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## Wildlife Poaching practices in Tanzania's Ruaha Landscape

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### ABSTRACT

Throughout the world, millions of wild species and products are illegally collected, used, traded and exported. Tanzania's Ruaha landscape is considered a critical area for biodiversity, as well as an area where poaching exists. Despite the area being rich in abundance and diversity of wildlife, in-depth analysis of wildlife species hunted most and the methods used by poachers is lacking. This study assessed the most hunted wildlife species, extracted products and uses, and associations between wildlife products, hunting methods, and ethnic groups. Data was collected by utilizing the snowball technique after 123 poachers were given a semi-structured questionnaire in villages near the Ruaha National Park. Among the most hunted species are did-dik, impala, kudu, lion, buffalo, and elephants. Bushmeat, skin, claws, ivory, and fat were the most harvested wildlife products. 60 % of wildlife products used for food and source of income, and the methods used for illegal hunting were domestic dogs, spears, snares, and torches. The findings are critical for understanding the link between the most poached species, products, and methods used in relation to ethnic groups in the Ruaha landscape. Increased anti-poaching patrols

and wildlife conservation awareness could help reduce the dependence of local communities on wildlife products.

**Keywords:** wildlife products – poachers - poaching methods - ethnic groups - Ruaha landscape.

### INTRODUCTION

Throughout the world, millions of wild species and products are illegally collected, used, traded, exported, and imported (Roe *et al.* 2002, Janine *et al.* 2018, van Uhm *et al.* 2018, Mrosso *et al.* 2022). Poaching of wildlife species has been found to have substantial detrimental consequences for the ecosystem and community's livelihood, including loss of biodiversity, an increase in illegal wildlife trafficking, and changes in land use (Ntiama-baidu 2014, Kidegesho 2016, Rija 2022). Because poaching is not selective mainly because of the methods used in illegal hunting, the rate of declining of important species including those serve as an umbrella and keystone species is high (Loibooki *et al.* 2002, Caro 2003, Ibanga 2017). For instance, elephants, rhinoceros, lions, tigers and pangolins are under the category of endangered species due to overuse of their body parts and trade (Vira *et*



al. 2014, Ibanga 2017, van Uhm *et al.* 2018, Challender *et al.* 2020). The miscellaneous uses of wildlife species not only influence illegal trade in these species but also create demand for other less concern wildlife species in the trade flow like impala, kudu, giraffe, warthogs and zebra (Wilfred and Maccoll 2010, Ibanga 2017, Andimile and Floros 2021).

The main variation of usage of wildlife products in many domestic and foreign marketplaces is monetary values, beliefs, myths, traditional remedies, and food. (Loibooki *et al.* 2002, Erosion 2014, Wong 2017). Any portion of a wild animal's body, such as horn, ivory, tooth, bone, claw, hoof, skin, meat, hair, feather, egg, or full body are referred as the, wildlife product (URT 2009, Bennett 2014). The majority of wildlife products are marketed and used in a variety of ways (Nijman *et al.* 2019). Meat is used as food; skin, bones, teeth, and claws for ornamentation; while fat and other parts of the animal are used for traditional medicine and witchcraft. For instance, in Nigeria they used feathers, lion and leopard skins in their ritual ceremonies when the kings come into power (Adeola 1992, Nijman *et al.* 2019). In East Africa, especially Tanzania wildlife products such as wild meat is widely used in the communities living near protected areas (Barnett 2000, Angela *et al.* 2012, Ceppi and Nielsen 2014, Mrosso *et al.* 2022). In other cases, there is a diverse use of wildlife products such as lion derivatives by the pastoral communities in order to earn respect and as a symbol of bravery and fame (Adeola 1992, Coal *et al.* 2020) wildlife products are one of the world's largest businesses projected to be treasured between \$9 to 20US billion dollars per year due to many applications including diet, treatments, furnishing, apparel, pets and spiritual items (Walsh 1995, Reeve 2002, Boakye *et al.* 2018, van Uhm *et al.* 2018), however, obtaining these wildlife items can be difficult depending on the location and law enforcement resources available (Lindsey *et al.* 2013). As a result, poachers who are local communities have developed a wide range of

hunting methods such as spears, bow and arrows, guns, poisons, traps, holes, and dogs in order to collect wildlife products like meat, skins, fat, ivory, bones and the whole animal body (Coppolillo 2004, Gandiwa *et al.* 2014, Ogada 2014, Samwel 2017). According to Swamy and Pinado-vasquez (2014) the availability of indigenous and modern hunting tactics or methods, which are extensively exploited by poachers to hunt wildlife species, facilitates the escalation and demand for wildlife species and their products.

Poaching threatens the protection of wildlife species in Tanzania, as it does in many other African countries (Kidegesho 2016, Nielsen *et al.* 2016, Rija 2022, Mrosso *et al.* 2022). The Ruaha landscape in Tanzania, where this study was conducted, is branded as one of the country's most important conservation areas, which is home to a diverse range of wildlife species (Dickman *et al.* 2014, Abade *et al.* 2014, Strampelli *et al.* 2022), however, is a landscape where poaching of wildlife species has been noted (Barnes and Kapela 1991, Knapp *et al.* 2017, Beale *et al.* 2018). Much of the existing research in this area focuses on iconic species like elephants and lions (Beale *et al.* 2018, Mkuburo *et al.* 2020, Coals *et al.* 2020, Strampelli *et al.* 2022). There is a scarcity of information about illegal wildlife products, their uses, and poaching techniques or methods used in the Ruaha landscape, particularly for several species. As a result, our study fills in the knowledge and information gaps described before. The findings from this study are essential in supporting conservation efforts in this region and elsewhere where similar issues exist.

## MATERIALS AND METHODS

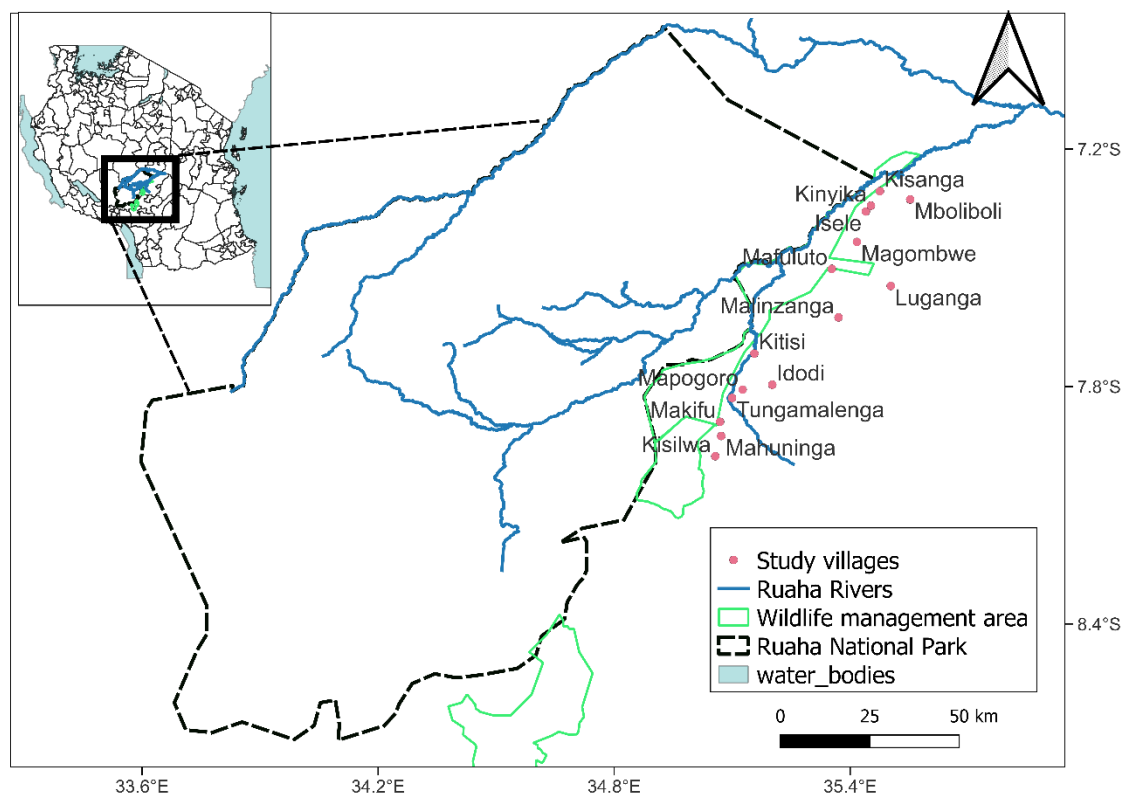
### Study area

Ruaha landscape covers about 43,000 km<sup>2</sup> and is composed of core Ruaha National Park, and the adjacent game reserves, game controlled areas, wildlife management areas, and village lands (Strampelli *et al.* 2022,



Kimaro *et al.* 2022). This landscape is abundant in wild species and diverse in flora and fauna (MNRT 2011). Our research focused on 16 villages, at the southeast boundary of Ruaha National Park and adjacent to the Pawaga-Idodi Wildlife Management Area, which are part of the Ruaha landscape, ranging from 33.5<sup>0</sup> to

35.5<sup>0</sup>E and from 5.7<sup>0</sup> to 8.7<sup>0</sup>S (Fig. 1). These villages between located in the Pawaga and Idodi divisions and were chosen because of their history of poaching, as indicated by other recent studies on illegal hunting of wildlife species in the area (Barnes and Kapela 1991, Coppolillo 2004, Knapp *et al.* 2017, Coals *et al.* 2020, Mrosso *et al.* 2022).



**Figure 1: Map of the study area.**

### Data collection

Each division (Pawaga and Idodi) had eight villages, each of which was divided into strata, the sampled population presenting independent sample in each division. We used a semi-structured interview to collect primary data from 123 poachers across the study villages, which we analyzed and improved with seven local experts and village leaders. The information covered demographics data, poaching experiences, preferred wildlife species, wildlife products involved, product uses, and wildlife hunting strategies. Our sample was formed from a list of people in the village who were known to be poachers, who then compiled a list of

additional poachers in the area, the majority of these poachers were men, a current weakness of this study is the lack of women's narratives on their poaching experiences, product use, and hunting techniques, which should be addressed in future research designs We employed snowballing technique to obtain the respondents (Bryman 2008, Vo 2020). We did not interview wildlife officials from the government, and we recognize that this present potential limitation of our understanding of the spatial and temporal poaching intensity in this landscape and the mitigation efforts that have been implemented. As a result, more research in this area is required.



Before beginning the interviews, we gave each person a thorough explanation of the study, including how their identity would be secured and how their interview data would be used, and we acquired verbal free and informed consent from each participant. Participants were informed that they could opt out of the study at any moment and have their personal information erased. Participants were also aware that they had the option of refusing to answer any questions during the interview process. The interview was performed in Swahili and participant replies were recorded in English. The PI was accompanied by an indigenous field assistant who assisted with the locating of participant residences.

### Data analysis

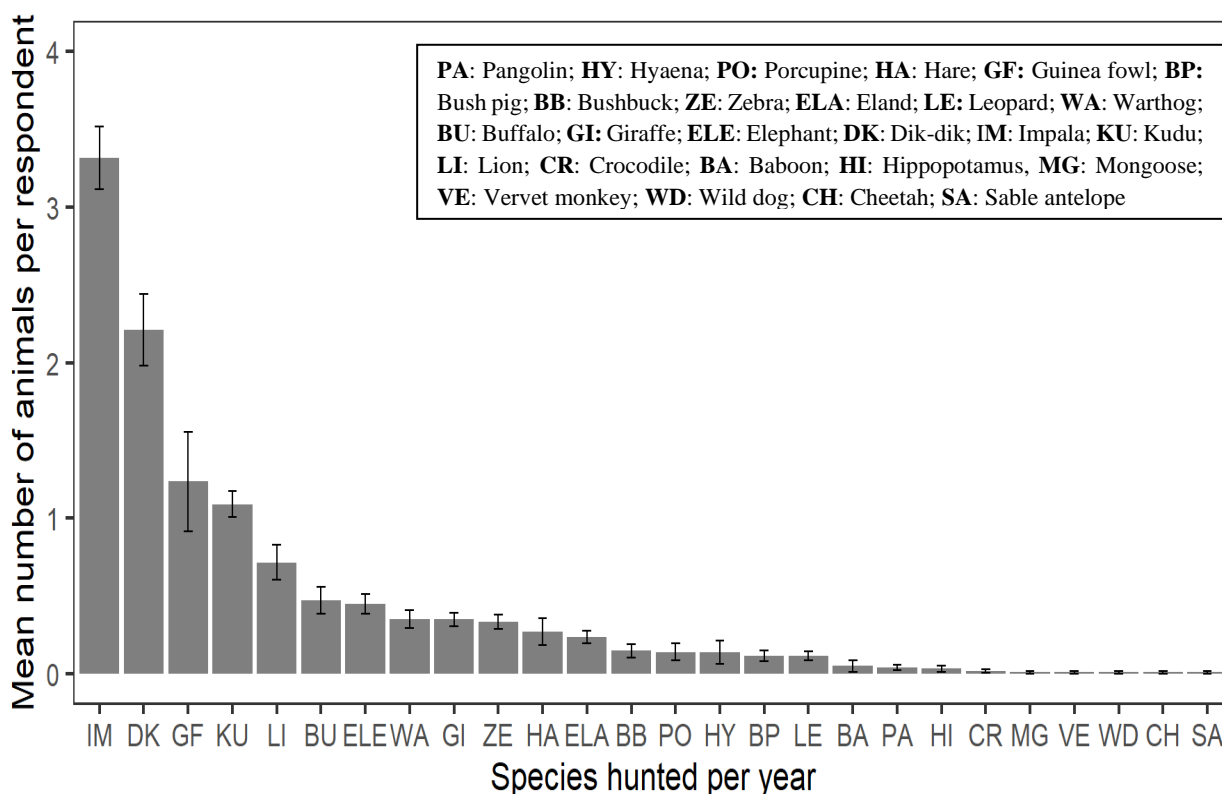
Data cleaning was done with Microsoft Excel, and data analysis was done with R software (R Core Team 2021). The Generalized Linear Model (GLM) was used to quantify the variation in number of

while Fisher's test was used to assess the association between wildlife products and species involved. The chi-square test was used to assess differences in product usage frequency. Mosaic analysis was performed to assess the correlation between wildlife products and ethnic groups. Furthermore, mosaic analysis was performed to assess the correlation between hunting methods and ethnic groups.

## RESULTS

### Most poached wildlife species

The study found a significant variation in number of animals hunted between different species (GLM, Deviance = 2625.37, DF = 25, P = 2.2e-16). Impala, dik-dik, kudu, guinea fowl, lion, buffalo and elephants were the most commonly hunted species (Fig. 2; full list of all species found in supplemental 2). This means that small and medium-sized wild animals are hunted more than large



animals hunted between different species, ones.

**Figure 2: Number of animals hunted per year, by species**

### Wildlife products



A total of forty wildlife products were identified, representing 26 species, including pangolin which is listed on CITES Appendix 1 as prohibited for trade (Supplemental 3). To improve precision, the study concentrated on species that contributed to more than 5% of total counts. The warthog, lion, kudu, impala, giraffe, elephant, dik-dik, and buffalo were among the species with sufficient counts (more than 5%) for further analysis (Fig. 3). The findings demonstrate a strong association between most hunted species and wildlife products harvested (Fisher's test,  $P = 2.2e-16$ ). Bushmeat hunting appeared to be associated with all species (warthog, lion, kudu, impala, giraffe, elephant, dik-dik, and buffalo). Skin, claws, and fat associated more with lions, while ivory associated with elephants (Fig. 3).

### Wildlife products use

The product use categories considered in this study had a substantial difference ( $\chi^2 = 62.409$ ,  $DF = 4$ ,  $P = 9.035e-13$ ). The majority of respondents (60%) said they used wildlife products for food and as a source of income (Fig. 4). When these categories were compared to each other, all pairs were significant ( $p < 0.05$ ) except for the comparison between a trophy and medicinal uses, trophy and spiritual uses, food and income use, income and food uses, and finally between medicinal and spiritual uses ( $P > 0.05$ , Table 1).

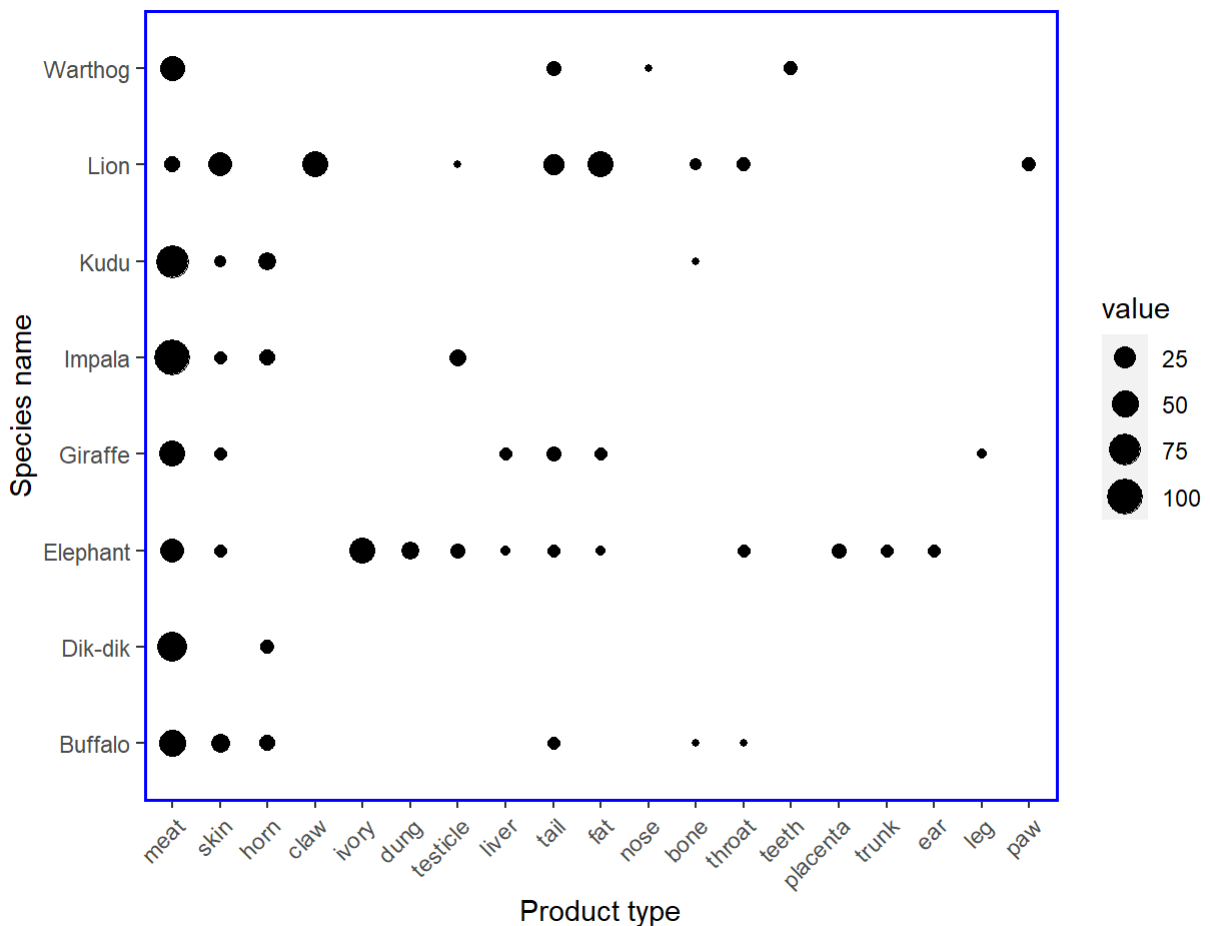
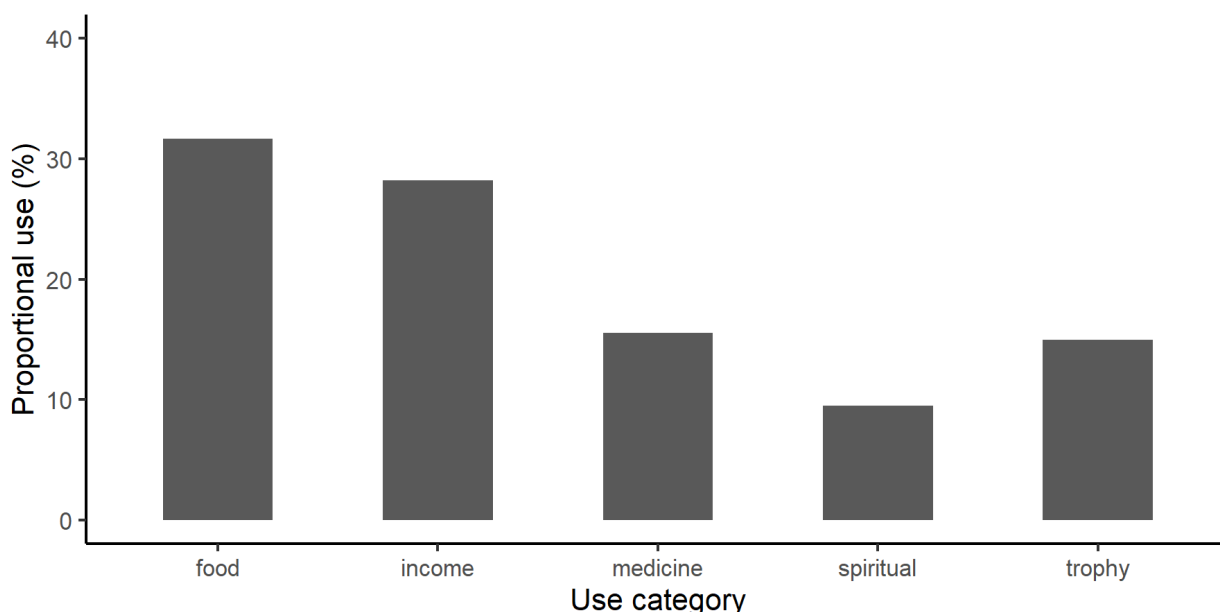


Figure 3: Frequency of wildlife products for each species as reported by participants around the Ruaha landscape.



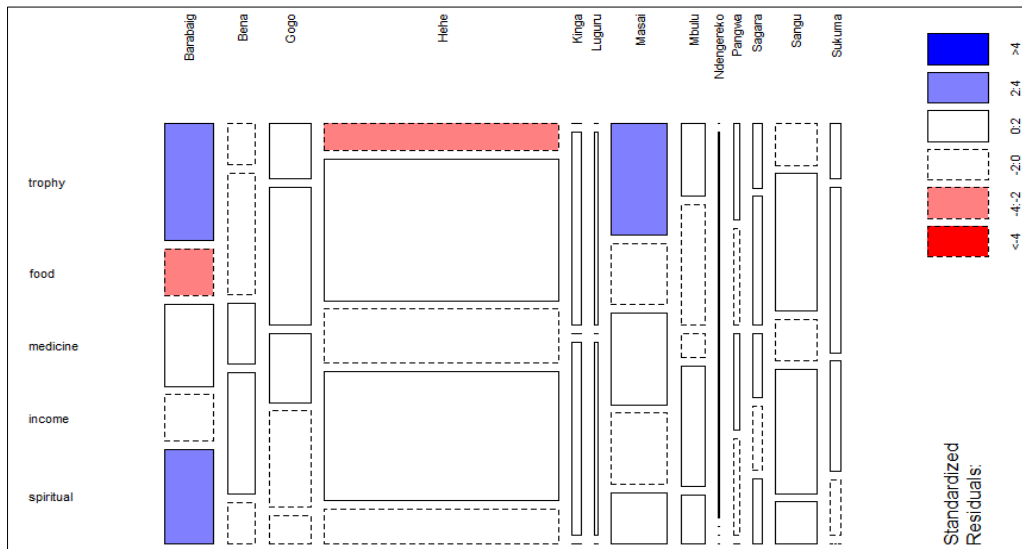
**Figure 4: Proportion of wildlife products per use category**

**Table 1: Chi-square post hoc pairwise results derived to compare probability values of wildlife product categories as reported by respondents.**

Wildlife product comparison	P value
Trophy vs food	1.4e-07
Trophy vs medicine	0.2436
Trophy vs income	1.2e-09
Trophy vs Spiritual	0.3932
Food vs medicine	0.0036
Food vs income	1.0000
Food vs Spiritual	0.0017
Medicine vs income	0.0001
Medicine vs Spiritual	1.0000
Income vs Spiritual	5.2e-05

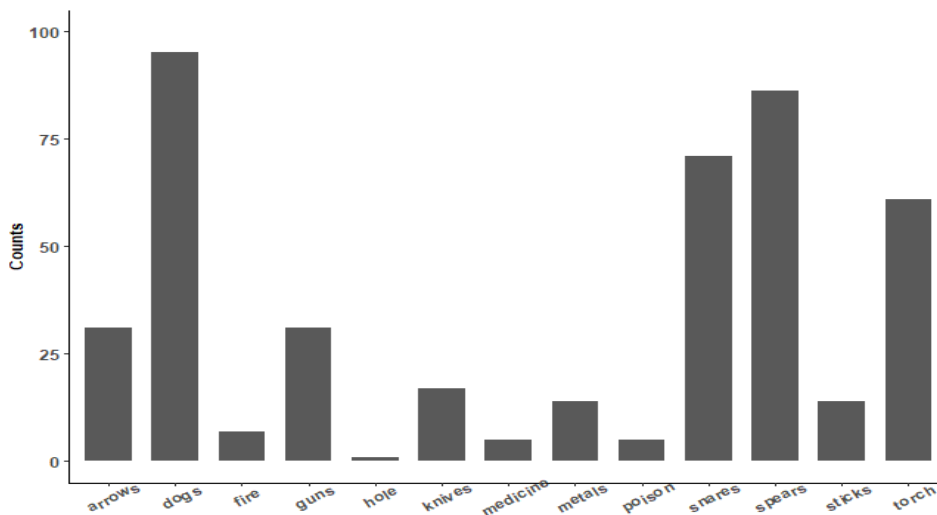
Further analysis suggested a link between wildlife products and ethnicity; however, ethnicity was found to have only a minor impact in our investigation (Fisher's test,  $P=0.05$ ). Despite the minor overall association of ethnicity with wildlife products, on a fine scale, the pastoral tribes particularly the Barabaig and Maasai had a strong positive association with using wildlife products as traditional trophies. Whereas non-pastoral tribes, particularly the Hehe tribe, had a negative association with using wildlife products as trophies, preferring to use them as food and a source of income (Fig. 5). In

comparison to other tribes, the Barabaig tribe has a stronger favourable connotation with the usage of wildlife products for spiritual purposes. Wildlife products were discovered to have various uses, with pangolin scales having more than other products (supplemental 4). This indicates that despite the fact that pangolins are not among the most hunted animals, their body parts, notably their scales, are widely used. Lion fats were another product shown to have several uses after pangolin scales (supplemental 4), showing that lion protection in the Ruaha landscape is critical



[bright blue = strong positive association; bright red = strong negative association; Solid bars = strong positive association; dashed bars = strong negative association]

**Figure 5: Association of wildlife product types and ethnic groups in the Ruaha landscape.**



**Figure 6: Hunting methods used by hunters for harvesting wildlife products in the Ruaha ecosystem**

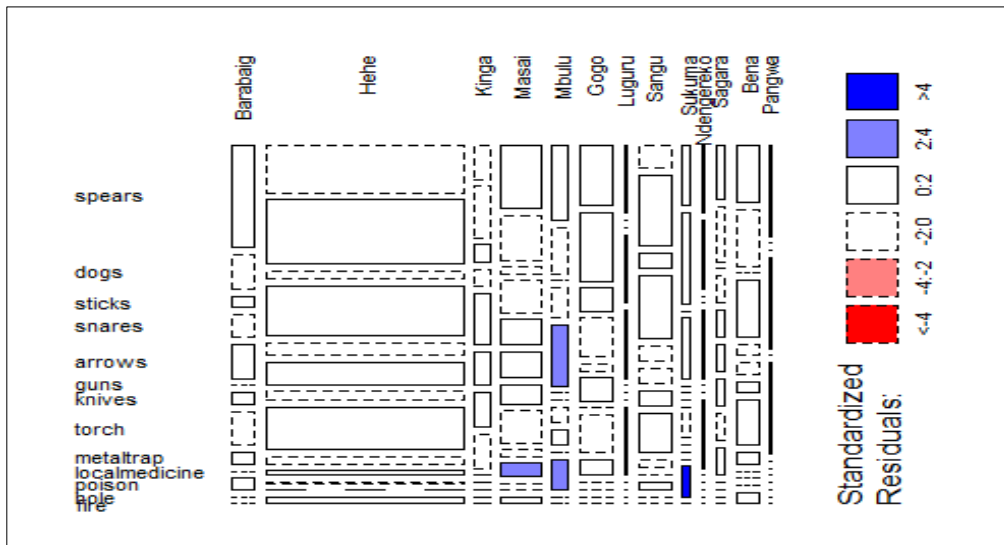
### Common hunting methods

According to our assessment of poaching methods, local poachers primarily utilize dogs, spears, snares, and torches included as an accessory to hunting tools (Fig. 6).

When we assessed the relationship between hunting methods and ethnicity, we found that agro-pastoral tribes, particularly the Mbulu tribe, had a strong positive association with the use of snares and poison as their primary

strategy for hunting wildlife (Fig. 7). Pastoral tribes, particularly the Maasai, have close ties to the usage of traditionally prepared organic poison for hunting wildlife, while the Sukuma tribe dug tunnels to capture animals (Fig. 7). As a result, hunting practices vary per tribe, which may aid in providing anecdotal evidence when examining wildlife mortalities and when addressing poaching issues.





[bright blue = strong positive association; bright red = strong negative association; Solid bars = strong positive association; dashed bars = strong negative association]

**Figure 7: Relationship between hunting methods and ethnic groups in the Ruaha landscape.**

### DISCUSSION AND CONCLUSION

This survey used semi-structured interviews to gather information regarding the most hunted wildlife species, types of wildlife products and their uses, and the techniques used in illegal hunting in Ruaha landscape Tanzania. This study found that wild animals such as impala, greater and lesser kudu, dikdik, giraffe, buffalo, lions and elephants and warthog were the most hunted species in the Ruaha landscape. Similar to the findings of Wilfred (2020), a comparable study from Setsaas *et al.* (2007) suggested that impala and other small mammals are widely poached in Ugalla Game Reserve and Serengeti National Park, also reported in other places in Africa (Goncalves *et al.* 2019, Andimile and Floros 2021, Rija 2022). The demand for wild meat is very high in Ruaha landscape (Knapp *et al.* 2017, Mrosso *et al.* 2022) and it was also pointed out by the recent study in the Serengeti National Park that illegal hunting for meat influence the decline of large mammals like buffalo and Topi (Samwel 2017, Rija *et al.* 2020). The reason could be due to the high value and large content of meat; it was also considered the source of protein in many parts of African families (Barnett *et al.* 2000). In the same

cases, Caro (2017) and Wilfred (2020) found that larger mammals like a hippopotamus and African elephants were highly poached due to their meat and teeth in Katavi National Park and also widely reported in other places (Lindsay *et al.* 2013, Kidegesho 2016, Rija 2017). Several studies in the Ruaha landscape and other places indicated the illegal killing of large carnivores like lions and hyenas for various reasons like traditional, spiritual, and commercial purposes (Dickman 2010, Ogada 2014, Coal *et al.* 2020). The illegal hunting of wildlife species is very common in the Ruaha landscape as it was reported in other protected areas (Fa *et al.* 2015). The diverse use of wildlife products is considered the reason for the high harvesting of these wildlife species in the Ruaha landscape.

The analysis of wildlife products demonstrates a strong relationship between most hunted species and wildlife products harvested, implying that products often reported by poachers are from the most hunted animal species. This corresponded to the study conducted in Ugalla Game Reserve which found similar results (Wilfred 2020). Wild meat appeared to be the most wildlife products obtained from these species similar



to the findings of Wilfred (2020). Here in the Ruaha landscape we found a total of 40 different wildlife products from 26 species like meat, skin, claw, fat, tail, horn, ivory, trunk, teeth, excreted, bones, liver, intestines, placenta, hair, scales, hooves, nose, ear, paw, spine, legs, testicles, throat, etc. The illegal hunting for these products was not only observed in the Ruaha landscape alone (Coal *et al.* 2020) but also Wilfred (2020) found that majority of the poachers in Ugalla Game Reserve were arrested and confiscated some similar wildlife products as mentioned in the Ruaha landscape (Adeola 1992, Boakye *et al.* 2018; Nijman *et al.* 2019). The demand for wildlife products continue to increase globally and its impact is widely experienced in decline of most important species like elephants, rhinoceros, lions, tiger, pangolins, and some primate species (Vira *et al.* 2014, Soewu and Sodeinde 2015, Wong 2017). Conservation strategies should put more effort in both source and destination of wildlife products, this could help to the reduce demand for wildlife products.

In the Ruaha landscape, we found diverse use of wildlife products mostly for food, income, medicines, trophy, and spiritual uses. Wild meat was the common product used by the majority as the food or source of protein supplements and as a commodity that generate income. Our analysis suggested that more than 60% of the illegal hunting is targeted for obtaining wild meat which is almost relevant to the findings of Mgawe *et al.* (2012) suggested more than 71% of the wild meat is hunted for food and income in the Katavi ecosystem. In line with this, a current study by Wilfred (2020) revealed more than 50% of the confiscated wildlife products were meat and was commonly used for a similar purpose. However, the previous study by Merode *et al.* (2004) found that there is high 90% dependence on wild resources especially meat by the majority of the people in the Congo DRC. Wild meat is sold extensively at the village levels and in some cases exported to urban or towns (Jones *et al.* 2019, Andimile and Floros 2021). Our study found that wild meat is

widely consumed and secretly sold within the villages, and in some cases, it can be exported to town to the specified customers as pointed out by previous studies (Lindsey *et al.* 2013; Jones *et al.* 2019; Ceppi and Nielsen 2014, Samwel 2017). This implies that wild meat is not only considered as an important source of protein but also a major alternative source of income. In other cases, some respondents claimed that they will not stop illegal hunting and consuming wild meat because it is part of the inherited culture and their forefathers were hunting in the Ruaha landscape. This finding is also consistent with the study conducted in Serengeti national park which denoted the consumption of Topi (*Damaliscus lanatus*) meat as a source of protein and income activity (Samwel 2017). However, we found a strong association between the use of wildlife products and the ethnic groups in the Ruaha landscape. The findings suggested that pastoralists were more strongly associated with possession of wildlife trophies than other tribes. This finding is consistent with previous studies conducted in the same area (Dickman 2009, Dickman *et al.* 2014; Coal *et al.* 2020).

Further analysis revealed the extensive uses of wildlife products for medicines, (trophy) decoration, and spiritual. The use of wildlife products for medicine, spiritual and as the trophy is consistent with other previous studies in Ugalla (Wilfred 2020), Serengeti (Samwel 2017), Katavi Rungwa ecosystem (Mgawe *et al.* 2012, Caro 2017) and western Africa (Adeola 1992). For instance, the majority of the respondent admitted to using skin, bones, fat, paws, tail, throats, and teeth of lions and leopards as traditional medicines to cure various ailments in children and adults, moreover, these parts are used as protection and chasing away evil spirits (Supplement 4). In several parts of Africa, the skin of lions or leopards is used as a symbol of power and authority (Adeola 1992; Barnett 2000), in Eastern Africa, these products are considered medicines and as an item of earning money (Dickman 2009, Coal *et al.* 2020). The case is very different in



Asian and European countries like China, Vietnam, and Thailand these products are wide luxury products and used to manufacture clothes, and shoes (Lindsay *et al.* 2013, Wong 2017). The previous studies the on illegal trade of wildlife products indicated China and other Asian countries were the big consumers of wildlife products especially elephant ivory, rhino horns, tiger bones, and pangolin products like scales and meat (Lee *et al.* 2019). This suggests the intensity of the illegal hunting in the Ruaha landscape which urgently needs a conservation plan for the future of the remaining population of wildlife species in this landscape.

Furthermore, the study revealed the commonly uses of dogs, spears, snares, and torches as methods of illegal hunting in the Ruaha landscape. The majority of the respondent in this landscape admitted to using those methods because are available and are less expensive compared to other methods like guns. However, Merode *et al.* (2004), Mgawe *et al.* (2012), and Knapp *et al.* (2017) reported that the majority of poachers use guns followed by wire snares to hunt wildlife species. Several studies in the Serengeti ecosystem reported wire snares as the most used methods for illegal hunting (Campbell *et al.* 2001, Knapp 2012, Bitanyi *et al.* 2012, Lindsay *et al.* 2013) but here in Ruaha dogs were mostly used as hunting gear for the majority of poachers. This implies that there is a geographical variation in using hunting methods. Any uses of these methods pose detrimental effects on the wildlife population since some of these methods are non-species selective such as wire snares (Bitanyi *et al.* 2012, Lindsay *et al.* 2013, IUCN 2018), pitfall traps, poisoning, and dogs (IUCN 2018, Wilfred 2020). Our results in the Ruaha landscape contradict that of Knapp and others (2017) who reported that the majority used guns followed by snares and arrows, our finding suggested that dogs were mostly used as hunting gear followed by spears, snares, and torches. Although there are slight differences, further analysis shows that the

use of spears is consistent in both studies. And also it was reported by other studies in the area that spears are responsible for declining of many wildlife species especially large carnivores (Dickman *et al.* 2014, IUCN 2018, Coal *et al.* 2020). Moreover, we found an ethnic variation in the hunting methods, generally, spears and poisons were commonly used by agro-pastoralists and pastoral communities like Maasai and Barbaig (Dickman *et al.* 2014). While Hehe and other non-pastoralist are strongly associated with using dogs and torches in illegal hunting. These findings suggested that hunting practices vary per tribe, which may aid in providing anecdotal evidence when examining wildlife mortalities and when addressing poaching issue

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