



Towards equitable conservation: Social capital, fear and livestock loss shape perceived benefit from a protected area[☆]

B.G. Parker^{a,*}, K.S. Jacobsen^a, J.A. Vucetich^b, A.J. Dickman^a, A.J. Loveridge^a,
D.W. Macdonald^a

^a Wildlife Conservation Research Unit, Department of Zoology, The Recanati-Kaplan Centre, University of Oxford, Tubney House, Abingdon Road, Oxford, OX13 5QL, UK

^b College of Forest Resources and Environmental Sciences, Michigan Technological University, Houghton, MI, USA, 49931

ARTICLE INFO

Keywords:

Protected areas
Benefit sharing
Local communities
Fair conservation
Social capital
Fear

ABSTRACT

Providing sufficient benefits to local people can be an important component of effective and equitable conservation, especially where local communities face substantial opportunity costs or disbenefits from conservation. However, the distribution of benefits to local people is often inadequate or inequitable. In this study we investigated the heterogeneity in the extent to which people living near Hwange National Park (HNP), Zimbabwe, perceive benefit from the presence of the park. Specifically, we examined the relationships between a diverse set of candidate predictor variables and perceived benefit from HNP. Our candidate predictor variables broadly relate to personal assets, social capital, value orientation, fear of lions, and belief and participation in human-wildlife conflict mitigation schemes. One third of respondents reported that their household experienced at least some benefits from HNP. Of all respondents, 6% perceived their household to benefit strongly from HNP and 2% very strongly. Livestock loss to wildlife was the most important factor for predicting perceived benefit, with those suffering more loss less likely to perceive benefit. Multiple demographic factors predicted perceived benefit with, for instance, older people and those with less education perceiving less benefit. Employment in conservation-related work positively affected perceived benefit, whereas fear of lions had a negative impact. Social capital appeared to have a positive influence on perceived benefit from HNP. The relationship between social capital and perceived benefit was positive and plateauing, which suggests that social capital is especially impactful on the benefit perceived by individuals reporting the least social capital. We also found a positive association between belief in compensation schemes and perceived benefit from HNP. We posit hypotheses for this association but are unable to determine the underlying drivers of this relationship. Finally, participation in the community guardians programme, a human-lion conflict mitigation programme, was positively related to perceived benefit from HNP. Thus, our findings emphasise the value of considering a diverse array of factors when investigating park-people relationships and yield insights for improving the equity of conservation in and around HNP and similar systems.

1. Introduction

Protected areas (PAs) are increasingly expected to achieve a diverse set of conservation, social and economic objectives (LE SAOUT *et al.*, 2013; WATSON *et al.*, 2014; WEST *et al.*, 2006). This expectation is exemplified by Aichi Target 11 of the Convention on Biological Diversity, which encourages the effective and equitable management of PAs (CBD, 2010). Importantly, the appropriate involvement of local

communities is a core component of just conservation in and around PAs (VUCETICH *et al.*, 2018).

Relationships between PAs and local communities, however, can be strained, especially if local people perceive excessive costs or insufficient benefits (THONDLANA and CUNDILL, 2017; ALLENDORF *et al.*, 2012; VON RUSCHKOWSKI, 2009; MACKENZIE *et al.*, 2017). The balance of costs and benefits from nearby PAs can affect economic development and individual well-being (JACOBSEN *et al.*, 2020; ZHANG *et al.*, 2020),

[☆] This paper has been recommended for acceptance by Jason Michael Evans.

* Corresponding author.

E-mail address: bg.parker@yahoo.com (B.G. Parker).

as well as the likelihood of local people adhering to PA rules and regulations (LEE et al., 2009; MBANZE et al., 2021). In these ways, perceptions of obtaining sufficient benefit from a nearby PA can contribute towards conservation and equity.

Local people may accrue various costs and benefits from a PA. For instance, restricting access to resources within a PA typically exacerbates costs and mars park-people relationships (VEDELD et al., 2012; SALZ and LOOMIS, 2006). Protected areas inhabited by large megafauna can also impose costs on local communities through human-wildlife conflict (MEGAZE et al., 2016; LAMICHHANE et al., 2018; LINDSEY et al., 2017). Such conflict can affect the fairness of conservation by affecting the well-being of both humans and non-humans (JACOBSEN and LINNELL, 2016; VUCETICH et al., 2018; Vucetich and Macdonald, 2017). Local people can also benefit from nearby PAs. For example, ecosystem services can benefit local people through the provision of natural resources (KARANTH and NEPAL, 2012) and intangible cultural services (VLAMI et al., 2017; SAVIANO et al., 2018). Similarly, local people may benefit from the revenue generated by a PA via direct employment or revenue-sharing programmes (SPENCELEY et al., 2019; MACKENZIE, 2012b; MUNANURA et al., 2016; MACDONALD et al., 2017).

In turn, perceived benefit from a PA relates to an individual's experiences of the relevant costs and benefits. And, as a perceptual phenomenon, perceived benefit from a PA can deviate from actual costs and benefits accrued. The extent of this deviation can differ amongst individuals. Moreover, perceived benefit from a PA is often heterogeneous amongst people. Understanding this heterogeneity is important as even the perception of insufficient or inequitable benefit distribution can create conflict (CLARKE and JUPITER, 2010; Christie, 2004) and deleteriously affect individual well-being (JACOBSEN, 2020).

Various studies have investigated which variables affect the heterogeneity in perceived benefit from PAs (MACKENZIE, 2012a; MACKENZIE, 2012b; MACKENZIE et al., 2017). However, such research has predominantly focussed on the influences of various demographic and socioeconomic variables (TOLBERT et al., 2019; SPITERI and NEPAL, 2008; MACKENZIE et al., 2017; MCLLANAHAN et al., 2012; KING and PERALVO, 2010). The deleterious effects of livestock loss, for instance, are often considered (MACKENZIE, 2012a; MACKENZIE et al., 2017; KARANTH and NEPAL, 2012). By contrast, an array of other factors have received little scrutiny despite their potential importance. Even the limited work on social capital, a phenomenon that relates to the social networks amongst people, demonstrates how perceived benefit from a nearby PA can increase with an individual's social capital (DIEDRICH et al., 2016). The influences of other phenomena on perceived benefit from PAs, such as conservation-related value orientation, fear and belief, have received even less attention.

In this paper we investigate how a diverse array of factors influence the extent to which local people perceive that their household benefits from Hwange National Park (HNP), Zimbabwe. Using data gathered via structured questionnaires, we explore the influences of multiple variables on perceived benefit from the PA. The variables broadly relate to personal assets, social networks, value orientation, fear, and belief and participation in human-wildlife conflict mitigation schemes. The foremost aim of this study is to provide a more comprehensive and nuanced depiction of the heterogeneity in perceived benefit from HNP amongst local people, in order to enable more effective and equitable conservation in the region.

2. Methods

2.1. Study site

Our study site covered 20 agro-pastoral villages in the Mabale area of Hwange Communal Land, located just outside of HNP. Hwange National Park (14,500 km²) was designated a game reserve in 1928 and is managed by the Zimbabwe Parks and Wildlife Management Authority.

Ndebele is the majority ethnicity in the area. The park harbours numerous iconic species, including lion (*Panthera leo*), leopard (*Panthera pardus*), spotted hyaena (*Crocuta crocuta*) and elephant (*Loxodonta africana*). Such species can disperse from the park and into human inhabited areas where human-wildlife conflict manifests as livestock depredation, crop loss and retaliatory killing (GANDIWA et al., 2013; LOVERIDGE et al., 2017). This conflict can affect the attitudes of people living nearby HNP towards particular species (JACOBSEN et al., 2020; SIBANDA et al., 2020a). Since 2007, the Trans-Kalahari Predator Programme (TKPP) has implemented various conflict mitigation activities, with a focus on lions (LOVERIDGE, 2015; PETRACCA et al., 2019; SIBANDA et al., 2020b). The TKPP employs local people to advise villages on livestock protection measures and to chase lions found close to human habitation back towards the park and also provides communities with mobile bomas (movable livestock enclosures) for livestock protection. The Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) programme operates in the area and in principle distributes revenue from conservation-related activities amongst local communities (GANDIWA et al., 2013); yet benefits from CAMPFIRE in this area are reportedly limited (DUBE, 2019).

2.2. Data collection

The interview questions were translated into Ndebele, Nambya and Tonga languages. Content validation tests were conducted for every question. Following three rounds of piloting, the interviews were carried out by a team of six native speakers. All interviewers were from the greater Hwange area to encourage trust and ensure culturally appropriate behaviour. The interviewers had no prior affiliation with the TKPP nor any other conservation actor. However, surveys were coordinated by the TKPP, which could have incentivised biased responses. Prior informed consent was obtained from each individual according to the approved guidelines of Oxford University's Research Ethics committee (Ref. no. R49682/RE001). Villages were randomly selected from the Mabale area within 30 km of the HNP border, and wherever possible, every person in every household within the target villages that was above the age of 18 and capable of giving consent to participation was interviewed. This method of selecting participants could result in individual occupation being a source of bias, as people working away from the village (e.g., seasonal work in towns, other parts of Zimbabwe, abroad, or work that keeps the individual away from the village until the evening) are likely to be underrepresented. Responses were recorded using the software Qualtrics (QUALTRICS, 2017).

2.3. Data analysis

We built an ordinal logistic regression mixed model, for which the response variable was a Likert-type item ranging from "Don't benefit at all" to "Very strongly benefits" on a five-point scale in response to the question "To what degree do you feel that your household benefits from the presence of Hwange National Park?". We believe this question made respondents reflect on both costs and benefits and therefore elicited responses that represented perceived net benefit. The independent variables (Table 1 and Table S1 in the Supplementary Materials) were chosen by reviewing the existing literature. *A priori* hypotheses for each independent variable can be found in Table S2 (Supplementary materials). Our social capital variable pertained to personal social capital, which relates to individual involvement in various social behaviours (BERRY and RICKWOOD, 2000). We therefore treated social capital as a latent variable and quantified it from responses to questions about organized events, social gatherings, and community support in R package "lavaan" (ROSSEEL, 2012). Hypothesised associations between social capital and each of the variables used to indicate social capital are included in Table S2 (Supplementary materials). The predictor variable, total wealth, measures the total annual value of a respondent's crop production, livestock, formal employment, and informal work. The

Table 1

Coefficients, standard errors (SE) and p-values for the ordinal logistic regression mixed model. Significance levels are denoted by ‘.’ for very low (0.1), ‘**’ for low level (0.05), ‘***’ for intermediate level (0.01), and ‘****’ for high level (0.001). The response variable in the model was a Likert-type item ranging from “Don’t benefit at all” to “Very strongly benefit” on a five-point scale in response to the question “To what degree do you feel that your household benefits from the presence of Hwange National Park?”

Variable	Coefficient	SE	P-Value	Significance Level
Age	-0.02	0.00	0.00	***
Gender (Female; Baseline: Male)	0.15	0.13	0.24	
Ethnicity (Nambya; Baseline: Ndebele)	0.37	0.18	0.04	*
Ethnicity (Tonga; Baseline: Ndebele)	-0.43	0.22	0.05	.
Ethnicity (Nyanja; Baseline: Ndebele)	0.33	0.26	0.21	
Education	0.81	0.25	0.00	**
Total Wealth	0.07	0.08	0.34	
Number of Livestock Owned	-0.00	0.02	0.85	
Proportion Non-Animal Wealth	0.10	0.29	0.73	
Wildlife Work (Baseline: No)	0.66	0.14	0.00	***
Number of Livestock Lost	-0.03	0.01	0.02	*
Crop Raiding by Wildlife (Baseline: No)	-0.02	0.13	0.90	
Participation in Bomas (Baseline: No)	0.36	0.28	0.20	
Participation in Community Guardians (Baseline: No)	0.45	0.16	0.00	**
Social Capital (L)	5.19	2.54	0.04	*
Social Capital (Q)	-5.27	2.40	0.03	*
Non-Anthropocentrism	0.35	0.22	0.11	
Fear of Lions	-0.56	0.15	0.00	***
Belief in Compensation Schemes (L)	0.41	0.17	0.01	*
Belief in Compensation Schemes (Q)	-0.59	0.16	0.00	***

variable, proportion of non-animal wealth, was the proportion of total wealth not from livestock. We used two predictors related to human-wildlife conflict, one binary variable pertaining to crop losses in the past 12 months and one continuous variable of livestock lost to lions over the previous three years. We also asked participants “To what extent do you agree with the following statement: lions have the right to exist?” as a way of eliciting their views on an aspect of non-anthropocentrism. Non-anthropocentrism is the view that humans and at least some nonhumans have intrinsic value (VUCETICH et al., 2015). For our fear variable we asked participants “To what degree does fear of lions interfere with your daily activities? (such as going to school, fetching water, going to visit friends or relatives, or other activities)”. We related the fear variable explicitly to lions because lions pose a threat to people’s livelihoods in the area, and occasionally to human life. Belief in the feasibility of compensation schemes was ascertained with the question “A strategy that is sometimes used to try to reduce human-wildlife conflict is to offer monetary compensation to people who live near protected areas for damages caused by wildlife. How likely do you think this suggestion can be implemented?”. Village was treated as a random variable to account for the spatial clustering of respondents in each village. The cmm function in the R package “ordinal” (CHRISTENSEN, 2019) in R version 4.0.0 (R CORE TEAM, 2020) was used to fit the model.

All predictor variables had acceptably low levels of heteroscedasticity and acceptably low levels of collinearity with other predictor variables. We also tested the proportional odds assumption of the ordinal model both graphically and statistically (LIU and ZHANG, 2018) and found no problematic breaches. The appropriateness of the logit link function was also assessed by comparing QQ plots for models with different link function. We plotted the raw data for each predictor variable with a significant quadratic relationship with perceived benefit (p

< 0.05) to visually inspect the shapes of each relationship (Figs. S1 and S2, Supplementary materials).

Average effect sizes on perceived benefit from HNP were calculated for each predictor variable that emerged as significant (p < 0.05) in the ordinal regression model. Average effect sizes were calculated as the average of the differences in effect size between the lowest and highest end of the range of the focal predictor variable at every level of perceived benefit. Additionally, a correlation matrix was generated that contained all of the predictor variables that had a significant relationship with perceived benefit from HNP (p < 0.05) in the ordinal regression model.

3. Results

In total, 1482 people participated, and 1399 responses remained following the removal of incomplete entries. The mean age of respondents was 37.9 years (SD = 15.6; Mdn: 35). Forty-four percent of participants were male and 56% female. Ndebele (68%), Nambya (14%) and Tonga (12%) peoples were amongst the respondents. The median and modal level of education was secondary (58%). Twenty-six percent of respondents were single, 61% were married, 13% were either a widow(er) or divorced. Median total wealth, which in this case was the total annual value of a respondent’s crop production, livestock, and work, was US\$1065. Ninety percent of people owned livestock, and the mean number of livestock was 2.8 (SD = 3.4). The median number of livestock owned was 1.8, and the interquartile range was 0.7–3.7. The mean proportion of income from non-animal sources was 0.66 (SD = 0.29; Mdn: 0.73). Twenty percent of respondents worked for either HNP or the Hwange Lion Project (now named the TKPP) or had a member of their household in such employment. The mean number of livestock lost to human-wildlife conflict over the preceding three years was 2.2 (SD = 5.1), and the median number was 0 and the interquartile range was 0–2. Sixty-six percent of respondents reported suffering from crop depredation within the preceding 12 months. Less than 5% of people were currently involved in the mobile bomas (livestock enclosure) programme, whereas 74% of people reported that the community guardians programme (where community representative help guard against lion attacks) covered their village (SIBANDA et al., 2020b). With respect to measures used to quantify the social capital variable: mean frequency of participation in organizations was 2.1 times per month (SD = 4.1), and the median was 0 and the interquartile range was 0–4. The median frequency of social gatherings with close friends and family was “Once a month” (12% of respondents) and the median response to the question on extent of local help was “Moderately” (20% of respondents). The median response to the question about belief in compensation schemes working was 6 (18% of respondents), on a scale of 0 (very unlikely) to 10 (very likely). For our non-anthropocentrism metric, the median response to whether lions had a right to exist was “Somewhat agree” (50% of respondents). The median response to the question of the extent to which fear of lions interferes with daily activities was “Severely interferes” (38% of respondents).

Thirty-one percent of the respondents perceived that their household benefitted to some extent from the presence of the national park. Amongst this 31% were respondents who perceived their household to “Benefit a little (12%), “Moderately benefit” (12%), “Benefit strongly” (6%) and “Very strongly benefit” (2%). Nevertheless, the median and modal score for perceived benefit from HNP, on a scale ranging from “Don’t benefit at all” to “Very strongly benefits” was “Don’t benefit at all” (69%).

Of the demographic variables considered, we found evidence for associations for age, education and ethnicity with perceived benefit from HNP (Table 1). Older people perceived less benefit, whereas respondents with higher levels of education perceived more benefit. Variation in perceived benefit was also detected among ethnicities. In comparison to the Ndebele, Nambya respondents perceived that they benefitted significantly more and Tonga respondents significantly less.

However, in contrast to our *a priori* hypotheses (Table S2), we did not identify an association between gender and perceived benefit from HNP.

An array of other variables also related strongly to perceived benefit from HNP. Employment in conservation work (i.e., with HNP or the TKPP) related to higher perceived benefit from the park. Losing a greater number of livestock to lions over the preceding three years was associated with lower perceived benefit from HNP, whereas having experienced crop loss to wildlife in the preceding 12 months did not relate strongly to perceived benefit. Although involvement in the community guardians programme had a positive relationship with perceived benefit, participation in the mobile bomas scheme yielded no such relationship. We had hypothesised that variables relating to personal assets (i.e. total wealth, proportion non-animal wealth, number of livestock owned) would relate to perceived benefits and costs from the presence of HNP due the differing degrees of vulnerability to livestock predation by carnivores associated with HNP and differing degrees of ability to capture benefits (Table S2). However, none were strongly linked with perceived benefit from HNP. Social capital had a positive, plateauing relationship with perceived benefit (Fig. S1, Supplementary materials). When social capital is scaled from zero to one, the relationship between social capital and perceived benefit plateaus at approximately 0.45. We also found evidence for a negative association between fear of lions and perceived benefit, whereas no such association was identified for our non-anthropocentrism metric. Belief in compensation schemes had a positive, plateauing relationship with perceived benefit from the park (Fig. S2, Supplementary materials). On a scale of one (low belief) to 11 (high belief), the relationship between belief in compensation schemes and perceived benefit from HNP plateaued at approximately six.

Of the variables that had a strong association with perceived benefit in the ordinal model, all had largely similar effect sizes (Table 2). Number of livestock lost to lions in the preceding three years had the largest effect size, followed by the demographic variables of age, education and ethnicity. The order of the remaining variables was fear of lions, social capital, belief in compensation schemes, wildlife work, and participation in the community guardians programme. All correlation coefficients between these variables were very low (Table S3, Supplementary materials).

4. Discussion

Our findings highlight the limited degree to which members of the local communities perceive that they benefit from HNP and emphasise the diversity of variables that contribute to heterogeneity in perceived benefit from HNP.

One third of people surveyed perceived that their household obtained at least some benefit from HNP, which echoes the 24% of respondents who reported to they had personally received benefits from conservation activities during a previous study in the area (WESTERN et al., 2019). This proportion of local people perceiving benefit from conservation activities is greater than reported in some other sites in

Table 2

Effect sizes for the significant predictor variables across all levels of the response variable (perceived benefit from Hwange National Park) in the logistic regression mixed model. Variables are ordered from highest to lowest.

Variable	Average Effect Size
Number of Livestock Lost	0.05 (SE = 0.02)
Age	0.05 (SE = 0.02)
Education	0.04 (SE = 0.02)
Ethnicity	0.03 (SE = 0.01)
Fear of Lions	0.03 (SE = 0.01)
Social Capital	0.03 (SE = 0.01)
Belief in Compensation Schemes	0.03 (SE = 0.01)
Wildlife Work	0.03 (SE = 0.01)
Participation in Community Guardians	0.02 (SE = 0.01)

Africa (e.g., Ruaha, Tanzania: 14%; WESTERN et al., 2019), comparable to some others (e.g., Kibale National Park, Uganda: 33%; MACKENZIE et al., 2017), and lower than others (e.g., Maasailand, Kenya: 49%; WESTERN et al., 2019). Moreover, respondents who perceived benefit from HNP varied in the amount of benefit obtained, with only 8% of all respondents perceiving strong or very strong benefit. Previous research has found that perceived benefit from HNP strongly relates to the well-being of local people and tolerance for lions (JACOBSEN et al., 2020; JACOBSEN, 2020). This implies that the overall well-being of communities living near HNP would be enhanced by increasing the number of people who perceive benefit from the park. In service to this aim, future research might use in-depth interviews to understand what combination of costs and benefits mean that certain households perceive to benefit substantially from HNP against a backdrop of overall low levels of perceived benefit.

We found evidence that perceived benefit from HNP was associated with a diverse range of predictors (Table 1). Although livestock loss and fear of lions related negatively to perceived benefit, social capital and belief in compensation schemes associated positively with perceived benefit from HNP. Similarly, employment in wildlife-related work and participation in the community guardians programme had positive relationships with perceived benefit. An array of demographic variables (age, education, ethnicity) also appeared influential. Thus, the overall finding is that perceived benefit is influenced by a diversity of variables. Awareness of that finding could aid managers in developing interventions that target sub-groups who accrue disproportionately little benefit from HNP and who, as a result, may have lower levels of well-being.

The demographic variables with strong associations with perceived benefit indicate which demographic groups should be prioritised for interventions to increase perceived benefits from HNP. The findings reveal that older people and those with a lower level of education perceived less benefit. Additionally, compared to the Ndebele, Nambya people perceived that they benefit significantly more from the park and Tonga peoples significantly less. Unfortunately, we are unsure why this finding emerged, and suggest that qualitative follow-up interviews would be needed to find out. Nevertheless, appropriate benefits tailored towards these demographic groups that currently perceive less benefit from HNP may be important for promoting fair and effective conservation.

Social capital also exhibited a strong positive association with perceived benefit from HNP. This finding supports the growing body of literature that stresses that social capital can influence perceived benefit from PAs (DIEDRICH et al., 2016; JONES et al., 2012; GUTIERREZ et al., 2011; JONES et al., 2017; THUY et al., 2011). This association might be present because social capital could affect perceived benefit from a PA through various mechanisms; for instance by increasing awareness of benefits, access to benefits, benefit sharing, and the extent to which people trust that they are receiving a fair share (DIEDRICH et al., 2016; THUY et al., 2011). Although our study does not consider these mechanisms, future research might investigate if and how such processes might mean that social capital affects perceived benefit from PAs. Nevertheless, our findings do identify a positive but plateauing relationship between social capital and perceived benefit from HNP, indicating that social capital might affect perceived benefit but mainly for individuals reporting low social capital. Thus, the most effective interventions to increase perceived benefit might prioritise building social capital among those with the least social capital.

As predicted, perceived benefit from HNP was also related to deleterious impacts of the PA, namely livestock loss and fear of lions. The strong, negative relationship between number of livestock reportedly lost in the preceding three years to lions and perceived benefit stresses the importance of reducing livestock loss to minimise perceived costs of living near HNP. Given that neither number of livestock owned nor proportion of non-animal wealth associated with perceived benefit from HNP, this finding suggests that actual loss of livestock is more impactful

than risk or relative financial impact of livestock loss. Also, the lack of relationship between experience of reported crop loss to wildlife in the preceding 12 months and perceived benefit from HNP suggests that, at least in the context of perceived benefit from HNP, crop raiding is less concerning than livestock depredation. Therefore, our main finding in relation to the deleterious impacts of HNP is the importance of reducing livestock loss in areas surrounding the park. The large effect size of this variable indicates that this could be one of the most effective means to improve the cost-benefit ratio associated with HNP. Additionally, fear of lions also had a negative association with perceived benefit from HNP. This demonstrates that the psychological stress associated with living in close proximity to HNP, and hence dangerous species like lions, has an influential impact on local people and implications for perceived benefit from the PA. Therefore, future studies that seek to characterise the distribution of costs and benefits arising from PAs from the perspective of local communities should acknowledge the multiple impacts experienced.

On the contrary, a positive impact of HNP associated positively with perceived benefit: employment by HNP or the Trans Kalahari Predator Project. This finding lends support for the common conservation strategy of employing people in wildlife-related industries to promote benefit distribution and increase local support for conservation (Secretariat of the Convention on Biological Diversity, 2008). In this case, employment in wildlife-related work appears to bolster perceived benefit from HNP for the 20% of respondents that were employed in wildlife-related work or that had a member of their household in such work. Thus, this finding demonstrates that whilst employment in wildlife-related work can enhance perceived benefit from a PA, this beneficial effect may only relate to relatively small subsets of local communities.

The variable representing belief in human-wildlife conflict compensation schemes also had a positive, plateauing relationship with perceived benefit from HNP. Interpreting this relationship is challenging, but we offer the following explanations. First, we hypothesise that believing in compensation schemes is an indication of accepting that whilst HNP may have costs, those costs can, at least in principle, be mitigated. Theoretically, if costs can be mitigated then it's more likely that net benefit is positive. In this context therefore, we would expect an individual who believes that costs from HNP can be mitigated to perceive more benefit from HNP. Another explanation for the positive relationship between belief in human-wildlife conflict compensation schemes and perceived benefit from HNP could be that people who have already formed more positive relationships with conservation agencies are more inclined to believe that such agencies could successfully implement compensation schemes. Thus, future research might explore the wider importance of belief, and trust in, conservation schemes and institutions for shaping perceived benefit from conservation activities. Nevertheless, the true drivers of this positive relationship between belief in human-wildlife conflict compensation schemes and perceived benefit from HNP cannot be identified at this stage.

Participation in the community guardians programme, which seeks to reduce livestock loss to wildlife from HNP, was associated with greater perceived benefit from the PA. This relationship broadly aligns with other findings on community perceptions of the community guardians programme. Although we found that 7% of respondents blamed the community guardian programme run by the TKPP for their losses to lions when asked the question, "Who do you think is responsible for your losses to predation?", SIBANDA et al. (2020b), using an experimental approach, showed that the community guardian programme run by the TKPP appears to overall promote more positive attitudes. So, in addition to improving local attitudes towards lions in and around HNP (JACOBSEN et al., 2020; SIBANDA et al., 2020b), the community guardian programme may reduce negative impacts from the presence of HNP (albeit with only a small effect size). Nevertheless, the relatively small effect size of participation in the community guardians programme on perceived benefit from HNP suggests that it should be used as a complement to other measures to increase conservation

fairness in the area.

In contrast to participation in the community guardians programme, participation in the mobile bomas programme did not appear to relate to perceived benefit from HNP, perhaps because only a small proportion of respondents had been involved (5%), or because any benefits from the bomas programme was attributed to TKPP and not HNP. Indeed, the respective extents to which local people consider benefits from TKPP as benefits also from HNP remains largely unclear for both the guardian and boma programmes. It is also important to acknowledge that perceived benefit from PAs like HNP, as well as the factors that might affect perceived benefit, are not static but dynamic and long-term concepts (DICKMAN, 2010). Hence, the apparent strengths of some of relationships identified in our study may well have changed over time and continue to change over time, especially the relationships that involve active efforts to bolster perceived benefit from HNP (e.g., participation in the community guardians and bomas programmes). Future research may choose to examine the dynamic nature of these concepts and their relationships in greater detail. Such research would be valuable for critically assessing the apparent finding of our model that the two human-wildlife conflict mitigation measures differ in their influence on perceived benefit from HNP.

The variables not associated with perceived benefit are also of interest. In contrast to our *a priori* hypotheses, neither gender nor many of the variables related to personal assets associated with perceived benefit. As other studies have identified relationships between benefits from PAs and gender (ALLENDORF and ALLENDORF, 2013), wealth (SPITERI and NEPAL, 2008) and number of livestock owned (PARKER et al., 2014), these findings highlight how the predictors of perceived benefit can differ between PAs and thus why measures to promote the fair distribution of benefits should be appropriately tailored.

Finally, we acknowledge that other studies may conceptualise and evaluate conservation fairness in other ways. For this study, we considered that improved conservation fairness would involve increasing the perceived benefit obtained by individuals who perceive that they accrue disproportionately little benefit at present. As such, we did not ask if and to what extent people perceived living near HNP as constituting a net detriment. Future research might choose to adopt and explore this, or another, alternative perspective on the concept of conservation fairness.

5. Conclusion

Although HNP warrants international recognition for its charismatic wildlife, our findings highlight that local people perceive that they obtain relatively little benefit. Increasing the extent to which local people benefit from the presence of HNP could bolster the fairness and effectiveness of conservation in the region. We investigated the heterogeneity in perceived benefit from HNP, in order to generate insights that could enable a fairer distribution of perceived benefits from the PA. A diverse range of factors was found to associate with perceived benefit. According to effect size, reported livestock loss to lions over the preceding three years had the largest effect size, with a greater number of livestock lost relating to lower perceived benefit from HNP. Multiple demographic variables appeared to affect perceived benefit; for instance, older individuals and those with a lower level of education recognised less benefit. A number of factors that have received little consideration to date were also found to associate strongly with perceived benefit. Fear, for example, appeared to negatively impact perceived benefit from HNP, whereas social capital appeared to positively bolster perceived benefit from the park. These insights can help conservation managers to develop interventions and target sub-groups of the population that perceive to obtain disproportionately little benefit from the presence of HNP. We recommend that future research on park-people relationships considers a diverse array of factors, and hope that the insights from this study can help practitioners formulate a fairer model of conservation Both for HNP and other similar protected

areas.

Credit author statement

Parker, B.G.: Conceptualisation, Methodology, Formal analysis, Writing – original draft, Project administration, Jacobsen, K.S.: Conceptualisation, Methodology, Investigation, Data curation, Writing – review & editing, Supervision, Project administration, Vucetich, J. A.: Writing – review & editing, Supervision, Dickman, A.J.: Writing – review & editing, Supervision, Loveridge, A.J.: Writing – review & editing, Supervision, Macdonald, D.W.: Writing – review & editing, Supervision, Funding acquisition

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We thank everyone from Mabale who participated in the survey, our research team (T. Ndlovu, E. Ncube, M. Luphahla, S. Gwedla, L. Lula, A. Ndebele, and L. Mpofu), and everyone at the Hwange Lion Project headquarters (J. Hunt, A. Lunyalalo, N. Ncube, and others). We thank the organizations whose funding facilitated this work: The Humane Society of the United States, the WildCRU, and the Darwin Initiative for Biodiversity (Grant DAR3270).

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jenvman.2022.115676>.

References

- ALLENDORF, T.D., ALLENDORF, K., 2013. Gender and Attitudes toward Protected Areas in Myanmar, vol. 26. *Society & Natural Resources*.
- ALLENDORF, T.D., AUNG, M., SONGER, M., 2012. Using residents' perceptions to improve park-people relationships in Chatthin Wildlife Sanctuary, Myanmar. *J. Environ. Manag.* 99, 36–43.
- BERRY, H., RICKWOOD, D., 2000. Measuring social capital at the individual level: personal social capital, values and psychological distress. *J. Publ. Ment. Health* 2, 35–44.
- CBD, 2010. The Strategic Plan for Biodiversity 2011–2020 and the Aichi Biodiversity Targets. UNEP/CBD/COP/DEC/X/2.
- CHRISTENSEN, R.H.B., 2019. Ordinal - Regression Models for Ordinal Data. R package version 2019.
- Christie, P., 2004. Marine protected areas as biological successes and social failures in Southeast Asia. *Am. Fish. Soc.* 42, 155–164.
- CLARKE, P., JUPITER, S., 2010. Law, custom and community-based natural resource management in Kubulau District (Fiji). *Environ. Conserv.* 37 (1), 98–106.
- QUALTRICS, 2017. Provo, US.
- CORE TEAM, R., 2020. R: A Language and Environment for Statistical Computing. In: R Version 4.0.0. R Foundation for Statistical Computing, Vienna, Austria.
- DICKMAN, A., 2010. Complexities of conflict: the importance of considering social factors for effectively resolving human-wildlife conflict. *Anim. Conserv.* 13.
- DIEDRICH, A., STOECKL, N., GURNEY, G.G., ESPARON, M., POLLNAC, R., 2016. Social capital as a key determinant of perceived benefits of community-based marine protected areas. *Conserv. Biol.* 31.
- DUBE, N., 2019. Voices from the village on trophy hunting in Hwange district, Zimbabwe. *Ecol. Econ.* 159.
- GANDIWA, E., HEITKONIG, I.M.A., LOKHORST, A.M., PRINS, H.H.T., LEEUWIS, C., 2013. CAMPFIRE and human-wildlife conflicts in local communities bordering northern gonarezhou national park. Zimbabwe 18.
- GUTIERREZ, N.L., HILBORN, R., DEPEO, O., 2011. Leadership, social capital and incentives promote successful fisheries. *Nature* 470, 386–389.
- JACOBSEN, K.S., 2020. Human Dimensions of Coexistence with Lions: Attitudes, Wellbeing and Economic Valuation. Doctor of Philosophy University of Oxford.
- JACOBSEN, K.S., LINNELL, J.D.C., 2016. Perceptions of environmental justice and the conflict surrounding large carnivore management in Norway – implications for conflict management. *Biol. Conserv.* 203, 197–206.
- JACOBSEN, K.S., DICKMAN, A., MACDONALD, D., MOURATO, S., JOHNSON, P.J., SIBANDA, L., LOVERIDGE, A., 2020. The importance of tangible and intangible factors in human-carnivore coexistence. *Conserv. Biol.* 35 (4), 1233–1244.

- JONES, N., CLARK, J.R.A., PANTELI, M., PROIKAKI, M., DIMITRAKOPOULOS, P.G., 2012. Local social capital and the acceptance of protected area policies: an empirical study of two Ramsar river delta ecosystems in northern Greece. *J. Environ. Manag.* 96, 55–63.
- JONES, N., MCGINLAY, J., DIMITRAKOPOULOS, P.G., 2017. Improving social impact assessment of protected areas: a review of the literature and directions for future research. *Environ. Impact Assess. Rev.* 64, 1–7.
- KARANTH, K.K., NEPAL, S.K., 2012. Local residents perception of benefits and losses from protected areas in India and Nepal. *Environ. Manag.* 49, 372–386.
- KING, B., PERALVO, M., 2010. Coupling community heterogeneity and perceptions of conservation in rural South Africa. *Hum. Ecol.* 38, 265–281.
- LAMICHHANE, B.R., PERSOON, G.A., LEIRS, H., POUDEL, S., SUBEDI, N., POKHERAL, C.P., BHATTARAI, S., THAPALIYA, B.P., DE LONGH, H.H., 2018. Spatio-temporal patterns of attacks on human and economic losses from wildlife in Chitwan National Park, Nepal. *PLoS One* 13 (4), e0195373.
- LE SAOUT, S., HOFFMANN, M., SHI, Y., HUGHES, A., BERNARD, C., BROOKS, T.M., BERTZKY, B., BUTCHART, S.H.M., STUART, S., BADMAN, T., RODRIGUES, A.S.L., 2013. Protected areas and effective biodiversity conservation. *Science* 342, 803–805.
- LEE, T.M., SODHI, N.S., PRAWIRADILAGA, D.M., 2009. Determinants of local people's attitude toward conservation and the consequential effects on illegal resource harvesting in the protected areas of Sulawesi (Indonesia). *Environ. Conserv.* 36.
- LINDSEY, P.A., CHAPRON, G., PETRACCA, L.S., BURNHAM, D., HAYWARD, M.W., HENSCHEL, P., HINKS, A.E., GARNETT, S.T., MACDONALD, D.W., MACDONALD, E. A., RIPPLE, W.J., ZANDER, K., DICKMAN, A., 2017. Relative efforts of countries to conserve world's megafauna. *Global Ecology and Conservation* 10, 243–252.
- LIU, D., ZHANG, H., 2018. Residuals and diagnostics for ordinal regression models: a surrogate approach. *J. Am. Stat. Assoc.* 113, 845–854.
- LOVERIDGE, A.J., 2015. Hwange Lion Project - Annual Report 2015.
- LOVERIDGE, A.J., KUIPER, T., PARRY, R.H., SIBANDA, L., HUNT, J.H., STAPELKAMP, B., SEBELE, L., MACDONALD, D.W., 2017. Bells, bomas and beefsteak: complex patterns of human-predator conflict at the wildlife-agropastoral interface in Zimbabwe. *PeerJ* 5.
- MACDONALD, D.W., LOVERIDGE, A.J., DICKMAN, A., JOHNSON, P.J., JACOBSEN, K.S., DU PREEZ, B., 2017. Lions, trophy hunting and beyond: knowledge gaps and why they matter. *Mamm. Rev.* 47 (4), 247–253.
- MACKENZIE, C.A., 2012a. Accruing benefit or loss from a protected area: location matters. *Ecol. Econ.* 119–129.
- MACKENZIE, C.A., 2012b. Trenches like fences make good neighbours: revenue sharing around Kibale National Park, Uganda. *J. Nat. Conserv.* 20, 92–100.
- MACKENZIE, C.A., SALERNO, J., HARTTER, J., CHAPMAN, C.A., REYNA, R., TUMUSIIME, D.M., DRAKE, M., 2017. Changing perceptions of protected area benefits and problems around Kibale National Park, Uganda. *J. Environ. Manag.* 200 (72), 217–228.
- MBANZE, A.A., DA SILVA, C.V., RIBEIRO, N.S., SANTOS, J.L., 2021. Participation in illegal harvesting of natural resources and the perceived costs and benefits of living within a protected area. *Ecol. Econ.* 179.
- MCCLANAHAN, T.R., ABUNGE, C.A., CINNER, J.E., 2012. Heterogeneity in Fishers' and managers' preferences towards management restrictions and benefits in Kenya. *Environ. Conserv.* 39 (4), 357–369.
- MEGAZZE, A., BALAKRISHNAN, M., BELAY, G., 2016. Human-wildlife conflict and attitude of local people towards conservation of wildlife in Chebera Churchura National Park, Ethiopia. *Afr. Zool.* 1–8.
- MUNANURA, I.E., BACKMAN, K.F., HALLO, J.C., POWELL, R.B., 2016. Perceptions of Tourism Revenue Sharing Impacts on Volcanoes National Park, Rwanda: a Sustainable Livelihoods Framework, vol. 24, pp. 1709–1726.
- PARKER, D.M., WHITTINGTON-JONES, B.M., BERNARD, R.T.F., DAVIES-MOSTERT, H. T., 2014. Attitudes of rural communities toward dispersing african wild dogs in South Africa. *Hum. Dimens. Wildl.* 19.
- PETRACCA, L.S., FRAIR, J.L., BASTILLE-ROUSSEAU, G., HUNT, J.E., MACDONALD, D., SIBANDA, L., LOVERIDGE, A., 2019. The effectiveness of hazing African lions as a conflict mitigation tool: implications for carnivore management. *Ecosphere* 10 (12), e02967.
- ROSSEEL, Y., 2012. Lavaan: an R package for structural equation modeling. *J. Stat. Software* 48, 1–36.
- SALZ, R.J., LOOMIS, D.K., 2006. Recreation specialization and anglers' attitudes towards restricted fishing areas. *Hum. Dimens. Wildl.* 187–199.
- SAVIANO, M., DI NAUTA, P., MONTELLA, M.M., SCIARELLI, F., 2018. Managing protected areas as cultural landscapes: the case of the Alta Murgia National Park in Italy. *Land Use Pol.* 76, 290–299.
- Protected Areas in Today's World: Their Values and Benefits for the Welfare of the Planet, 2008. SECRETARIAT OF THE CONVENTION ON BIOLOGICAL DIVERSITY, Montreal, Technical Series.
- SIBANDA, L., VAN DER MEER, E., HUGHES, C., MACDONALD, E.A., HUNT, J.E., PARRY, R.H., DLODLO, B., MACDONALD, D.W., LOVERIDGE, A., 2020a. Exploring perceptions of subsistence farmers in northwestern Zimbabwe towards the african lion (*Panthera leo*) in the context of local conservation actions. *African Journal of Wildlife Research* 50.
- SIBANDA, L., VAN DER MEER, E., JOHNSON, P.J., HUGHES, C., DLODLO, B., PARRY, R. H., MATHE, L.J., HUNT, J.E., MACDONALD, D., LOVERIDGE, A., 2020b. Evaluating the effects of a conservation intervention on rural farmers' attitudes toward lions. *Hum. Dimens. Wildl.*
- SPENCELEY, A., SNYMAN, S., RYLANCE, A., 2019. Revenue sharing from tourism in terrestrial African protected areas. *J. Sustain. Tourism* 27.
- SPITERI, A., NEPAL, S., 2008. Evaluating Local Benefits from Conservation in Nepal's Annapurna Conservation Area. *Environmental Management*.

- THONDHLANA, G., CUNDILL, G., 2017. Local people and conservation officials' perceptions on relationships and conflicts in South African protected areas. *International Journal of Biodiversity Science, Ecosystem Services and Management* 204–215.
- THUY, N.N., DWIVEDI, P., ROSSI, F., ALAVALAPATI, J.R.R., THAPA, B., 2011. Role of social capital in determining conservation attitude: a case study from Cat Tien National Park, Vietnam. *Int. J. Sustain. Dev. World Ecol.* 18.
- TOLBERT, S., MAKAMBO, W., ASUMA, S., MUSEMA, A., MUGABUKOMEYE, B., 2019. The perceived benefits of protected areas in the virunga-bwindi massif. *Environ. Conserv.* 46, 76–83.
- VEDELD, P., JUMANE, A., WAPALILA, G., SONGORWA, A., 2012. Protected areas, poverty and conflicts: a livelihood case study of Mikumi National Park, Tanzania. *For. Pol. Econ.* 21, 20–31.
- VLAMI, V., KOKKORIS, I.P., ZOGARIS, S., CARTALIS, C., KEHAYIAS, G., DIMOPOULOS, P., 2017. Cultural landscapes and attributes of “culturalness” in protected areas: an exploratory assessment in Greece. *Sci. Total Environ.* 595, 229–243.
- VON RUSCHKOWSKI, E., 2009. Causes and Potential Solutions for Conflicts between Protected Area Management and Local People in Germany. *Rethinking Protected Areas in a Changing World*, pp. 240–244.
- VUCETICH, J.A., BRUSKOTTER, J.T., NELSON, M.P., 2015. Evaluating whether nature's intrinsic value is an axiom of or anathema to conservation. *Conserv. Biol.* 29, 321–332.
- VUCETICH, J.A., BURNHAM, D., MACDONALD, E.A., BRUSKOTTER, J.T., MARCHINI, S., ZIMMERMAN, A., MACDONALD, D., 2018. Just conservation: what is it and should we pursue it? *Biol. Conserv.* 221, 23–33.
- Vucetich, J.A., Macdonald, D., 2017. Some essentials on coexisting with carnivores. *Open Access Government* 216–217.
- WATSON, J.E.M., DUDLEY, N., SEGAN, D.B., HOCKINGS, M., 2014. The performance and potential of protected areas. *Nature* 515, 67–73.
- WEST, P., IGOE, J., BROCKINGTON, D., 2006. Parks and peoples: the social impact of protected areas. *Annu. Rev. Anthropol.* 35, 215–277.
- WESTERN, G., MACDONALD, D.W., LOVERIDGE, A.J., DICKMAN, A.J., 2019. Creating landscapes of coexistence: do conservation interventions promote tolerance of lions in human-dominated landscapes? *Conserv. Soc.* 17, 204–217.
- ZHANG, J., YIN, N., LI, Y., YU, J., ZHAO, W., LIU, Y., FU, B., WANG, S., 2020. Socioeconomic impacts of a protected area in China: an assessment from rural communities of Qianjiangyuan National Park Pilot. *Land Use Pol.* 99.