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RESEARCH ARTICLE

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Wild animal attacks and other occupational risks perceived by Indigenous hunters and fishers in the Yangambi landscape

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ABSTRACT

Hunting and fishing support diverse food systems in tropical forest areas, but carry serious occupational risks. Health and safety at work is important to human wellbeing and constitutes an element of Indigenous rights. This issue has received attention in the regulated sector, but needs additional focus in subsistence and informal economies. We draw on semi-structured interviews with Turumbo hunters and fishers in the Yangambi Biosphere Reserve region (DRC) to assess perceptions of occupational risk, especially attacks from wild animals. Fishers were concerned about drowning and cuts, while hunters cited bad weather and injuries from faulty equipment. There was gender-specific perception of risk from wild animals that reflected different roles: women noted snake bites and wasps, while men feared larger animals. Retaliatory behaviors among respondents included killing various species. The risks associated with fishing and hunting in tropical forests should be addressed in policies that consider the wellbeing of the poor.

KEYWORDS

Health and safety; sustainable use; tropical forests; wildlife conflict; workplace injury; UN SDGs

Introduction

Hunting and freshwater fisheries are part of the informal economy of many tropical forest areas, providing pathways to reduction of poverty and inequality, and guaranteeing food and income for the poor (Cawthorn & Hoffman, 2015; Coad et al., 2019; Noble et al., 2016). Opportunistic harvesting of fish (Funge-Smith & Bennett, 2019) and wild meat (Alexander et al., 2015; Nielsen et al., 2018) can fulfill nutritional needs in typically unreliable and informal cash economies (Dounias, 2016; Golden et al., 2011; Lewark, 2022). These wild resources may represent a safety net, or fall-back in times of emergency, e.g., illness or major floods (Coomes et al., 2010; Shackleton et al., 2011). Hunting is often resorted to in periods of shortage and by vulnerable households to overcome crop failures or natural disasters (De Merode et al., 2004; Schulte-Herbrüggen et al., 2013; van Vliet, Schulte-Herbruggen, et al.,

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2018), while riverine households in the Amazon Basin respond to crop losses primarily by intensifying fishing effort (Takasaki et al., 2010).

Given their significance to food security and local economies, small-scale hunting and fishing are incorporated into several of the UN Sustainable Development Goals (SDGs). These capture sectors are also recognized as an important pressure on many exploited animal populations, being addressed by sustainable use policies in much of the Global South (FAO, 2022), although higher level impacts from pollution, river modification and deforestation often induce more significant environmental impacts (IUCN, 2022). Despite the prominence of hunting and fishing, there has been relatively little focus on the occupational risks associated with these potentially dangerous activities in Indigenous systems (Chen et al., 2020). Evidence from temperate and northern regions shows that hunters can be exposed to severe risks, including hearing loss from gun shots (Kluth & Wurm, 2018), accidents due to changing ice conditions in the Artic (Laidler et al., 2009), and high suicide rates for male hunters due to occupational stress (Skegg et al., 2010). In tropical regions, fishers commonly experience fever and diarrhea, as well as dangerous weather conditions (Zakaria et al., 2022) and injuries from animals (Prusty & Sharma, 2023). Hunters can also experience animal attacks (Headland & Greene, 2011), and may be exposed to zoonotic diseases (Deutz et al., 2002) which pose potential risks to broader public health (Van Vliet et al., 2017). Perceived danger from wild animals can translate into retaliatory behavior, including killing of various species (Allen et al., 2023).

Human safety and wellbeing, especially freedom from workplace-related sicknesses and injuries, underpin social, economic and environmental aspects of sustainable development (Jain et al., 2018; Jilcha & Kitaw, 2017; Kavouras et al., 2022; Molamohamadi & Ismail, 2014; Reis et al., 2020). This important link exists because workplace accidents and illness lead to poor health outcomes and loss of productivity which can negatively affect individuals, households, and the broader economy. Even in regulated sectors, occupational health and safety challenges are particularly acute in Africa and other parts of the Global South (Jilcha & Kitaw, 2017; Yovi et al., 2021). In this context, the International Labour Organization (ILO, 2022) specifically connects health and safety at work (including in the home) to the UN SDGs. Health and safety challenges may be even greater for local people who are reliant on unregulated hunting and fishing for income or subsistence (Mosepele & Ngwenya, 2010; Kolawole & Bolobilwe, 2019), leading the FAO Committee on Fisheries to suggest that improving safety in small-scale fisheries is an element of Indigenous people's rights (Aguilar-Manjarrez, 2018).

The main objective of this study was to better characterize occupational risks, especially animal attacks, in unregulated Indigenous hunting and fishing systems. A second aspect was to evaluate how perceived risks from wild animals can result in retaliatory killing of potentially vulnerable species. We present results from 382 semi-structured interviews with Turumbo hunters and fishers in the Yangambi region of the Democratic Republic of Congo (DRC), where these activities support both subsistence and an important informal market. We assessed perceptions of risks in both hunting and fishing, taking into consideration variables such as gender.

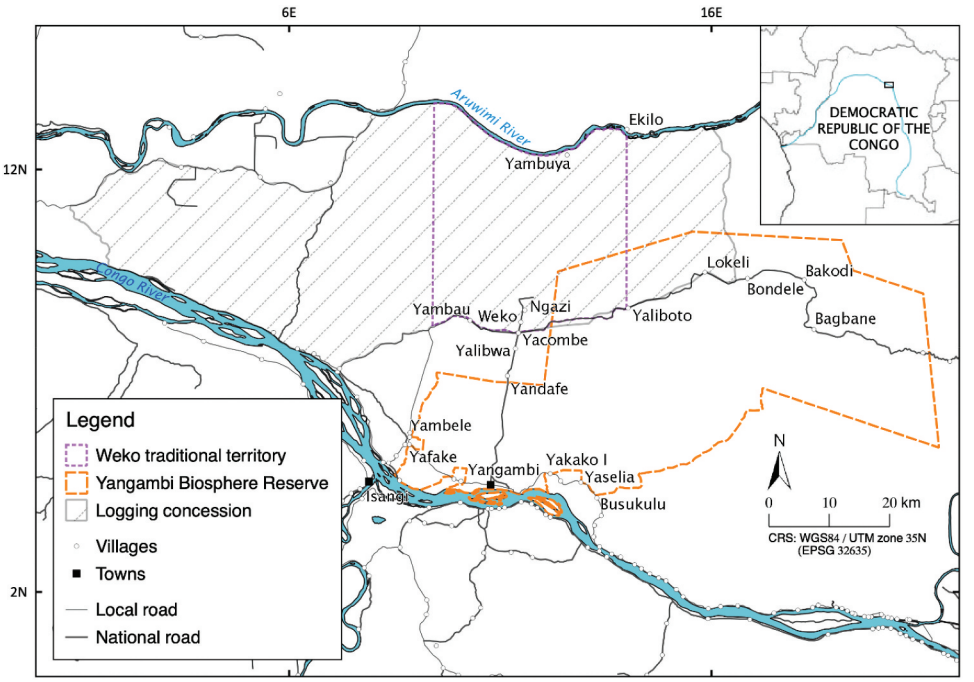


Figure 1. Map of the Yangambi study region in DRC.

Methods

Study Site

Our study focused on eight villages in the Yangambi Landscape (Figure 1) located in the northeast of the DRC, about 100 km West of Kisangani City in Tshopo Province. The Yangambi landscape comprises the Man and Biosphere Reserve and the town of Yangambi. The local Registry Office estimated in 2016 that about 142,000 people of mixed ethnic origins live around the reserve. Most of the rural population identify as Turumbo, traditionally known for their hunting skills (Omasombo Tshonda, 2020). Fishing and hunting are both legal around Yangambi, and contribute an important component of dietary intake among both rural and urban households (Alves & van Vliet, 2018) despite gradual population declines among larger target species (Shephard et al., 2024). Traditional agriculture, including cultivating cassava, banana, and maize, is the main activity in local villages and provides basic household food security and livelihood.

Data Collection

Data were collected as part of the development and conservation project FORETS (Formation, Recherche et Environnement dans la TShopo) implemented by the Center for International Forestry Research (CIFOR) in partnership with national research institutes and in close collaboration with village authorities. We received approval for this study from the CIFOR ethical committee and obtained permission from village chiefs before conducting any field work. Informed consent was sought at individual level, asking

respondents if they were willing to participate in the survey after the interviewer explained the objectives of the research. Our research team has worked with community members from the Yangambi landscape since 2017 and has built a relationship of mutual trust over the years, which helped us to gather clear and accurate information during the interviews, as well as ensure enough time to observe local practices.

We deployed a mixed-methods approach based on participant observation and semi-structured interviews applied to adults involved in either fishing or hunting in all eight Turumbo communities in the Yangambi landscape. In 2018, van Vliet, Muhindo, et al. (2018) identified 285 persons (all men) that self-identified as professional hunters (hunting being their primary income generating activity) in the eight Turumbo communities. A further 399 persons self-identified as professional fishers, amongst which 40% were women. To select persons to be interviewed, we visited these hunters and fishers pre-identified in van Vliet, Muhindo, et al. (2018), with the aim of interviewing a representative sample of hunters (men only) and fishers (women and men) for the current study. Household visits took place during the evening to ensure that we would not interfere with other important household activities. If the hunter or fisher was available and willing to participate in the interview, we proceeded to explain the purpose of the study and asked for personal consent to proceed with the interview.

Interviews were conducted from September to November 2021. The semi-structured interview included questions about the socio-economic background of the person (age, gender and main livelihood activity). The questionnaire inquired about the main methods used for fishing or hunting and the most commonly targeted species in the last 30 days, as well as primary ongoing risks that participants perceived in their main occupation and what strategies they might put in place to reduce those risks. If wildlife impacts were mentioned as part of the primary risks, we asked the interviewee to list the main species concerned, the specific risks posed (injury or death, destruction of equipment or other). To gather more information about these wild animal-related events, we also asked the interviewee to tell a personal story of where such an event had occurred, describing the circumstances of the event and how they felt about it.

Data Analysis

We categorized perceived risk for hunters into use of unsafe equipment, killing or being killed by another hunter, not finding any game, and various risks related to wild animals. Risks perceived by fishers were categorized into wild animal attacks, bad weather (e.g., extreme cold, storms etc.), being hurt with a knife, lack of sleep, dangerous insect bites, lack of equipment, lack of fish, drowning and snake bites.

To understand the potential roles of gender, age and main occupation on perceived risks, we used multivariate analysis linking the type of perceived risk to reported social variables as follows. For hunters, we computed Multiple Correspondence Analyses (MCA) to determine whether the risk perceived was correlated with age, hunting method, hunting alone or in group, and with or without dogs (but not gender, because all hunters were men). For fishers, we computed a similar MCA analysis to determine whether the risk perceived was correlated with gender, age or main fishing method. Chi square tests were used to test the significance of associations between variables that showed correlations based on the MCA (for alpha equal to 0.05). Quotes from participant stories were used to further illustrate related behaviors and values toward wildlife.

Results

A total of 180 fishers were interviewed (98 female and 82 male). This group represented 45% of the total 399 persons that identified themselves to van Vliet, Muhindo, et al. (2018) as professional fishers. There were also 202 hunters interviewed (71% of all the previously identified hunters).

Hunting and Fishing Practices

Among the Turumbo, hunting was exclusively a male activity, even though women may have accompanied their husband on hunting trips and were involved in other key stages along the wildmeat market chain. As many as 34 species of wild animals were hunted and traded to local markets. About half of the hunters combined hunting with guns and snares. Only 12% of the hunters specialized in gun hunting. Hunting with dogs was practiced by 12.5% of the hunters (exclusively by gun hunters). Hunting with snares was apparently more frequent among the youngest and oldest hunters, but this relationship was not significant (chi square = 18.85, df = 12, $p = .09$). Hunting was practiced as a group or with a partner by 78% of the hunters, while a minority (19%) hunted alone. Most hunting occurred at dawn and dusk, or at night using torch lamps.

Fishing was practiced by both men and women, but fishing methods differed between genders. Women almost exclusively used the pond fishing method which is a collective activity practiced during the daytime by groups of women and children, consisting of emptying pools still flooded during the low-water season in the otherwise dry floodplain in order to capture the fish that have sought refuge there. Pond fishing was most productive during the dry months, from January to March and July to September. Dams were built with branches and leaves to form ponds that remained flooded during the low water season and served as fishing grounds. In contrast, men fished using seines, nets and hooks. These fishing methods were practiced at dawn, dusk and nighttime, and could be undertaken alone or in small groups of two-three people. The catch of fish was very diverse, with most species coming from *Clarias sp*., *Labeo sp., Protopterus sp*., and *Distichodus sp.*

Perceived Occupational Risks Related to Fishing

The most frequently reported risks associated with fishing were dangerous encounters with wildlife, cuts from knives or fish bones, and back pain (Figure 2). The interviewed male fishers were particularly wary of crocodiles for their bites and the destruction of nets, hippopotamus for their aggressive behavior running into the boat and destroying nets (Figure 3). Women were particularly afraid of venomous snakes (Figure 3), which they encountered when plunging their hands into the mud of ponds to search for fish. Hippopotami seemed to be relatively uncommon on the section of the Congo River close to Yangambi, but isolated animals were said to attack fishermen at any time of the day. Snakes and crocodiles were considered by respondents to be most likely to attack at night. Back pain was related to lifting heavy nets, bending down to empty the ponds or searching for bait. The risk of being cut with a knife or fish bones happened while cleaning the fish, but also while holding a fish either to remove it from the nets or hooks or from the fishing ponds.

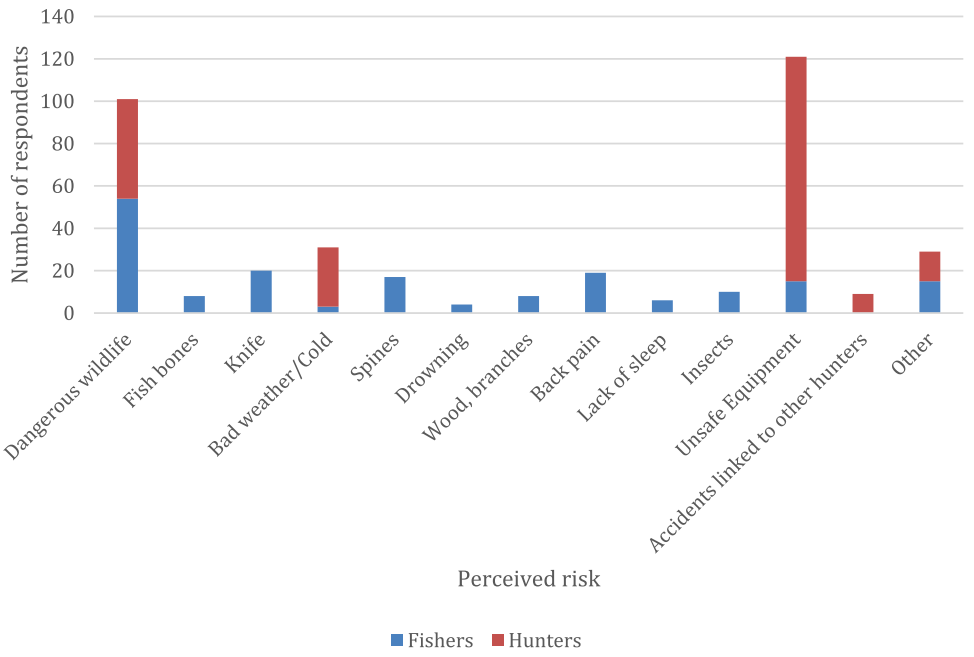


Figure 2. Perceived occupational risks among hunters ($n = 202$) and fishers ($n = 180$). All hunters were male.

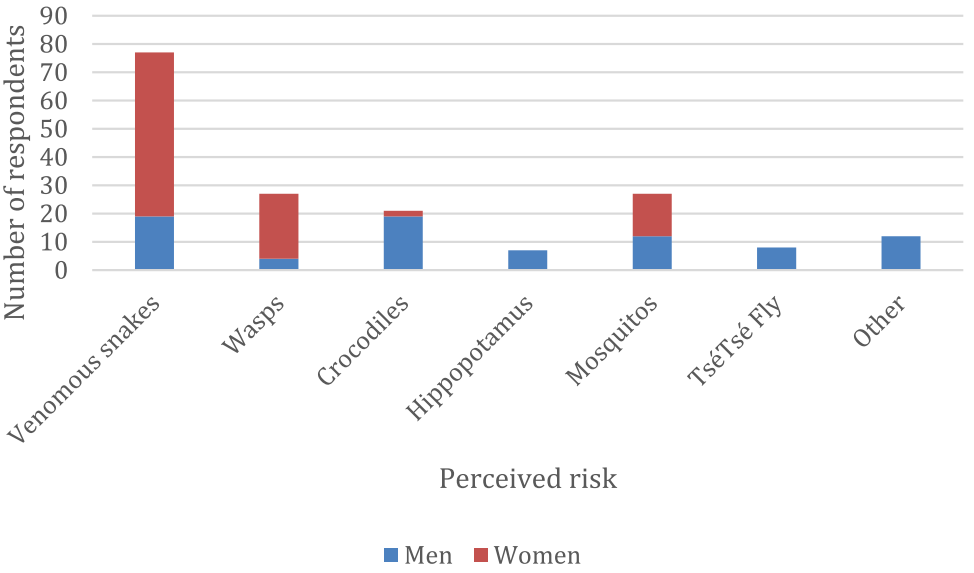


Figure 3. Differences in perceived primary wildlife risks between male and female Turumbo fishers ($n = 180$).

The difficulties perceived by men and women differed significantly (chi square = 45.41, df = 13, $p < .0001$), likely linked to the different fishing methods used among each group (Figure 3). While both men and women feared animals or the risk of being cut with a knife, women were more likely to fear insect bites (particularly wasps), back pain and risk of being cut or hurt by broken branches. These risks reflected the female pond fishing method, which involved long hours bent forwards, standing barefoot in the pond and lifting heavy buckets full of water. In contrast, men were more likely to fear the risk of drowning, lack of sleep and lack of adequate equipment. Bad weather conditions (storms, strong winds, heavy rain) were often mentioned as factors increasing the risk of drowning and the experience of extreme cold, particularly when fishing at night. The type of risk perceived was also significantly related to participant's age (chi square = 44.45, df = 26, $p = .014$), with younger fishers being more likely to express fear of being cut by broken branches, while elder participants were more concerned about the risk of drowning, extreme cold and lack of sleep.

Perceived Occupational Risks Related to Hunting

The main risk perceived by hunters was being hurt with hunting equipment or a dangerous animal (see below), or suffering from bad weather conditions, cold and fatigue (Figure 2). Lack of safe equipment was mentioned as the primary source of risk, irrespective of which hunting technique was used. Locally manufactured guns were usually heavier than purchased ones, and the release mechanism may malfunction, resulting in explosion of gunpowder in the hands or eye of the hunter. Non-lethal consequences related to incidents with locally manufactured guns included the partial or total loss of a part of the body (e.g., hand, ear, or eye) and shoulder pain. Snare hunters mentioned that serious accidents could take place if a snare was triggered un-intentionally and the cable hit the face of the hunter. Accidental injury or death caused by another hunter was mentioned a few times, mostly by gun hunters. While associations were not significant (chi square = 19.49, df = 10, $p = .08$), hunting with guns was more associated with fear of dangerous animals, as well as killing or being killed by another hunter. Accidents among hunters were reported to be frequent, due to the growing number of hunters in the forest and the lack of expertise and experience of some new entrants. We found no difference between the types of dangers perceived by hunters who hunt alone and those that hunt in a group (chi square = 6.98, df = 15, $p = .54$) implying that hunting in a group does not modify the primary concerns. Similarly, the main risks perceived by hunters using dogs did not differ from those of hunters without dogs (chi square = 6.13, df = 4, $p = .18$), meaning that using dogs also did not typically modify perception of danger. To avoid accidents related to tree branches, hunters avoided being in the forest in rough weather and camped far from large trees with dead branches.

Encounters with Animals

Hunters were particularly concerned about the risk of encounters with dangerous animals, especially venomous snakes, leopards, bush pig, chimpanzee, wasps and buffalo, in order of importance. Together, these animals were mentioned by 91% of hunters among the species that represent the greatest potential danger in the forest. Thirty hunters (15%) interviewed had already been bitten by a snake at least once during their lifetime. The reaction of

hunters in the event of a bite is to stop the flow of blood, use traditional medicines and try to reach the village as soon as possible. Leopard attacks were said to take place when the hunter went to check his trap and the leopard was nearby. As one man explained: *"If by misfortune, a leopard cub has fallen into the trap, then the mother waits for you there until you arrive to check your trap and attacks you directly to kill you without mercy"* (Interview, Weko, 2017). According to the hunters, animals usually attacked when they had young offspring or when they were injured or hungry. Buffalo, leopard and chimpanzee were reported to attack at any time of the day, while snakes attacked mostly at night.

To avoid the dangers from wildlife, hunters mentioned using caution (55%), putting themselves in God's hands (35%) or respecting local traditions and taboos (10%). These traditions include the fact that certain animals (e.g., leopard, civet, python or eagle) must be brought back to the village chief and consumed during a ceremony where the carcass is hung at the top of a specific tree. Once faced with danger, hunters chose to kill the animal in 68% of cases, to hide and avoid the animal (18%) or to flee/climb a tree (13%). Generally, the animal causing harm to the human was killed and a sense of dominance and happiness was conveyed in the stories collected from the interviewees. For example, one hunter described, *"I am proud that I was able to control the buffalo by myself. We ate it in the forest"* (Interview, Ngazi, 2017). Among hunters, buffaloes or chimpanzees are not targets as game, but may end up as part of the hunting bags in retaliation, self-defense or for the protection of crops. "*I am angry at the chimpanzee, because he destroys our plantain, and also at other monkeys which destroy our maize field and the brush-tailed porcupine, which eats our rice fields*" (Interview, Weko, 2017).

Discussion

Hunting and fishing are unregulated in many tropical forest regions and involve occupational risks that are seldom approached from a health and safety perspective or addressed in development policy. Our study used a sociocultural approach to highlight occupational health and safety risks perceived by Turumbo hunters and fishers in Yangambi, DRC. We emphasized the effect of gender in perceived risks among fishers and considered how wildlife-related risks may shape retaliatory behaviors toward wildlife (Margulies & Karanth, 2018; Massé, 2016; Pollnac & Poggie, 2008).

In common with other temperate and tropical systems, we found that fishing was perceived as a dangerous activity (Matheson et al., 2001; Novalbos et al., 2008), with drowning, cuts with equipment and animal attacks being listed among the main causes of injury and death (Kolawole & Bolobilwe, 2019; Shrestha et al., 2022). Elsewhere, most drownings were reported as being caused by storms and heavy rains (Marvasti, 2017), as well as collisions and boat characteristics (Shrestha et al., 2022). We also reiterated that the arduousness of the work was related to lifting heavy weights (nets or buckets of water), linked to physical health issues such as back pain and musculoskeletal problems (Barreto Moreira Couto et al., 2019).

Our findings complemented the existing literature by adding a gender dimension to fishing activity and associated risks. We showed that women were more frequently exposed to snake bites, wasp stings and cuts with spines or branches. In contrast, men were more worried about drowning, intense cold and bad weather conditions. Wildlife encounters were cited by both hunters and fishers as a significant factor affecting occupational health

and safety, although specific concerns also differed with gender. Women tended to mention snakes and wasps, while men were more wary of larger animals, e.g., leopards, buffalo and chimpanzee. Most respondents mentioned killing perceived dangerous animals in response to such fears, but these retaliation or self-defense kills were seldom reported as part of the catch.

Among Turumbo hunters, we found that unsafe equipment was by far the main cause of perceived occupational risk. Indigenous hunters frequently operated with minimal use of personal safety equipment (King & Furgal, 2014). While unintentional injuries due to firearms have been commonly reported among hunters (Cole & Patetta, 1988), the lack of access to safe and standard firearms significantly increased the risk for Turumbo. Hunting at night was known to increase the possibility of injury by wildlife, and injuries during travel, e.g., sprains, puncture wounds, infection and broken bones (Knapp, 2012). Risk-related changes in hunting practices in DRC (increased number of hunters in the forest, greater use of headlamps to hunt at night, and increased use of locally manufactured guns) have resulted from the lack of alternative sources of income after the dismantling of agro-processing factories during the 1990s conflict, which left thousands of families without income and imposed increased reliance on bushmeat consumption and trade (van Vliet, Muhindo, et al., 2018).

The perception of risk associated with being injured from hunting equipment is consistent with our observations during long-term research in the region. For example, each time our researchers have been in Weko, one of the hunters has been observed to be injured by his weapon or home-made cartridges. We have been told that some of the injured subsequently recovered, and some of them were unable to hunt again due to losing a limb or other life-altering injury. In Weko, local leaders told us that they have reported six fatal accidents and about fifteen serious injuries in the last 10 years. Our team witnessed the death of two hunters over four years, including death from hemorrhage in the forest as result of a wound sustained from a faulty firearm.

Other studies have shown that the rush for wildlife resources in a context of extreme dependence or crisis may lead hunters to take more occupational risks, for example by going hunting during stormy weather (Pfeiffer & Gratz, 2016). We did not ask about the importance of hunting and fishing to household income, but this role is probably related to likely risk taking. Younger generations of hunters may be less well trained and less respectful of hunting practices (van Vliet, Muhindo, et al., 2018). We found that only 10% of the hunters and fishers – all from older age groups – relied on traditional knowledge and taboos to overcome and better prepare for risks. Changing wildmeat systems may suffer from impaired transmission of traditional knowledge and skills (Shephard et al., 2023), and erosion of traditional knowledge, e.g., among the Inuit in Canada's Nunavut Territory, can undermine safe and successful hunting (Ford & Smit, 2004). Given the importance of hunting to livelihoods and food security, ensuring that traditional and safe hunting knowledge is passed on, rather than eroded, is something that should be supported.

Interestingly, hunters in our study site did not perceive any occupational risk linked to zoonotic diseases. Hunters can be prone to contagions including *Streptococcus suis meningitis, Brucella sp* (Franco-Paredes et al., 2017; Pereira et al., 2020). *Leptospira interrogans* (Deutz et al., 2002), and *Mycobacterium bovis* (Vayr et al., 2018), and hunters using dogs have higher tick exposure (Panczuk et al., 2019; Toepp et al., 2018). The fact that zoonotic

risks were not perceived in our study has important implications for disease risk reduction strategies among hunters, because acceptability of recommended risk-reduction strategies may be correspondingly low, for example in relation to wearing gloves, washing hands and avoiding blood during butchering (Massey et al., 2011). A clear recommendation is that more, or more effective awareness and educational campaigns around the risk of zoonotic disease transmission within the context of Indigenous hunting and consumptive forms of sustainable use may be necessary.

Conclusions

In this article, we highlighted occupational health and safety in unregulated Indigenous hunting and fishing systems. Our results suggest that the risks associated with these sectors need to be addressed as an integral part of sustainable use policies. This is especially the case because sustainable use is a primary objective and strategy in the UN Sustainable Development Goals (SDGs), the Convention on Biological Diversity, and the International Union for the Conservation of Nature (IUCN) which has a specialist group on Sustainable Livelihoods, among other conservation and development organizations and institutions. Wildlife management actions often focus on the ecological sustainability of harvest through quotas, seasons, regulation of equipment etc., but far less attention is given to the social aspects of sustainable use. These elements should include provisions to reduce address hardship in these tasks that sustain local livelihoods and guarantee local food security in remote areas where governmental services are poor. Many of the injuries described by fishers and hunters, and associated loss of productivity suffered by individuals, households, and communities, could be prevented or minimized by providing training, legal access to reliable gear, and access to safety equipment and first aid supplies (FAO, 2010).

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Disclosure Statement

No potential conflict of interest was reported by the author(s).

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Data Availability Statement

The data used to support the findings of this study are available from the corresponding author upon reasonable request.

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