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SHORT COMMUNICATION

Trends in elephant poaching in the Mid-Zambezi Valley, Zimbabwe: Lessons learnt and future outlook

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1 | INTRODUCTION

The conservation of African elephants (*Loxodonta africana*) has important ecological, economical, cultural and aesthetic values, at both local and global levels (Pittiglio et al., 2014). Despite the important role elephants play as keystone species, their populations have been dwindling due to human activities (Sibanda et al., 2016). The most serious threats to elephant's survival across most of its range include illegal wildlife trade which has been exacerbated by an increase in organised poaching (Ouko, 2013). Poaching for both meat and ivory is by far the most acute problem across Africa according to data derived from the Monitoring the Illegal Killing of Elephants (MIKE) and Elephant Trade Information System (ETIS; WWF, 2017). This is a complex global threat to the survival of the African elephant across most of its range (Dejene et al., 2021; Ouko, 2013; Wittemyer et al., 2014).

Poaching methods are constantly changing and more detrimental methods such as poisoning with cyanide or lead (Muboko et al., 2014; Ogada, 2014) are becoming more common. For instance, during the 2013 dry season, 100–135 elephants were poisoned in Hwange National Park, Zimbabwe (Muboko et al., 2014, 2016). This marked the first instance of mass elephant poisoning in Zimbabwe and poisoning events have been increasing ever since. Conceived consequences of elephant poaching include loss of ecosystem services (Poulsen et al., 2018), biodiversity annihilation (e.g. the death of 219 vultures [Muboko et al., 2014]), loss of community livelihood options (Duffy & St. John, 2013), decline in tourism (Muboko et al., 2016; Naidoo et al., 2016) and loss of Gross Domestic Product (Rademeyer, 2016).

Although anti-poaching efforts are in place (Lunstrum, 2014; Mukwazvure & Magadza, 2014), elephant poaching remains the major driver of elephant decline (e.g. in the Mid-Zambezi Valley, Zimbabwe). The Mid-Zambezi Valley is a critical elephant range area and an ecological corridor for elephant movement between Botswana, Zimbabwe, Zambia and Mozambique (Osborn & Parker, 2003). In 2014, there was an alarming 40% decline in elephant population to 11,656 ± 2259 in the Mid-Zambezi Valley (Dunham, 2015). Following this decline, mainly related to poaching, anti-poaching strategies have increased within the Mid-Zambezi Valley to combat the illegal killing of elephants. Ideally, increased anti-poaching or law enforcement strategies are expected to reduce poaching incidences in any protected area (Mahatara et al., 2018; Mogomotsi & Madigele, 2017). For instance, increased patrol effort allows the early detection of poaching activity (e.g. presence of wire

snares and poisoned salt licks) before any damage is caused thus reducing poaching incidences. Understanding the dynamics related to poaching might meliorate law enforcement efforts and enhance the conservation of threatened species (Rija & Kideghesho, 2020). However, the effect of these anti-poaching strategies in reducing elephant poaching remains largely unknown.

Research on elephants has mainly focused on their ecological role (Cristoffer & Peres, 2003), home range (Leggett, 2006; Shannon et al., 2006) and habitat use (Gara et al., 2016; Harris et al., 2008; Ndaimani et al., 2017) in different landscapes. To the best of our knowledge, there exists a dearth of literature related to trends in the illegal killing of elephants in the Mid-Zambezi Valley. Hence in this study, we assess the trends in the illegal killing of elephants within the Mid-Zambezi Valley. We sought to understand whether there has been an increase or decrease in the illegal killing of elephants. We used data from 2015 to 2019 collected by field rangers in six protected areas within the Mid-Zambezi Valley. In addition to assessing the effectiveness of law enforcement efforts in elephant poaching, results of this study are important for improving planning, monitoring and mitigating mechanisms critical for curbing elephant poaching.

2 | MATERIALS AND METHODS

2.1 | Study area

The study was carried out in the mid-Zambezi valley, northern Zimbabwe. The mid-Zambezi valley is ~1,187,900 ha and is bordered by Zambia to the north, Mozambique to the east, and the Zambezi River to the northwest (Figure 1). The Mid-Zambezi valley is part of the man and biosphere reserve, an important bird area and world heritage site.

Mid-Zambezi Valley is characterised mainly by a dry (March–October) and wet season (November–April) with an average annual rainfall of 768 mm and mean temperature fluctuating around 31°C (Sibanda et al., 2016). Vegetation is predominantly miombo woodlands (*Brachystegia and Julbernadia spp*) and in some areas mopane (*Colophospermum mopane*). The major water source is the Zambezi River, although there are several seasonal rivers and natural water pans. The wild mammal fauna includes lion (*Panthera Leo*), buffalo (*Syncerus caffer*) and leopard (*Panthera pardus*).

In 2014, the elephant population in the Zambezi valley had reduced by at least 40% as compared to 2001 figures and the elephant density had reduced to 0.69 elephant/km^2 from 1.13 elephant/km^2 in 2001 (Dunham et al., 2015). Consequently, after this observation, patrol efforts increased to curb the continued decline in elephant populations. The area is secured through different types of patrols. These patrols include: (i) daily patrols, (ii) strategic patrols and (iii) reaction patrols and rangers covering an average of 20 km^2/ day similar to IUCN guidelines (Henson et al., 2016). However, some areas within the Mid-Zambezi valley have fewer rangers, zero patrol vehicles and minimum anti-poaching artillery. In such instances, patrols are mainly concentrated in poaching hotspots.

2.2 | Data collection

Data used in the study were collected during ranger patrols from 2015 to 2019. The data were collected from six protected areas within the Mid-Zambezi Valley, these include Hurungwe Safari

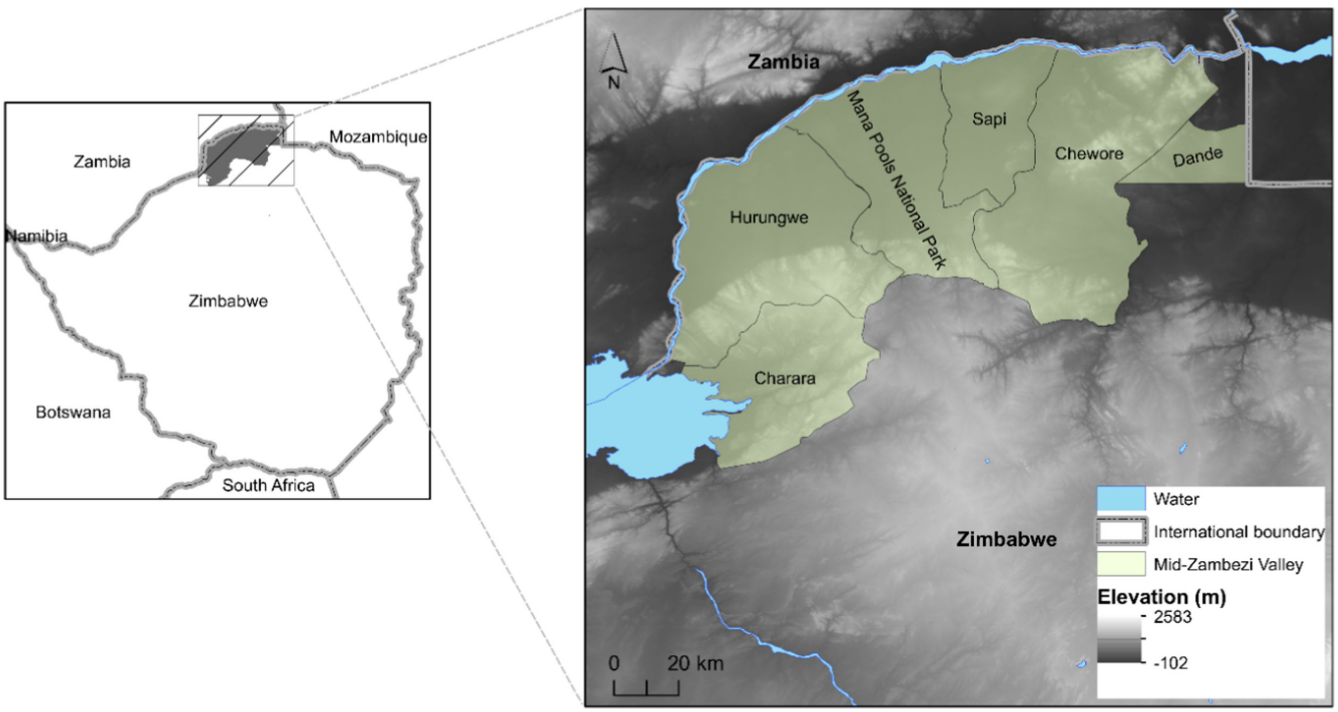

FIGURE 1 Location of mid-Zambezi Valley in northern Zimbabwe and the different protected areas therein

Area, Charara Safari Area, Mana-Pools National Park, Sapi Safari Area, Chewore Safari Area and Dande Safari Area. The management regimes in these protected areas are different and include hunting areas. The data collected in the study sites correspond to data available from the Monitoring the Illegal Killing of Elephants (MIKE) website (Figure 2; https://cites.org/eng/prog/mike/index.php/portal).

2.3 | Statistical analysis

Before testing for any trends in the data set, we tested our data for normality and autocorrelation. We tested whether our data were serially correlated using the auto-correlation function (Venables & Ripley, 2002) in R (Team R., 2015), and normality was tested using the *Shapiro–Wilk* test (Royston, 1992). Our data were normally distributed ($W = 0.88$, p-value = 0.31) and did not exhibit any autocorrelation. Trend analysis was assessed using the Mann-Kendall non-parametric test. Mann-Kendall test is a simple and robust measure of monotonic trends in parametric data (Libiseller & Grimvall, 2002; Shadmani et al., 2012). Our data satisfied the Mann-Kendall assumptions; hence, it was used to test for poaching trends in our study area. The p-value and S-value returned from the Mann-Kendall test were used to evaluate the significance of the trend and the rate of elephant poaching respectively. The significance was tested at a 90% confidence interval.

3 | RESULTS AND DISCUSSION

In this study, we sought to test whether there was any trend in elephant poaching incidences in the Mid-Zambezi Valley, Zimbabwe from 2015 to 2019. Our results show that elephant poaching has decreased by at least 0.055 elephants/year. In addition, the decrease in elephant poaching in our study area was statistically significant (z-value = −1.7146, $p = 0.086$; Figure 3).

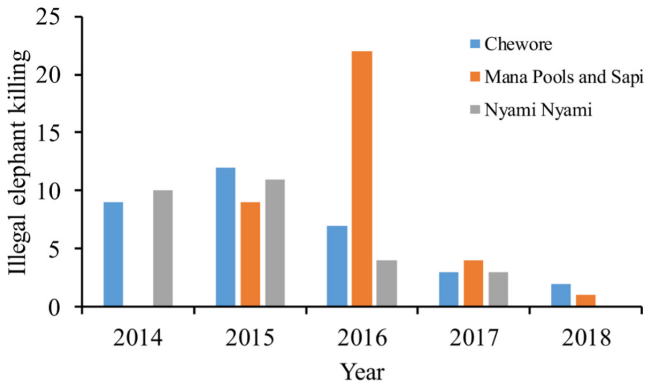

FIGURE 2 The number of illegally killed elephants in monitoring the illegal killing of elephants (MIKE) areas within the mid-Zambezi Valley. The data used were downloaded from https://cites.org/eng/prog/mike/index.php/portal

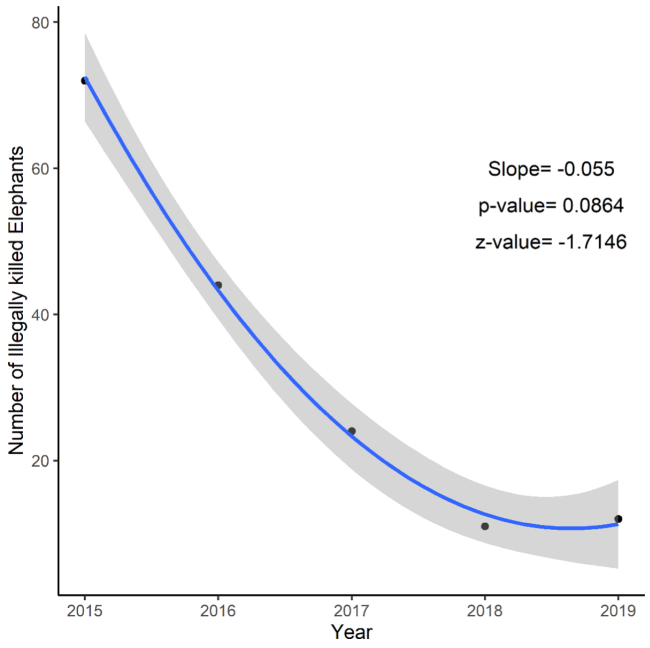

FIGURE 3 The trend in elephant poaching fitted with a polynomial curve estimator. Significance was calculated at a 90% confidence interval

Elephant poaching has been increasing in most wildlife areas and approximately 40,000 elephants are poached each year in Africa alone (Wittemyer et al., 2014). Elephant poaching is challenging to control because poaching tactics are constantly changing and poaching is well funded (Challender & MacMillan, 2014; Mabele, 2017). In areas of high human–elephant contact, locals also resort to retaliatory killings especially after crop raids (Dublin & Hoare, 2004; Hedges & Gunaryadi, 2010). However, law enforcement efforts have been helpful in attempting to curb/control poaching in most countries (Leader-Williams et al., 1990; Martin, 2010; Milner-Gulland & Leader-Williams, 1992). In this study, our results show that elephant poaching has been monotonically decreasing between 2015 and 2019. Decreased elephant poaching shows evidence that law enforcement strategies within our study area have been deterrent enough.

In the past decade, law enforcement strategies have been evolving and there has been increased use of the technology to increase coverage and patrol efforts (Arcese et al., 1995; Duporge, 2016; O'Donoghue & Rutz, 2016). These technologies include GPS collars (Galanti et al., 2000), Spatial Monitoring and Reporting Tool (SMART; Lynam et al., 2016) and unmanned aerial vehicles (Hodgson et al., 2016). Specifically in the Mid-Zambezi Valley, there has been some reinforcement in law enforcement and security through the integration of Zambezi Valley Anti-Poaching Unit (ZAVARU), Zimbabwe Republic Police (ZRP), Zambezi Society (ZAMSOC), Tashinga Initiative, Big 5 Safaris, African Wildlife Foundation (AWF), Padenga, Global Environmental Facility (GEF), CITES MIKE, Hemmersbach Rhino Force, Zimbabwe Hunters Association (ZHA), Great Plains, Bush life Safari and the surrounding local community. All these stakeholders have been key actors in reinforcing organised

law enforcement and they have continued to scour the environment in reducing poaching in the Mid-Zambezi valley through improving ranger welfare and training, improved VHF communication equipment, environmental awareness to the community, enhanced wildlife area patrols, manpower level increase, increased motivation of organised patrol groups, increased mobility, increased surveillance equipment, and informer groups, surveys and park planning.

Results from this study are among the first to attempt to assess law enforcement efforts in the Mid-Zambezi Valley, Zimbabwe, and our results show how these efforts are promising. Notwithstanding the fact that MIKE data were not available for 2019, it can be observed that, the declining trend in elephant killings within MIKE areas within the Mid-Zambezi Valley was coherent to our field data thus supporting our findings. However, the data used in this study used carcass observations made by rangers, and carcasses located in inaccessible areas might have been excluded during patrols. Notwithstanding this setback, our results still have merit and could help motivate park rangers and managers on the need for more efficient anti-poaching strategies to continually reduce poaching in the Mid-Zambezi Valley.

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CONFLICT OF INTEREST

The authors declare that there exists no competing financial interests or personal relationships that could have appeared to influence the work reported in this study.

DATA AVAILABILITY STATEMENT

Data on elephant mortalities are available upon request from Zimbabwe Parks and Wildlife Management Authority.

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