

# **Nyika-Vwaza Trust Research Study Report**

## **Bushmeat hunting and consumption in Malawi: prevalence, drivers and implications for management**

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February 2020



Nyika national Park, 2018. By Julia van Velden

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## Abstract

The aim of this work was to provide vital information regarding the illegal hunting and consumption of bushmeat from Nyika National Park and Vwaza Marsh Wildlife Reserve in Malawi. We conducted a large-scale community-based survey with local communities surrounding these two parks. We found that bushmeat hunting and consumption exists at appreciable levels within these communities, reaching up to 39% of the population consuming bushmeat in Vwaza Marsh. Hunting in Nyika in the pre-harvest wet season was the highest of four protected areas surveyed, with 19% of the population hunting at this time. We also found that consumption was strongly linked with poverty, but hunting was not. The consumption of bushmeat appears to play a key role in food security, but there are indications that hunting may be performed by the wealthier sections in society, or that people become wealthier when they hunt.

We also investigated how local communities would perceive a number of different interventions relating to bushmeat hunting. We found that interventions with a strong development focus, such as micro-enterprise initiatives or skills training, are likely to have a positive effect on reducing hunting and potentially consumption of bushmeat, and are perceived to be very fair by communities. However, such programs must be strongly linked back to conservation goals in order to be effective.

We finally conducted a workshop with Malawian conservation experts, which led to systems models for hunting and for consumption, which can be used by management in order to predict the effects of various programs on the system as a whole. Wildlife farming was of particular interest as a way to combat both hunting and consumption of bushmeat.

We recommend that the perceptions and socio-economic realities of local communities are strongly incorporated in conservation planning, and that conservationists should be careful not to treat the hunting and consumption of bushmeat as one issue. Rather these issues should be recognised as having different drivers and potential solutions. We hope that the information presented in this report can be effectively incorporated in conservation programs.

## Study justification and objectives

The illegal bushmeat trade represents a major threat to biodiversity (Ripple et al., 2019), but little is known about the magnitude of this threat outside of forest regions (Lindsey et al., 2013) or how it can be countered. Our project aims to address this pressing issue by focusing on protected areas in Malawi. Malawi is one of the world's poorest nations, and has a high dependence on natural resources. Malawi also has diverse terrestrial biodiversity (Government of Malawi, 2014), despite its small size. However, many mammal species are thought to have drastically declined, although data is deficient for almost all areas (Munthali & Mkanda, 2002). There are large gaps in knowledge regarding the effect of bushmeat hunting on wildlife populations, as well as the dependency of local people on this activity for both income and protein. There is therefore an urgent need for baseline data about bushmeat hunting and consumption in Malawi in order to ensure the long-term persistence of wildlife and to avoid negative livelihood impacts for local communities. We aim to establish baseline levels of both bushmeat hunting and consumption, and establish the socio-economic drivers of each. This will enable us to identify interventions that incorporate community preferences and therefore foster compliance and sustainability. We aimed to work closely with conservation authorities and NGOs to ensure that results inform future interventions to address bushmeat.

**Our objectives therefore are:**

1. Investigate the prevalence of bushmeat hunting and consumption around 4 protected areas in Malawi, as a percentage of respondents who participate in these behaviours, with confidence intervals
2. Understand the main socio-economic variables related to the prevalence of bushmeat hunting and consumption within Malawi
3. Understand community perceptions and responses to up to six possible future interventions used to reduce bushmeat hunting or consumption
4. Facilitate decision-making among stakeholders relating to interventions to reduce bushmeat hunting and consumption in a participatory setting

**Start date:** 01 June 2018

**Finish date:** 31 January 2020

**Team:**

- Julia van Velden (PhD candidate)
- Dr Duan Biggs (Griffith University)
- Prof Hamish McCallum (Griffith University)
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- Dr Boyson Moyo (Lilongwe University of Agriculture and Natural Resources)

**Partners:**

- **African Parks:** provided consultations and permissions for research in Nkhotakota and Majete Wildlife Reserves
- **Department of National Parks and Wildlife, Malawi:** provided insights, consultations and permissions for the study more broadly
- **Lilongwe Wildlife Trust:** consulted on methodological and conceptual questions, and provided accommodation in Vwaza Marsh Wildlife Reserve

**Funders:**

- **Nyika-Vwaza Trust:** The Nyika-Vwaza Trust funded the fieldwork costs for research in communities surrounding Nyika and Vwaza March protected areas and the stakeholder meeting held in Lilongwe in 2019.
- **Griffith University:** Contributed to flights and car expenses for the fieldwork
- **The Rufford Foundation:** Contributed to fieldwork costs for the research in all four protected areas in our larger study
- **National Geographic:** Contributed toward fieldwork costs for Majete wildlife reserve and the stakeholder meeting held in Lilongwe in 2019.

**Acknowledgments:**

We would like to acknowledge H. Travers, H. Ibbett, A. Hinsley and S. Brittain for methodological advice, and E. Stone, J. Vaughan, P. Zamadula, M. Ngosi, A. Kataya, W. Mgoola, S. Kamoto and C. Hay

for help with fieldwork in Malawi. We would also like to thank B. Lwisha, C. Basikolo, E. Kacheche and S. M'bama for their work as enumerators. We would also like to thank all participants.

#### **Note on geographic scope of the report:**

Although research was conducted at four protected areas in Malawi, namely Nyika National park, Vwaza Marsh Wildlife Reserve, Nkhotakota Wildlife Reserve and Majete Wildlife Reserve, this report focusses its reporting on those results particularly pertinent to Nyika and Vwaza Marsh. Graphs and figures present the results for all four parks for comparison purposes, but the results text focusses specifically on results relevant to Nyika and Vwaza Marsh. The conclusions and recommendations are broadly pertinent to all four protected areas, unless otherwise stated.

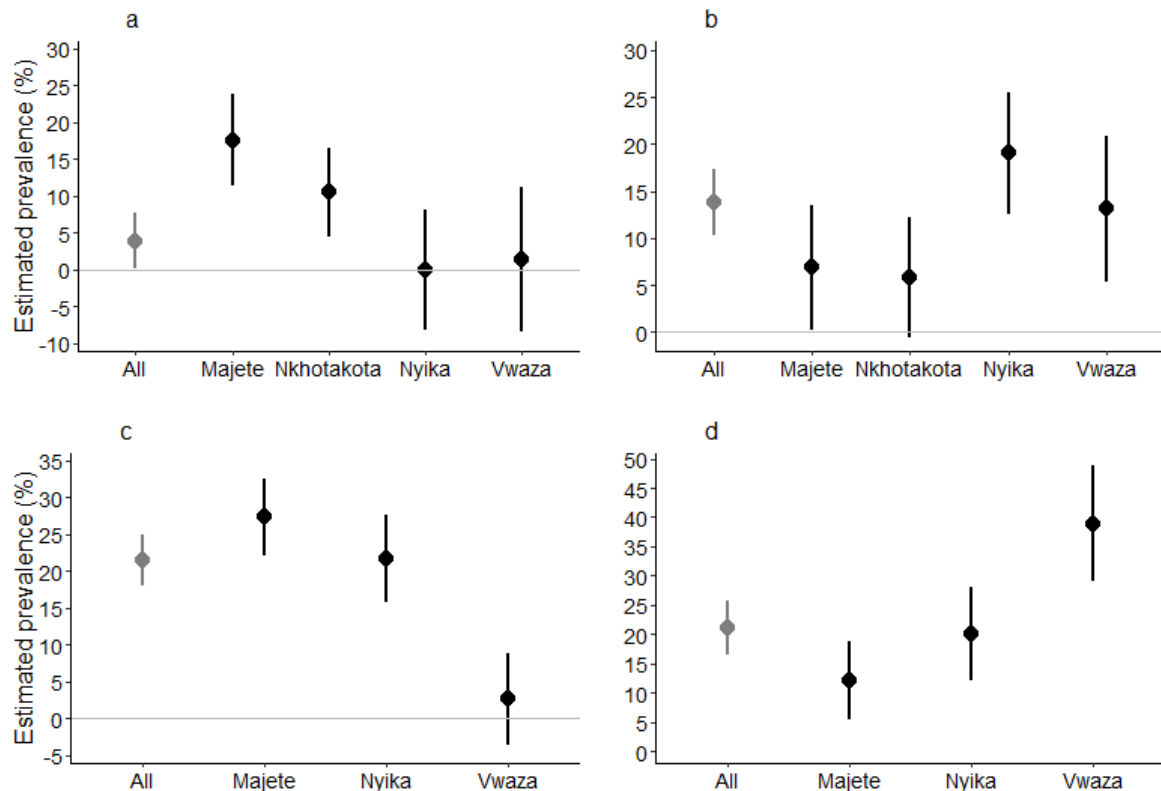
### Summary of study

#### **Objective 1 & 2: prevalence of bushmeat hunting and consumption in Nyika and Vwaza Marsh**

We conducted this research at four national parks in Malawi namely Nyika National Park, Vwaza Marsh Wildlife Reserve, Nkhotakota Wildlife Reserve and Majete Wildlife Reserve between July and November of 2018.

We began by conducting 1562 household interviews with communities living around these four protected areas. The number of interviews conducted in Nyika and Vwaza Marsh were 309 and 231 respectively. Interviews were conducted in person by Malawian enumerators in English, ChiChewa or Tumbuka. We used a combination of socio-demographic questions and the unmatched count technique during interviews. The unmatched count technique is a methodology which can help counter-act the sensitivity of topics by providing anonymity in answers, and is appropriate if the activities are not too rare and a large sample size can be achieved (Hinsley et al., 2019). The premise behind this method is that a sensitive item is aggregated with a list of non-sensitive items on a treatment card. The respondents then indicate how many of the items on the list apply, but not which ones. This is known as a treatment group. The control group receives the same card, but without the sensitive item. To calculate the prevalence of each sensitive behaviour (bushmeat hunting and bushmeat consumption in both the dry and wet seasons for each park) we calculated the difference-in-means estimate between control and treatment groups. We next fitted ordinary linear mixed models to the number of items selected from each UCT card, which allowed us to investigate which socio-economic factors are important for each activity.

We found that hunting peaked in the wet season between November to March, in both Nyika and Vwaza Marsh, with  $19.05\% \pm 6.48$  and  $13.15\% \pm 7.78\%$  of communities hunting during this period respectively. Hunting during the dry season (June-October) was low, at around  $0.4\% \pm 8$  and  $1.35\% \pm 9.79$ , which indicates the activities are so rare as to be not detectable using the UCT method. Consumption was similar in Nyika year-round with  $21.7\% \pm 5.84$  of the population consuming bushmeat in the dry season and  $19.96\% \pm 7.98$  in the wet season. At Vwaza Marsh however consumption peaked in the wet season, with  $38.93\% \pm 9.87$  of the population consuming bushmeat, and  $2.65\% \pm 6.27$  consuming bushmeat in the dry season. See **Figure 1** for comparison to other parks in Malawi.

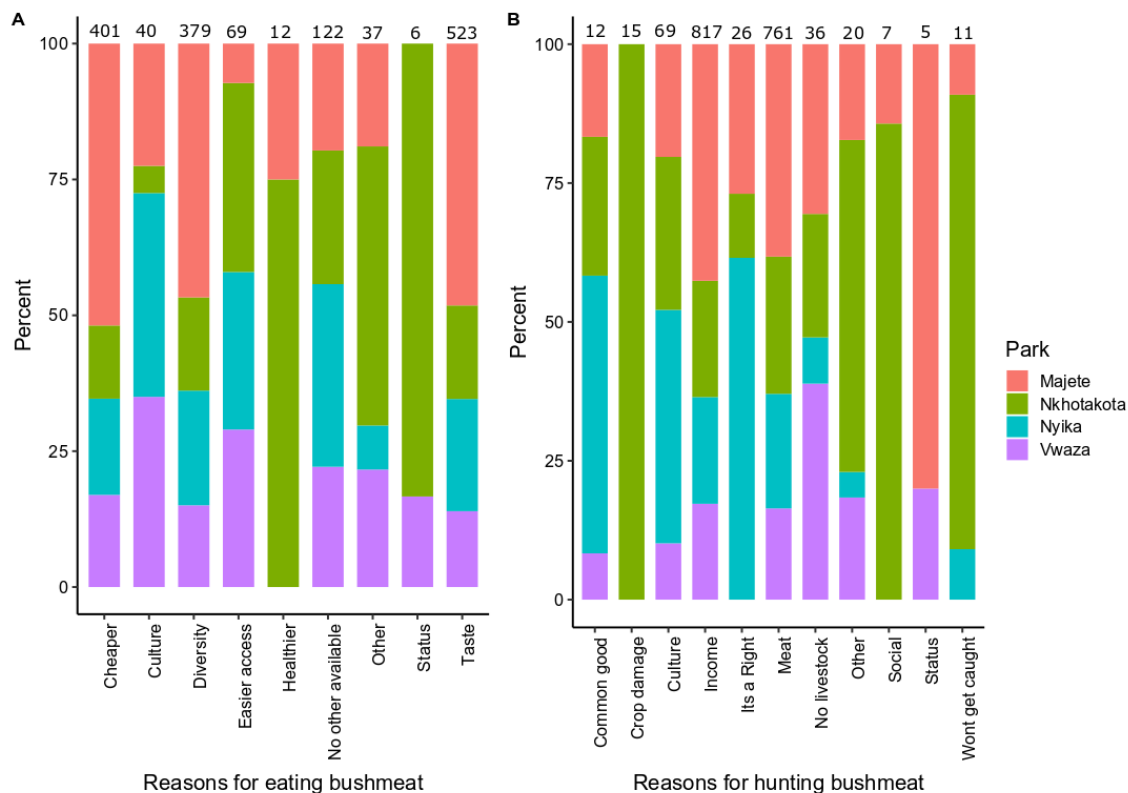


**Figure 1: Estimated percentage prevalence ( $\pm$ SE) of (a) hunting in the past month (post-harvest, June to October depending on PA), (b) hunting pre-harvest (November-March), (c) consumption in the past month (post-harvest, June to October depending on PA) and (d) consumption pre-harvest (November-March) for protected areas in Malawi. The estimates for all PAs combined together are represented in grey. Estimates are the difference in means between control and treatment UCT cards. The grey line indicates when standard error bars overlapped zero. Consumption was not estimated for Nkhotakota.**

We found a number of key variables were linked to hunting and consumption of bushmeat. At Nyika we found that, in both wet and dry seasons, wild meat was predominately eaten by poorer households. Additionally, we found that households able to eat three meals per day were consuming more wild meat than those able to eat two meals per day, indicating that bushmeat is a key aspect of food security. Involvement in more park-based community projects lowered consumption. Livestock ownership was only important for consumption post-harvest (dry season) at Nyika national park, where households owning livestock ate significantly more wild meat than those without livestock, potentially because they were more able to afford it. Also, households without any knowledge of Village Natural Resource Committees (VNRCs) consumed significantly more wild meat than those that knew about the VNRCs. Finally, marital status was important in Nyika pre-harvest (wet season), where households with widow/ers consumed significantly more wild meat than single (unmarried) households. At Vwaza Marsh we again found that wild meat was predominately eaten by poorer households. Households with knowledge of VNCRs consumed significantly more bushmeat than households without knowledge, the opposite effect to Nyika. Hunting had different drivers to consumption. Number of meals was an important variable in Vwaza Marsh, where those households eating one meal a day hunted more wild meat than those eating two or three meals a day. We also found that households which participated in more community projects in Vwaza Marsh were significantly less likely to hunt than those participating in fewer projects. We also found that at Nyika, male respondents were more likely to report hunting in their households than female respondents. Poverty was not an important predictor of hunting at both

Nyika and Vwaza, however there were indications from the other two parks (Majete and Nkhotakota) that wealthier households may hunt more than poorer households.

When asked about the motivations for conducting these activities we found that a preference for the taste of wild meat and for added diversity in diet were key drivers of consumption, whereas hunting was primarily motivated by the need for income and meat for hunter households. Cultural reasons played a significantly more important role in Nyika national park and Vwaza Marsh than at Majete and Nkhotakota. See **Figure 2** for counts of reasons.



**Figure 2: Reasons given by respondents for a) eating bushmeat and b) hunting bushmeat, represented as proportions of answers given at each park. The total count of a reason is shown at the top of the bar.**

### Conclusions for Objective 1 & 2:

Our results reveal that wild meat hunting and consumption exists in Malawi at appreciable levels and depends strongly on the local context in which a PA is situated. Several factors were found to be consistently important drivers, including household poverty and food security, but these drivers did not have the same effect on hunting versus consumption of wild meat. We show that hunting and consumption can remain a pervasive issue in PAs with substantial investment into enforcement and community programmes. Given the four PAs surveyed in Malawi are currently recovering from periods of low enforcement effort due to lack of funds and subsequent high poaching, it is likely these estimates were substantially higher in the past.

The drivers behind wild meat hunting and consumption are complex and vary widely across studies and locations. Importantly, the drivers of hunting and consumption differ (Harrison et al., 2015), although many studies conflate them. Wild meat consumption was more prevalent in poorer



households, but hunting appeared to be more prevalent in wealthier households. This may indicate that households are wealthier due to hunting, while consumption is generally related to food or income needs. Hunting may be a way for households to lift themselves out of poverty, by generating income for their household. Also, wealthier households may have greater access to more effective hunting methods (Damania et al., 2005). Wealthier rural households elsewhere in Africa have been found to harvest more wild meat (de Merode et al., 2004) and to be more likely to choose to continue to hunt wild meat when offered alternative incomes (Nielsen et al., 2013). Poverty is often seen as the key driver to hunt, however multidimensional, complex relationships are likely to exist (Travers et al., 2019). Consumption of wild meat in our study was mostly limited to households with Basic Necessity (our indicator of poverty) Scores below 60%, indicating that it is accessible to the poorest households. Consumption of wild meat has been found to increase among poorer households in rural areas (Brashares et al., 2011), and act as safety net during lean periods. However, given the high human densities around Malawi's PAs, it is likely that harvest could become so low as to cease to play any major role in food security, except as a safety net in lean conditions.

Motivations behind hunting and eating wild meat are multi-faceted and are not only related to economic factors. Taste was a significant factor in consumption of wild meat as has been found elsewhere in Africa. Cultural factors were found to be important for both hunting and consumption in Nyika and Vwaza Marsh, but not important in Majete or Nkhotakota.

#### Recommendations for Objectives 1&2:

- Interventions should be tailored to the differences in drivers and motivations between hunters and consumers. E.g. poorer households could be targeted for consumption interventions (such as alternative protein projects), while middle to wealthier households could be targeted for hunting interventions (such as alternative livelihood projects). One type of project should not be assumed to be able to affect both hunting and consumption.
- Key assumptions should be validated before projects are implemented, including A) the assumption that alternative proteins or livelihoods would lead to participants substituting their current protein/activity choices with the newly provided project, rather than treating it as an addition to their current activities; B) the assumption that community engagement models that reduce poverty decrease consumption, given that increasing purchasing power may increase the demand for bushmeat
- The prevalences estimated here need to be replicated at set intervals (e.g. 4 years) to understand the effect of increasing enforcement and intervention programs



**Our team of enumerators at work collecting surveys around Vwaza Marsh wildlife reserve.**





**The view while surveying a village near Livingstonia. The escarpment of Nyika national park can be seen in the background.**

### Objective 3: community perceptions and responses to possible future interventions

Intervention programs used to reduce bushmeat hunting and consumption from protected areas are often difficult to implement and achieve desired outcomes from, with simplistic narratives about the motivations and drivers behind bushmeat hunting obscuring the complex reality behind this issue. Given this complexity, managers often struggle to make informed decisions about the best course of action for their particular protected area.

We used scenario-based interviewing to provide evidence of the responses of communities to a range of different bushmeat interventions prior to their implementation. Scenarios represent alternative futures in which a specific change is made and allowed to play out. This approach can provide vital insights as to probable responses to interventions prior to implementation, and challenge assumptions about outcome pathways and levels of uptake.

We conducted a further 250 interviews with respondents at each of the four protected areas of interest. We explored responses to seven different intervention types aimed to reduce bushmeat hunting and/or consumption, including alternative income projects, alternative protein projects and increased enforcement. For each scenario we asked respondents how time on current activities and meat consumption might change and how fair they perceive these interventions to be. These were used as proxy measures as asking directly about bushmeat was considered too sensitive for direct questioning.

The types of programs investigated in the scenarios were:

1. Park-based product enterprise (PPR): respondents offered the option of being able to harvest products from the park in order to make an income selling the products at a fixed price, in exchange for not partaking in any wildlife crime in the park. This could be e.g. harvesting honey, mushrooms or wild fruits to sell. Markets would be made available for these products. If the person was found to have committed a crime they would be removed from the scheme.

2. Micro-enterprise (MIC): respondents offered the option of being part of a microenterprise scheme, where participants would receive training and a start-up grant to start a business of their choice. The businesses would be formed in groups of ten where loans and profits could be pooled. In exchange respondents would not partake in any wildlife crime in the park. If they contravened this rule they would be removed from the program and contributions to the group returned back to them.
3. Livestock donation (household; LIN): Respondents were offered the option to receive livestock in exchange for no participation in illegal activities within the park. Households would receive 3 goats, and training in livestock management and health. If participants committed a wildlife crime, the household would have to pay a fine. To extend the scheme, participants would also have to give the first offspring of the livestock to another participant joining the program.
4. Livestock donation (group; LGR): participants would receive a donation of livestock in groups of ten households, and the group would receive 2 cows and 6 goats. The group would also receive training in management and livestock health. The profits would be put into a group fund and split equally. If anyone in the group is found to have committed a wildlife crime the whole group would pay a fine out of the profits.
5. Skills training (SKL): respondents were offered training for a skill of their choice, lasting a period of six months. The skills would be tailored to the locality, but could include skills like carpentry, or crafts making. However if they were found to have committed a wildlife crime they would be removed from the scheme.
6. Regulated hunting (HNT): hunting of wild animals in the park would be made legal, subject to conditions e.g. only hunting certain species, bag limits for each year (e.g. 10 animals per year). The hunter would also only be allowed to use the meat within their household, and not sell it to others. If a person was hunting without a permit they would receive the same fines as current, and would not be able to get permits in future. These same penalties would apply for selling of meat.
7. Increased enforcement (ENF): the level of enforcement experienced in the park, as a function of the likelihood of apprehension by rangers. In this scenario the likelihood of apprehension would double from current levels. For example if a person was only caught one in every ten trips, they would be caught twice in every ten trips.

**Fairness of interventions:** We asked respondents how fair they found each of the scenarios, on a scale from "very unfair" to "very fair". Microenterprise was seen to be the fairest option, followed by individual livestock donation, and then skill provision. Regulated hunting was seen as the most unfair, followed by enforcement. Perception of fairness was influenced by a number of factors. Those respondent households eating two and three meals were significantly less likely to perceive the scenarios as very fair than those eating four meals a day. Secondly, those who own more livestock and have a higher Tropical Livestock Unit score were more likely to find scenarios to be very fair. Thirdly, those respondent households who worked more hours in the post-harvest seasons were more likely to perceive scenarios as "very fair" than those who work less. Finally, males were significantly more likely to perceive the scenarios as fair or very fair than females. See **Figure 3a** for probabilities of respondents answering in a specific category of fairness.

When asked for the reasons behind respondent's perceptions of fairness, all scenarios except hunting and enforcement were found to be fair because they were seen as improving income and living standards in their households. Respondents did not like the rules stipulated in the group livestock donation scenario, and found it unfair that the group should receive a fine if one of them infringes in the park. However, other respondents felt that this option may be very fair as it provided

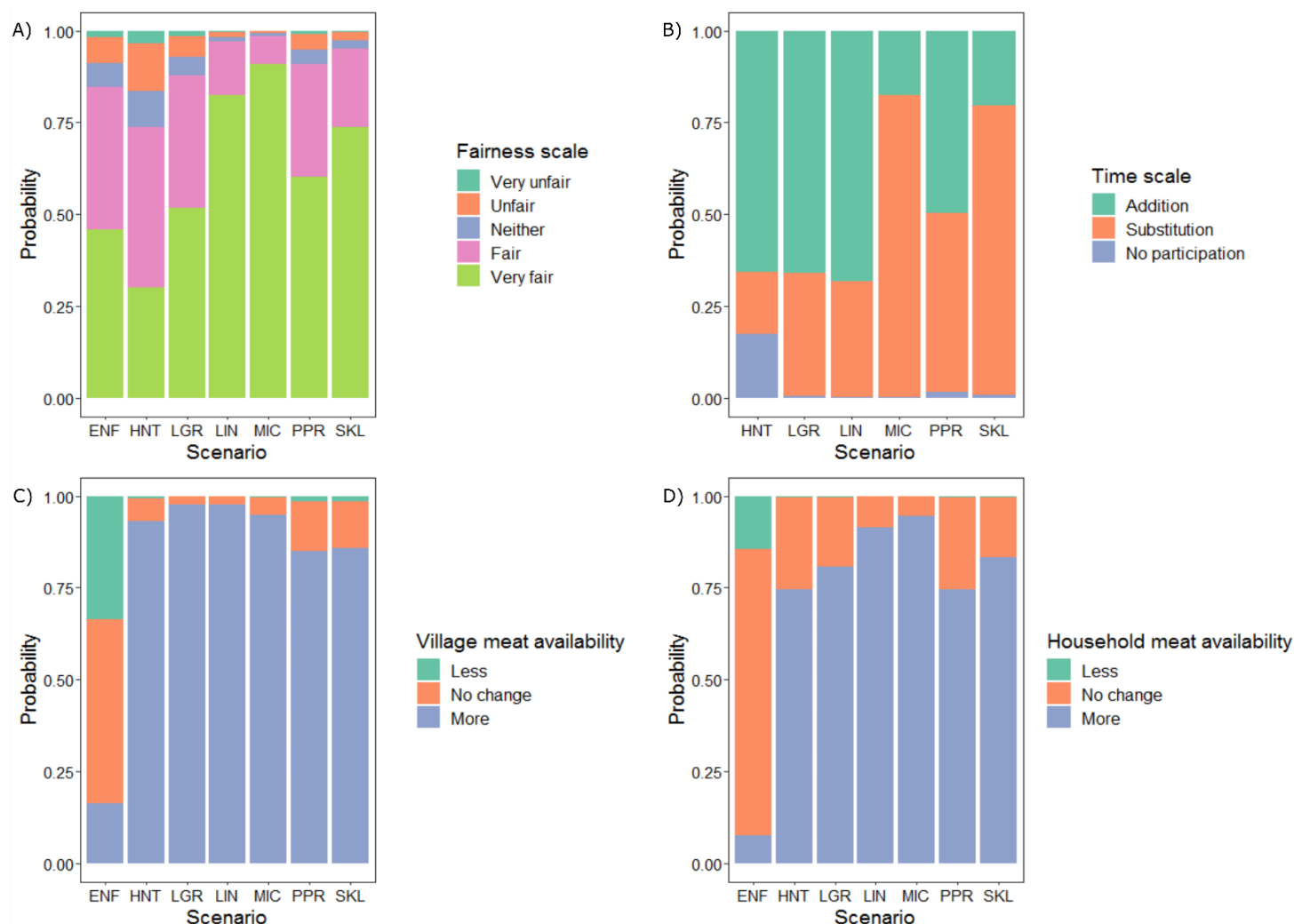
the community an opportunity to work together. Microenterprise and skills-training was perceived as providing long-term empowerment to communities. Surprisingly, more respondents felt that enforcement was a fair or very fair option as it conserved the environment, compared to those who felt it was unfair as it limits access to natural resources.

**Time spent on current activities:** It is vital that projects cause participants to substitute the time they spend on current activities (including illegal hunting) with the program offered, and not treat it as an addition, where they complete the program offered as well as their usual activities (including hunting). We therefore asked respondents how they would react to each program: would they treat it as an addition, a substitution or would they choose not to participate? The microenterprise and skills-training scenarios were most likely to result in a substitution of time spent on current activities (both legal and illegal), with respondents aiming to switch from their current activities to these programs (**Figure 3b**). Both livestock scenarios and the park-based product scenario were most likely to be seen as an addition to current activities. The regulated hunting scenario had the largest proportion of non-participation (17.4% chance), and had a significantly greater chance of being seen as an addition rather than a substitution compared to the microenterprise, park-based products and skills-training scenarios. Apart from the scenario, time spent on current activities was also significantly influenced by which protected area the respondent lived near, and the Tropical Livestock Unit (TLU) score of the respondent. Both Majete and Nkhotakota was significantly more likely to consider a scenario as a substitution rather than an addition, compared to Nyika and Vwaza Marsh. An increase in Tropical Livestock Units increased the likelihood that respondents would see scenarios as additions or would not participate, compared to substitutions.

The most common reason for respondents to treat a scenario as an addition to their current activity was that they believed they could conduct the activity in their free time, while they would treat a scenario as a substitution because they would prefer to concentrate on that activity rather than their current activities or that they would earn replacement income and as such would not need to conduct their current activities. We found that 11% of participants with valid answers to the enforcement scenario said that they would spend more time conducting legal livelihood activities (e.g. more time farming rather than hunting) under the enforcement scenario, while 87% said there would be no change in their time budgets under this scenario as they did not participate in illegal hunting.

**Meat availability in villages:** All of the scenarios except enforcement were likely to increase the availability of meat in the village (**Figure 3c**). Enforcement had 0.34 probability of resulting in less meat and a 0.5 probability of having no change. The two livestock scenarios, hunting and microenterprise had a higher probability of increasing meat availability in villages than park products and skill provision. The perception of village meat availability was influenced by which park the respondent was living near, the number of park-based projects the household was involved in, and number of meals their household ate per day. Respondents from Nkhotakota was significantly less likely to say they would eat more meat than respondents from Vwaza Marsh.

**Meat availability in households:** Similar to village meat availability all scenarios except enforcement were perceived to be likely to increase the availability of meat to households (**Figure 3d**). However, hunting was less likely to increase meat availability in households compared to the village as a whole, followed by park-based products and group livestock donation. Enforcement had a 14.5% chance of decreasing a household's meat availability.



**Figure 3: Probability of responses to scenarios for four different response variables a) intervention fairness, b) addition or substitution effect on time spent on current activities, c) availability of meat in village, d) availability of meat in household. N=245. ENF=enforcement scenario, HNT=regulated hunting, LGR= Livestock donation (group), LIN= Livestock donation (individual), MIC= micro-enterprise, PPR= park-based products, SKL=skills training**

### Conclusions for Objective 3:

We found that microenterprise and skills-training programs were most likely to cause respondents to substitute their current activities (including illegal hunting) with the program. All programs except increased enforcement were likely to increase the availability of meat in both households and villages, however there was a difference in the perceived effect of programs on village level compared to household level. Projects that provided long-term skills such as a microenterprise program or skills training were preferred over and seen to be fairer than programs relating to

resource use, such as regulated hunting and park-based product schemes. These results illustrate that for community-based programs to successfully reduce bushmeat hunting and consumption, protected areas need to move towards programs that can harness development goals, while linking back to conservation outcomes.

#### Recommendations for Objective 3:

- Explore the potential of involving development agencies to start community-based programs based on micro-enterprise or skills training. E.g. Village Enterprise Organisation or Heifer International.
- Design projects with explicit conservation links, such that project participation is dependant on not committing wildlife crimes within the park.
- Target consumption and hunting with separate initiatives, taking into account that livestock donation programs may fulfil the role that bushmeat plays in consumption needs, but not necessarily the needs met by hunting.



**A beehive locative in Nyika national park, as an example of potential park-based product initiatives**



**A coffee production enterprise, located near Nyika national park, as an example of a potential microenterprise initiative.**

#### Objective 4: Facilitation of decision-making among stakeholders

Conservation problems such as bushmeat occur in complex socio-ecological systems, and are best solved using multiple sources of data. Expert knowledge is vital to include to provide interpretation about the local political, social and ecological context that may otherwise not be fully represented. Participatory modelling is a way in which complex systems can be understood, by allowing multiple stakeholders such as experts to give their input into how the system works. This approach can be used to understand how a system may change in response to a conservation intervention, without having to collect on-the-ground data, which is vital given that many systems do not have enough information, time, money or expertise to develop an appropriate mathematical model. This is especially important in developing countries where conservation problems are urgent and there are high social and ecological stakes, but data is often not available. Importantly, this approach also allows diverse stakeholders to have a say in decision-making and make clear what social values and preferences need to be included, which is vital for conservation efforts to acquire the support they need (Nyaki et al., 2014).

We used a type of participatory modelling called Fuzzy Cognitive Mapping (FCM) to map the bushmeat hunting and consumption systems, using knowledge from Malawian conservation experts. FCMs are quick and easy to acquire, can incorporate as many knowledge sources as needed, and are easily modified, allowing changes in behaviours of the model to become clear (Özesmi & Özesmi, 2004). The FCM process was undertaken at a workshop in Lilongwe in November 2019, with participants representing 5 different organisations, including 2 universities, the international NGO African Parks, the Department of National Parks and Wildlife (both staff from individual protected areas and executives) and the Lilongwe Wildlife Trust, a local conservation NGO. The maps of the bushmeat hunting and consumption systems were generated via a two-step process where we first asked respondents to individually identify important components of the bushmeat systems and how they relate to each other and then we discussed these individual ideas during a group workshop.

We found that the hunting map had double the amount of components and connections than the consumption map, indicating greater complexity than consumption. For the hunting map, besides hunting for bushmeat, the most central variables were poverty, human population, effective prosecution, strength of law enforcement, drought and effective perimeter fencing. For the consumption map, the most central variables besides consumption of bushmeat were poverty, food security, education level, dependence on natural resources and taste of meat. Centrality indicates how connected a variable is to other variables, indicating its overall contribution to the map. Three concepts were shared as important across hunting and consumption: poverty, human population and political will. The difference between consumption and hunting maps illustrates that important components relating to hunting often relate to the effectiveness of enforcement, while consumption relates to socio-demographic factors.



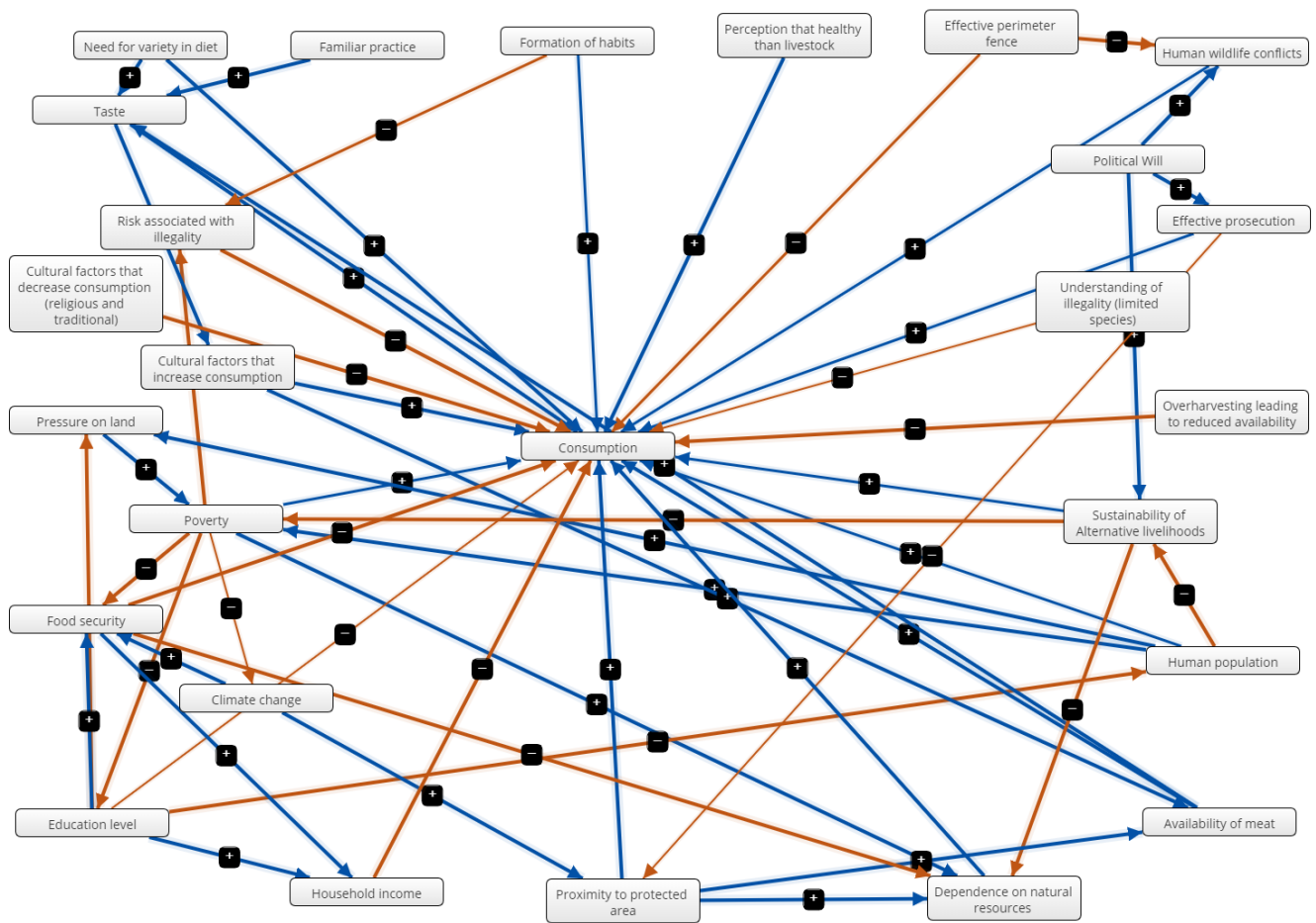


**Conducting a workshop where results were fed back to stakeholders and systems maps generated by experts.**

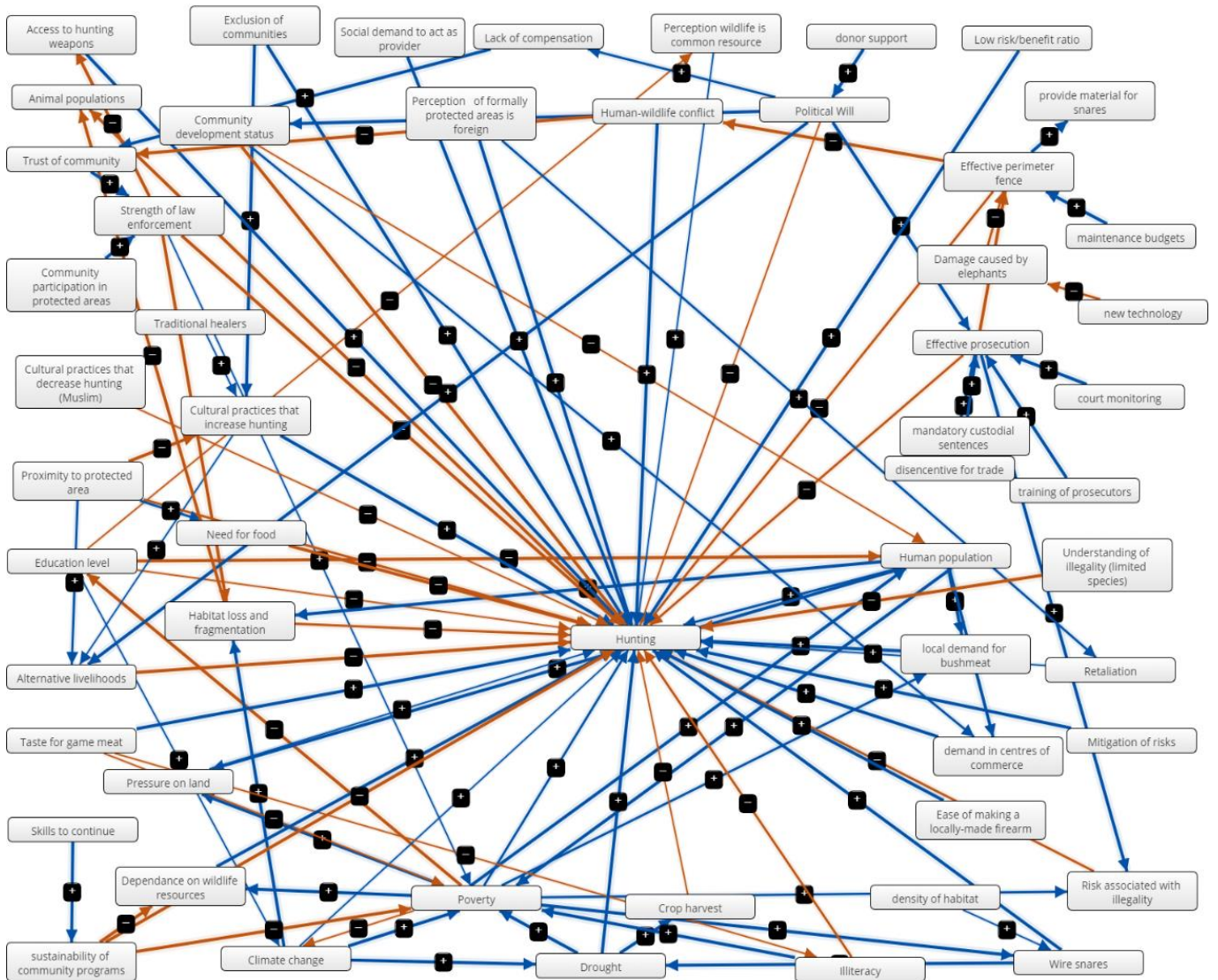


**Some of the workshop participants.**





**Figure 4: The final Fuzzy Cognitive Map for bushmeat consumption in Malawi, where blocks represent important components and arrows represent relationships between components. The colour of the arrow indicates whether the relationship is positive (blue) or negative (orange), and the width of the arrow indicates the strength of the relationship (strong relationships are wider than weak).**



**Figure 5: The final Fuzzy Cognitive Map for bushmeat hunting in Malawi, where blocks represent important components and arrows represent relationships between components. The colour of the arrow indicates whether the relationship is positive (blue) or negative (orange), and the width of the arrow indicates the strength of the relationship (strong relationships are wider than weak).**

### The effect of interventions of the bushmeat system maps:

We next investigated the effect of 3 different scenarios on the group maps. These scenarios were drawn from programs which had been investigated previously (Objective 3) and from suggestions from the group, thinking about efficacy towards reducing bushmeat hunting and consumption, cost, effect on communities and ease of implementation. These three scenarios were added as individual components to the group maps for both hunting and consumption and linkages made to other components, and the effect of the components on the stable state of the system was recorded. The programs participants chose to investigate were:

1. Wildlife farming: small/medium-sized wildlife farmed by communities to meet protein and income needs of hunters and the need for diversity in diets and taste for consumers
2. Microenterprise initiatives: participants would receive training and a start-up grant to start a business of their choice. This would help meet the income needs of hunters and allow them to move away from hunting of bushmeat

3. Ecotourism programs: local communities would directly benefit from tourism and therefore have reduced incentive to hunt

Of the three programs investigated by workshop participants, only wildlife farming was expected to directly impact both hunting and consumption of bushmeat (**Figure 6**). The other two programs were expected to impact hunting only, although given bushmeat consumption may be based on hunting, reduced hunting may lead to reduced consumption (this assumption needs to be interrogated much more thoroughly however).

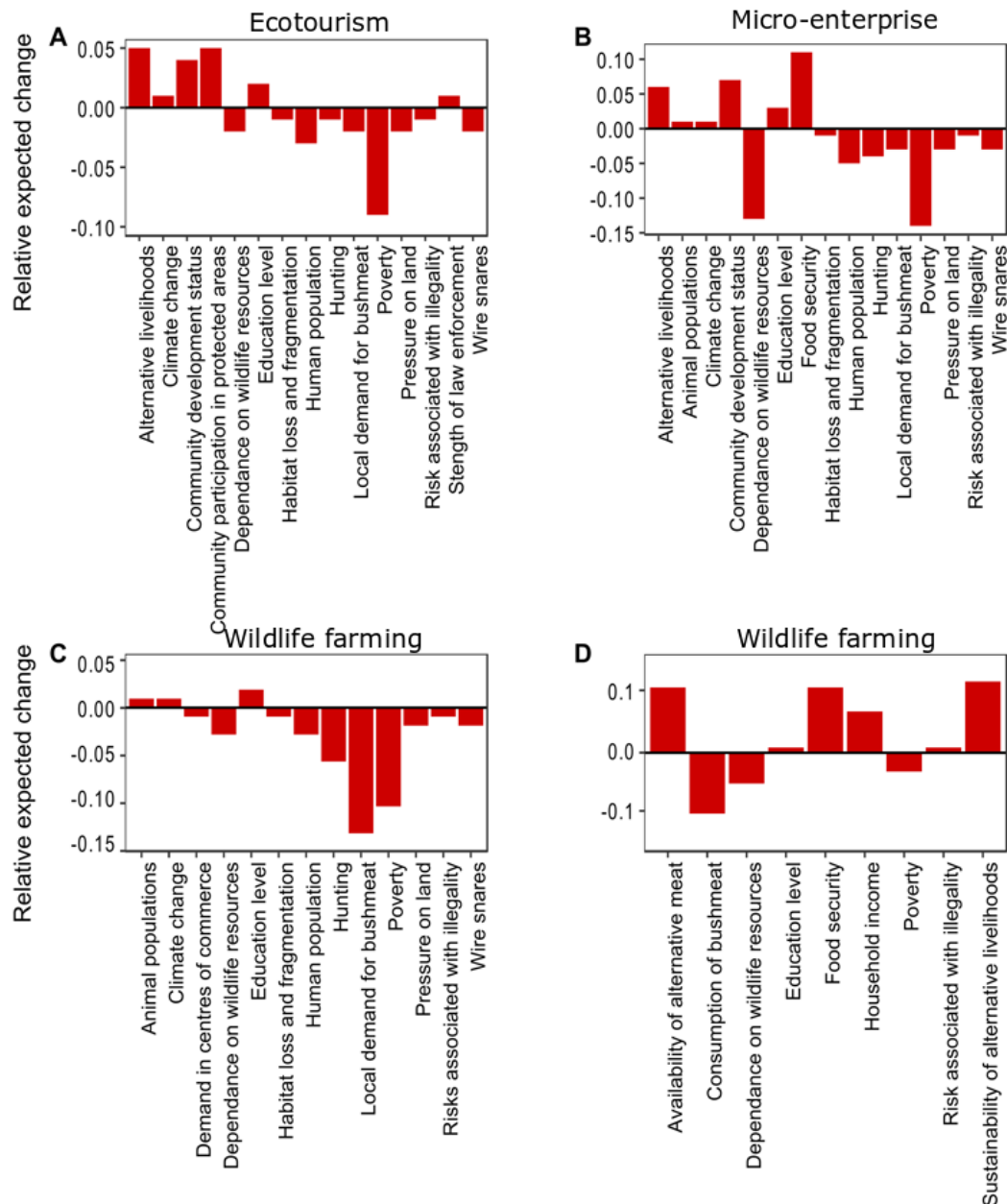
Wildlife farming was expected to have the largest reduction in bushmeat hunting, compared to microenterprise and ecotourism. All programs had relatively the same effect of decreasing poverty in communities. Animal populations in protected areas were expected to increase under the wildlife farming program and the microenterprise program. Ecotourism however resulted in more community participation in protected areas than the other two programs. Food security was expected to increase the most under the microenterprise program in the hunting model, and for wildlife farming in the consumption model. Microenterprise had the largest effect on decreasing dependence on natural resources. Local demand for bushmeat was most decreased by wildlife farming. Climate change was expected to increase slightly under all scenarios, and habitat loss was expected to decrease. Risk associated with the illegality of bushmeat hunting decreased in all hunting scenarios.

#### Conclusions for Objective 4:

Using participatory modeling and expert knowledge we were able to generate comprehensive systems maps for both bushmeat hunting and consumption. These maps can be used as a starting point for managers, and updated with new information to reflect new knowledge about this complex issue. We found that both hunting and consumption were strongly influenced by poverty, human population and political will. Human populations and poverty are key drivers of resource extraction across the world (Brashares et al., 2011; Mackenzie & Hartter, 2013), and are therefore expected to have been vital components in the bushmeat system. However, the effect of poverty on hunting and consumption has been found to vary (Travers et al., 2019), and Objective 1's results indicate that hunting increases with wealth, while consumption decreases with wealth. Therefore programs need to recognize the potential negative ecological consequences of increasing wealth in communities.

Political will affects both directly tackling bushmeat hunting via enforcement, as well as support for initiatives like community-based natural resource management or income generation projects. Governments may be unwilling to aggressively enforce anti-poaching laws in areas where communities are heavily natural resource-reliant, and protected areas themselves may often be seen as politically complex, given their history of displacement and changes to land use rights (West et al., 2006). Income initiatives and CBNRM are often seen as politically desirable as they positively impact communities and allow them rights and benefits to wildlife, and the enabling frameworks are often well established in Malawi (Mauambeta & Kafakoma, 2010). However, enforcement and community-based initiatives must work hand-in-hand and the value that wildlife holds must be adequately recognised at all levels.

Wildlife farming was potentially the most impactful of the three interventions studied, as it is expected by experts to affect both hunting and consumption of bushmeat. Wildlife farming is widely known as a supply-side intervention, which aims to supply cheap substitutes of wildlife products under the assumption that as farmed products enter the market profit from poaching will decrease and therefore there will be less economic motivation to hunt (Bulte & Damania, 2005). Wildlife farming may also act as a microenterprise scheme, allowing alternative incomes to hunters. Therefore wildlife farming can act in three ways: it can meet consumer demand legally and therefore decrease demand for illegal bushmeat, it can reduce the economic incentive for hunting, and it can provide alternative livelihood options for hunters.



**Figure 6: Relative expected change as a result of programs simulated a) impact on bushmeat hunting system as a result of an ecotourism program, b) impact on bushmeat hunting system as a result of a micro-enterprise program, c) impact on bushmeat hunting system as a result of a wildlife farming program and d) impact on bushmeat consumption system as a result of a wildlife farming program.**



## Recommendations for Objective 4:

- Conduct a feasibility assessment on wildlife farming, potentially in partnership with an NGO experienced in starting up projects based on natural resources
- Investigate the need for partnerships with veterinarians and animal husbandry specialists to ensure programmes include training on husbandry techniques, intensification of production, disease management and book-keeping
- Conduct qualitative surveys with communities to test whether farmed wildlife would be seen as a true and complete substitute for wild-caught bushmeat
- Extend the semi-quantitative maps generated to quantitative system dynamics models, which will increase the overall practical utility of such maps and link them to quantitative measures, especially animal population counts.
- Acknowledge the complexity of these systems and do not assume that one project will meet all needs, and continue community-based activities over the long term in order to build trust.

## Publications

We have three publications planned for this work:

1. Van Velden, J.L., Wilson, K., Lindsey, P.A., McCallum, H., Moyo, B., Biggs, D. (2020). Bushmeat hunting and consumption is a pervasive issue in African savannahs: insights from four protected areas in Malawi. *Biodiversity and Conservation*, *in press*.
2. Van Velden, J., Travers, H., Moyo, B., Biggs, D. (2020). Long-term skills rather than short-term resources: understanding community responses to bushmeat reduction programmes using scenario-based interviews. *Expected submission February 2020*.
3. Using participatory models and expert knowledge to understand the bushmeat hunting crisis in Malawi. *Expected submission March 2020*.

We also have a full in-depth stakeholder document in preparation, expected to be released by March 2020.

## Proposed future studies

- An evaluation project on current livelihood projects being conducted at Nyika and Vwaza, at different intervals along the project. The livestock donation project currently being implemented could be evaluated using our methods relating to sensitive topics prior to implementation, then at six months, 1 year and 2 years into the project. Key indicators would be changes to prevalences of bushmeat hunting and consumption, as well as perceptions towards the parks. Focussing in-depth on one specific project would allow key problems and assumptions to be identified.
- A study looking at bushmeat availability in urban centres, including Rumphu and Mzuzu, on the assumption that the majority of bushmeat in these areas would be sourced from Nyika

and Vwaza parks. This study could include a supply chain analysis, identifying the key actors including hunters, transporters, traders and consumers of bushmeat and their relevant drivers.

- A study investigating how much bushmeat contributes towards food security for rural communities, and investigates how different interventions may impact food security. A household economy approach could be used to identify how households cope with shocks and benefits of interventions, with the aim of ensuring that households can appropriately respond to increasing enforcement, as well as replace current bushmeat-based income with livelihood alternative programs.

## Ethics statement

We received informed consent before each interview and ensured anonymity of respondents. As respondents had low literacy levels consent as obtained verbally. This research implemented the guidelines from the Australian National Statement on Ethical Conduct in Human Research (Griffith University ethics permit number 2018/250), which was ratified by Lilongwe University of Agriculture and Natural Resources. We also received a research permit from the Department of National Parks and Wildlife Malawi (Ref 10/2018).

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