Effectiveness of the Mbirikani Predator Consolation Fund: Mitigating Human-Lion Conflicts and Enhancing Attitude, Tolerance, and Coexistence within Communities

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ABSTRACT

Lions (*Panthera Leo)* have seen a significant decline throughout their range in Kenya, largely due to retaliation by local Maasai in response to livestock predation. The Mbirikani Predator Consolation Fund (MPCF) was established in 2003 to address the issue of retaliatory attacks and foster positive attitudes and tolerance towards lions. There is uncertainty as to the effectiveness of the MPCF in influencing the attitude, tolerance, and coexistence of local Maasai, due to the occurrence of recent retaliatory killings. Previous research has shown predator compensation programs can increase attitude and tolerance and reduce retaliatory attacks on lions. A mixed-methods approach was used to collect empirical data, combining household surveys and key informant interviews. Attitude, tolerance, and coexistence were analyzed across the attributes of village, level of formal education, tropical livestock units owned, and gender. Analysis shows that retaliatory attacks have dramatically declined since the MPCF was initiated. We found that this decline was due to the PCF program, the Wildlife Scholarship Education program for students, and employment provided by Big Life Foundation (BLF). Average tolerance and attitude levels were high. PCF is generally effective in improving community tolerance of lions. Community attitudes cannot solely be addressed by PCF — a holistic approach including scholarships, education, and employment is highly useful. This paper recommends the continuation of MPCF, scholarship programs and employment, as well as efforts to improve relations between community members and Big Life Foundation.

Key Words: Mbirikani Predator Consolation Fund, Human-wildlife conflict, Livestock predation, Retaliatory attacks, Coexistence, Amboseli Region, Lions.

INTRODUCTION

Lion (*Panthera leo*) populations across Africa have experienced a precipitous decline in recent history. Before the arrival of European settlers, lion numbers were estimated to have been above one million in continental Africa (Myers, 1975). By 1950, their population had halved (Myers, 1975) and by 2013 the African lion population was estimated at approximately 32,000 individuals (Nicholson et al., 2023; Riggio et al., 2013). This drastic decline is largely attributed to anthropogenic factors such as habitat loss, land degradation, population fragmentation, and increased human-wildlife conflict (HWC). Historical estimates put the African lion range at 22,211,900 km² (Ray et al., 2005), but this has diminished to about 3.4 million km² in 2013 and continues to shrink (Riggio et al., 2013). Consequent to this reduction in population and range area, the IUCN now labels lions as vulnerable to extinction (Nicholson et al., 2023).

The absence of apex predators such as lions disrupts ecosystem balance and undermines economic productivity of a landscape. Lions play a crucial role in regulating distribution, abundance, and diversity of prey species, a phenomenon known as trophic cascade. Furthermore, lions draw an abundance of tourists from around the world. Consequently, the loss of lions in an ecosystem threatens to erode both local communities and governmental revenues derived from tourism. Nevertheless, the greatest threat lions currently face is intentional hunting and poisoning by people as retaliation for livestock depredation (Bauer et al., 2008). The Amboseli region in southern Kenya faces such challenges and there has been a dramatic decline in the lion population in this area. Due to hunting and poisoning, the lion population in the Amboseli region was reduced dramatically in the early 2000s (Ogeto, 2007). Since then, there have been more active efforts in the region to conserve lions, however, as the human population rapidly grows and encroaches upon lion territories, conflicts arise over livestock predation and threats to human safety. In response, local communities such as the pastoralist Maasai retaliate against lions to protect their livelihoods. Historically, poisoning in particular has been a widespread method of eliminating lions; locals lace bait with toxic substances, which leads to indiscriminate deaths of lions, scavengers, and other wildlife (Nicholson et al., 2023).

Fostering coexistence between humans and wildlife is vital to long-term conservation initiatives. Although Maasai pastoralists coexisted with lions for centuries, recent growth in human population and changes in land use have led to conflict (Fernández-Llamazares et al., 2020). An article published in 2020 estimated that lion populations have decreased by 43% since 2000 (Bauer et. al., 2015) and that retaliatory attacks on lions due to livestock predation contribute heavily to this decline (Lindsey et. al., 2017, Loveridge et. al., 2017). Poor levels of coexistence are exemplified by the extirpation of lions in the Amboseli National Park between 1991 and 1994, primarily through poisoning and spearing (Chardonnet, 2002). In response to HWCs, a body of literature is emerging that discusses the state of coexistence with lions as well as the strategies designed for its achievement. Coexistence can be conceptualized as a compromise on how humans and wildlife can exist together in different ecological niches (Frank, 2016), which allows for the persistence of self-sustaining carnivore populations in human-dominated landscapes (Chapron & López-Bao, 2016). The coexistence of the human population and large predators can be understood through two indices: competitive ability and niche differentiation between the two species (Chapron & López-Bao, 2016). Strong coexistence firstly requires high niche differentiation, characterized by adopting practices that decrease chances of negative interaction — for example, the use of predator-proof bomas; secondly, coexistence requires low competitive ability, for humans in this case this refers to overexploitation and destruction of the habitat of large predators — which can be intentionally reduced through strategies such as legislation, improved attitude, and perhaps through financial incentive schemes. Financial incentive schemes have been suggested as a strategy for achieving tolerance and coexistence with lions (Maclennan et. al., 2009); a predator consolation fund (PCF) involves granting payments to individuals whose' livestock are killed by predators with the hope of easing the loss such that the individual will not retaliate on wildlife.

Improving community attitudes through economic incentives in order to increase tolerance to livestock loss - ultimately aiming to reduce human-wildlife conflict, is the foremost goal of the MPCF. This is done in the form of compensation, student scholarships, and employment. Without such a mechanism, community attitude would be degraded in the events of livestock depredation, over time leading to reduced tolerance and eventually retaliatory killing (Figure 1).

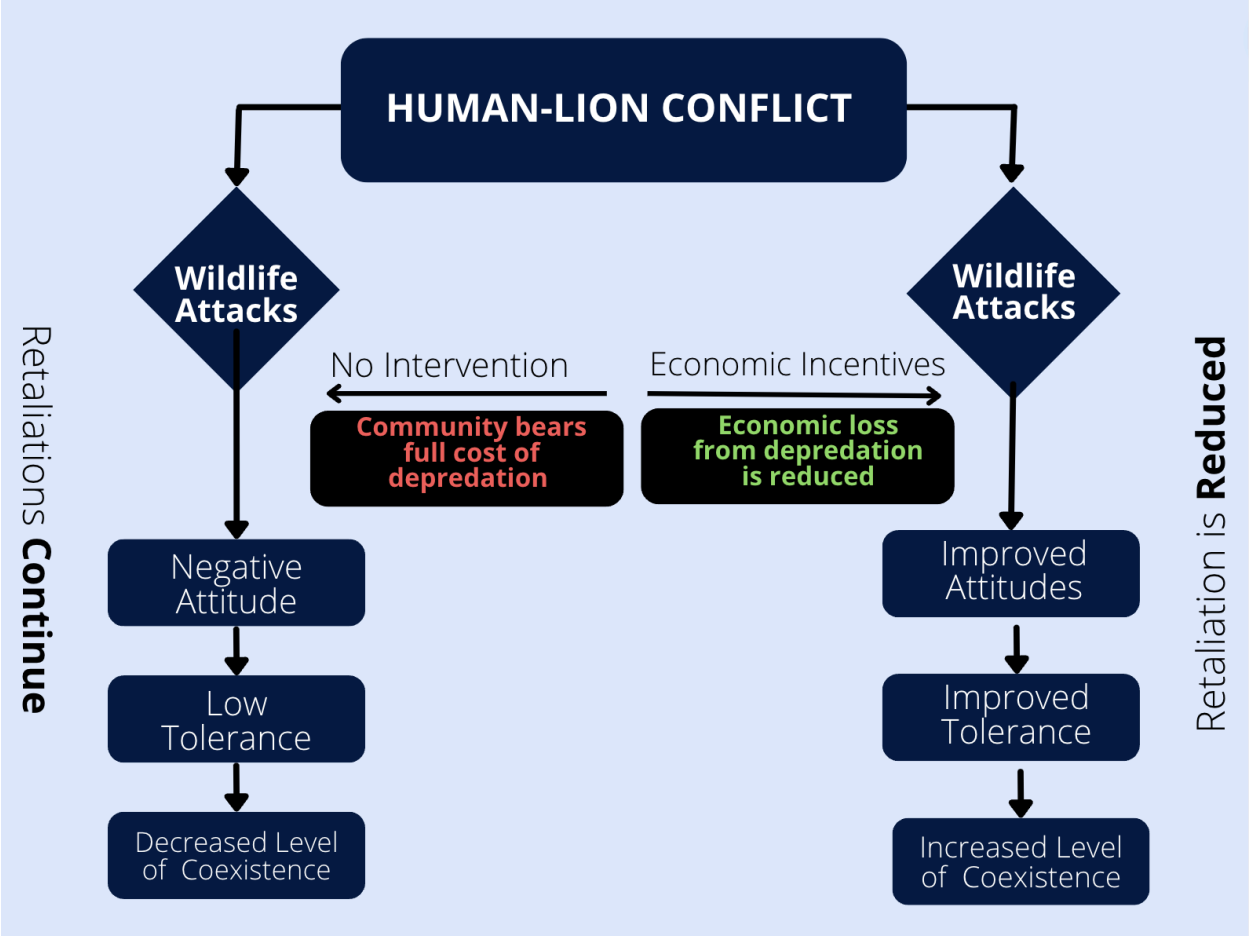

Figure 1: *Flow chart comparing coexistence levels when economic incentives are provided versus when there is no consolation program in place.*

The Mbirikani Predator Consolation Fund (MPCF) was established in 2003 when the population of lions in the Amboseli region was nearing 20 as a result of retaliatory attacks and traditional Maasai lion hunting practices. The consolation fund was created to dampen the impacts of livestock predation in order to improve human attitudes and tolerance towards lions. The intent to foster human livelihoods alongside lions has been key in changing community mindsets, as humans are less likely to buy into the program if they see no tangible benefit. It was evident that Maasai communities could not simply be moved away from the predators, but in saying so, lions would need significant attention from those sharing the land with them. The way that humans would agree to buy into this idea was through incentives. The multi-faceted approach to address attitude and tolerance is the function of coexistence.

The MPCF operates on the principle of providing financial incentives to deter retaliatory attacks against predators (reducing human competitive ability against lions). By compensating pastoralists for livestock losses and promoting better animal husbandry practices, such as reinforced bomas and improved herding techniques (increasing niche differentiation), the MPCF aims to minimize HWCs in the Amboseli region.

Evaluations of the MPCF have been conducted in the past, revealing a dramatic 95% reduction in lion killings in the first 20 years of the program (Big Life, 2023). Despite this reduction, there have been recent occurrences of retaliation on lions - namely the May 2023 incident where 6 lions were speared in the Mbirikani GR - leading to considerable international and domestic outcry[1]. Because of the continued killing of lions, it is necessary to evaluate MPCF's effectiveness with current empirical data. This paper draws from a directed research project conducted in Spring 2024 analyzing the effectiveness and sustainability of MPCF. The paper explores the effectiveness of the MPCF on fostering coexistence, particularly in three specific areas:

Research Questions

1. How has the MPCF influenced the occurrence of human retaliatory attacks on lions?

2. How has the MPCF changed the attitude of local pastoral communities towards lions and their conservation?

3. How does the MPCF contribute to local communities' willingness to tolerate losses from conflicts with lions and coexistence in the landscape?

This paper holds significance for three key stakeholders: Maasai pastoralists, conservation policymakers, and the scientific community. Maasai Pastoralists face a large burden from livestock predation, including by lions, so it is vital that policymakers are well informed of their current opinions on PCF and lions in order to better address locals' ability to tolerate such predation and help them coexist with wildlife. Conservation policymakers would benefit from a current empirical study on the effectiveness of MPCF, which is called into question by continued lion killing and is shadowed by a history of the near anthropogenic extirpation of lions in the

[1] https://www.aljazeera.com/news/2023/5/14/six-lions-killed-by-herders-in-blow-to-kenyas-conservation-push

area. Furthermore, the MPCF model is replicated in other parts of Kenya, so it is especially important to evaluate its effectiveness. Finally, this paper will build upon a scholarly understanding of coexistence. MPCF serves usefully in exploring what factors influence human coexistence with large predators, with longitudinal data now furnished with current empirical results; it is useful to know what kind of strategies are important in fostering coexistence, whether financial incentives, intensified legal repercussions, scholarships, employment, and so on. We will be presenting the methods of the study, followed by the findings, discussion, conclusion, and recommendations.

METHODOLOGY

Study Site

The data that this paper draws from was conducted in the Mbirikani Group Ranch, part of the larger Amboseli-Tsavo ecosystem. In particular, fieldwork was done in four villages: Noosilale, Emukutan, Inkoisuk, and Namelok. The Amboseli-Tsavo ecosystem (Figure 2) is located in the Southern Rift Valley of Kenya. The semi-arid area contains a variety of habitat types, including dense and open shrubland, woodland, bushland, riverine, and dry areas (Okello et al., 2014). The region is important for wildlife dispersal and contains crucial corridors between its national parks: Amboseli and Tsavo West. These corridors allow wildlife to move toward resources during drought and promote population connectivity, benefiting genetic diversity. Soils in the area are classified as volcanic and are thus high in alkaline and saline. Soil near water sources is particularly fertile; generally, however, the land is most suitable for pastoralism and wildlife grazing (Katampoi et al., 1990). Maasai commonly own cattle, sheep, goats, and donkeys, with cattle holding a high socio-cultural and economic value.

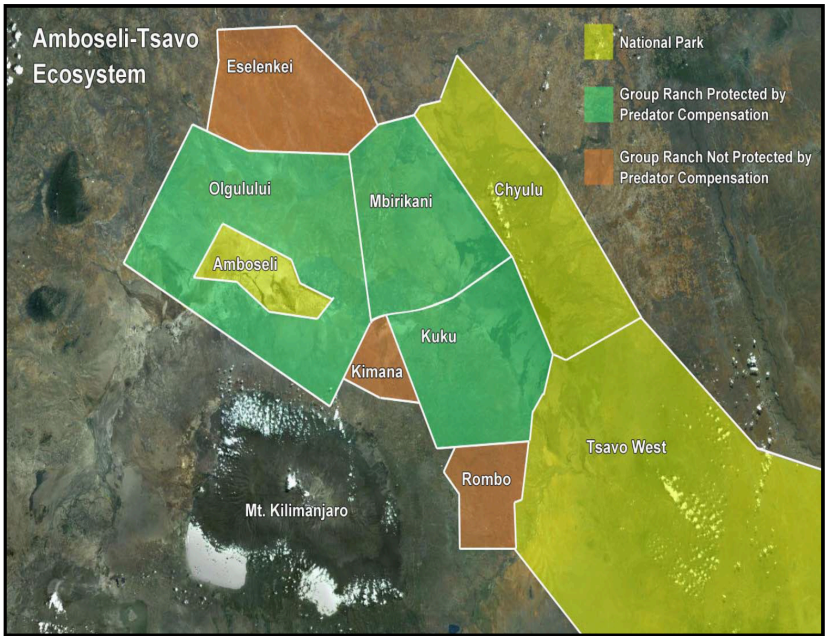

Figure 2: Group ranches where the MPCF is being implemented in the Amboseli Ecosystem (Okello et al., 2014).

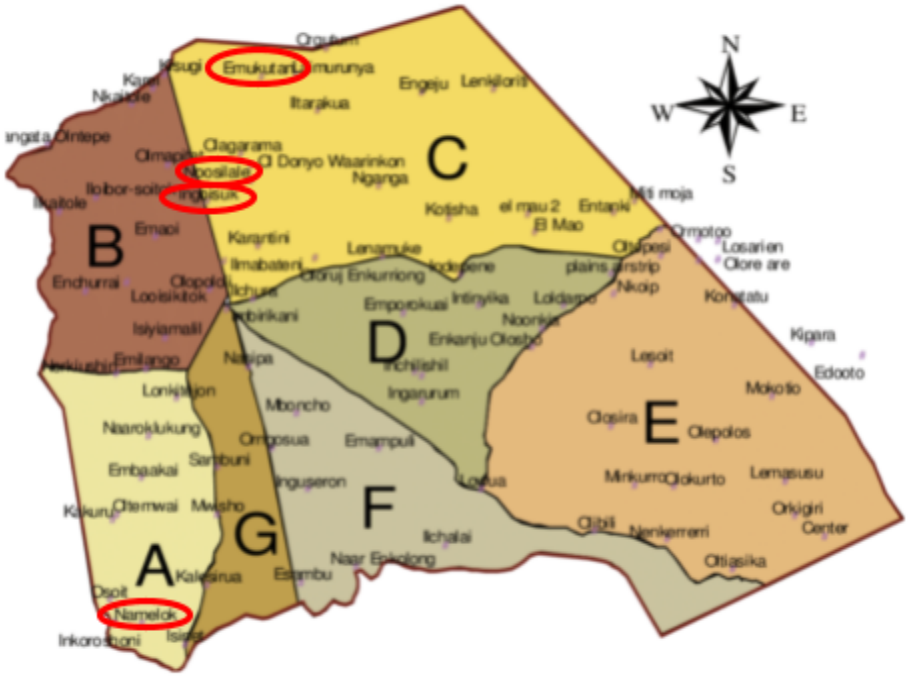

Figure 3: The map above shows the villages where fieldwork was conducted (Rodriguez, 2008) *Ingoisuk = Inkoisuk

The Amboseli-Tsavo ecosystem comprises six Maasai group ranches: Eselenkei, Olgulului/Olararashi, Kimana, Mbirikani, Rombo, and Kuku; Mbirikani covers 1,229 km^2. Population growth and land tenure change have induced ecological threats from agricultural expansion, water scarcity, and land subdivision, greatly inhibiting wildlife movement due to infrastructure (Ogeto, 2007). Corridors like those in Mbirikani host 70% of Kenya's wildlife (Anyango-Van Zwieten et al., 2015), however, the protection of these lands is a challenge given contemporary changes in historical land use practices. Traditionally pastoral Maasai communities held livestock as the primary form of wealth, whereas land ownership is now becoming an important sign of wealth (Okello et al., 2014; Hazzah et al., 2009). This popularizes group ranch subdivision, which entitles individuals within a community to their segments of land. Additionally, Maasai are shifting towards an agro-pastoralist lifestyle, consisting of livestock and land cultivation, which has accelerated land degradation and resource consumption.

Data methods

A mixed-methods approach was used to gather data, blending household surveys and key informant interviews. Household surveys employed non-probability random sampling to recruit heads of households. Surveys were digitized using Kobo Collect Toolbox for efficient data management. Surveys were conducted in the villages of Noosilale, Emukutan, Inkoisuk, and Namelok. Key informant interviews used purposeful sampling to select individuals directly involved and knowledgeable about the program in the study villages. The key informants will be referred to in the paper in codes (KI1, KI2, KI3, etc.) to protect their privacy and confidentiality.

A total of 285 respondents were interviewed across a nine-day period from April 10th through April 19th, 2024. All data was collected within the Mbirikani Group Ranch, specifically the villages of Noosilale, Emukutan, Inkoisuk, and Namelok. The gender of respondents was split relatively evenly, 52% were male while 48% were female. Most of the respondents were between the ages of 18-35, making up 49% of the population interviewed, with 66% of the population's primary source of livelihood being pastoralism.

Data collection occurred during the day, occasionally disrupting the work of informants - mostly farmers or pastoralists. Additionally, we had to adjust our village visits due to heavy rainfall, which posed challenges in accessibility during the peak of the rainy season. The villages of Enkaji Naibor and Ilchalai were replaced with Noosilale and Emukutan, which are still located within the Mbirikani Group Ranch. To counter this, interviewers aimed for a balanced representation of male and female participants. Data was securely stored on password-protected SFS hard drives to ensure informant anonymity. Responses were recorded using Kobo Collect Toolbox and compiled into an Excel spreadsheet. Closed-question responses were entered into SPSS for quantitative analysis. Overall attitudes and tolerance were quantified on a scale of 1 to 4, derived from respondent agreement levels. The average per respondent across the seven questions was incorporated into a range from 1 through 4. Based on the average, respondents were either highly negative, or very low (<1.75); negative, or low (1.75 - 2.49); positive, or high (2.50 - 3.25); and highly positive, or very high (>3.25). Coexistence was quantified by finding the combined averages of tolerance and attitude. Coexistence is also put through the same scale, grouping the scores from very low (<1.75) to very high (>3.25). As a result, overall attitude, tolerance, and coexistence were treated as quantitative data. Descriptive and inferential statistics, including mean, frequency, chi-square goodness of fit, and cross tabulations, were utilized. Qualitative data underwent manual thematic analysis, with narratives extracted to illustrate emerging themes. Open-ended survey responses were categorized into themes and quantified. Due to involvement with human subjects, an exemption application was submitted to the School for Field Studies (SFS) Institutional Review Board (IRB).

Ethics

Ethical approval was granted by the SFS IRB under approval number 2024-03-KEN-01. Efforts were made to minimize risks for participants, focusing on key ethical considerations including informed consent, participant competence, time and income loss, anonymity and confidentiality, emotional distress, and researcher competency. Verbal, voluntary, and informed consent was obtained from all interviewees before each interview. No foreseeable threats to participants were identified. Interviews were not pre-arranged, and all participant information remained confidential and anonymous. Official names were not recorded, and no identifying information

was published. Information collected was not shared with unauthorized individuals. Researchers and translators maintained neutrality and possessed experience in questionnaire administration, mitigating potential biases. Sensitive questions about lion killing were asked towards the end of interviews to minimize their influence on other responses. The research strictly adhered to Free Prior and Informed Consent (FPIC) principles and aimed to Do No Harm to participants. Further details on participant risk mitigation are provided below:

Informed Consent	Respondents were given essential information about the study to decide whether to participate, covering the study's procedures, purpose, benefits, and risks. Verbal, voluntary, and informed consent was obtained from all participants before each interview. Participants had the freedom to decline or end the interview at any point.
Competent Persons	Only mentally competent adults aged eighteen or older were interviewed to ensure informed consent. Participants were free to decline the interview and were not obligated to answer every question. They had the right to withhold information, skip questions, or terminate the interview at any time without explanation.
Lost Time, Income, or Energy	To alleviate the burden on participants, the survey's duration was disclosed during informed consent. Interviews lasted no more than an hour, allowing participants to take breaks or end the interview at any point to minimize disruption to their work or other commitments.
Anonymity and Confidentiality	Respondents' information remained confidential and anonymous, with no official names recorded or any data published that could identify them. Data was securely stored behind password-protected accounts accessible only to authorized individuals.
Emotional or Psychological Distress	To reduce emotional or psychological distress, questions were formulated in the third person, enabling respondents to answer more candidly without revealing uncomfortable or potentially self-incriminating details. Interviews

	were held in locations chosen by participants to respect their privacy, and participants were informed that they had the option not to answer any question and could end the interview at any time during debriefing.
Researchers Competence	Researchers and translators were well-versed in the dynamics of human-livestock-lion interactions in the community. Translators ensured participants comprehended all questions, especially sensitive ones while guaranteeing full anonymity. They also remained neutral and underwent training in questionnaire administration to mitigate social biases. Participants were reminded that there were no right or wrong views on lions or conservation before answering attitude scales. Sensitivity regarding lion killing was addressed by asking related questions towards the end to minimize their impact on other responses.

RESULTS

Introduction

In this section, the findings of the study are presented within three overarching research questions. They are:

1. What impact has MPCF had on occurrences of human retaliatory attacks on lions?
2. How has MPCF changed the attitude of local pastoral communities toward lions and their conservation?
3. How does MPCF contribute to local communities' willingness to tolerate losses from conflicts with lions and coexistence in the landscape?

Regarding overall demographic numbers, we found that the average respondent owned 15.32 $\pm$ 1.77 TLUs, and experienced 2.63 $\pm$ 0.13 predator attacks on livestock per year, lost 0.96 $\pm$ 0.12

TLUs in the last year, and indicate that people experience 2.47 ± 0.15 lion attacks per month (Table 1).

Table 1: *Population means regarding the total livestock unit and the predation felt by respondents within the Mbirikani Group Ranch*

	Total Tropical livestock unit (TLU)	**Total number of times livestock was attacked in the last year**	**Total TLU Lost to livestock predation in the last year**	**Number of times people experience lion attacks on livestock within a month**
N	285	175	284	268
Mean	15.32	2.63	0.96	2.47
Std. Error	1.77	0.13	0.12	0.15

Retaliation

The vast majority of respondents perceived the trend of retaliatory attacks on lions to be decreasing since the Big Life compensation program began (97.5%, n=278). When asked what could have contributed to the significant retaliatory attacks, predator compensation funds emerged as the most frequently mentioned reason (67.7%, n=130) (*Table 2*).

Table 2. *Respondents' opinions on what contributed to the decline of retaliatory attacks on lions.*

Response	**Frequency of Mention**	**Percent of Mention**
Predator compensation paid by Big Life	88	67.7%

Educational aid: scholarships and bursaries	37	28.5%
Socioeconomic benefits from Lions: employment by Big Life	26	20.0%
Increased surveillance by predator & game scouts	19	14.6%
Changing perceptions on the value of lions	14	10.8%
Strict laws and enforcement on retaliation against lions (eg: fines, loss of socio-economic benefits, prosecution by KWS)	11	8.5%

KI2, a MPCF founder, indicated that BLF has been involved with several economic incentivization operations that improve community attitude and tolerance towards lions, while also lowering retaliatory attacks on the apex predator. They said that the MPCF is the principal channel of distribution of these benefits to the Mbirikani Group Ranch members. Other economic incentive strategies include scholarships, and employment. KI2 shared that Big Life is providing 480 full scholarships for students in a given year, to which KI4, a BLF program manager, expanded on by saying that including partial scholarships, the number of students on scholarships increases to 900 annually. Additionally, he included that Big Life employs 582 people, many of which are from the local community. KI3, a MPCF founder, invoked the *Maasai Olympic* program, which engages young men in friendly athletic competition as an alternative to lion hunting. He indicated that people greatly enjoy this program. These act as incentives to motivate a positive attitude amongst the communities in the Mbirikani Group Ranch.

Table 3: Respondents opinions on what the MPCF should improve upon

Response	**Frequency of**	**Percent of**

	Mention	Mention
Predator compensation paid by Big Life should increase	130	57.27%
Increase surveillance by predator & game scouts should continue	16	14.04%
Improve understanding of community members' needs	25	11.01%
MPCF must reduce corruption	7	6.14%
Educational and socio-economic benefits (scholarships, bursaries, and employment) should increase.	3	1.32%

Respondents said compensation was the primary deterrent for retaliatory attacks on lions (67.7%, n=88). The following incentives, as indicated by respondents, are reported in order of significance: educational scholarships (28.5%, n=37), employment by Big Life (20.0%, n=26), surveillance by predator and game scouts (14.6%, n=19), changing perceptions on the value of lions (10.8%, n=14), and law enforcement on retaliation against lions (8.5%, n=11).

In contrast to these benefits, there were, however, improvements to the program which many respondents indicated. The most common critique (57.27%, n=130) was that compensation must be increased. This was followed by the suggestion to increase surveillance (14.04%, n=16), the need to understand community members' needs (11.01%, n=25), to reduce corruption (6.14%, n=7), and to increase scholarships and employment by Big Life (1.32%, n=3).

Respondents' village, formal education, total TLU, and gender were disaggregated with the survey questions "What has been the trend of retaliatory attacks since the Big Life compensation program began?" and "Have there been retaliatory attacks in your community because of

livestock predation in the last 12 months?" The only statistically significant relationship was the opinion on the existence of retaliatory attacks with gender. Village did not show dependence for the question regarding trends in retaliation (x^2= 16.175, df = 9, p = 0.063) or the existence of retaliatory attacks (x^2= 8.246, df = 6, p = 0.221). This was similar when looking at respondents education formal education (x^2= 7.213, df = 9, p = 0.615), (x^2= 5.551, df = 6, p = 0.475) or TLU of respondents (x^2= 10.344, df = 9, p = 0.323), (x^2= 9.880 df = 6, p = 0.130).

Lastly, the opinion on the trend of retaliatory attacks was independent of the gender of respondents (x^2= 0.300, df = 6, p = 0.999). However, the opinion on the existence of retaliatory attacks was dependent on the gender of respondents (x^2= 13.027, df = 4, p = 0.011). The majority of female responses reported 'no' to whether there have been retaliatory attacks on lions in the last 12 months (95.6%, n=131), while a significantly smaller majority of male respondents said 'no' (82.3%, n=121) (Figure 1). Around 4 times as many men (16.3%, n=24) than women (4.4%, n=6) reported that there has been a retaliatory attack in the last 12 months.

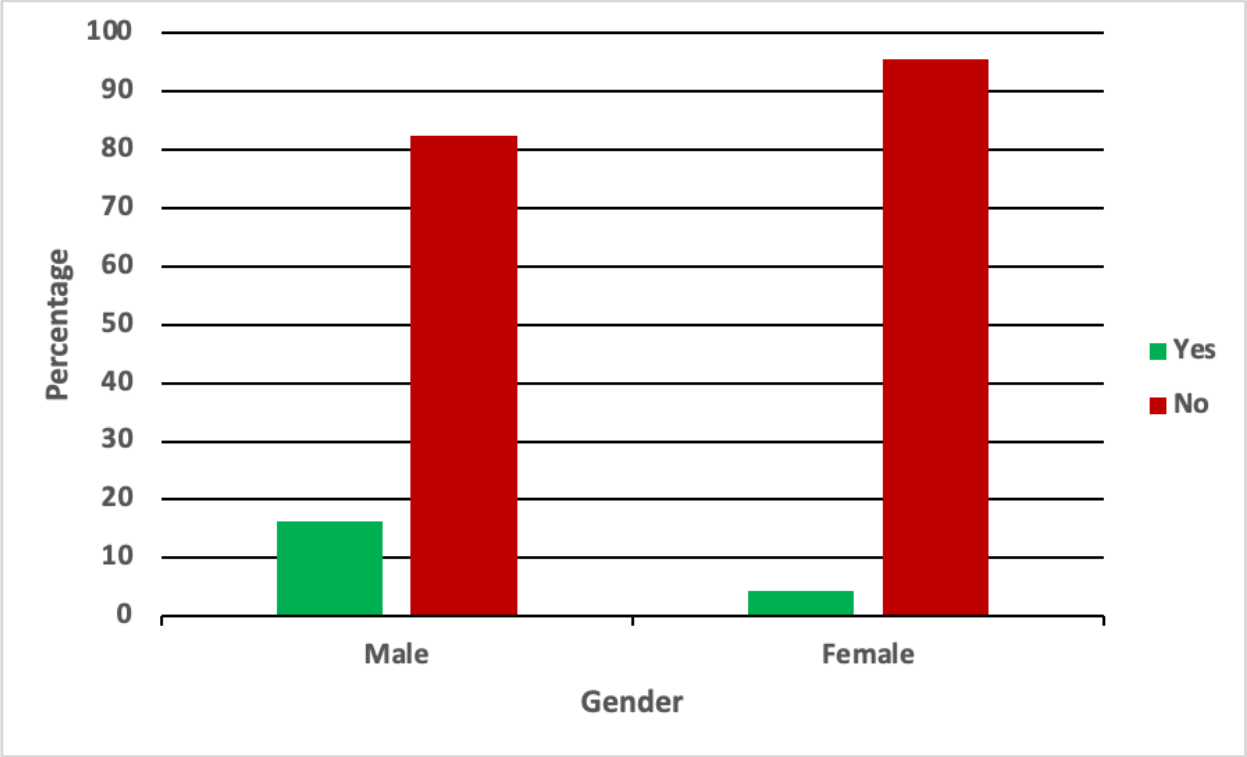

Figure 1. *Respondents' opinions on the existence of retaliatory attacks on lions according to gender within the Mbirikani Group Ranch*

Attitude

As already described in methods, attitude levels were quantified on a scale of 1 to 4, derived from respondent agreement levels. The average of each respondent across the seven questions was incorporated into a range 1 through 4. Based on these numbers, respondents were either highly negative (<1.75), negative (1.75 - 2.49), positive (2.50 - 3.25), or highly positive (>3.25). As a result, overall attitudes were treated as quantitative data.

Overall, community members' attitude levels were high, with a mean attitude level of 2.98 $\pm$ 0.04. Of the total respondents, very negative attitude levels made up the lowest percentage (4.9%, n=14), followed by negative attitude levels (17.5%, n = 50), then positive attitude levels (36.8%, n = 105), and finally very positive attitude levels (40.0%, n=114). Attitude level of the respondents toward lions and their conservation was independent of the village where

respondents resided (x^2= 15.195, df = 9, p = 0.086). The overall attitude level of the respondents toward lions and their conservation was dependent on the respondents' education level (x^2= 17.59, df = 9, p = 0.04). Most respondents with primary education (45.5%, n=25), and secondary education (43.8%, n=21) had a 'positive' overall attitude level on lions and their conservation (Figure 2). Average attitude levels of respondents with primary education were 2.79 ± 0.09 and 2.96 ± 0.09 for those with secondary education. However, most of the respondents with no education (74.6%, n=69), and tertiary education (44.4%, n=16) had a 'highly positive' overall attitude (Figure 2). Average attitude levels of respondents with no formal education were 3.06 ± 0.06 and 2.91 ± 0.10 for those with tertiary education.

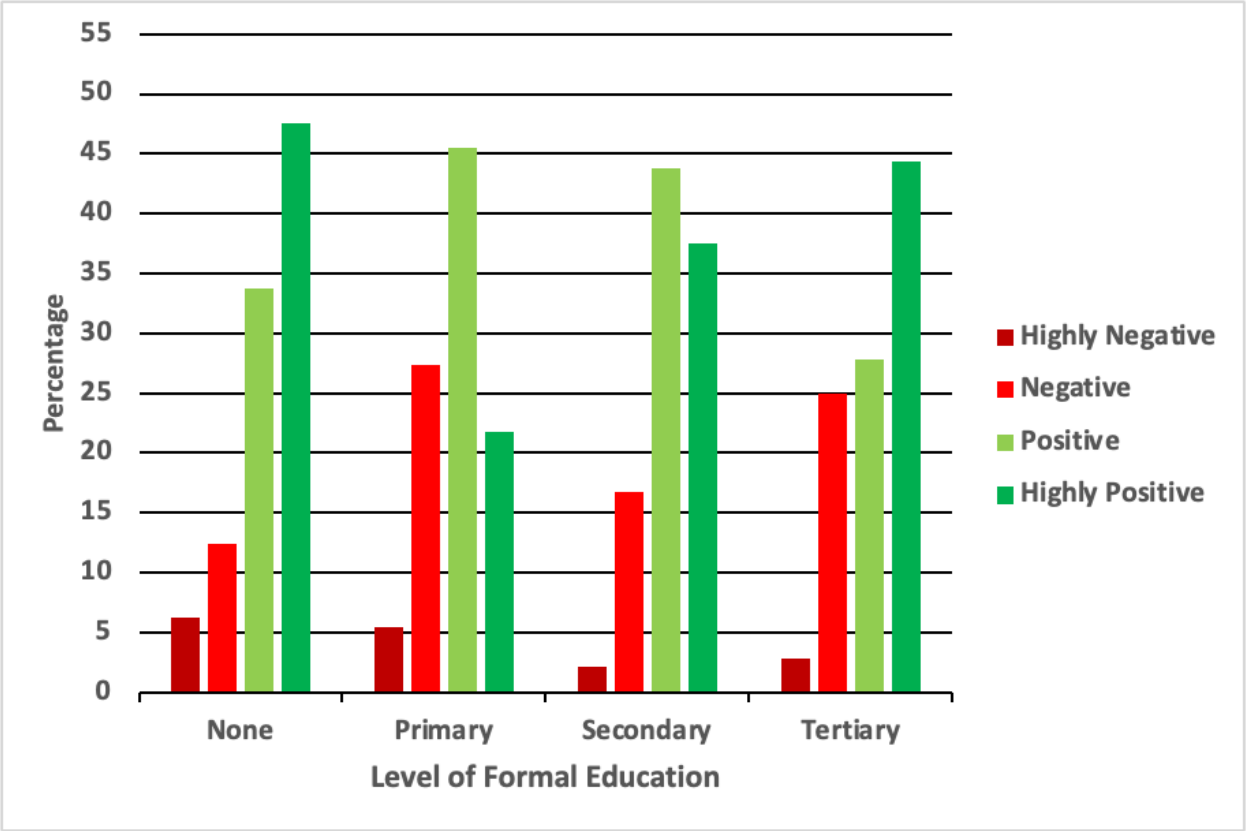

Figure 2. *Respondents' attitude toward lions according to levels of formal education within the Mbirikani Group Ranch*

Respondents' attitude level toward lions and their conservation was independent of respondents' total TLUs owned (x^2=14.513, df=9, p=0.105), as well as gender (x^2=7.406, df = 6, p=0.285).

Community members had a positive attitude (>2.50) towards lions and their conservation, with an average response being rated at 3.51 $\pm$ 0.39. Respondents had three major perceptions that were notable. Respondents had highly positive attitudes about reporting to Big Life if they saw a lion within the community (97%, n=276) and valuing lions within the community (84%, n=239). However, respondents had highly negative attitudes about Big Life caring more about lions than members of the community (83%, n=237).

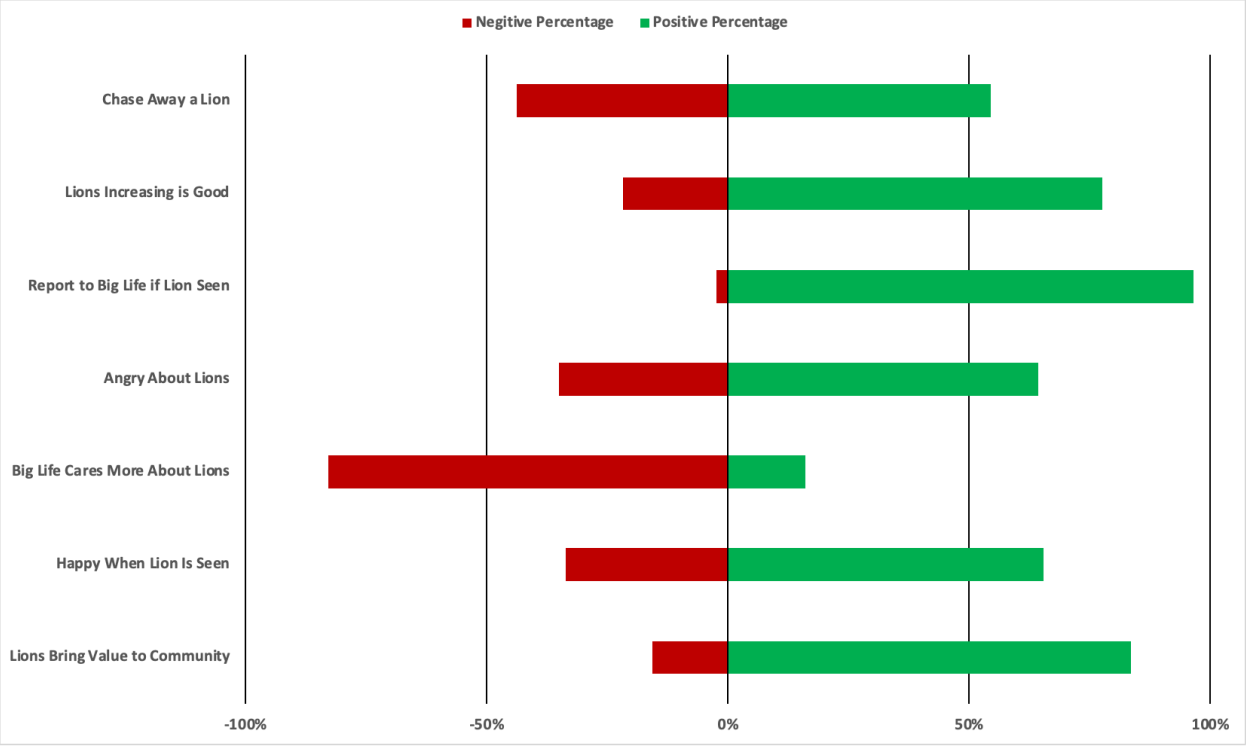

Figure 3. *Respondents' positive and negative attitudes toward lions within the Mbirikani Group Ranch*

Tolerance

The procedure for calculating tolerance levels is similar to calculating attitude levels, which is described in the above section.

Overall, community members had a ‘high’ tolerance level towards lions. The mean tolerance index was 2.39 ± 0.05, however ‘high’ was most often reported. We found the following general tolerance level distribution: very low (21.1%, n = 60), low (25.6%, n=73), high (39.6%, n=113), and very high (13.3%, n =38). Opinion on tolerance level towards lions was independent of the village of respondents (x^2 =10.317, df=9, p=0.325). We found that the tolerance level was dependent on the level of formal education of respondents (x^2 =30.069, df =9, p<0.001). Respondents with no formal education (44.1%, n=64) and with primary education (43.6%, n=24) most often reported a ‘high’ overall tolerance level. However, respondents with secondary education (35.4%, n=17) and tertiary education (47.2%, n=17) most often reported a ‘low’ overall tolerance level (Figure 4). When considering tolerance indices, respondents with no formal education on average reported ‘high’ tolerance levels: 2.58 $\pm$ 0.07; respondents with primary (2.21 $\pm$ 0.08) and secondary education (2.24 $\pm$ 0.10) on average reported ‘low’ tolerance levels; and respondents with tertiary level education had the lowest average tolerance index: 2.14 $\pm$ 0.12.

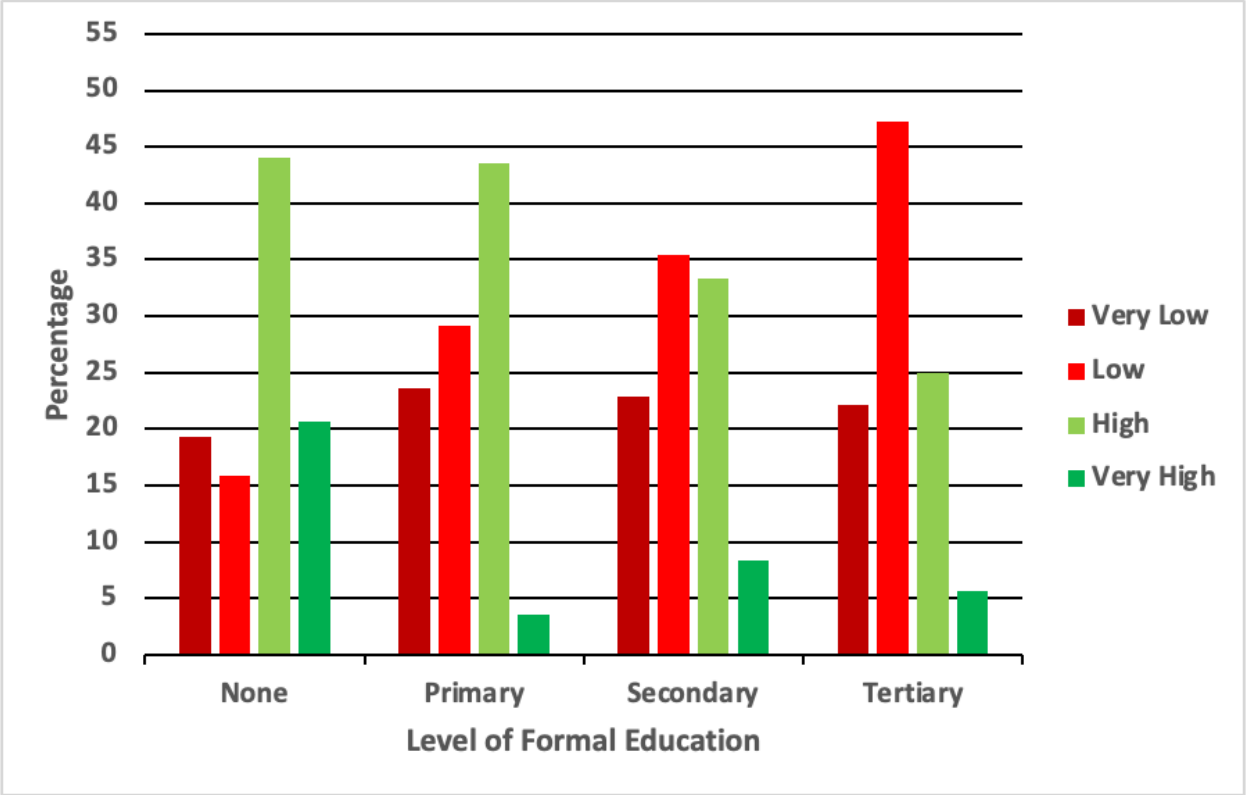

Figure 4. *Respondents' tolerance toward lions according to levels of formal education within the Mbirikani Group Ranch*

Opinion on tolerance level towards lions was independent of the total number of TLUs owned (x^2= 8.438, df = 9, p = 0.491), as well as gender (x^2= 6.391, df = 6, p = 0.381).

We found that respondents held four notable responses to questions regarding tolerance (Figure 5). Two questions indicated especially low tolerance levels; the majority of respondents agreed that they would retaliate against a lion that killed a person (71%, n=205), the average tolerance index for this question was 1.80 ± 0.07. Additionally, a majority of respondents agreed that lions should be fenced off into national parks (63%, n=180) - the questions' average tolerance index was 2.08 ± 0.08. Two questions yielded responses indicating a 'high' tolerance level; a large majority of respondents reported that they would not kill a lion that kills their livestock (69%, n=198) - the questions' average tolerance index was 3.31 ± 0.08. Additionally, a majority of all respondents agreed that there was less worry about livestock predation by lions because of the

MPCF (55.5%, n=157), the average tolerance index was 2.96 ± 0.08. Furthermore, we found that the relationship between perception of reduced worry about predation on livestock by lions due to MPCF was independent of village (x^2 =16.608, df=9, p=.055), level of education (x^2 =7.004, df=9, p=0.637), total TLUs owned (x^2 =8.731, df=9, p=.462) and gender (x^2 =2.979, df=6, p=.811).

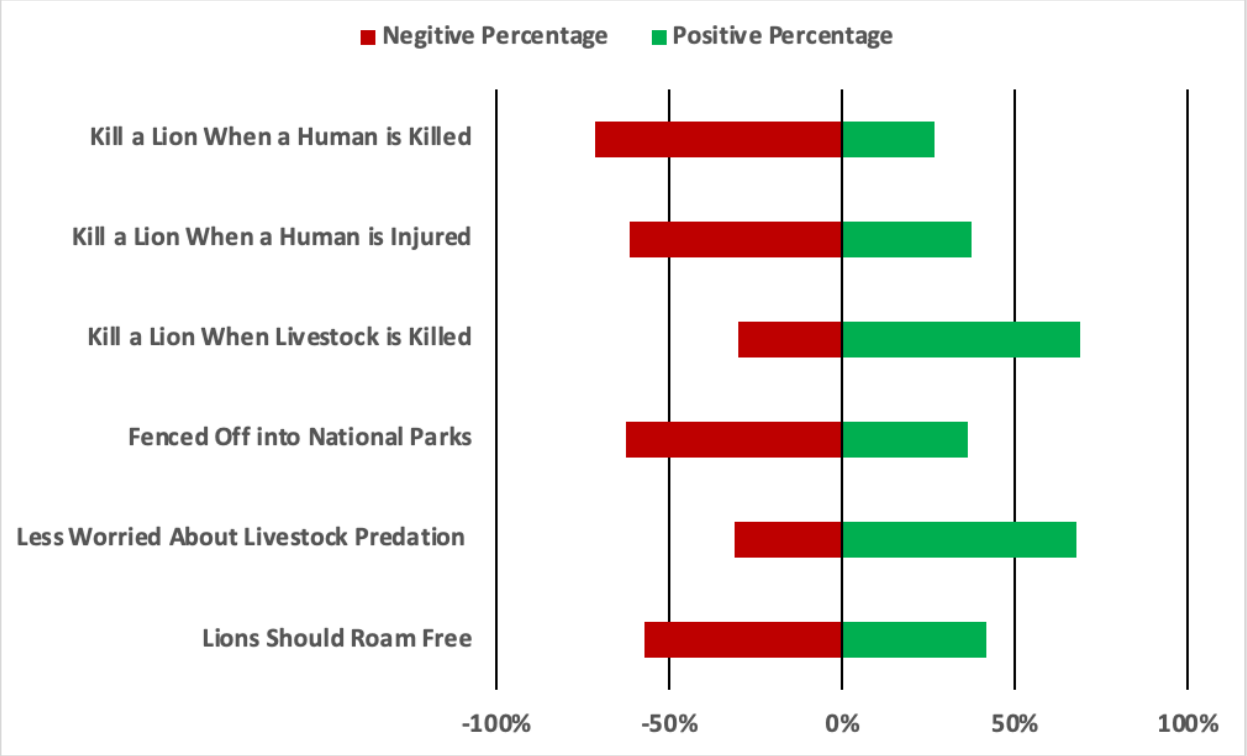

Figure 5. *Respondents' positive and negative tolerance toward lions within the Mbirikani Group Ranch*

Coexistence

The procedure for calculating coexistence levels is similar to calculating attitude and tolerance levels, which is described in a previous section. Coexistence indices were calculated by taking the means of attitude and tolerance indices.

We found that the coexistence level was 'high' overall, with an average coexistence index of 2.69 ± 0.04. We found the following overall distribution of coexistence levels: very low (9.1%,

n = 26), low (28.8%, n=82), high (42.5%, n=121), and very high (18.9%, n =54). Coexistence level displayed a dependent relationship with the village of the respondent (x^2= 17.777, df = 9, p = 0.038); respondents in Noosilale (47.3%, n=35), Emukutan (42.9%, n=30), and Inkoisuk (52.9%, n=36) most often reported a high level of coexistence. However, in Namelok most respondents (40.3%, n=29) reported a low tolerance level (Figure 6). The mean coexistence indices were: Namelok (2.57 ± 0.07), Emukutan (2.60 ± 0.07), Inkoisuk (2.72 ± 0.06), and Noosilale (2.84 ± 0.07), all indicating 'high' coexistence levels.

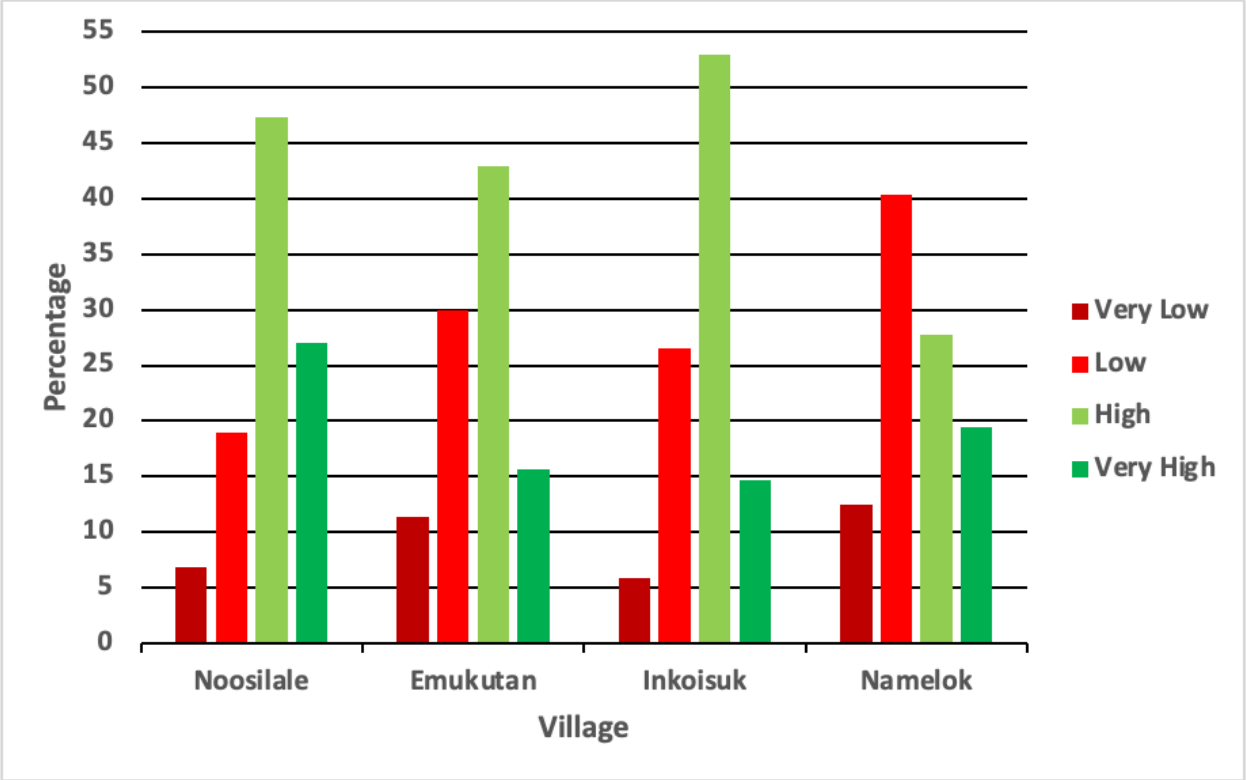

Figure 6. *Respondents' coexistence with lions according to village within the Mbirikani Group Ranch*

We found that the level of coexistence is dependent on the type of formal education the respondents had received (x^2= 26.391, df = 9, p = 0.002) (Figure 7). Most frequently, respondents with no formal education (44.1%, n=64), primary education (43.6%, n=24), and

secondary education (43.8%, n=21) reported 'high' levels of coexistence. However, respondents with tertiary education (47.2%, n=17) most often reported 'low' levels of coexistence. When comparing means, respondents of each category of education reported high coexistence indices. Nonetheless, there was variance across means: none (2.82 ± 0.05), primary (2.51 ± 0.07), secondary (2.60 ± 0.07), and tertiary (2.53 ± 0.09).

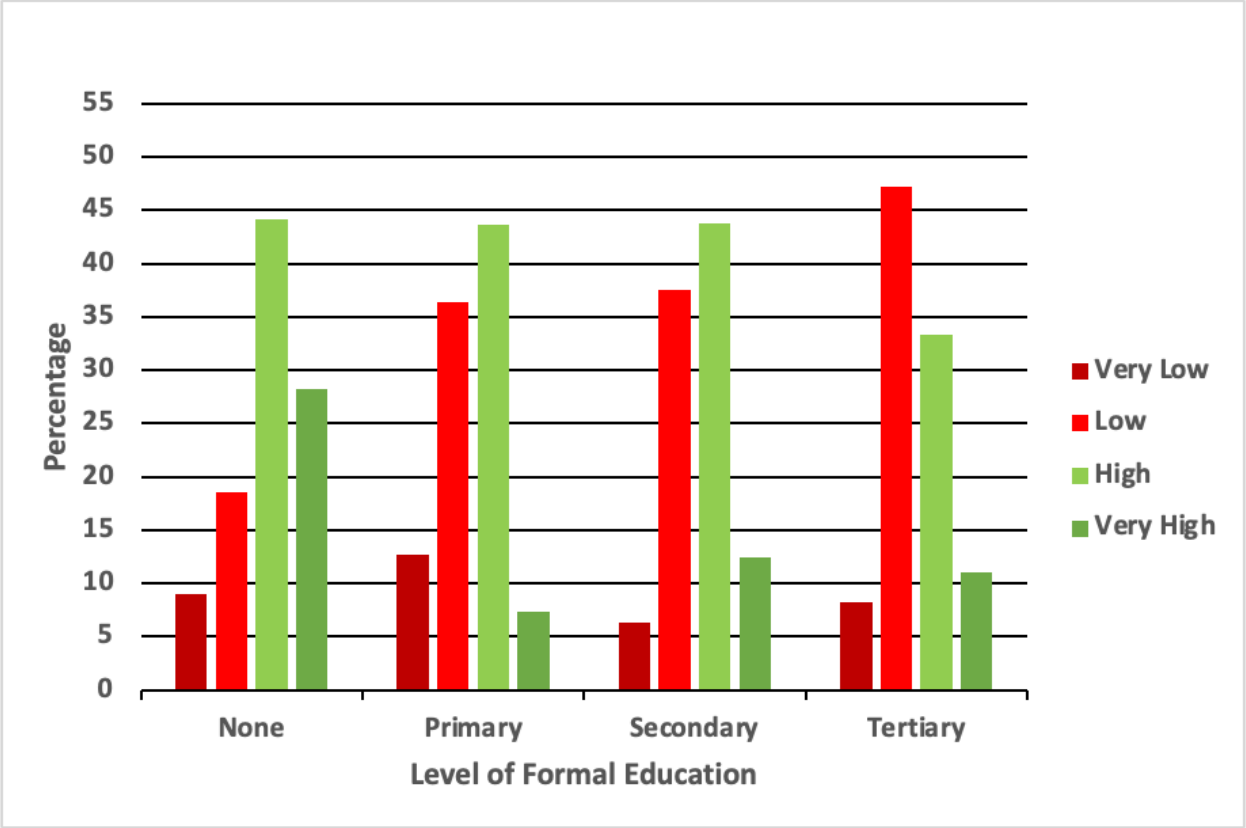

Figure 7. *Respondents' coexistence with lions according to levels of formal education within the Mbirikani Group Ranch*

Additionally, we found that coexistence levels were independent of total TLUs owned (x^2= 11.413, df = 9, p = 0.248). Coexistence levels exhibited a dependent relationship with the gender of respondents (x^2= 12.642, df = 6, p = 0.049). Women reported an average coexistence index of 2.64 ± 0.06, and men 2.74 ± 0.04. The majority of male respondents (46.6%, n=68) had a stronger 'high' level of coexistence with lions than female respondents (38.7%, n=53) (Figure 8).

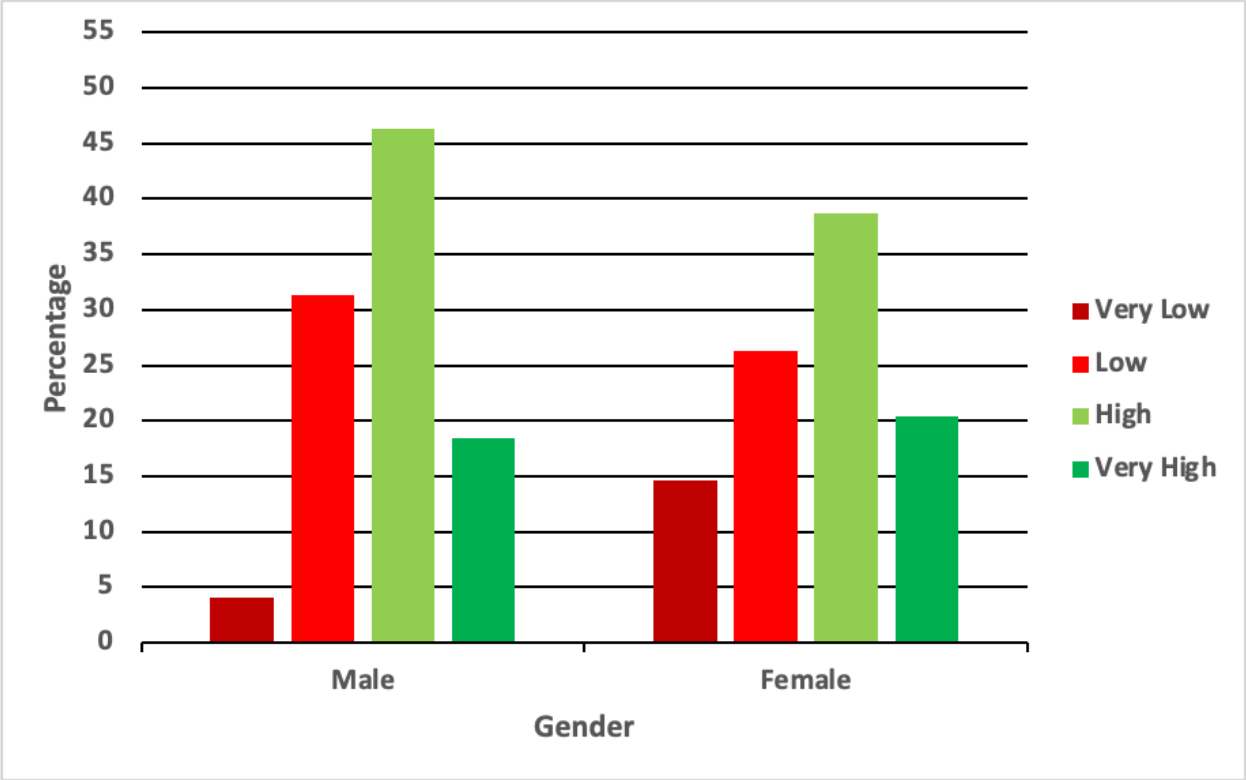

Figure 8. *Respondents' coexistence with lions according to gender within the Mbirikani Group Ranch*

Conclusion

The majority of respondents believe that (1) retaliatory attacks have decreased since the establishment of the MPCF, and (2) there have been no retaliatory attacks in the Mbirikani group ranch in the last year. Whether retaliatory attacks occurred in the last year was dependent on gender, with a larger percentage of males reporting "yes" than females. Overall, attitude levels were 'high' and independent of village, TLUs owned, and gender. Attitude levels were dependent on education, with those with primary and secondary education having 'positive' attitude levels and those with no formal education and tertiary education having 'highly positive' attitude levels. Similarly, the tolerance level was also 'high' and independent of village, TLUs owned, and gender - tolerance level was dependent on education, with those with primary and no education having a 'high' tolerance level compared to those with secondary and tertiary

education who reported ‘low’ tolerance level. The majority of respondents agreed that MPCF improves tolerance. Overall, coexistence levels were high; Namelok had a ‘low’ coexistence level compared with ‘high’ levels in the other three villages; respondents with tertiary education reported a ‘low’ coexistence level compared to ‘high’ levels for those with none, primary, and secondary education, and men reported ‘high’ coexistence significantly more than women.

DISCUSSION

Introduction

As mentioned previously, the research question this paper explores is the effectiveness of the MPCF on fostering coexistence, particularly in three specific areas:

1. How has MPCF influenced the occurrence of human retaliatory attacks on lions?
2. How has the MPCF changed the attitude of local pastoral communities towards lions and their conservation?
3. How does MPCF contribute to local communities’ willingness to tolerate losses from conflicts with lions and coexistence in the landscape?

The majority of survey participants indicated that both retaliatory attacks have decreased since the inception of the MPCF, and that there have been no retaliatory incidents in the Mbirikani group ranch within the past year. Gender played a role in the occurrence of retaliatory incidents, with a higher proportion of males answering affirmatively compared to females. Overall attitudes were deemed 'high' and were consistent across villages, livestock ownership, and gender. However, attitudes varied based on education level, with individuals having primary and secondary education displaying 'positive' attitudes, while those with no formal education or tertiary education showed 'highly positive' attitudes. Similarly, tolerance levels were generally 'high' and unaffected by village, livestock ownership, or gender, yet education influenced tolerance, with individuals with primary or no education exhibiting 'high' tolerance compared to those with secondary or tertiary education reporting 'low' tolerance. Most respondents concurred that the MPCF contributes to enhanced tolerance. Coexistence levels were predominantly high, with Namelok exhibiting a 'low' level compared to the other three villages; respondents with

tertiary education reported lower coexistence levels compared to those with no, primary, or secondary education; men reported higher coexistence levels than women.

Retaliatory Attacks

The data collected reveals that the majority of people believe retaliatory attacks on lions, due to livestock predation, have decreased since the MPCF began. While competition with wildlife still exists, Maasai who live along park boundaries agree that lions should not be extirpated (Bauer et. al., 2017). Because livelihood change is not simple, there are incentives attributed to the decline in retaliatory attacks, including the compensation Big Life distributes to victims of livestock predation, the Wildlife Education program for local students, employment of villagers by Big Life, increased surveillance from predator and game scouts, changing perceptions on the value of lions, and strict law enforcement. Livestock owners are deterred from resulting in retaliation during human-lion conflicts, but there are still issues that the communities have expressed with the compensation fund. If people are able to link those benefits to lions, then they are inclined to conserve the species.

Monetary compensation from Big Life is the number one reason - according to respondents - as to why retaliation has decreased. This finding was consistent with a similar study in Mbirikani, where compensation was a leading influence in deterring subjects from killing carnivores (Rodriguez, 2008). In light of the prevailing financial scarcity that characterizes the area, any support is highly appreciated (Fleury, 2014).

Provision of educational scholarships and bursaries, as well as employment by Big Life, were considered the second and third motivating factors for a reduction in retaliatory attacks. Big Life is a vital instrument to the many students and employees of the Mbirikani GR, and despite some imperfections, most people are willing to cooperate because of the benefits they offer. KI2 explained a scenario in June 2023 when 6 lions were killed: 30 individuals were fined, and all funding including student scholarships, were pulled from the village for two months. The funding was reintroduced to the community as they did not want to punish students, but this will not be the case in the instance of future offenses. This made it clear to communities that the repercussions of retaliation will not be taken lightly.

The fourth contributor to decreased retaliatory attacks is the increase in game scouts, who are employed community members that know the area well (Sargent, 2021). Interviewees indicated that when they report livestock predation, surveillance teams are stationed locally to respond to needs accordingly. By employing a game scout who is familiar with the area as well as the community members, stronger relationships can be made with Big Life for the future of the program. If more common people, as opposed to NGO executive members, can vouch for the MPCF, the program has a higher probability of creating trust and attaining success.

The fifth most prominent mention in decreasing retaliatory attacks is the change in perception of the value of lions. KI4 mentions that BLF communicates to communities that they are literally sitting on a "gold mine" in order to persuade them to protect wildlife, and that the ability to preserve their space will continue to result in shared revenue. Community members may look at the land they have and see only commodities. By emphasizing the importance and scarcity of the land, the people will be motivated to make a difference.

The sixth and final reason that some respondents believe retaliation decreased, was the implementation of laws and fines for retaliation. A fear of authority may unfortunately be essential until more trust is built between community members and the stakeholders. An independent study conducted found that a significant number of respondents fear arrest in the context of killing carnivores (Rodriguez, 2008). KI1 indicated that undercover informants work with these surveillance teams to ensure there is no dishonorable behavior going on.

While these successes are notable and deserve recognition, there are issues with the program that many respondents addressed.

Even though average compensation is only about a third of what is actually lost, it has contributed to the deterrence of livestock owners from engaging in retaliatory attacks. The compensation amount is largely disputed among victims of livestock predation, but KI2 indicated that the amount is communicated and agreed upon with community members, who have the chance to provide input in bi-yearly meetings. Because NGOs are considered some of the most trusted organizations (Sargent, 2021), individuals will likely be open to future discussion on continued critiques.

Issues regarding insufficient educational aid, like scholarships, were brought up; the analyses pointing out that they were few and may not reach everyone in need. While this is true, it has been

recognized by stakeholders who are continuously working to increase donor funding on the international scale (KI2). Additionally, those students who cannot be provided with full scholarships are given one-off aid to advance them through their final year of school (KI4).

The feeling that BLF has an inadequate understanding of community members' individual needs is mentioned, regardless of the various types of aid provided. While it is frustrating to share benefits amongst a large community, it is more effective in the long-run, as individuals need one another to survive (Sargent, 2021). Addressing the group as a whole is unfortunately the easiest way to make the program possible, but informing community members of this limitation is crucial for good relations.

While some indicated they would like to see BLF reduce the amount of corruption, others indicated that laws in place have reduced retaliatory attacks. While fear is not ideal, it is effective in managing honesty from community members, who have lied in order to receive higher compensation amounts (KI2). The line between corruption and seeking the truth from individuals is often unclear, and must be clarified.

While the compensation program is not perfect, it takes a multi-faceted and rather holistic approach to try and address the many concerns of the people. The compensation program was developed in 2003 after discovering issues within the community (Fleury, 2014), and has since aimed to address community concerns in tandem with one another (Fleury, 2014).

Based on our findings, opinion on whether retaliatory attacks have occurred in the last 12 months was dependent on gender, as men believed there to be more attacks than women. There is literature which disproves its significance - indicating that it is the impact of the solutions women suggest in mitigating HWC which differs from that of men, rather than the actual occurrences of HWC which they perceive (Gore et. al., 2012). In this given study, perceptions of HWC remained the same for both genders, but women believed that there were more risks to wildlife depending on these mitigation strategies (Gore et. al., 2012). Separating their compassion for wildlife from their familiarity of the situation therefore disputes our findings which indicate that they are less observant of such occurrences of HWC. Our hypothesis suggested that because men spend more time with livestock while grazing, they would have higher exposure to conflict with lions, which would explain the higher percentage of perceived retaliatory attacks on lions. While these two findings contradict themselves, we can assume that the statistics we gathered were in support of our hypothesis, as the quantitative data cannot expand on this matter further.

It is essential that Big Life continues to research more easily attainable methods of human-wildlife conflict resolution. For example, the construction expense of predator-proof bomas is a deterrent for individuals in securing their livestock, so collaborating with other NGOs like Lion Guardians would be helpful in mitigating the effects of a single program for all conservation needs. Additionally, local communities must be engaged with stakeholders to form collaborative solutions. Their engagement creates harmony amongst the two groups, who often experience tension because of a lack of transparency. Community involvement in conservation is essential in the sustainability of the program. That is, the finding helps to recast the needs of people living with wildlife if any meaningful conservation must take place (Kothari et. al. 2013). Instead of being preoccupied with culture change, there is a need to focus on protection of Maasai livelihoods and meeting the needs so required. Additionally, retaliation is not a cultural belief, as many try to prove, but rather a means of survival for the Maasai. Conservation must be embedded in the wider socioeconomic contexts of the communities whose lands are home to the many wildlife we want to conserve (Kothari et al. 2013; Schnegg and Kiaka 2018, Manfredo et al. 2004).

Attitude

Overall, we found respondents most often reported a ‘positive’ attitude level towards lions. We found no significant relationship with tolerance level across villages, gender, total TLUs owned, or primary source of livelihood.

With that said, there is a growing acknowledgment that narrowly concentrating on carnivore biology and ecology in conservation efforts restricts conservationists' capacity to mitigate human-induced killings (Ontiri, 2021, Croes, 2008). This underscores the necessity to address human-related factors in management solutions (Baruch-Mordo et al., 2009, Manfredo et al., 2004). The attitudes of the Maasai toward lions, coupled with adherence to traditional customs, most accurately forecast actual instances of lion killing (Hazzah et al., 2017). Negative attitudes point towards lions being destructive to Maasai livelihoods, risking retaliation when they attack (Ontiri et al., 2019). Attitudes serve as predictors of behavior in scenarios where local communities possess robust knowledge about the species, like lions (Jhamvar-Shingote, 2013). This aligns with the Maasai context, as warriors

possess an in-depth familiarity and comprehension of lions, viewing them both as a source of conflict and as creatures that bestow honor and prestige upon them (Dolrenry, 2016).

There is a strong correlation between attitudes and lion killings. Enhancing local attitudes, alongside employing suitable mitigation strategies, could be an effective approach to reducing lion killings (Hazzah et al., 2017). Nevertheless, attitudes do not consistently forecast positive conservation behavior regarding animal killing in general (Hazzah et al., 2017); for instance, despite experiencing long-term conservation benefits and expressing favorable attitudes toward wildlife and conservation, communities residing around Lake Mburu National Park in Uganda continued to engage in regular wildlife poaching (Infield, 2001). This suggests that the illegal killing of wildlife, whether for political-economic gain or subsistence purposes, may not be readily anticipated based on attitudes. A critical flaw in the conservation strategy of this national park was the lack of an economic motivation mechanism. Economic motivation to communities is critically important in shaping the attitude outcome towards wildlife and their conservation. However, research indicates that retaliatory killings of carnivores following livestock depredation can be anticipated based on attitudes (Sillero-Zubiri, 2001). These findings go hand in hand with the findings from this paper. On average, respondent's attitudes were positive regarding lions. Community members responded overwhelmingly positively to reporting a lion to Big Life Foundation. Because of this, one might assume that the holistic approach that Big Life Foundation has taken through the PCF program and other benefits that the community has worked. However, community members overwhelmingly feel less valued compared to lions by Big Life — they feel a lack of respect from the organization. Respondents frequently mentioned that they would like to see quicker response times from predator scouts when predation is reported, as well as compassion and sympathy to community members that lose livestock to predation would create a better relationship between the Big Life Foundation and the community that surrounds it. Not only that but it would also increase attitude levels of the community ensuring safety for both lions and the surrounding communities.

The distribution of attitude levels across different levels of education reveals a significant association between education and attitude. Specifically, respondents with no education and those with tertiary education exhibited a significantly higher prevalence of 'highly positive' overall attitudes compared to those with primary or secondary education levels. While it's somewhat surprising that respondents

with no formal education demonstrated such high levels of positivity, it could be speculated that other factors, such as cultural norms or personal experiences, may influence their attitudes to a greater extent. Animals like lions are deeply embedded in local folklore, rituals, and belief systems. In Maasai culture, lions are often seen as symbols of strength, bravery, and prestige (Dolrenry, 2016). As such, cultural norms that value coexistence or respect for wildlife may shape individuals' attitudes, regardless of their level of formal education. Similarly, those benefiting from wildlife-based tourism or employed by conservation initiatives may hold more positive attitudes. On the other hand, the positive attitudes among respondents with tertiary education are consistent with existing research indicating a positive correlation between higher education levels and more favorable attitudes toward lions and their conservation (Gebresenbet et al., 2018).

Tolerance

Overall, we found respondents most often reported a 'high' tolerance level towards lions. In general, the majority of all respondents indicated that PCF reduced their worry about lions killing their livestock. This is a good indication that PCF is effective in increasing local communities' tolerance of lion predation. Additionally, we found that the response to this question was not significantly related to village, education, TLUs owned, or gender. This finding is supported by literature, which has found there is tolerance towards lions in Mbirikani GR, but that it is largely contingent on PCF being in place. When PCF was in operation 4% of respondents indicated they would kill a carnivore for attacking livestock compared to 45.5% of respondents when PCF was not operational (Rodriguez, 2008). We found that 66.7% of respondents (n=190) agreed that people in the community *would not* kill a lion for livestock depredation — this is a large fraction of people indicating that the entirety of the community is tolerant of lions attacking livestock, which agrees with literature (Rodriguez, 2008).

We also found a significant relationship between respondents' level of education and level of tolerance towards lions. Our data showed that respondents with no or only primary education most often reported 'high' tolerance, as compared to respondents with secondary and tertiary education who most often reported 'low' tolerance. This finding goes against the general assumption that higher education imparts more responsible views on conservation. This may be due to shifting values towards wildlife and land use following higher education — perhaps people with limited formal

education feel they have no choice but to tolerate lions in the rural landscape; educated people may have spent more time in urban areas where wildlife has essentially been dominated, leading to a desensitization to coexistence with predators like lions.

Literature indicates that socioeconomically disadvantaged people are disproportionately affected by HWC, which can contribute to perpetuating poverty (Barua et al., 2013) — it is thus important to examine respondents' affluence, for which we use total TLUs owned as a proxy, in terms of tolerance to see whether MPCF and the BLF adequately account for differences in affluence. We found no significant relationship between tolerance and total TLUs owned which is contrary to literature findings; literature suggests that in Mbirikani GR proportional loss of livestock to lions is highly influential on likelihood to retaliate — those who own fewer TLUs to begin with experience a larger proportional loss when a lion attacks their livestock making them more likely to retaliate (Hazzah, 2009). In the 13 years since the previously cited paper was published, it is possible that benefits of lions such as scholarship, employment, and PCF have had ample time to influence community feelings such that tolerance towards lions is now independent of TLUs owned; furthermore, heightened security and legal punishment within the last decade could be responsible.

We found that the majority of respondents agreed that they would retaliate against a lion which killed a person. This is important, because it shows us the threshold of tolerance. The large majority of people are willing to tolerate livestock predation but when a human is killed by a lion, that is intolerable for the local community.

Another key finding is that the majority of respondents agreed that lions should be fenced off inside national parks. The response to this question hints that as tolerant as people are towards lions, or as high as their attitude is — the community would rather they weren't there at all, despite the scholarships, employment and PCF which lions bring. Because of the generally high levels of attitude, tolerance, and coexistence, there seems to be an indication that without MPCF and other associated benefits, the community would have no wish to coexist with lions.

Coexistence

Overall, coexistence levels were high. As with tolerance levels, we found a significant relationship between level of coexistence and education. Respondents with tertiary education reported a significantly lower level of coexistence compared to the other three education levels. Similar to tolerance levels, this is at odds with the general assumption that formal education would make people more ecologically minded; we can hypothesize similar causes of this relationship as with the relationship between education and tolerance.

We found that males show a stronger response of 'high' coexistence level than females. This lower coexistence level in women may be explained by current structural gender-based inequalities, much of which is the remnant of colonization. Whether or not a girl will receive an education is usually the decision of the father or husband (Clemens, 2017); our results showed that scholarships are the second most frequently cited benefits which Big Life offers the community, meaning that women and girls are more separated from measures intended to bring benefit from wildlife. Furthermore, women from nearby Kimana/Tikondo Group Ranch reported that raising and paying for children's education are solely the responsibility of women (Clemens, 2017). Considering that the average amount paid in bursaries by BLF cannot cover a single semester for one child, it is reasonable that women feel less inclined to coexist with lions that pose a large threat to household income. Another explanation for this finding are the cultural differences in upbringing between men and women in Maasai society. From childhood on, boys are raised to become warriors and protectors of the community; women are less encouraged to be courageous in the face of wildlife (Fialkov, 2022). Perhaps men are more likely to be willing to live alongside lions because of the importance placed on bravery and warriorhood, compared to women who may be less willing to share a landscape with lions.

We found that the level of coexistence significantly differed across villages, with Namelok being the only village to most frequently report a 'low' coexistence level, whereas all other villages most often reported a 'high' coexistence level. This may be because respondents in Namelok suffered the greatest proportional loss of livestock to predation. On average, Namelok residents owned the fewest total TLUs and lost the most TLUs to predation. Namelok's low coexistence level is supported by literature which indicates that greater proportional livestock losses cause lower tolerance towards lions in Mbirikani (Rodriguez, 2008).

Recommendations

Our recommendation are as follows:

1. The MPCF should continue to offer predator consolation.
2. Big Life should continue their holistic approach to lion conservation by providing support beyond PCF, such as scholarships and employment.
3. The MPCF should improve communication and transparency between the organization and the Mbirikani group ranch members.
4. Future research could explore the socio-cultural factors involved in the relationship of education with attitudes, tolerance and coexistence

Limitations

It's essential to acknowledge the limitations of this study. The study involved cross-sectional design and the inherent biases associated with self-reported data, calling for careful consideration in future research endeavors. Key informants associated with Big Life Foundation may have had biases when speaking about their own programs. Furthermore, the presence of language barriers may have led to potential misinterpretations between the posed questions and respondents' answers. Lastly, the timing of the research during the rainy season required modifying village selections due to accessibility issues caused by the adverse weather conditions.

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