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Rule-breaking in terrestrial protected areas of sub-Saharan Africa: A review of drivers, deterrent measures and implications for conservation

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ABSTRACT

Nature conservation relies largely on peoples' rule adherence. Nevertheless, non-compliance with regulations threatens *in situ* conservation in nearly every protected area (PA) and remains an intractable issue. We reviewed the available published scholarly literature on non-compliant biological resource-use in terrestrial protected areas (TPAs) of sub-Saharan Africa. The focus is on two objectives, firstly, to disentangle the complex drivers behind the various types of deviant behaviour observed in these PAs, and secondly, to assess the strategies deployed on the ground to deter such illegalities. Using 72 selected journal articles published between 2001 and 2021, we recorded nine types of deviant behaviour or illegal resource extraction that were reported. Poaching activity overshadowed all other criminal behaviours. Drivers varied according to the type of crime perpetrated or resources targeted. Poverty was the most cited driver of non-compliance, particularly for illegal bushmeat hunting. PA resentment prompted by destructive errant wildlife was almost as strong a motivation as material poverty. To deter offenders from committing a crime, a combination of interventions, i.e., law enforcement and a spectrum of non-enforcement approaches, such as Reformed Poachers Associations, long-term research sites and resource-access agreements, were deployed. Our synthesis demonstrates that the growing sub-Saharan African literature on non-compliant biological resource-use in TPAs is dominated by bushmeat poaching drivers. Other motives for PA offences by border villagers are scarcely dealt with in the peer-reviewed literature. Future studies of wildlife crime need to address PA transgression multidimensionality, not just bushmeat poaching, to reveal further drivers of transgressive behaviour and ultimately allow for evidence-informed conservation intervention design.

1. Introduction

There are many approaches to the conservation of biodiversity and management of natural resources. These depend, to varying extents, on rules that restrain use by humans (Keane et al., 2008; Gavin et al., 2010). Rules governing human behaviour, whether implicit or explicit, are at the heart of every conservation and natural resource management system (Ostrom, 1990; Keane et al., 2008). These rules are often implemented through formal institutions and mechanisms in a myriad of natural resource conservation contexts. For instance, "protected areas" (PAs), whether terrestrial, marine, private or state administered, prohibit specific human behaviours

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within their borders (e.g., Jachmann, 2008a, 2008b; Cazalis and Prévot, 2019).

PAs, are believed to be the last bastions of nature in a world facing numerous environmental challenges (e.g., Jacobson et al., 2019; Pacifici et al., 2020). PAs are regularly proposed as a solution to deviant and illegal behaviour in conservation, introducing new laws and regulations that place substantial restrictions on people's actions within their boundaries (Holmes, 2014; Cazalis and Prévot, 2019). Consequently, the amount of land and sea designated as formally protected has markedly increased over the past century (Watson et al., 2014). Some scholars fear PAs may have been created faster than our capacity to manage them (e.g., Sutherland et al., 2009). For example, between 1990 and 2000 alone, the number of PAs recognised worldwide by the International Union for Conservation of Nature (IUCN) quadrupled from 6,931 to 28,8442, and the total coverage of PAs and biosphere reserves expanded from 803 million hectares to 1,115 million hectares (World Resources Institute, 2005).

The increase in PAs is an impressive policy achievement, but declaring and designating an area as protected does not necessarily mean that it is securely protected as suggested by the name (Abukari and Mwalyosi, 2018). The ultimate success of these areas is largely reliant on people's compliance with their rules, e.g., no hunting without a permit, no livestock grazing, no firewood extraction within PAs (e.g., Kahler and Gore, 2012; Mascia et al., 2014; Solomon et al., 2015). Many conservation achievements indeed were obtained by setting proper regulations and by better enforcing existing ones, making them effective in practice (Cerri et al., 2018).

Earlier works on *in situ* illegal resource-use in the conservation sector highlight that non-compliance is often the rule rather than the exception (Robbins et al., 2006; Arias, 2015; St. John et al., 2015). In fact, Robbins et al. (2006) is convinced that rule-breaking in PAs is likely to remain the norm for some time to come. It is one of the ongoing central problems facing wildlife conservationists. Even in some of the best-funded and globally venerable PAs, or in rich nations where management efforts are intense (e.g., United States and Canada), transgressive behaviours have been seen to thrive (Gregorich, 1992; Stern, 2008; Hill et al., 2020). Depending on its magnitude, non-compliance can render a rule ineffective, meaning that the state of a PA would probably be the same as without the rule, thus defeating the rule's purpose to protect the target from people's illegal use (Arias, 2015). Non-compliance with biodiversity conservation rules, particularly if unresolved, can lead to serious PA ecological impairment and degradation. Examples are the 'empty forest syndrome', which refers to forested areas that have been depleted of their animal populations through uncontrolled poaching (Redford, 1992), extreme cases of PA downgrading (a decrease in legal restrictions on the number, magnitude, or extent of human activities within a PA), downsizing (partial PA erasure), and/or degazettement (complete PA erasure; collectively PADD) (Mascia and Pailler, 2011; Bragagnolo et al., 2017; Lindsey et al., 2021). Ultimately, without compliance established rules are meaningless (Keane et al., 2008).

The question why people living in PA neighbourhoods unlawfully exploit natural resources within PA boundaries has triggered increasing interest in scholars and conservation practitioners (e.g., Robbins et al., 2006; Keane et al., 2008; Gavin et al., 2010; Gore et al., 2013; Arias, 2015; Solomon et al., 2015; Bragagnolo et al., 2017; Ponta et al., 2021), yet it is exceedingly challenging to address (Gavin et al., 2010). Indeed, the motivations underpinning PA neighbour deviation from rules and regulations are heterogeneous, often not obvious and require different policy responses (Duffy and St. John, 2013; Duffy et al., 2016; Bragagnolo et al., 2017; Travers et al., 2019; Newth et al., 2021).

The motivations that drive criminal behaviour can vary enormously from one individual to another, and even within the same individual may change across different contexts or at different times in their rule-breaking career (Forsyth et al., 1998; Kahler and Gore, 2012; Ponta et al., 2021). On the other hand, there is an entrenched, pervasive idea that the deviant behaviour and crime in terrestrial conservation are largely poverty-driven (e.g., Hariohay et al., 2019; Sabuhoro et al., 2020; Anagnostou et al., 2021). However, not all environmental rule-breaking is driven by livelihood imperatives (e.g., Robbins et al., 2006; Bell et al., 2007; Duffy et al., 2016; Hübschle, 2016a; Travers et al., 2019).

Conservation practitioners are often urging the academic publishing fraternity to take a more expansive view and go beyond the simplistic, single-driver narratives so that complex realities of a given context are not obscured. This is central, given that conservation is embedded within wickedly complex environments (Liu et al., 2007; Mason et al., 2018). Although human poverty is often assumed to be the ultimate driver of illegal practices in PAs, this is not necessarily true. Alarming, poverty has been used as a technique of neutralisation by wildlife crime offenders in the indictment process, e.g., poaching of deer (*Odocoileus* spp.) in the Western United States (Eliason and Dodder, 1999). In summary, scholarly opinion on the motivations underpinning non-compliant terrestrial resource-use in the published wildlife crime literature is divided (e.g., Mbanze et al., 2019).

Information on the driving factors and motivations focus on wildlife poaching (e.g., Muth and Bowe, 1998; Keane et al., 2008; Gandiwa, 2011; Kahler and Gore, 2012; Lindsey et al., 2013; Von Essen et al., 2014; Duffy et al., 2016; Carter et al., 2017; Ntuli et al., 2021), even though it is well-known that it is not the only act of criminality detected within protected parks. The multidimensionality of PA transgression is not embraced in the vast majority of wildlife crime studies and it's considered a key limitation by Critchlow et al. (2015) and Ponta et al. (2021). This perspective is reinforced by Cerri et al. (2018), who in a nature conservation context found non-compliance to manifest itself in different forms with differing implications in northern Italy. Beyond the issue of natural resource crime, scholars routinely focus on the drivers behind the illegal killing of protected wildlife species. The motivations sustaining this deviant activity have been labelled speculative or even contradictory in nature in some cases (e.g., Muth and Bowe, 1998; Kahler and Gore, 2012; van Velden et al., 2018; Assogba and Zhang, 2021). Thus, given the shortfalls in evidence and the magnitude of illegal natural resource-use problems further research for a better understanding of the underlying causes of non-compliance is needed (Gavin et al., 2010; Nuno and St. John, 2015; Solomon et al., 2015; Reuter et al., 2018).

Without a solid understanding of the nuances of criminal motivations, it is notoriously difficult, if not impossible, to formulate management schemes that succeed at reducing undesirable behaviours (Travers et al., 2019; Ponta et al., 2021; Newth et al., 2021). With that background, dealing with conservation-area rule-breaking is no small task and it is not clear how well protected PAs are on the ground. Evidence of the efficacy of the different interventions to reduce or prevent adversary behaviours in terrestrial conservation

is severely limited and inconclusive (e.g., Roe et al., 2015; van Velden et al., 2018), which can lead to misguided use of finite conservation funds.

Non-compliance with rules in terrestrial conservation is an issue of high concern at a global scale (e.g., Gavin et al., 2010; Solomon et al., 2015; Bragagnolo et al., 2017). Rule violation rates have been observed to be particularly acute in the developing world, where conservation funds are critically scarce (Bruner et al., 2004; Lindsey et al., 2021), land ownership and resource tenure are unclear and often contested (Wunder, 2007; Lindsey et al., 2013), and reliance on wild resources such as firewood, medicinal plants and bushmeat by rural communities is intensive and extensive (Atuo et al., 2020). In fact, in low-income countries there is an increasing number of “paper parks” or PAs with little or no formal management on the ground (e.g., Geldmann et al., 2015).

In many parts of Africa biological resources in and around PAs are under immense pressure as a result of illegal activities (e.g., Wilfred et al., 2019; Anagnostou et al., 2020; Atuo et al., 2020). For example, in sub-Saharan Africa, an assessment of the status of the terrestrial protected areas (TPAs) of the Central African Republic revealed that only 32% of the PAs from a total of 15 PAs covering about 10.9% of the country were adequately managed (Blom et al., 2004). Furthermore, in the Waza National Park (NP), Cameroon, a biodiversity scenario described as the “crumbling fortress” was recorded, whereby Waza NP was devoid of frontline staff resulting in severe and devastating illegal natural resource exploitation (Kelly, 2013). Elsewhere, in southern Côte d’Ivoire, unchecked poaching and agricultural expansion stemming from an absence of monitoring and weak law enforcement has been reported disastrous, exposing wildlife to such perils in many PAs (Bitty et al., 2015). Moreover, in Uganda, an ecological survey of the Bwindi Impenetrable NP showed that rule-breaking was reported to be a routine activity in this terrestrial ecosystem (Butynski, 1984), which is home to Africa’s iconic mountain gorillas (*Gorilla beringei beringei*) (Wilson and Primack, 2019). Lastly, Akinsorotan et al. (2019) evaluated rule-breaking behaviour in the protected Oba Hills Forest Reserve, Nigeria, and found nearby inhabitants to exhibit a high degree of non-compliance with rules governing this particular reserve.

Uncovering the roots of non-compliance and the illegal acquisition of resources in PAs is a precondition for devising influential management interventions and to improve future conservation planning. This narrative review on non-compliant biological resource-use in TPAs of sub-Saharan Africa was undertaken, to advance deviance research in conservation, with two objectives: (1) to disentangle the complex drivers behind the various types of deviant behaviour observed in PAs, and (2) to assess the strategies deployed on the ground to deter such illegalities. We focused on sub-Saharan Africa as it hosts some of the globe’s most valuable biodiversity, including charismatic megafauna, a great diversity of avifauna, and a huge number of endemic and ecological processes that are threatened with obliteration due to human-based activity (Wilson and Primack, 2019; Lindsey et al., 2021).

2. Methods

We conducted a review of accessible peer-reviewed literature on non-compliant resource extraction in terrestrial sub-Saharan African PAs. Searches for papers were performed in Scopus and Google Scholar between July and August in 2021. The search terms used were “protected areas* ” or “terrestrial protected area* ” and “illegal resource-use”, “illegal wildlife use”, “wildlife poaching”, “conservation rules”, “illegal activities”, “illegal hunting”, “crime”, “rule-breaking”, “enforce” or “law enforcement* ”. For further filtering, “Africa” was included with these terms in this search, using the AND operator. The search returned 2483 publications with many duplicates. Most studies focused on other aspects of illegal resource-use in TPAs, such as illegal resource extraction quantification, spatial dynamics in the use of resources, the illegal trade in natural resources (bushmeat) and consumption drivers, i.e., *ex situ* illegal resource-use activities, that were outside the scope of our review focus. An additional 27 publications were identified through backward, i.e., using the reference list to identify new papers to include, and forward snowballing, i.e., identifying new papers

Table 1
Classification of illegal activities in TPAs of sub-Saharan Africa.

Illegal activity class	Authors	Count	Publications
Bushmeat hunting	Loibooki et al., 2002; Yamagiwa, 2003; Kaltborn et al., 2005; Van Vliet and Nasi, 2008; Mfunda and Roshash, 2010; Gandiwa, 2011; Lindsey et al., 2011; Knapp, 2012; Kahler and Gore, 2012; Gandiwa et al., 2013; Nuno et al., 2013a, 2013b; Ayivor et al., 2013; Damnyag et al., 2013; Fischer et al., 2014; Harrison et al., 2015; Friant et al., 2015; Moreto and Lemieux, 2015; Borgerson et al., 2016; Knapp et al., 2017; Rogan et al., 2018; MacKenzie, 2018; Manqele et al., 2018; Spira et al., 2019; Moreto, 2019; Travers et al., 2019; Hariohay et al., 2019; van Velden et al., 2020; Akinsorotan et al., 2020; Afriyie et al., 2021; Ntuli et al., 2021; Mbanze et al., 2019, 2021; Adetola and Ofuya, 2021	33	45.8%
Forest resource extraction (plant collection commercial)	MacKenzie and Hartter, 2013; Damnyag et al., 2013; Hariohay et al., 2019; Mbanze et al., 2019, 2021; Adetola and Ofuya, 2021	6	8.3
Fishing	Gandiwa et al., 2012; Travers et al., 2019; Adetola and Ofuya, 2021	3	4.2
Artisanal mining	Spira et al., 2019; Hariohay et al., 2019; Mbanze et al., 2019, 2021; Adetola and Ofuya, 2021	5	6.9
In-park livestock grazing	Ayivor et al., 2013; MacKenzie and Hartter, 2013; MacKenzie, 2018; Hariohay et al., 2019; Travers et al., 2019; Adetola and Ofuya, 2021	6	8.3
Medicinal plant harvesting	Harrison et al., 2015; MacKenzie, 2018; Mbanze et al., 2019	3	4.2
Natural wild honey collection	Harrison et al., 2015	1	1.4
Basketry material extraction	Harrison et al., 2015	1	1.4
Building pole/firewood collection	Ayivor et al., 2013; MacKenzie and Hartter, 2013; Harrison et al., 2015; MacKenzie, 2018; Travers et al., 2019; Adetola and Ofuya, 2021	6	8.3
Total		64	

Table 2

Descriptions of common drivers of non-compliance in TPAs of sub-Saharan Africa. Motives for non-compliance presented are not behaviour specific but largely bushmeat poaching aligned (exceptions include [Gandiwa et al., 2012](#); [MacKenzie and Hartter, 2013](#); [Harrison et al., 2015](#); [Hariohay et al., 2019](#)).

Driver	Description. Communities fringing TPAs engage in non-compliant behaviours because:	Authors	Count	Publications
Poverty	Community suffers serious livelihood hardships; livelihood insufficiency including limited opportunities for formal employment	Loibooki et al., 2002 ; Kaltenborn et al., 2005 ; Van Vliet and Nasi, 2008 ; Mfunda and Roshash, 2010 ; Gandiwa, 2011 ; Lindsey et al., 2011 ; Gandiwa et al., 2012 ; Knapp, 2012 ; Kahler and Gore, 2012 ; Gandiwa et al., 2013 ; Nuno et al., 2013 ; Ayivor et al., 2013 ; Damnyag et al., 2013 ; MacKenzie and Hartter, 2013 ; Harrison et al., 2015 ; Friant et al., 2015 ; Moreto and Lemieux, 2015 ; Borgerson et al., 2016 ; Knapp et al., 2017 ; Rogan et al., 2018 ; MacKenzie, 2018 ; Manqeale et al., 2018 ; Spira et al., 2019 ; Travers et al., 2019 ; Hariohay et al., 2019 ; Akinsorotan et al., 2020 ; Afriyie et al., 2021	27	37.5%
Enforcement	Perceived or actual lack of enforcement from surveillance efforts to low prosecution/conviction rates; the judiciary not fulfilling enforcement responsibilities effectively; PAs treated as consequence-free environments	Abbot and Mace, 1999 ; Lindsey et al., 2011 ; Knapp, 2012 ; Gandiwa et al., 2012 ; Ayivor et al., 2013 ; Gandiwa et al., 2013 ; Fischer et al., 2014 ; Kaaya and Chapman, 2017 ; Rogan et al., 2018 ; Spira et al., 2019 ; Travers et al., 2019 ; Atuo et al., 2020 ; Akinsorotan et al., 2020 ; Adetola and Ofuya, 2021 ; Atim nchor et al., 2021 ; Mbanze et al., 2021	16	22.2
Human-wildlife conflict (HWC)	Community provoked or threatened by destructive large errant wildlife and unresolved issues of compensation payment; conservation perceived as problem	Kaltenborn et al., 2005 ; Kahler and Gore, 2012 ; Harrison et al., 2015 ; MacKenzie, 2018 ; Moreto, 2019 ; Travers et al., 2019 ; Mbanze et al., 2019, 2021 ; Ntuli et al., 2021 ; Afriyie et al., 2021	11	15.3
Benefits	Conservation does not bring any benefits but causes problems (often linked to HWC); inequity in how benefits are distributed amongst actors	Lindsey et al., 2011 ; MacKenzie, 2012 ; Kahler and Gore, 2012 ; Lindsey et al., 2013 ; Ayivor et al., 2013 ; Harrison et al., 2015 ; Kaaya and Chapman, 2017 ; MacKenzie, 2018 ; Mbanze et al., 2019 ; Travers et al., 2019 ; Akinsorotan et al., 2020 ; Ntuli et al., 2021 ; Mbanze et al., 2021	13	18.1
Ranger deviance	Frontline conservation territory rangers taking bribes or giving illicit assistance to non-compliant individuals through advice on where to perform forbidden resource-use activities	Lindsey et al., 2013 ; Moreto et al., 2015 ; Atuo et al., 2020 ; Mmahi and Usman, 2020	4	5.6
Proximity/convenience	Human settlement nearness to the PA edge	Gandiwa et al., 2012 ; MacKenzie and Hartter, 2013 ; Fischer et al., 2014 ; Harrison et al., 2015 ; MacKenzie, 2018 ; Mbanze et al., 2021	6	8.3
Thrill of the deviance	Outsmarting gamekeepers in the cop-and-robber like interaction as exhilarating experience	Kaltenborn et al., 2005 ; Gandiwa, 2011 ; Kahler and Gore, 2012 ; Mbanze et al., 2019 ; Afriyie et al., 2021	5	6.9
Governance	Governance or management of the PA ineffective or non-inclusive or not included in the launching or management of the PA; community wildlife management programmes associated with the PA, e.g., conservation, seem to only benefit foreigners/local elites	Kahler and Gore, 2012 ; MacKenzie, 2012 ; Ayivor et al., 2013 ; Kaaya and Chapman, 2017 ; Lubilo and Hebinck, 2019 ; Akinsorotan et al., 2020 ; Ntuli et al., 2021	7	9.7
Traditional or cultural needs	Fulfilment of traditional or cultural-related needs paramount to peripheral communities; believe it is their birth right or it is the social norm/injunctive norms (i.e., non-compliance enjoying and being furthered by the cultural support it gets/normalised)	Loibooki et al., 2002 ; Kaltenborn et al., 2005 ; Van Vliet and Nasi, 2008 ; Gandiwa, 2011 ; Knapp, 2012 ; Harrison et al., 2015 ; Friant et al., 2015 ; Moreto and Lemieux, 2015 ; Knapp et al., 2017 ; Manqeale et al., 2018 ; Mbanze et al., 2019 ; Lubilo and Hebinck, 2019 ; Spira et al., 2019 ; Mmahi and Usman, 2020 ; Atuo et al., 2020 ; van Velden et al., 2020 ; Afriyie et al., 2021	17	23.6
Dependence	Dependence on resource extraction (e.g., building material, medicinal herbs/non-commercial plants, grazing grasslands, bushmeat or fish); benefits not sufficient to prevent collecting resources from a PA	Gandiwa et al., 2012 ; Friant et al., 2015 ; Harrison et al., 2015 ; Rogan et al., 2018 ; MacKenzie, 2018 ; Atuo et al., 2020	6	8.3
Greed	Commercial interests in illegal conservation activities (i.e., hunting), to maximise household income even when benefitting from a PA via legal channels (community projects); enjoying some decent form of employment locally; just wanting to not only to survive but rather survive well	Loibooki et al., 2002 ; Van Vliet and Nasi, 2008 ; Kaltenborn et al., 2005 ; Lindsey et al., 2011 ; Kahler and Gore, 2012 ; MacKenzie and Hartter, 2013 ; Moreto and Lemieux, 2015 ; Nuno et al., 2013 ; Knapp et al., 2017 ; Manqeale et al., 2018 ; Rogan et al., 2018 ; Spira et al., 2019 ; Travers et al., 2019 ; van Velden et al., 2020 ; Afriyie et al., 2021	15	20.8
Stochasticity at the edge	Disasters of any kind or magnitude can be experienced with tragic consequences, i.e., food shortages/starvation/crop failure due to natural events (drought	Loibooki et al., 2002 ; Yamagiwa, 2003 ; Lindsey et al., 2011 ; Gandiwa et al., 2012, 2013	5	6.9

(continued on next page)

Table 2 (continued)

Driver	Description. Communities fringing TPAs engage in non-compliant behaviours because:	Authors	Count	Publications
Awareness	stresses) or political unrest/civil wars/increased access to fire arms; economic instability issues precipitate and entrench conservation crimes Deficits in knowledge of rules or what biodiversity conservation entails resulting in 'unintentional' violation	Gandiwa et al., 2012; Gore et al., 2013; Mbanze et al., 2019; Akinsorotan et al., 2020	4	5.6
Opposition to the restrictions	Non-compliance because PA laws and implementation methods are perceived as harsh	Infield and Namara, 2001; Kahler and Gore, 2012; Gore et al., 2013; Lubilo and Hebinck, 2019; Witter, 2021; Ntuli et al., 2021; Mbanze et al., 2021	7	9.7
Total			143	

based on those papers citing the paper being examined (Wohlin, 2014). Based on the titles and abstracts of the papers retrieved, the list was narrowed by identifying studies that exclusively dealt with drivers of non-compliant resource-use in PAs in sub-Saharan Africa and/or the measures applied to disrupt the illegal incursions. Studies that met the above-mentioned parameters were selected for inclusion, resulting in 72 publications (published from 2001 to 2021) for this review. To extract insights, i.e., drivers that pertained to why non-compliance was occurring and/or the strategies to deter the criminality, remaining articles were read several times to identify themes and categories. After familiarisation, we developed the initial coding framework. As coding proceeded, several additional themes emerged and were added to the framework. Coding was therefore an iterative process, grounded in the data. An inductive qualitative data analysis approach was used where major themes were derived from interpreting each article and later grouping these into each of the identified and defined themes (Strauss and Corbin, 1998). The primary purpose of inductive analysis is to allow research findings to emerge from the frequent, dominant, or significant themes inherent in the data (Thomas, 2006).

3. Findings and discussion

3.1. Non-compliant human behaviour nature and accompanying drivers in a sub-Saharan African setting

Within existing literature, we identified nine types of deviant behaviour or illegal resource-use to occur in sub-Saharan African TPAs (Table 1). Of the identified wildlife offences, poaching for bushmeat was the most frequently mentioned or documented type of violation across TPAs of the region. Illegal procuring of medicinal plants, wild honey, basketry material and building poles (plant collection non-commercial) were patchily documented resource extraction forms or the least widespread in terms of their scope. Although the poaching behaviour overshadowed other illegal behaviours, this does not necessarily mean that they were not severe or widespread. There is a paucity of data on illegal resource-use in the majority of countries in sub-Saharan Africa. This phenomenon has also been reported at global level (e.g., Gavin et al., 2010; Conteh et al., 2015). Some illegal activities were relatively difficult to detect or "cryptic", such as nocturnal subsistence fishing, hence data are rare (Gavin et al., 2010; Gandiwa et al., 2012). The spectrum of wildlife crimes was quite broad within TPAs as described in a review on Ugandan parks (Harrison et al., 2015a, 2015b). However, most studies did not consider the full range of illegal activities that occur within a PA (Critchlow et al., 2015). Moreover, some violation types may be labelled minor infractions and dismissed as insignificant without considering the degree of resistance and resilience of the affected ecological system (Gavin et al., 2010). Although offences vary in seriousness and sophistication, those classified as minor may facilitate the performance of more heinous crimes.

Human pressures can act both individually and synergistically on PAs because threats rarely occur in isolation. A detailed description of environmental synergisms has been given by Laurance and Peres (2006). For example, Gandiwa et al. (2011) documented synergistic effects of human encroachments on wildlife habitats and increases in arson fire incidences in two of Zimbabwe's NPs (Nyanga and Gonarezhou). In addition, in West Africa, Brashares et al. (2004) established a link between fish and terrestrial mammal poaching that resulted in a transfer of harvest pressure; i.e., when fish populations deteriorate, hunting for bushmeat species spikes, resulting in a decline in the biomass of land mammals. Elsewhere, in the Democratic Republic of Congo, illegal mining and bushmeat poaching occurred in synergy at Kahuzi-Biega NP and the Itombwe Nature Reserve pushing the endemic Grauer's gorilla (*Gorilla beringei graueri*) to the brink of extinction (Spira et al., 2019).

In this review, drivers varied according to the type of criminal behaviour and the type of resources or commodities targeted (e.g., Harrison et al., 2015; Hariohay et al., 2019). We identified several prevalent drivers of non-compliant activities across sub-Saharan African TPAs. For ease of discussion, offender motivations were summarised into 14 categories (Table 2). Of all these driver categories, poverty was the most commonly cited motivation and wildlife law enforcement ranger deviance the least recorded or cited in the peer-reviewed literature (e.g., Lindsey et al., 2013; Moreto et al., 2015; Atuo et al., 2020). Economic poverty in villagers living closest to PA peripheries was a top issue discussed across publications. It has been reported that household inhabitants specifically take up poaching as a way of yanking themselves out of poverty (e.g., Ayivor et al., 2013). However, from our literature review this poverty appeared to be a product of PA existence (i.e., human well-being impacts) and not necessarily generational poverty (cf. Harrison et al., 2015). This observed trend is not uncommon, but it demonstrates the need to take poverty reduction issues seriously (e.g., MacKenzie and Hartter, 2013; Anagnostou et al., 2021). Even though some may argue that PAs are seldom designed specifically to reduce it or the reason behind the impoverishment (e.g., Scherl et al., 2004; Naughton-Treves and Holland, 2019).

In some cases, poverty weakly influenced non-compliant behaviours (e.g., at Murchison Falls and Queen Elizabeth PAs, Uganda: Travers et al., 2019). In Madagascar, for instance, poverty was found to be the symptom of illegal behaviour (Gore et al., 2013). In Uganda, a study of two parks found resentment stirred by human-wildlife conflicts (HWCs) pervasiveness to contribute vitally to the violation behaviour in peripheral villages (Travers et al., 2019). HWC results in food scarcity for the household and loss of income (Matseketsa et al., 2019), therefore, making it interlinked to poverty, ultimately driving the resentment. Moreover, we also discovered that some households, making use of a PA's natural resources illegally, were not the poorest of the poor. In some areas, wealthier or better-off households, for example with livestock wealth and higher rates of employment, showed greater non-compliance in the form of poaching than the households in extreme poverty (e.g., Ruaha NP, Tanzania (Knapp et al., 2017); Okavango Delta, Botswana (Rogan et al., 2018); four TPAs in Malawi (van Velden et al., 2020), and two of Uganda's largest NPs (Travers et al., 2019)). In addition, some rural households committed crimes, particularly hunting, even where communities benefit via legal means from wildlife, i.e., community-based conservation programmes, or enjoy income from formal employment (Loibooki et al., 2002; Rogan et al., 2018). In this regard, it becomes unclear if conservation non-compliance is 'need-based' or 'greed-based' or influenced by both.

The interaction of drivers can be complex and their interpretation also multifaceted (Ponta et al., 2021). When characterising the profiles and motivations of unauthorised resource users at Bwindi Impenetrable NP in Uganda, Harrison et al. (2015) reported that medicinal plants were coveted and illegally exploited for the following reasons: (i) perception that these work better than modern healthcare, (ii) only grow in the forest, and were used instead of modern health centres that were too far away or perceived too slow to treat people. In such cases, the original or fundamental driver of non-compliance could be dependence, and not necessarily rural poverty. However, it is likely that dependence and poverty are interwoven, one leading to the other. For example, wealthy rural villagers may use a prohibited park, an area that may have provided natural resources for centuries prior the enclosure, because they have developed a dependence that cannot be undone overnight. Atuo et al. (2020) hypothesizes that village communities who depend on a PA's natural resources for their sustenance are likely to exploit them with little or no restraint. Discerning the offender's real motivations for engaging in these illegal activities becomes extremely strenuous under these circumstances because poverty has been widely used as a technique of neutralising wildlife crime (e.g., Sykes and Matza, 1957; Eliason and Dodder, 1999; Eliason, 2003; Enticott, 2011), although in some instances it may indeed be a genuine motivation for wildlife law violations.

The role of poverty, and the extent to which poverty orchestrates non-compliant PA behaviours can be hard to test (e.g., Duffy and St. John, 2013; Knapp et al., 2017). Humans are simply rationalizers and the motivations underpinning deviant behaviours in TPAs are of a multi-faceted nature and not straightforward (Brisset and Edgley, 1990). They are not only consumptive or profit-based in nature. Nonetheless, an emergent pattern is observed where certain PA offences, especially poaching, is motivated by commercial gain (e.g., Loibooki et al., 2002; Gandiwa, 2011; Kahler and Gore, 2012; Rogan et al., 2018; Spira et al., 2019). There appears to be a clear tendency to abandon the subsistence-driven hunting and gathering of natural products from PAs for more commercially-oriented and even ruthless wildlife exploitation in the region. Humans are not purely rational beings, weighing up the costs and benefits of each and every decision in an economic framework (St. John et al., 2010; Newth et al., 2021), but other non-instrumental motives also exist. Examples, are the desire to retaliate for direct losses due to the presence of large mammals, for being arrested or harassed by the primary caretakers of PAs, the wildlife rangers, or for current or historical perceived conservation injustices. Such circumstances have been reported to be delinquent human behaviour precipitators or escalators (e.g., Yamagiwa, 2003; Gandiwa, 2011; Moreto, 2019). For instance, the latter was found to bolster and forcefully drive non-compliance at Kainji NP in Nigeria where poachers rationalised and plausibly justified hunting as their heritage and thus claimed not to be committing any offence (Mmahi and Usman, 2020). In other words, hunting in PAs seen as part of a culture is not considered as poaching because locals perceive it as their right. Along the same line of thought, Kaltenborn et al. (2005) at Serengeti NP, Tanzania observed non-compliance in the form of hunting and collection of terrestrial fauna to be deeply rooted in community life, i.e., hunting is a "a way of life".

Non-compliant TPA resource-use can extend beyond the immediate poverty issue, especially given that it is driven by a complex range of factors. Another significant driver of illegal behaviours is PA security. In some studies the degree of rule-breaking was reported acute in situations where enforcement was imperfect or limited (e.g., Abbot and Mace, 1999; Gandiwa et al., 2013; Atim nchor et al., 2021). PA security was further found to greatly collapse in moments of political instability, civil wars and national economy melt-downs resulting in increased rule violations and biodiversity declines (e.g., see Kahuzi-Biega NP, Democratic Republic of the Congo: Yamagiwa, 2003; Gonarezhou NP, Zimbabwe: Gandiwa et al., 2013). It is well known in criminology how a broken window, or the violation of a rule, facilitate further violations, independently of how 'respectable' the neighbourhood is (Wilson and Kelling, 1982). This behaviour is also known in the nature conservation context, where a low perceived probability of detection or sanction increases the benefits of non-compliant behaviour versus the potential risks (Gandiwa et al., 2013, 2014; Arias and Sutton, 2013; Oyanedel et al., 2020). In conclusion, our review revealed that law-breakers are not solely influenced by one driver category, motivations are inter-related, often operating in concert or that one non-compliance driver facilitates another (Moreto and Lemieux, 2015). Furthermore, the immediate environment plays a pivotal role in the performance of non-compliant behaviours, such that natural resource crime is viewed as a product of opportunity rather than underlying motivation or an interaction of both (see the Okavango Delta, Botswana: Rogan et al., 2018).

3.2. Deterrents of illegal conservation behaviours

The evaluated evidence from peer-reviewed wildlife crime research revealed a spectrum of responses to reduce offences in TPAs of sub-Saharan Africa with mixed success, with most interventions addressing bushmeat hunting. We classified interventions into two broad categories for ease of discussion: law enforcement, distinguished further into three subcategories or enforcement modes, and non-enforcement approaches (Table 3). Law enforcement had a higher deterrent effect than other measures of combatting crime (e.g.,

Table 3
Deterrents of illegal conservation behaviours.

Intervention	Description	Authors	Count	Publications
<i>Law enforcement</i>				
(i) collaborative enforcement	Frontline PA management conducting joint patrols, i.e., in partnership with peripheral communities or well-resourced conservation non-governmental organisations	Lotter and Clark, 2014; Gonedelé Bi et al., 2019; Anagnostou et al., 2020; Adetola and Ofuya, 2021; Moreto and Charlton, 2021	5	6.9%
(ii) Non-collaborative enforcement	Traditional top-down enforcement of wildlife regulations occasionally accompanied with the use of efficient patrol allocation techniques	Hilborn et al., 2006; Jachmann, 2008, 2008; Gandiwa, 2011; Gandiwa et al., 2014; Harrison et al., 2015; Plumptre et al., 2014; Plumptre et al., 2014; Critchlow et al., 2015, 2017; Denninger Snyder et al., 2019; Moore et al., 2021; Afriyie et al., 2021	13	18.1
(iii) "Extreme" enforcement	Militarised vigilance of PAs/use of technology to optimise rule-breaker detectability, i.e., conservation characterised as a place of war	Hart et al., 2015; Witter, 2021	2	2.8
<i>Non-enforcement approaches</i>				
Conservation awareness creation and education	Educational activities on biodiversity conservation matters to improve conservation knowledge and awareness of the socio-economic value associated with PA existence to increase peripheral community member buy-in and possibly elicit behaviour change	Gandiwa, 2011; Harrison et al., 2015; Adetola and Ofuya, 2021; Moreto and Charlton, 2021; Afriyie et al., 2021; Atim nchor et al., 2021	6	8.3
Resource-access agreements	Formal agreements between PA management and peripheral communities that allow certain resources (e.g., fuelwood or species) to be harvested during specific time periods and specific locations on the premise that communities discontinue all forms of illegal use of resources	Infield and Namara, 2001; Chhetri et al., 2003; Mackenzie et al., 2012; Moreto and Charlton, 2021	4	5.6
Alternative livelihood and income generating options	Providing peripheral communities with other means of earning a sustainable living outside of PA, i.e., alternative sources of protein and/or income-earning opportunities to reduce or divert dependence of local populations on critical biodiversity habitats	van Velden et al., 2020; Adetola and Ofuya, 2021; Moreto and Charlton, 2021	3	4.2
Community conservation banking (COCOBA)	Microfinance initiatives designed to reduce poaching involvement of peripheral communities by training them to open small, environmentally-friendly business enterprises	Kaaya and Chapman, 2017	1	1.4
Establishment of long-term research sites	Presence of researchers inside a PA providing a protective effect for wildlife populations, mainly by reducing poaching pressure	Campbell et al., 2011; Tagg et al., 2015	2	2.8
Revenue sharing schemes	Sharing revenues arising from conservation (e.g., PA entrance fees) with the aim of balancing the burdens (e.g., HWC) people encounter residing next to PAs while fostering improved conservation behaviours	Mackenzie, 2012; Harrison et al., 2015; Travers et al., 2019	3	4.2
"Reformed Poacher Associations"	Engaging peripheral communities in solutions to wildlife crime, especially those that once lived a life of crime with knowledge of the ins and outs of the trade; e.g., poachers become protectors	Yamagiwa, 2003; Harrison et al., 2015	2	2.8
Communal Areas Management Programme for Indigenous Resources (CAMPFIRE)/integrated conservation and development (ICD) projects	Awarding monetary and developmental benefits to peripheral communities so that locals buffer the PA from damaging illegal activities, i.e., 'social fencing'.	Infield & Namara, 2001; Gandiwa, 2011; Gaodirelwe et al., 2020	3	4.2
Buffer zone designation/boundary demarcation	Gazetting clear conservation boundaries and/or buffer zones to protect resources within the park's core area from illegal use while providing resource benefits to neighbouring people	Adetola & Ofuya, 2021	1	1.4

(continued on next page)

Table 3 (continued)

Intervention	Description	Authors	Count	Publications
Basic amenities	Providing services to peripheral communities (e.g., health centers/clinics, schools, water) to "buy" support and discourage acts of illegal resource collection, particularly bush meat poaching.	Harrison et al., 2015; Kirumira et al., 2019; Adetola & Ofuya, 2021; Moreto & Charlton, 2021	4	5.6
Total			49	

Hilborn et al., 2006; Jachmann, 2008; Gandiwa, 2011; Gandiwa et al., 2014; Plumptre et al., 2014; Critchlow et al., 2015, 2017; Moore et al., 2021; Afriyie et al., 2021; Adetola and Ofuya, 2021). However, law enforcement differed in its implementation and biodiversity outcomes across PAs. For instance, the collaborative mode of enforcement, although rarely deployed or documented in the published literature, appeared superior at incapacitating illegal bushmeat harvesters (e.g., Lotter and Clark, 2014). Moreover, when top-down traditional enforcement strategies were applied and supplemented with the sophisticated use of efficient patrol allocation techniques crime rates were reduced (e.g., Plumptre et al., 2014). Sub-Saharan Africa's PAs often deploy multiple protection measures because tackling the array of illegal activities by emphasising law enforcement above other options can be problematic and potentially unsustainable (Atuo et al., 2020).

We noted that some strategies to counteract transgressive tendencies had positive effects on biodiversity preservation but their application was confined to certain PAs/countries, e.g., "Reformed Poachers Associations" (Kahuzi-Biega NP, Democratic Republic of Congo and Bwindi Impenetrable NP, Uganda); community conservation banking (COCOBA) initiative unique to Serengeti NP and its affiliated PAs, Tanzania (Kaaya and Chapman, 2017); long-term research site establishment, i.e., researchers deterring crime not with guns but presence at Tai NP, Côte d'Ivoire and in the Dja Conservation Complex, southeast Cameroon (Campbell et al., 2011; Tagg et al., 2015), and resource-access agreements (PA downgrades due to substantial transgression pressure) were commonly utilised in Ugandan NPs (e.g., Kibale (Mackenzie et al., 2012), Mt Elgon (Chhetri et al., 2003), and Lake Mburo (Infield and Namara, 2001)). Such anti-wildlife crime interventions maybe considered by other PAs in the region to accrue conservation benefits over large areas. Nonetheless, what works in one area may not necessarily work in another. PAs are morphologically completely different and wildlife crime is often unique to the location it is occurring in, the species or resources in question, and the overarching sociocultural nuances that influence the everyday lives of individuals (Skidmore, 2021).

Many PAs aim for a combination of both enforcement and non-coercive measures to ensure policing of illegal activities (e.g., Cross River NP, Nigeria (Adetola and Ofuya, 2021)). However, the strategies currently employed in safeguarding TPAs have been accused of being ineffective. For instance, intensifying anti-poaching law enforcement to make it harder and riskier for rule-breakers to commit wildlife crimes, particularly illegal hunting has been criticised as "green militarisation" and often seen to incite adversary behaviours or recidivism (Duffy, 2014; Lunstrum, 2014; Witter, 2021), as corroborated in this review. Other evidence suggests that law enforcement can reduce, for example, bushmeat poaching in the short term, but long-term solutions require working with frontline communities to address the motivations to offend and the disincentives to conserve wild biodiversity (Challender and MacMillan, 2014; Cawthorn and Hoffman, 2015; Atuo et al., 2020). Within TPAs an ongoing debate is whether enforcement can halt the non-compliant resource-use problem, especially bushmeat exploitation (Hilborn et al., 2006; Fischer, 2008). For instance, wildlife law enforcement is considered a volatile strategy because once its relaxed or perceived weak it loses its purpose (Ponta et al., 2021). This is likely to be the norm, given the widespread shortfalls in African PA resourcing (Lindsey et al., 2021), e.g., budget crunches experienced even at America's NPs (Bachmann, 2018).

Most non-enforcement approaches, are designed to boost prosperity in peripheral communities, such as alternative livelihood schemes. However, they have been condemned for potentially mitigating the financial motivations for non-compliance, without necessarily addressing the socio-political drivers (Rogan et al., 2018). Termed, 'conservation by distraction' (Ferraro and Simpson, 2002; Duffy and St. John, 2013), these distractions are typically offered through alternative livelihoods and are central to integrated conservation and development projects (ICDPs). Moreover, there is concern that some interventions, e.g., community sensitisation, maybe more effective at changing law-breakers' attitudes rather than their actual behaviours that negatively impact on PAs (e.g., Infield and Namara, 2001; Lepp and Holland, 2006; St. John et al., 2010). Additionally, there is limited scientific input into the design of conservation interventions to remove opportunities and drivers that cause a specific illegal behaviour (e.g., Travers et al., 2019), leading to substantially lowered probability of success. Accordingly, this current synthesis demonstrates that non-compliant use of natural resources is remarkably widespread despite the various deterrent measures in place to dissuade it. Consequently, there is an urgent need to find alternative solutions and design more tailored interventions to deter human intrusions and disturbance in protected spaces (Moreto and Gau, 2017).

3.3. Limitations

As with all narrative overviews limitations exist. Although we acknowledge that non-peer reviewed grey literature may have contributed additional information, we decided to focus on the peer-reviewed literature. Moreover, this narrative inquiry goes beyond reviews of its type as it leans on systematic review methodologies, a style of writing recommended for creating quality narrative overviews (see Ferrari, 2015). This study is an in-depth qualitative exploration to ascertain the state of wildlife crime evidence with some quantification. More quantitative focus is beneficial in quantifying the true impact of interventions used in curtailing illegal

incursions, making comparisons, and establishing key patterns in wildlife crime to improve intervention strategies.

4. Implications for conservation

The current review on illegal biological resource-use in TPAs of sub-Saharan Africa provides three important insights for their management: (i) conservation non-compliance has multiple causes, (ii) different kinds of non-compliant behaviours are prevalent in TPAs, and (iii) drivers are highly complex and diverse and can be behaviour or resource-specific. The first insight, that non-compliance has multiple causes is an important step in realising that a single, one-size fits all response is unlikely to be effective. The second insight highlights that PA offences vary in types. We noticed that unproportionally more attention is given to unveiling the drivers for wildlife poaching than other drivers. Not fully acknowledging the breadth of crimes has also been noticed by scholars of criminology (e.g., Moreto and Lemieux, 2015; Kahler and Rinkus, 2021). Consequently, it is important to determine which motivating factors drive non-compliance for rarely or infrequently studied deviant behaviours. For instance, is it poverty pushing people to enter into PAs and illegally graze their livestock, a symbol of affluence and status in the countryside? PA transgression is multidimensional and embracing this may invite new solutions (Ponta et al., 2021). Failing to account for PA transgression’s multidimensionality hinder solutions or result in poorly tailored crime reduction measures and retaining the current status. Moreover, different forms of non-compliance have different implications for biodiversity (Robbins et al., 2006). The third insight casts some light on the complexities of motivations that cause people to violate regulations. We deduce that a more nuanced approach to crafting counter-wildlife crime interventions should be taken, given the multi-facetedness of drivers, multiplicity and specificity (non-compliant behaviour or resource-specific).

Prior to deploying interventions, considerable effort should be invested into understanding the criminal behaviour and what triggers or sustains it. This is the basis for the development of initiatives to promote behavioural change or threat reduction actions. For instance, interventions that have the greatest impact on reducing rural household participation in wildlife crime are those that directly tackle the main drivers, i.e., response strategies that reduce drivers and facilitators of the problem (e.g., Solomon et al., 2015; Travers et al., 2019). Durable solutions should be based on the drivers or, alternatively, conservation scientists need to think like wildlife criminals in order to develop effective and efficient responses or wicked problem thinking (see Game et al., 2014).

Human behaviour can be a profound source of solutions to the considerable environmental dilemmas PA management faces (Clayton and Myers, 2010; Williamson and Thulin, 2021). Recognition of this has led to increasing calls for frameworks that develop understanding of detrimental human behaviours affecting PAs (Nuno and St. John, 2015; Redpath et al., 2018). In the current review,

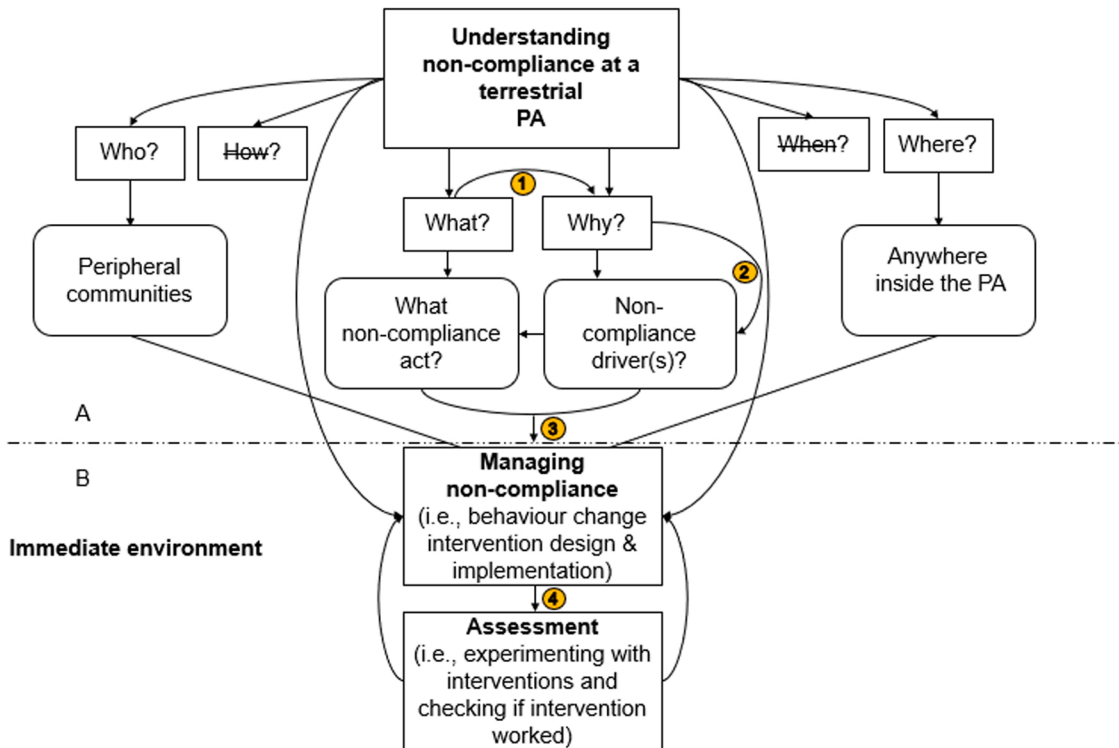


Fig. 1. Conceptual model for (A) understanding and (B) managing local non-compliance with resource-use rules at a terrestrial PA based on the Kipling Method (5 W + 1 H). Assumptions: (1) various forms of non-compliance are experienced at a PA, (2) for every non-compliance act encountered the drivers are likely to vary, (3) each non-compliance driver, in a given situation, could yield different solutions, and (4) dependable interventions are those whose design is informed by a richer understanding of key non-compliance behaviour drivers as well as the dynamic contexts within which behaviour operates and manifests.

we provide a simplified, interpretable but novel adaptive framework based on the Kipling method or 5W1H (5 W + 1 H, who, what, where, when, why, and how) to aid PA manager's understanding of non-compliance and ultimately its management (Fig. 1; Kipling, 1902). 5W1H was put forward by Kipling (1902). The 5W1H method can be applied to different situations or any domain. It serves as a basis for information gathering and practical problem solving (Sosnowski et al., 2021). The method is useful in analysing a problem and dismantling it into its most basic elements to reduce the complexity (Game et al., 2014), by examining it from different angles, as well as finding new and effective solutions (Kipling, 1902; Lemieux and Pickles, 2020).

We propose that an explicit and more systematic understanding of non-compliant TPA resource use would open up fresh pathways for reducing and preventing future rule-breaking and improve the way in which TPAs are managed. The method is based on six trigger questions: (i) **Who** are (or could be) the rule-breakers? (ii) **What** non-compliant activities occur? (iii) **Where** does the illegal resource-use occur? (iv) **When** does the illegal resource-use occur? (v) **Why** does an individual decide to break rules? (vi) **How** does the illegal resource-use occur? These questions can be used as stimuli for creative thinking in research. Based on the answers, evidence-based information is generated to support the design of tailored initiatives to cope with non-compliance on the ground (Arias, 2015; Bragagnolo et al., 2017). For the current review we concentrated on 2 W's, the 'what' and the 'why', as these appear to be most critical for formulating robust conservation interventions in the context of TPAs and marine environments (Arias, 2015). Specifically, we present a four-step design process, providing an outline and guidance on how to generate optimal interventions to conserve biodiversity housed in TPAs: (1) identification of the target behaviours that need to be altered, (2) disentangling the pressing motivations behind each behaviour of interest, (3) behaviour change intervention design or initiation, and (4) assessing the impact of implemented response and share lessons learnt (Fig. 1). These steps are often skipped or not made explicit, but are critical to intervention success. By adhering to the four-step framework, two common pitfalls are avoided by practitioners in TPA management; firstly, the crafting and implementation of interventions that do not correspond to a specific illegal behaviour and secondly, the forming of interventions that barely reduce or remove the drivers underpinning the illegal conservation behaviours.

Interventions should be behaviour-specific and not umbrella-like (e.g., Moreto, 2019). Intervention projects to encourage compliance frequently improve PA-human neighbour relations, without genuinely altering a specific illegal behaviour or reducing the facilitators of the problem (van Velden et al., 2018). For example, at Kibale NP in Uganda, launching a novel conservation strategy in form of a mobile health clinic improved people-PA relations but was ineffective in lowering poaching (Kirumira et al., 2019). Furthermore, communities around Lake Mburo NP in Uganda that had been part of a seven-year-long community conservation programme had a more positive attitude towards the PA and wildlife than communities not exposed to the programme, but the high levels of poaching and illegal grazing persisted (Infield and Namara, 2001). Indeed, conservation interventions frequently only alter or influence local human attitudes but not necessarily the specific behaviours that pose a threat to PAs (St. John et al., 2010). These observations highlight that interventions need a clearer link to conservation outcomes.

If predictors of human behaviour are incorrectly diagnosed, management interventions or the chronically scarce funds maybe misdirected. For instance, a PA could be experiencing poaching which is largely driven by HWC. However, without adequately profiling perpetrators, wildlife officials may feel the need to increase patrols. As Atuo et al. (2020) and Afriyie et al. (2021) documented, PA management enforcement has been idealised as the only viable alternative, i.e., more enforcement is believed to result in greater deterrence. At a time where there is a growing recognition for the need of using conservation expenditure efficiently by prioritising conservation efforts based on the best available evidence (Rytwinski et al., 2021), such routine investments can be wasteful or even produce enduring counter-productive results. For example, rule-breakers can become innovative when performing specific wildlife crimes, i.e., creative deviance (Green, 2011; Knapp, 2012; Arias, 2015). This mismatch between a PA's circumstances and management strategies is shown by the Kibale NP case where the introduction of a mobile clinic with the hope to lower poaching was not effective (Kirumira et al., 2019). The mobile clinic initiative may have stood a chance if poaching was undertaken to acquire certain wild animal or plant materials believed to work as medicines as observed at Bwindi Impenetrable NP, Uganda (Harrison et al., 2015). Moreover, a revenue sharing programme to resolve problems of wildlife crime set up around the Kibale NP had minimal impact because frontline villagers felt that the intervention project did not deal with the crop foraging by stray park-protected wildlife, a primary motive behind wildlife violations (MacKenzie, 2012).

5. Conclusion

This narrative review presents an insight into the state of wildlife crime research within TPAs of sub-Saharan Africa. Several illegal park behaviours were cited in the peer-reviewed literature with bushmeat poaching emerging as the top act of delinquency within the region. The wildlife crime literature was overwhelmingly dominated by studies that aimed at understanding offender's motivations to poach. The causes of other PA offences were under-represented and are in dire need of conservation attention. Overall, a range of motivations for engaging in law-violating habits was established, with rural poverty being a consistently mentioned driver, especially in propelling poaching-related transgressions. While poverty emerged to be the ultimate driver of wrongdoings or enmeshed in the motivations of transgressors, the situation is more intricate and exceptions exist in the region. For instance, in some contexts and settings, the widely held belief that poverty is the leading cause of wildlife crime was challenged.

The drivers for wildlife crime varied according to the type of crime or the type of resources or commodities targeted. Recognising this heterogeneity when devising interventions is key for maximum impact (Keane et al., 2012). Thus, understanding the causes of various forms of deviant behaviour, apart from poaching and effective measures for controlling them in terrestrial conservation, is of immediate priority. The available research is insufficient given the apparent scarcity of evidence, magnitude and importance of rule-breaking behaviour. By embracing PA transgression's multidimensionality, various illegal activity classes additional drivers of transgressive behaviour are likely to be uncovered leading to the design of more robust conservation interventions. Our review

identified an array of illegal behaviour deterrents in TPAs with law enforcement emerging as the top deterrent to unauthorised activity, though in some contexts it was not sufficient to stop all destructive intrusions.

In order to enhance conservation efforts in sub-Saharan Africa and to build a better research agenda for TPAs on non-compliance, conservation scientists need to consider human behaviour and the factors that motivate it. For instance, the importance of understanding animal behaviour is widely acknowledged in conservation science. However, human behaviour and the factors that drive it remain woefully underappreciated (Cowling, 2014; Cinner, 2018). Yet, it is human behaviour that is the greatest threat to the future of the region's TPAs. We argue that influencing human rule-breaking behaviour could be the key to successful PA management. The initiation of new or even expansion of ongoing conservation initiatives need to be grounded in an understanding of the drivers underpinning the deviance at a given time. The timing factor is also vital given that human behaviour is malleable and motivations can over time gradually evolve as shown for poaching motivations that went beyond subsistence (Kahler and Gore, 2012). We conclude that understanding motivations for unauthorised behaviour and criminal contexts should be given greater priority to reduce illegal use of natural resources in TPAs of sub-Saharan Africa.

Declaration of Competing Interest

Nothing to declare.

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