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Analyzing Human - Nonhuman Primate Conflict Mitigation Techniques in Mto wa Mbu, Northern Tanzania

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Abstract

Human – non-human primate conflict is particularly crucial due to primates' high capacity to live among human populations. The study to analyze Human - Nonhuman Primate Conflict Mitigation Techniques, was carried in November 2023 at Mto wa Mbu, Northern Tanzania. To analyze techniques currently being used to mitigate human – non-human primate conflict, this study collected data through semi-structured interviews. Over 87% (n=35) of respondents used multiple mitigation techniques simultaneously. 80% of respondents (n=32) reported using projectiles to ward off foraging primates, 75% of respondents (n=30) reported using loud noises (made either by the voice/body or by manipulating noisemakers), 67.5% (n=27) reported using crop-guards, and 7.5% (n=3) reported using physical barriers to mitigate Human Primate Conflict. Both fire and deterrent objects (in this case, a scarecrow) were reported in use by one participant each. While fire had the highest possible average effectiveness score (3), the associated costs made it much less efficient (33%). The mitigation methods with the highest overall efficiency were projectiles (44%) and crop guarding (43%). As interactions between human and non-human primate populations is inevitable, it is imperative that effective mitigation techniques that prioritize the livelihoods of humans and wildlife be developed and implemented. This study recommends that communities living in close contact with wildlife benefit financially from conservation programs to mitigate financial damages from human wildlife conflict, and that mitigation techniques developed in the future place emphasis on low labor and time costs for communities.

Keywords*: Analyzing, Human – Nonhuman, Primate Conflict, Mitigation Techniques, Mto wa Mbu, Northern Tanzania*

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Chapter 1

Introduction

1.1 Background

Human-wildlife conflict (HWC) describes any interaction between humans and wildlife with adverse consequences for either or both parties, and is a common issue faced by those living in contact with wildlife, particularly when resource availability is low (Barua et al., 2013; Blackie, 2023). As a phenomenon, human-wildlife conflict is well-documented in sub-Saharan Africa (Gusset et al., 2009; Marker & Boast, 2015; Nicole, 2019), due in part to expanding human populations using subsistence agriculture and environmental alienation caused by top-down conservation (Mekonen, 2020). While human-carnivore and human-elephant conflict are particularly well documented due to their scale (Shaffer et al., 2019; Gulatti et al., 2021), the rate of human-primate conflict (HPC) is increasing as human-primate interactions become more frequent (Hockings, 2016; Uddin et al., 2020).

Interactions between humans and non-human primates occur globally, ranging from bustling city centers to rural agricultural land, dry savannahs to dense tropical rainforests. These interactions occur in a dizzying variety of environments, given primates' (both human and nonhuman) high adaptability, which some scientists attribute to our generalist diet (as well as our shared ability to communicate information) (Chapman & Chapman, 1990; Alberts & Altmann, 2006; Reader et al., 2011). These factors allow primates to integrate themselves more easily into urban environments than larger, more nutritionally limited animals (Sinha & Vijayakrishnan, 2017). Of special interest to ecologists and anthropologists alike is the fact that these interactions can be extremely complex (Hill, 2021), although they are often simply placed on a spectrum from beneficial to hostile.

HPC can be defined as "any human–primate interaction which results in negative effects on human social, economic or cultural life, primate social, ecological or cultural life or the conservation of primates and their environment…" (Hockings & Humley, 2009). These interactions often impose substantial costs upon those living alongside primates, including the loss of crops and livestock, damage to stored food, property damage, zoonotic disease transmission, and physical injury. The most reported conflict occurring between humans and

primates in Sub-Saharan Africa is crop foraging, with some studies reporting between 29.94% (Siraj, 2014) and 59.2% (Jaleta & Tekalign, 2023) harvest loss attributed to primates, namely olive baboons (*Papio anubis*) and vervet monkeys (*Chlorocebus pygerythrus*). These conflicts, among the others listed, pose a serious threat to the financial, physical, and psychological well-being of subsistence farmers (Barua et al., 2013; Blackie, 2023).

While these damages certainly are a driver of HPC, the competing interests of different humans, namely those of different socioeconomic backgrounds and differing levels of political empowerment, must be considered. These newly defined "conservation conflicts" have been described as "situations that occur when two or more parties with strongly held opinions clash over conservation objectives and when one party is perceived to assert its interests at the expense of another" (Redpath et al., 2013). In nations where wildlife tourism is a major source of economic growth, conservation regimes imposed by the government, which prioritize government profit, are often at odds with the interests of local people. Additionally, filtering the complex array of human-primate interactions through the sieve of conflict may serve to vilify local peoples and cultivate animosity toward them on behalf of conservationists (Treves & Santiago-Ávila, 2020).

HPC mitigation techniques vary depending on geographical location, primate species, and the nature of the conflict intended to be mitigated. Farmers commonly use crop guards, projectiles, physical barriers, loud noises, stationary/handheld fires, deterrent objects (such as scarecrows and rubber snakes), biochemical deterrents (such as chili and dried fish), and the cultivation of plants not preferred/repulsive to the target primate population (Hockings & Humley, 2009; Sharma et al., 2018). The application of mitigation techniques must also take primate species diversity into account, as foraging strategies can differ enormously across sympatric primate species (Garber, 1987; Trapanese et al., 2019), and even across different groups of the same species (Coleman & Hill, 2009). As home to mainland Africa's highest number of primate species, Tanzania has the potential to host a diverse array of human-primate interactions and conflicts (De Jong & Butynski, 2012). These diverse primates have an equally diverse array of behaviors and methods of executing such behaviors (ex. foraging, vigilance, scouting). A burgeoning field of research is examining animal behavior, and the impacts of human activity on

said behavior, to develop more effective HWC mitigation techniques (Blackwell et al., 2016; Lischka et al., 2020).

1.2 Problem Statement

As human populations grow and agricultural activities expand, the frequency of human-wildlife interactions, including those involving humans and primates, will continue to rise (Hockings, 2016; Uddin et al., 2020). As instances of HWC and conflict between different human actors increase globally, the issue is modeled further by Tanzania, which currently holds 36% of its land under some form of ecological protection (Gizachew et al., 2020). Existing literature has gone extensively into the damages caused by large herbivores and large predators (Shaffer et al., 2019; Gulatti et al., 2021), but substantially fewer published works currently examine the effect of primates, which are increasingly living in overlap with human populations (Hockings, 2016; Uddin et al., 2020) and remain capable of being involved in a wide range of conflicts due to their diverse diet and high intelligence (Chapman & Chapman, 1990; Alberts & Altmann, 2006; Reader et al., 2011). These factors allow primates to integrate themselves more easily into urban environments than larger, more nutritionally limited animals (Sinha & Vijayakrishnan, 2017). While previous research has explored various methods used worldwide to mitigate these interactions (Hockings & Humley, 2009; Sharma et al., 2018) only a few studies have delved into how primates respond to these mitigation techniques beyond just to their success or failure (Hill & Wallace, 2012). A more comprehensive analysis, analyzing the factors going into an individual's decision to use a given mitigation technique, will guide further steps in safeguarding both human livelihoods and primate conservation (Blackwell et al., 2016; Lischka et al., 2020).

Effective and cost-efficient conflict mitigation techniques are essential for the financial, physical, and psychological well-being of subsistence farmers (Barua et al., 2013; Blackie, 2023). To bolster the substantial existing literature on HPC, this study aims to analyze human nonhuman primate conflict mitigation techniques in and around the Mto wa Mbu ward of the Arusha region in Northern Tanzania.

1.3 Scope and Limitation of Study

Over the course of 11 days, the study was conducted within the community of central Mto wa Mbu during the short rainy season of November 2023. The focus of this study was limited to the

adult human population of this area. Primary participants were 40 adult residents of Mto wa Mbu who have experienced HPC. The data was limited empirically by the narrowness of the study area, and analytically (in terms of accuracy and communicability) by the relative inexperience of the author (Akanle et al., 2020).

1.4 Justification and significance

The rationale of this study is to bridge the existing shortage of comprehensive literature on the specific costs and effectiveness of human – non-human primate mitigation techniques, as well as supplement the growing body of literature on human – non-human primate conflict generally. Given that primates are both agile and intelligent beings, they pose a formidable challenge to the current methods of mitigation. Furthermore, obtaining additional data on mitigation technique effectiveness and cost could provide valuable insights into effective human – non-human primate mitigation and therefore enhance sustainable coexistence of human livelihoods and conservation (Blackwell et al., 2016).

1.5 Objectives

1.5.1 General objective

i. To analyze human nonhuman primate conflict mitigation techniques in Mto wa Mbu, Northern Tanzania.

1.5.2 Specific objectives

i. To characterize Human – nonhuman primate conflict mitigation techniques in Mto wa Mbu.
ii. To examine the effectiveness of human – nonhuman primate conflict mitigation techniques in Mto wa Mbu.

1.5.3 Research questions

i. What human – nonhuman primate conflict mitigation techniques are used in Mto wa Mbu?
ii. How effective are the human – nonhuman primate conflict mitigation techniques being used in Mto wa Mbu?

Chapter 2

Literature Review

2.1 Human – Non-Human Primate Mitigation Techniques

Existing literature has catalogued a wide array of human – non-human primate mitigation techniques. According to two studies, farmers commonly use crop guards, projectiles, physical barriers, loud noises, stationary/handheld fires, deterrent objects (such as scarecrows and rubber snakes), biochemical deterrents (such as chili and dried fish), and the cultivation of plants not preferred/repulsive to the target primate population (Hockings & Humley, 2009; Sharma et al., 2018). Hockings & Humley (2009) documented techniques in terms of traditional methods (guardians, noise, fire, projectiles, clearing areas, and simple fenced barriers), non-traditional methods (electric fencing, netting, broadcast alarm calls, and chemical repellents), and land-use changes (reducing settlement, relocation, changing cropping regimes, sustainable agriculture techniques, wildlife corridor creation, expanding protected areas, and many more).

2.2 Effectiveness of Human – Non-Human Primate Mitigation Techniques

While documenting the variety of mitigation techniques used within a given population can be an important source of preliminary data, comparative analysis of the cost and effect of varying mitigation techniques is critical for practical application. *Best practice guidelines for the prevention and mitigation of conflict between humans and great apes* evaluates the effectiveness and cost of a myriad of mitigation techniques in the context of human nonhuman great-ape conflict, referred to as HGAC within the article, using questionnaire data. While the study documented the effectiveness of each mitigation technique as reported by the farmers that use them, long-term observation by a third party may have been able to give additional insight, particularly for mitigation techniques whose effectiveness is simply listed as “unknown”. The applicability of these guidelines to this study are limited in terms of the species they address (great apes as opposed to, in the context of this paper, old world monkeys), as the two groups have, in addition to high levels of internal diversity, key distinctions in group size, foraging behavior, and physical scale (Temerin & Cant, 1983).

Chapter 3

Methodology

3.1 Study area description

The research took place in the administrative ward of Mto wa Mbu, a tourist hub located in the Monduli District of northern Tanzania, located at 3.3731° S, 35.8525° E. As of 2022, the population was 7,995 (Tanzania National Bureau of Statistics, 2022). The ward is extremely diverse, both linguistically and ethnically (Amin, 1978), and is composed of 120 of Tanzania's 126 major ethnic communities (Arens, 1970). In November, temperatures in the broader Arusha region can range between 15-26 degrees Celsius (Tanzania National Bureau of Statistics, 2018) While Mto wa Mbu experiences two major periods of rainfall (one minor wet season from October to December and one major wet season from March to May), its proximity to Lake Manyara makes year-round cultivation possible (Nonga et al., 2011). Major crops cultivated include bananas, maize, rice, pumpkins, and squash. Common primates include olive baboons (*Papio anubis*) and vervet monkeys (*Chlorocebus pygerythrus)*, both of which are known to feed on a wide variety of crops cultivated in Mto wa Mbu, with rice and coconuts as notable exceptions.

Figure 1. Location of Mto wa Mbu, in Monduli district of the Arusha region of Tanzania, in East Africa.

3.2 Study Design

This case study concerned two cohorts, namely the primates, both human and nonhuman, experiencing HPC in Mto wa Mbu. The study uses a Mixed Methods Research (MMR) design in that, in analysis, it assigns numerical values to qualitative categories. The survey data was qualitative in terms of the average effectiveness/cost of each mitigation technique as well as each categorized instance of primate behavior: namely fear, aggression, and habituation.

3.3 Methods

3.3.1 Semi-Structured Interview

For this study, a questionnaire (see appendix I) was administered via snowball sampling to residents of Mto wa Mbu, Tanzania. The questionnaire covered several facets of the human – non-human primate conflict issue, including type of conflict (in the case of the questionnaire, crop damage, livestock loss/injury, property damage, human injury, none, and other), as well as the type and variety of mitigation techniques used and self-reported ratings of their cost and effectiveness. A questionnaire is a series of questions administered to a participant to collect data on demographics, opinions, and personal experiences (Setchell *et al.* 2016). A face-to-face questionnaire was chosen as one of the data collection methods for this study because it allows for elaboration on key questions for the purpose of metadata collection and helps build rapport between the respondent and administrator (Jones *et al.* 2013). While vulnerable to researcher bias, the preplanned structure of a questionnaire makes it easier and more time efficient to replicate *en masse* than other qualitative methods (Setchell *et al.* 2016).

3.4 Data Collection Instruments

For the purposes of this study, data was collected using questionnaires (see appendix I), in addition to a notebook for field notes.

3.5 Sampling techniques and procedure

Two non-probability sampling techniques, namely purposive and snowball sampling, were utilized to select adult residents of Mto wa Mbu who have been affected by HPC for participation in this study. The initial participant, who plays a pivotal role in starting the participant chain, was purposefully chosen with the assistance of a local contact on the ground.

Subsequently, the remaining participants were recruited through snowball sampling, where each new participant in the chain was suggested by a previous participant.

3.6 Data Analysis

After data collection, paper survey data was grouped by question in Microsoft Excel. Using Microsoft Excel, data categories were analyzed using descriptive statistics, namely mean, for the demographic questions as well as the average three-fold (financial, labor, and time) cost and level of effectiveness. Each mitigation technique had its cost and effectiveness rated on a scale of low, medium, and high, as previously modeled by existing HPC literature (Hockings & Humley, 2009). Using an Mixed-Methods Research (MMR) design, these qualitative values (low, medium, and high) were assigned numerical values (1, 2, and 3, respectively) to allow for the comparison and contrast of average three-fold cost and effectiveness for each mitigation technique (Hochwald et al., 2023).

3.7 Ethical Considerations

It is critical to any study using survey data that informed consent from all participants be obtained (Hammer, 2017; Oxford, 2021). Before being given the questionnaire, all participants were informed of the length, purpose, and content of the study. In addition, participants were informed of their ability to withdraw at any time, with no penalty (full compensation given). For observations, no addresses were disclosed, and permission was asked to venture onto any private property.

Chapter 4

Results

4.1 Demographic Data

Of the 40 total respondents, 60% (n=24) mentioned agriculture as a major source of income generation, and an additional 25% (n=10) mentioned having small gardens and farms for supplementary nutrition. 15% (n=6) mentioned livestock keeping as a major source of income generation, and an additional 5% (n=2) mentioned keeping livestock for supplementary nutrition. 15% (n=6) reported maintaining a small business as a major source of income, and 10% (n=4) mentioned working in eco-tourism (national parks or lodges) as a major source of income. More than 30% of respondents had multiple sources of income generation. All but two respondents (95%, or n=38) reported experiencing human – non-human primate conflict within the past three months. One of these two respondents described regular experiences with foraging primates on their property but opted not to describe these experiences as conflicts.

Of the respondents who reported experiencing HPC, 84.6% (n=33) reported conflict with Vervet Monkeys (*Chlorocebus pygerythrus*), 74.3% (n=29) reported conflict with Olive Baboons (*Papio anubis*), and 25.6% (n=10) reported conflict with Blue Monkeys (*Cercopithecus mitis*). While some respondents mentioned experiencing conflict with either baboons or vervet monkeys alone, conflict with blue monkeys was always mentioned in conjunction with conflict from both vervet monkeys and olive baboons.

Crops foraged by non-human primates included bananas (both ripe and unripe), mangos, corn, spinach, beans, avocados, papayas, pomegranate, tomatoes, and carrots. In addition, livestock, including ducks, chickens, and small goats were reported as attacked, killed, and/or eaten by baboons, and domestic guard dogs were reported as commonly attacked by baboons.

4.2 Mitigation Techniques

Of the 40 respondents, 5% (n=2) reported using no mitigation techniques, 7.5% (n=3) reported using only one mitigation technique, 37.5% (n=15) reported using two different mitigation techniques, 42.5% (n=17) reported using three different mitigation techniques, and 7.5% (n=3) reported using four different techniques. 80% (n=32) reported using projectiles to ward off foraging primates, 68.7% (n=22) of which did so by using a slingshot (*manati*), 28% (n=9) of

which mentioned throwing rocks by hand, and 3.1% (n=1) reported using a spear. 75% of respondents (n=30) reported using loud noises (made either by the voice/body or by manipulating noisemakers), 67.5% (n=27) reported using crop-guards, and 7.5% (n=3) reported using physical barriers to mitigate HPC. Both fire and deterrent objects (in this case, a scarecrow) were reported in use by one participant each.

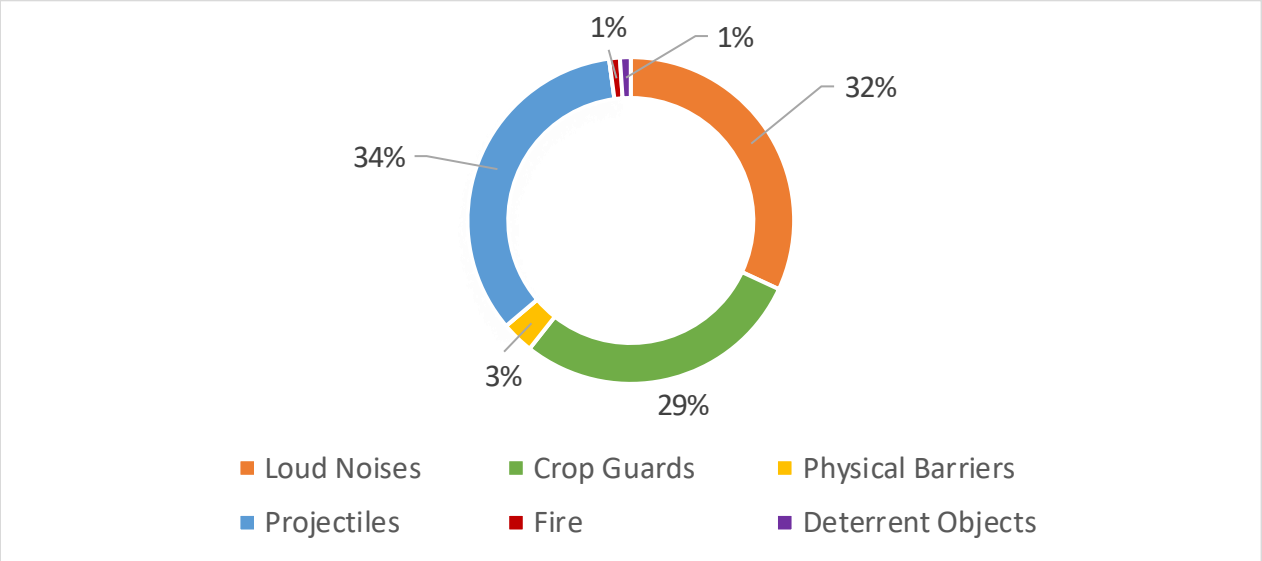

Figure 2. Distribution of Human – Non-human Primate Mitigation Techniques Reported out of Total Reported Mitigation Techniques by the Respondents in Mto wa Mbu, Tanzania

4.3 Cost and Effectiveness of Mitigation Techniques

Using the MMR technique described in section 3.6 (Data Analysis), projectile usage had an average gross score of 2.69 (with low effectiveness at 1 and high effectiveness at 3). As a proportion of the total of its three-fold costs (financial cost + labor cost + time cost; 1.84 + 2.06 + 2.18) the average efficiency was the highest of all the techniques, at 44.2%, with 11.1% representing the lowest effectiveness to cost ratio (1:3+3+3) and 1 representing the highest effectiveness to cost ratio (3:1+1+1).

The average gross score of crop guards was 2.27, and the average efficiency of the method was 43%. Loud noises were given an average gross score of 2.14, with an average efficiency of 40%. Deterrent objects were given an average gross score of 1 and an average efficiency of 33%. While fire had an average gross score of 3, its average efficiency was also 33%. Lastly, physical barriers were given an average gross score of 2 and an average efficiency of 28.6%.

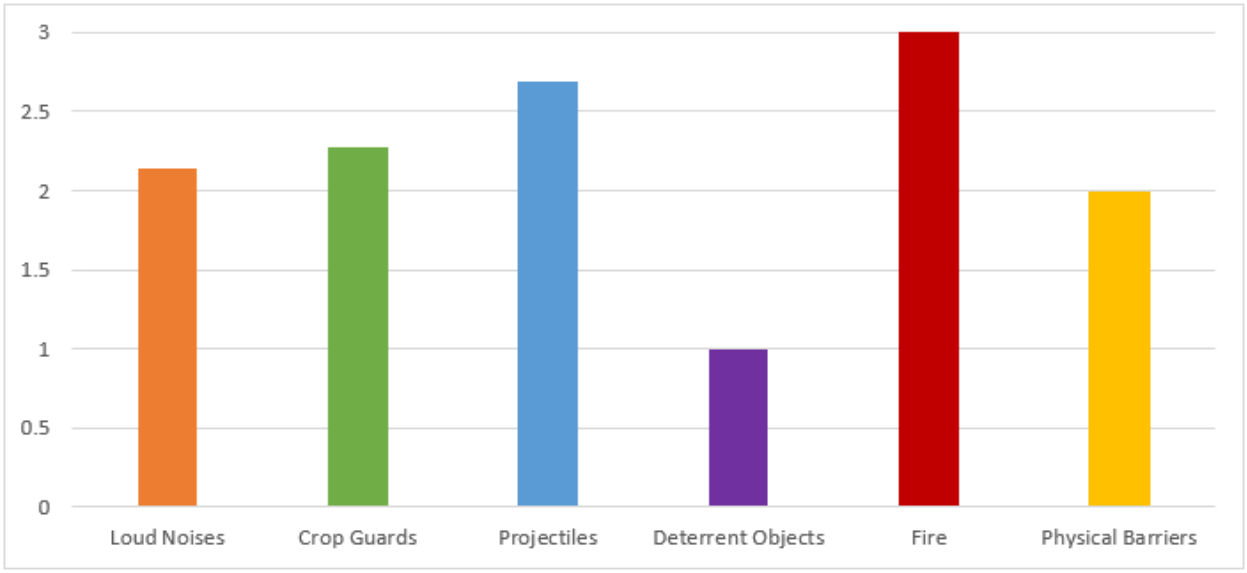

Figure 3. Total Average Score Calculated from Respondents' Self-Reported Effectiveness Ratings

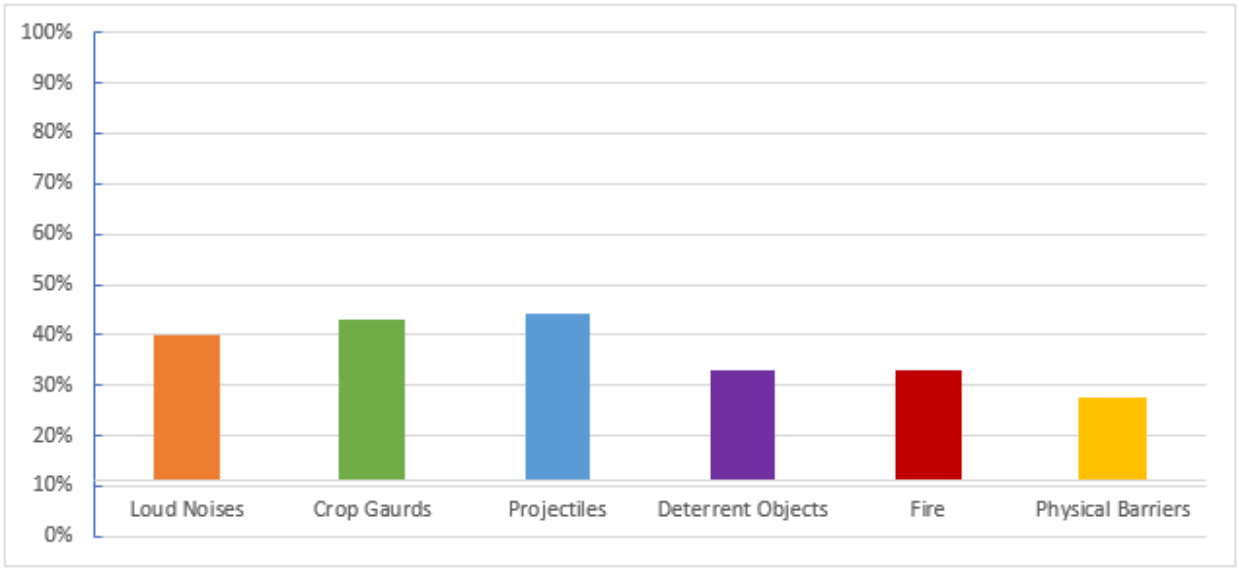

Figure 4. Average % Efficiency Calculated from the Respondents' Self-Reported Effectiveness Ratings as a Ratio of the Total Three-Fold Cost

Chapter 5

5.0 Discussion

5.1 Mitigation Techniques

While crop guarding, projectiles, noisemaking, physical barriers, fire, and deterrent objects (scarecrows) all appeared in the sample, use of other mitigation methods, such as chemical deterrents (such as chili oil) and cultivation of deterrent/non-preferred crops, were not reported. The lack of chemical deterrents could be due to the high labor cost associated with applying the chemical to individual crops or the technical knowledge requirement associated with preparing the appropriate concentration of the chemical (Hockings & Humley, 2009). The cultivation of deterrent/non-preferred crops could be impractical due to low economic demand/unfavorable environmental conditions for non-preferred crops, such as chili, cotton, aloe vera, sorghum, and ginger, among others (Parker & Osborn, 2006; Sharma et al., 2018). Alternatively, lack of access to and/or knowledge about these alternative crops could also be a limiting factor.

Projectiles were among the most popular methods in use. While some respondents mentioned killing and/or injuring non-human primates using this method, some preferred to launch rocks in the general vicinity, while others still, in the case of the slingshot (*manati*) opted not release the cradle but aim with it to frighten. A greater number of participants than reported may have been aiming to strike the primates but opted not to report this due to fear of penalty from conservation authorities through the research team.

Noisemaking and crop guarding were similarly popular, likely due to their low overall cost (with an important exception in hired crop guards, which exchanged some time and labor cost for high financial cost). Several participants reported using these methods exclusively in tandem with one another, and many reported ongoing body and voice fatigue from these methods, whether using them simultaneously or individually. As with many of the other methods, one significant factor limiting the effectiveness of these two methods was reoccurrence of the primates, some reporting the return of the troop and/or troop individuals within 30 minutes to two hours, and some participants reporting from 3-6 recurrences per day.

Physical barriers were diverse in specifics, with three participants reporting using three different types of physical barrier, namely protective bags around ripening produce, barbed wire fences, and biological fence.

Fire and physical deterrents were the least popular options, which could potentially be explained by high cost and low effectiveness, respectively. The one participant who reported using fire as a mitigation method was able to afford the high associated costs (buying firewood and keeping the fire going during the night), but these costs may be preventing the method from being more popular. The participant using a physical deterrent (in this case, a scarecrow) reported effectiveness against foraging birds, but low effectiveness against foraging primates and large herbivores.

5.2 Cost and Effectiveness of Mitigation Techniques

As replicated in outside literature, projectiles were rated highly in terms of both gross effectiveness and average efficiency (Hockings & Humley, 2009). However, projectiles present a potential 4th cost (in addition to labor, time, and financial costs) of mitigation. Namely, non-human primate injury and mortality, which, in addition to potentially spreading zoonotic diseases to the local human population, may need to be monitored as a potential threat to primate conservation in the greater area.

While crop guards were very often the respondents themselves, some, especially larger landowners, opted to hire crop guards. In this case, wages for crop guards presented a clear financial barrier for some, leaving them with the high labor/time cost of guarding crops themselves. Many of these individuals opted to use noisemaking in tandem with crop guarding, reporting the two methods to be more effective in combination with one another. Interestingly, many participants reported a significant demographic impact on the effectiveness of both crop guarding and noisemaking. Several women reported lower levels of effectivity for these methods, and higher levels of effectivity for their spouses, male family members, or male peers. This presents a clear disparity, with implications for the impact of human non-human primate conflict (and human wildlife conflict on a greater scale) on women's health and wellbeing worldwide.

Physical barriers presented a far less popular option, likely because of the low effectiveness to high-cost ratio. The barriers mentioned among the sample included bags tied around crops, bio-

fences, and barbed wire. High labor cost was the primary concern behind the tied-bag barrier, while low effectiveness and high financial cost were the primary concerns behind the bio-fence and the barbed wire, respectively. By innovating to remove financial and labor cost values behind differing physical barrier methods, and increasing the efficiency of others, these methods may become more viable in the future.

While the most efficient mitigation techniques (projectiles, crop guards, and loud noises) all present a degree of effectiveness, they are far from the 100% ideal (that being the highest level of effectiveness limited by the lowest possible cost).

5.1.4 Limitations

This study, while somewhat limited by the relative inexperience of the author, was largely limited by its methodological approach. Given that semi-structured interviews, and, more specifically, questionnaires, are subject to bias on behalf of the interviewer and interviewee, the empirical basis of the study could be questioned. For future research, a secondary technique, such as scan-sampling occurrences of mitigation usage for primate behavioral responses, could help to remedy this gap. While this study initially attempted to utilize this methodology for cross-validation, the semi-structured interviews took priority. Ultimately, future research would benefit from allotting two different periods of data collection for each methodological approach, as opposed to combining them into one, to divide time more equitably between the two approaches.

6.0 Conclusion and Recommendations

Moving forward, experimental ecological studies concerning the costs and effects of newly implemented mitigation techniques (or improvements to existing ones) may guide the international community towards a more cohesive state of human wellbeing and conservation. The substantial resources required by this undertaking could potentially be redistributed throughout impacted communities to outweigh the financial costs from primate and other wildlife foraging behaviors. Existing resources do not adequately address community needs, particularly in the case of human – non-human primate conflict. Many respondents mentioned calling park rangers in the presence of large herbivores and carnivores, but not in the presence of non-human primates. They cited the low numbers of available rangers and the prioritization of larger herbivores and carnivores by rangers as the primary reason behind this discrepancy. While their physical well-being has some precedent for government support in the existing system, the protection of their financial well-being (which is inextricably linked with their physical well-being due to the realities of poverty) has fewer resources allocated to it. If financial benefit from conservation efforts were to be more broadly shared with the communities that experience HWC from protected areas, crop-foraging would place less financial stress on subsisting on agriculture for nutrition and/or income. This idea is bolstered by the experience of one respondent within the sample, who experienced non-human primate crop foraging on their property, described it as conflict, but did not use any mitigation techniques to prevent it. They were the spouse of a Manyara National Park employee, and therefore benefiting financially from the park. They remarked that, in such case as the cost of human wildlife conflict became greater than their household's financial benefit from Manyara National Park, they would consider moving. While the option to move one's household is certainly limited to those who can afford it, the participant's thought process is indicative of the larger conflict occurring between disenfranchised groups and the larger conservation community. Those with the privilege and ability to hire crop guards or pursue other means of income generation may have livelihood interests that align with those of conservationists, particularly in the cases of those who profit from Tanzania's national park system and the tourism the nation receives as a result. Others who spend high amounts of time and effort on human non-human primate mitigation may be doing so because their livelihood interests are fundamentally different than the interests of conservation, as opposed to inextricably linked. By acknowledging these differing livelihood interests and the

differing capacities with which people can protect those livelihood interests, conservationists and the disenfranchised can develop a common language with which to address their desires in tandem.

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Appendices

i. Participant Survey

Analyzing Human – Nonhuman Primate Conflict Mitigation Techniques in Northern Tanzania

Hello! I'm Lily Adams, a University of Denver student studying with the School of International Training, based in Arusha. I'm currently conducting research on human/nonhuman primate conflict, with the goal of improving livelihood outcomes for both people and primates. Thank you so much for taking the time to fill out this survey. Your experiences will be an integral part of my ongoing and future work and will contribute to the growing body of knowledge concerning HPC.

This questionnaire should take between 10-15 minutes. At any point, you may withdraw from at no cost and will be compensated 3,000 Tsh for your time. All answers are anonymous.

1. What is your primary source of income?
    - Agriculture
    - Livestock keeping
    - Small business
    - Eco-tourism
    - Other: _____
2. Have you recently (within the past three months) experienced human wildlife conflict with primates?
    - Yes
    - No
        - If so, what kind of damage resulted from this conflict?
    - Crop damage/loss
    - Livestock injury/loss
    - Personal injury
    - Property Damage
    - Other: _____
        - Which nonhuman primate species were involved?
    - Baboon

- Vervet Monkey
- Other: _____

3. Do you use mitigation techniques to prevent human-primate conflict?
   - Yes
   - No
     - If so, which of the following methods have you used?
   - Loud noises (Shouting, banging loud objects, etc.)
   - Crop guards (Human, trained dogs, etc.)
   - Physical barriers (Fences, cleared areas)
   - Chemical deterrents (Chili, dried fish, poison, etc.)
   - Projectiles (Throwing rocks, slingshots)
   - Cultivation of repellant/non-preferred crops
   - Fire (periphery or handheld)
   - Deterrent objects (Scarecrow, rubber snakes, etc.)
   - Other: _____
     - If used, rate the following mitigation techniques by effectiveness and cost (Low, Medium, or High):

Method	Effectiveness	Financial (Cost)	Labor (Cost)	Time (Cost)	Side Effects/Other: considerations
Loud Noises (Shouting, banging loud objects, etc.)					
Crop Guards (Human, dog, etc.)					
Physical Barriers (Fences, cleared areas, etc.)					
Chemical Deterrents (Chili, dried fish, poison, etc.)					
Projectiles (Throwing rocks,					

slingshots etc.)					
Cultivation of repellant/non-preferred crops					
Fire (periphery or handheld)					
Deterrent objects (Scarecrow, rubber snakes, etc.)					

4. Do you give permission for your data to be used in future research?
    - Yes
    - No

You have completed the questionnaire! Thank you for your time. For all questions and inquiries please feel free to contact me by email at lily.adams@du.edu.

ii. Work Plan

Tuesday (14/11)	Travel to Mto wa Mbu
Wednesday (15/11)	Speak with and deliver letter to local government office, Run participants
Thursday (16/11)	Run participants and make mitigation observations at sites
Friday (17/11)	Run participants and make mitigation observations at sites
Saturday (18/11)	Run participants and make mitigation observations at sites
Sunday (19/11)	Run participants and make mitigation observations at sites
Monday (20/11)	Run participants and make mitigation observations at sites

Tuesday (21/11)	Run participants and make mitigation observations at sites
Wednesday (22/11)	Run participants and make mitigation observations at sites
Thursday (23/11)	Run participants and make mitigation observations at sites
Friday (24/11)	Run participants and make mitigation observations at sites
Saturday (25/11)	Conclude data collection and travel back to Arusha

iii. Budget

Expense Type	#	Cost per unit (Tsh)	Total (Tsh)
Accommodations (Fanaka, Breakfast and Dinner provided)	11	35,000	385,000
Translator (Mwatatu)	8	20,000	160,000
Translator (Furaha)	2	20,000	40,000
Financial Incentive for questionnaire respondents	40	3,000	120,000
(Bajaj) Daily Transport within Mto wa Mbu	20	700	14,000
(Bus) Transport to and from Mto wa Mbu and Arusha	2	7,000	14,000
Total (Tsh)			733,000