



Perceptions of Risk From Man-Eating Lions in Southeastern Tanzania

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Perceptions of risk are a critical component of understanding the human dimensions of human-wildlife conflict as perceptions greatly affect peoples' attitudes and behaviors toward wildlife. However, accurately assessing perceptions can be difficult since risk is often subjective and perceptions are affected by both emotions and experience. Lions attacked over 1,000 people in Tanzania between 1990 and 2007. We conducted questionnaire surveys to examine multiple aspects of risk perceptions in the areas with the highest incidence of lion attacks, focusing on three general questions: (1) how villagers perceive their overall risk of attack; (2) what factors influence risk perceptions; and, (3) what aspects of risk are perceived accurately. Overall, people overestimated their risk from lions: 53% of respondents felt they are very likely to be attacked while the actual risk is estimated at less than 1% over an average lifespan. Risk perceptions were correlated with gender, age, education, acres of cultivated land and number of livestock owned but not with previous experience with lion attacks in either the village or family or with sighting of lions or lion signs. Nevertheless, people were very aware of who was at relatively high risk and when and where risks were greatest. People also accurately assessed the risk from lions compared with mega-herbivores but not compared with other predatory species or with disease and famine, emphasizing the tendency for people to overestimate risks that are rare but elicit strong fears. This study highlights the value of using interdisciplinary techniques to examine human dimensions of human-lion conflict as risk perceptions and local knowledge can identify gaps in understanding that could improve conflict-prevention programs.

Keywords: human-wildlife conflict (HWC), risk perceptions and knowledge, human-dimensions, lions (*Panthera leo*), Tanzania

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INTRODUCTION

Lions attacked over 1,000 Tanzanians between 1990 and 2007 (Kushnir et al., 2010, 2014). The overwhelming majority of these cases were unprovoked, where lions entered human-dominated areas specifically to prey on people (Packer et al., 2005; Kushnir et al., 2010). Understanding how people perceive the risk of lion attacks is important to the development and design of an effective conflict-mitigation program because perceptions reveal how society and individuals view and respond to hazards (Tate et al., 2003). Peoples' perceptions affect attitudes and behaviors, making perceptions as important to consider as actual risk (Naughton-Treves, 1998; West and Parkhurst, 2002; Conforti and de Azevedo, 2003; Naughton-Treves and Treves, 2005; Gore et al., 2006; Baird et al., 2009; Thornton and Quinn, 2010). Perceptions also greatly influence support for conservation

and the likelihood of retaliation toward species implicated in human-wildlife conflict (Conforti and de Azevedo, 2003) and are therefore critical for managing prevention efforts (Henderson et al., 2000; Kretser et al., 2009).

Numerous studies have examined perceptions and attitudes toward protected areas or wildlife (Manfredo et al., 1998; Bauer, 2003; Gadd, 2005; Lucherini and Merino, 2008) so as to determine how communities view conservation efforts. Other studies have specifically examined perceptions of problem animals or the damage they inflict on crops and livestock (McIvor and Conover, 1994; Naughton-Treves, 1997, 1998; Henderson et al., 2000; West and Parkhurst, 2002; Gillingham and Lee, 2003; Marker et al., 2003; Linkie et al., 2007; Kretser et al., 2009) or on human safety (Zinn and Pierce, 2002; Conforti and de Azevedo, 2003; Kleiven et al., 2004; Gore et al., 2006; Kaltenborn et al., 2006; Thornton and Quinn, 2010).

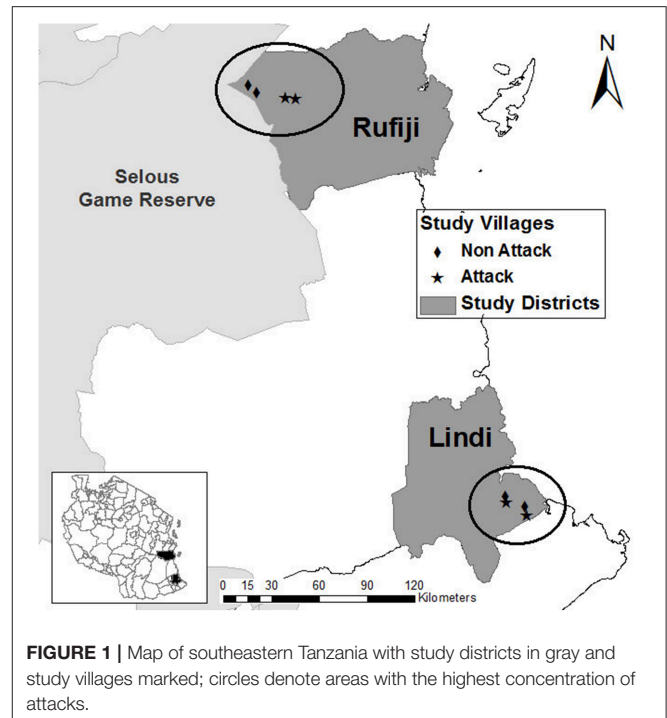
Many of these studies have either assessed overall perceptions (McIvor and Conover, 1994; Zinn and Pierce, 2002; Conforti and de Azevedo, 2003); (Marker et al., 2003; Gore et al., 2006; Kaltenborn et al., 2006; Kretser et al., 2009; Thornton and Quinn, 2010) or identified socioeconomic, demographic, cultural, or attitudinal factors that influence perceptions (Naughton-Treves, 1997; Zinn and Pierce, 2002; Conforti and de Azevedo, 2003; Kleiven et al., 2004; Gore et al., 2006; Kaltenborn et al., 2006; Kretser et al., 2009; Thornton and Quinn, 2010), while others have compared actual risk or damage to perceptions (Naughton-Treves, 1997, 1998; Henderson et al., 2000; Gillingham and Lee, 2003; Linkie et al., 2007). However, few studies have so far obtained a comprehensive picture of local knowledge and risk perceptions by examining not only overall perceptions but also examining the specific situations in which people feel at risk.

We investigated perceptions of man-eating lions in a situation where risks were real, fatal, and widespread. We examined risk perceptions to answer three questions: (1) How do people perceive their risk of being attacked by a lion? (2) How do past experience, demographics, socioeconomics and location affect perceptions? (3) How does perceived risk compare to documented attacks? Examining these aspects of risk provides a nuanced view of risk perceptions and local knowledge associated with lion attacks and contributes to the growing body of interdisciplinary research on human-lion conflict.

METHODS

Study Area

We worked in the two Tanzanian districts with the highest number of lion attacks: Rufiji and Lindi. These districts differ from each other in the abundance of wildlife and human activity patterns during lion attacks. Rufiji is near Selous Game Reserve and home to larger lion and herbivore populations than Lindi, which is not near any major protected area. In Rufiji, the majority of attacks occur at night in agricultural fields while victims are sleeping inside huts. In Lindi, the majority of attacks occur in the late evening, both in villages and agricultural fields, while victims are walking or conducting activities just outside their homes. Despite these contrasts, both districts experienced a major outbreak of lion attacks from 2001 to 2004. In both



areas, most rural villagers are subsistence farmers who suffer considerable losses from nocturnal crop pests, particularly bush pigs (*Potamochoerus porcus*), which are important lion prey in these agricultural areas (Packer et al., 2005; Kushnir et al., 2010). The seasonality of lion attacks, outcome, and victim demographics were similar between districts Kushnir et al., 2010. Most attacks in Lindi and Rufiji occurred during the wet season, which corresponds to the harvest season, and the months with the most attacks were December, January, March, April, and May (when farmers remain in their fields to guard against nocturnal crop pests, Kushnir et al., 2010). Sixty-six percent of attacks on humans in Rufiji and Lindi were fatal ($N = 274$), 58% of victims were male, and 74% were adults.

In each district, we conducted questionnaire-based interviews in the areas with the highest recorded concentration of attacks (Figure 1). Using attack locations obtained from district records verified through site visits to each village, we selected four villages in each study area: two with a history of attacks and two neighboring villages with no attacks. An “attack village” is a village that had attacks within its boundaries, which includes agricultural areas within its jurisdiction. A “non-attack village” is a village with no attacks from 1990 to 2007 as verified by both district records and site visits. In Rufiji, the two selected attack villages are between 18 and 29 km from the two selected non-attack villages. In Lindi, the two selected attack villages are between 4 and 6 km from the two selected non-attack villages.

Data Collection and Analysis

We conducted 128 questionnaire-based interviews with the help of a translator by randomly selecting 16 households from each village register and alternately selecting female and male household heads to ensure an even gender ratio; there was no

indication that female household heads answered the surveys differently than males. Questionnaires included questions on demographics, socioeconomics, education, attack history in the family, sighting of lions and lion signs, and whether attacks increased or decreased over their lifetime.

Perceived Risk

We asked two prompted questions (where we gave interviewees a list of possible responses) to gauge perceived risk from lion attacks:

- (1) Perceived likelihood—How likely do you think you are currently to be attacked by a lion (not at all, somewhat, very)?
- (2) Worry—Are you worried about being attacked by a lion (not at all, a little, worried, very)?

Because of low responses for some categories for question 2, we grouped “not at all” and “a little” together and “worried”/“very” together for analysis.

With SPSS 16.0, we used the chi-square goodness-of-fit test and analysis of variance (ANOVA) to compare responses according to demographics (male/female, child/adult), socioeconomics, education, attack history in the family, sighting of lions and lion signs, and whether attacks increased or decreased over their lifetime.

Perceived Risk vs. Documented Attacks

We asked a number of questions about attack specifics (note that in Swahili, “risk” in the context of lion attacks translates to “danger”). Some of these were open-ended questions and others were prompted with possible answers provided:

- Do you think the following activity puts people at risk for lion attacks, if so how much risk (prompted—list of 11 activities: collecting firewood, getting water, collecting timber, fishing, walking alone during the day, walking alone when dark, guarding crops, sleeping in agricultural fields, using the toilet after dark, cooking outside after dark, sitting/resting outside after dark)?
- Where do you feel most at risk (prompted—village center, agricultural field, both, other/wild areas)?
- During which times of day do you feel most at risk (open-ended)?
- Who in your village do you think is most at risk of lion attacks (open-ended)?

Results from these questions were compared to details from documented attacks (whether those attacks were fatal or not). For activities, we categorized questionnaire and attack data into five categories that best aligned with each other. These five categories were: (1) activities outside the house including cooking outside after dark and sitting/resting outside after dark; (2) bathroom/bathing; (3) farming/guarding crops including sleeping in agricultural fields; (4) walking at any time of day; and (5) helping another victim. We chose to exclude five perceived risky activities that did not match with documented attack data because the level of details of attacks data was not as precise as the questionnaire. These were collecting firewood, getting water, collecting building materials, fishing, and

collecting wild tubers. For times of day, we grouped responses for questionnaire and attack data into five categories (early morning, morning, afternoon, evening, night). We also grouped questionnaire responses for who is most at risk into child/adult and male/female to compare to documented attack data. Once data was categorized, we calculated the percent of responses in each category for questionnaire data and calculated the proportion of attacks in each category for documented attacks. We then plotted these results on a scatter plot (**Figure 2**).

To better understand perceived risk vs. documented attacks, we also asked respondents which threat poses the greatest risk: another wildlife/non-wildlife risk, a lion or both (comparison of risks). The additional wildlife included elephants (*Loxodonta africana*), hippopotamus (*Hippopotamus amphibius*), buffalo (*Syncerus caffer*), crocodile (*Crocodylus niloticus*), leopard (*Panthera pardus*), and snake. Non-wildlife risks included drought, famine, malaria, and AIDS. We did not question people in Lindi about hippopotamus and crocodile because these species were not present in the area. We used chi-square to test for significant differences between lion-attack risk and other wildlife/non-wildlife risks and tested for differences in responses between attack- vs. non-attack villages and between people who had or had not had attacks in their family.

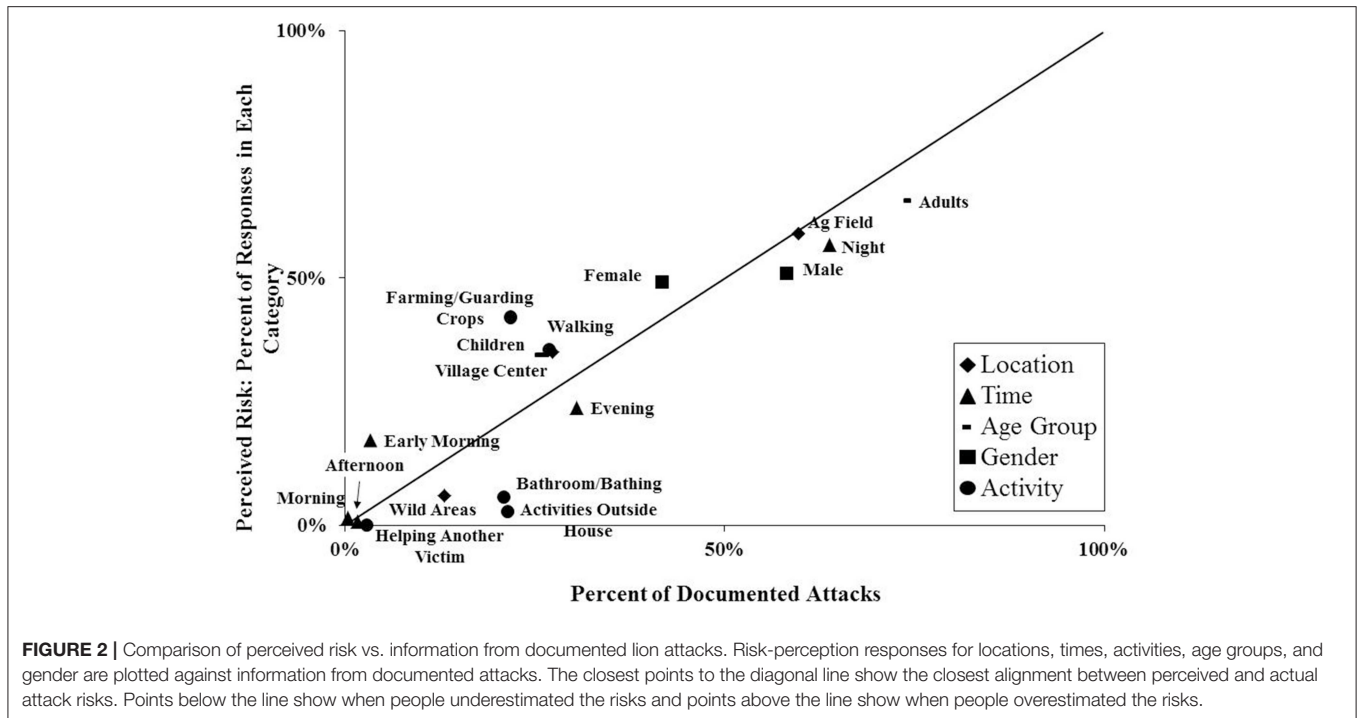
RESULTS

Perceived Risk

Overall, 53.2% thought they were very likely to be attacked, and 69.0% worried about being attacked. Given an average of 15.5 attacks per year in Rufiji and Lindi, a combined population of ~450,000 people in the two districts, and an average lifespan in Tanzania of 55.9 years, a realistic estimate of an individual's lifetime chances of being attacked is well below 1%. There were no significant differences in response to the two perception questions (perceived likelihood, worry) between people living in an attack or non-attack village or between people with or without an attack in their family. There was also no significant difference in perceptions (perceived likelihood, worry) based on sightings of lions or lion signs in villages or agricultural fields, with one exception: people who saw lion signs in their village were more likely to be worried/very worried about attacks as compared with those that did not ($X^2 = 5.529, p < 0.05$). Males and females were equally worried about attacks, but females were more likely than males to think that they were not at all likely to be attacked ($X^2 = 10.123, p < 0.01$). People with more education (having completed Standard 5–7) were more worried ($X^2 = 9.978, p < 0.01$) about attacks and thought they were more likely to be attacked ($X^2 = 12.703, p < 0.05$) than those with less education (Standard 1–4) or no education at all. Although age did not have a significant effect on risk perceptions, people who thought attacks had increased were younger on average than those who thought that attacks had decreased ($F = 7.052, p < 0.01$).

Perceived Risk vs. Documented Attacks

Figure 2 shows risk-perception responses for locations, times, activities, age groups, and gender plotted against information from documented attacks. The closest points to the diagonal line



show the closest alignment between perceived and actual attack risks. Points below the line show when people underestimated the risks and points above the line show when people overestimated the risks. Overall, perceptions aligned well with attack data as most points lie close to the diagonal. Perceptions diverged most for “activities”—people overestimated risks from farming and guarding crops and underestimated risks from using the toilet, bathing, and conducting activities just outside the house.

Overall, the majority of people considered lions to be more dangerous than elephants, hippopotamus, and buffalo and that crocodiles, leopards, and snakes were equally as dangerous as lions (Figure 3). Although most people said that risks from drought, famine, malaria, or AIDS were higher than risks from lions, a large proportion of villagers viewed these risks as equal to lion attacks (Figure 3). Significant differences were found between the three responses (lion, other, both equally) for all wildlife and non-wildlife risks except drought (elephant $X^2 = 37.434$, $p < 0.01$; hippo $X^2 = 16.000$, $p < 0.01$; buffalo $X^2 = 32.469$, $p < 0.01$; crocodile $X^2 = 14.281$, $p < 0.01$; leopard $X^2 = 30.333$, $p < 0.01$; snake $X^2 = 23.453$, $p < 0.01$; famine $X^2 = 8.172$, $p < 0.05$; malaria $X^2 = 15.559$, $p < 0.01$; AIDS $X^2 = 23.688$, $p < 0.01$). There were no significant differences in responses comparing lions to other wildlife or non-wildlife risks between attack- vs. non-attack villages or between persons who had or had not had attacks in their family.

DISCUSSION

Perceived Risk

A majority of individuals, even in villages that have never experienced attacks, felt that it was likely that a lion would

attack them. Considering that over the course of an average lifespan people in Rufiji and Lindi districts have less than a 1% chance of being attacked, perceptions of risk appear to be considerably exaggerated.

An examination of the psychological literature on risk perceptions provides a framework for understanding why people are overly concerned about lion attacks. Numerous studies have discussed how emotions and feelings relate to risk perceptions and have shown that people often estimate risks on feelings rather than on an analytical risk assessment (Fischhoff et al., 1993; Slovic and Peters, 2006; Slovic et al., 2007). Studies have shown that people have an inflated perception of risk for involuntary and uncertain situations over which they have little control. The more sensational or vivid the consequences and the more feeling of dread associated with the risk, the higher people perceive their own risk to be (Johnson and Tversky, 1983; Slovic, 1987; Fischhoff et al., 1993; Tate et al., 2003; Slovic et al., 2007). One example is the tendency for people to overestimate their personal risks from an airplane crash; people focus so much on the outcome and nature of the event that they do not consider that it is unlikely to occur (Slovic and Peters, 2006). Lion attacks mirror risks like airplane crashes because even though lion attacks are rare, the consequences are high, the situations are terrifying, and attacks are completely out of peoples' control.

There was no relationship between an individual's previous experience with attacks, proximity to protected areas, and awareness of lions being present in villages and agricultural fields and his/her perceptions of risk, as defined by the two questions designed to measure perceived risk (perceived likelihood, worry). The only exception is that people who saw lions in their village were more worried about attacks.

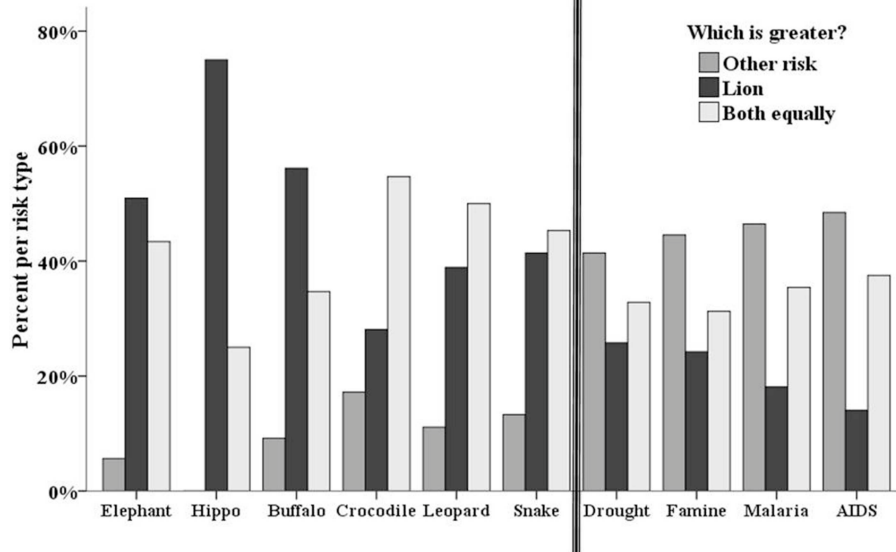


FIGURE 3 | Comparison of risk between lions and other wildlife (Left) and non-wildlife (Right) risks. Most people view the risk from lions to be greater than elephant, hippo, and buffalo and the same as crocodile, leopard, and snakes. Most people view drought, famine, malaria, and AIDS to be greater than the risk from lions.

Our findings contrast with earlier studies showing that people were more likely to report negative perceptions or higher levels of fear if they had experienced more economic loss, physical damage, or contact with wildlife (West and Parkhurst, 2002; Kleiven et al., 2004; Kretser et al., 2009; Thornton and Quinn, 2010). In our study, individuals with previous experience did not perceive their risk to be higher than individuals who lacked previous experience. This could be because the sensational nature of lion attacks on humans makes these events much easier to recall. According to the availability heuristic, this would lead people to consider themselves more likely to be attacked regardless of their personal experience. The availability heuristic states that “a person evaluates the frequency...or the probability of events by...the ease with which relevant instances come to mind” (Tversky and Kahneman, 1973). The extreme and uncontrollable nature of these events makes them easy to remember. Although there is almost no media publication of these events and little public transport between villages, most people can still recount stories of attacks that occurred multiple villages away.

Perceived Risk vs. Documented Attacks

People tend to be overly worried about attacks and to overestimate their likelihood of being attacked. This is not unusual, as many studies that compare perceived wildlife damage to actual damage have shown that people perceive loss to be worse than actual loss (Naughton-Treves, 1997, 1998; Gillingham and Lee, 2003). People also have a broader concept of risk than death or injury and often include outcomes such as psychological stress or loss in productivity in their risk assessments whereas experts generally consider risk only in terms of the likelihood of death or injury (Slovic, 1987). Perceptions may be amplified by people's

inability to cope or lack of control over the situation (Naughton-Treves, 1997; Gillingham and Lee, 2003). For example, when people reflect on perceptions of crop damage they may not just be responding to direct crop loss but also the indirect cost of abandoning a field (Naughton-Treves and Treves, 2005). Additionally, there is always bias introduced by the questionnaire itself (Johnson and Tversky, 1983). Respondents knew that we were lion researchers and could have consequently exaggerated their concerns.

People are known to better identify relative risks even if they are unable to judge the true extent of a particular risk (Fischhoff et al., 1993; Slovic et al., 2007). By asking respondents about who might be most at risk (adult/child, female/male) and about the riskiest locations, activities and times, we found that the villagers' perceptions of at risk individuals, locations, activity, and times matched with actual risks, though some aspects of risk were more easily recognized than others. People generally did a good job assessing risk of specific locations, activities, and times, as well as the members of their community who were most at risk. However, compared with data from actual attacks, people tended to perceive higher risk from farming and guarding crops and lower risk from activities around the house, using the toilet and bathing. It is particularly striking that people most underestimated the risk around their home. This may indicate a false belief about safety of mundane activities, much like the tendency to underestimate the risk from driving while overestimating the risk from flying (Johnson and Tversky, 1983).

Comparing the risk of lion attacks to other dangers also highlighted a mismatch between perceptions and actual risk. People generally believe that lions are more dangerous than elephants, buffalo, and hippopotamus and that lions are equally as dangerous as crocodiles and leopards. Dr. Dennis Ikanda of

the Tanzania Wildlife Research Institute surveyed district records in six districts in southeastern Tanzania and found that lions are responsible for 55% of all wildlife related deaths and injuries followed by crocodiles (13%), leopards (12%), hyenas (7%), elephant (6%), hippopotamus (5%), and buffalo (2%). These data show that people assess their risk from the mega-herbivores correctly, as elephants, hippopotamus, and buffalo do kill less people than lions. However, peoples' tendency to rate the risk of lions as equal to that of leopards and crocodiles illustrates the tendency to overestimate risk from situations that elicit dread and fear. People may not be responding to actual objective risk of death or injury but to a deep generalized fear of predatory species.

Most people viewed the danger from drought (41%), famine (45%), malaria (46%), and AIDS (48%) to exceed that from lions. However, a substantial number of people viewed these risks as being similar to lions (drought 33%; famine 31%; malaria 35%; AIDS 38%). According to the United Nations World Food Programme (2009), 58% of Tanzania's population lives on less than \$1 a day, 44% are undernourished, and 38% of children under five are malnourished. The country is also plagued with irregular rainfall and 1.4 million people (3.4% of the total population) are living with HIV/AIDS (World Food Programme, 2009). Considering these statistics, it is remarkable that almost 40% of the interviewees perceived the risk from lion attacks to be the same as drought, famine, malaria, and AIDS when they had less than a 1% chance of being attacked by a lion over their lifetime. One explanation for this could be that though attacks are rare, the mortality rate from these attacks is very high (66%).

CONCLUSION

This research contributes to the growing body of interdisciplinary research on human-lion conflict by examining perceptions, an important human dimension of conflict that should be considered when designing policy and program interventions. Consistent with the literature on risk perceptions of other spectacular though rare events, people in Rufiji and Lindi districts overestimated their likelihood of being attacked by a lion. However, when questioned about specifics, people were very aware of where and when they were most at risk. Consistent with the availability heuristic, the majority of the population was presumably concerned about attacks because details were easy to recall. Knowing this, management officials could potentially implement prevention efforts just as easily in communities with a history of attacks as those without attacks. Heightened perception

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of risk and easy recall of human-wildlife conflict events could make people more likely to take preventative action that can save lives and livelihoods and forestall retaliation against threatened wildlife species.

Beyond overall perception of risk, it is critical to identify the specific locations and activities where people feel most at risk. This information can help conservation practitioners target conflict prevention measures and community education programs. For example, in Rufiji and Lindi, people underestimate their attack risk near their homes and may more readily take preventative actions in agricultural fields or walking in the village periphery. This means education must not only focus on risk in areas outside of village centers but also closest to peoples' homes.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the Institutional Review Board (IRB) at the University of Minnesota. The research involved minimal risk to subjects, thus, the IRB approved a waiver of informed consent for the project.

AUTHOR CONTRIBUTIONS

HK designed and conducted the field research, analyzed the data, interpreted the result, and wrote the manuscript. CP provided input into study design, data analysis, and interpretation of results and provided feedback on the manuscript.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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