Biodiversity and Conservation (2019) 28:2977–3003
https://doi.org/10.1007/s10531-019-01809-5

ORIGINAL PAPER

Factors influencing local communities' perceptions towards conservation of transboundary wildlife resources: the case of the Great Limpopo Trans-frontier Conservation Area

Herbert Ntuli, et al. *[full author details at the end of the article]*

Received: 18 October 2018 / Revised: 30 May 2019 / Accepted: 24 June 2019 / Published online: 2 July 2019

Abstract
Local communities' perceptions of protected areas are important determinants of the success of conservation efforts in Southern Africa, as these perceptions affect people's attitudes and behaviour with respect to conservation. As a result, the involvement of local communities in transboundary wildlife conservation is now viewed as an integral part of regional development initiatives. Building on unique survey data and applying regression analysis, this paper investigates the determinants of the perceptions of local communities around the Great Limpopo Trans-frontier Conservation Area in Zimbabwe and South Africa. Our results illustrate that people perceiving the park as well-managed tend to have more positive perceptions regarding the benefits from the park, rules governing the park, and wildlife conservation in general. Household expertise on resource extraction, in turn, tends to make people more likely to perceive environmental crime as morally acceptable. Furthermore, the results indicate that if people perceive the rules of the park in a negative way, then they are less likely to conserve wildlife. Receiving benefits from the park has a positive impact on people's perceptions of the rules governing the park, as well as on their perception of wildlife conservation in general, but not on perceptions about environmental crime. Surprisingly, perceived high levels of corruption is positively associated with people's perception of wildlife benefits and with perceptions of that environmental crime is morally justified. There is also evidence of the role of socioeconomic variables on people's perceptions towards wildlife. However, unobservable contextual factors could be responsible for explaining part of the variation in people's perceptions. Our results speak to the literature on large-scale collective action since perceptions of wildlife benefits, corruption, environmental crime, park management and rules governing the parks, all affect local communities' ability and willingness to self organize. These variables are interesting because they can be influenced by policy through training and awareness campaigns.

Keywords Perceptions · Attitudes · Behaviour · Collective action · Transfrontier conservation area

Communicated by David Hawksworth.

This article belongs to the Topical Collection: Biodiversity appreciation and engagement.

Introduction

In this article we aim at identifying and understanding the drivers behind people's perceptions towards wildlife conservation, benefits, rule compliance and environmental crime in the context of a Trans-frontier Conservation Area (TFCA). Specifically, we characterize the differences in perceptions between South Africa and Zimbabwe, and try to explain the factors driving people's various perceptions.

The study of people's perceptions towards conservation of natural resources such as wildlife, forests and water resources is a popular vehicle for understanding the complex relationship between human beings and nature in the context of social-ecological systems (SES) (Allendorf et al. 2012; Allendorf 2007; Holmes 2003; Infield and Namara 2001). In our endeavour to understand the drivers behind people's perceptions towards wildlife conservation, we define *perception* as what people know or understand (Huong and Lee 2017; Fischer and van der Wal 2007; Ingold 2000; Mansfeld and Ginosar 1994) as compared to *attitudes* which refer to how they think or feel (Ashok et al. 2002). Sociologists theorise that such a distinction is valid as perceptions tend to translate into attitudes and then behaviour (Beedell and Rehman 2000; Fisbien and Ajzen 1985). This study acknowledges different theories that are put across by scholars in various disciplines to explain human behaviour, such as research focusing on the role of local ecological knowledge (Berkes 1999) and the social exchange theory (Homans 1961). The social exchange theory proposes that social behaviour is a result of an exchange process and that people weigh the potential benefits and costs of social relationships. Other scholars argue that human behaviour is guided by human need (Overskeid 2018), while in development studies the theory of change suggests that people respond to policies or interventions that seek to achieve certain outcomes (Clark and Taplin 2012; Brest 2010). Therefore, understanding the determinants of people's perceptions can make us understand their attitudes and behaviour towards conservation.

To a great extent, the success of Integrated Conservation and Development Projects (ICDPs) in many developing countries depends on the participation of local communities living adjacent to protected areas. The idea about ICDP gained momentum during the 1990s when the World Bank and pressure groups started advocating for the inclusion of local communities in wildlife conservation (Sandker et al. 2009; Baral et al. 2006; Alpert 1996). The main aim of these ICDPs is to fill the developing world's need for externally funded, locally based projects (Alpert 1996), while at the same time striking a balance between conservation and development goals in rural areas characterised by conflict between people and wildlife (Ntuli and Muchapondwa 2017; Sandker et al. 2009; Murombedzi 1999). A new development paradigm related to ICDPs involves the creation of Trans-frontier Conservation Areas (TFCAs) shared by different communities in several countries. Unlike localised ICDPs, TFCAs have a regional perspective that facilitates the supply of wildlife habitat and movement through land aquisions and the creation of corridors, while still maintaining the original idea of inclusive development (Spenceley 2006; Wolmer 2003). Transboundary wildlife resources, such as elephants, require huge tracks of land to forage for food and they migrate from country to country in response to seasonal variations in rainfall. However, the establishment of TFCAs has increased conflicts between people and wildlife, as communities' ancestral land, on which they reside, has become corridors facilitating the movement of wildlife between different parks.

In order to examine factors influencing local communities' perception towards wildlife conservation in communities sharing a transboundary resource, we use purposefully

collected primary data and instrumental variables estimation with heteroscedasticity-based instruments.[1] The people included in the study reside in communities located within the Great Limpopo Trans-frontier Conservation Area (GLTFCA) in both South Africa and Zimbabwe. Viewed as an emerging way for managing transboundary resources, the GLTFCA is an interesting case study, since wildlife to a large part roam freely across the national borders. Thus, wildlife resources are shared by different local communities in both South Africa, Zimbabwe and Mozambique.[2] These communities benefit from wildlife conservation in various ways, e.g., they get income from trophy hunting and tourism. As a result, if a fugitive species is threatened in one country through poaching, then all communities are affected. This lies in the inherent characteristics of wildlife being a common pool resource (CPR). In other words, whereas it is hard to exclude people from the extraction of wildlife, the subtraction of it also limits other people's access to wildlife and the benefits from it (Becker and Ostrom 1995). Thus, as a common pool resource, the sustainable use of wildlife relies on the behaviour and cooperation of different communities and game parks in the GLTFCA. The key wildlife resources found in the GLTFCA include elephants, rhinos, buffalos, lions and leopards, which constitute the big five. These species are key because they are the largest tourist attraction in the region.

This paper *compares* the perceptions of wildlife management among indigenous communities in different countries. Currently, there are few studies conducting comparisons of perceptions among local communities, across countries, mainly due to data limitation. As a result, the literature is populated with single or localized case studies of a national park done in a single country. Thereby, this paper thus contributes to the study of complex SESs and large-scale collective action when investigating the behavioural underpinnings of the link between human beings and nature in the context of a TFCA shared by several developing countries. It is believed that local communities will protect wildlife if they perceive that the benefits from conservation are greater than the costs of conservation, i.e., if the design of the conservation scheme is incentive compatible.

We develop a conceptual framework linking (i) perceptions and human behaviour, and (ii) human behaviour and the environment. As its underpinnings, the conceptual framework borrows from the theories and literature on the role of local ecological knowledge, social exchange theory, human need and theory of change (Levitt 2013; Sawitria et al. 2015; Ostrom 2007; Homburg and Stolberg 2006; Kollmuss and Agyeman 2002). Based on these different strands of literature and theories, we argue that the way people perceive wildlife is based on their experiences (e.g., of the current management regime and benefits in the past). This in turn affects their attitudes towards conservation, which influence behaviour and final conservation outcomes. In line with Ebua et al. (2011), we assume that interventions, such as training and benefit sharing, can influence the way people think about wildlife, which in turn affects conservation and welfare in the latter case. The role of information provisioning to local communities on wildlife conservation should not be underestimated, as this has the potential to transform the way people think about a resource (Ntuli and Muchapondwa 2017). The argument we make is that if we understand the determinants of people's perceptions in

[1] We employed instrumental variables estimation with heteroscedasticity-based instruments because of endogeneity issues. The endogeneity problem and this technique are discussed in more detail in the methodology section.

[2] Local communities around the Limpopo National Park (LNP) in Mozambique are also part of the GLTFCA, but they are not included in the study.

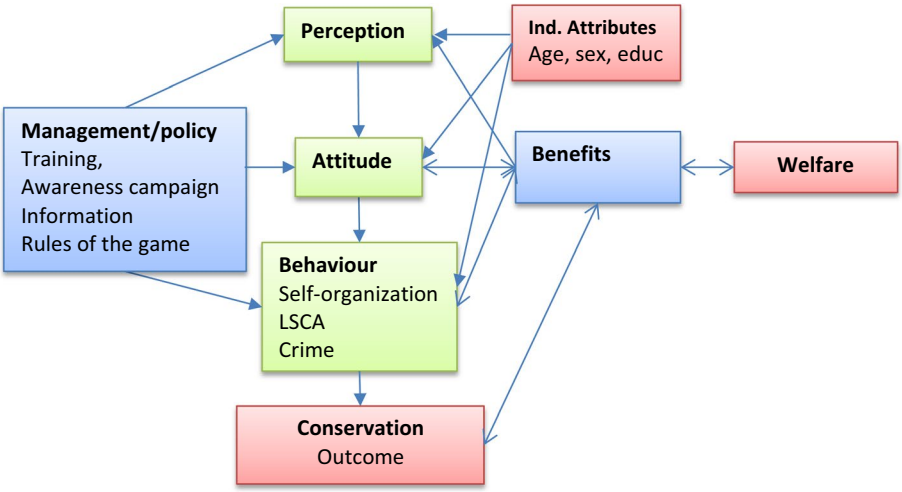

Fig. 1 Conceptual framework. *Source* Own diagram

different contextual settings, then we will be able to develop sound CPR institutions that will change people's attitudes. In turn, this can incentivise people to behave in a way that is consistent with sustainable development and show good environmental citizenry (Fig. 1).

Though recognising the relevance of the full framework, we limit our focus to the investigation of how perceptions about the park management, including its ecology and benefits (i.e., policy variables) and individual characteristics, influence people's opinion about wildlife conservation and the GLTFCA.

Understanding the determinants of people's perceptions in regards to wildlife management is not only pertinent in light of previous research, but becomes imperative also from a policy perspective, because obtaining information about people's behavior makes it possible for both policymakers and development practioners to improve and harmonize conservation policies and strategies in order to cater to these diverse communities. Furthermore, it is essential to seek the participation of local communities in conservation as the willingness to follow rules has been shown to be higher when the rules correspond to local moral beliefs and norms, i.e., when legitimacy is higher (see for example Jentoft 1989; Stern 2008; Hauck and Kroese 2006). Thus, taking in the perspective of the local communities can hopefully also contribute to the generation of policies that better correspond to the conditions and needs of local communities and hence improve incentives for locals to protect transboundary resources such as wildlife.

With this background, we ask the following questions:

(i) Is there a significant difference in perceptions towards wildlife management and conservation of local communities between communities in South Africa and Zimbabwe?
(ii) What are the factors driving the observed variation in local communities' perceptions in these two countries?

The potential differences in people's perceptions could be the source of observed variation in conservation outcomes. We expect this variability to exist because of different experiences and contexts.

The remainder of the paper is divided into six sections. "Literature review" section provides a review of literature and theoretical framework of the study. The research methods in "Research methods" section presents information about the study site, nature of the data collected, sampling techniques and the empirical model specifications. "Results" section presents the results, while "Discussion" section provides a discussion of these results. Finally, "Conclusion" section concludes.

Literature review

There is a tremendous amount of literature that enhances our understanding of SES by focusing on the link between people and nature (Thondhlana and Muchapondwa 2014; Lindahl et al. 2012; Ntuli and Muchapondwa 2018; Ostrom 2007; Shackleton and Shackleton 2006; Agrawal 2001). Two common attributes of many natural resources are jointness of supply and difficulties in excluding outsiders (Becker and strom 1995). As a result of these characteristics, the management of natural resources often produce what Olson (1965) referred to as "the collective action dilemma" and Hardin (1968) "the tragedy of the commons". This means that when resource users cannot be excluded from enjoying the benefits provided by others, they tend to freeride[3] on the efforts of others, in spite of the fact that the most rational behaviour would clearly be to act in the interest of the collective (Ostrom 1990). Subsequently, this can have immense consequences for the environment as the expectations that others will overexploit the resource create incentives for every resource user to overexploit the resource (Ostrom 1998). Nevertheless, recent decades of research indicates that many resources actually can be governed sustainably through self-governing institutions of trust, reputation and norms of reciprocity (Ostrom et al. 1994; Baland and Platteau 1996; Gibson et al. 2005).

Several strands of the literature come from the field of behavioural economics and these studies use both lab and framed field experiments to examine the link between human behaviour and the ecological system. These include studies on the role of trust (Johnson and Mislin 2011; Cox 2004), monetary and non-monetary punishment (Masclet et al. 2003) and social ostracism (Akpalu and Martinsson 2011) in stabilizing large scale collective action in natural resource management. There is also an increase in experimental studies focusing on behavioural responses to latent endogenously driven regime shifts in ecosystems (Ntuli et al. 2019; Lindahl et al. 2016; Schill et al. 2015; Crépin et al. 2012). Resource economists are especially interested in endogenously driven regime shifts because these can be avoided when people coordinate their actions as opposed to exogenously driven regime shifts that are caused by nature (Crépin et al. 2012).

Human behaviour has also been at the centre of empirical studies that focus on the role of institutions in cooperation and conservation of natural resources such as forests (Agrawal 2009; Agarwal and Chhatre 2006), wildlife (Ntuli and Muchapondwa 2018; Frost and Bond 2008; Murphree 2004), rangelands (Woods and Ruyle 2015) and water

[3] Freeriding, in our case, means that some users tend to benefit on the conservation effort of others thereby generating the incentive in the group to overexploit the resource if they assume that everybody else is doing so.

(Maganga 2002; Pollard and du Toit 2011). These studies link institutions to conservation through collective action and its role in curbing illegal harvesting of natural resources (Ntuli and Muchapondwa 2018), since institutions are meant to constrain human behaviour (North 1990). Regionally, poaching is a major challenge in the management of common pool resources (CPR) such as wildlife because of poor local institutions (Ntuli and Muchapondwa 2018). Environmental crime[4] in developing countries is caused by many factors ranging from poverty to selfishness (Hübschle 2016). Critics of conservation projects attribute failure or limited success of these initiatives to ICDP designs that are not incentive compatible (Ntuli and Muchapondwa 2017). Other scholars attribute failure of ICDPs to lack of capacity to self-organize by communities managing a CPR and hence they recommend the use of coercive force by the state (Romero et al. 2012; Adams and Hutton 2007). Recent evidence reveals that some communities, particularly in Asia, have been able to develop robust CPR institutions in order to manage their resources (Ostrom 2007).

There is also a literature focusing on the role of people's perceptions and attitudes towards natural resource management and conservation in the context of the developing world (Ciocaneaa et al. 2016; Bennett and Dearden 2014; Ebua et al. 2011; Lia et al. 2010; Newmark et al. 1993). Perceptions and attitudes form the basis of people's behaviour that in turn will affect the possibility of collective action (Karanth et al. 2008). Perceptions and attitudes are in turn shaped by people's experiences with CPRs, i.e., ownership of the resource, fairness in terms of institutions governing resource access, whether households receive benefits from the resource, or whether they suffer loss through interaction with the resource. People gather information about their environment and form perceptions about the environment, which in turn affect their attitudes and finally their behaviour (Ingold 2000). Perceptions and attitudes towards conservation of CPRs are also influenced by socioeconomic characteristics such as age, gender, level of education, training related to natural resource management, and the type of resource in question (Mutanga et al. 2017; Levitt 2013; Ebua et al. 2011; Lia et al. 2010; Allendorf 2007; Mansfeld and Ginosar 1994; Newmark 1993).

While transboundary conservation of natural resources and wildlife have the potential to increase conservation effectiveness, these conservation arrangements could also face challenges in terms of reaching collective action, because of their increased scale and complexity (see Death 2016; Petursson et al. 2011). Considering fugitive resources, such as wildlife straddling across borders, the possibility of large-scale collective action is complicated by different institutional settings in different countries, such as differences in legislation, sanctions and administrative capacity. These different contexts in which wildlife and local communities interact around GLTFCA yields different experiences and this in turn affect people's perceptions and attitudes. For instance, communities under Zimbabwe's Communal Area's Management for Indigenous Resources (CAMPFIRE) programme[5] lose livestock and suffer crop damages from wildlife intrusion on a regular basis, yet the short-term benefits from conservation are negligible (Balint and Mashinya 2006). In Mozambique, there are no institutional arrangements to facilitate the flow of benefits from wildlife conservation to local communities and as a result, some communities may resort to poaching

[4] Environmental crime include all human activities that are classified as illegal, e.g., poaching, harvesting firewood in protected areas, gold panning.

[5] The CAMPFIRE project was established by the government of Zimbabwe with the aim of balancing both conservation and developing goals (Murombedzi 1999).

(Whande and Suich 2009). The South African case is unique since the Makuleke community generates revenue from land owned inside the Kruger National Park, which is managed by a safari operator on their behalf (Reid 2001). These different contexts potentially affect and shape perceptions and attitudes towards conservation of local communities in the three different countries.

We only take these existing accounts of people's perceptions towards wildlife conservation as our starting point and instead set out to empirically investigate their determinants. People's perceptions towards wildlife conservation can be classified into several themes and measured by asking questions pertaining to their perceptions of the rules governing the park, wildlife, benefits and environmental crime. While most studies have been conducted at the local level, thereby mainly studying a small number of resource users (see Agrawal 2001), our empirical investigation focuses on a large-scale social-ecological system i.e., a transfrontier conservation area. Together, local communities' perceptions affect the possibility of collective action (Kelly 2001), which is essential for the management and sustainable exploitation of CPRs. As such, since perceptions are argued to translate into attitudes and in the longer run shape people's behaviour (Beedell and Rehman 2000; Fisbien and Ajzen 1985), we contribute both empirically and theoretically to the research field by studying the foundations for collective action in a much larger-scale setting. Our argument is that if we understand the determinants of perceptions in different contextual settings, then we will be able to develop sound policies promiting CPR institutions that will change people's attitudes, thereby incentivising them to behave in a way that is consistent with sustainable development.

Research methods

Study area

As already implied, in this study we focus on the Great Limpopo Trans-frontier Conservation Area (GLTFCA). Formally established in 2000, when a common treaty was signed, this is a collaboration between the governments of South Africa, Zimbabwe and Mozambique (Spenceley 2006). A new treaty was approved in 2002 recognizing the 'core protected areas' of the region and thereby establishing the Great Limpopo *Transfrontier Park (TP)*. Today, the park stretches over an area of about 35,000 km^2 including three national parks: the Kruger National Park in South Africa, the Limpopo National Park in Mozambique and the Gonarezhou National Park in Zimbabwe (SANParks 2018). The future plan is however for the trans-frontier park to become a trans-frontier conservation area, expanding into surrounding areas covering almost 100,000 km^2; thereby becoming one of the world's largest TFCAs.

The overall goal with GLTFCA is to foster transnational collaboration and increase the effectiveness of ecosystem management. Ideally, it was supposed to provide mobility of both people and wildlife within the TFCA. Aside from that, another important purpose is for the local communities to receive economic benefits through increased eco-tourism in the region. The park further holds its own organizational structure with a Trilateral Ministerial Committee, a joint management board as well as management committees (SANParks 2018).

Figure 2 shows a map of the GLTFCA, where the national parks are shown in dark green and surrounding areas identified for future expansion in light green. The park is

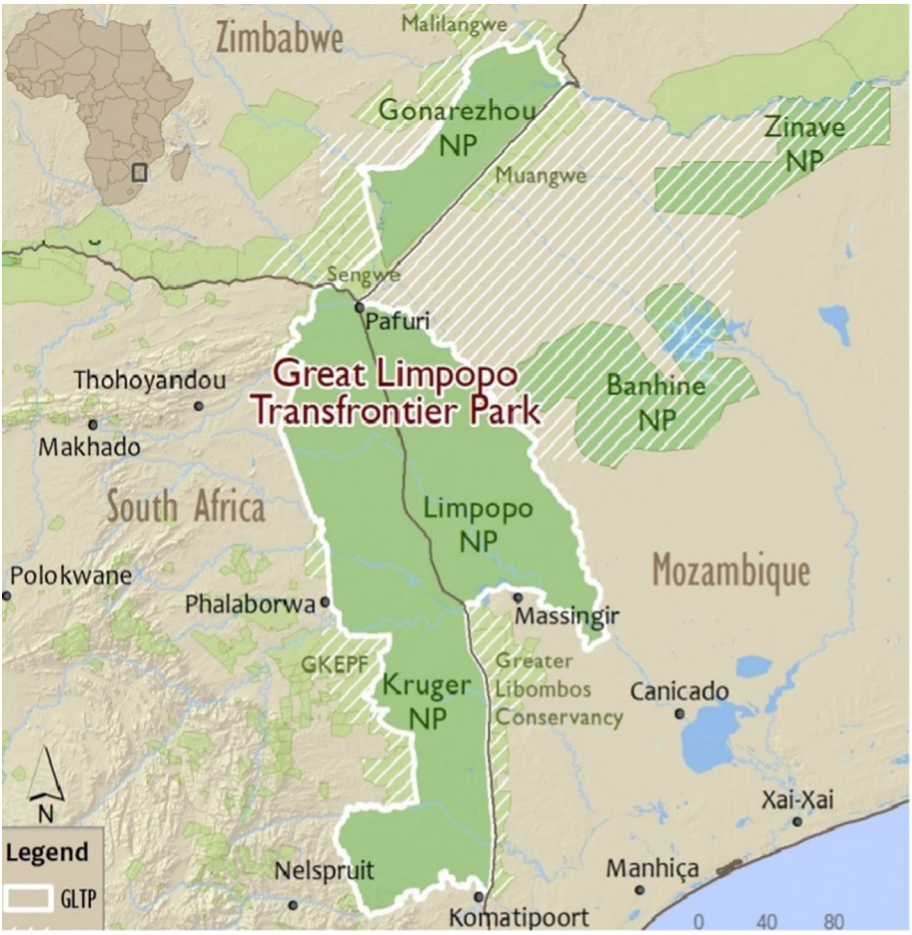

Fig. 2 Map of the Great Limpopo trans-frontier conservation area. *Source* Peace Park Foundation, 12 April 2019

located between 22°22′S and 31°22′E, with arid conditions thus less suitable for rain fed agriculture (Gandiwa and Kativu 2009; Ntuli and Muchapondwa 2017). The mode of production is predominantly subsistence agriculture, combining livestock and crop cultivation. Furthermore, the study area is dominated by Shangani speaking people (approx. 95%) although other languages such as Shona, Ndau and Ndebele in Zimbabwe and Venda and Zulu in South Africa are also spoken.

On the Zimbabwean side, local communities are organized into CAMPFIRE projects, which are dotted around the Gonarezhou National Park (Gandiwa et al. 2013; Frost and Bond 2008). In contrast, in South Africa the Makuleke community own land inside the Kruger National Park, but hires a safari operator to engage in tourism activities while South Africa National Parks manage wildlife on the community's behalf (Reid 2001). CAMPFIRE communities do not own land but manage wildlife traversing the buffer zone through their respective Rural District Councils (RDCs). The proceeds from

wildlife conservation are in turn shared between the RDC (47%) and the CAMPFIRE communities (50%), while the balance goes to the CAMPFIRE association.

Data and sampling

To anwer our research questions, we make use of unique household survey data collected from local communities residing no more than 10 km from the GLTP. This study then forms part of a larger literature applying a quantitative research design to investigate people's perceptions and attitudes in regard to conservation and environmental issues (see for example Huong and Lee 2017; Lia et al. 2010; Mansfeld and Ginosar 1994; Samdahl and Robertson 1989). The survey data was collected between May and September 2017 and consists of face-to-face interviews totalling 1351 respondents, of which 769 respondents were from the Zimbabwean side and 582 respondents from the South African side. The survey consisted of questions on the respondents' socio-economic conditions[6] and themes such as willingness to follow formal rules, perceptions of corruption and law enforcement, the function and management of the park, poaching trends and the respondents' attitudes towards different strategies and policies to combat poaching.

Random sampling was applied to select 11 out of 29 CAMPFIRE projects located near Gonarezhou National Park. These were all identified by the RDCs in Zimbabwe. In South Africa, a full sample of five villages closely situated to Kruger National Park was identified by the local chief. Thereafter, the chairpersons of each CAMPFIRE project and each chief, provided a list of beneficiaries in each project and community, respectively. We then performed a systematic random sampling procedure starting with a random household on the list. Each household was chosen after every n households where n is the sampling interval calculated as the total number of households in the project divided by the required sample size. The selection procedure continued until the required number of households in the sample was achieved.[7] Table 4 in the Annex shows the number of households that were selected from from different villages in the 11 CAMPFIRE projects and from each of the five South African villages. The sample sizes were based on the proportion of households in different communities. In Zimbabwe, permission to conduct the study was granted by the Ministry of Lands and Local Government, the Rural District council, councillors and Chiefs, while in South Africa we sought permission from the local Chief.

The relatively large sample size of the study decreases the risk of the results being biased. This is a clear advantage of this study in relation to studies based on smaller sample sizes, which make it difficult to generalize the results to the broader population. To further avoid interview bias, the enumerators were trained for 2 days during which they got the opportunity to go through the survey and get familiar with the questions. A pilot round was also carried out in one village before the data collection started, testing applicability of the questionnaire. The data collection process was further monitored on a continuous basis to ensure that the enumerators understood the questions and to make sure that the responses were consistent. The questionnaires were checked thoroughly for completeness, errors and consistency before submission and a meeting was scheduled each day to discuss

[6] The socio-economic variables included the respondent's age, gender, level of education, employment status and household income.

[7] If we reached the end of the household list before collecting the required number of households, we restarted the sampling process selecting a different starting point at random on the list. The target sample was exceeded in all communities except in three, i.e. Dopi, Gondweni and Mugiviza.

Table 1 Expanatory variables and their definition

Variable	Explanation	Expected effect on perception
Gender	0 = Female, 1 = male	−
Education	Number of years in School	+
Age	In years	+
Holdsize	Number of household members	Undetermined
Employment	Is household head employed?	±
Electricity	Is your house electrified? 0 = no, 1 = yes	+
Group size	How big is your community?	−
Livestock	Does household own livestock? 0 = No, 1 = yes	−
Socialgrant	Does household receive a social grant?	Undetermined
Foodinsecure	Number of days household slept without eating	−
Sellassets	Has household been forced to sell assets? [0,1]	Undetermined
Manageindex	Management index	±
Expetindex	Expertise	Undetermined
Benefitindex	Wildlife benefits	+
Rulesindex	Rule compliance	±
Corruptindex	Corruption	−

Source empirical literature and theory

potential issues that had arisen in the field. However, the study does not include a sample of respondents from the Mozambican side of the park. Even though this would be of high interest, this was not possible because of logistical aspects at the time the survey was conducted. Still, a project is now under its way to collect data in communities located in Mozambique, which could be used and supplement future studies in the research field.

Table 1 describes the explanatory variables used in our regression models and their expected signs. Theoretical, empirical and experimental studies suggest that both socio-economic variables and governance or management outcomes affect people's perceptions of natural resources (Agrawal et al. 2008; Ostrom et al. 2007; Kemp et al. 2005). However, the results are mixed because the effects of socio-economic variables on perceptions depend on contextual factors and the type and size of resource under consideration (Ostrom 2007; Agrawal 2001). Empirical literature seems to suggest that group size, livestock ownership and employment are negatively associated with perceptions about the value of conservation, while women are more likely to perceive natural resources in a positive way than men since they are involved in harvesting resources such as firewood, insects, weaving material and wild vegetables on a daily basis (Ntuli and Muchapondwa 2017; Thondhlana and Muchapondwa 2014; Shackleton and Shackleton 2006).

Other studies demonstrate that education, age, employment and access to electricity have a positive effect on people's perception towards natural resources (Pollnac 2000; Nazarea et al. 1998; Samdahl and Robertson 1989). Theoretical studies predict that benefits from conservation affect people's perceptions in a positive way (Marks and Davis 2012; Fisher et al. 2008; Ostrom et al. 2007), while corruption affects perceptions negatively (Sandker et al. 2009; Ostrom 2007; Smith and Walpole 2005). The effects of management outcomes and institutional variables such as rules are mixed since the impact of these

Table 2 Characterization of the sample

Variable	Zimbabwe			South Africa			Total		
	Obs	Mean	Std	Obs	Mean	Std	Obs	Mean	Std
Gender	769	0.39	0.49	582	0.28	0.45	1351	0.34	0.48
Education	769	5.82	3.83	582	8.59	4.43	1351	7.01	4.32
Age	769	43.03	15.14	582	42.12	15.15	1349	42.64	15.14
Hhold size	769	6.21	2.53	581	4.63	2.12	1351	5.53	2.49
Employment	769	0.13	0.33	581	0.28	0.45	1351	0.19	0.39
Electricity	769	0.02	0.13	581	0.91	0.29	1350	0.40	0.49
Group size	769	60.20	53.22	582	937.19	208.28	1351	439.69	457.49
Livestock	769	0.72	0.72	582	0.15	0.21	1351	0.47	0.56
Socialgrant	768	0.10	0.30	581	0.76	0.43	1350	0.39	0.49
Foodinsecure	768	2.27	4.83	581	1.04	3.83	1351	1.73	4.47
Sellassets [0,1]	768	0.55	0.50	581	0.14	0.35	1351	0.37	0.48
Manageindex	768	80.57	7.13	581	81.88	5.21	1349	81.13	6.40
Expetindex	768	2.98	7.57	581	0.56	2.07	1349	1.94	5.98
Wildlifeindex	768	96.86	6.43	581	97.36	5.09	1349	97.07	5.90
Benefitindex	768	69.64	23.27	581	60.16	19.47	1349	65.49	22.18
Rulesindex	768	97.93	3.99	581	98.40	0.85	1349	98.13	3.07
Environindex	768	83.51	20.54	581	85.59	16.47	1349	84.40	18.92
Corruptindex	768	94.63	6.17	581	95.58	1.73	1349	95.04	4.82

Source survey data May–September 2017

variables also depend on the context under consideration (Kitthananan 2006; Kemp et al. 2005; Kellert et al. 2000). The effects of variables such as household size, social grants, whether households sell assets during difficult times and expertise in resource extraction on people's perception towards natural resources, could not be determined a priori from the literature.

The analysis discussed in this section was done using STATA version 14. Table 2 indicates that there is great variability between the two countries in terms of both socioeconomic characteristics and important policy variables. In both countries, there are more women than men in the samples, which is not surprising since most able-bodied males in both countries migrate from rural to urban areas in search of employment. Our results show that South Africa has household heads with more education, a higher employment rate and a greater number of households with access to electricity and social grants. Hence, the welfare of households on the South African side is much higher than that for Zimbabwe. On the other hand, Zimbabwe has slightly more female-headed households, more livestock per household (suggesting a higher degree of agricultural orientation), slightly older household heads, households that are more prone to food insecurity and households that frequently sell assets during shocks.

When we consider important variables about people's perceptions towards wildlife that matter for conservation, we observe variability across the two countries. Conventional tests using the standard *t* test show significant differences between the two countries for expertise in resource extraction, benefits and the environmental crime index. The environmental

crime index measures the perception that environmental crime is morally acceptable. Non-parametic tests[8] suggest significant differences for the management index, expertise, wildlife, benefits, rule compliance, corruption and environmental crime index. Zimbabwe has slightly higher indices for resource extraction expertise and wildlife benefits, while South Africa has slightly higher indices for management, wildlife perception, rule compliance, environmental crime and corruption. We expected the index for environmental crime to be higher in Zimbabwe because the CAMPFIRE communities are relatively poor and thus rely more on less-valuable environmental resources such as firewood and wildlife vegetables. Poor households feel the need to illegally harvest fuel and vegetables. However, studies have shown that richer communities actually consume more environmental resources than relatively poor households because they have the means (Ntuli and Muchapondwa 2017; Thondhlana and Muchapondwa 2014; Shackleton and Shackleton 2006).

Results

This section starts by explaining the empirical model specification. We model the attitudes and perceptions of local communities around the GLTFCA in South Africa and Zimbabwe towards the rules of the park. In particular, the paper focuses on the determinants of people's perceptions, and how these factors differ across the two countries. We cannot observe people's attitudes, but we can ask questions about their perceptions and infer their attitude from this information as suggested by the framework that we developed earlier. Usually, for government programmes such as conservation initiatives, people's attitudes are difficult to observe. The government imposes rules on the communities and use force to make sure that these rules are followed, while the community does not have an option. As a result, it is difficult for the community to reveal their negative attitudes such as disinterest or hostility and the government does not know whether people support the initiative or not because of information asymmetry. The general assumption is that the rules are followed. Thus, we ask a number of questions for each of the different themes highlighted in the previous section and then use factor analysis to recover the latent variables measuring people's perceptions.

Consistent with theory and empirical literature, we assume that people's perceptions are linked to their attitudes and behaviour; if this is the case, then the same factors that influence perceptions also influence attitudes, whether directly or indirectly via the influence of perceptions on attitude (Allendorf et al. 2012; Holmes 2003; Infield and Namara 2001). The dependent variables used in the regression models are related to people's perceptions of benefits from conservation, rules governing the GLTFCA, wildlife conservation and environmental crime. Table 5 in the Annexes shows the types of questions that were asked under each theme. We asked a number of questions related to each theme and then used factor analysis to recover the variables. All categorical variables and variables that require respondents to rate from 1 to 5 were converted into binary variables and the computed index was expressed as a fraction between zero and one for ease of interpretation. For instance, a question that asked respondents either to rate between 1 and 5, or to order categories, was recorded as one of two values: zero if the response is negative and 1 if it is positive. Before the indices were computed, negative questions were re-coded to match

[8] The Mann–Whitney U test was used to test for significance differences between two medians.

questions that were asked in a positive sense. This was done so that the index lies between 0 and 1 and is easy to read, where zero signifies a negative outcome or a bad situation and one stands for a positive outcome.

We suspect that there are certain endogeneity problem in our regression models. For instance, perceptions about wildlife benefits affect how people perceive the rules of the park, wildlife in general and environmental crime. On the other hand, these three variables also affect how people perceive wildlife benefits. Because of this problem, we employ instrumental variables estimation with heteroscedasticity-based instruments (Lewbel 2016), which methodologically deals with the problem of endogeneity (also see Prono 2014; Baum et al. 2013; Lewbel 2012; Hausman et al. 2012; Chao et al. 2012).[9]

This technique is gaining popularity and it is being used widely in many studies (e.g. Ntuli and Muchapondwa 2018; Mishra and Smyth 2015; Banerjee et al. 2013; Emran et al. 2012). Using two data sets from China to compare an identification strategy that utilises a heteroscedastic covariance restriction to construct an internal IV and the standard IV, Mishra and Smyth (2015) found that Lewbel's method provides plausible estimates in datasets in which conventional IVs are not available. The major drawbacks of Lewbel's approach is that identification relies upon higher moments, and is likely to be less reliable than identification based on coefficient zero restrictions. For a detailed description and the mathematics behind the method for constructing instruments as simple functions of the model's data, we refer the readers to Lewbel (2012) and Baum et al. (2013). We also checked for multicollinearity, under identification, weak-identification and over-identification of instruments using the VIF test, the Kleibergen-Paap test, the Cragg-Donald Wald F-statistic and the Hansen J statistic before proceeding with heteroscedasticity-based instruments in both models.

We run four models shown in Table 3 with perceptions of benefits, rules, wildlife conservation and environmental crime as dependent variables. Our results indicate that perceptions of successful management of the park is positively associated with perceptions of benefits from the park, rules governing the park, and how people perceive wildlife conservation in general. The results further show that perceptions of good park management is negatively associated with perceptions of environmental crime. In other words, people that perceive that the park is well-managed, tend to be less inclined to perceive environmental crime as acceptable. Household expertise on resource extraction is on the other hand positively associated with perceiving environmental crime as morally acceptable.

Furthermore, people perceiving that they receive benefits from the park are more likely to have a positive perception about the rules governing the park as well as about wildlife conservation in general, but the variable does not have an effect on their perception that environmental crime is acceptable. Our results also show that if people have negative

[9] This method estimates an instrumental variables regression model providing the option to generate instruments and allowing the identification of structural parameters in regression models with endogeneity in the absence of traditional identification information such as external instruments (Chao et al. 2012; Lewbel 2012; Rigobon 2003). Identification is in this context achieved by having explanatory variables that are uncorrelated with the product of heteroscedastic errors (Lewbel 2016; Baum et al. 2013). Instruments may be constructed as simple functions of the model's data (Lewbel 2012). As a result, the approach can be applied in cases where no external instruments are available or be used to supplement weak external instruments in order to improve the efficiency of the instrumental variables estimator. Thus, Lewbel's approach is a good substitute for the standard IV approach in terms of addressing the problem of endogeneity. The choice one uses depends on the availability of sound external instruments. If good external instruments are available, then the standard IV approach is superior. If external instruments are either weak or not available, then the method of heteroscedasticity-based instruments is superior to the conventional IV approach.

Table 3 Results of IV estimation with heteroscedasticity-based instruments

Explanatory variables	Benefits index	Rules index	Wildlife index	Environmental crime index
Number of obs	1316	1316	1316	1316
Prob > F	0.0000	0.0001	0.0000	0.0000
F-statistic	232.45	320.20	160.71	92.23
Centred R2	0.122	0.0314	0.0586	0.0619
Uncentred R2	0.134	0.0451	0.0590	0.0727
Management index	0.288** (0.0926)	0.0522*** (0.0136)	0.190*** (0.0264)	−0.110** (0.0859)
Expertise index				0.407*** (0.0866)
Benefits index		0.00732* (0.00407)	0.0170** (0.00763)	−0.00546 (0.0241)
Rules index			−0.0045** (0.0593)	0.753*** (0.187)
Corruption index	0.301** (0.121)			2.433** (1.150)
Country	32.87*** (7.088)	2.410** (1.048)	1.531 (1.294)	8.374** (4.099)
Gender	−0.852 (1.255)	0.123 (0.183)	0.174 (0.349)	−1.036 (1.110)
Education	0.0899 (0.178)	0.0244 (0.0260)	−0.00779 (0.0496)	−0.0045 (0.158)
Age	0.0909* (0.0487)	−0.00421 (0.00716)	−-0.00965 (0.0136)	−0.00563 (0.0432)
Group size	−0.00851** (0.00404)	−0.000600 (0.000595)	−0.00172 (0.00114)	−0.0082** (0.00361)
Electricity	−3.322 (2.650)	0.446 (0.389)	0.425 (0.740)	0.0976 (2.336)
Livestock	−2.190 (1.661)	0.116 (0.244)	−0.293 (0.465)	−0.121 (1.471)
Employment	0.592 (1.535)	0.0591 (0.225)	0.149 (0.427)	−0.674 (1.350)
Social grant	−7.639*** (1.630)	−0.180 (0.241)	−0.0993 (0.457)	−1.267 (1.447)
Food insecurity	−0.0306 (0.133)	0.00523 (0.0196)	−0.0938** (0.0372)	0.447*** (0.117)
Sell asserts	2.892** (1.365)	−0.341* (0.201)	0.367 (0.380)	1.135 (1.200)
Constant	1.843 (14.10)	1.89*** (1.396)	4.73*** (5.579)	1.79*** (18.88)
Under identification LM test	82.208	56.450	139.319	95.452
$\chi^2(10)$ P-val	0.0001	0.0000	0.0000	0.0000
Weak identification F-test	18.373	26.281	25.420	31.568

Table 3 (continued)

Explanatory variables	Benefits index	Rules index	Wildlife index	Environmental crime index
Overidentification test	11.574	8.584	6.0430	7.561
$\chi^2(9)$ P-val	0.2308	0.2623	0.8352	0.543
Breusch-Pagan test	18.543	29.172	21.954	19.753
Prob > χ^2	0.0000	0.0000	0.0000	0.0000

Source survey data May–September 2017

NB: Standard errors shown in brackets

*Significant at 10%, **significant at 5%, ***significant at 1%

perceptions about the rules of the park, they also tend to have negative perceptions about conservation of wildlife in general. Negative perceptions about the rules of the park also tend to increase the likelihood of perceiving environmental crime as morally acceptable. Surprisingly, perceptions of higher corruption levels is positively associated with perceptions of wildlife benefits and perceptions that environmental crime is justified.

Finally, in our regression models, we also controlled for other socioeconomic characteristics of the respondents. Most socioeconomic variables in the regression models were insignificant. There is therefore a need to interpret our results with caution. We interpreted only those variables that are significant. Although the significant level is low or approaching insignificance, the age of a person is positively associated with his or her perceptions of the benefits of conservation. The variable age seems not to affect a person's perception of the rules governing the park, wildlife conservation in general and perception of environmental crime. The size of the group is negatively associated with people's perceptions about that the benefits are fair and that environmental crime is morally acceptable.

Our results also demonstrate that receiving social grants is negatively associated with people's perceptions about wildlife benefits. Food insecurity at the household level is associated with negative perceptions of wildlife conservation in general, whereas being positively associated with perceptions that environmental crime is morally acceptable. Furthermore, households that have sold assets in the past year because of a shock tend to have negative perceptions of the rules of the GLTFP.

Discussion

Following the results from our regression analysis, several observations are worth discussing in relation to our two research questions. First, is there a significant difference in perceptions towards wildlife management and conservation of local communities between communities in South Africa and Zimbabwe? Second, what are the factors driving the observed variation in local communities' perceptions in these two countries? The communities on the Zimbabwean side are organized into CAMPFIRE projects and each project has a wildlife management committee responsible for managing wildlife income. We identified close to 30 CAMPFIRE communities in the study area through the help of the RDC, while 11 of these communities were finally sampled. The fact that appropriation rights belong to the RDC, makes CAMPFIRE communities weaker in terms of their bargaining power and, as a result, they are viewed as mere beneficiaries by other stakeholders. In South Africa, we identified five communities; Makuleke, Mabilikwe, Makahlule, Kombo and Humula. Out of these five communities, only Makuleke is directly involved in wildlife management through its community board and its hiring of a safari operator. Although the main language used in the study area is the same (i.e., Shangani speaking communities in both countries), our study show that people may have different perceptions both within and across communities and countries. These differences in perceptions could be driven more by policy and unobserved contextual factors than by other socioeconomic variables. The fact that most socioeconomic variables in the models were insignificant suggests that they are not important in explaining variation in people's perceptions and also that unobservable contextual factors may be responsible for explaining part of this variation. These contextual factors are absorbed by the constant in model 2, 3 and 4, thereby making the intercept large and highly significant.

Our results show that people's perceptions about the management of the park is positively associated with their perception of benefits from the park, rules governing the park and how people perceive wildlife. However, it is simultaneously negatively associated with perceptions about environmental crime. There is a very strong policy message behind this result, which calls for respect of local communities and other important stakeholders, if, e.g., park management whish to develop increased dialogue in order to improve and strengthen people's perception of and engagement in wildlife conservation (Mutanga et al. 2017; Teferra and Beyene 2014).

Household expertise in resource extraction actually increases the likelihood that people will engage in environmental crime. Mukul et al. (2014) reported that households with expertise or knowledge of environmental resources have greater incentives to engage in illegal harvesting of resources. Studies have shown that rule compliance and conservation attitudes depend on whether people perceive benefits as fair or not (Arias et al. 2015). The idea of ICDP is strongly tied to incentives which in turn translate to rule compliance and conservation.

Wildlife benefits can influence rule compliance and improve the way communities view wildlife, but might not stop people from illegal harvesting of less valuable resources, like firewood. From a moral point of view, people do not feel ashamed when they harvest firewood and do not even consider it as an environmental crime (Ntuli and Muchapondwa 2017). Child and Child (2015), Goldman (2011), Muchapondwa (2003) and Songorwa et al. (2000) argue that wildlife benefits create the necessary incentives for wildlife conservation through their role in promoting and shaping the way people view wildlife and rules governing the park. Balint and Mashinya (2006) argue that wildlife benefits derived by local communities in Southern Africa are too small to achieve such impacts suggesting that there is a threshold that is unknown to authorities and if benefits were to increase, or reach this point, then people's perceptions would change.

Communities in Zimbabwe value benefits from wildlife conservation more than communities in South Africa do, are more compliant to the rules of the GLTFCA, while at the same time they are the ones who engage in environmental crime. This might be true given that CAMPFIRE communities are very poor and more dependent on the environment. Although they might value wildlife more than communities in South Africa, they are more likely to be caught loitering (trespassing), harvesting firewood and certain food items from the park.

Different sources of income were identified in the study area and these include agriculture, employment, wildlife, environmental income and social grants. Most rural households in South Africa are eligible for different types of social grants including for disability, old age, and benefits for children under the age of five (Maitra and Ray 2003). If social grants contribute significantly towards total household income, then this may greatly affect household perception of wildlife benefits. Studies done in South Africa report that social grants support well over 33% of the population in the country, and the majority of the beneficiaries are found in rural areas (Du Toit and Neves 2009; Booysen and van der Berg 2005). The negative relationship between social grants and people's perceptions about wildlife benefits suggest that households that receive grants value wildlife benefits less than non-beneficiary households. This result is strongly driven by one of the countries since social grants are only administered by the government of South Africa.

As opposed to CAMPFIRE communities in Zimbabwe, most communities on the South African side do not have direct access to wildlife benefits as this privilege is monopolized by only one community, namely, Makuleke. Wildlife and tourism on the land inside the Kruger National Park that belongs to the community is managed by the park authority and

a private company, respectively, while the board responsible for administering and managing wildlife benefits is based in Makuleke. Key informant interviews revealed that wildlife benefits are not fairly distributed across communities as some community leaders were disgruntled by the status quo. This might have serious consequences on how the communities perceive wildlife and their attitude towards conservation in general. Although they might value wildlife benefits, households that experience shocks such as food insecurity or are forced to sell assets have a negative perception of the rules of the GLTFP since they feel marginalized. Poor rural household benefit from haversting environmental resources which cusion them from household shocks. Most of these resources are found inside the protected areas where access is restricted by law.

Ntuli and Muchapondwa (2017) reported a negative relationship between group size and wildlife benefits and conservation. The negative relationship between group size and environmental crime is not surprising since extensive resources such as wildlife need a larger group for easy monitoring. However, enforcement is still a challenge for both small and large group sizes because of poor institutions in local communities (Ostrom et al. 2007). Along this line, previous studies demonstrate that external monitoring and enforcement by the state is much worse compared to the case when it is done by local communities due to limited state resources (Ostrom 2007; Murphy and Cardenas 2004). It is worthwhile to invest in local common pool resource institutions in order to strengthen capacity of communities so that they are able to reach effective monitoring and enforcement.

Thus the most important determinants of people's perception towards transfrontier conservation areas are related to their perception of park management, benefits, crime, institutional rules and unobservable contextual factors. All these factors are interwoven and they should not be considered in isolation, but as part of the bigger picture. Theory and empirical evidence suggest that these variables are important for stabilizing large-scale cooperation in the management of common pool resource that involve indigenous communities. When we compare our results, looking from a broader lense of large-scale conservation activities in the GLTFCA to the results of other studies on collective action involving individual case studies, we observe striking similarities in terms of the influence of these key variables, which could be a target of policy interventions.

Our results speak to both large-scale collective action and wildlife conservation in the GLTFCA, in different ways. Theory and empirical evidence seem to suggest that people's perceptions and attitudes affects collective action, which in turn influence behaviour towards wildife conservation (Ostrom 2000). From a policy perspective, both park management and the distribution of benefits are critical to conservation and deserve to be executed in a manner that people perceive as fair. Furthermore, variables such as household expertise, group size and people's perception of the park, wildlife and rules governing the park should be given priority in future policy reforms, since they have bearing on local community involvement. Wildlife management training and awareness campaigns might play an important role in changing people's perception towards conservation, and thus influencing large-scale collective action. Ntuli and Muchapondwa (2018) found a positive and significant effect of training on cooperation in local communities around the GNP in Zimbabwe. Understanding the circumstances under which wildlife conservation occurs in the GLTFCA is of prime importance since this has bearing on people's perceptions and attitudes, which in turn is essential for stabilizing large-scale collective action.

Conclusion

Based on a conceptual framework linking human behaviour and the environment, the paper set out to examine the determinants of perceptions of local communities sharing a transboundary wildlife resource around the Great Limpopo Trans-frontier Conservation Area bordering South Africa, Zimbabwe and Mozambique. This study is important because perceptions shape people's attitudes in the very short-run and behaviour in the longer-run. People's attitudes and behaviour are closely linked to people's culture, beliefs and norms that develop over time. This study further contributes to the literature when focusing on people's perceptions towards conservation in a larger socio-ecological system, in contrast to the majority of studies within the field that often studies a small number of resource users within a geographically well-defined and comparatively small area. As perceptions is argued to translate into attitudes and in the long run shape people's behaviour, this study investigates the foundations for collective action in a large-scale setting—in this case the Great Limpopo Trans-frontier Conservation Area.

Our results show that perceptions of the park as being well managed, is positively associated with perceptions of benefits from the park, the rules governing the park and how people perceive wildlife conservation in general. Simultaneously, people that perceive that the park is well-managed, tend to be less inclined to perceive environmental crime as acceptable, while people's expertise in resource extraction instead tends to make people more likely to perceive environmental crime as morally acceptable. Furthermore, perceptions of benefits is associated with having more positive perceptions about the rules governing the park and wildlife conservation in general, but not on environmental crime.

Our results imply that if people perceive the rules of the park in a negative way, then they are less likely to conserve wildlife and at the same time this will increase the likelihood of environmental crime. Somewhat surprisingly, we also find that corruption seems to positively affects people's perception of wildlife benefits and environmental crime.

Most socioeconomic variables were insignificant, which suggests that they are not important in explaining variation in people's perceptions. Thus, unobservable contextual factors could instead be responsible for explaining part of this variation. These contextual factors are absorbed by the constant thereby making it large and highly significant. Subsequently, there is a need for further studies, both in the Great Limpopo TFCA and in other trans-frontier parks, in order to fully understand the determinants of people's perceptions towards wildlife across time and space in larger socio-ecological systems.

From a policy point of view, people's perceptions towards wildlife conservation have great implication on stabilizing large-scale cooperation that is needed to manage transboundary resources such as wildlife in a sustainable manner. Since wildlife straddles across political boundaries it is dependent on cooperation among local communities across several countries. Moreover, positive perceptions towards wildlife conservation increase cooperation at a local level which will in turn yield large-scale collective action within the transfrontier park. Appropriate interventions at the grassroot level such as capacity building in the form of training related to natural resource management and awareness campains are thus needed to change the way communities residing in the TFCA perceive wildlife conservation.

Acknowledgements We thank the communities around the Gonarezhou in Zimbabwe and Kruger National Park in South Africa for their willingness to participate in the surveys. Swedish Research Council (SRC) with Grant No. 2021005208 and the Centre for Collective Action Research (CeCAR) at the University of Gothenburg. Last but not least, we thank both friends and collegues for their useful comments.

Annexes

See Tables 4 and 5.

Table 4 Names of villages

Country	Community	Ward	Population	Target		Actual
				No.	%	
Zimbabwe	Dopi	8	415	79	11.3	78
	Chehondo	8	368	70	10.0	81
	Chingele	9	700	133	19.0	132
	Machindu	9	259	49	7.0	49
	Gondweni	9	208	39	5.7	34
	Pahlela	13	416	79	11.3	86
	Sengwe	14	350	67	9.5	72
	Mugiviza	15	174	33	4.7	29
	Samu	15	124	24	3.4	24
	Dumisa	15	314	60	8.5	62
	Malipati	15	350	67	9.5	74
	Hlarweni**	15	–	–	–	48
	Subtotal		3678	700	100	769
South Africa	Makuleke	33	1066	114	28.6	162
	Mabilikwe/Qaza	33	1020	109	27.3	158
	Makahlule	33	985	106	26.4	164
	Kombo	33	560	60	15.0	81
	Humula	33	100	11	2.7	17
	Subtotal		3731	400	100	582
Total			7409	1100	100	1351

**Hlarweni was used for piloting

Table 5 Type of question asked by theme

Theme	Type of questions
Dependent variables	
Perception of benefits	Does the rules from "the park" benefit you, for instance by generating income or employment? 0 = No 1 = yes
	Does your community receive any income from recreational hunting in the area? 0 = No 1 = Yes
	To what extent do you believe that these economic benefits will be distributed fairly? 1 = Not at all 2 = to a limited extent 3 = to some extent 4 = to a great extent
Perception of rules	How willing are you to follow the rules of the park? 1 = Not at all willing 2 = not willing 3 = neither willing nor reluctant 4 = willing 5 = very willing
	To what extent do you consider violating the rules of the park? 1 = Do not consider it at all 2 = do not consider it 3 = neither willing nor reluctant 4 = to some extent 5 = to a large extent
	In general, to what extent do you actually obey the regulations of the park? 1 = Not at all 2 = To a limited extent 3 = To some extent 4 = To a large extent 5 = To a complete extent
	Rules governing the park are clear and simple to understand 0 = No, 1 = Yes
	You are well informed about the park and its rules? 0 = No, 1 = Yes
	Rules governing the park intend doing the right thing 0 = no, 1 = yes
	Rules governing the park are enforced fairly 0 = No, 1 = Yes
	There is a moral obligation to comply with the rules governing the park [0, 1]
	A person would feel shame if caught for violating the rules governing the park
	Local communities are involved in the making of rules governing the park [0, 1]
	Authorities listen to local communities when designing rules governing the park
Perception of wildlife	What the people and its livestock need is more important than saving plants and wild animals? 0 = No, 1 = Yes
	It is important to protect wildlife for our children 0 = No, 1 = Yes
	There are so many wild animals nowadays that the laws to protect them are no longer necessary 0 = No, 1 = Yes
	Wildlife and nature in the area of the park is in risk of being depleted
	Wildlife is nowadays more abundant than it used to be
	In recent time, the overall threats to wildlife and resources have increased
	Has your property or any person you know been damaged by wildlife? [0, 1]

Table 5 (continued)

Theme	Type of questions
Perception of environmental crime	Collecting firewood in a protected area 1 = Not wrong 2 = wrong but understandable 3 = wrong and should be punished
	Collecting firewood in a protected area 1 = Not wrong 2 = wrong but understandable 3 = wrong and should be punished
	Shooting an animal that destroys your crops 1 = Not wrong 2 = wrong but understandable 3 = wrong and should be punished
	Fishing although there is a closed season 1 = Not wrong 2 = wrong but understandable 3 = wrong and should be punished
	Poaching inyalas or impalas for bushmeat 1 = Not wrong 2 = wrong but understandable 3 = wrong and should be punished
	Has illegal hunting increased or decreased during recent years? 1 = decreased 2 = not changed 3 = Increased
	How many poaching events have you heard about during the recent year? 0 if < 3 and 1 if > 3
	Most poachers in this area never get caught
	It is sometimes justified to harbour a poacher in your house
	You would tell authorities if you had information that could send a poacher in front of the legal system to face sanctions
	Poaching for commercial use is morally wrong
	Poaching for subsistence use is morally wrong
	Collecting firewood, although illegal, is morally acceptable
	People engaged in poaching should face harder sentences
	If a poacher comes from another country then it is more acceptable to tell the police about this person
Explanatory variables	
Park management	What are your opinions about the current management of the park? 5 = Very good 4 = good 3 = neither good nor bad 2 = bad 1 = very bad
	How common is it that local communities are involved in monitoring rules governing the park? 1 = Very rare 2 = rare 3 = common 4 = very common
	How effective is enforcement to reduce violations? 1 = Not effective at all 2 = somewhat effective 3 = effective 4 = very effective
	How much of illegal behaviour related to conservation in your area will the rangers generally be able to hinder? 1 = Nothing 2 = hardly anything of it 3 = some of it 4 = most of it
	How often are you in contact with rangers or other state employees enforcing the park rules? 1 = Less than once a year 2 = on some occasions over a year 3 = every month 4 = every week 5 = almost daily
	Rangers from your country are more efficient than rangers from neighbouring countries
	Help park rangers in their surveillance by telling them of suspicious activities

Table 5 (continued)

Theme	Type of questions
	A joint ranger force with staff from all the countries engaged in the TFCA
	Surveillance of poaching activities should be increased
	Are you ever in contact with enforcement officers from other countries? 0 = No 1 = yes
Corruption	Offering a bribe to avoid being arrested by the police
	1 = Not wrong 2 = wrong but understandable 3 = wrong and should be punished
	You personally know some of the rangers [0,1]
	Rangers are on friendly terms with your community [0,1]
	You can pay rangers them to make refrain to impose sanctions for rule violations
	Rangers from your country are more easily bribed than rangers from neighboring countries
Expertise	Do you consider yourself or anyone else in the household to be a hunter? 0 = No 1 = yes
	Do you consider yourself or anyone else in the household to be a fisherman? 0 = No 1 = yes
	Do you consider yourself or anyone else in the household to be reliant on activities that consist of using natural resources? 0 = No 1 = yes
	How many times have you eaten bushmeat within the previous month? (state a number) 0 if <5 times and 1 if ≥ 5

References

Adams W, Hutton J (2007) People, parks and poverty: political ecology and biodiversity conservation. Conserv Soc 5(2):147–183

Agrawal A (2001) Common property institutions and sustainable governance of resources. World Dev 29(10):1649–1672

Agrawal B (2009) Rule making in community forestry institutions: the difference women make. Ecol Econ 68:2296–2308

Agrawal A, Chhatre A (2006) Explaining success on the commons: community forest governance in the Indian Himalayas. World Dev 34(1):149–166

Agrawal A, Chhatre A, Hardin R (2008) Changing governance of the world's forests. Science 320:1460–1462

Akpalu W, Martinsson P (2011) Ostracism and common pool resource management in a developing country – young fishers in the laboratory. J Afr Econ 21(2):266–306

Allendorf TD (2007) Residents' attitudes toward three protected areas in southwestern Nepal. Biodivers Conserv 16:2087–2102

Allendorf TD, Aung M, Songer M (2012) Using residents' perceptions to improve park-people relationships in Chatthin Wildlife Sanctuary, Myanmar. J Environ Manage 99:36–43

Alpert P (1996) Integrated conservation and development projects: examples from Africa. BioScience 46(11):845–855

Arias A, Cinner JE, Jones RE, Pressey RL (2015) Levels and drivers of fishers' compliance with marine protected areas. Ecol Soc 20(4):19. https://doi.org/10.5751/ES-07999-200419

Ashok K, Dillon W, Yuan S (2002) Extending discrete choice models to incorporate attitudinal and other latent variables. J Mark Res 39:31–46

Banerjee S, Chatterji P, Lahiri K (2013) Effects of psychiatric disorders on labor market outcomes – a latent variable approach using multiple clinical indicators. CESifo Working Paper Series No. 4260
Baland K, Platteau JP (1996) Halting degradation of natural resources: is there a role for rural communities?. Clarendon Press, Oxford
Balint PJ, Mashinya J (2006) The decline of a model community-based conservation project—governance, capacity, and devolution in Mahenye, Zimbabwe. Geoforum 37(5):805–815
Baral N, Stern M, Heinen J (2006) Integrated conservation and development project life cycles in the annapurna conservation area, Nepal. Biodiversity Conservation. Springer, Dordrecht
Baum CF, Lewbel A, Schaffer ME, Talavera O (2013) Instrumental variables estimation using heteroskedasticity-based instruments. United Kingdom Stata User's Group Meetings 2012 07, Stata Users Group
Becker CD, Ostrom E (1995) Human ecology and resource sustainability: the importance of institutional diversity. Annu Rev Ecol Syst 26(1):113–133
Beedell J, Rehman T (2000) Using social-psychology models to understand farmers' conservation behaviour. J Rural Stud 16:117–127
Bennett NJ, Dearden P (2014) Why local people do not support conservation: community perceptions of marine protected area livelihood impacts, governance and management in Thailand. Mar Policy 44:107–116
Berkes F (1999) Sacred ecology: traditional ecological knowledge and resource management. Taylor and Francis, Philadelphia, p 209
Booysen F, Van der Berg S (2005) The role of social grants in mitigating against the socio-economic impact of HIV/AIDS in two Free State communities. S Afr J Econ 73:545–563
Brest P (2010) "The Power of Theories of Change". Stanford Social Innovation Review. Spring
Chao JC, Swanson NR, Hausman JA, Newey WK, Woutersen T (2012) Asymptotic distribution of JIVE in a heteroskedastic IV regression with many instruments. Econom Theory 28:42–86
Child G, Child B (2015) The conservation movement in Zimbabwe: an early experiment in devolved community based regulation. Afr J Wildl Res 45:1–16
Ciocăneaa CM, Sorescub C, Ianoşi M, Bagrinovschia V (2016) Assessing public perception on protected areas in Iron Gates Natural Park. Procedia Environ Sci 32:70–79
Clark H, Taplin D (2012) Theory of change basics: a primer on theory of change. ActKnowledge, New York
Cox JC (2004) How to identify trust and reciprocity. Games Econ Behav 46:260–281
Crépin A-S, Biggs R, Polasky S, Troell M, de Zeeuw A (2012) Regime shifts and management. Ecol Econ 84:15–22
Death C (2016) Green states in Africa: beyond the usual suspects. Environ Politics 25(1):116–135
Du Toit A, Neves D (2009) Trading on a grant: Integrating formal and informal social protection in post-apartheid migrant networks. Manchester: Brooks World Poverty Institute. (BWPI working paper; no. 75.)
Ebua VB, Agwafo TE, Fonkwo SN (2011) Attitudes and perceptions as threats to wildlife conservation in the Bakossi area, South West Cameroon. Int J Biodivers Conserv 3(12):631–636
Emran MS, Robano V, Smith SC (2012) Assessing the frontiers of ultra-poverty reduction: evidence from targeting the ultra-poor (CFPR/TUP) program in Bangladesh. IIEP Working Paper IIEP-WP-2009-06
Fisbien M, Ajzen T (1985) Belief, attitudes, intension and behaviour: an introduction to theory and research reading. Addison Wesley Publishing Co, Phillippines
Fischer A, van der Wal R (2007) Invasive plant suppresses charismatic seabird—the construction of attitudes towards biodiversity management options. Biol Cons 1(35):256–267
Fisher R, Magginis S, Jackson W, Barrow E, Jeanrenaud S (2008) Linking conservation and poverty reduction: landscapes, people and power. Earthscan, London
Frost PGH, Bond I (2008) The CAMPFIRE programme in Zimbabwe: payments for wildlife services. Ecol Econ 65:776–787
Gibson CC, Williams JT, Ostrom E (2005) Local enforcement and better forests. World Dev 33(2):273–284
Gandiwa E, Kativu S (2009) Influence of fire frequency on colophospermum mopane and combretum apiculatum woodland structure and composition in northern Gonarezhou National Park, Zimbabwe. Koedoe 51(1):685. https://doi.org/10.4102/koedoe.v51i1.685
Gandiwa E, Heitkönig IMA, Lokhorst AM, Prins HHT, Leeuwis C (2013) CAMPFIRE and human-wildlife conflicts in local communities bordering northern Gonarezhou National Park, Zimbabwe. Ecol Soc 18(4):7
Goldman M (2011) Strangers in their own land: maasai and wildlife conservation in Northern Tanzania. Conserv Soc 9(1):65–79
Hardin G (1968) The tragedy of the commons. Science 162(3859):1243–1248
Hauck M, Kroese M (2006) Fisheries compliance in South Africa: a decade of challenges and reform 1994–2004. Marine Policy 30(1):74–83

Hausman JA, Newey WK, Woutersen T, Chao JC, Swanson R (2012) Instrumental variable estimation with heteroskedasticity and many instruments. Quant Econ 3:211–255
Holmes CM (2003) The influence of protected area outreach on conservation attitudes and resource use patterns: a case study from western Tanzania. Oryx 37:305–315
Homans George (1961) Social behavior: its elementary forms. Harcourt Brace Jovanovich, New York, p 13
Homburg A, Stolberg A (2006) Explaining pro-environmental behavior with a cognitive theory of stress. J Environ Psychol 26:1–14
Hübschle AM (2016) The social economy of rhino poaching: of economic freedom fighters, professional hunters and marginalized local people. Curr Sociol. https://doi.org/10.1177/0011392116673210
Huong PM, Lee JH (2017) Finding important factors affecting local residents' support for tourism development in Ba Be National Park, Vietnam. For Sci Technol 13(3):126–132
Infield M, Namara A (2001) Community attitudes and behaviour towards conservation: an assessment of a community conservation programme around Lake Mburo National Park, Uganda. Oryx 35:48–60
Ingold T (2000) The perception of the environment: essays on livelihood, dwelling and skill. Psychology Press, London
Jentoft S (1989) Fisheries co-management: delegating government responsibility to fishermen's organizations. Mar Policy 13(2):137–154
Johnson ND, Mislin AA (2011) Trust games: a meta-analysis. J Econ Psychol 32(5):865–889
Karanth KK, Kramer RA, Qian SS, Christensen NL (2008) Examining conservation attitudes, perspectives, and challenges in India. Biol Cons 141:2357–2367
Kellert SR, Mehta JN, Ebbin SA, Lichtenfeld LL (2000) Community natural resource management: promise, rhetoric, and reality. Soc Nat Resour 13(8):705–715
Kelly C (2001) Group identification, intergroup perceptions and collective action. University of London, London
Kemp R, Parto S, Gibson R (2005) Governance for sustainable development: moving from theory to practice. Int J Sustain Dev 8(1/2):12–30
Kitthananan A (2006) Conceptualizing governance: a review. J Soc Soc Policy 5(3):1–19
Kollmuss A, Agyeman J (2002) Mind the Gap: why do people act environmentally and what are the barriers to proenvironmental behavior? Environ Educ Res 8:239–260
Levitt M (2013) Perceptions of nature, nurture and behaviour. Life Sci Soc Policy 9:13
Lewbel A (2012) Using heteroskedasticity to identify and estimate mismeasured and endogenous regressor models. J Bus Econ Stat 30(1):67–80
Lewbel A (2016) Identification and estimation using heteroscedasticity without instruments: the binary endogenous regressor case. Econ Lett 165:10–12
Lia L, Wangb J, Shia J, Wangc Y, Liud W, Xu X (2010) Factors influencing local people's attitudes towards wild boar in Taohongling National Nature Reserve of Jiangxi Province, China. Procedia Environ Sci 2:1846–1856
Lindahl T, Crépin A-S, Schill C (2012) Managing resources with potential regime shifts: using experiments to explore social ecological linkages in common resource system. Beijer Discussion Paper Series No. 232
Lindahl T, Crépin A-S, Schill C (2016) Potential disasters can turn the tragedy into success. Environ Resour Econ 65(3):657–676
Maganga FP (2002) The interplay between formal and informal systems of managing resource conflicts: some evidence from south western Tanzania. Eur J Dev Res 14(2):51–70
Maitra P, Ray R (2003) The effect of transfers on household expenditure patterns and poverty in South Africa. J Dev Econ 71(1):23–49
Mansfeld Y, Ginosar O (1994) Determinants of locals' perceptions and attitudes towards tourism development in their locality. Geoforum 25(2):227–248
Marks SJJ, Davis J (2012) Does user participation lead to sense of ownership for rural water systems? Evidence from Kenya. World Dev 40(8):1569–1576
Masclet D, Noussair C, Tucker S, Villeval MC (2003) Monetary and nonmonetary punishment in the voluntary contributions mechanism. Am Econ Rev 93(1):366–380
Mishra V, Smyth R (2015) Workplace policies and training in China: evidence from matched employee-employer data. Int J Manpow 36(7):986–1011
Muchapondwa E (2003) The economics of community-based wildlife conservation in Zimbabwe. PhD dissertation. Goteborg University, Sweden
Mukul SA, Herbohn J, Rashid AZMM, Uddin MB (2014) Comparing the effectiveness of forest law enforcement and economic incentives to prevent illegal logging in Bangladesh. Int For Rev 16(3):363–375
Murombedzi JC (1999) Devolution and stewardship in Zimbabwe's CAMPFIRE programme. J Int Dev 11:287–293

Murphree M (2004) Communal approaches to natural resource management in Africa: from whence to where? J Int Wildl Law Policy 7:203–216
Murphy JJ, Cardenas JC (2004) An experiment on enforcement strategies for managing a local environmental resource. J Econ Educ 31(1):47–61
Mutanga CN, Muboko N, Gandiwa E (2017) Protected area staff and local community viewpoints: a qualitative assessment of conservation relationships in Zimbabwe. PLoS ONE 12(5):e0177153. https://doi.org/10.1371/journal.pone.0177153
Nazarea V, Rhodes R, Bontoyan E, Gabriela F (1998) Defining indicators which make sense to local people: intra-cultural variation in perceptions of natural resources. Hum Organ 57(2):159–170
Newmark WD, Leonard NL, Sariko HI, Gamassa DGM (1993) Conservation attitudes of local people living adjacent to five protected areas in Tanzania. Biol Cons 63(2):177–183
North DC (1990) Institutions, institutional change, and economic performance. Cambridge University Press, Cambridge
Ntuli H, Muchapondwa E (2017) Effects of wildlife resources on community welfare in Southern Africa. Ecol Econ 131:572–583
Ntuli H, Muchapondwa E (2018) The role of institutions in community wildlife conservation in Zimbabwe. Int J Commons 12(1):134–169
Ntuli H, Crépin AS, Muchapondwa E, Schill C (2019) Sanctioned quotas vs information provisioning for community wildlife conservation in Zimbabwe: a framed field experiment approach. Environment for Development Initiative Discussion Paper, MS 724 DP 19–15
Olson M (1965) Logic of collective action. Public goods and the theory of groups. Harvard University Press, Cambridge
Ostrom E (1990) Governing the commons: the evolution of institutions for collective action. Cambridge University Press, Cambridge
Ostrom E (1998) A behavioural approach to the rational choice theory of collective action: presidential adress, American Political Science Association, 1997. Am Political Sci Rev 92(01):1–22
Ostrom E (2000) Collective action and the evolution of norms. J Econ Perspect 14(3):137–158
Ostrom E (2007) A diagnostic approach for going beyond panaceas. Proc Natl Acad Sci USA 104(39):15181–15187
Ostrom E, Gardner R, Walker J (1994) Rules, games, and common-pool-resources. University of Michigan Press, Ann Arbor
Overskeid G (2018) Do we need the environment to explain operant behavior? Front Psychol 9:373. https://doi.org/10.3389/fpsyg.2018.00373
Petursson JG, Vedeld P, Kaboggoza J (2011) Transboundary biodiversity management: institutions, local stakeholders, and protected areas: a case study from Mt. Elgon, Uganda and Kenya. Soc Nat Res 24(12):1304–1321
Pollard S, du Toit D (2011) Towards adaptive integrated water resources management in Southern Africa: the role of self-organisation and multi-scale feedbacks for learning and responsiveness in the Letaba and Crocodile Catchments. Water Resour Manage 25(15):4019–4035. https://doi.org/10.1007/s11269-011-9904-0
Pollnac RB (2000) Villager's perceptions of aspects of the natural and human environment of Balikpapn Bay, Indonesia. J Pesisir & Lautan: J Indonesian J Coast Mar Res 3(2):19–29
Prono T (2014) The role of conditional heteroskedasticity in identifying and estimating linear triangular systems, with applications to asset pricing models that include a mismeasured factor. J Appl Econom 29(5):800–824
Reid H (2001) Contractual national parks and the Makuleke community. Hum Ecol 29(2):135–155
Rigobon R (2003) Identification through heteroskedasticity. Rev Econ Stat 85(4):777–792
Romero C, Athayde S, Collomb JE, DiGiano M, Schmink M, Schramski S, Seales L (2012) Conservation and development in Latin America and Southern Africa: setting the stage. Ecol Soc 17(2):17
Samdahl DM, Robertson R (1989) Social determinants of environmental concern: specification and test of the model. Environ Behav 21(1):57–81
Sandker M, Campbell BM, Nzooh Z, Sunderland T, Amougou V, Defo L, Sayer J (2009) Exploring the effectiveness of integrated conservation and development interventions in a Central African forest landscape. Biodivers Conserv 18:2875–2892
Sawitria DR, Hadiyantob H, Hadi SP (2015) Pro-environmental behaviour from a social cognitive theory perspective. Procedia Environ Sci 23:27–33
Schill C, Lindahl T, Crépin, A-S (2015) Collective action and the risk of ecosystem regime shifts: insights from a laboratory experiment. Ecol Soc 20(1):48
Shackleton CM, Shackleton SE (2006) Household wealth status and natural resource use in the Kat River Valley, South Africa. Ecol Econ 57(2):306–317

Smith RJ, Walpole MJ (2005) Should conservationists pay more attention to corruption? Oryx 39(03):251–256
Songorwa AN, Buhrs T, Hughey KFD (2000) Community-based wildlife management in Africa: a critical assessment of the literature. Natl, Resour J 40(3):603–643
South African National Parks (SANParks) (2018) Great Limpopo Transfrontier Park. Available from: https://www.sanparks.org/conservation/transfrontier/great_limpopo/. Accessed June 26, 2018
Spenceley A (2006) Tourism in the Great Limpopo Transfrontier Park. Dev South Afr 23(5):649–667
Stern MJ (2008) Coercion, voluntary compliance and protest: the role of trust and legitimacy in combating local opposition to protected areas. Environ Conserv 35(3):200–210
Teferra F, Beyene F (2014) Indigenous claims and conflicts in managing the Abijata-Shalla Lakes National Park, Ethiopia. Int J Biodive Sci Ecosyst Serv Management 10(3):216–227. https://doi.org/10.1080/21513732.2014.942372
Thondhlana G, Muchapondwa E (2014) Dependence on environmental resources and implication for household welfare: evidence from the Kalahari drylands, South Africa. Ecol Econ 108:59–67
Whande W, Suich H (2009) Transfrontier conservation initiatives in Southern Africa: observations from the Great Limpopo Transfrontier Conservation Area. In: Suich H, Child B, Spenceley A (eds) Evolution and Innovation in wildlife conservation: parks and game ranches to Transfrontier Conservation Areas. Earthscan, London, pp 373–391
Wolmer W (2003) Transboundary conservation: the politics of ecological integrity in the Great Limpopo Transfrontier Park. J South Afr Stud 29(1):261–278
Woods SR, Ruyle GB (2015) Informal rangeland monitoring and its importance to conservation in a U.S.Ranching community. Rangel Ecol Manag 68:390–401

Affiliations

Herbert Ntuli[1,2] · Sverker C. Jagers[3,4] · Amanda Linell[3,4] · Martin Sjöstedt[3,4] · Edwin Muchapondwa[1,2,5]

✉ Herbert Ntuli
ntlher001@myuct.ac.za

[1] School of Economics, University of Cape Town, Private Bag, Rondeboch 7701, Cape Town, South Africa

[2] Environmental Policy Research Unit (EPRU), University of Cape Town, Cape Town, South Africa

[3] Department of Political Science, University of Gothenburg, Gothenburg, Sweden

[4] Centre for Collective Action Research, University of Gothenburg, Gothenburg, Sweden

[5] Department of Business Administration, Technology and Social Sciences, Luleå University of Technology, 97187 Luleå, Sweden