



Do armed field-rangers deter rhino poachers? An empirical analysis



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ABSTRACT

The poaching of rhino for their horns has reached unprecedented levels, and the world can expect to witness their extinction in the wild by 2035 if a breakthrough is not made. The links between poaching, global instability and possibly terrorism have led to substantial investment from the developed world into conservation security development in Africa. Such an investment requires a quantitative monitoring approach that allows for the effectiveness of the expenditure to be determined. By combining criminological deterrence theory and spatially explicit field-ranger patrol monitoring, we develop a framework to measure the presence of field-rangers in the landscape. We test this framework empirically by comparing the presence of field-rangers in the landscape against the presence around 40 rhino poaching incidents. We empirically demonstrate that the analysed field ranger human resources and their deployment in a well-staffed protected area in Africa did not deter rhino poachers.

1. Introduction

Rhinoceros (rhinos) are a group of species synonymous with marked conservation successes and failures. Poaching of rhino for their horn is not a new phenomenon; rhino horn has been coveted and rhinos persecuted for their horns since the 1800s, particularly from the Far East and Yemen (Martin, 1985; Western and Vigne, 1985; Leader-Williams, 1988; Leader-Williams et al., 1990). In Africa, over the last 50–60 years alone, this is the second “catastrophic crisis” facing rhino. Conservation failures during this time are reflected in the functional extinction of the Northern White Rhino (*Ceratotherium simum cottoni*) (Emslie, 2011a, b) and the extinction of the western subspecies of Black Rhinoceros (*Diceros bicornis longipes*) in 2011 (Emslie, 2011a, b). However, major successes have been had as concerted global conservation efforts in the 1990s reversed the negative trends in certain rhino populations, and resulted in and expansion of Southern White Rhinoceros (*Ceratotherium simum simum*) and Southern Black Rhinoceros (*Diceros bicornis bicornis*). The recent upsurge in poaching pressure, attributed in part to the accelerated growth of the Vietnamese middle-class and acutely increased demand for rhino horn as a status symbol (Ayling, 2013; Milliken and Shaw, 2012), has eaten away at this success. Continued loss of rhino threatens these conservation achievements, and even the species themselves, with predictions of the species

extinction in the wild by 2035 (Di Minin et al., 2014).

Protected areas (PAs) form the foundation of global efforts to protect biodiversity (Pfeifer et al., 2012). The majority of rhino are found within state-funded PAs that are patrolled by armed security personnel. The surge in rhino poaching has spawned a reactive increase in investment of substantial human and financial resources aimed at ensuring the safety of the rhino populations within PAs (Duffy, 2014). However, even a protected area with a sufficient contingent of trained and dedicated staff will not achieve its biodiversity conservation objectives if poachers are depleting its biodiversity (Hockings and Phillips, 1999). An inability to prevent poaching within a heavily-patrolled PA may have less to do with total resource allocation than with the strategy by which the resources are deployed. Given that conservation agencies are notoriously underfunded, how those resources are allocated is of utmost importance to ensure the maximum conservation impact.

International institutions have recognised the threat that poaching, along with its illicit revenue generation, has on global security and natural heritage; consequently, funding has been increased dramatically and is being invested into combating wildlife crime. For example, in July 2013 the United States Government committed a Presidential Task Force charged with developing a National Strategy for Combating Wildlife Trafficking. Furthermore, the US government pledged ten

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million US Dollars to African Partners (Office of the Press Secretary, White House, 2013). In February 2014 the Dutch and Swedish postcode lotteries donated 15.4 million Euro to the Peace Parks Foundation (Peace Parks Foundation, 2014). In March 2014, 23.7 million US Dollars was given by the Howard G Buffet Foundation to South African National Parks (The Howard G. Buffet Foundation, 2014). In 2016, GEF released a report showing that over \$1.3 billion was committed by 24 international donors between 2010 and late 2016, which approximated \$190 million per year (The Global Environmental Facility, 2016). With international donations of this magnitude being made, it is imperative that the effectiveness of these expenditures be measured in a manner that allows for the direct cost-benefit analysis to be done.

It is a challenge to quantify the effect/efficacy of law enforcement actions because criminological studies are often too poorly conducted to draw precise or even realistic assessments as they are often retrospective in nature, inferred from interventions that are set up without rigorous experimental design (Paternoster, 2010). However, with the incorporation of increasingly sophisticated patrol monitoring systems such as SMART conservation software (www.smartconservation.org) combined with a Cybertracker based patrol monitoring system (Hamilton, 2012), the quantity and quality of data available for patrol effectiveness analyses has improved. The volume and resolution of these patrol effort data, allow for patrol management to be viewed in a unique manner, linking fine scale spatiotemporal data to poaching activities. As the data volumes increase, new methods need to be developed to analyse the data and feed new information back into the security operations to allow for them to adapt at a rate fast enough to counter the poachers.

1.1. Quantifying the effectiveness of law enforcement action: the Presence framework

Presence is a well-utilized law enforcement concept, referring to whether a law enforcement officer is there at the time a crime is perpetrated. To maximise deterrence; it is important to maximise law enforcement officer presence or at least the perception thereof (Durlauf and Nagin, 2011). The presence of a law enforcement officer at a point in space and time should prevent a crime from happening at that point in space and time, as the threat of sanction is certain and swift. Unless a law enforcement officer is complicit in the act, it then follows that it is possible to measure the spatiotemporal law enforcement presence in an area. In this paper, we utilize the location of field-rangers in space and time to determine their presence. Poaching events are distributed in space and time, and an armed field-ranger team is either there when a poaching crime is committed, or they are not.

In wildlife crime, it is a sound axiom that deterring an activity is more beneficial to maintaining biodiversity objectives than apprehension after the fact. Deterrence refers to the omission of a criminal act because of the fear of sanctions or punishment (Paternoster, 2010). Deterrence theory is well established in criminology, and law enforcement agencies the world over manipulate the Certainty, Severity and Celerity (What is the certainty of a sanction actually being imposed on a perpetrator, how severe is the cost of the sanction if it is imposed and, how quickly the sanction is imposed if it occurs) aspects of sanctions to maximise the deterrence of criminals (Nagin, 2013). A general maxim is that certainty of punishment is more of a deterrent to crime than the severity of punishment (Doob and Webster, 2003; Mendes, 2004). This finding has profound implications for law enforcement strategies and is one of the drivers behind policies on visible policing, with the goal being to allocate police officers, and their criminal justice partners, in ways that heighten the perceived risk of apprehension (Durlauf and Nagin, 2011).

Numerous wildlife crime studies have investigated the effect of law enforcement effort in relation to the levels of illegal activities (Leader-Williams, 1988; Leader-Williams et al., 1990). Spatially explicit analyses are less common, but are recently being developed and demon-

strated in conservation law enforcement (Critchlow et al., 2016, 2015; Hofer et al., 2000; Plumptre et al., 2014) and, there are few clear guidelines for effective field-ranger resource requirements. The International Union for the Conservation of Nature (IUCN) advises a human resource capacity of 1 field-ranger per 100 km² (Emslie and Brooks, 1999) in rhino reserves. However, despite many South African protected areas meeting this goal, rhino poaching has still increased. Although a valuable guideline, it was developed prior to the recent upsurge in poaching and incorporation of GPS based patrol monitoring, and therefore does not take into consideration the increased demand for rhino horn, the price paid to poachers and associated acceptance of risk, or the potential for more detailed investigations. Nor does the universal value take into account the temporal component of field-ranger deployment.

In many, if not the majority of PAs, foot-based patrols are still utilized as a significant deterrent and law enforcement force by PA management. There are financial, human resource and time constraints to managing the staff, equipment and infrastructure necessary to maintain regular foot patrols in a given area. By default, with a finite budget, the maintenance of foot-patrols is made at the expense of other possible interventions such as investing in intelligence operations or specialised anti-poaching units. Concurrently, well-intentioned donor funding is directed to expensive, media-friendly, yet ultimately untested technologies, such as drones and helicopters, sometimes at the expense of foundational security activities.

This paper has addressed a parochial aspect of law enforcement, the optimization of local law enforcement resource distribution. It is important to realize that this optimization process is nested within the larger socio-political landscape of protected area management. Many other factors need to be addressed to ensure a functional and resilient protected area, and these factors are distributed across multiple levels of organization (Cumming et al., 2015). For instance, optimized foot patrols are of no use if there is no ability to prosecute as the entire law enforcement chain is broken, or there is a large disjunct between socio-political values and conservation values (e.g., Barichiev et al. unpublished data). Corruption can undermine all aspects of the law enforcement chain and required good management practices and governance to address (Smith et al., 2015), and demand can change the nature of the threat. Therefore, reducing the demand and increasing governance, and research around mechanisms to achieve this (Biggs et al., 2013, 2016) is inextricable from a debate of environmental law enforcement.

1.2. The presence framework

We investigate Presence as follows: We assume that deterrence is directly proportional to a function of field-ranger presence ($DT \propto f(P)$; where $DT = Deterrence$ and $P = Presence$). We divide field-ranger presence (P) into its two components that can be pragmatically managed; Frequency (F) and Duration (D). Frequency is a measure of how often a field-ranger is in a particular place over a specified time, while Duration is a measure of the length of time a field-ranger spends at a particular place. The distinction between the two has profound implications for how field-rangers are deployed when on patrol, and are already implicitly utilized by law enforcement management when directing observational patrols or general walking patrols.

A patrol group of field-rangers can only be at one place at any one time; it follows then that for any given point in space, the Frequency \times Duration is equal to the presence of field-ranger in that particular place over a specified period ($DT \propto F \times D$). Given that Duration and Frequency are quantifiable, we can plot them to generate what we term a presence framework, depicted in Fig. 1 generated from hypothetical data. The area covered by data points is indicative of the total presence available to law enforcement operations (Fig. 1). The utility of the framework for management is that the frequency and duration of the field-ranger movements can be manipulated in space

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