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Will the Sustainability of Lion Tourist Hunting be Certain Amidst Non-compliance to Conservation Legal Frameworks? A Case from the Selous Game Reserve, Tanzania

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Abstract

This paper examined the understanding and compliance with the IUCN sustainability principles among hunting practitioners of the Selous Game Reserve (SGR) for sustainable trophy hunting. Five administrative sectors of the SGR to include Ilonga, Msolwa, Liwale, Miguruwe and Kingupira were purposively sampled for assessment between August and October 2018. It applied the theory of planned behavior (TPB) to understand predictors of compliance, and the unmatched count technique (UCT) to estimate prevalence of unsustainable hunting practices. UCT, semi-structured interviews, key informants interviews, direct field observations and Documentary review were used to collect data. Analysis of compliance was conducted using multiple logistic regression models in SAS Version 9.4 software. The findings indicated that, majority of the hunting practitioners are not familiar with IUCN hunting principles. Accordingly, nearly a half of the respondents did not comply with the principles. The predictors of compliance could be working experience (p=0.0079) and awareness with IUCN principles (p=0.0034) as they were significant in expressing positive attitude towards sustainable trophy hunting. The paper recommends; (1) much emphasis on the awareness rising and clear understanding of IUCN sustainability principles to the licensed hunting practitioners; (2) effective monitoring and evaluation of the hunting activities to reinforce compliance of sustainability principles.

Key words: sustainability, IUCN hunting principles, hunting practitioners, trophy quality, African lion

Introduction

Potentials of trophy hunting are still debatable across the globe (Creel et al., 2016; Makuyana, 2018). Hunters append economic value to wildlife as the

only means to guarantee its protection (Baldus, 2009; Muposhi et al., 2016). Protectionists dispute trophy hunting as a lucrative business with wee ecological return (Ripple, et al., 2019). However, trophy hunting in states rich in biodiversity remains as a plausible source of conservation fund and opportunities to rural development (Di Minin et al., 2016). Different initiatives have been put forward to perk up trophy hunting for effectual wildlife conservation (Miller et al., 2016). Amongst others, is the campaign on sustainability of trophy hunting for livelihood improvements and wildlife protection (Brink et al., 2016; Makuyana, 2018).

Wildlife conservation is the immensely demanding task mainly in terms of fiscal and technical skilful human assets requisite for its management. In the nonattendance of ample funding to support conservation, depopulation of game species and loss of their associated habitats are the immediate dooms (Ripple et al., 2019). For instance, anthropogenic disturbances such as rampant poaching, logging, expansion of agricultural fields and settlement in wildlife ecosystems are frequently reported (Kideghesho, 2016; Kyando et al., 2017). In biodiversity rich landscapes, where photographic tourism is unfeasible, trophy hunting is the sole contrivance for generating conservation fund (Di Minin et al., 2016; Lescuyer et al., 2016). In some cases, trophy hunting is also used as an exclusive means of detaining local community conservation interests by providing livelihood opportunities to the people (Baldus, 2009).

For effective fostering and nurturing wildlife through trophy hunting, sustainability is a fundamental element yet remains a decidedly controversial subject in the field of conservation (Muposhi et al., 2016; Ripple et al., 2019). In 2000 the International Union for Conservation of Nature (IUCN) in Amman, Jordan approved the policy statement on sustainable use of natural resources including wildlife as the promising facet rousing conservation and sustains resources in the long term while human wellbeing is passably realized (Makuyana, 2018). In the same outlook, but in a Tanzanian context, the paper defined sustainable trophy hunting as the selective harvesting of game animals whereby a hunter pays fee for the purpose of getting desired parts of the animals such as horns, tusks, teeth, claws, bones, hoofs, feathers, skins, hair, or any portion of an individual animal hunted with the broad objective of maintaining the species viability and relieve poverty among local populations. Sustainable trophy hunting is comparatively challenging as it is all about managing human behaviours (Moreto, 2016; Makuyana, 2018).

Hunting process is implemented under the laws, rules and regulations yet various socioeconomic and ecological problems abate the efforts towards the industry sustainability just because the established legal frameworks suffers non-compliance among hunting practitioners (Creel et al., 2016; Muposhi et al., 2016). IUCN identified illegal hunting, weak governance, excessive quotas, poor monitoring, corruption and lack of transparency as the elements of unsustainable trophy hunting in many counties to date (IUCN, 2016). Insufficient financial and technical skilled human resources limit regular wildlife census resulting to quota setting based on guesswork (Songorwa & du Toit, 2007; Lindsey et al., 2013). Moreover, inadequate funding limits game wardens to supervise the allocated quota during hunting operation consequently some of the hunting safaris are conducted by operators in the absence of government representatives (Malembeka, 2013; Lescuyer et al., 2016). It is also important to note that, the process of concessions allocation is mainly implemented under the prudence of few persons paving the way for nepotism and corruption (Lindsey et al., 2013; Chomba et al., 2014). Therefore, donation of concessions' holders to anti-poaching and community development are rarely obligatory and are mostly left in their interests (Creel et al., 2016). In most cases the short-tenure concessions lessen the moral of the outfitters to bestow in conservation, support anti-poaching and livelihood developments and instead endorse unsustainable harvests (Lindsey et al., 2013; Brink et al., 2016). Corruption is habitually reported to sway government officials to favour some operators in hunting blocks allocation and overshooting of quotas (Lindsey et al., 2013; Moreto, 2016).

Tanzania resides as the only state that embarks on trophy hunting in East Africa (TAWIRI, 2016). The country supports largest number of foreign hunting clients of free ranging wildlife including lions in the world (Miller et al., 2016). After South Africa, Tanzania was the second exporter conveyance 42% of the trophies of free ranging lions to U.S. between 2005 and 2014 (Brink et al., 2016). Notwithstanding, the state designated more than a quarter of her land for trophy hunting, budget constraints have imperfect the country to thrive wildlife protection in hunting areas (Baldus, 2009; Zafra-Calvo et al., 2018). The African lion is amongst the affected species suffering from illegal persecution, threatening its conservation status (Brink et al., 2016; Benyr et al., 2017). In ecosystems where trophy hunting is potentially conducted the population of the game species including lion declines (Wilfred, 2012; Malembeka, 2013; Lindsey et al., 2017).

Following such adverse impacts of trophy hunting, in 2012 IUCN Species Survival Commission (SSC) stated that trophy hunting should not: (1) contribute to long-term population declines of the hunted species or of other species sharing its habitat; (2) substantially alter processes of natural selection and ecosystem function; (3) inadvertently facilitate poaching or illegal trade of wildlife; (4) artificially and/or substantially manipulate ecosystems or their component elements in ways that are incompatible with the objective of supporting the full range of native biodiversity. Selous Game Reserve (SGR) in Tanzania is a World Heritage Site with an international recognition as a mega lion trophy-hunting destination (Baldus, 2009). However, between 1996 and 2008, the reserve experienced lion overhunting which surpassed the recommendable sustainable off-take rate of 1 lion per 1000km^2 (Brink et al., 2016; Zafra-Calvo et al., 2018). Since 2010, hunting off-take of lion in SGR has dwindled sharply irrespective of the sizeable quota allocated annually (Brink et al., 2016). These observations indicate that hunting sustainability particularly for iconic species like lion is not yet certain. Several studies addressed sustainability of lion trophy hunting in terms of population dynamics (Malembeka, 2013; Creel et al., 2016; Lescuyer et al., 2016; Brink et al., 2016; Miller et al., 2016). Others reported the impacts of unsustainable trophy hunting on trophy quality and evolution of game species (Chomba et al., 2014; Muposhi et al., 2016; Festa-Bianchest et al., 2018). However, Fairbrass et al. (2015) investigated the determinants of compliance with wildlife protection laws to avert bird persecution in Portugal, yet inadequate information exists on how non-compliance to legal frameworks like the IUCN guidelines exacerbates unsustainable hunting. The paper therefore investigated how licensed hunting practitioners comply with the IUCN guiding principles in the SGR. Specifically, it intended to determine the SGR's hunting practitioners understanding on IUCN biological hunting principles and the level of compliance to the principles to guarantee sustainability.

Theoretical framework

Understanding compliance with legal frameworks among hunting practitioners is the complex process involving investigating human behaviours (Fairbrass et al., 2015). Non-compliance to conservation rules governing hunting is sensitive practices that one would not reveal the reality. The paper applied the theory of planned behaviour (TPB) as the socio-psychological model to investigate the influence of demographic factors to the behavioural determinants such as attitudes, subjective norms and perceived behavioural control. The TPB explains behaviour as the function of attitude, subjective norms, and behavioural control (Shrestha et

al., 2012). Individuals with positive attitudes towards unsustainable hunting, he/she is expected to undertake it in particular under poor enforcement of the hunting regulations. Subjective norm of a person not to comply with hunting rules depends on how another person or group of people surrounding him/her approve or disapprove his/her engagement in unsustainable trophy hunting. Perceived behavioural control as another aspect of TPB entails that if an individual has the belief that his/her experience or skills in performing unsustainable hunting practices are effective to protect him/her against regulation penalty will keep doing such particular behaviour. The three major determinants of behaviour explained above have been assessed on how they affect individuals' compliance with wildlife protection laws using the TPB (Shrestha et al., 2012; Fairbrass et al., 2015; Abukari, 2018). However, authors have suggested the need for expanding the model to provide other factors making it more explanatory. In this paper, investigation was made on how various demographic characteristics such as age, sex, marital status, education, working experience and awareness with IUCN principles could influence the compliance of an individual to sustainable trophy hunting.

Materials and Methods

The study was conducted in the Selous Game Reserve (SGR) (Figure 1) before 60% of it being upgraded to Nyerere National Park in late 2019. Therefore, the findings reported in this paper are for the old SGR (both northern and southern SGR). The reserve is found in the southeastern part of the country, characterized by *miombo* woodlands dominated by the *Brachystegia* species (Kyando et al., 2017). The reserve has a wide variety of game species to include but not limited to elephants (*Loxodonta africana*), buffalo (*Syncerus cafer)*, wild dogs *(Lycaon pictus)*, lions *(Panthera leo)*, and leopards (*Pantherapardus*) (Baldus, 2009). The reserve is similarly rich in birds and reptile species (Zafra-Calvo et al., 2018).

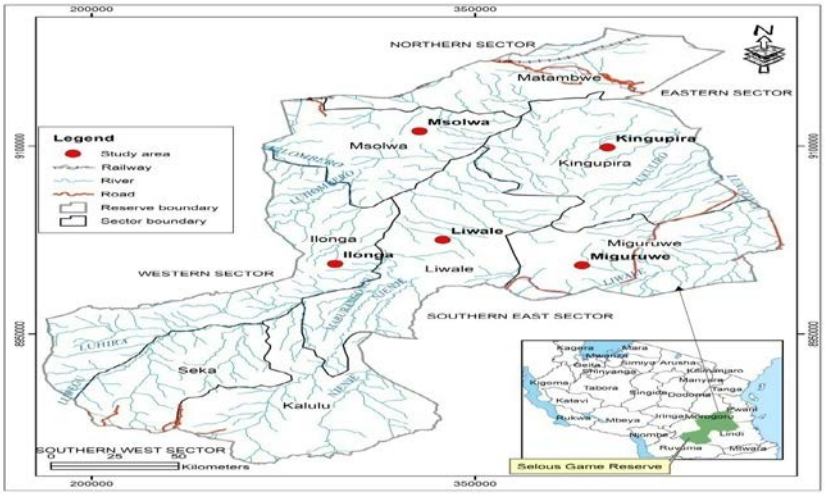

Fig. 1: Map of Selous Game Reserve showing the study sites (IRA GIS Lab, 2018).

Purposive sampling was employed to select five (5) SGR administrative sectors out of eight (8) to include Msolwa, Ilonga, Liwale, Miguruwe and Kingupira (Figure 1) as they hunted large numbers of lions between 1995 and 2018 than others could tell. Using Israel (1992) sampling formula; $n= N/[1+(N \times e^2)]$ at the confidence interval of 95%, sampling error (e) of 5%, the sample size of 120 respondents was selected including wildlife officials, professional hunters, hunting outfitters and hunting clients. Semi-structured interviews, key informants interviews, unmatched count technique, direct field observations and documentary review were employed to collect data.

Statistical analysis for quantitative data was conducted using the SAS Version 9.4 software. The influence of social-demographic variables on compliance of the respondent to the IUCN sustainability principles were assessed using multiple logistic regression models (Agrest, 2002). The criterion for statistical significance was set at a p-value of 0.05. The Unmatched Count Technique (UCT) data were analysed by comparing the mean number of activities done by respondents in the control group to that of treatment group (Fairbrass et al., 2016). Therefore, the level (prevalence) of noncompliance (sensitive behaviour) was determined as the difference between the averages of response in the control and treatment group (Harrison et al., 2015). Since the variances of the two means from control and treatment group were different, Welch's t-test was preferred in calculating standard error of the estimates (Nuno et al., 2013). Using the

SAS Version 9.4 software, the rate of hunting off take for lion in 43 hunting blocks leased to various outfitters at different times between 1995 and 2018 in SGR was determined. The off takes for hunting concessions within the same administrative sector were combined to calculate the mean annual off take for lion in the respective sector. Using the linear regression model, the changes in the annual off take over times between 1995 and 2018 were determined using the number of lions harvested in such period (Brink et al., 2016). On other side, template analysis technique was used to analyse the qualitative data from the key informants, observation, and documentary review.

Results and Discussion

Awareness about IUCN sustainability principles of hunting

IUCN SSC sustainability principles assessed include avoiding population declines of the species, protecting processes of natural selection and ecosystem function, preventing poaching, as well as avoiding manipulation of ecosystems supporting the native biodiversity. The findings of the assessment revealed that 45% (n=54) of the interviewees were aware of the IUCN guiding principles for hunting. However, when probed on the number of principles, only 21% (n=25) of the respondents managed to mention correctly that there are four principles. The few individuals tried to describe the IUCN guidelines were those with higher education, such as bachelor and master degree. None of the respondents was able to clearly state the principles. The paper, therefore, revealed that, despite the IUCN guidelines being informative and instrumental in managing trophy hunting, they are less known to the hunting practitioners in the study area. Little emphasis given on the principles during training, induction and working might be the factor underpinning poor knowledge on IUCN regulations. A similar observation was reckoned through key informants' interviews as one official had this to say:

> *The IUCN hunting principles of 2012 are not well known to most of us and rarely emphasized during training and working, it is easier for one to remember CITES issues but not IUCN* (Key informant at Ilonga sector of SGR, 2018).

It seems that this problem trends in other countries. The study done by Fairbrass et al. (2015) reported that majority of the bird hunters in Portugal did not understand the conservation regulations resulting to high prevalence of bird trapping, shooting and poisoning which is illegal as per the Berne Convention and the European Bird Directive of which Portugal is the party. Less knowledge on policies and legislations among conservationists and

related practitioners is the challenge in achieving resources sustainability as protection relies on the rules application to amend human practices (Keane et al., 2008).

The IUCN principles are integrated in the National Wildlife Policy of 2007, Wildlife Act of 2009, and the hunting regulations of 2015. For instance, the vision, mission and objectives of the wildlife policy emphasize on the sustainable conservation and utilization of wildlife resources. The policy clarify that sustainability in utilization of wildlife resources will be achieved through provisioning of clear policy guidelines, stimulating public and private sector investment in the wildlife industry and issuing of permits and licenses (URT, 2007). Similarly, the National Wildlife Act of 2009, among other things foster sustainable and legal use of wildlife resources and take appropriate measures to prevent illegal use of wildlife (URT, 2009). Furthermore, the hunting regulations of 2015 elaborate about adherence to hunting quota and age of male individual lions to be hunted as the way to ensure sustainable harvesting (URT, 2015). Assessment on the knowledge of the IUCN principles among hunting practitioners took into account what have been stated in the national legal frameworks about hunting sustainability. Therefore, low understanding among respondents on the maintenance of species population, protection of natural selection processes, prevention of poaching, and avoidance of ecosystems manipulation regardless of being emphasized in both national and international conservation rules could be the potential challenge threatening hunting sustainability. However, the new Wildlife Conservation (Special Wildlife Investment Concession Areas) Regulations recently introduced on 17 January 2020 highlighted on sustainable multiple forms of wildlife utilization and tourism development as an additional efforts of stimulating hunting sustainability in the country (URT, 2020). Noteworthy, the regulations are expected to promote sustainable trophy hunting if proper awareness is created among wildlife officials, concessionaires (outfitters), professional hunters and hunting clients about what to be done in the Special Wildlife Investment Concession Areas allocated within the protected area. The clear understanding of the regulations will enhance effective implementation to realize intended conservation and economic benefits.

Compliance of hunting practitioners to the IUCN sustainability principles

Figure 2 indicates the proportion of hunting practitioners complied with the four IUCN sustainability principles.

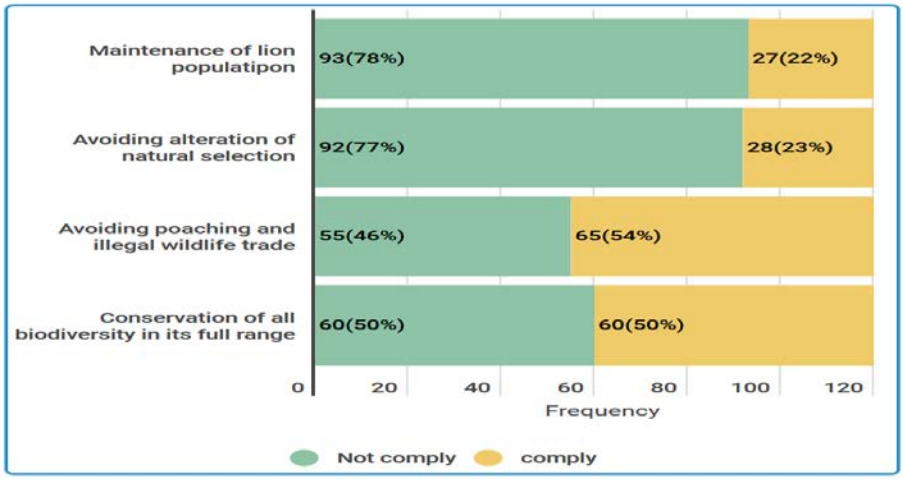

Fig. 2: Level of compliance with IUCN sustainability principles among hunting practitioners (Field data, 2018).

Our results show higher compliance on the avoidance of poaching and illegal wildlife trade among licensed hunting practitioners (Figure 2). Moreover, Table 1 indicates that the prevalence estimate for poaching and illegal wildlife trade through UCT was small. The low estimate of UCT shows that people do not facilitate poaching and illegal wildlife trade hence higher compliance on the avoidance of poaching and illegal wildlife trade. The avoidance of poaching and illegal wildlife trade can be explained by the TPB as the indicator of positive attitude of hunting practitioners towards sustainable trophy hunting. This could be due to effective law enforcement executed by the responsible authorities in controlling illegal activities including poaching to reinforce sustainable hunting in the reserve.

Table 1: Rate of prevalence as estimated by UCT and direct questioning technique for compliance of IUCN principles in the past two years (2016-2018)

S/N	IUCN principles in form of UCT activity	UCT			Direct questioning
		Estimate prevalence	Standard error	p-value	Estimate prevalence
1	Overhunting leading to population decline	58%	17	0.021	22%
2	Hunting underage affecting natural selection	31%	13	0.018	14%
3	Facilitating poaching and illegal wildlife trade	6%	11	0.039	16%
4	Manipulating ecosystem and biodiversity in its full range	11%	9	0.044	19%

Source: Field data, 2018

Also, a majority (68%, n=82) of the respondents perceived poaching in the reserve to have been decreased to large extent since 2015. Through direct field observation, the study observed effective patrols done by wardens and the high conservation commitment exercised by the SGR management in controlling illegal wildlife activities. The high number (173,902) of patrols conducted across SGR between 2014 and 2015 facilitated to a reduced poaching and illegal wildlife trade (TAWIRI, 2016). In the same response, one of the key informants stated that:

> "*Despite that wildlife poaching is still a challenge all over the country; there have been few cases of poaching and illegal wildlife activities inside the reserve for the past 20 months. It is the plan of the management to work in teams with other practitioners to ensure poaching is completely eliminated from SGR"* (Key informant at SGR headquarters, 2018).

Our findings are supported by the report to EU CITES scientific review group on sustainability of lion and elephant trophy hunting. The report indicates that, the implementation of a National Strategy and Action Plan to combat poaching and illegal wildlife trade reduced commercial

poaching in the country by over 90%, and the carcass count for mega species like elephants decreased from 219 to 16 between 2013 and 2016 (Benyr et al., 2017). The few poaching cases observed were mainly in the form of bush meat potentially done by local people for subsistence.

Poaching and related illegal wildlife practices are similarly prohibited by national legal frameworks; for example, the Wildlife Act of 2009 on the aspect of institutional arrangement, and administration authorizes the Minister of Natural Resources and Tourism to establish the Wildlife Protection Unit. The Unit, which comprises wildlife officers, wardens and rangers, protects the wildlife against unlawful utilization related to the hunting, capturing, and photographing of wildlife as well as securing of trophies (URT, 2009). Additionally, the National Wildlife Policy of 2007 elaborates the same on combating illegal taking of wildlife resources both within and outside wildlife protected areas. The policy emphasize the provision of adequate manpower, enhancement of staff morale, and equipment to encourage compliance of wildlife laws and strengthen governmental capabilities to carry out anti-poaching operations effectively (URT, 2007). Remarkably, respondents asserted that poaching and illegal wildlife trade are combated in the study area, using the national regulatory frameworks that possibly imply the similar compliance of both the IUCN principle and the state wildlife regulations. Such an argument was clarified by one of the key informants, who stated that:

> *For any international or regional agreement of which Tanzania is a party, there are legislative proposals with appropriate measures to implement the agreements. Therefore, we comply with the IUCN principles via our hunting regulations of 2015, wildlife act of 2009 and wildlife policy of 2007 as they prohibit illegal acts on wildlife and its habitats* (Key informant at Miguruwe sector of SGR, 2018).

However, further investigation is needed to confirm that argument by assessing the extent of compliance specifically to the state regulatory frameworks among hunting practitioners to enhance sustainable harvesting of game species in the study area and the country at large.

Notwithstanding, the new Wildlife Conservation Regulations of 2020 established to enhance tourism investment in the special wildlife concession areas under effective implementation is expected to stimulate efforts against poaching and illegal wildlife trade. The regulations on the aspect of criteria for designation of special wildlife investment concessions areas grant the

longer concession leases of thirty (30) years to the concessionaire with appropriate exit clauses for those underperformed (URT, 2020). This is probable in building obligation among concessionaires in maintaining the quality of concessions unlike in the past where they had shorter leases of five (5) years which revealed to aggravate unsustainable practices and disregarding investment in poaching control (Brink et al., 2016). The regulations also require the concessionaires in developing and marketing the tourism products to be capable in maintaining the quality of the protected areas (URT, 2020). The aftermath of such aspect is the concessionaires to be responsible for fighting against poaching incidences and related illegal practices for proper protection of their concessions. Moreover, the same regulations of 2020 specify that among the qualifications of the concessionaire to win concession award should not have been convicted of any offence relating to poaching, money laundering or terrorism (URT, 2020). Thus, it is anticipated that the list of concessioners to be offered concession contracts will join the efforts against poaching and related illegal activities in the Tanzanian wildlife habitats.

Furthermore, the analysis revealed that a half of the respondents to comply with the conservation of all biodiversity in its full range (Figure 2). Accordingly, UCT results show lower prevalence in performing sensitive behaviour (manipulation of ecosystem and degrading biodiversity) during hunting (Table 1), implying higher compliance with the conservation of biological diversity. Higher compliance to effective conservation of biodiversity could be explained by the TPB that hunting practitioners in the study area have good attitude towards conserving all native biological diversity in its full range. The joint efforts executed among responsible conservation authorities from ministry level, non-governmental organizations and SGR management in combating illegal activities were cited by respondents as the reasons to express higher compliance to conservation of biodiversity within the reserve. Respondents clarified that, unlike in the past, nowadays when a person is apprehended with evidence of poaching or doing any illegal act in the reserve, the court convicts him/her and imposes a fine, or imprisonment instantly without unnecessary delay.

Our results may possibly be explained by the fact that, the new political regime in the country since 2015 put much emphasis on good governance of natural resources. Wildlife management and trophy hunting are effectively supported unlike a long ago where game rangers were bribed to overlook overshooting and politicians corrupted by some operators during concessions allocation (Kideghesho, 2016; Zafra-Calvo et al., 2018). Political commitment was similarly observed by Benyr et al. (2017) that

reforms of various wildlife regulations facilitated the country to guarantee the best practices and diminished cases of illegal wildlife off takes. Additionally, Ariffin (2015) asserted that political commitment of government to wildlife conservation was instrumental to supporting the law enforcement agencies for sustainable management of the resources in Malaysia.

Empirical studies elsewhere have indicated that overhunting aggravates depopulation of game species (Creel et al., 2016; Miller et al., 2016) and threatens species sustainability in hunting regions (Brink et al., 2016; Lescuyer et al., 2016). Findings from various interviews with respondents show low compliance on avoidance of the long-term population declines of lion during hunting (Figure 2). This is contrary to IUCN principles, Wildlife Policy of 2007, Wildlife Act of 2009 and hunting regulations of 2015 which all emphasize on sustainable utilization of wildlife resources. For instance, to enhance sustainable harvesting through trophy hunting, the National Wildlife Act of 2009 on the aspect of consumptive and non-consumptive use of wildlife, section 40 states that, *"A person shall not hunt any specified animal except under and in accordance with the conditions of a hunting license issued to that person"*. Similarly, in the national hunting regulations of 2015 on part II procedure for application and allocation of hunting blocks section 4 (d) one of the criteria for establishing hunting block states that, "*The area should have potential for wildlife recovery upon a given time frame and investment*". This indicates that depopulation of lion species in the study area and country at large may perhaps be the result of the low compliance to IUCN sustainability principle of avoiding population declines. Accordingly, as sustainable harvesting of game species is similarly emphasized in the national regulatory frameworks, the reported decline in lion population could entails that the state conservations laws are also suffering low compliance. Nevertheless, as stated earlier, further research is required to ascertain specifically the level of compliance to national wildlife laws and regulations among the hunting practitioners.

In the same way, Table 1 indicates that UCT has accurate estimate of higher prevalence in doing sensitive behaviour (overhunting) implying low compliance to the avoidance of population declines. The majority of hunting practitioners to admit doing overharvesting could be explained by the TPB that, their attitude towards overhunting may perhaps be motivated by the low retribution effect of the hunting regulations and poor enforcement; their subjective norms (perceptions of social expectations) towards doing overhunting are common and socially tolerable among the community; and

their perceived behavioural control (ability to undertake overhunting without being convicted) is high due to ineffective law enforcement. This suggested that the noted unsustainable trophy hunting could have been resulted among other factors depopulation of the African lion in the study area (Muposhi et al., 2016; Makuyana, 2018). However, as noted earlier that the new political regime has made a number of reforms to enhance effective natural resources management, including wildlife. Exemplary is the proposed Wildlife Conservation (Special Wildlife Investment Concession Areas) Regulations of 2020 that possibly will stimulate the sustainability in trophy hunting as the regulations allow the Directorate of Tourism and Business Services undertaking proper monitoring and evaluation of tourism projects in accordance with the concession contract (URT, 2020). Noteworthy, upon renewal of the concession contract, the concessionaire should score above fifty percent in the performance of various obligations such as ecological integrity, compliance of laws, business plan in conservation, tourism and communities. This approach will enhance effective commitment among the concessionaires leased with concessions in the country and reduce unsustainable practices in the hunting industry.

Regarding the avoidance of substantial alteration of natural selection processes among hunting practitioners, the interviewees shown low compliance (Figure 2). Poor compliance on the principle was similarly revealed right through UCT results as the analysis indicated higher prevalence estimate in doing sensitive behaviour (hunting underage) among respondents (Table 1). The TPB explains that, an individual is likely to undertake behaviour of which his/her attitude, subjective norms and behavioural control are positively motivated. Hunting practitioners in the study area revealed that it is difficult to estimate the age of matured lion at distant hence find themselves shooting the underage individuals which is perceived to be disrespecting the formal rules and regulations put forward to reinforce their instrumental compliance. The aspect of harvesting the underage individuals could implies that trophy hunting is probably not well monitored in terms of its long term impacts on species genetics. Evolution due to natural selection occurs in an ecosystem if there is variation in heritable traits of a species as well as the difference in growth and reproductive potential of the organisms (Festa-Bianchest and Mysterud, 2018). SGR is a wildlife ecosystem with high species richness and abundance subjected under tourist hunting since colonial era (Zafra-Calvo et al., 2018). Therefore, it was our interest to understand the impact of hunting and other anthropogenic pressure on lion trophy size. Altering natural selection processes result in changes in population-genetic characteristics of species including decrease in trophy size (Pigeon et al., 2016). We assessed

lion trophy quality by asking respondents whether they have noticed any change in trophy size over decades, and the potential drivers of such change. The results showed that 83% (n=100) of respondents admitted to have observed decrease in trophy size. Our findings agree with that by Songorwa and du Toit (2008) who reported a decrease of 12% in trophy size for the lion hunted in Msolwa sector of SGR between 1999 and 2004. Additionally, through key informants' interviews, respondents had the more or less similar observations as cited by one of the participant in Kingupira administrative sector of SGR that:

> *"Since the introduction of age criterion restricting hunting lions under 6 years of age, it is hard for a client to get lion even if it is allocated in his quota implying that recommendable trophy lions have depleted"* (Key informant at Kingupira sector of SGR, 2019).

The failure of the hunter and his client to secure a lion trophy could have diverse implications including but not limited to less effort devoted in the pursuit of the animal or hunting plan organized by the hunter and outfitter for not hunting lion so that the client may come next season. However, it might be the result of excessive off take that occurred in the past decades to the extent of depleting the individuals with recommendable trophy size. These findings were supported by Muposhi et al. (2016) who stated that, excessive off takes occurred in most African hunting regions reduced the trophy quality that could be the reason for the decreased number of tourists willing to harvest some game species in the continent. Similarly, Patmore et al. (2014) reported that, overhunting and higher trophy selectivity of elephant and buffalo in the Sengwa Wildlife Research Area, Zimbabwe, resulted into a decrease in their trophy size. Selective nature of trophy hunting coupled with unsustainable off takes occurred in Tanzanian hunting areas for the past decades influenced social and genetic variation in lion population (Wilfred, 2012).

In relation to the respondents' perception on the decline in trophy size, we also interviewed them to rank the factors driving down trophy quality in accordance with their severity. The results showed that, more than one-third of the respondents cited tourist hunting as the major reason for lion trophy size decline in SGR (Table 2). The disproportionate lion hunting that occurred in the study area over decades could be the reason for such perception. The finding is supported by the study of Patmore et al. (2014) who observed that trophy hunting and poaching are the main threats affecting trophy quality of African elephant, Buffalo and African lion in

Sengwa Wildlife Research Area, Zimbabwe. However, it is contrary to the study by Chomba et al. (2014) who asserted that excessive hunting of lions in Zambia between 1967 and 2000 did not result into trophy size decline. Nonetheless, empirical studies revealed that selective nature of tourist hunting, focusing on individuals with best trophy, rendered to the loss of wild animals with high vigour (Darimont and Child, 2014; Pigeon et al., 2016). Other factors perceived to cause trophy quality decrease in the study area are presented in Table 2.

Table 2: Drivers of lion trophy quality decline

S/N	Factor affecting trophy quality	Frequency	Percentage (%)	Rank
1	Tourist hunting	46	38	1
2	Habitat loss	31	26	2
3	Retaliatory killing	22	18	3
4	Poaching of prey base	13	11	4
5	Cleo-parasitism, infanticide, diseases	8	7	5
	Total	**120**	**100**	

Source: Field data, 2018

Mortality induced by either form could have adverse effects on behaviour, gene pool, and social structure of lion (Creel et al., 2016; Festa-Bianchest and Mysterud, 2018). The study revealed that, besides trophy hunting other factors either singly or in combination, could have impacted the lion trophy size indirectly as they can reduce species reproductive potential. These results are supported by another empirical investigation in the study area that shift in lion sex ratio from 1.2 to 1.3 in some parts of Selous is a multifaceted process of various threats (Brink et al., 2013).

The results of the overall compliance to the IUCN sustainability principles among hunting practitioners are presented in Figure 3. Considering the fact that the operational definition of compliance in this paper was the compliance of at least half of the principles, it was revealed that 57% of the respondents complied with the principles although, a big majority of them complied with only a half of the IUCN sustainability principles (Figure 3).

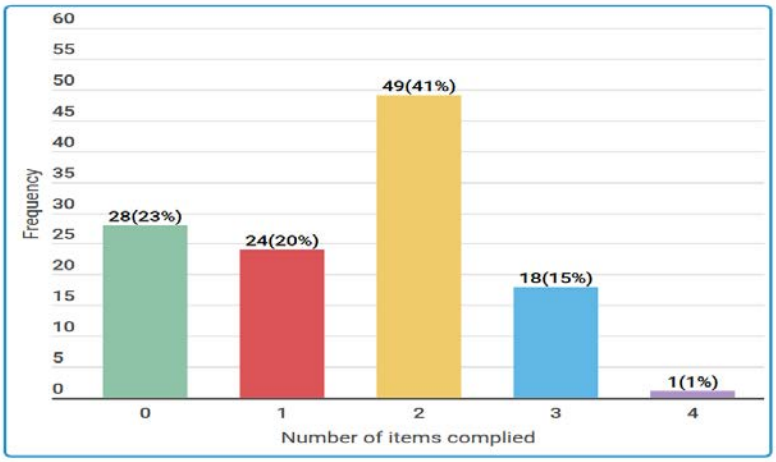

Fig. 3: Levels of compliance of hunting stakeholders with the IUCN sustainability principles (Field data, 2018).

Since the compliance analysis involved all the four IUCN principles which insist on various aspects of wildlife conservation to enhance trophy hunting sustainability, only 57% of compliance indicates that some components emphasized in the principles could have been compromised during trophy hunting hence unsustainable practices. Noncompliance to conservation regulations is documented to accelerate overutilization of resources. For instance, Rowcliffe et al. (2004) stated that noncompliance on wildlife laws among commercial hunters in the Democratic Republic of Congo threatened some species of large mammals to verge of local extinction. Similarly, low compliance to legal frameworks regulating international trade was the major constraint to law enforcement agencies to combat wildlife crimes in Malaysia (Ariffin and Mustafa, 2013).

Sustainability of lion trophy hunting was further assessed based on the recommendable annual offtake rate of 1 lion per 1000km^2 to confirm the respondents' perceptions (URT, 2009; URT, 2015). The study revealed that hunting in Ilonga, Msolwa, Matambwe and Kingupira sectors of SGR exceeded the annual off-take rate of 1 lion per 1000km^2 between 1995 and 2018 (Table 3). The observed overharvesting of lion in the study area confirms the unsustainable practices perceived by respondents during questionnaire survey. Unsustainable hunting of African lion was similarly reported by Brink et al. (2016) that the annual hunting off take across SGR between 1996 and 2008 was 1.55 ±0.70 lions/1000km^2 and relatively higher (about 2.38 ± 1.14 lions/1000km^2) in some parts of the reserve.

Table 3: Lion hunting off take in Selous Game Reserve between 1995 and 2018 by sectors

Sector	Hunting blocks	Area of sector (km^2)	Average lion hunting off take (lions/1000km^2)	Annual change in hunting off take
Msolwa	9	4642	2.26±1.23	-11%
Matambwe	3	1738	2.19±1.42	-4%
Ilonga	10	7521	2.23±1.37	-6%
Kingupira	7	9345	1.94±1.16	-2%
Likuyu Seka	4	5025	1.19±0.97	8%
Kalulu	3	4989	0.71±0.62	3%
Miguruwe	3	6124	0.67±0.44	4%
Liwale	4	4716	0.58±0.17	2%
Total	43	44100	1.62±0.33	-6%

Source: Field data, 2018

Demographic characteristics influencing compliance with IUCN principles

We assessed the compliance of IUCN sustainability principles among respondents against their demographic characteristics. Table 4 shows the results of the fitted models in unadjusted analysis in which gender, marital status, education level, working experience, and awareness of IUCN principles were associated with the compliance of a respondent. However, in the adjusted analysis, the predictors of compliance were working experience, and awareness of IUCN principles. Individuals admitting to comply with IUCN principles were strongly predicted to have positive attitude towards sustainable trophy hunting and tended to have higher hunting experience (at least 3 years) as they had higher chance (significantly greater odds) of compliance unlike those who were recently employed in the industry (Table 4). This suggests that, probably under adequate positive motivation, working in the hunting industry for a considerable time influence a person to become responsible and develop a positive interest in wildlife management.

Table 4: Logistic regression model for compliance of IUCN principles

Variable	Unadjusted Analysis		Adjusted Analysis	
	OR (95% CI)	P-Value	AOR (95%CI)	P-Value
Age (years)		0.3014		
20-30	1			
31-40	0.54[0.23,1.23]	0.1435		
41-50	0.56[0.21,1.53]	0.2573		
Sex				
Male	1		1	
Female	2.81[1.14,6.95]	**0.0253**	1.89[0.64,5.54]	0.2464
Marital status				
Not married	1		1	
Married	0.41[0.18,0.93]	**0.0327**	0.31[0.11,0.92]	0.3800
Education level				
Primary/secondary	1		1	
College	4.20[1.39,12.69]	**0.0110**	1.83[0.48,7.04]	**0.0353**
Time (years) working with SGR		0.2249		**0.0366**
1-2	0.60[0.71,18.25]	0.1220	0.16[0.03,2.73]	0.2889
3-5	3.86[0.40,1.84]	0.6996	0.31 [0.04,0.66]	0.0108
>5	1		1	
Working experience (years)		**0.0148**		**0.0079**
1-2	1.86[0.74,4.71]	0.1897	5.48[1.31,22.91]	0.0197
3-5	3.84[1.53,9.62]	0.0041	11.33[2.40,53.56]	0.0022
>5	1		1	
Awareness of IUCN principles				
Aware	3.88[1.78, 8.46]	**0.0007**	4.12[1.31,22.91]	**0.0034**
Not aware	1		1	

Source: Field data, 2018

Accordingly, the study also revealed that the level of compliance was relatively high for respondents knowledgeable of the IUCN principles as they had strong positive perceptions of social expectations (subjective norms) in doing sustainable practices during hunting compared to those who were not familiar with the principles (Table 4). As noted early that knowledge/awareness of IUCN principles was underpinned by the level of

education possessed by an individual, the findings suggested that individuals with higher education had positive attitude towards sustainable hunting. Despite the fact that respondents with higher education (bachelor or master degree) were heads of departments, we observed them being much committed to conservation issues compared to the rest. The results could entail that through further training one acquires technical knowledge-generating voluntary compliance to hunting rules/laws in general and IUCN principles in particular. Nevertheless, some of the demographic groups revealed compliance with IUCN principles. This suggests that the demographic characteristics such as working experience and awareness/knowledge influence behaviour of an individual suggesting the need of adding demographic features on the TPB to enhance its descriptive power.

Similar observations were made in Portugal, such that knowledge of wildlife protection laws among people influenced their positive acts towards endangered species (Fairbrass et al., 2016). Most of the individuals with a better understanding of the negative impacts associated with disrespecting natural resources management are likely to comply with conservation norms, rules and regulations for sustainable development.

Conclusion

Trophy hunting is a major source of income for wildlife conservation in areas where photographic tourism is incompatible. However, sustainable harvesting has been uncertain as hunting regulations suffer non-compliance among hunting practitioners. The scenario for SGR is not different, as we noted that the majority of the hunting practitioners are not familiar with IUCN hunting principles guiding sustainability. Accordingly, nearly a half of the respondents did not comply with the principles, making the sustainability of tourist hunting in the study area uncertain. However, the poor compliance was on the maintenance of lion population, and avoiding alteration of natural selection principles. Hunting practitioners associated their low compliance with the perceived overhunting and decrease in trophy size of the species. Overhunting was confirmed through calculation of the mean annual off takes occurred in the study area between 1995 and 2018, which was 1.62 ± 0.33 lions/1000km^2 relatively higher than the recommended sustainable annual off take of 1 lion per 1000km^2. The logistical regression model indicates that, predictors of compliance could be working experience ($p=0.0079$) and awareness with IUCN principles ($p=0.0034$). This suggests that, working experience and awareness/knowledge of IUCN principles, influence the attitudinal behaviour of an individual complying with sustainable trophy hunting.

Therefore, other factors such as socio-demographic characteristics may be included in the TPB to make it more explanatory. We recommend (1) emphasis on the awareness rising and clear understanding of IUCN sustainability principles to the licensed hunting practitioners; (2) effective monitoring and evaluation of the hunting activities to reinforce compliance of sustainability principles; (3) emphasis on animal census prior quota setting for better population estimates to avoid overhunting; and (4) empowering the reserve with adequate financial and skilled human resources for effective implementation of wildlife regulatory frameworks.

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