the area's boundaries, unemployment and lack of other options for livelihood and subsistence. As a result, they declared adopting a cautious and light touch approach to enforcing the regulations of the area focusing on mitigation, opening dialogue, providing aid to villages, monitoring whether new plots are cleared rather than issuing sanctions or destroying existing plots.[112]

At this research site, I encountered one example in which this cautious and diplomatic approach is reflected in rangers' data collection and reporting through technologies like SMART. Rangers did use the software to record wildlife sightings and traces of illegal incidents encountered in forest patrols as the database was initially designed for. As community outreach is a central aspect of their work, they included related information in the SMART data as well. This allowed them to input into the database and assorted narrative reports, the dates and details of their visits to specific villages in order to keep in contact with villagers, hear their concerns, gather information, socialise protected area rules and policies and provide agricultural development or small scale infrastructure support.[113] This shows how versatile the SMART software, initially developed with law enforcement patrols in mind, can be as it can be co-opted by on-the ground conservation staff to support their own approach.

[111] 3.42, in notebook pp.112-118

[112] This was discussed in interviews 3.30, 3.31, 3.33, 3.35, 3.40

[113] 3.38, 3.35, 3.33

When it comes to the increased surveillance of rangers and their work presented above, it is difficult to identify definitive causal links between different management styles and reactions to new surveillance tools without conducting in-depth comparative studies. However, my interviews with people hired by international conservation NGOs to support the development of SMART or its implementation in a range of countries as well as existing research on employee surveillance can help highlight relevant trends. Interviewees and workplace surveillance literature indeed suggest that resistance or enthusiasm for this type of work monitoring can indeed be linked to the degree of feedback and support that accompany its deployment. Sintov et al. (2018) have looked at ranger's willingness to adopt the Protection Assistant for Wildlife Security (PAWS), a tool that uses data such as that collected in SMART to automatically generate patrol routes. They concluded that educational interventions about the technology before its implementation could increase the perceived usefulness of the tool and intention to adopt it.

In a broader review of studies on employee monitoring technologies, Tomczak et al. (2017) have remarked that surveillance systems are less likely to encounter opposition if management is transparent about its existence and about the use of data collected. Attitudes towards technology-mediated surveillance are indeed linked to the type of management policies associated with it, encountering better results when it is used as a starting-point for training and skills development rather than sanction (Zubroff, 1988; Amick and Smith, 1992; Alder and Ambrose, 2005). The degree to which the data collected accurately represents their tasks (Grant, Higgins and Irving, 1988; Evans and Kitchin, 2018) and comes to bear on promotion or management and human resources decisions could also be a determining factor in employees' satisfaction with the tool. This has been the experience of an INGO employee who has seen an increased appreciation for SMART in the area where he works after coordinating more communication and feedback around the tool:

'*We have seen that anywhere that we are recording and feeding back to them either patrol plans or just any kind of data, the next batch of data that comes in is higher quality. Some of these places have just started doing monthly meetings and that will really... What the rangers used to do was they used to go on their patrols, give the information to head office and never hear anything back from it. Now that we are doing these monthly meetings […] it gives the rangers an opportunity to present their work to the chief, to the NGOs and to whoever else is there, maybe some people from the regional office, and that incidentally helps build a bit of pride in their work as well and we found that as a positive feedback of having all this data in one place, in SMART, is being able to show their work, they are able to showcase their work a little bit better than they were if they had just gone on patrol and took a few photos.'* - 3.24 INGO Employee

Additional in-depth comparative research would be desirable to explore the relevance of these explanations to the conservation sector but my material shows how double-edged the implementation of SMART as a staff surveillance technology can be depending on the government practices that accompany it.

Conclusions

In this chapter, I have drawn on insights from governmentality and broader research on surveillance in workplaces to show that ranger-based data collection tools are in effect also staff surveillance technologies used to encourage rangers to conform to imagined identities. These technologies can be used to collect individualised and geo-localised data. Because of this, they can be used to evaluate and direct local conservation staff and encourage or constrain them to adopt active field-going conducts. As such, these systems are a tool of government in the Foucauldian sense. Conservation law enforcement technologies are indeed one of 'the thousand and one different modalities and possible ways that exist for guiding men, directing their conduct, constraining their action and reaction and so on' (Foucault, 2008: 1-2). 'Men' being wildlife conservation professionals, in particular rangers, in the context of this chapter, with the aim that their conduct will match capacities, attributes and duties expected of them i.e. identities.

The increased surveillance and documentation associated with protected areas data-management systems has led to perverse incentives and mixed reactions. These responses range from refusals to engage with the tool to enthusiastic appreciation for it. As Foucault writes, 'counter conducts' (Foucault, 2009: 194-195, 201) are inseparable from attempts to impose practices and norms. With efforts to impose new practices come a series of conflicts, agreements and concessions between imposers and imposees. Contributions from labour sociology, management research and surveillance studies can help shed a light on why reactions to these tools are so diverse: feedback and transparency around the data collected and its uses as well as the weight of quantitative surveillance data in managerial decisions likely play a role.

In the following chapter, I delve further into the data that law enforcement technologies collect and explore what knowledge they serve to produce. In fact, I mobilise the concepts of knowledge and visibilities from the five-fold Foucauldian framework presented in Chapter 1 to analyse some of the understandings and frames of reference for conservation action that these data inform.

Chapter 8: Surveillance data and frames of reference for conservation law enforcement

I previously examined how the introduction of technologies, in particular geolocation and data collection systems is affecting the day to day tasks and practices of conservation workers. While advertised as a way to automate and simplify the working patterns of conservation agents, these tools require human labour to function and create new tasks. They also affect the practices of on-the-ground conservation workers by enabling their managers to watch and direct them to an unprecedented degree. Rangers seek to evade, make concessions to or fulfil the expectations of their hierarchical superiors to varying degrees. These reactions can be read as practices brought on by data management systems just as much as the button pushing required to make the tools run in the first place. Yet, it is not only the practices of conservation professionals that are affected by such technologies but also their knowledge. In the Foucauldian sense presented in Chapter 1 'knowledge' refers to the frames of reference, understanding and information handling that guide the action of conservation professionals.

In this chapter, I focus on the forms of knowledge that are being produced through the use of some conservation technologies such as data management systems for protected areas and, to a minor extent, camera traps. I argue that the data gathered and parsed though technologies such as SMART are at the same time perpetuating old forms of knowledge and creating new visibilities in the body of expertise that conservation workers rely on to make decisions and act. I show that these new visibilities are in part inspired by criminology and urban policing.

Examining the enmeshing of technologies supporting the government of protected areas and those who use them, I continue to draw on Foucault and his followers' work. I therefore use the term knowledge to refer to the formal expertise and intellectual developments that enable thinking about specific problems, in this case the biodiversity living in designated areas and illegal wildlife harvest, with a view to acting on them. These ways of representing and conceptualising issues shape future action. By exploring the relationship between knowledge, the fourth and last component of government examined in this thesis, and the deployment of law enforcement technologies in protected areas, I complete my inquiry into the relationship between these systems and the ways in which they constrain the actions of those who govern protected areas.

I first explain that knowledge generated with the support of data collection systems breathes new life into and reinforces pre-existing attempts to represent conservation work in a standardised and technical manner. However, digital databases and maps simultaneously represent a turning-point in that they enable the development of a criminological approach to conservation inspired by the analysis of urban crimes. The aim of this body of knowledge, only recently applied to conservation issues, is to better direct human and material resources to tackle illegal activities. This mode of reasoning is extended by forays into real time and predictive applications which bring artificial intelligence into play as a source of conservation expertise. I highlight the limits of these intellectual developments in grasping and explaining the issues they seek to address as well as their shortcomings in supporting on-the-ground staff.

Technologies and the reinforcing of the intellectual logic of technical reporting

Conservation technologies, and geolocation databases in particular, contribute to the production of technical, quantifiable ways of representing and evaluating conservation interventions. They are instrumental in standardising and harmonising representations of human-environment interactions. They help calculate metrics and produce visualisations that tell of the achievements of wildlife protection and law enforcement programmes. As such, these technologies only reinforce previous attempts to present conservation interventions as technical and quantifiable.

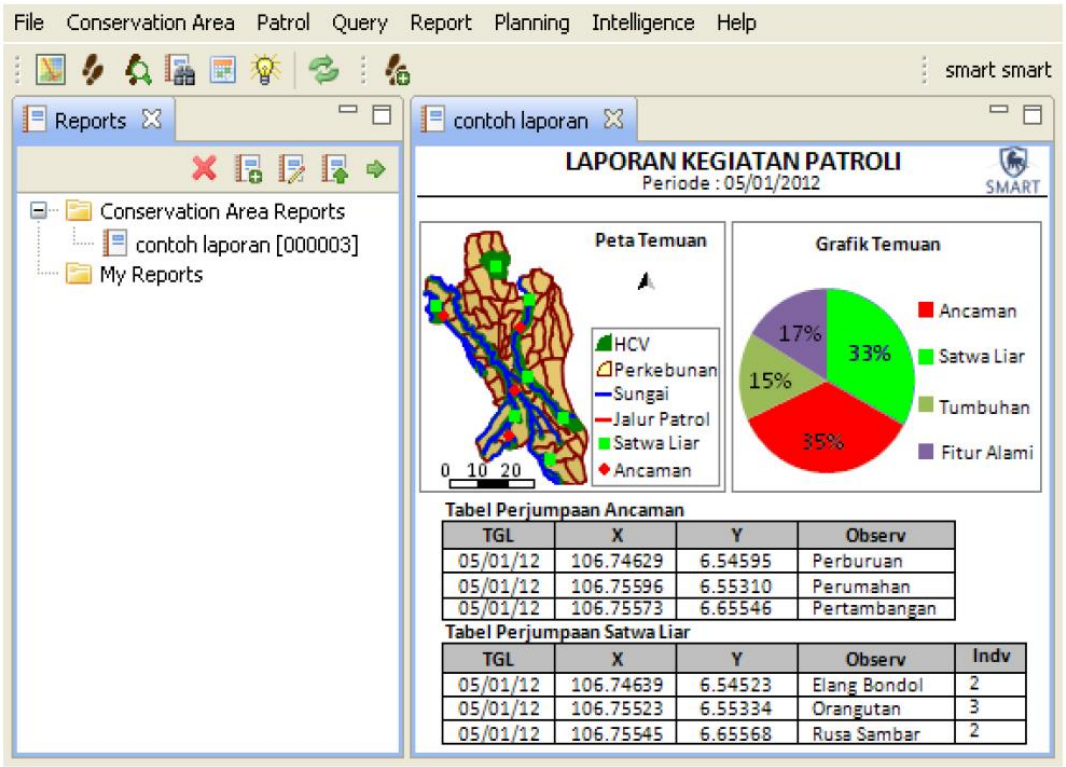

Figure 12: SMART one-day patrol report with a table summarising threats and the other listing fauna encountered. Source: SMART-RBM Buku II: Modul Applikasi. 2016. SMART Working Group Indonesia

In a few clicks, SMART can produce synthetic tables summarising the number of kilometres patrolled, the number of traces of charismatic animals encountered, the number of snares disarmed or of people arrested in a given amount of time. It is just as easy to produce a map of the areas inspected by rangers over a certain period showing where the sightings recorded took place. Figure 12 provides an example of what these diagrams look like. These are handy points of reference to be able to include in reports to protected area managers, national authorities or donors. This is why they are produced and where they end up. Other technologies also provide quantifiable and visual ways to determine whether a conservation initiative has been 'successful.'[114] Satellite imagery and drones for instance can be the basis for calculating and showing deforestation rates. These functionalities are welcomed by conservation practitioners as a way to document their work for those who provided financial backing:

*'**Interviewer**: Coming back to donors then, do they ask for reports on…do they ask for some of the data?* ***Interviewee**: Of course. No they don't ask for the data but they want us to create reports through SMART with the little reporting monitoring routines that had been put in place. We'd send them that to show them how far along we'd come in the system's implementation.'* 3.11 - NGO employee specialised in anti-poaching

[114] 3.59, 3.08

SMART has been equally approved of by donors as a way to receive evidence of the actions they fund. Indeed, a number of development funding agencies such as USAID, USFWS, the World Bank, the German development bank KFW and the EU are listed on the SMART partnership website as associates whose support has been instrumental to the development of this system. An employee of a bilateral donor organisation I interviewed explained that their organisation facilitates national coordination and knowledge sharing around SMART in Indonesia as a way to generate performance indicators which could help parks to access more budget or identify personnel deserving promotion.[115] Another one went as far as to describe it in these glowing terms: '*I think there is in most protected areas where there is budget and NGO support, I see SMART as the new standard.*' (3.61).

'Standard' is a recurring term in the words of interviewees describing the use of SMART and its impact. SMART 'has a standard data capture regime'[116], enables data collection in a 'standardised way.'[117] It is used as a 'standard operational monitoring tool'[118] and enables the production of 'standard reports.'[119] Indeed, setting up applications such as SMART amounts to a process of normalizing the representation of human-environment interactions. One of the first steps in starting to use the application is to label all features that could be encountered in the area and are potentially of interest to the administration and to structure these items in a database. This process is a fine balancing act between capturing local specificities and maintaining a broader relevance to the information. The SMART consortium offers a comprehensive default database which sites, regions or countries adapt to fit their purposes. The SMART training manuals devised by the Indonesian national taskforce illustrate this. The taskforce has devised six slightly different model databases to account for the diversity of environments found in the archipelago: one for Sumatra, Java, Sulawesi, Kalimantan, the Lesser Sunda Islands and Papua (Kholis et al., 2016). They also sought to remove uncertainty in the way natural features, protected area staff activities and people's mark on the landscape are recorded. The taskforce identified which of these phenomena were worthy of notice. They detailed and formalised which related elements should be noted down thereby circumscribing these issues, making some visible and potentially hiding others to protected areas administrators. The training manual also includes pictures to contextualise these abstract categories. The category entitled 'human-wildlife conflict' for instance, as broken down on Figure 13, prompts rangers to report the species and number of animals

[115] 3.26
[116] 3.06
[117] 3.24
[118] 3.15
[119] 3.47

involved. The database's creators restrict the definition of a human-wildlife conflict by listing potential damages as numbers: that of crops destroyed, surface of land cleared, dead or ill livestock, damaged buildings or dead people. While in certain regions, human-animal conflict can amount to noise complaints, the raiding of bins and mauling, Indonesian rangers are tasked with focusing on more dramatic encounters. It is nevertheless possible to add 'additional information', potentially a qualitative description of the incident under the item 'explanation.'

Atribut Dampak Konflik	
Jenis Kerugian	Ternak; Tanaman; Bangunan; Manusia; Satwa Liar
Jenis Satwa	Diisi jenis satwa yang terlibat konflik
Jumlah satwa konflik	Diisi jumlah satwa yang berkonflik
Jumlah kerugian tanaman	Diisi jumlah tanaman yang rusak
Jumlah kerugian ternak	Diisi jumlah ternak yang sakit/mati
Jumlah kerugian bangunan	Diisi jumlah bangunan yang rusak.
Jumlah kerugian	Diisi jumlah luas lahan yang rusak
Jumlah manusia yang diserang	Diisi jumlah korban manusia
Keterangan	Diisi informasi tambahan untuk obyek yang diamati

Figure 13: Database items and pictures illustrating the attributes of the human-wildlife conflict category. Source: SMART-RBM, Explanation of the Terms and Structure of the Data Model (Kholis et al., 2017: 38)

These descriptive items are complemented by elements to report on the response by protected area administrations which encourages them to fill in, amongst other details, how they learnt about the issue, how long the conflict and response lasted for, whether the rangers intervention succeeded or not and what the perception of the conflict by the local population was. The nature of the response is the object of a drop-down menu which restricts the options available to rangers to evacuating the animal, killing the animal, surveillance, follow up, obstruction, capturing the animal or doing nothing. The database makes no mention of monetary compensation to those affected for instance.

An INGO interviewee described a similar process in relation to a potential uptake of the system by the parties to the Agreement to the Conservation of Polar Bears:

'So each country will have a national SMART polar bear system, you know database and then certain agreed-upon standard metrics will filter up to the global level. The issue there for instance as it was described to me is that in the early stages a polar bear incident or a polar bear attack, I forget the phrasing but you know what is called

an incident is...

***Interviewer**: Would that be human-wildlife conflict or polar bears being killed?*

Human-wildlife conflict yes, and the issue is they need to standardise that so in Alaska an incident with a polar bear is tipping over a garbage can and in Russia it's when a polar bear attacks a person and they are recording the data the same way and so they need to deal with that and I guess there is big gaps in the data anyway so the gist behind that is standardisation between the different state and bring in the central management.' - 3.04

As reflected in the quote above, the standardisation of data and ease of reporting enabled by SMART is key to smooth communication between stakeholders at different scales. Monthly SMART reports can be shared between different sections of a protected area and with their central office. Aggregated data can be circulated between neighbouring protected areas as part of landscape level initiatives, sent over to national level authorities and, as previously mentioned, shared with donors. This information eases communication between actors focusing on similar issues but with various levels of expertise and data literacy through the visual language of maps as noted by an NGO interviewee:

'You need to know where are the animals, you need to know where are the poachers and you need to know where are your rangers and SMART does that very effectively in a simple language by producing maps.' - 3.08

Through this shared, standardised and visual language, a common representation and conceptualisation, i.e. a common knowledge, of conservation issues is produced. In particular knowledge is produced about outlawed hunting and harvest of charismatic species.

In facilitating the development of a shared language, SMART also invites comparison and harmonisation between protected areas and conservation projects. In that way, it participates in and reinforces an older and wider movement of creating global and replicable standards for conservation interventions. In 2001 for instance, at a time when SMART was not even in prototyping phase, the Management Effectiveness Tracking Tool (METT) was published by WWF and the World Bank. The METT is effectively a protracted questionnaire covering everything from staff numbers and budget to the presence of invasive species, benefits provided to local communities or geological events. The questionnaire and supporting evidence documents are used to calculate a score and award international recognition for good conservation practices (WWF International, 2007; Stolton and Dudley, 2016).[120] The aim is to measure progress of individual protected areas against internationally recognised standards for good practice and to identify steps to take in the future. Submitting this evaluation portfolio is requested of World Bank and Global

[120] See also interviews 3.01 and 3.07

Environment Facility funding beneficiaries as well as of protected areas designated under the World Heritage Convention and Ramsar Convention on Wetlands. SMART data can now contribute to filling in this evaluation report. In fact, most topics covered in the METT questionnaire correspond to items in the Indonesian SMART Data Model. It is no wonder as the monitoring technology fully builds on this line of thinking according to an interviewee involved in its inception:

'One of the reasons why we wanted to do this was to say that there is actually a unified front of conservation organisations that are subscribing to a sort of common standard and that it would become more easy to compare and evaluate what is happening across projects, across countries, across continents even. Just to standardise and then be able to implement standard operating procedures.' - 3.15

One of the advertised objectives of SMART and other evaluations tools is therefore to measure progress made against agreed upon objectives associated with improvements for wildlife and a reduction of threats to it. A related aim is to build on the information collected to adapt interventions. This is another way in which the use of SMART maps onto the Foucauldian framework of government and the associated concept of knowledge. Indeed, the data produced through the software is used to think about and calculate issues as well as to determine the best way to act on them. Effectively, the METT and SMART's philosophies are so similar that the use of SMART is noted as a positive point in some METT assessments (Hockings, Stolton and Dudley, 2018) or is considered as one of the alternative methods to assess the management of protected areas (Campese and Sulle, 2019). Finally, in December 2019 a workshop was held to discuss combining the two tools more effectively. A new version of the METT questionnaire fulfilling this goal is expected in 2020.[121]

However, researchers have questioned whether SMART can really provide evidence for progress in tackling illegal activities threatening wildlife. They have expressed reservations about the conclusions that can be inferred from data collected by patrols on the link between law enforcement activities and the levels of illegal activities (Dobson et al., 2018; Dancer, 2019). Dobson et al. (2018) for instance detailed the biases contained in data collected by patrolling rangers: patrols are not randomly distributed across protected areas but target areas where higher rates of poaching are suspected, they are often not taking place at regular intervals and the effect of specific patrols on poacher's behaviours is likely to be differed and therefore not recorded. Additionally, elements that are not captured in the metric such as the seasonality of animal

[121] See *What's New* [Online] Equilibrium Research. Retreived from: http://equilibriumresearch.com/whatsnew.asp [Last Accessed: 30/06/2020]

migrations and social events also affect poaching rates. According to the team of researchers, these biases mean that the standard 'catch per unit' metric pulled out of SMART to measure the effectiveness of patrols (i.e. the number of signs of illegal activities found per number of days or size of area patrolled) is not an accurate representation of whether patrols are deterring poachers from operating in a protected area.

Some interviewees also readily agree that SMART should be complemented by other sources of information on illegal activities. According to them, flora and fauna data recorded in SMART cannot replace biodiversity surveys to estimate wildlife populations.[122] Beyond the statistical validity of patrol data, and as show in Chapter 6, human resources and data analysis skills are not always available to go beyond data entry and to translate this raw information into recommendations for changed conservation practices. Despite being a far from perfect tool to capture socio-environmental change, SMART and similar tools almost automatically provide a set of metrics that are mutually recognised by donors, NGOs and protected area authorities. These metrics facilitate communication between these actors and on the whole satisfy them[123] by serving other purposes than that of perfect yardstick for progress related to biodiversity and law enforcement efforts.

Indeed, evaluation tools and standards meet an interest for a narrowly defined 'progress' achieved in protecting biodiversity but also, perhaps more importantly, answer concerns about the use of international public money. The Foucauldian concept of knowledge applies here as it not only encompasses thinking around social phenomena but also reasoning around how government should be carried out. In this case, the process of conservation as a form of government involves ensuring best value for money. In practice, SMART's auditing potential make it attractive to donors on several counts as interviewees explained:

'So I mean we are running all from funding from grants so we are writing grants for different funding organisations but we have to be able to present the current situation so we can present the baseline to the donor […] we sort of want to show areas we want to reach based on this patrol data you know we have a large part of the park which has been unpatrolled because they don't have the funds or the gear necessary to get there so we would like to support them in terms of equipment and patrol to get there.' - 3.24 INGO in-country staff

[122] See interviews 3.06, 3.24, 3.71, 3.39, 3.07

[123] One episode hints at the fact that this status of SMART as a trusted measurement instrument is fragile. In 2016, in the face of a mounting number of grant applications mentioning SMART as their evaluation tool of choice, the US Fish and Wildlife Service commissioned a report to investigate what prerequisites needed to be in place for SMART to be an effective monitoring application (Source: 3.15. Report is not publically available).

The first reason for SMART's attractiveness is that it can help produce the kind of detailed evidence base that donors require as part of grant applications. The data collected can help demonstrate that parks have specific, measurable issues or needs, such as patrolling new areas, which can be addressed within a set budget and amount of time. Donors understand this type of argument and are reassured by it. They are more likely look favourably on applicants building their case in this way. The second reason this system facilitates the relationship between donors and on-the-ground practitioner is that it can also help document how funds are spent once granted:

'*No, they [donors] don't ask for the data but they want us to send reports through SMART with the little reporting routines that we started. We would send them that to update them on where we were with setting up the system in the area […] The reports were little tables with the number of patrols that were carried out in the month, the number of track days according to the number of rangers in the field, how many kilometres were travelled and then you had a map with a grid of where all the patrols were'* - 3.11 Protected area management consultant

Last but not least, SMART's popularity rests on the shared belief in a causal link between using the tool, improving patrols and reducing illegal activities even though this link has been challenged in peer-reviewed research:

'*Well yes because… so SMART is a really good… because if you hop on SMART it makes your patrolling more efficient so if you were telling a donor that all your patrolling efforts are being monitored and made smarter by SMART then that's great because their money is being spent most appropriately.'* - 3.02 INGO headquarters staff

If SMART makes law enforcement more efficient as it promises to, then it is good value for donor's money. Under this assumption, SMART's function as an evaluation and planning instrument and as an auditing tool are brought together.

While harmonised targets can provide motivation and direction to global efforts to protect wildlife, scholars have warned about the effects of making conservation interventions, and the closely related development projects, measurable and technical. Murray Li (2007) and Ferguson (1994) have led the way in denouncing the consequences of such technical framings on deeply political issues about who can access land and resources by highlighting that this process may make root causes invisible, erase local voices and close off alternative paths to addressing these issues without so much as a debate.

Technologies such as SMART help collect data and present data in standardised and simplified ways. Because of this, they contribute to the action-oriented knowledge supporting conservation. More importantly, they participate in this long-identified trend of rendering political interventions

technical and quantifiable with the risks that this implies. These devices also contribute to newer ways of approaching human-nature interactions through the lens of criminology and predictive patrolling inspired by policing applications.

Technology and the development of an applied conservation criminology

SMART and other data collection systems, while being used in an attempt to provide a comprehensive view of a protected area and what goes on within it, also paradoxically enable novel ways of zooming in and prioritising issues. The data tabulated and maps produced serve to highlight patterns and hotspots of illegal activity thereby supporting the development of a criminology-inspired body of knowledge destined to conservation workers on the ground. Massé et al. (2020) have identified how crime and law enforcement notions permeated a high level conservation policy gathering such as the London Conference on the Illegal Wildlife Trade. In this section, I show that crime-focused approaches to conservation and law enforcement technologies feed off each other. Criminology-inspired understandings of illegal activities threatening wildlife form a body of knowledge. They are a tool of government in that they provide a way of rationalising these issues in order to act on them. Technologies can supply empirical information to frame poaching, deforestation or illegal fishing as crimes. This data can be used in devising strategies to police these crimes. In turn, crime-focused and criminology-inspired approaches influence the uses and continued development of conservation technologies.

During my research, I have been privy to a number of improvised courses demonstrating technologies' helpfulness in detecting and fighting wildlife 'crime.' In 2019, on the side-lines of a large annual conservation conference, I finally attended a structured course, slides, handouts and practice exercises included. I and about ten others learnt how to use 'crime science to counter deep forest poaching' and listened to 'tips on how to catch poachers safely and effectively.' Based on their anti-poaching experience, the instructors had developed their approach into a step-by-step replicable method. We were invited to deconstruct the steps leading to an animal being poached in contexts we were familiar with in order to reconstruct it as a crime's modus operandi: 'How do poachers prepare?' we were asked, 'Where do they find their weapons? How do they enter the protected areas? What hunting methods do they use? What do they do with the animal carcass? How do they leave the scene?' The instructors then described how to build a detailed picture of poaching in-context, how to decide on the best stage to intervene to stop offenders and how to draw on military counter-insurgency tactics to close in on poachers and apprehend them. Throughout this training, SMART was mentioned as instrumental to routinely record information

about the specificities of poaching in a particular landscape, to identify priority areas to patrol and to keep track of how regularly these are patrolled i.e. how up to date the information on these areas is.

The short course I attended can be placed within a broader context of INGO practitioners, often trained in biology or conservation science, expressing admiration for police and military know-how and technological resources and drawing parallels between their work and that of traditional law enforcement. An interviewee from this kind of background describing how many protected areas still relied on paper files until recently for instance told me:

'Probably police was also doing the same thing [sic], but the police have changed. Now the police uses forensics, police use computers, police uses i2 databases [sic] but the Forest Department has not changed that much and that's what we are trying to do through our programmes is to support them.' - 3.08

Another participant from a similar background who was explaining their efforts to improve anti-poaching methods said they were '*taking lessons learned from loads of policing and how that's worked because the parallels are very, very pertinent.*'[124] Former policemen or soldiers can also be found within INGO staff or consulting for them.[125]

There is of course a long history of police, military and para-military techniques, personnel, know-how and knowledge being called upon to secure natural resources. The army or paramilitary forces have been called upon to evict people from their lands in the name of conservation. They have been tasked with guarding production forests or protected areas in contexts as diverse as Indonesia and India but also the United-States, Guatemala, Uganda or South Africa (Peluso, 1993; Cronon, 1996b; Ybarra, 2012; Lunstrum, 2016; Duffy *et al.*, 2019; Ashaba, 2020; Dutta, 2020).

Yet, associations between conservation and State forces have been given a new lease of life. This is noticeable in the realm of knowledge production. In the last decade or so, for example, criminologists by training have worked on reviving and defining disciplinary subfields such as environmental criminology (White, 2008) or conservation criminology (Gibbs *et al.*, 2010; Gore, 2011). Conservation criminology aims to analyse the causes and unfolding of a range of crimes and risks, to assess their impact on the natural environment, but this field also means to 'inform proactive and reactive policy decisions' (Gibbs et *al.,* 2010: 131).

Trained criminologists have therefore sought to apply the concepts of their discipline to conservation issues with a view to support wildlife authorities in their task. Lemieux et al. (2014)

[124] 3.71
[125] See interviews 3.16 and 3.18

and Kahler (2018) for instance recommend applying situational crime prevention as a way to analyse the *modus operandi* of poachers and other offenders and to find the most appropriate stage to intervene to stop them. Moreto (2015) suggests drawing inspiration from intelligence-led policing proactively to use information available to authorities in preventing and investigation poaching cases. Simultaneously, conservation researchers and INGO workers are also writing about law enforcement in English peer-reviewed journals with a view to 'improve' it or 'increase its effectiveness.' These papers are not necessarily mobilising criminology literature but still very much frame poaching as an issue that calls for more law enforcement in the shape of regular and targeted patrols (Jachmann, 2008b; Linkie *et al.*, 2015; Duangchantrasiri *et al.*, 2016; Hötte *et al.*, 2016b; Johnson *et al.*, 2016; Risdianto *et al.*, 2016; Critchlow *et al.*, 2017). It is less the development of these literatures as such which is of interest here than its relationship with conservation surveillance technologies and the knowledge they underpin.

Conservation technologies, data management systems in particular, support this knowledge production effort. Some of the publications cited above explicitly draw on data collected through SMART (Jachmann, 2008b; Lemieux *et al.*, 2014; Duangchantrasiri *et al.*, 2016; Hötte *et al.*, 2016b; Critchlow *et al.*, 2017) or its ancestor, MIST, by wildlife authorities' agents or INGO teams on the ground. Others do not clarify whether they have used SMART data but use information that could be collated through this software or similar ones (Risdianto *et al.*, 2016). Some authors also make a point to recommend the use of this kind of applications (Linkie *et al.*, 2015; Moreto, 2015; Kahler, 2018).

In turn concerns around criminality, capturing patterns of illegal activities and tracing the characteristics of offenders permeate the development of new functionalities for conservation technologies. In 2018, SMART update number six was released and the software now includes a functionality called Profiles (SMART Partnership, 2018). Profiles enables to tracing and visualising the links between individuals spotted around the protected area, objects and vehicles seen or confiscated. Before its launch, an interviewee involved in the process described how these ideas influenced the development of the application:

'There are things that people want to do within SMART that are hard to explain let alone code, for example over the 7 years there's always been an interest in what has sometimes been called intelligence and it's kind of a reference to knowing where things are happening and who's doing them and kind of having that at your fingertips and helping you point out where problems might occur or who the criminals may be and gathering evidence.' - 3.12

The above quote shows that the concept of 'intelligence', usually the preserve of secret services and criminal investigation have been used as guide to design one of SMART's functionality. This

is a clear instance of a policing-inspired frame being embedded into the coding of a conservation technology.

Similarly, cameras traps, a tool long used for surveying non-intrusively count and observe the behaviour of animals are also being repurposed and customised with the concern of producing information about criminal activities. Camera designs are being adapted so that they can better blend in the landscape to covertly capture images of potential hunters or loggers, recognise whether people are pictured and in some cases send a real time alert to a ranger's mobile (World Wildlife Fund US, 2016; Rogers, 2017). Back to the boardroom where I was initiated to stopping forest poachers in 2019, the training's PowerPoint was illustrated with blurred camera trap pictures of people who had entered protected forests. We were told that these images could be an important source of information amongst others to identify these people's ethnic or social background and their methods. Analysing their clothing and what they carried, from large backpacks to weapons or wires, could help us understand who they were and how they did what they did, thereby bringing us closer to thwarting them.

While they are certainly not the primary cause nor the only tools involved, technologies such as data capture and management systems or camera traps are supporting the framing of illegal harvesting of wildlife as crimes and are assisting responses guided by this framing. These devices and the data they produce contribute to body of knowledge framing conservation authorities as law enforcement actors and feed into understandings of localised illegal wildlife harvest as crimes. Furthermore, technologies also contribute to anchoring knowledge of illegal activities in the immediate present, such as the alerting cameras, or projecting it into the future. Making illegal activities visible within new timeframes is another way in which technologies influence the knowledge conservation practitioners draw on as I explain next.

Technology and the early days of predictive and automated ranger work

Digitised databases of geo-located information relating to wildlife and human activities in protected areas are creating the conditions necessary to the development of machine learning and predictive applications. Although this potential is not fully exploited in the majority of protected areas, such technological systems are taking conservation further into the realm of automation or what Adams (2017) calls 'conservation by algorithm.' Adams envisages an increase in conservation decisions taken automatically on the basis of data that is collected, cleaned, analysed and transformed into actionable recommendations entirely by machines.

Indeed, the collection and standardised labelling of large amounts of data that SMART and similar application enable is a precondition to the development of algorithms. Such algorithms can automate the recognition of patterns, make predictions and outsource some of conservations staff's intellectual work and expertise to computers. Predictions here is nothing like the prophecies of a medium, what technology can help with is identifying what is statistically more likely to happen in the future based on what has happened in the past. This is how a computer science researcher worded it: '*more importantly, as I've said, the fact that there's a large number of past poaching incidents so that allows us to use machine learning to make intelligent predictions."*[126]

The potential of artificial intelligence in the context of anti-poaching has not been missed by multilateral funding bodies and computer science researchers. In 2013 for instance, a group of scientists from the University of South California took an interest in this topic which lead to a collaboration with the Uganda Wildlife Authorities at Queen Elizabeth National Park who had accumulated several years of SMART data (Yang *et al.*, 2014). They parsed through the database and developed an algorithm based on game theory that predicts routes for rangers to patrol on the basis of past recorded poaching incidents. After several trials in protected areas, scientists and conservationists involved in the development claim that the patrols following routes recommended by this algorithm, baptised Protection Assistant for Wildlife Security (PAWS), are 'effective in finding human activity signs and animal signs' (Fang *et al.*, 2016: 3971). According to them, this means that the algorithm does pick up on areas that are accessible by both humans and animals, have a higher wildlife density and are potential poaching hotspots. So much so that at the time of writing, there was an ambition to adapt the algorithm to handle information from different environments and expand this application to make it available to all protected areas already using SMART (Ballon, 2019; Xu *et al.*, 2019).[127] Technical meetings to achieve this goal were on-going at the time of writing. Similarly, a US-based researcher and an employee of the South African National Park services have developed a couple of algorithms to support rangers in planning preventive patrols routes as well as a chase active poachers (Haas and Ferreira, 2018).

The body of knowledge underlying applications such as these must be further examined. Research on predicting areas with a high risk of poaching, including the algorithms behind PAWS, has drawn on game theory principles. According to these, protagonists such as rangers and poachers can be conceptualised as rational agents looking to allocate their resources in the most optimal way, to satisfy their preferences, maximise benefits and minimise risks. Their behaviour

[126] 3.21
[127] These plans were also mentioned during interviews 3.04 and 3.21

and interactions can be represented by a sequence of statistical models (Fang *et al.*, 2017; Haas and Ferreira, 2018). Game theory is therefore becoming embedded in day to day conservation thinking and practice.

However, the relevance of game theory to the issue of poaching must be taken with a pinch of salt. Critchlow et al. (2017), a group of researchers also interested in improving the detection and prevention of illegal activities in national parks through patrolling have highlighted that the intellectual methods previously deployed to this aim, including game theory, 'rely on many assumptions, may struggle to cope with the complexity of illegal activities in practice: for example, we demonstrated that different illegal activities (e.g., poaching for high-value animal products versus cattle encroachment) occur in different regions of a protected area' (*idem* : 573). To Critchlow and colleagues, the main issue is that illegal activities, poaching included, are too varied to be tackled by one rational agent model and one strategy. Political science which has had to deal with similar assumptions that human behaviour is rational and can be modelled allows to push this critique further.

On a theoretical level, game theory has been judged overly deterministic and the explanations it provides severely restrict the spectre of possible outcomes to social interactions (Hay, 2002: 103). Individuals are thought to have a set of preferences and face with a given situation, there is only one rational choice they can make to satisfy preferences. So they have a choice regarding their preferences but all of their actions automatically flow from that initial set of likes and dislikes. Poachers' preferences are thought to be to seize a prized animal or plant and above all not be caught. They cannot decide at the last minute to not take any animals or plants or judge that it is more advantageous to meet with rangers, whom they might know already, and negotiate with them, bribe them or any other course of action. Empirically, there is much more to poaching or illegal logging than is recorded in the databases predictive applications are relying on.

The information and assumptions on which the algorithms are built can also be biased. Rangers and protected area managers sometimes do not wish to input and share the details or particular incidents. Rangers can support or turn a blind eye to intruders or sometimes collect protected species themselves. The information included in the protected area databases and the training of algorithms is also a poor description of what these activities entail. This data focuses on traces specific incidents, often after the fact, or arrest of individuals. Yet, poaching for instance cannot be reduced to the pursuit of a prized target for financial gain and the avoidance of arrest and punishment. Forms of outlawed hunting can be practiced in line with local traditions, due to unawareness of hunting laws, for subsistence or to express grievances about land use and revenue

sharing (Muth and Bowe, 1998; Duffy, 2000; Bell, Hampshire and Topalidou, 2007; Kahler, Roloff and Gore, 2013; Hübschle, 2017).

There is therefore a risk that predictive applications lead on-the ground staff to lose sight of the bigger picture of why poaching is happening and paradoxically, erode critical investigation skills. There will often be a statistical margin of error in the accuracy of the course of action machine learning tools recommend or the patterns they identify. Artificial intelligence applications comport risks of false positives and false negatives that too often reflect race, gender or class prejudice (O'Neil, 2016; Buolamwini and Gebru, 2018; Benjamin, 2019). Beyond mathematical cautiousness, and as we have just seen, these tools are a very limited representation of the illegal activities their designers would like them to counter.

The knowledge guiding the government of protected areas now includes automated reasoning. Expertise derived from the recommendations of computerised applications is likely to be of increasing importance in conservation decision-making. However, this expertise represents a narrow view of poaching issues. If the experience of other sectors in any indication, the automated knowledge production might lead conservation staff to overly rely on machines and lose sight of other sources of information, knowledge and practices that are needed to interpret the significance of automated recommendations and to act on conservation issues (Bainbridge, 1983; Strikwerda, 2020). The interaction between knowledge that is relied on to govern protected areas and technologies therefore potentially affects the success of conservation interventions.

Conclusions

My analysis of the information gathered through protected area data management systems and how this information is handled has shown that these technologies draw on pre-existing forms of knowledge. Yet, they also accompany the development of more recent bodies of expertise on how to deal with illegal activities seen to endanger wildlife. These digital applications reinforce a technical approach to conservation where targets towards desired outcomes are set and checked against quantifiable metrics. Meanwhile protected areas surveillance devices and software have also become a tool of choice to conceptualise and respond to illegal activities as crimes. So much so that applications are being developed to automate instructions on how to respond to these crimes.

Because the knowledge supported by conservation technologies is used to come up with responses to illegal activities and to evaluate these policies, it has an impact on the chance of survival of endangered species and ecosystems. Bodies of knowledge that emphasize the technical and criminal dimension of activities threatening wildlife risk missing other fundamental historical

and social dimensions of these activities. If that is the case, they will not be a sufficient and reliable guide to adequately halt the killing and harvest of rare species.

Automating the analysis of the situation in protected areas and instructions to conservation workers might also lead to an over-reliance on digital systems and the loss professional reflexes or critical thinking from on-the-ground staff. This tendency has been noted in other sectors such as transportation, healthcare or the justice system where staff trusted the recommendations of machines more than other insights and lost practice in performing critical parts of their roles that had been automated.

After investigating the balance of powers between institutions involved in the spread of conservation technologies and the relationship between these tools and processes of government such as visibilities, practices and identities, this examination of the relation between knowledge, technologies and conservation action concludes my enquiry into monitoring and surveillance system's influence on the various dimensions of government. I argued that the data produced through technologies consolidates pre-existing ways of understanding conservation manifested in technical reporting. I also demonstrated that new ways of collecting and analysing data feed into the emergence of enforcement-oriented and increasingly automated forms of conservation expertise.

Conclusion

Monitoring and surveillance technologies are tools that organisations and people involved in the management of protected areas in Indonesian and elsewhere turn on themselves to encourage certain understandings of and ways of practicing conservation. I followed technologies such as SMART from the international conferences where they are promoted to the Sumatran protected areas and wildlife authorities where they are used. Doing this allowed me to highlight that surveillance systems are an object of negotiations and oppositions between actors involved in the government of protected areas such as international non-governmental organisations (INGOs) and national conservation authorities.

Using a multi-sited case study approach, I described and analysed the processes of surveillance technology development, funding and promotion within the international conservation sector and in Indonesia. I gave accounts of how these technologies are used in day to day conservation work. This produced new and original empirical material to enrich emerging debates about use of surveillance technology in conservation settings (Arts, van der Wal and Adams, 2015; Adams, 2017). This thesis also contributes to theoretical debates about surveillance, which examine similar technologies using Foucauldian concepts but have not fully addressed their use in rural and conservation areas so far.

Michel Foucault's ideas of government and the ways they have been interpreted by those researching environmental conservation are central to the theoretical framing of my research. I examined how surveillance technologies for conservation operate as a tool of government in mediating the different processes of government identified by Foucault such as practices, identities, visibilities and knowledge. With this analysis, I proposed an interpretation of the governmentality framework which differs from that generally adopted by environmentality scholars. Those who draw on Foucault's work to understand conservation efforts tend to look at the implications of these programmes for rural populations (Agrawal, 2005; Rutherford, 2007; Fletcher and Cortes-Vazquez, 2020). I on the other hand have tweaked the focus and looked at the relationship between technologies of government and those in charge of conservation themselves. This has allowed me to explore the how the practices and understandings of conservationists as well as the expectations placed on them related to the spread of law enforcement technologies.

In this concluding chapter, I summarise the main findings of my research in more detail, outline their practical implications for the protection of nature and suggest avenues for future research.

Research findings and their implications

In this thesis I examined the relationship between monitoring and surveillance systems and the people and processes involved in the government of protected areas. This enables me to foreground three main themes that characterise this relationship which I initially set out to understand. I found that the development and implementation of SMART and similar systems are an object of power struggles between actors involved in the policy and funding of protected areas at a macro level such as INGOs, donors and states like Indonesia. At the same time, I uncovered that implementing and using these technologies does have an influence on work practices and identities at a micro level in protected areas. Finally, I found that such technologies and the data they produce paint a specific picture of the issues facing protected areas and adequate responses to these problems. I now review the main elements that I have observed in relation to these themes and their implication for the conservation of wildlife in protected areas.

Monitoring and surveillance technologies crystallise power struggles between the different institutions involved in making decisions about the management and funding of protected areas such as INGOs, donors and government departments. This argument unfolded over three chapters. In *Chapter 3*, I analysed how Europe and US-based INGOs as well as national and multilateral donors have been involved in funding, commissioning and promoting these technological systems. These actors have traditionally held a lot of sway in conservation funding and policy making. Indeed, SMART is the most widely used bespoke data collection and analysis system for protected areas and is the product of a collaboration between such influential and well-resourced INGOs. The taskforces that make up this partnership lead on decisions about functionalities to include in the software, what hardware is most suitable and which regions to prioritise for training and deployment. The vast majority of protected areas that SMART is used in are situated in the Global South. In this way, neo-colonial power relationships that have long structured the international conservation have translated to the issue of technologies.

Focusing on the history of protected areas and wildlife legislation in Indonesia in *Chapter 4* allowed me to illustrate the colonial legacy of conservation in a more grounded way. Land use regulations introduced by the Dutch colonial government in the mid-19th to early 20th century in Indonesia have largely centralised land control under the authority of the government which has power to lease or sell vast expanses of it to businesses. This created overlapping claims to land and conflicts over natural resources that persist and impede efforts to protect wildlife to this day. In this context, mapping, monitoring, surveillance, counter-mapping and sousveillance technologies have been invested in and used by a range of groups such as rural and indigenous communities,

environmental NGOs, forestry and agro-commodities businesses as well as various branches of the Indonesian government to further their claims and interests in relation to Indonesian land and natural resources. Therefore, mapping, data collection and analysis technologies have come to mediate power struggle over land, including land set aside for conversation.

Chapter 5, allowed me to nuance the argument introduced in Chapter 3 that surveillance systems are imposed by international actors onto states in the Global South. Through the case of Indonesia, I found that concerns of national sovereignty played an important role in shaping what technology was implemented to support conservation law enforcement. These concerns related to national control over biodiversity and natural resources but also to issues surrounding the safety and storage of digital data. These matters influenced what technology states like Indonesia consented to implement in their forest, wildlife or fishing authorities. These questions were also at the heart of the decision to build bespoke national monitoring or surveillance tools even though similar systems that could be tailored to their purposes had already been developed by INGOs. The example of SMART Connect, which relies on cloud technology, is particularly telling of this dynamic. The Connect functionality allows data collected through SMART locally to be automatically synchronised in the cloud, thus enabling better communication between different sections of a protected area or different branches of wildlife authorities within countries. Yet, a number of states have refused to implement this aspect of the system unless the data generated was hosted on servers based in the country rather than using commercial cloud storage with servers abroad. This is an example the negotiations and compromises between governments and other actors involved in the management of protected areas which influence what forms technological systems for conservation law enforcement take.

A second aspect characterising the relationship between monitoring and surveillance systems and the government of protected areas is their influence on the day to day work, norms and expectations within such areas. In *Chapter 6*, I demonstrated that implementing monitoring technologies has an impact on the practices of protected areas administrators and rangers. Using a technology like SMART in the way its promoters intend is very labour intensive. It supposes that outings in the field become more regular and become a major source of information feeding into day to day and longer term decision making about management of the protected area. Data must be collected during patrols in a standardised way that matches the categories of the database. This data is sometimes transmitted automatically to the central database but in Indonesia it must still be entered manually from handwritten notes. An employee then has to produce tables and reports interpreting the trends emerging from the information collected and their significance. In many protected areas, this process either represents entirely new tasks for employees or an adaptation

of previous duties which entails a period of learning. Because of this using the technology affects the nature of rangers and administrators' work.

Activities associated with the use of SMART such as patrolling, systematic information gathering and reporting are deemed key aspects of the success of conservation law enforcement by promoters of SMART. This is why, as I explain in *Chapter 7* this system is also frequently used as a surveillance tool to ensure that protected areas' employees do conform and carry out these tasks. Because using SMART produces a record of where rangers who patrol protected areas have been and what they have observed, it can be drawn on to evaluate their work. The data collected through surveillance systems is used to verify that field rangers have carried out the tasks assigned. In some cases, this data is also mobilised to produce instructions and targets for the next patrols as well as to reward or sanction rangers. Such reward and sanction mechanisms are intended to push them to commit to regular and extensive data gathering and patrolling.

The last element that characterises the relationship between the government of protected areas and surveillance systems is the understanding it promotes of the issues facing protected areas and how these should be addressed. In *Chapter 8*, I explained how the standardised categories of the SMART databases and the statistics produced through the software are used to support the writing of technical reports and grant applications. These documents represent ways of conceptualising conservation issues as problems to be addressed in a linear and quantifiable way. This form of knowledge predates and shaped the development of SMART. However, the information produced through surveillance technologies also contributes to emerging ways of framing breaches to environmental regulations. Indeed, surveillance systems provide unprecedented records of where and how illicit activities take place in protected areas. This information is key to the development of a body of expertise inspired by policing and criminology which suggests ways of preventing these activities recorded as crimes and intercepting the offenders.

What are the implications of these findings for the protection of endangered wildlife? My research points to the fact that, although monitoring technologies do in many ways contribute to conservation efforts, they can be counterproductive when mobilised for surveillance and used to bolster securitised and crime-focused conservation approaches. In these cases, these tools may even hinder attempts to protect wildlife found in protected areas from harmful human activities in the long run. There are three main reasons for this which I detail below.

The first reason why monitoring and surveillance technologies can be counterproductive is that, as shown in *Chapter 5 and 6*, many technology deployments struggle to take off or encounter resistance by intended users, i.e. local conservation staff. In these circumstances, efforts to deploy

these new technologies can amount to a waste of time and resources that could have been put to better use.

Increased surveillance of work in protected areas through technology can also be counterproductive as it can alienate those who are directly tasked with the day to day business of administering these spaces dedicated to wildlife. As I reported in *Chapter 6*, some participants pointed out that monitoring systems are meant to improve the work of rangers in two ways. Firstly, these tools are supposed to increase the motivation of ranger by documenting their work and making it more visible. Secondly, these surveillance systems are a way to increase oversight and prevent wrong doing from corrupt rangers or employees not fulfilling their duties. Naturally, increased oversight is unlikely to please wrong doers. However, it is not necessarily only those at fault that are discontented. In *Chapter 7* I detailed the acts of everyday resistance that are resorted to by rangers to express their disagreement with new technology-enabled forms of supervision. Existing research regarding what rangers enjoy about their job points to the fact that independence (Sherblom, Keränen and Withers, 2002; Eliason, 2006) as well as recognition and respect from superiors (Spira, Kirkby and Plumptre, 2019; Kuiper *et al.*, 2020) are important elements of job satisfaction in the contexts studied. If data from surveillance systems is used to assess and direct rangers more punctiliously, the use of these tools can be interpreted as a sign of lack of trust and micromanagement. This may have demotivating rather than motivating effects.

Finally, as shown in *Chapter 8*, a narrow statistical approach to issues of poaching and environmental degradation fails to capture the nuance and root causes of illicit activities threatening wildlife and therefore can only serve as a band-aid. The machine learning approaches currently on the market to analyse and inform patrol routes operate within the boundaries of protected areas. The algorithms make suggestions for patrol routes where poachers are more likely to be found based on information collected in the past. At most, these applications contribute to an increase in the detection and arrest of suspected poachers who are therefore temporarily prevented from hunting and harvesting endangered species. However, because these algorithms only support one type of conservation action, patrols and arrest operations, they risk acting as blinkers. Indeed, a more diversified approach is necessary to tackle outlawed activities such as poaching which have more complex causes than the stylised risk and reward model underpinning these applications (Kahler and Gore, 2012; Duffy *et al.*, 2016; Hübschle, 2017). In *Chapter 4*, I showed for instance how violations of protected area regulations were tied to historical conflicts over access to land and natural resources. These drivers have their source outside of the boundaries of protected areas, sometimes thousands of kilometres away as consumers on different continents

are willing to spend small fortunes on wildlife products (Thomas-Walters *et al.*, 2020). If these broader factors that have their source outside of protected areas' boundaries are not considered, there is a strong risk that the artificial intelligence applications discussed in this thesis only feed into a protracted game of cat and mouse between stylised rangers and suspected offenders within the confines of state protected areas.

Recommendations and areas for future research

In this section, I suggest a practical shift building on my findings, I then discuss some of the limitations of the research presented in this thesis and propose directions for future research.

A practical recommendation emerging from this research is linked to one of the recurring pitfalls of conservation law enforcement technologies I identified across *Chapter 3* and *Chapter 5*. I showed that the engagement with stakeholders who are directly concerned these tools is insufficient during their development and implementation process. A potential avenue for action is collaborating directly and on an equal footing with field conservationists and protected area staff. This would entail involving these actors in discussions regarding the rationale for and functionalities of future technologies, not simply gathering their feedback after these choices have been made. This process could produce new ideas about ways to improve their working conditions and equipment. The design of and protocol for the use of technologies meant to assist them in their day to day tasks would be part of this dialogue which may eventually also benefit the wildlife field staff are tasked with protecting.

My research has consisted of an exploratory foray into the implications of deploying monitoring and surveillance technologies in protected areas. It is limited in its temporal and geographical scope to a small number of protected areas and conservation offices in two provinces of Sumatra. However, as highlighted in *Chapter 4 and 5*, national context matters in influencing the outcomes of technology implementation. Indeed, data legislation, wildlife regulations, enforcement practices and the organisation of nature conservation authorities all contribute to shaping what systems are introduced and how. These political, cultural and historical dimensions' influence how law enforcement tools are mobilised in the long run both for decision making concerning protected areas, but also for human resources management. It would therefore be interesting to compare protected areas in different countries and regions to investigate the extent to which my findings apply to other contexts and over time.

A comparative research design would be particularly productive in uncovering and assessing the various factors that might lead to resistance to technologies used as work surveillance tools. In *Chapter 6*, I explained that in some instances where data collection systems have been

used to evaluate the work of field agents, they resisted the tools. In other cases, they appreciated the feedback and scrutiny the technology enabled. Sometimes both reactions coexisted at the same site. I drew on the literature regarding electronic surveillance of employees in another context to advance hypotheses as to why SMART and similar tools encountered overt resistance from rangers in some instances and not others (Zubroff, 1988; Tomczak, Lanzo and Aguinis, 2017). It could, for instance, have to do with the relationship between protected area employees and their hierarchy or how the data collected contributes to evaluating ranger's performance and plays into promotions or sanctions. A comparative approach drawing on the frameworks developed in the electronic performance monitoring literature (Stanton, 2000; Ravid *et al.*, 2020) would help ascertain which, if any, of these factors are really at play and are most significant. It would be particularly interesting to compare in more depth protected areas in Indonesia where INGOs involved in the SMART partnership are directly and continuously involved in providing technical assistance, funding and organising patrols and those where they are not. Indeed, as the staff management approach of INGOs tends to rest on objects and sanctions/reward mechanisms in a way that Indonesian government officials' management style does not as I highlighted in *Chapter 7*. In terms of a cross-country comparison, it could be interesting to compare Indonesia with one of the countries often cited in promotional reports and webinars as a model implementer of the system such as the Philippines.

Finally, I want to highlight the need for research on the growing automation of conservation tasks. The places I have visited and been told about still rely heavily on manual data input and on human analysts to make sense of the information collected and provide recommendations. This is the situation I have described in *Chapter 5*. However, the trend is towards increased automation of data input and synchronisation but also automation of analysis and recommendations to conservation agents in the field. This is what I detailed in *Chapter 8,* where I analysed the development of algorithms drawing on past information about illegal activities to recommend patrol routes to protected area employees. How will this deepening trend impact the work of conservation agents in the field? The effects of artificial intelligence and automation on the quantity of jobs and the nature of work is a question that goes far beyond concerns around environmental conservation (Clifton, Glasmeier and Gray, 2020; Schlogl and Sumner, 2020). How does work evolve when it's being done in tandem with data crunching machines? This is a question with far-reaching implications for job satisfaction, education and learning, workers' rights and safety, socio-economic inequality and more. Continuing to research how data collection systems with embedded recommendation algorithms impact the tasks of protected area staff would contribute new insights to broader debates surrounding the automation and the future of work.

My research was a first step in exploring the connections between digital technologies, work and conservation. I examined the relationship between technologies such as SMART and the government of protected areas. Adopting a multi-sited approach to this issue enabled me to foreground previously under searched aspects of the spread of surveillance technologies in this context. I documented the debates surrounding the development and investment in particular technologies and negotiations about the deployment of these technologies between states in biodiversity-rich regions and international conservation actors. Finally, I examined the implications of using such systems for field conservation work in protected areas. Through this analysis, I put forward a vision of technologies for conservation as a double-edged sword. In some ways these tools facilitate communication between authorities' and people involved in the management of protected areas but they also crystallise power struggles between them.

Bilbliography

Abraham, S. (2013) 'The fight for digital sovereignty', *Economic and Political Weekly*, 48(42), pp. 84–85.

Acker, S. (2001) 'In/out/side: positioning the researcher in feminist qualitative research - ProQuest', *Resources for Feminist Research* , 28(3/4), pp. 153–172. Available at: https://search-proquest-com.sheffield.idm.oclc.org/docview/194894506/fulltext/FB37CA2AC6014663PQ/1?accountid=13828 (Accessed: 1 May 2020).

Adams, R. T. (2015) 'Neoliberal Environmentality among Elites: Becoming "Responsible Producers" in Santarém, Brazil', *Culture, Agriculture, Food and Environment*, 37(2), pp. 84–95. doi: 10.1111/cuag.12055.

Adams, W. M. (2004) *Against Extinction*, *Against Extinction: The Story of Conservation*. doi: 10.5950/0738-1360-24.3.301.

Adams, W. M. (2017) 'Geographies of conservation II: Technology, surveillance and conservation by algorithm', *Progress in Human Geography*, pp. 1–4. doi: 10.1177/0309132517740220.

Adler, P. A. and Adler, P. (2008) *Of Rhetoric and Representation: The Four Faces of Ethnography*, *Source: The Sociological Quarterly*. Winter.

Adler, P. S. (1992) *Technology and the Future of Work*. Oxford: Oxford University Press. Available at: https://ebookcentral.proquest.com/lib/sheffield/detail.action?docID=241618.

Affandi, D. Y. (2018) 'Long, winding road for indigenous rights ', *The Jakarta Post*. Available at: https://www.thejakartapost.com/academia/2018/07/30/long-winding-road-for-indigenous-rights.html (Accessed: 17 September 2020).

Affandi, O. (2005) *Dampak kebijakan IPPK dan IUPHHK terhadap perekonomian masyarakat di Kabupaten Malinau*, *Governance Brief*. Center for International Forestry Research (CIFOR). doi: 10.17528/cifor/001808.

Agrawal, A. (2005) *Environmentality: Technologies of Government and the making of subjects*. USA: Duke University Press. Available at: https://ebookcentral.proquest.com/lib/sheffield/detail.action?docID=3007810.

Aiello, J. R. and Kolb, K. J. (1995) 'Electronic Performance Monitoring and Social Context: Impact on Productivity and Stress', *Journal of Applied Psychology*, 80(3), pp. 339–353.

Aiello, J. R. and Svec, C. M. (1993) 'Computer Monitoring of Work Performance: Extending the Social Facilitation Framework to Electronic Presence', *Journal of Applied Social Psychology*, 23(7), pp. 537–548. doi: 10.1111/j.1559-1816.1993.tb01102.x.

Aiyadurai, A. (2016) 'Tigers are Our Brothers: Understanding Human-Nature Relations in the Mishmi Hills, Northeast India', *Conservation and Society*, 14(4), pp. 305–316. doi: 10.4103/0972-4923.197614.

Akst, D. (2013) 'Automation Anxiety', *The Wilson Quarterly*, 37(3). Available at: https://www-jstor-org.sheffield.idm.oclc.org/stable/pdf/wilsonq.37.3.06.pdf?refreqid=excelsior%3A379aa3e2e98002bb4371e91bcc8b46a3 (Accessed: 18 September 2019).

Alder, G. S. and Ambrose, M. L. (2005) 'An examination of the effect of computerized performance monitoring feedback on monitoring fairness, performance, and satisfaction', *Organizational Behavior and Human Decision Processes*, 97(2), pp. 161–177. doi: 10.1016/j.obhdp.2005.03.003.

Amick, B. C. and Smith, M. J. (1992) 'Stress, computer-based work monitoring and measurement systems: a conceptual overview', *Applied Ergonomics*, 23(1), pp. 6–16. doi: 10.1016/0003-6870(92)90005-G.

Anonymous (2016) 'Data Colonialism: Critiquing Consent and Control in "Tech for Social Change"', *Model View Culture*. Available at: https://modelviewculture.com/pieces/data-colonialism-critiquing-consent-and-control-in-tech-for-social-change (Accessed: 15 November 2019).

Anteby, M. and Chan, C. K. (2018) 'A Self-Fulfilling Cycle of Coercive Surveillance: Workers' Invisibility Practices and Managerial Justification', *Organization Science*, 29(2), pp. 247–263. doi: 10.1287/orsc.2017.1175.

Ariansyach, ifan (2018) *Fisheries Country Profile: Indonesia*. Available at: http://www.seafdec.org/fisheries-country-profile-indonesia/ (Accessed: 21 September 2020).

Arthur, C. (2013) 'Fears over NSA surveillance revelations endanger US cloud computing industry | US news | The Guardian', *The Guardian*. Available at: https://www.theguardian.com/world/2013/aug/08/nsa-revelations-fears-cloud-computing (Accessed: 22 May 2020).

Arts, K., van der Wal, R. and Adams, W. M. (2015) 'Digital technology and the conservation of nature', *Ambio*, 44, pp. 661–673. doi: 10.1007/s13280-015-0705-1.

Ashaba, I. (2020) 'Historical roots of militarised conservation: the case of Uganda', *Review of African Political Economy*. doi: 10.1080/03056244.2020.1828052.

Asiyanbi, A. P. (2016) *Birthing a Conservation Regime: Governmentality, Subjectivities and Impacts of REDD+ in Nigeria's Cross River*. King's College London.

Aspinall, E. and Van Klinken (2011) *The State And Illegality In Indonesia*. Leiden: KITLV Press. doi: 10.1163/9789004253681.

Associated Press (2019) 'Theft Deterrence for an Arizona Icon', *The New York Times*. Available at: https://www.nytimes.com/2008/10/12/us/12cactus.html (Accessed: 20 November 2019).

Astuti, R. and McGregor, A. (2015) 'Responding to the green economy: how REDD+ and the One Map Initiative are transforming forest governance in Indonesia', *Third World Quarterly*, 36(12), pp. 2273–2293. doi: 10.1080/01436597.2015.1082422.

Attewell, P. (1987) 'Big Brother and the Sweatshop: Computer Surveillance in the Automated Office', *American Sociological Association*, 5(1), pp. 87–100.

Austin, K. G. *et al.* (2019) 'What causes deforestation in Indonesia?', *Environmental Research Letters*, 14(2), p. 024007. doi: 10.1088/1748-9326/aaf6db.

Autor, D. H. (2015) 'Why are there still so many jobs? The History and Future of Workplace Automation', *Journal of Economic Perspectives*, 29(3), pp. 3–30. Available at: https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.29.3.3 (Accessed: 9 September 2019).

Autor, D. H., Levy, F. and Murnane, R. J. (2003) 'The Skill Content of Recent Technological Change: An Empirical Exploration', *The Quarterly Journal of Economics*, 118(4), pp. 1279–1333. Available at: https://www.jstor.org/stable/25053940?seq=1#metadata_info_tab_contents (Accessed: 9 September 2019).

Bain, P. and Taylor, P. (2000) 'Entrapped by the "electronic panopticon"? Worker resistance in the call centre', *New Technology, Work and Employment*, 15(1), pp. 2–18. doi: 10.1111/1468-005X.00061.

Bainbridge, L. (1983) 'Ironies of Automation', *Automatica*, 19(6), pp. 775–779.

Baldry, C., Bain, P. and Taylor, P. (1998) '"Bright Satanic Offices": Intensification, Control and Team Taylorism', in Thompson, P. and Warhurst, C. (eds) *Workplaces of the Future*. Basingstoke: Macmillan.

Baldwin, A. (2003) 'The Nature of the Boreal Forest', *Space and Culture*, 6(4). doi:

10.1177_1206331203253189.

Ball, K. (2010) 'Workplace surveillance: An overview', *Labor History*, 51(1), pp. 87–106. doi: 10.1080/00236561003654776.

Ball, K., Haggerty, K. D. and Lyon, D. (2012) 'Routledge Handbook of Surveillance Studies'. Routledge Ltd - M.U.A. doi: http://purl.oclc.org/metadata/dublin_core/.

Ball, K. and Wilson, D. C. (2000) 'Power, Contol and Computer-based Performance Monitoring: Repertoires, Resistance and Subjectivities', *Organization Studies*, 21(3), pp. 539–565. doi: 10.1177/001872679805100701.

Ballon, M. (2019) 'AI is for Animals', *USC Viterbi Magazine*. Available at: https://magazine.viterbi.usc.edu/spring-2019/features/srepok-wildlife-sanctuary/ (Accessed: 24 January 2020).

Bambang Danono, A. (2017) *Statistics. General Directorate for the Conservation of Natural Ressources and Ecosystems.*

Barbora, S. (2017) 'Riding the Rhino: Conservation, Conflicts, and Militarisation of Kaziranga National Park in Assam', *Antipode*, 49(5). doi: 10.1111/anti.12329.

Barr, C. *et al.* (2006) *Decentralization of forest administration in Indonesia: implications for forest sustainability, economic development and community livelihoods*. Bogor, Indonesia. doi: 10.17528/cifor/002113.

Bates, J., Lin, Y.-W. and Goodale, P. (2016) 'Data journeys: Capturing the socio-material constitution of data objects and flows', *Big Data & Society*. doi: 10.1177_2053951716654502.

BBC News (2017) 'Can drones stop wildlife poachers? '. Available at: https://www.youtube.com/watch?v=4Ub0W9PL35w (Accessed: 21 May 2020).

Beinart, W. and Hughes, L. (2009) 'Environment and Empire (Oxford History of the British Empire Comanion Series)', I, p. 395.

Belecky, M., Singh, R. and Moreto, W. D. (2018) *Life on the frontline 2018*.

Bell, S., Hampshire, K. and Topalidou, S. (2007) 'The political culture of poaching: a case study from northern Greece', *Biodiversity and Conservation*, 16, pp. 399–418. doi: 10.1007/s10531-005-3371-y.

Benjamin, R. (2019) *Race after technology : abolitionist tools for the new Jim code*. John Wiley & Sons, Ltd.

Benson, E. (2010) *Wired Wilderness: Technologies of Tracking and The Making of Modern Wildlife*. Johns

Hopk. Baltimore, Md, London. Available at: https://find.shef.ac.uk/primo-explore/fulldisplay?docid=44SFD_ALMA_DS21190494620001441&context=L&vid=44SFD_VU2&lang=en_US&search_scope=SCOP_EVERYTHING&adaptor=Local Search Engine&tab=everything&query=any,contains,wired wilderness&offset=0.

Berenschot, W. (2018) 'The Political Economy of Clientelism: A Comparative Study of Indonesia's Patronage Democracy', *Comparative Political Studies*, 51(12), pp. 1563–1593. doi: 10.1177/0010414018758756.

Berger-Tal, O. and Lahoz-Monfort, J. J. (2018) 'Conservation technology: The next generation', *Conservation Letters*, 11(6). doi: 10.1111/conl.12458.

Bernstein, E. S. (2012) 'The Transparency Paradox: A Role for Privacy in Organizational Learning and Operational Control', *Admini*, 57(2), pp. 181–216. doi: 10.1177/0001839212453028.

Bersaglio, B. (2017) 'Green Grabbing and the Contested Nature of Belonging in Laikipia, Kenya: A Genealogy', *ProQuest Dissertations and Theses*, p. 285.

Bersaglio, B. (2018) 'Green violence: Market-driven conservation and the reforeignization of space in Laikipia, Kenya', in Molett, S. and Kepe, T. (eds) *Land Rights, Biodiversity Conservation and Justice: Rethinking Parks and People*. Oxford: Routledge, pp. 71–88. doi: 10.4324/9781315439488.

Berthier, T. and Kempf, O. (2016) 'Vers une géopolitique de la donnée', *Annales des Mines - Réalités industrielles*, Août 2016(3), p. 13. doi: 10.3917/rindu1.163.0013.

Bettinger, K. A. (2015) 'Political contestation, resource control and conservation in an era of decentralisation at Indonesia's Kerinci Seblat National Park', *Asia Pacific Viewpoint*, 56(2), pp. 252–266. doi: 10.1111/apv.12069.

Bevins, V. (2020) *The Jakarta Method*. New York: Hachette Book Group Inc. Available at: https://libro.eb20.net/Reader/rdr.aspx?b=209776747 (Accessed: 16 October 2020).

Bluwstein, J. (2017) 'Creating ecotourism territories: Environmentalities in Tanzania's community-based conservation', *Geoforum*, 83, pp. 101–113. doi: https://doi.org/10.1016/j.geoforum.2017.04.009.

Bondi, E. *et al.* (2018) 'SPOT Poachers in Action: Augmenting Conservation Drones With Automatic Detection in Near Real Time', *The Thirtieth AAAI Conference on Innovative Applications of Artificial Intelligence (IAAI-18)*, pp. 7741–7746. Available at: https://www.aaai.org/ocs/index.php/AAAI/AAAI18/paper/view/16282.

Bonn, A., Rodrigues, A. S. L. and Gaston, K. J. (2002) 'Threatened and endemic species: are they good indicators of patterns of biodiversity on a national scale?', *Ecology Letters*, 5(6), pp. 733–741. doi: 10.1046/j.1461-0248.2002.00376.x.

Boomgaard, P. (1999) 'Oriental nature, its friends and its enemies: Conservation of nature in late-colonial Indonesia, 1889-1949', *Environment and History*, 5(3), pp. 257–292. doi: 10.3197/096734099779568245.

Boomgaard, P., Colombijn, F. and Henley, D. (1997) *Paper Landscapes. Explorations in the environmental History of Indonesia*. Leiden: KITLV Press.

Brockington, D. (2002) *Fortress Conservation: The Preservation of the Mkomazi Game Reserve, Tanzania*. International African Institute, Indiana U Press.

Brockington, D., Duffy, R. and Igoe, J. (2008) *Nature Unbound. Conservation, capitalism and the future of protected areas*, *Nature Unbound*. London; Sterling, VA: Earthscan. doi: 10.4324/9781849772075.

Brockington, D. and Scholfield, K. (2010) 'Expenditure by conservation nongovernmental organizations in sub-Saharan Africa', *Conservation Letters*, 3(2), pp. 106–113. doi: 10.1111/j.1755-263X.2010.00094.x.

Bryant, R. L. (2002) 'Non-Governmental Organizations and Governmentality: "Consuming" Biodiversity and Indigenous People in the Philippines', *Political Studies*, 50(2), pp. 268–292. doi: 10.1111_1467-9248.00370.

Bryman, A. (2016) *Social Research Methods*. 5th Edition. Oxford University Press. Available at: https://bibliu.com/app/#/view/books/9780192529497/epub/OEBPS/00-Bryman-FM6.html%23page_vii (Accessed: 7 October 2020).

Brynjolfsson, E. and McAfee, A. (2016) *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*. New York: W.W. Norton & Company.

Buolamwini, J. and Gebru, T. (2018) 'Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification', *Proceedings of Machine Learning Research*, 81, pp. 1–15. doi: 10.2147/OTT.S126905.

Burgess, R. *et al.* (2012) 'The Political economy of Deforestation in the Tropics ', *The Quarterly Journal of Economics*, 133(2), pp. 1707–1754. doi: 10.1093/QJE.

Callon, M. (1984) 'Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay', *The Sociological Review*, 32(1_suppl), pp. 196–233. doi:

10.1111/j.1467-954X.1984.tb00113.x.

Campaign for National Parks (2015) *Impact of grand cuts on English National Park Authorities*. doi: 10.1017/CBO9781107415324.004.

Campbell, J. and Jensen, D. (2019) *The promise and peril of a digital ecosystem for the planet*, *Medium*. Available at: https://medium.com/@davidedjensen_99356/building-a-digital-ecosystem-for-the-planet-557c41225dc2 (Accessed: 20 November 2019).

Campese, J. and Sulle, E. (2019) *Management Effectiveness, Governance, and Social Assessments of Protected and Conserved Areas in Eastern and Southern Africa A rapid inventory and analysis to support the BIOPAMA programme and partners Management Effectiveness, Governance, and Social Assessments of Protected and Conserved Areas in Eastern and Southern Africa* .

Carruthers, J. (1995) *The Kruger National Park: a social and political history*. Pietermaritzburg, South Africa: University of Natal Press. Available at: https://www.cabdirect.org/cabdirect/abstract/20056704235.

Castree, N. (2014) *Making Sense of Nature*. Abingdon: Routledge.

Cepek, M. L. (2011) 'Foucault in the forest: Questioning environmentality in Amazonia', *American Ethnologist*, 38(3), pp. 501–515. doi: 10.1111/j.1548-1425.2011.01319.x.

Chalykoff, J. and Kochan, T. A. (1989) 'Computer-aided monitoring: Its influence on employee job satisfaction and turnover.', *Personnel Psychology*, 42, pp. 807–834.

Chapin, M. (2004) 'A Challenge to Conservationists', *World Watch Magazine*, pp. 17–31.

Clawson, D. and Clawson, M. A. (2017) 'IT Is Watching: Workplace Surveillance and Worker Resistance', *New Labor Forum*, 26(2), pp. 62–69. doi: 10.1177/1095796017699811.

Clifton, J., Glasmeier, A. and Gray, M. (2020) 'When machines think for us: the consequences for work and place', *Cambridge Journal of Regions, Economy and Society*, 13(1), pp. 3–23. doi: 10.1093/cjres/rsaa004.

Coalition to End Wildlife Trafficking Online (2020) 'Offline and in the wild: A progress report of the Coalition to End Wildlife Trafficking Online'. Available at: www.endwildlifetraffickingonline.org.

Coleman, E. G. (2013) *Coding Freedom: The Ethics and Aesthetics of Hacking*. Princeton, New Jersey: Princeton University Press. Available at: https://press.princeton.edu/books/paperback/9780691144610/coding-freedom.

Cooke, S. J. *et al.* (2017) 'Troubling issues at the frontier of animal tracking for conservation and management', *Conservation Biology*, 31(5), pp. 1205–1207. doi: 10.1111/cobi.12895.

Corson, C. (2016) *Corridors of Power: The Politics of Environmental Aid to Madagascar*. New Haven, US; London, UK: Yale University Press. Available at: https://books.google.com/books/about/Corridors_of_Power.html?id=Jue7DAAAQBAJ.

Corson, C. *et al.* (2019) 'Assembling global conservation governance', *Geoforum*, 103, pp. 56–65. doi: 10.1016/j.geoforum.2019.03.012.

Cribb, R. (2007) 'Conservation in Colonial Indonesia', *Interventions*, 9(1), pp. 49–61. doi: 10.1080/13698010601173817.

Critchlow, R. *et al.* (2017) 'Improving Law-Enforcement Effectiveness and Efficiency in Protected Areas Using Ranger-collected Monitoring Data', *Conservation Letters*, 10(5), pp. 572–580. doi: 10.1111/conl.12288.

Cronon, W. (1996a) 'The Trouble with Wilderness: Or, Getting back to the Wrong Nature', *Environmental History*, 1(1), pp. 7–28. Available at: http://dx.doi.org/.

Cronon, W. (1996b) 'The Trouble with Wilderness or Getting Back to the Wrong Nature', *Environmental History*, 1(1), pp. 7–28. Available at: https://academic.oup.com/envhis/article-abstract/1/1/7/525047 (Accessed: 26 February 2020).

Dancer, A. (2019) 'On the evaluation, monitoring and management of law enforcement patrols in protected areas', *Doctoral thesis, UCL (University College London)*.

Darier, E. (1999a) *Discourses of the Environment*. Oxford UK; Malden, MA, USA: Blackwell Publishers.

Darier, E. (1999b) 'Foucault and the Environment: An Introduction', in Darier, E. (ed.) *Discourses of the Environment*. Oxford, UK; Malden, MA, USA: Blackwell Publisherd.

Dauvergne, P. (2020) *AI in the Wild* . Cambridge, MA: MIT Press. Available at: https://mitpress.mit.edu/books/ai-wild (Accessed: 12 October 2020).

Davies, C. A. (2008) *Reflexive ethnography : a guide to researching selves and others*. Routledge. Available at: https://www.dawsonera.com/readonline/9780203822272 (Accessed: 1 May 2020).

Dean, M. (2010) *Governmentality. Power and Rule in Modern Society*. 2nd Editio. London: SAGE Publications Ltd.

DEFRA (2019) *Illegal Wildlife Trade Challenge Funging- Project List*.

Diantoro, T. D. (2011) 'Peambahan Kawasan Hutan Pada Konservasi Taman Nasional (Studi Kasus Taman Nasional Tesso Nilo Riau)', *Mimbar Hukum*, 23(3), pp. 431–645. Available at: http://www.theodoreroosevelteenter.org/Essay.asp?ID=11, (Accessed: 15 September 2020).

Diantoro, T. D. (2020) *Politik Hukum Kawasan Hutan Dalam Sistem Hukum Sumber Daya Alam*. University Gadjah Mada. doi: 10.1017/CBO9781107415324.004.

DLA Piper (2017) *Data Protection Handbook*.

Dobson, A. D. M. *et al.* (2018) 'Detecting deterrence from patrol data', *Conservation Biology*, 33(3). doi: 10.1111/cobi.13222.

Dourish, P. and Gó Mez Cruz, E. (2018) 'Datafication and data fiction: Narrating data and narrating with data', *Big Data & Society*, pp. 1–10. doi: 10.1177/2053951718784083.

Duangchantrasiri, S. *et al.* (2016) 'Dynamics of a low-density tiger population in Southeast Asia in the context of improved law enforcement', *Conservation Biology*, 30(3), pp. 639–648. doi: 10.1111/cobi.12655.

Duffy, R. (2000) *Killing for conservation: wildlife policy in Zimbabwe*. Bloomington & Indianapolis: Indiana University Press.

Duffy, R. *et al.* (2019) 'Why we must question the militarisation of conservation', *Biological Conservation*, 232. doi: 10.1016/j.biocon.2019.01.013.

Duffy, R. and Humphreys, J. (2014) *Mapping Donors : key areas for tackling illegal wildlife trade (Asia and Africa)*. doi: 10.12774/eod_hd.june2014.duffy_et_al.

Duflo, E., Hanna, R. and Ryan, S. P. (2012) 'Incentives Work: Getting Teachers to Come to School', *The American Economic Review*, 102(4), pp. 1241–1278. doi: 10.1257/aer.102.4.1241.

Dutta, A. (2020) 'Forest becomes frontline : Conservation and counter-insurgency in a space of violent conflict in Assam , Northeast India', *Political Geography*, 77(August 2019), p. 102117. doi: 10.1016/j.polgeo.2019.102117.

Earthrise, A. J. (2017) 'Saving Ecuador's Cerro Blanco'. Al Jazeerah English. Available at: https://www.youtube.com/watch?v=z_1R_oepLwY&feature=youtu.be.

Eliason, S. (2006) 'Factors influencing job satisfaction among state conservation officers', *Policing: An International Journal of Police Strategies & Management*, 29(1), pp. 6–18.

Eliason, S. L. (2006) 'A Dangerous Job? An Examination of Violence against Conservation Officers', *The Police Journal: Theory, Practice and Principles*, 79(4), pp. 359–370. doi: 10.1350/pojo.2006.79.4.359.

Eliason, S. L. (2011) 'Patrolling the peaks and the plains: An examination of big sky game wardens', *Criminal Justice Studies*, 24(4), pp. 409–418. doi: 10.1080/1478601X.2011.626153.

Eliason, S. L. (2017) 'Becoming a Game Warden: Motivations for Choosing a Career in Wildlife Law Enforcement', *Journal of Police and Criminal Psychology*, 32(1), pp. 28–32. doi: 10.1007/s11896-016-9200-2.

Emerson, R. M. (1987) 'Four Ways to Improve the Craft of Fieldwork', *Journal of Contemporary Ethnography*, 16(1), pp. 69–89. doi: 10.1177/0891241687161005.

Escobar, A. (1996) 'Construction nature: Elements for a post-structuralist political ecology', *Futures*, 28(4), pp. 325–343. doi: https://doi.org/10.1016/0016-3287(96)00011-0.

Evans, L. and Kitchin, R. (2018) 'A smart place to work? Big data systems, labour, control and modern retail stores', *New Technology, Work and Employment*, 33(1), pp. 44–57. doi: 10.1111/ntwe.12107.

Fang, F. *et al.* (2016) 'Deploying PAWS: Field Optimization of the Protection Assistant for Wildlife Security', *IAAI-16: The Twenty-Eighth Annual Conference on Innovative Applications of Artificial Intelligence*. doi: 10.1016/j.cub.2015.10.018.

Fang, F. *et al.* (2017) 'PAWS - A deployed game-theoretic application to combat poaching', *AI Magazine*, 38(1), pp. 23–36. doi: 10.1609/aimag.v38i1.2710.

Farid, H. (2005) 'Indonesia's original sin: mass killings and capitalist expansion, 1965–66', *Inter-Asia Cultural Studies*, 6(1), pp. 3–16. doi: 10.1080/1462394042000326879.

Ferguson, J. (1994) *The anti-politics machine : 'development,' depoliticization, and bureaucratic power in Lesotho*. Cambridge University Press.

Fernie, S. and Metcalf, D. (1998) *(Not) Hanging on the Telephone: Payments Systems in the New Sweatshops*.

Fleming, P. and Sewell, G. (2002) 'Looking for the good soldier, švejk: Alternative modalities of resistance in the contemporary workplace', *Sociology*, 36(4), pp. 857–873. doi: 10.1177/0038038502036004 04.

Fletcher, R. (2010) 'Neoliberal environmentality: Towards a poststructuralist political ecology of the conservation debate', *Conservation & Society*, 8(3), pp. 171–181. doi: 0972-4923.

Fletcher, R. (2017) 'Environmentality unbound: Multiple governmentalities in environmental politics', *Geoforum*, 85(Supplement C), pp. 311–315. doi: https://doi.org/10.1016/j.geoforum.2017.06.009.

Fletcher, R. and Cortes-Vazquez, J. A. (2020) 'Beyond the green panopticon: New directions in research exploring environmental governmentality', *Environment and Planning E: Nature and Space*, 3(2), pp. 289–299. doi: 10.1177/2514848620920743.

Flyvbjerg, B. (2006) 'Five Misunderstandings About Case-Study Research', *Qualitative Inquiry*, 12(2), pp. 219–245.

Foucault, M. (1978) *The History of Sexuality. Vol. 1, The Will to Knowledge*. New York, NY: Pantheon Books.

Foucault, M. (1982) 'The Subject and Power', *Critical Inquiry*, 8(4), pp. 777–795. Available at: http://dx.doi.org/.

Foucault, M. (1986) *The History of Sexuality*. New York, NY: Pantheon Books.

Foucault, M. (1989) *The Birth of the Clinique: an archeology of medical perception*. Routledge.

Foucault, M. (1991) 'Questions of method', in Burchell, G., Gordon, C., and Miller, P. (eds) *The Foucault Effect. Studies in Governmentality*. London: Harvester Weatsheaf, pp. 73–86.

Foucault, M. (1995) 'Discipline and punish : the birth of the prison'. New York: Vintage Books, Random House.

Foucault, M. (2008) *The Birth of Biopolitics*, *The Birth of Biopolitics*. Edited by M. Senellart. Basingstoke: Palgrave McMillan. doi: 10.1057/9780230594180.

Foucault, M. (2009) *Security, Territory, Population*. Edited by M. Senellart. Basingstoke: Palgrave McMillan.

Frey, R. M., Hardjono, T., *et al.* (2017) 'Secure Sharing of Geospatial Wildlife Data', 17. doi: 10.1145/3080546.3080550.

Frey, R. M., Miller, G. A., *et al.* (2017) *Wild Animals in Daily Life*. Available at: http://www.internetofelephants.com (Accessed: 20 November 2019).

Geraldine, A. (2019) 'Bora: Msia's efforts to save Sumatran rhino thwarted by apathetic parties', *New Straits Times*. Available at: https://www.nst.com.my/news/nation/2019/11/541623/bora-msias-efforts-save-sumatran-rhino-thwarted-apathetic-parties (Accessed: 22 May 2020).

Gerring, J. (2004) 'What Is a Case Study and What Is It Good for ?', *American Political Science Review*, 98(2), pp. 341–354.

Gibbs, C. *et al.* (2010) 'Introducing Conservation Criminology. Towards Interdisciplinary Scholarship on Environmental Crimes and Risks', 50, pp. 124–144. doi: 10.1093/bjc/azp045.

Gibson, C. C. (1999) *Politicians and poachers. The politicial economy of wildlife policy in Africa*. Indiana Un. Available at: 9780511625640.

Glover, J. (2019) *Landscapes Review*.

Gokkon, B. (2019a) 'Bid to breed Sumatran rhino is handicapped by bureaucratic "quibbling"', *Mongabay*. Available at: https://news.mongabay.com/2019/10/sumatran-rhino-breeding-indonesia-malaysia-endangered-extinction/ (Accessed: 22 May 2020).

Gokkon, B. (2019b) 'Malaysia's last Sumatran rhino dies, leaving Indonesia as the final refuge', *Mongabay*. Available at: https://news.mongabay.com/2019/11/malaysias-last-sumatran-rhino-dies-leaving-indonesia-as-the-final-refuge/ (Accessed: 22 May 2020).

Gokkon, B. (2020) 'Indonesia-WWF split puts rhino breeding project in Borneo in limbo', *Mongabay*. Available at: https://news.mongabay.com/2020/02/indonesia-wwf-sumatran-rhino-captive-breeding-kalimantan/ (Accessed: 22 May 2020).

Goldman, M. J., Nadasdy, P. and Turner, M. D. (2011) 'Knowing Nature : conversations at the intersection of political ecology and science studies'. Chicago, Ill. ; London: University Of Chicago Press. doi: http://purl.oclc.org/metadata/dublin_core/.

Goldman, M. J. and Turner, M. D. (2011) 'Introduction', in Goldman, M. J., Nadasdy, P., and Turner, M. D. (eds) *Knowing Nature. Conversation at the Intersection of Political Ecology and Science Studies*. University Of Chicago Press, p. 374.

Gomez, L. and Shepherd, C. R. (2019) 'Bearly on the radar – an analysis of seizures of bears in Indonesia', *European Journal of Wildlife Research*, 65(6), p. 89. doi: 10.1007/s10344-019-1323-1.

Goodyear, D. (2019) 'Succulent-Smugglers Descend on California', *The New Yorker*. Available at: https://www.newyorker.com/news/california-chronicles/succulent-smugglers-descend-on-california (Accessed: 20 November 2019).

Gordon, C. (1991) 'Governmental Rationality: An Introduction', in Burchell, G., Gordon, C., and Miller, P. (eds) *The Foucault Effect. Studies in Governmentality*. London: Harvester Wheatsheaf, pp. 1–53.

Gore, M. L. (2011) 'The Science of Conservation Crime', *Conservation Biology*, 25(4), pp. 659–661. doi: 10.1111/j.1523-1739.2011.01701.x.

Gough, R., Ballardie, R. and Brewer, P. (2014) 'New technology and nurses', *Labour & Industry: a journal of the social and economic relations of work*, 24(1), pp. 9–25. doi: 10.1080/10301763.2013.877118.

Grant, R. A., Higgins, C. A. and Irving, R. H. (1988) 'Computerized Performance Monitors: Are They Costing You Customers?', *Richard H Sloan Management Review*, 29(3), pp. 39–45.

Greiner, C. (2012) 'Unexpected Consequences: Wildlife Conservation and Territorial Conflict in Northern Kenya', *Human Ecology*, 40(3), pp. 415–425. doi: 10.1007/s.

Guha, R. (1983) 'Forestry in British and Post-British India: A Historical Analysis', *Economic And Political Weekly*, 18(44), pp. 1882–1896. doi: 10.2307/4372653.

Haas, T. C. and Ferreira, S. M. (2018) 'Optimal patrol routes: interdicting and pursuing rhino poachers', *Police Practice and Research*, 19(1), pp. 61–82. doi: 10.1080/15614263.2017.1295243.

Hall, D., Hirsch, P. and Murray Li, T. (2011) *Powers of Exclusion – Land Dilemmas in Southeast Asia*. Singapore: National University of Singapore.

Hansen, M. C. *et al.* (2013) 'High-Resolution Global Maps of 21st-Century Forest Cover Change', *New Series*, 342(6160), pp. 850–853. doi: 10.1126/science.l239552.

Hanson, P. W. (2007) 'Governmentality, Language ideology and the production of needs in Malgasy conservation and development', *Cultural Anthropology*, 22(2), pp. 244–284. doi: 10.1525/can.2007.22.2.244.

Hasyim, Z. *et al.* (2020) 'Challenges facing independent monitoring networks in the Indonesian timber legality assurance system', *Forest Policy and Economics*, 111, p. 102025. doi: 10.1016/j.forpol.2019.102025.

Hay, C. (2002) *Political analysis*. Palgrave.

Hayhow, D. *et al.* (2019) *State of Nature*.

Heeks, R. (2010) 'Do information and communication technologies (ICTs) contribute to development?', *Journal of International Development*, 22(5), pp. 625–640. doi: 10.1002/jid.1716.

Heilmann, D. (2015) 'After Indonesia's Ratification: The ASEAN Agreement on Transboundary Haze Pollution and its Effectiveness as a Regional Environmental Governance Tool', *Journal of Current Southeast Asian Affairs*, 34(3), pp. 95–121. doi: 10.1177/186810341503400304.

Hicks, J. (2019) '"Digital colonialism": why some countries want to take control of their people's data from Big Tech', *The Conversation*. Available at: https://theconversation.com/digital-colonialism-why-some-countries-want-to-take-control-of-their-peoples-data-from-big-tech-123048 (Accessed: 19 December 2019).

Hicks, R. (2020) 'WWF has forest conservation fieldwork permit revoked in Indonesia | News | Eco-Business | Asia Pacific', *Eco-business.com*. Available at: https://www.eco-business.com/news/wwf-has-forest-conservation-fieldwork-permit-revoked-in-indonesia/ (Accessed: 22 May 2020).

Hill, A. P. *et al.* (2019) 'Leveraging conservation action with open-source hardware', (April), pp. 1–8. doi: 10.1111/conl.12661.

Hockings, M., Stolton, S. and Dudley, N. (2018) *Protected Area Management Effectiveness (PAME) Report on a training course for protected area staff in Myanmar*.

Hodgkinson, S. and Young, D. (2016) *The Internet of Things for Protected Areas : The Application of Innovative Technologies to Improve Management Effectiveness*.

Hötte, M. H. H. *et al.* (2016a) 'Indicators of success for smart law enforcement in protected areas: A case study for Russian Amur tiger (Panthera tigris altaica) reserves', *Integrative Zoology*, 11(1), pp. 2–15. doi: 10.1111/1749-4877.12168.

Hötte, M. H. H. *et al.* (2016b) 'Indicators of success for smart law enforcement in protected areas: A case study for Russian Amur tiger (Panthera tigris altaica) reserves', *Integrative Zoology*, 11(1), pp. 2–15. doi: 10.1111/1749-4877.12168.

Hübschle, A. M. (2017) 'The social economy of rhino poaching: Of economic freedom fighters, professional hunters and marginalized local people Special section: Clusters of Order: Society, State and Illegal Markets', *Current Sociology*, 65(3), pp. 427–447. doi: 10.1177/0011392116673210.

Hussein Alatas, S. (1977) *The Myth of the Lazy Native: A Study of the Image of the Malays, Filipinos ... - Hussein Alatas (Syed) - Google Books*. London: Frank Cass. Available at: https://books.google.co.uk/books?hl=en&lr=&id=vAwbP7a-nCcC&oi=fnd&pg=PP2&dq=Syed+Hussein+Alatas+&ots=C1iltJ8tld&sig=33383X3KfKDp0Z70-UILuqmLy78&redir_esc=y#v=onepage&q=Syed Hussein Alatas&f=false (Accessed: 24 June 2020).

Irani, L. (2015) 'Hackathons and the Making of Entrepreneurial Citizenship', *Science, Technology, & Human Values*, 40(5), pp. 799–824. doi: 10.1177/0162243915578486.

Ives, M. (2019) 'Using Old Cellphones to Listen for Illegal Loggers', *The New York Times*. Available at: https://www.nytimes.com/2019/10/15/climate/indonesia-logging-deforestation.html?utm_source=twitter&utm_medium=worldresources&utm_campaign=social media.

Jachmann, H. (2008a) 'Monitoring law-enforcement performance in nine protected areas in Ghana', *Biological Conservation*, 141(1), pp. 89–99. doi: 10.1016/j.biocon.2007.09.012.

Jachmann, H. (2008b) 'Monitoring law-enforcement performance in nine protected areas in Ghana', *Biological Conservation*, 141(1), pp. 89–99. doi: 10.1016/j.biocon.2007.09.012.

Jasanoff, S. (2017) 'Virtual, visible, and actionable: Data assemblages and the sightlines of justice', *Big Data & Society*, pp. 1–15. doi: 10.1177_2053951717724477.

Jepson, P., Barua, M. and Buckingham, K. (2011) 'What is a Conservation Actor?', 9(3), pp. 229–235. doi: 10.4103/0972-4923.86993.

Jepson, P. and Whittaker, R. J. (2002) 'Histories of Protected Areas: Internationalisation of Conservationist Values and their Adoption in the Netherlands Indies (Indonesia) on JSTOR', *Environment and History*, 8(2), pp. 129–172. Available at: https://www.jstor.org/stable/20723220 (Accessed: 16 September 2020).

Jessop, B. (2016) *The State. Past, Present, Future*. Cambridge: Polity Press. Available at: https://www.vlebooks.com/Vleweb/Product/Index/683966?page=0 (Accessed: 6 April 2021).

Johnson, A. *et al.* (2016) 'To protect or neglect? Design, monitoring, and evaluation of a law enforcement strategy to recover small populations of wild tigers and their prey', *Biological Conservation*. doi: 10.1016/j.biocon.2016.08.018.

Johnson, N. *et al.* (2014) 'Are You Watching Me? A Look at Panoptic Perceptions Surrounding Computer Monitoring Systems', *Journal of Information Technology Case and Application Research*, 16(1), pp. 9–26. doi: 10.1080/15228053.2014.912475.

Jong, H. N. (2019) 'Indonesian ban on clearing new swaths of forest to be made permanent', *Mongabay*. Available at: https://news.mongabay.com/2019/06/indonesian-ban-on-clearing-new-swaths-of-forest-to-be-made-permanent/ (Accessed: 23 September 2020).

Jong, H. N. (2020) 'Indonesian environment ministry ends WWF partnership amid public spat', *Mongabay*. Available at: https://news.mongabay.com/2020/01/indonesia-environment-ministry-klhk-wwf-partnership-forest-conservation/ (Accessed: 22 May 2020).

Jong, N. H. (2020) 'Indonesia to receive $56m payment from Norway for reducing deforestation', *Mongabay*. Available at: https://news.mongabay.com/2020/05/indonesia-norway-redd-payment-deforestation-carbon-emission-climate-change/ (Accessed: 14 October 2020).

Joseph, J. (2009) 'Governmentality of What? Populations, States and International Organisations', *Global Society*, 23(4), pp. 413–427. doi: Global Society, Vol. 23, No. 4, October 2009, pp. 413–427.

Joshi, K. (2005) 'Understanding User Resistance and Acceptance during the Implementation of an Order Management System: A Case Study Using the Equity Implementation Model', *Journal of Information Technology Case and Application Research*, 7(1), pp. 6–20. doi: 10.1080/15228053.2005.10856057.

Kahler, J. (2018) *The Situational Prevention of Wildlife Poaching in Developing community-based wildlife crime prevention techniques*. Michigan State University. Available at: https://www.researchgate.net/publication/325391901 (Accessed: 10 February 2020).

Kahler, J. S., Roloff, G. J. and Gore, M. L. (2013) 'Society for Conservation Biology Poaching Risks in Community-Based Natural Resource', *Biology*, 27(1), pp. 177–186. doi: 10.1111/j.

Kaye, M. (2015) 'Minister explains sustainability claims behind Indonesia's boat bombing', *Mongabay*. Available at: https://news.mongabay.com/2015/03/minister-explains-sustainability-claims-behind-indonesias-boat-bombing/ (Accessed: 22 May 2020).

Keynes, J. M. (1963) 'Economic Possibilities for our Grandchildren', in *Essays in Persuasion*. New York: W.W.Norton & Co., pp. 358–373.

Kholis, M. *et al.* (2016) *SMART-RBM Buku I. Pendoman Implementasi SMART di Kawasan Konservation*. Jakarta.

Kholis, M. *et al.* (2017) *SMART-RBM Buku III. Penjelasan Istilah dan Struktur Data Model*. Bogor.

Kiik, L. (2018) 'Conservationland : Toward the anthropology of professionals in global nature conservation', *Critique of Anthropology*, pp. 1–29. doi: 10.1177/0308275X18821177.

Kleine, D. and Unwin, T. (2009) 'Technological revolution, evolution and new dependencies: What's new about ICT4D?', *Third World Quarterly*, 30(5), pp. 1045–1067. doi: 10.1080/01436590902959339.

KLHK, P. D. dan I. (2019) *Statistik Lingkungan Hidup dan Kehutanan Tahun 2018*. doi: 10.1017/CBO9781107415324.004.

Kling, R. (1992) 'Audiences, Narratives, and Human Values in Social Studies of Technology',

Sicence, Technology & Human Values, 17(3), pp. 349–365.

Kling, R., Mckim, G. and King, A. (2003) *A Bit More to It: Scholarly Communication Forums as Socio-Technical Interaction Networks*.

Koh, L. P. and Wich, S. A. (2012) 'Dawn of drone ecology: Low-cost autonomous aerial vehicles for conservation', *Tropical Conservation Science*, 5(2), pp. 121–132. doi: 10.1177/194008291200500202.

Krishnasamy, K. and Zavagli, M. (2020) *Southeast Asia: At the heart of wildlife trade*. Petaling Jaya, Selangor, Malaysia. Available at: https://www.traffic.org/site/assets/files/12648/sea-traps-february-2020.pdf (Accessed: 21 September 2020).

Lahoz-Monfort, J. J. *et al.* (2019) 'A Call for International Leadership and Coordination to Realize the Potential of Conservation Technology', *BioScience*, 69(10), pp. 823–832. doi: 10.1093/biosci/biz090.

Latour, B. (2005) *Reassembling the social: an introduction to actor-network-theory*. Oxford: Oxford University Press.

Latour, B. and Woolgar, S. (1979) *Laboratory Life: the social construction of scientific facts*. Beverly Hills; London: Sage Publications.

Leckart, S. (2012) 'The Hackathon Is On: Pitching and Programming the Next Killer App | WIRED', *Wired*. Available at: https://www.wired.com/2012/02/ff_hackathons/ (Accessed: 13 November 2019).

Lemieux, A. *et al.* (2014) *Situational prevention of poaching*. Edited by A. Lemieux. Routledge.

Leverington, F. *et al.* (2010) 'A global analysis of protected area management effectiveness', *Environmental Management*, 46(5), pp. 685–698. doi: 10.1007/s00267-010-9564-5.

Lewis, M. (2005) 'OpenMAX ™ Integration Layer Application Programming Interface Specification Errata', *Journal of the History of Biology*, 38, pp. 185–207. doi: 10.1007/s10739-004-1486-1.

Li, T. M. (2007) *Governmentality*, *Anthropologica*.

Liker, J. . and Majchrzak, A. (1994) 'Designing the human infrastructure for technology', in Karwowski, W. and Salvendy, G. (eds) *Organization and Management of Advanced Manufacturing*. New York: John Wiler & Sons, pp. 121–164. Available at: https://books.google.co.uk/books?hl=en&lr=&id=Mz_tLNoWaPkC&oi=fnd&pg=PA121&dq

=human+infrastructure+technology&ots=aPfvHDImeh&sig=evy3xCbwOtr8P7jAYRl3912jb1g&redir_esc=y#v=onepage&q=human infrastructure technology&f=false (Accessed: 19 June 2020).

Linkie, M. *et al.* (2014) 'Breaking the Vicious Circle of Illegal Logging in Indonesia', *Conservation Biology*, 28(4), pp. 1023–1033. doi: 10.1111/cobi.

Linkie, M. *et al.* (2015) 'Safeguarding Sumatran tigers: Evaluating effectiveness of law enforcement patrols and local informant networks', *Journal of Applied Ecology*, 52(4), pp. 851–860. doi: 10.1111/1365-2664.12461.

Lorimer, J. (2017) 'Probiotic Environmentalities: Rewilding with Wolves and Worms', *Theory, Culture and Society*, 34(4), pp. 27–48. doi: 10.1177_0263276417695866.

Lövbrand, E. and Stripple, J. (2011) 'Making climate change governable: accounting for carbon as sinks, credits and personal budgets', *Critical Policy Studies*, 5(2), pp. 187–200. doi: Critical Policy Studies, Vol. 5, No. 2, July 2011, pp. 187–200.

Lucas, A. and Warren, C. (2013) *Land for the People: The State and Agrarian Conflict in Indonesia*. Ohio University Press. Available at: https://ebookcentral.proquest.com/lib/sheffield/detail.action?docID=1743657&pq-origsite=primo (Accessed: 16 October 2020).

Luke, T. W. (1999) 'Environmentality as Green Governmentality', in Darier, E. (ed.) *Discourses of the Environment*. Oxford, UK; Malden, MA, USA: Blackwell Publishers, pp. 121–151.

Lund, C. (2014) 'Of What is This a Case?: Analytical Movements in Qualitative Social Science Research', *Human Organization*, 73(3), pp. 224–234. doi: 10.17730/humo.73.3.e35q482014x033l4.

Lunstrum, E. (2015) 'Conservation Meets Militarisation in Kruger National Park: Historical Encounters and Complex Legacies', *Conservation and Society*, 13(4), pp. 356–369. doi: 10.4103/0972-4923.179885.

Lunstrum, E. (2016) 'Conservation Meets Militarisation in Kruger National Park: Historical Encounters and Complex Legacies', *Conservation and Society*, 13(4), p. 356. doi: 10.4103/0972-4923.179885.

Van Maanen, J. and Kolb, D. (1985) '"The Professional Apprentice: Observations on Fieldwork Roles in Two Organizational Settings"', *Research in the Sociology of Organizations*, 4, pp. 1–33.

Mabele, M. B. (2017) 'Beyond forceful measures: Tanzania's "war on poaching" needs diversified

strategies more than militarised tactics', *Review of African Political Economy*, 44(153). doi: 10.1080/03056244.2016.1271316.

Madianou, M. (2019) 'Technocolonialism: Digital Innovation and Data Practices in the Humanitarian Response to Refugee Crises', *Social Media + Society*, (July-September), pp. 1–13. doi: 10.1177/2056305119863146.

Marcus, G. E. (1995) 'Ethnography in/of the World System: The Emergence of Multi-Sited Ethnography', *Annual Review of Anthropology*, 24(1), pp. 95–117. doi: 10.1146/annurev.an.24.100195.000523.

Margono, B. A. *et al.* (2014) 'Primary forest cover loss in Indonesia over 2000-2012'. doi: 10.1038/NCLIMATE2277.

Margulies, J. (2018) 'The Conservation Ideological State Apparatus', *Conservation and Society*, 16(2), p. 181. doi: 10.4103/cs.cs_16_154.

Marler, J. H. and Liang, X. (2012) 'Information technology change, work complexity and service jobs: A contingent perspective', *New Technology, Work and Employment*, 27(2), pp. 133–146. doi: 10.1111/j.1468-005X.2012.00280.x.

Marvin, D. C. *et al.* (2016) 'Integrating technologies for scalable ecology and conservation', *Global Ecology and Conservation*. doi: 10.1016/j.gecco.2016.07.002.

Marx, K. (2013) *Capital Vol 1 and 2*. Ware, Hertfordshire: Wordsworth.

Massé, F. (2019) 'Conservation Law Enforcement: Policing Protected Areas'. doi: 10.1080/24694452.2019.1630249.

Massé, F. *et al.* (2020) 'Conservation and crime convergence? Situating the 2018 London illegal wildlife trade conference', *Journal of Political Ecology*, 27(1), pp. 23–42. doi: 10.2458/v27i1.23543.

Massé, F. and Margulies, J. D. (2020) 'The geopolitical ecology of conservation: The emergence of illegal wildlife trade as national security interest and the re-shaping of US foreign conservation assistance', *World Development*, 132, p. 104958. doi: 10.1016/j.worlddev.2020.104958.

Mateescu, A. and Elish, M. C. (2019) 'AI in Context: The Labor of Integrating New Technologies AI in Context', pp. 1–54. Available at: https://datasociety.net/wp-content/uploads/2019/01/DataandSociety_AIinContext.pdf.

Mayo, E. (1946) *The human problems of an industrial civilization*. 2nd editio. Boston, Mass.: Harvard University.

Mbaria, J. and Ogada, M. (2017) *The Big Conservation Lie*. Auburn, Washington, USA: Lens & Pens Publishing.

McCarthy, J. F. (2002) 'Power and interest on Sumatra's rainforest frontier: Clientelist coalitions, illegal logging and conservation in the Alas Valley', *Journal of Southeast Asian Studies*, 33(1), pp. 77–106. doi: 10.1017/S0022463402000048.

McCarthy, J. F. (2006) *The Fourth Circle. A political ecology of Sumatra's Rainforest Frontier*. Stanford, California: Stanford University Press.

McCarthy, J. F. (2011) 'The limits of legality: state, governance and resource control in Indonesia', in Aspinall, E. and van Klinken, G. (eds) *The State and Illegality in Indonesia*. Leiden: KITLV Leiden, pp. 89–106.

McGivney, A. (2019) '"Yanked from the ground": cactus theft is ravaging the American desert', *The Guardian*. Available at: https://www.theguardian.com/environment/2019/feb/20/to-catch-a-cactus-thief-national-parks-fight-a-thorny-problem (Accessed: 20 November 2019).

Meridian, A. H. *et al.* (2018) *SVLK: Proses Menuju Tata Kelola Bertanggung Gugat by Jaringan Pemantau Independen Kehutanan*. Bogor. Available at: https://issuu.com/jaringanpemantauindependenkehutanan/docs/svlk__proses_menuju_tata_kelola_ber (Accessed: 12 April 2021).

Meyer, E. T. (2007) *Socio-Technical Perspectives on Digital Photography: Scientific Digital Photography Use by Marine Mammal Researchers*.

Meyer, E. T. (2014) 'Examining the Hyphen: the Value of Social Informatics for Research and Teaching', *Social Informatics: Past, Present and Future*, pp. 56–72. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2479323.

Ministry of Environment and Forestry Indonesia (2018) *The state of Indonesia's forests 2018*.

Misany, B. and Fiantis, D. (2018) '"Helicopter research": who benefits from international studies in Indonesia?', *The Conversation*. Available at: https://theconversation.com/helicopter-research-who-benefits-from-international-studies-in-indonesia-102165 (Accessed: 1 May 2020).

Mitchell, T. and Brynjolfsson, E. (2017) 'Track how technology is transforming work', *Nature*, 544(7650), pp. 290–292. doi: 10.1038/544290a.

Moreto, W. D. (2015) 'Introducing intelligence-led conservation: bridging crime and conservation science', *Crime Science*, 4, p. 15. doi: 10.1186/s40163-015-0030-9.

Moreto, W. D. (2016) 'Occupational stress among law enforcement rangers: Insights from Uganda', *Oryx*, 50(4), pp. 646–654. doi: 10.1017/S0030605315000356.

Moreto, W. D. *et al.* (2017) 'Occupational motivation and intergenerational linkages of rangers in Asia', *Oryx*, pp. 1–10. doi: 10.1017/s0030605317001041.

Moreto, W. D., Brunson, R. K. and Braga, A. A. (2015) 'Such misconducts don't make a good ranger: Examining law enforcement ranger wrongdoing in Uganda', *British Journal of Criminology*, 55(2), pp. 359–380. doi: 10.1093/bjc/azu079.

Moreto, W. D., Lemieux, A. M. and Nobles, M. R. (2016) '"It's in my blood now": the satisfaction of rangers working in Queen Elizabeth National Park, Uganda', *Oryx*, 50(4), pp. 655–663. doi: 10.1017/s0030605316000387.

Mullings, B. (1999) 'Insider or outsider, both or neither: some dilemmas of interviewing in a cross-cultural setting', *Geoforum*, 30, pp. 337–350. doi: 10.1177/1744987106056956.

Murray Li, T. (2007) *The Will to Improve. Governmentality, Development and the Practice of Politics*. Duke University Press. Available at: https://ebookcentral.proquest.com/lib/sheffield/detail.action?docID=1170540.

Muth, R. M. and Bowe, J. F. (1998) 'Illegal harvest of renewable natural resources in North America: Toward a typology of the motivations for poaching', *Society & Natural Resources*, 11(1), pp. 9–24. doi: 10.1080/08941929809381058.

Myers, N. *et al.* (2000) 'Biodiversity hotspots for conservation priorities', *Nature*, 403(6772), p. 853. doi: doi:10.1038/35002501.

Myers, N. (2003) 'Biodiversity Hotspots Revisited', *BioScience*, 23(10), pp. 916–917. Available at: http://dx.doi.org/.

Nasution, Z. P. (2018) *Forest Conservation , Mining and Local Responses : Drawing the Boundaries in Batang Gadis National Park, North Sumatra, Indonesia*. The University of Leeds.

Nebeker, D. M. and Tatum, B. C. (1993) 'The Effects of Computer Monitoring, Standards, and Rewards on Work Performance, Job Satisfaction, and Stress', *Journal of Applied Social Psychology*, 23(7), pp. 508–536. doi: 10.1111/j.1559-1816.1993.tb01101.x.

Neumann, R. P. (1998) *Imposing wilderness: struggles over livelihoods and nature preservation in Africa*. Berkeley and Los Angeles, California, US; London, UK: University of California Press.

Nijman, V. (2017) 'Orangutan trade, confiscations, and lack of prosecutions in Indonesia',

American Journal or Primatology, 79. doi: 10.1002/ajp.22652.

Nugraha, Y. and Sastrosubroto, A. S. (2015) 'Towards Data Sovereignty in Cyberspace', in *The 3rd International Conference of Information and Communication Technology*.

O'Mahony, S. (2007) 'The governance of open source initiatives: What does it mean to be community managed?', *Journal of Management and Governance*, 11(2), pp. 139–150. doi: 10.1007/s10997-007-9024-7.

O'Neil, C. (2016) *Weapons of math destruction : how big data increases inequality and threatens democracy*. Crown Books.

Oels, A. (2005) 'Rendering climate change governable: From biopower to advanced liberal government?', *Journal of Environmental Policy and Planning*, 7(3), pp. 185–207. doi: Journal of Environmental Policy & Planning, Vol. 7, No. 3, September 2005, pp. 185–207.

Ojanperä, S., O'Clery, N. and Graham, M. (2018) *Data science, artificial intelligence and the futures of work*. doi: 10.5281/ZENODO.1475162.

Oliver, W. M. and Meier, C. A. (2006) '"Duck Cops", "Game Wardens" and "Wildlife enforcement": Stress Among Conservation Officers', *Applied Psychology in Criminal Justice*, 2(1).

Orme, C. D. L. *et al.* (2005) 'Global hotspots of species richness are not congruent with endemism or threat', *Nature*, 436(7053), pp. 1016–1019. doi: doi:10.1038/nature03850.

Palmer, C. . and Bryant, C. . (1985) 'Keepers of the King's deer: game wardens and the enforcement of fish and wildlife law', in Byrant, C. . et al. (eds) *The rural workforce: non-agricultural occupations in America*. Bergin and. South Hadley, MA.

Parameswaran, P. (2015) 'Explaining Indonesia's "Sink The Vessels" Policy Under Jokowi – The Diplomat', *The Diplomat*. Available at: https://thediplomat.com/2015/01/explaining-indonesias-sink-the-vessels-policy-under-jokowi/ (Accessed: 23 September 2020).

Patin, T. (1999) 'Exhibitions and empire: National parks and the performance of manifest destiny', *Journal of American Culture*, 22(1), pp. 41–60. Available at: http://proquest.umi.com.sheffield.idm.oclc.org/pqdweb?did=000000054554270&Fmt=4&clientId=43168&RQT=309&VName=PQD.

Peluso, N. L. (1992) 'The Political Ecology of Extraction and Extractive Reserves in East Kalimantan, Indonesia', *Development and Change*, 23(4), pp. 49–74. doi: 10.1111/j.1467-7660.1992.tb00469.x.

Peluso, N. L. (1993) 'Coercing conservation?. The politics of state resource control', *Global Environmental Change*, 3(2), pp. 199–217. doi: 10.1016/0959-3780(93)90006-7.

Peluso, N. L. (1994) *Rich Forests, Poor People. Resource Control and Resistance in Java*. University of California Press. Available at: https://www.ucpress.edu/book/9780520089310/rich-forests-poor-people (Accessed: 15 September 2020).

Peluso, N. L. (2012) 'What's Nature Got To Do With It? A Situated Historical Perspective on Socio-natural Commodities', *Development and Change*, 43(1), pp. 79–104. doi: 10.1111/j.1467-7660.2012.01755.x.

Peluso, N. L., Afiff, S. and Rachlan, N. F. (2008) 'Claiming the Grounds for Reform: Agrarian and Environmental Movements in Indonesia', *Journal of Agrarian Change*, 8(2–3), pp. 377–407. doi: 10.1111/j.1471-0366.2008.00174.x.

Peluso, N. L. E. and Vandergeest, P. (2001) 'Genealogies of the Political Forest and Customary Rights in Indonesia , Malaysia , and Thailand', *The Journal of Asian Studies*, 60(3), pp. 761–812. doi: 10.1111/j.1467-8330.1995.tb00286.x.

Peluso, N. L. and Vandergeest, P. (2001) 'Genealogies of the Political Forest and Customary Rights in Indonesia, Malaysia and Thailand', *The Journal of Asian Studies*, 60(3), pp. 761–812. Available at: http://dx.doi.org/.

Peluso, N. L., Vandergeest, P. and Potter, L. (1995) 'Social Aspects of Forestry in Southeast Asia: A Review of Postwar Trends in the Scholarly Literature', *Journal of Southeast Asian Studies*, 26(01), pp. 196–218. doi: 10.1017/S0022463400010584.

Pennaz, A. B. K. (2017) 'Is that Gun for the Bears? The National Park Service Ranger as a Historically Contradictory Figure', *Conservation & Society*, 15(3), pp. 243–254. doi: 0972-4923.

Phippen, W. J. (2016) 'Busting Cactus Smugglers in the American West - The Atlantic', *The Atlantic*. Available at: https://www.theatlantic.com/science/archive/2016/02/cactus-thieves/470070/ (Accessed: 20 November 2019).

Pianta, M. (2018) *Technology and Employment: Twelve Stylised Facts for the Digital Age*, *Indian Journal of Labour Economics*. Springer India. doi: 10.1007/s41027-018-0124-5.

Pierce, L., Snow, D. C. and McAfee, A. (2015) 'Cleaning House: The Impact of Information Technology Monitoring on Employee Theft and Productivity', *Management Science*, 61(10), pp. 2299–2319. doi: 10.2139/ssrn.2318592.

Pimm, S. L. *et al.* (2015) 'Emerging Technologies to Conserve Biodiversity', *Trends in Ecology and Evolution*, 30(11), pp. 685–696. doi: 10.1016/j.tree.2015.08.008.

Pinch, T. J. and Bijker, W. E. (1984) 'The Social COnstruction of Facts and Artefacts: How the Sociology of Science and the Sociology of Technology might Benefit Each Other', *Social Studies of Science*, 14, pp. 399–441.

Pinto, R. Á. (2018) 'Digital Sovereignty or Digital Colonialism?', *Sur International Journal on Human Rights*, 15(27), p. 15. Available at: https://sur.conectas.org/wp-content/uploads/2018/07/sur-27-ingles-renata-avila-pinto.pdf (Accessed: 17 December 2019).

Poppe, J. (2012) 'Conservation's Ambiguities: Rangers on the Periphery of the W Park, Burkina Faso', *Conservation & Society*, 10(4), pp. 330–343. doi: 0972-4923.

Potter, L. and Badcock, S. (2001) *The Effects of Indonesia's Decentralisation on Forests and Estate Crops in Riau Province: Case Studies of the Original Districts of Kampar and Indragiri Hulu Case Studies on Decentralisation and Forests in Indonesia*.

Potter, L. and Badcock, S. (2004) 'Tree crop smallholders, capitalism, and adat: Studies in Riau Province, Indonesia', *Asia Pacific Viewpoint*, 45(3), pp. 341–356. doi: 10.1111/j.1467-8373.2004.00245.x.

Prince, P. *et al.* (2019) 'Deploying acoustic detection algorithms on low-cost, open-source acoustic sensors for environmental monitoring', *Sensors (Switzerland)*, 19(3), pp. 1–23. doi: 10.3390/s19030553.

Radjawali, I., Pye, O. and Flitner, M. (2017) 'Recognition through reconnaissance? Using drones for counter-mapping in Indonesia', *The Journal of Peasant Studies*, 44(4), pp. 817–833. doi: 10.1080/03066150.2016.1264937.

Ramkumar, P. (2018) 'M-STrIPES app to aid foresters', *The Times of India*. Available at: https://timesofindia.indiatimes.com/city/coimbatore/m-stripes-app-to-aid-foresters/articleshow/66119051.cms (Accessed: 22 May 2020).

Ranganathan, A. and Benson, A. (2017) *While Workers Engaged in Complex Work Understood Monitoring As Coercive*.

Rangarajan, M. (2001) *India's Wildlife History: An Introduction*. Available at: https://books.google.co.uk/books?id=a89yMml_etQC&printsec=frontcover&dq=india%27s+wildlife+history&hl=en&sa=X&ved=2ahUKEwih8YiWprvrAhUDhlwKHcrdB-

EQ6AEwAHoECAMQAg#v=onepage&q=india's wildlife history&f=false (Accessed: 19 December 2019).

Ravid, D. M. *et al.* (2020) 'EPM 20/20: A Review, Framework, and Research Agenda for Electronic Performance Monitoring', *Journal of Management*, 46(1), pp. 100–126. doi: 10.1177/0149206319869435.

Ravindran, S. (2014) 'India is now tracking its tigers by counting their stripes — Quartz India', *Quartz India*. Available at: https://qz.com/india/310448/india-is-tracking-its-tigers-by-counting-their-stripes/ (Accessed: 19 December 2019).

Reid, A. (2014) *The Blood of the People: Revolution and the End of Traditional Rule in* . Singapore: NUS Press. Available at: https://nuspress.nus.edu.sg/products/the-blood-of-the-people (Accessed: 25 September 2020).

Ribot, J. C., Agrawal, A. and Larson, A. M. (2006) 'Recentralizing While Decentralizing: How National Governments Reappropriate Forest Resources', *World Development*, 34(11), pp. 1864–1886. doi: 10.1016/j.worlddev.2005.11.020.

Rieffel, A. and Pramodhawardani, J. (2007) *Out of business and on budget : the challenge of military financing in Indonesia*. United States-Indonesia Society.

Risdianto, D. *et al.* (2016) 'Examining the shifting patterns of poaching from a long-term law enforcement intervention in Sumatra', *Biological Conservation*, 204, pp. 306–312. doi: 10.1016/j.biocon.2016.10.029.

de Rivaz, C. *et al.* (2019) *Turning the tide? Learning from Responses to Large-Scale Illegal Unreported and Unregulated Fishing in Five Countries*. London. doi: 10.1890/1540-9295-7.8.447.

Robbins, P. (2012) *Political ecology : a critical introduction*. 2nd edn. Chichester, West Sussex; Malden MA: J.Wiley & Sons. Available at: http://find.shef.ac.uk/primo_library/libweb/action/dlDisplay.do?vid=SFD_VU2&afterPDS=true&docId=44SFD_ALMA_DS21239865750001441.

Rocheleau, D. E. (2008) 'Political ecology in the key of policy: from chains of explanations to webs of relation', *Geoforum*, 39(2), pp. 16–727. Available at: http://dx.doi.org/.

Rochmyaningsih, D. (2018) 'Study of "sea nomads" under fire in Indonesia', *Science*. American Association for the Advancement of Science, pp. 318–319. doi: 10.1126/science.361.6400.318.

Rochmyaningsih, D. (2019) 'Indonesia gets tough on foreign scientists', *Science Mag*, pp. 304–305.

doi: 10.1126/science.365.6451.304.

Rochmyaningsih, D. (2020) 'Wildfire researcher deported amid growing rift between Indonesian government and scientists', *Science*, 12 February. doi: 10.1126/science.abb2763.

Rogers, K. (2017) 'Camera Traps Are Now Watching Poachers, Instead of Wildlife - VICE', *Motherboard*. Available at: https://www.vice.com/en_us/article/43dyzp/camera-traps-are-now-watching-poachers-instead-of-wildlife (Accessed: 26 February 2020).

Rose, N. (1999) *Powers of Freedom*. Cambridge: Cambridge University Press.

Rose, N., O'Malley, P. and Valverde, M. (2006) 'Governmentality', *Annual Review of Law and Social Science*, 6, pp. 83–104. doi: 10.1146/annurev.lawsocsci.2.081805.105900.

Rothe, D. (2017) 'Seeing like a satellite: Remote sensing and the ontological politics of environmental security', *Security Dialogue*, 48(4), pp. 334–353. doi: 10.1177_0967010617709399.

Rutherford, S. (2007) 'Green governmentality: Insights and opportunities in the study of nature's rule', *Progress in Human Geography*, 31(3), pp. 291–307. doi: 10.1177/0309132507077080.

Rye, S. A. and Kurniawan, N. I. (2017) 'Claiming indigenous rights through participatory mapping and the making of citizenship', *Political Geography*, 61, pp. 148–159. doi: 10.1016/j.polgeo.2017.08.008.

Sadikin, L. *et al.* (2016) *SMART-RBM Buku II. Modul Aplikasi SMART-RBM*. Jakarta.

Safitri, M. A. (2016) 'Dividing the Land: Legal Gaps in the Recognition of Customary Land in Indonesian Forest Areas', *Kasarinlan: Philippine Journal of Third World Studies*, 30(2,1), pp. 31–48.

Saldaña, J. (2009) *The coding manual for qualitative researchers*. 1st edn. London: SAGE.

Sambasivan, N. and Smyth, T. (2010) 'The human infrastructure of ICTD', *ACM International Conference Proceeding Series*. doi: 10.1145/2369220.2369258.

Samson, R. *et al.* (2019) *Exploring the potential for data trusts to help tackle the illegal wildlife trade*. Available at: http://www.ghbook.ir/index.php?name=فرهنگ و رسانه های نوین&option=com_dbook&task=readonline&book_id=13650&page=73&chkhashk=ED9C9491B4&Itemid=218&lang=fa&tmpl=component.

Sandbrook, C. (2015a) 'The social implications of using drones for biodiversity conservation', *Ambio*, 44(4), pp. 636–647. doi: 10.1007/s13280-015-0714-0.

Sandbrook, C. (2015b) 'What is conservation?', *Oryx*, 49(4), pp. 565–566. doi:

10.1017/S0030605315000952.

Sandbrook, C., Luque-Lora, R. and Adams, W. M. (2018) 'Human Bycatch: Conservation Surveillance and the Social Implications of Camera Traps', *Conservation and Society*, pp. 1–12.

Schlogl, L. and Sumner, A. (2020) *Disrupted Development and the Future of Inequality in the Age of Automation*, *Disrupted Development and the Future of Inequality in the Age of Automation*. Springer International Publishing. doi: 10.1007/978-3-030-30131-6.

Scott, J. (1998) *Seeing like a state : how certain schemes to improve the human condition have failed*. New Haven, Conn.; London: Yale University Press. Available at: http://find.shef.ac.uk/primo_library/libweb/action/dlDisplay.do?vid=SFD_VU2&afterPDS=true&docId=44SFD_ALMA_DS21188956120001441.

Seaver, N. (2017) 'Algorithms as culture: Some tactics for the ethnography of algorithmic systems', *Big Data and Society*, 4(2), pp. 1–12. doi: 10.1177/2053951717738104.

Seccombe, S. (2019) *Instant Detect 2.0 emerges*, *Wildlabs.net*. Available at: https://www.wildlabs.net/resources/case-studies/instant-detect-20-emerges (Accessed: 19 November 2019).

Sewell, G. and Wilkinson, B. (1992) '"Someone to Watch Over Me": Surveillance, Discipline and the Just-in-time Labour Process', *Sociology*, 26(2), pp. 271–289.

Shahab, N. (2016) *Taking stock of Indonesia's social forestry program*. Available at: https://forestsnews.cifor.org/58344/taking-stock-of-indonesias-social-forestry-program?fnl=en (Accessed: 29 November 2018).

Sherblom, J. C., Keränen, L. and Withers, L. A. (2002) 'Tradition, tension, and transformation: A structuration analysis of a game warden service in transition', *Journal of Applied Communication Research*, 30(2), pp. 143–162. doi: 10.1080/00909880216579.

Shrestha, Y. and Lapeyre, R. (2018) 'Modern Wildlife Monitoring Technologies: Conservationists versus Communities? A Case Study: The Terai-Arc Landscape, Nepal', *Conservation and Society*, 16(1), pp. 91–101. doi: 10.4103/cs.cs_16_83.

Sintov, N., Seyranian, V. and Lyet, A. (2018) 'Fostering adoption of conservation technologies: a case study with wildlife law enforcement rangers', *Oryx*, (May), pp. 1–5. doi: 10.1017/S0030605317001533.

Sivaramakrishnan, K. (1999) *Modern forests: Statemaking and Environmental Change in Colonial Eastern*

India. Stanford University Press. Available at: http://books.google.com/books?id=TM7oYBG4M04C (Accessed: 22 May 2020).

Sloan, S. (2014) 'Indonesia's moratorium on new forest licenses: An update', *Land Use Policy*, 38, pp. 37–40. doi: 10.1016/j.landusepol.2013.10.018.

SMART Partnership (2015) *SMART Partnership Annual Report*.

SMART Partnership (2016) *SMART Partnership Annual Report*.

SMART Partnership (2018) *SMART Partnership 2018 Annual Report*.

SMART Partnership (no date a) *Get the SMART solution for your protected area*.

SMART Partnership (no date b) *Join the SMART partnership*.

Smith, M. J. *et al.* (1992) 'Employee stress and health complaints in jobs with and without electronic performance monitoring', *Applied Ergonomics*, 23(1), pp. 17–27. doi: 10.1016/0003-6870(92)90006-H.

Sobreperez, P., Ferneley, E. and Wilson, F. (2005) 'Tricks or trompe l'oeil? : An examination [of] workplace resistance in an information rich managerial environment', in *Proceedings of the Thirteenth European Conference on Information Systems*, pp. 484–494. Available at: http://www.informatik.uni-trier.de/~ley/db/conf/ecis/ecis2005.html.

Sodikoff, G. (2009) 'The low-wage conservationist: Biodiversity and perversities of value in Madagascar', *American Anthropologist*, 111(4), pp. 443–455. doi: 10.1111/j.1548-1433.2009.01154.x.

Spaan, D. *et al.* (2019) 'Thermal Infrared Imaging from Drones Offers a Major Advance for Spider Monkey Surveys', *Drones*, 3(2), p. 34. doi: 10.3390/drones3020034.

Spira, C., Kirkby, A. E. and Plumptre, A. J. (2019) 'Understanding ranger motivation and job satisfaction to improve wildlife protection in Kahuzi–Biega National Park, eastern Democratic Republic of the Congo', *Oryx*, pp. 1–9. doi: 10.1017/S0030605318000856.

Sprague, R. (2007) 'From Taylorism to the Omnipticon: Expanding Employee Surveillance beyond the Workplace', *Journal of Computer and Information Law*, 25, pp. 1–35.

Stanton, J. M. (2000) 'Reactions to Employee Performance Monitoring : Framework , Review, and Research Directions', *Human Performance*, 13(1), pp. 85–113. doi: 10.1207/S15327043HUP1301.

Stanton, J. M. and Julian, A. L. (2002) 'The impact of electronic monitoring on quality and quantity of performance', *Computers in Human Behavior*, 18(1), pp. 85–101. doi: 10.1016/S0747-

5632(01)00029-2.

Steedly, M. M. (2013) *Rifle reports: A story of Indonesian independence*, *Rifle Reports: A Story of Indonesian Independence*. University of California Press. doi: 10.1355/sj30-3h.

Stokes, E. J. (2010) 'Improving effectiveness of protection efforts in tiger source sites: Developing a framework for law enforcement monitoring using MIST', *Integrative Zoology*, 5(4), pp. 363–377. doi: 10.1111/j.1749-4877.2010.00223.x.

Stoler, A. (1995) *Capitalism and Confrontation in Sumatra's Plantation Belt, 1870-1979*, *Capitalism and Confrontation in Sumatra's Plantation Belt, 1870-1979*. Ann Harbor: University of Michigan Press. doi: 10.3998/mpub.23838.

Stolton, S. and Dudley, N. (2016) *METT Handbook: A guide to using the Management Effectiveness Tracking Tool (METT)*.

Strikwerda, L. (2020) 'Predictive policing: The risks associated with risk assessment', *The Police Journal: Theory, Practice and Principles*, p. 0032258X2094774. doi: 10.1177/0032258X20947749.

Swyngedouw, E. (1999) '"Modernity and Hybridity: Nature, Regeneracionismo, and the Production of the Spanish Waterscape, 1890-1930"', *Annals of the Association of American Geographers*, 84, pp. 443–65.

Tacconi, L., Rodrigues, R. J. and Maryudi, A. (2019) 'Law enforcement and deforestation: Lessons for Indonesia from Brazil', *Forest Policy and Economics*, 108, p. 101943. doi: 10.1016/j.forpol.2019.05.029.

Tang, C., Chen, Y. and Roberson, J. (2015) 'Restructuring Human Infrastructure: The Impact of EHR Deployment in a Volunteer-Dependent Clinic', in *CSCW '15: Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing*, pp. 649–661.

The Economist (2013) 'Espionage and America - Rules for spies '. Available at: https://www.economist.com/leaders/2013/11/02/rules-for-spies (Accessed: 22 May 2020).

The Jakarta Post (2019) 'New law allows Indonesia to jail foreign researchers for breaking rules - National - The Jakarta Post'. Available at: https://www.thejakartapost.com/news/2019/07/16/house-passes-bill-imposing-criminal-charges-on-foreign-researchers-into-law.html (Accessed: 1 May 2020).

The Royal Society (2018) *Science : tackling the illegal wildlife trade. Technology Update*.

The Times of India (2019) 'Monitoring of tigers set for a leap with M-STrIPES ', *The Times of India*.

Available at: https://timesofindia.indiatimes.com/city/kochi/monitoring-of-tigers-set-for-a-leap-with-m-stripes/articleshow/68465603.cms (Accessed: 22 May 2020).

The World Bank (2006) *Sustaining Indonesia 's Forests. Strategy for the World Bank 2006-2009*. Jakarta.

Thomas, M. and Curless, G. (2017) *Decolonization and Conflict : Colonial Comparisons and Legacies*, *Decolonization and Conflict : Colonial Comparisons and Legacies*. Bloomsbury Academic. doi: 10.5040/9781474250412.

Thornham, H. and Gómez Cruz, E. (2016) 'Hackathons, data and discourse: Convolutions of the data (logical)', *Big Data & Society*, 3(2), p. 205395171667967. doi: 10.1177/2053951716679675.

Tilley, L. (2020) '"The impulse is cartographic": Counter-Mapping Indonesia's Resource Frontiers in the Context of Coloniality', *Antipode*, 52(5), pp. 1434–1454. doi: 10.1111/anti.12634.

Tomczak, D. L., Lanzo, L. A. and Aguinis, H. (2017) 'Evidence-based recommendations for employee performance monitoring', *Business Horizons*, 61(2), pp. 251–259. doi: 10.1016/j.bushor.2017.11.006.

Tsujino, R. *et al.* (2016) 'History of forest loss and degradation in Indonesia', *Land Use Policy*, 57, pp. 335–347. doi: 10.1016/j.landusepol.2016.05.034.

Tulloch, A. I. T. *et al.* (2018) 'A decision tree for assessing the risks and benefits of publishing biodiversity data', *Nature Ecology and Evolution*, 2(8), pp. 1209–1217. doi: 10.1038/s41559-018-0608-1.

Turner, W. *et al.* (2015) 'Free and open-access satellite data are key to biodiversity conservation', *Biological Conservation*, 182, pp. 173–176. doi: 10.1016/j.biocon.2014.11.048.

U.S. Department of Justice (2019) 'Promoting Public Safety, Privacy, and the Rule of Law Around the World: The Purpose and Impact of the CLOUD Act (White Paper)', (April), p. 18.

Van Uhm, D. P. and Moreto, W. D. (2018) 'Corruption Within the Illegal Wildlife Trade: A Symbiotic and Antithetical Enterprise', *British Journal of Criminology*, 58(4). doi: 10.1093/bjc/azx032.

UNEP-WCMC (2014) *Megadiverse Countries definition*, *Biodiversity A-Z*. Available at: https://www.biodiversitya-z.org/content/megadiverse-countries (Accessed: 22 September 2020).

United Nations Environment Programme (UNEP) (2014) 'Emerging Technologies: Smarter ways to fight wildlife crime', *Environmental Development*, 12, pp. 62–72. doi: 10.1016/j.envdev.2014.07.002.

Unknown (2018) *Birdcrime 2018 Exposing bird of prey persecution in the UK.*

UNODC (2020) *World Wildlife Crime Report. Trafficking in Protected Species*. Vienna.

US Department of the Interior (2017) *National Park Service. Fiscal Year 2017 Budget Justifications*.

US Department of the Interior (2018) *National Park Service Fiscal Year 2018 Budget Justifications*. Available at: https://www.nps.gov/aboutus/upload/FY-2018-NPS-Greenbook.pdf.

US Department of the Interior (2019) *National Park Service Fiscal Year 2019 Budget Justification*. Available at: https://www.nps.gov/aboutus/upload/FY2019-NPS-Budget-Justification.pdf.

Verma, A., van der Wal, R. and Fischer, A. (2016) 'Imagining wildlife: New technologies and animal censuses, maps and museums', *Geoforum*, 75, pp. 75–86. doi: 10.1016/j.geoforum.2016.07.002.

Vermeulen, C. *et al.* (2013) 'Unmanned Aerial Survey of Elephants', *PLoS ONE*. Edited by A. L. Roca, 8(2), p. e54700. doi: 10.1371/journal.pone.0054700.

Vickers, A. (2012) *A History of Modern Indonesia*. Cambridge University Press.

Wade, R. H. (2002) 'Bridging the digital divide: New route to development or new form of dependency?', *Global Governance*, 8(4), pp. 443–466. doi: 10.1163/19426720-00804005.

Ward, R. H. and Mabrey, D. J. (2013) *Transnational Organized Crime in East Asia and the Pacific. A Threat Assessment*. doi: 10.4135/9781483349091.n7.

Wearn, O. R. and Glover-Kapfer, P. (2017) *Camera trapping for conservation: a guide to best-practices*. Woking, United-Kingdom.

West, P. (2006) 'Environmental Conservation and Mining: Strange Bedfellows in the Eastern Highlands of Papua New Guinea', *The Contemporary Pacific*, 18(2), pp. 295–313. doi: 10.1353/cp.2006.0031.

Westin, A. F. (1992) 'Two key factors that belong in a macroergonomic analysis of electronic monitoring: Employee perceptions of fairness and the climate of organizational trust or distrust', *Applied Ergonomics*, 23(1), pp. 35–42. doi: 10.1016/0003-6870(92)90008-J.

White, R. D. (Robert D. (2008) *Crimes against nature : environmental criminology and ecological justice*. Willan.

Whittle, A. and Spicer, A. (2008) 'Essai Is Actor Network Theory Critique?' doi: 10.1177/0170840607082223.

Widianto, S. (2020) 'Indonesia's forestry ministry ends WWF partnership over fire row - Reuters', *Reuters*. Available at: https://www.reuters.com/article/us-indonesia-environment/indonesias-forestry-ministry-ends-wwf-partnership-over-fire-row-idUSKBN1ZS1F4 (Accessed: 22 May 2020).

Widoyoko, D. (2014) 'Deforestation, rent seeking and local elections in West Kalimantan - Inside Indonesia', *Inside Indonesia*. Available at: https://www.insideindonesia.org/deforestation-rent-seeking-and-local-elections-in-west-kalimantan-4 (Accessed: 17 September 2020).

Wike Huger, J. (2013) *Interview with Jonathan Palmer of the Wildlife Conservation Society*, *Opensource.com*. Available at: https://opensource.com/life/13/6/SMART (Accessed: 19 November 2019).

WILDLABS.NET (2019) *WILDLABS.NET Community Review 2018-2019*.

Wilson, G. (2006) 'Beyond the technocrat? The professional expert in development practice', *Development and Change*, 37(3), pp. 501–523. doi: 10.1111/j.0012-155X.2006.00488.x.

Winkel, G. (2012) 'Foucault in the forests—A review of the use of "Foucauldian" concepts in forest policy analysis', *Forest Policy and Economics*, 16, pp. 81–92. doi: https://doi.org/10.1016/j.forpol.2010.11.009.

Wolcott, H. F. (1990) 'Making a study "more ethnographic"', *Journal of Contemporary Ethnography*, 19(1), pp. 44–72. doi: 10.1177/089124190019001003.

Woolgar, S. and Grint, K. (1991) *Computers and the Transformation of Social Analysis*. Available at: https://www.jstor.org/stable/689920 (Accessed: 23 April 2020).

World Wildlife Fund US (2016) *WWF develops a new technology to stop poachers in their tracks | Stories | WWF*. Available at: https://www.worldwildlife.org/stories/wwf-develops-a-new-technology-to-stop-poachers-in-their-tracks (Accessed: 26 February 2020).

WWF-US (2018) *Annual Report*.

WWF International (2007) *Management Effectiveness Tracking Tool. Reporting Progress at Protected Area Sites. Second Edition*. doi: 10.1136/bmj.1.5114.113-a.

Wyatt, T. *et al.* (2018) 'Corruption and Wildlife Trafficking: Three Case Studies Involving Asia', *Asian Journal of Criminology*, 13(1). doi: 10.1007/s11417-017-9255-8.

Xu, L. *et al.* (2019) 'Stay Ahead of Poachers: Illegal Wildlife Poaching Prediction and Patrol Planning Under Uncertainty with Field Test Evaluations', *ICDE*. Available at: https://github.com/lily-x/paws-public (Accessed: 28 January 2020).

Yang, R. *et al.* (2014) 'Adaptive resource allocation for wildlife protection against illegal poachers', *13th International Conference on Autonomous Agents and Multiagent Systems, AAMAS 2014*, 1(Aamas), pp. 453–460.

Ybarra, M. (2012) 'Taming the jungle, saving the Maya Forest: sedimented counterinsurgency practices in contemporary Guatemalan conservation'. doi: 10.1080/03066150.2012.666974.

Ybarra, M. (2017) *Green Wars. Conservation and Decolonization in the Maya Forest*. Berkley and Los Angeles, US; London, UK: University of California Press.

Yeuk-Mui, M. T. (2001) 'Information technology in frontline service work organization', *Journal of Sociology*, 37(2), pp. 177–206.

Yin, R. K. (2018) *Case Study Research and Applications: Design and Methods*. 6th edn. Los Angeles: SAGE Publications.

Yonariza and Webb, E. L. (2007) 'Rural household participation in illegal timber felling in a protected area of West Sumatra, Indonesia', *Environmental Conservation*, 34(1), pp. 73–82. doi: 10.1017/S0376892907003542.

Youatt, R. (2008) 'Counting Species: Biopower and the Global Biodiversity Census', *Environmental Values*, 17(3), pp. 393–417. doi: info:doi/10.3197/096327108X343149.

Youdelis, M. (2013) 'The competitive (dis)advantage of ecotourism in Northern Thailand', *Geoforum*, 50, pp. 161–171. Available at: http://dx.doi.org/.

Zafir, A. W. A. *et al.* (2011) 'Review Now or never: what will it take to save the Sumatran rhinoceros Dicerorhinus sumatrensis from extinction?', *Oryx*, 45(2), pp. 225–233. doi: 10.1017/S0030605310000864.

Zubroff, S. (1988) *In the age of the smart machine : the future of work and power*. Oxford: Heinemann Professional.

Annex 1: Participant Information Document

Participant Information Sheet

Monitoring technologies and the governance of biodiversity conservation

You are being invited to take part in a research project. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Please take time to decide whether or not you wish to take part. Thank you for reading this.

Purpose of the Project
This research investigates the increasing use of monitoring and mapping technologies for biodiversity conservation. It aims at gaining a better understanding of what the social implications of using these technologies are, what they change for practitioners and conservation planning. Laure Joanny is a visiting fellow at the University Gadjah Mada and this study is conducted as part of a wider European Research Council-funded project based at the University of Sheffield.

This wider research team aims at generating new kinds of empirical data on responses to habitat loss and the wildlife trade from source to consumption sites and to examine the ways in which global conservation policies and programmes have evolved in recent years. This research seeks to provide policy relevant information to government agencies, international organisations and NGOs. The research project is led by Professor Rosaleen Duffy and is based in the Politics Department, University of Sheffield, UK.

Why am I being contacted?
You have important specialist knowledge of the design, implementation or use of data collection and analysis systems in the field of conservation. We believe that your input into this research is critically important and will provide us with unique insights into what changes these technologies bring to conservation practice and planning. As such, our team hope that this research will ultimately provide policy relevant information and advice for key stakeholders in the conservation community.

Do I have to take part?
Participation is entirely voluntary. It is up to you to decide whether to take part or not.
If you do decide to take part, you will be given this information sheet to keep (and be asked to sign a consent form) and you can still withdraw at any time. You do not have to give a reason.

What does it mean for me if I decide to take part?
Laure Joanny will contact you to arrange a convenient time for a semi-structured interview, consisting of open-ended questions about the approach of your organisation to monitoring technologies and your experience of them. Typically interviews last 30 – 60 minutes and are conducted either at your place of work or another agreed location. Interviews will be recorded with your consent; if you prefer not to be recorded that is also fine, and the interviewer will take brief notes instead. Your comments will be anonymised – your name will be kept separate from the transcript and you will be anonymised in any written outputs (papers, policy briefs etc). The project team will be the only individuals given access to the transcript of your interview.

What are the risks of taking part?
The project team have worked carefully to avoid and minimise any potential risks for participants. This research looks critically at the opportunities and challenges of implementing new technologies on conservation projects which some organisations might not view favourably, The research is expressly ***not*** about detecting behaviours which might negatively impact biodiversity or evaluating the performance of specific organisations – instead it centres on understanding general trends in the

responses of practitioners to habitat loss and the wildlife trade. The team will endeavour to ensure that your comments are anonymised; all data will be stored securely on encrypted flash drives and password protected computers. We will not store confidential data on cloud-based platforms for this research project.

What are the benefits of taking part?
As conservation stakeholders enthusiastically adopt a range of monitoring and remote-sensing technologies, a number of questions arise around secure data storage and sharing, data analysis and use as well as the perception of staff on the ground. The project team aim to develop new approaches to assist and support user groups in practical actions. We hope that this research will inform and shape effective conservation strategies.

What if I wish to make a complaint?
We welcome feedback, both positive and negative, in order to improve our research practice. If you wish to make a complaint then please contact the Principal Investigator on the project, Professor Rosaleen Duffy, r.v.duffy@sheffield.ac.uk and Lucy Dunning, the project manager on l.a.dunning@sheffield.ac.uk. If you do not feel that your complaint has been dealt with properly then you can directly contact Lucy Martinez, the research manager in the Department of Politics, who will be able to take the complaint forward to the Head of Department and through the appropriate channels in the University. Her contact details are l.martinez@sheffield.ac.uk/ +44 (0)114 2220665.

Will my taking part be kept confidential?
Yes. All the information we collect will be kept confidential. You will not be named in any reports or publications.

What will happen to the results of the research?
The results will be written up into a Laure Joanny's doctoral thesis, academic publications, policy reports, working papers and presentations for conferences/workshops. We also aim to make a short film about the project, you will not be identified in any of these. Due to the nature of this kind of qualitative research, the information you provide will not be made available for secondary use by other researchers.

Who is funding the research?
This project is funded by a European Research Council Advanced Investigator Award, 2016-2020.

Who has reviewed this project ethically?
This project has obtained ethical approval from the Department of Politics at the University of Sheffield, which is the appropriate authority to carry out reviews for the University Research Ethics Committee. It has also undergone additional ethical review by the European Research Council.

Contact for further information
Please do not hesitate to contact us, Laure Joanny laure.joanny@sheffield.ac.uk/ (+62) 812 1832 8217, Rosaleen Duffy r.v.duffy@sheffield.ac.uk, or Lucy Dunning on l.a.dunning@sheffield.ac.uk (+44) 0114 222 1659 for further information.

Annex 2: Participant Consent Form

Participant Consent Form

Title of Research Project: Using monitoring technologies for environmental conservation – *Menggunakan teknologi untuk konservasi alam*

Interview Identification Number:

TAKING PART IN THIS PROJECT / *MENGIKUTI PROYEK INI*

1. I confirm I have read and understand the participant information sheet and/or the project has been fully explained to me. ☐

Saya menbaca dan mengerti dokumen informasi peserta dan/atau proyek sudah dijelaskan ke saya.

2. I understand that my participation is voluntary and that I am free to withdraw my consent at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions during the interview, I am free to decline. ☐

Saya mengerti kesertaan saya bersifat sukarela dan saya bisa mencabut persetujuan saya tanpa menjelaskan atau tanpa konsekuensi negativ.

3. I agree for the audio recording of my interview (where applicable) to be transcribed for use by the research project team. ☐

Saya setujuh rekaman audio wawancara ini, kalau ada, bisa ditranskripsikan dan mengutipkan oleh tim peneliti

4. I agree for the anonymised responses collected from me to be used in research outputs by project team members only ☐

Saya setujuh anonim yang dikumpulkan dari saya untuk digunakan dalam hasil penelitian oleh anggota tim proyek saja

HOW MY INFORMATION WILL BE USED DURING AND AFTER THIS PROJECT (please initial box)

5. I understand that my responses will be kept strictly confidential and anonymised prior to storage and publication and that my personal data is not accessible to anyone outside the research team. I understand that my name will not be linked with the research, and that I will not be identified or identifiable in any research output. ☐

Saya mengerti jawaban saya akan dijaga kerahasiaannya dan dianonimkan sebelum penyimpanan dan publikasi dan bahwa data pribadi saya tidak dapat diakses oleh siapa pun di luar tim peneliti. Saya mengerti bahwa bahwa saya tidak akan diidentifikasi atau diidentifikasi dalam hasil penelitian.

6. In some cases, interview audios may be transcribed by a third party transcription company, rather than the researcher. I give my consent for the recording of my interview to be shared with these third party transcription companies, on the understanding that no other personal data will be shared with them. I understand that these companies are bound by disclosure agreements that protect my confidentiality. ☐

Kadan kandan rekaman audio wawancara mungkin ditranskripsikan oleh perusahaan transkripsi, bukan peneliti sendiri. Saya setujuh bawah rekaman audio dikirim ke perusahaan transkripsi itu dan mengerti tidak ada data lain yang akan dibagikan dengan mereka.

7. I agree to my anonymised data being saved for 10 years with effect from ……. I understand that the Data Controller for this research project is the University of Sheffield, and that I can request to access my personal data held by the University and/or request its deletion at any time ☐

Saya setujuh bawah data anonim saya yang disimpan selama 10 tahun dengan efek dari tanggal ……

Saya mengerti bahwa Pengontrol Data untuk proyek penelitian ini adalah Universitas Sheffield,

dan saya bisa meminta untuk mengakses data pribadi saya yang dipegang oleh Universitas dan / atau meminta penghapusannya kapan saja

8. I agree to take part in the above research project on the above terms. ☐
Saya sejutuh mengikuti proyek penelitian ini sesuai kondisi ini

PROJECT CONTACT INFORMATION

- General contact for the project: Lucy Dunning, Project Manager, l.a.dunning@sheffield.ac.uk
- Name of project lead researcher: Professor Rosaleen Duffy, r.v,duffy@sheffield.ac.uk
- University of Sheffield Privacy Policy: https://www.sheffield.ac.uk/govern/data-protection/privacy/general
- External contact (for use in event of complaint only): Ms Anne Cutler, Data Protection Officer/Freedom of Information, University of Sheffield, a.cutler@sheffield.ac.uk

_____	_____	_____
Name of Participant / Nama Peserta	Date/ Tanggal	Signature / Tanda Tangan
_____	_____	_____
Name of researcher / Nama Penelitiam	Date/ Tanggal	Signature/ Tanda Tangan

Copies:
Once this has been signed by all parties, the participant should receive a copy of the signed and dated participant consent form, A copy will also be saved in the research data file.