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Understanding carnivore killing behaviour: Exploring the motivations for tiger killing in the Sundarbans, Bangladesh



Chloe Inskip^{a,*}, Zubair Fahad^b, Rowan Tully^b, Thomas Roberts^{a,1}, Douglas MacMillan^a

^aDurrell Institute of Conservation and Ecology, Marlowe Building, University of Kent, Canterbury CT2 7NR, UK

^bWildTeam (formerly the Wildlife Trust of Bangladesh), Cosmos Centre, 69/1 New Circular Road, Malibagh, Dhaka 1217, Bangladesh

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ABSTRACT

This paper provides the first in-depth exploration of tiger killing behaviour in communities bordering the Sundarbans mangrove forest, Bangladesh. Our findings demonstrate the complexity of carnivore killing behaviour in situations of human–wildlife conflict. We find that killings are not purely retaliatory in nature (i.e. driven by a desire for retribution following livestock depredation or attacks on humans by tigers), and that previous negative experience of tigers is not the sole determinant of villagers' acceptance of killing behaviour. Inter-related socio-psychological factors (risk perceptions, beliefs about tigers and the people that kill tigers, general attitude towards tigers), perceived failings on the part of local authorities whom villagers believe should resolve village tiger incidents, perceived personal rewards (financial rewards, enhanced social status, medicinal or protective value of tiger body parts), and contextual factors (the severity and location of tiger incidents) motivate people to kill tigers when they enter villages and foster the widespread acceptance of this behaviour. The complexity of these factors highlights the need for conservation practitioners to explore and understand people's motivations for killing endangered carnivore species, in order to address better the community-led killing of these animals. For the Sundarbans area, knowledge of these motivational factors can be used to develop conservation actions suitable for developing both communities' capacity and, crucially, desire to co-exist with tigers and to respond with non-lethal action to village tiger incidents.

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1. Introduction

At both a global and local scale, human behaviours (respectively, for example, climate change or the illegal killing of wild animals by communities in situations of human–wildlife conflict²) drive ecosystem and species declines (Cowling, 2014; Veríssimo, 2013). Sixty-one percent of the world's largest carnivore species ($n = 31$), including tigers (*Panthera tigris*), are threatened with extinction and, as carnivore populations decline, ecosystem structure, function and resilience become increasingly compromised; so

* Corresponding author at: 10 South Road, Herne Bay, Kent CT6 5AR, UK. Tel.: +44 1227 360411/+44 7540 831118.

E-mail addresses: chloeinskip@gmail.com (C. Inskip), zh.fahad@gmail.com (Z. Fahad), rowantully@gmail.com (R. Tully), t.m.roberts@surrey.ac.uk (T. Roberts), D.C.Macmillan@kent.ac.uk (D. MacMillan).

¹ Present address: Department of Sociology, Faculty of Arts and Human Sciences, AD Building, Levels 3 and 4, University of Surrey, Guildford GU2 7X, UK.

² Throughout the paper the terms 'illegal killing', 'killing' or 'killing behaviour' are used to describe community-led killings of animals in situations of human–wildlife conflict i.e. what is traditionally referred to as 'retaliatory killing'. The terms do not encompass poaching of wild animals for trade.

much so that, along-side climate change, human-caused mortality of carnivores is now recognised as being one of the most significant anthropogenic impacts on nature (Ripple et al., 2014).

For tigers and many other large carnivores, conflict with people and illegal killing present a significant and, in some cases, a growing threat to population persistence (Inskip and Zimmermann, 2009; Treves and Karanth, 2003; White and Ward, 2010; Woodroffe and Ginsberg, 2000). Carnivore conservation will succeed only if illegal killing, and the other human behaviours which threaten carnivore populations such as poaching and prey depletion, are reduced i.e. if people's behaviour towards carnivores changes for the better (Schultz, 2011). Changing threat behaviours will be possible only if the factors that motivate them are identified, understood and targeted effectively by conservation interventions (Butler et al., 2013; Mascia et al., 2003; St John et al., 2010).

Traditional human–wildlife conflict management practices aimed to reduce the negative effects of wild animals on humans, in the hope that this would stem the rate of illegal killing. However, in many situations, killing frequency does not reflect proportionately the damage caused by a species (Dickman, 2010). Identification of the factors that motivate people to kill carnivores

(and other wild animals) is therefore imperative: not only will it facilitate the development conservation actions capable of reducing this important threat behaviour, it will also facilitate more effective use of limited conservation funds and resources (Kansky et al., 2014).

Social–psychological research and theory provides insight into the social and psychological factors which determine human behaviour and that are, therefore, likely antecedents of carnivore killing behaviour (Ajzen and Fishbein, 2005; St John et al., 2010). For example, beliefs (about the positive and negative outcomes of a behaviour, the social acceptability of a behaviour, and one's ability to carry out a behaviour), and attitude towards a behaviour, both influence a person's behavioural intentions and ultimately determine whether or not they perform that behaviour (Ajzen and Gilbert Cote, 2008; Ajzen, 1991).

Indeed, recent studies suggest that the killing of carnivores in South Africa and intentions to kill jaguars (*Panthera onca*) in Brazil may be driven by complex socio-psychological factors including attitude towards the behaviour and beliefs about the behaviour (Marchini and Macdonald, 2012; St John et al., 2012). Furthermore, there is evidence to suggest that social acceptance of carnivore killing behaviour may be influenced by cultural factors including, for example, traditional hunting practices (Kissui, 2008), religion (Liu et al., 2011), and informal institutions, such as taboos (Jones et al., 2008).

Despite recognition of the conservation importance of reducing illegal killing of tigers (Goodrich, 2010; Nyhus and Tilson, 2010), the drivers of this behaviour are not well understood. What little information there is (e.g. Miquelle et al., 2005) suggests that tiger killing is also driven by multiple factors and not

simply a desire for retaliation following a tiger attack on a person or livestock. Using mixed social research methods suitable for the exploration of complex and sensitive conservation situations involving illegal human behaviours (Inskip, 2013; MacMillan and Leitch, 2008; MacMillan and Phillip, 2010), we therefore investigate individuals' motivations for, and the social acceptability of, tiger killing in villages bordering the Sundarbans mangrove forest, Bangladesh.

2. Methods

2.1. Study site

The Bangladesh Sundarbans area suffers what is arguably the most severe HTC in the world (Ahmad et al., 2009; Barlow, 2009). Although there is no permanent human habitation within the Sundarbans, over 1.7 million people live in the 'upazilas' (sub-districts) which border the northern and eastern forest boundaries (Fig. 1), and the majority of households are dependent on the Sundarbans' natural resources for domestic use and/or livelihoods. Encounter rates between people and tigers are high and each year, approximately 50 people, 80 livestock and 1–3 tigers are killed in HTC incidents; more are injured (Barlow, 2009; Barlow et al., 2011; Rahman et al., 2009). Tigers are typically killed when they enter villages (village tiger incidents). The Sundarbans tiger population has undergone a severe decline since 2007 (Rahman et al., 2012) and the killing of tigers that enter villages is categorised as a medium priority threat requiring immediate attention (Aziz et al., 2013).

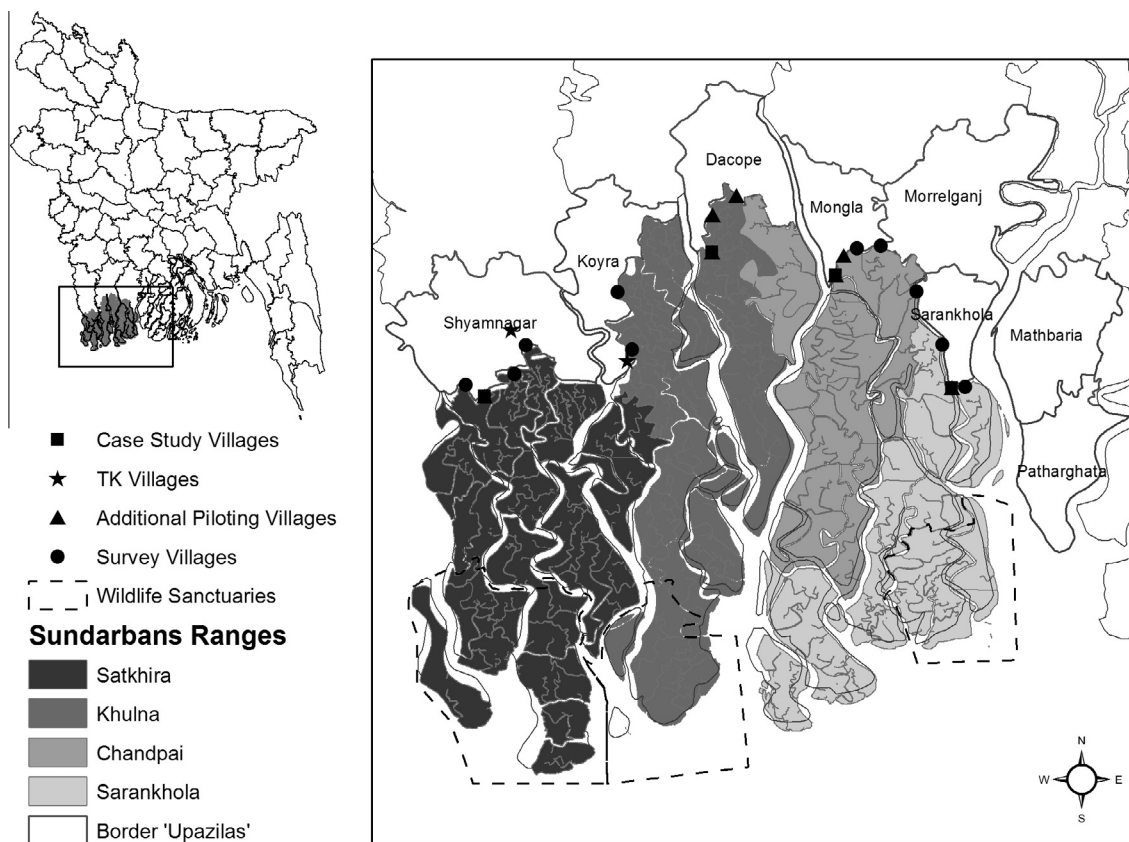


Fig. 1. Location of the Sundarbans Reserve Forest (SRF) in south-west Bangladesh (top left) and study village locations along the border of the SRF (main map). The 8 'upazilas' (sub-districts) which border the SRF's northern and eastern boundaries are shown, as are the Sundarbans forest ranges (administrative divisions) and the SRF's three wildlife sanctuaries (collectively a UNESCO world heritage site). TK Village: village where a tiger was killed by villagers in 2010.

2.2. Methodology

Data collection comprised two distinct phases. First, between October 2010 and January 2011, we carried out 55 qualitative semi-structured interviews in six case study villages, including two where tigers were known to have been killed in 2010 (Fig. 1). These inductive interviews allowed us to gather detailed information about village tiger incidents and tiger killings. We recorded and translated into English all interviews. Qualitative data were coded in NVivo 8 software. The qualitative results reflect the key themes that emerged from the data during coding (Newing et al., 2011).

Second, we developed and piloted a quantitative questionnaire survey, which we administered in 10 border villages that we had not previously visited (May–June 2011; Fig. 1). We used a targeted sampling strategy to ensure that data were collected from respondents with each of 3 direct tiger experiences (livestock depredation, a non-fatal attack on a household member or a fatal attack on a household member) and those with no direct tiger experience. Questionnaires were predominantly carried out with male household heads, although a handful of household heads were female. In a number of households, we also carried out a questionnaire with the household head's wife to ensure that sufficient data were collected from women. (For a detailed account of the methods, see Inskip, 2013).

To explore social acceptability, we asked questionnaire respondents whether they agreed that a tiger should be killed in each of three scenarios of increasing severity: (1) a tiger has entered your village but has not attacked people or livestock; (2) a tiger has entered your village and attacked livestock; (3) a tiger has entered your village and attacked a person (Table 1). Respondents' acceptance of killing a tiger that has attacked a person in the forest and of killing all tigers in the forest was also assessed.

We categorised respondents by the least severe scenario in which they found tiger killing to be acceptable, providing an ordinal scale of acceptability (Table 1). The influence of the following *a priori* identified experiential and socio-psychological variables on acceptability was examined using Spearman's rank correlation and ordinal regression analysis (Table 1; Appendix A):

- Negative experience with tigers.
- General attitude towards the Sundarbans' tiger population.
- Beliefs about the value of live tigers for people, the value of dead tigers for people, and the people who kill tigers.
- Perceived current likelihood of tigers entering villages, and of tiger attacks on people or livestock in villages (collectively village tiger incidents).

3. Results

Semi-structured interviews were carried out with 1–16 people in each case study village (39 men and 16 women in total). Interviewees were 15–85 years old and were of Islamic (70%), Hindu (28%) or Christian (2%) faith. One or more of the household members of 9 interviewees had been killed by a tiger; 7 interviewees had been injured by a tiger; 7 had experienced livestock depredation by tiger; and 24 had no direct experience with tigers. Two men who had killed tigers in their village (in September 2010 and ca. 10 years ago respectively) were interviewed.

In total, 385 questionnaires were completed (65% male; 35% female). Of the women interviewed, 13% were household heads; all of whom were 'tiger widows'. Respondents were 18–82 years old. Respondents had either never been to school (36%), or been in education for less than 5 years (37%), for 6–10 years (22%) or for more than 10 years (5%). Respondents were Muslim (84%) or Hindu (16%). The proportion of respondents with each tiger

experience type was a result of the sampling strategy (Table 1); 94% of respondents said that at least one tiger had entered their village during their lifetime.

3.1. Motivations for tiger killing

Interviewees reported that, within their lifetimes, tigers have ventured into each of the case study villages several times, sometimes attacking people or livestock once in the village. Crowds of hundreds, even thousands, of people gather around tigers in villages and, typically, it is crowd members – particularly those who attempt to kill the tiger – that are attacked. At least one tiger has been killed by villagers in each case study village in the last 10 years. Villagers spoke freely about these incidents, providing vivid accounts of the killings:

[One evening at the end of 2003] a tiger came into the village. Thousands of people went to the scene. The tiger entered a house and people closed the whole house with fishing nets. Then some brave men climbed on to the roof of the house and made some hanging ropes. From the roof they caught the tiger with the hanging rope and then other people beat the tiger to death.

The accounts of the two men who had killed tigers, combined with those from witnesses of these and other tiger killings, provide valuable insight into the drivers of this behaviour in Sundarbans border villages (Table 2). Motivations were linked to four key themes that emerged from villagers' narratives: (1) worry about/fear of the tiger attacking people or livestock in the immediate future; (2) a perceived lack of support from the local authorities when tigers enter villages; (3) retaliation or revenge for past attacks on people or livestock; and (4) personal or social incentives for killing tigers.

Most common in villagers' narratives were statements such as "The tiger could harm a person. This thought made me decide to beat it," and "People beat the tiger to death in order to save their lives" suggesting that the principal motivator for killing tigers is the perception that the tiger will harm people or livestock if it remains in the village. The longer a tiger stays in a village (this can be several hours) the greater the perceived risk of a person or domestic animal being attacked and the more likely the villagers are to resort to lethal control.

Also common in interviewees' narratives were statements which indicate a level of dissatisfaction with local authorities' (i.e. Forest Department, Coastguard, Police) responses to village tiger incidents. For example:

[The authorities] did not make a plan to send the tiger to the jungle. They did not try to scare the tiger off with gun shots [blank fire] or 'potka' [firecrackers]. They did not do anything. They came and were standing normally. We saw that they had no role in helping us: one was making a call to his wife another to his daughter to say that they were in front of a tiger. Then we thought we had to do something for ourselves. We could not depend on them, otherwise we would be killed. We were forced to kill the tiger...they forced us to kill the tiger.

Four witnesses of the above incident corroborated this account (Table 2). Similar accounts of perceived failings on the part of local authorities were heard in other case study villages (Table 2).

Statements about a desire for "revenge" for past attacks on people in the forest or "anger" resulting from repeated recent village tiger incidents were comparatively rare in interviewees' accounts, suggesting that retaliation for past HTC incidents is a relatively weak motivator for killing behaviour. However, if a tiger attacks livestock and/or people while it is in the village this may incense the villagers and increase the likelihood of tiger killing. In such a

Table 1

Dependent and *a priori* defined independent variables used to explore the social acceptability of tiger killing behaviour in Sundarbans border villages. PC: Principle Component; VT: tiger in a village; AH: tiger attack on human; LD: livestock depredation by tiger; HH: household; HHM: household member.

Variable	Response options and % respondents selecting each response option						Belief PC (factor loading)	Spearman's rho, r_s
Acceptability ^a (dependent variable)	VT 16.4	LD/AH 46.2	Never 36.1	–	–	–	–	–
General attitude towards the tiger population ^b	Tiger population increase 46.5	Tiger population stable 31.2	Tiger population decrease 22.4	–	–	–	–	0.45 ^c
Tiger experience ^d	HHM killed 26.0	Respondent or HHM injured 22.1	HH's livestock attacked 26.0	No experience 26.1	–	–	–	–0.256 ^c
Beliefs	Strongly agree	Slightly agree	Unsure	Slightly disagree	Strongly disagree	–	–	–
Tiger body parts are sought after by people here	59.2	10.1	20.5	2.6	7.5	–	1 (0.833)	0.181 ^{c,e}
Tiger body parts have medicinal value	72.2	8.8	17.1	0.5	0.8	–	1 (0.815)	–
People who kill tigers are brave	89.4	3.4	2.6	0.8	3.9	–	2 (0.834)	0.357 ^{c,e}
People who kill tigers are admired by people here	57.1	5.5	4.7	7.3	25.5	–	2 (0.739)	–
Tigers benefit people by protecting the Sundarbans	87.0	6.2	3.9	1.3	1.6	–	3 (0.808)	0.256 ^{c,e}
Tigers benefit people by attracting tourists to the area	58.7	18.4	15.3	2.1	5.5	–	3 (0.748)	–
HTC incident frequency	Commonly	Occasionally	Rarely	Never	Do not know	–	–	–
AH in village	1.8	41.8	30.1	26.2	0.0	–	–	–0.070 ^f
LD in village	6.2	55.6	22.3	15.8	0.0	–	–	–0.035 ^f
ST in village	3.9	51.9	35.8	8.3	0.0	–	–	–0.039 ^f
Incident trend ^g	Increasing a lot	Increasing a little	Staying the same	Decreasing a little	Decreasing a lot	Do not know	–	–
AH in village (284)	2.9	8.6	11.9	31.7	18.7	0.0	–	–
LD in village (324)	14.9	7.8	12.7	41.8	16.9	0.0	–	–
Tiger in village (353)	3.9	8.8	14.3	39.5	25.2	0.0	–	–

^a Acceptability reflects the least severe village tiger scenario in which respondents considered killing a tiger to be acceptable. VT: respondent accepts killing when a tiger has not harmed people or livestock (and in the more severe scenario where the tiger has attacked people or livestock); VT LD/AH: respondent accepts killing only when it has attacked livestock or people; never: respondent does not accept killing in any scenario.

^b Attitude towards the tiger population was assessed by asking respondents whether in the future they would like the tiger population to increase relative to the current population size, stay the same, or decrease.

^c Significant at the 0.01 level.

^d The proportion of respondents having household members or livestock killed or injured by a tiger, or who had no negative experience with tigers was a consequence of the sampling strategy designed to facilitate statistical comparison between these groups.

^e Spearman's rho represents the relationship between each of the factor scores for the 3 belief principal component variables and acceptability (Appendix A).

^f Spearman's rho represents the relationship between each of the combined incident likelihood index variables (i.e. incident frequency scores multiplied by incident trend scores for the three incident types) and acceptability (Appendix A).

^g The trend question for an incident was not applicable to those respondents who had stated that the incident type 'never' occurred in preceding frequency questions. N for each trend variable is therefore presented in parentheses. All respondents who stated that an incident type never occurred received a score of 0 in the incident likelihood index.

scenario, "...no one would have the sentiment that we should scare away the tiger [from the village]. At that time we will try to kill it." This suggests that, as a driver of killing behaviour, retaliation may be context specific.

Finally, interviewees' narratives provide insight into a number of other factors which may act to sanction and encourage killing behaviour. First, the people responsible for killing tigers were referred to as "brave" or "courageous" men who receive praise and admiration from their fellow villagers. In some instances, villagers noted that these men receive "...money as a reward for their courage and for the risk they have taken." Second, interviewees acknowledged the social and medicinal value of tiger body parts which are often taken by villagers following killing incidents (Table 2).

3.2. Acceptability

Further insight into the acceptability of tiger killing was provided by the quantitative data. Respondents' beliefs about the

value of live and dead tigers, their beliefs about people who kill tigers, their experience with tigers and their general attitude towards the tiger population were all associated with how readily they accepted killing, while perceived likelihood of village tiger incidents was not (Tables 1 and 3).

The proportion of people agreeing that a tiger should be killed in each of the five scenarios differed significantly ($\chi^2 = 422.662$, $df = 4$, $p < 0.001$) with more people agreeing that a tiger should be killed if it attacks people or livestock in a village than in the other scenarios (Table 1). Respondents were less accepting of killing a tiger which had attacked a person in the forest than of killing a tiger which had attacked a person in a village ($\chi^2 = 110.313$, $df = 1$, $p < 0.001$). Of the respondents who agreed that a tiger should be killed in one of the scenarios, over 90% agreed that tigers should be killed in the more severe scenarios.

Ordinal regression analysis was used to explore acceptance. The experience and attitude variables were included in the regression model as factors, while the belief PCA factor score variables were included as covariates. Village incident likelihood variables were

Table 2
Examples of qualitative data which identify the socio-psychological motivators for tiger killing behaviour, acceptance of killings, and crowd formation during village tiger incidents.

Motivator	Supporting evidence from interviewees' narratives ^a
<i>Individuals' killing behaviour</i>	
Perceived risk of harm to people or livestock	See main text. Also statements such as: "My husband was killed by the tiger. The tiger could kill another man if it stayed alive. So I felt good [when it was killed]"
Perceived absence of, or ineffective, responses by authorities	Witnesses of the tiger killing incident documented in the main text confirmed that members of the authorities were "...watching the situation like spectators...and did not try to stop the people killing the tiger." After initial attempts to find a stray tiger in another village had failed, members of the local authorities reportedly returned to their offices for lunch during which time the villagers found and killed the tiger. In yet another village, members of the authorities reportedly requested that the villagers kill a stray tiger, saying: "We can't handle [this incident]. You beat [the tiger] up"
Desire for retaliation ^b	See main text. Also, tigers were occasionally referred to by villagers as their "enemy" or as "rascals" who "torture" the villagers
Desire for revenge ^b	See main text
Financial gain ^c	See main text
<i>Social acceptability of killing behaviour (Sanctions)</i>	
Social status of men who kill tigers	Interviewees often referred to the people responsible for killing tigers as "brave" or "courageous" men who receive praise and admiration from their fellow villagers
Value of tiger body parts within the community	Tiger body parts are a status symbol: Interviewees often spoke of tigers' fur, teeth, claws and whiskers being removed by villagers after a tiger had been killed: "Some people take these [things] as a souvenir. Some take fur from the tiger to show that they went to see a tiger. Sometimes, others feel jealous of a person who has tiger fur" Tiger body parts are believed to have medicinal value: To cure back problems, people wear around their waists 'taga' made from a piece of string which has previously been wrapped around a tiger's waist (as tigers are believed to have great strength in their waists). Villagers also wear tiger teeth pendants or rings believed to keep their bodies "fit and healthy" and, additionally, store whiskers in 'tabiz' worn around the top of the arm as they are believed to provide protection from tiger attack
<i>Social drivers for crowd formation during village tiger incidents</i>	
Curiosity about tigers	"The tiger lives beside us in the forest. But the number of people who have actually seen a tiger is very few. So people want to see what a real tiger looks like"
Social stigma	"The brave people must come out of their home. Only women and children stay at home. People will call a man who did not go to see the tiger a coward"

^a All quotations taken from interviews with villagers in case study villages.

^b Retaliation or revenge for past tiger attacks on people or livestock.

^c Payments from fellow villagers for killing a tiger.

Table 3
Ordinal regression model results for the acceptability of tiger killing behaviour in villages which border the Sundarbans, Bangladesh. HH: household.

Independent factors/covariates	Estimate, <i>b</i>	S.E.	95% CI	COR
Beliefs about value of dead tigers ^a	0.269 ^b	0.108	0.058–0.481	0.764
Beliefs about the people who kill tigers ^a	0.610 ^c	0.126	0.363–0.856	0.544
Beliefs about the value of live tigers ^a	0.260 ^b	0.110	0.045–0.476	0.771
Experience 0 (no experience)	0.950 ^c	0.303	0.356–1.544	0.387
Experience 1 (livestock depredation)	0.640 ^b	0.299	0.054–1.226	0.527
Experience 2 (non-fatal attack on HH member)	–0.284	0.297	–0.866 to –0.299	–
Experience 3 (fatal attack on HH member)	0 ^d	–	–	–
Attitude 1 (population decrease preferred)	–1.836 ^c	0.302	–2.427 to –1.244	6.269
Attitude 2 (stable population preferred)	–1.145 ^c	0.258	–1.651 to –0.639	3.143
Attitude 3 (population increase preferred)	0 ^d	–	–	–
–2 Log-likelihood Ratio Test	$\chi^2 = 143.535$, $df = 8$, $p < 0.001$			
Pearson Goodness-of-Fit ^e	$\chi^2 = 463.699$, $df = 482$, $p = 0.718$			
Nagelkerke's R^2	0.361			
<i>N</i>	380			

^a Belief principal component factor scores.

^b Significant at the 0.05 level.

^c Significant at the 0.01 level.

^d Coefficients for reference level factors are not provided; the default reference level in SPSS is the category of each factor in the model with the highest score.

^e A non-significant result for the Pearson Goodness-of-Fit Statistic reflects a well-fitting model.

omitted from the ordinal regression model as they were not significantly correlated with acceptability (Table 1). The model did not violate the assumption of parallel lines ($\chi^2 = 13.925$, $df = 8$, $p = 0.084$) and was a good fit to the data (Table 3). The model had a moderate effect size (Nagelkerke's $R^2 = 0.361$) and accurately predicted 61% respondents' scores on the dependent variable, thereby improving upon chance predictions of respondents' scores (Garson, 2012; Appendix B). All parameter estimates apart from that for 'Experience' category 2 (i.e. respondent injured by a tiger or household member injured by a tiger) were significant (Table 3).

In comparison to 'Experience' and 'Attitude', 'Beliefs' had the weakest effects in the model (Table 3). However, their effects were

still significant (COR 0.544–0.771; see Appendix A) showing that respondents with more positive beliefs (i.e. beliefs that live tigers are of benefit to local people, that tiger body parts do not have medicinal or social value, and that people who kill tigers are not brave and do not deserve admiration), had higher cumulative odds of being less accepting of killings than those with more negative beliefs. Of the three belief variables, beliefs about people that kill tigers had the strongest effect.

Direct negative experience with a tiger had the second greatest effect in the model (Table 3). Respondents with either no tiger experience (Experience 0; COR 0.387) or livestock depredation experience (Experience 1; COR 0.527) had higher cumulative odds

of being less accepting of killings than did respondents from fatal tiger attack households (Experience 3). Acceptability did not differ significantly ($b = -0.284, p > 0.05$) between respondents from non-fatal attack households (Experience 2) and fatal attack households.

Finally, attitude towards tigers had the strongest effect in the model (Table 3). In comparison to respondents who want the tiger population to decline (Attitude 1; COR 6.269) or to stay stable (Attitude 2; COR 3.143), respondents who want the tiger population to increase (Attitude 3), had higher cumulative odds of being less accepting of killings.

4. Discussion

This research identifies motivations for, and factors associated with acceptance of, tiger killing behaviour. Specifically, worry and fear of harm by tigers, a perceived lack of support from local authorities, retaliation, and personal and social benefits motivate people to kill tigers. Various beliefs, past experiences with tigers and attitude towards the tiger population are associated with acceptance of these killings. Context (incident severity and location) influences both behaviour and acceptance.

Evidence from interviewees' narratives suggests that perceived affective risk (i.e. fear of, or worry about, a tiger attacking livestock or people while in a village), and a perceived lack of effective responses to village tiger incidents by the authorities, were stronger drivers of tiger killing than was retaliation. These results add to the growing body of literature which suggests that carnivore killing behaviour is complex and nuanced, not solely the consequence of retaliation (e.g. St John et al., 2012; Marchini and Macdonald, 2012). Further support for this viewpoint is provided by wildlife management research which has found that people's hunting intentions are influenced by complex socio-psychological factors (Mattson and Ruther, 2012; Shrestha et al., 2012). Thus, the term 'retaliatory killing' which is common within the conflict literature presents an over simplified picture of killings.

The strongest predictor of acceptance was attitude towards the tiger population: a more positive attitude was related to a more negative attitude towards tiger killing and vice versa. In line with well-established theories of human behaviour (e.g. Ajzen, 1991; Ajzen and Fishbein, 2005), this indicates that general attitude towards tigers may influence both specific attitude towards killing behaviour and the social norms which sanction the behaviour in this community.

In line with previous studies of wildlife-related behaviours (Bruskotter et al., 2009; Casey et al., 2005; Don Carlos et al., 2009; Zinn and Pierce, 2002), context appears to play an important role in determining villagers' behaviour towards tigers. Interviewees' narratives suggest that as the severity of a village tiger incident escalates, so too does the likelihood of the tiger being killed. Likewise, acceptance of tiger killings in the more severe village tiger scenarios was greater. The data also suggest that acceptance of killing behaviour is location specific, with more respondents in favour of killing a tiger that had attacked a person in a village than had the attack occurred in the forest. Lower tolerance for, or increasingly negative attitudes towards, carnivores when they enter areas of human habitation or approach people's homes have been documented in other locations (Kleiven et al., 2004; Riley and Decker, 2000a; Zimmermann et al., 2005). In the Sundarbans, the effect of location on acceptability may reflect the belief that "...the forest area is his [i.e. the tigers'] and the village area is ours..."; to an extent by entering the forest, people accept the risk of tiger attack whereas in villages this risk is involuntary (Slovic, 1987).

A number of positive social (respect, admiration and in some cases, rewards for killing a tiger; and, the social desirability of tiger body parts), health-related (medicinal value of body parts) and

spiritual (protection against tiger attack afforded by tiger body parts) incentives for tiger killing were also identified during interviews. Such incentives are likely to enhance the perceived benefits of tiger killing and, therefore, to shape individuals' attitudes towards killing as well as the acceptability thereof (Ajzen and Gilbert Cote, 2008; Marchini and Macdonald, 2012). In line with this finding was the result that survey respondents' beliefs about the value of live tigers to local people, beliefs about social status achieved by killing tigers, and beliefs about the medicinal and social value of tiger body parts were associated with acceptance (albeit relatively weakly). It is worth noting, however, that people may provide what they perceive to be legitimate or more acceptable explanations for their behaviour, concealing to an extent their true motivations (Kissui, 2008; MacMillan and Phillip, 2010). In the context of this research which explores the drivers for an illegal behaviour, interviewees may have tended to reveal motivations that they believed would absolve them of responsibility or which would depict them acting for the good of the wider community, rather than revealing the personal and more selfish motivations associated with social status and personal gain. These seemingly secondary factors may actually have a greater influence over people's behaviour than is suggested and is an area for future investigation.

Although affective risk perceptions were commonly stated justifications for killing behaviour, the perceived likelihood of village tiger incidents – which represents a cognitive appraisal of risk – was not related to acceptance. Risk research has shown that cognitive and affective risk perceptions need not be strongly correlated (Sjoberg, 1998). Risk perceptions' influence on carnivore killing behaviour is, therefore, another interesting area for future investigation. In particular, it may be pertinent to explore and compare in other human-wildlife conflict situations, the effects of both cognitive and affective risk perceptions on carnivore killing behaviour and related social norms. As suggested by our results it may be that affective risk perceptions are more strongly associated with killing behaviour and acceptability thereof than are cognitive evaluations of carnivore risk.

4.1. Management recommendations and further research

Our results suggest that while reducing the number of people and livestock attacked by tigers is an important and necessary component of HTC management actions, it will not by itself be sufficient to eradicate killings (see also Dickman, 2010). This is because there are several factors which motivate and sanction killings. We therefore recommend a holistic approach to HTC management which:

- (1) Allays fear of and worry about tiger attacks on people and livestock during village tiger incidents. Given that affective risk perceptions motivate tiger killing behaviour and that risk perceptions are often not closely related to actual risk levels (Riley and Decker, 2000b; Slovic, 1987) actions which reduce the perceived likelihood of such incidents are imperative (Inskip et al., 2013). For example, tiger-proofing houses and livestock pens, the provision of solar electricity within villages (villagers believe this will help keep tigers out of villages and aid the timely detection of tigers should they still enter a village) and, establishing local mobile medical teams who can treat tiger-related injuries (thus improving survival rates for tiger victims) could help allay affective risk perceptions (Inskip et al., 2013).
- (2) Builds village capacity to respond to village tiger incidents by non-lethal means. A perceived lack of support from the authorities during village tiger incidents was a key antecedent of several tiger killings. Empowering villagers to respond

effectively to these incidents will help reduce their dependence on other parties, thus providing a sustainable response strategy. In the Sundarbans, WildTeam's Village Tiger Response Team (VTRT) initiative is built on this premise. Currently, 65% of border villages have a VTRT trained to return tigers to the forest, control crowds of spectators, and thus minimise the likelihood of harm to people, livestock and tigers during these incidents. When necessary these teams work alongside the Bangladesh Forest Department and NGO staff to resolve particularly challenging village tiger incidents. Establishing VTRTs in the remaining border villages will strengthen further local capacity to respond effectively to village tiger incidents with non-lethal actions.

- (3) Addresses crowd formation behaviour. People are more likely to kill and accept killing of tigers that have harmed people. Typically, tiger attacks on people in villages are defensive, a reaction to being surrounded by large numbers of people. Discouraging crowd formation behaviour will therefore help ensure the safety of both people and tigers in villages. Drivers for this behaviour include curiosity and social stigma (Table 2). Social marketing, which is increasingly being used to address conservation-related behaviours (see Butler et al., 2013 for a useful overview of social marketing for conservation), would be a useful tool to address crowd formation behaviour (Veríssimo, 2013).
- (4) Develops within communities the desire to respond by non-lethal means. Currently, social norms and personal and social incentives sanction and encourage tiger killing behaviour. Typically, tiger killings are associated with positive outcomes for those involved (i.e. praise, admiration and rewards). Thus the benefit-cost ratio of the behaviour encourages, rather than discourages, killing behaviour. If this behaviour is to change, this ratio needs to be reversed: the incentives for tiger killing must be reduced and the disincentives increased; simultaneously the incentives for not killing tigers must be increased and the barriers to alternative favourable behaviour(s) reduced (Butler et al., 2013; McKenzie-Mohr, 2000). As with crowd formation behaviour, targeted social marketing, will complement the VTRT initiative (an incentive not to kill tigers) and help to address social norms and remove the perceived benefits (e.g. beliefs about the medicinal and spiritual properties of tiger body parts) of tiger killing behaviour. Strengthening law enforcement and increasing prosecution rates for people who kill tigers would act as a strong disincentive for the behaviour.

Given this study's preliminary nature, it has highlighted the need for additional research to improve further our understanding of this complex behaviour and support HTC management in the Sundarbans area. In addition to the two areas for research already highlighted (personal and social incentives and risk perceptions), we suggest that the following aspects of killing behaviour be explored further: (1) the relationship between negative tiger experience and a desire for retaliation and other, less emotionally charged, reasons for desiring tiger killings (e.g. economic incentives such as protecting household incomes or livestock); (2) the relationship between acceptability and intention to kill tigers as Marchini and Macdonald (2012) found that attitudes towards jaguar killing behaviour were associated with intentions to kill jaguars in Brazil.

5. Conclusion

This is the first study of tiger killing behaviour, grounded by in-depth social research. The results demonstrate the complexity of

carnivore killing behaviour and highlight the need for conservation action to be built on a better understanding of, and to address effectively, human behaviour. However, collecting reliable data on the incidence of and motivations for conservation-related human behaviours can be extremely difficult (MacMillan and Han, 2011; St John et al., 2012). This research shows that in-depth qualitative research and broad scale quantitative surveys can, in combination, provide useful insight into carnivore killing behaviour. Qualitative research facilitates a deep, grounded understanding of a community and can be particularly useful for identifying social norms which make carnivore killing more, or less, acceptable. It is also invaluable for the development of culturally appropriate and situation-specific interventions which not only reduce threats to endangered carnivores but to local communities. Where possible, qualitative research should therefore precede and underpin quantitative assessments of behaviour or behavioural intentions.

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Appendix A. Quantitative data analysis

Acceptability scale

Agreement/disagreement with each tiger killing statement was measured on a 5-point binomial scale ('strongly agree' to 'strongly disagree' with a mid-point of 'unsure'). Questionnaire respondents were categorised by the least severe scenario in which they found killing to be acceptable, providing an ordinal scale of acceptability where: 1 = killing acceptable when a tiger enters a village but does not harm people or livestock (respondent readily accepts killing); 2 = killing acceptable when a tiger kills livestock and/or people in a village (respondent accepts killing less readily than in scenario 1; note that these two scenarios were combined due to the small proportion of respondents who accepted killing only when the tiger had attacked a person); 3 = killing not acceptable in any scenario (Table 1). Chi square tests were used to ascertain whether the proportion of people agreeing with tiger killing in each scenario differed significantly.

Past negative experience with tigers

Respondents were assigned a rank score based on the most severe negative tiger experience their household had suffered (3 = a household member killed by a tiger; 2 = respondent or a household member injured by a tiger; 1 = household's livestock killed by tiger; 0 = no direct tiger experience).

Attitude towards the tiger population

Respondents' attitude towards the tiger population was assessed by asking whether in the future they would like the tiger population

to increase relative to the current population size (coded 3), stay the same (2), or decrease (1) (Decker and Purdy, 1988; Inskip, 2013). A desire to see the tiger population increase reflected a more positive attitude towards tigers, while a desire for the tiger population to remain constant or decline reflected increasingly negative attitudes.

Incident likelihood index

The incident likelihood index was based on respondents' perceptions of the current frequency and trend of village-based HTC incidents (i.e. village tiger incidents and tiger attacks on people or livestock in villages). Perceived frequency and trend were measured on 4 and 5 point scales respectively (Table 1). Respondents' incident frequency and trend scores were multiplied together to create an index score for each incident type (range 0–15) which reflected respondents' perceived likelihood of incidents occurring (higher scores represented a greater perceived likelihood of occurrence).

Beliefs

Responses to six belief statements were recorded on a 5-point binomial scale (Table 1). Positive responses (i.e. those where the respondent slightly or strongly agreed with the statements concerning the value of live tigers for people or slightly or strongly disagreed with the statements about the value of dead tigers and about the people who kill tigers) received positive scores (1 or 2) while negative responses received negative scores (–1 or –2); 'unsure' responses were coded as zero. Principal Components Analysis (PCA) was applied to the 6 belief statement variables. Three theoretically sound principal components with eigenvalues >1 were extracted, explaining 65% of the variance in the original variables. Orthogonal (varimax) rotation revealed that two original belief statement variables had significant factor loadings (i.e. >0.7; Field, 2009) on each of the components extracted (Table 1). These represented beliefs about: (a) the value of live tigers for people; (b) people who kill tigers; and (c) the value of dead tigers for people. Factor scores for the three components were used in all further analysis. Higher factor scores reflected more positive beliefs (i.e. beliefs that live tigers have a value for people, that dead tigers are of little value to people and that the people who kill tigers are not brave or admired).

Univariate analysis

Spearman's rank correlation was used to explore the univariate relationship between acceptability and each of the independent variables. Ordinal regression analysis (logit link function) was used to explore quantitatively the determinants of acceptability in the Bangladesh Sundarbans (Hosmer and Lemeshow, 2000). A global main effects model which included all of the independent variables shown to be significantly correlated with acceptability was run. Model fit was assessed using the test of parallel lines (which confirms the proportional odds assumption) and goodness-of-fit statistics (likelihood ratio test and Pearson chi square statistic). Model effect size was assessed via Nagelkerke's R^2 and the model's 'hit rate' (i.e. the proportion of respondents correctly assigned by the model to the categories of the dependent variable; Norusis, 2011; Garson, 2012). The effects of the independent variables on TK acceptability were assessed by parameter estimates (b) and their respective cumulative odds ratios (COR; Garson, 2012). Cumulative odds ratios (i.e. the exponential of the parameter estimates: $COR = \text{EXP}(-b)$) provide an indication of the effect size of each independent variable in the model while controlling for other variables (Garson, 2012; Strand et al., 2011). Simply, high COR scores (>1) reflect higher odds of being in a lower category of the

Table B.1

Classification table and hit rates for ordinal regression model. The model hit rate (C/T) is the proportion of respondents correctly assigned by the model to categories of the dependent variable. The chance hit rate (d/T) reflects what would be the percentage of respondents correctly assigned by the model based on 'chance' i.e. if the model were to successfully predict the scores all of those respondents in the most common category (d ; Garson, 2012).

Observed category	Predicted response category			Total, T
	1	2	3	
1	19 ^a	42	2	63
2	10	135 ^b	33	178 ^d
3	1	60	78 ^c	139
Total	30	237	113	380
Total correct, $C (a + b + c)$	232			
Model hit rate (C/T)	61%			
Chance hit rate (d/T)	47%			

dependent variable, while low COR scores (<1) reflect lower odds of being in a lower category (i.e. greater odds of being in a higher category). COR scores approaching 1 indicate relatively weak effects (Garson, 2012). Data were analysed in IBM SPSS Statistics 19; CORs were calculated in Microsoft Excel 2010.

Appendix B. Classification table for ordinal regression model

See Table B.1.

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