

# Interactions between humans, crocodiles, and hippos at Lake Kariba, Zimbabwe

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**Abstract:** Human–wildlife conflicts (HWCs) are on the increase due to shrinking space that results in increased competition for land, water, and other natural resources between humans and wildlife. Investigating the occurrence of HWCs is important in that the results can be used to formulate better management policies and strategies. In this paper, we describe the nature of HWCs emerging between humans and the Nile crocodile (*Crocodylus niloticus*) and between humans and the African hippopotamus (*Hippopotamus amphibius*; hippo) on Lake Kariba, Zimbabwe. Lake Kariba is the second largest manmade lake by volume in the world. Conflicts involving humans and these species are readily noticeable and played out around water bodies, which are sources of daily human sustenance and important habitats for aquatic wildlife. We used a mixed-methods approach to gather data on these conflicts, including questionnaires, face-to-face interviews, focus group discussions, and participant observation. The research participants involved national parks officials, fishing camp residents, and HWC victims. Our research confirmed that crocodiles and hippos have negatively affected humans through deaths, injuries, instilling fear, and destruction of sources of livelihood for fishermen such as fishing nets and boats. In retaliation, humans have implemented lethal methods to remove problem animals. The results of this research can inform the conservation community about the severity of the conflicts, which have been exacerbated by current economic hardships, to better inform conservation policies.

**Key words:** African hippopotamus, *Crocodylus niloticus*, economic hardships, fishing, *Hippopotamus amphibius*, human–wildlife conflicts, Lake Kariba, Nile crocodile, subsistence economy, Zimbabwe

**THE PHRASE** human–wildlife conflict (HWC) is commonly used to describe situations that involve any negative interactions between humans and wildlife. The “conflicts can be either real or perceived, economic or aesthetic, social or political” (Messmer 2000, 97). Human–wildlife conflicts are increasing globally in both rural and urban communities because of both human and animal population growth (Messmer 2009). Human population growth has led to the intensification of the demand for more land, water, and other natural resources (Manfredo and Dayer 2004, Kanga et al. 2011).

The nature and intensity of HWCs may vary by the status of the species, both temporally and spatially, as well as the socioeconomic status of the humans impacted by the conflict (Messmer 2000). The animals involved in HWCs differ and the impacts to humans may not be evenly

distributed among people and communities. In cases where the wildlife species involved in the conflict are endangered, human retaliation tends to impact conservation efforts (Treves et al. 2006). These conflicts are magnified around water bodies that are central to both humans’ and wild animals’ daily sustenance and also as important habitats for aquatic wildlife.

Conflicts between humans and crocodiles (*Crocodylus* spp.) are increasing due to an increase in human population (Zakayo 2014, Rose et al. 2020) and changes in land use policies (Aust 2009). The human dimensions of these conflicts have been documented in various communities across the globe (Rose et al. 2020). Literature focusing on human–crocodile conflicts mainly focuses on conflicts resulting from saltwater crocodiles (*C. porosus*; Fukuda et al. 2014, Amarasinghe et al. 2015, van der



**Figure 1.** Nile crocodile (*Crocodylus niloticus*; (photo courtesy of L. Bedford under license <https://creativecommons.org/licenses/by/2.0/>).



**Figure 2.** An African hippopotamus (*Hippopotamus amphibius*; photo courtesy of B. Gagnon under license <https://creativecommons.org/licenses/by-sa/4.0/>).

Ploeg et al. 2019), the Nile crocodile (*C. niloticus*; McGregor 2005, Aust et al. 2009, Fergusson 2010, Chihona 2014, Zakayo 2014, Pooley 2015, Pooley et al. 2020), and the Phillipine crocodile (*C. mindorensis*; van der Ploeg et al. 2011). Our research focuses on the Nile crocodile that inhabits Lake Kariba, Zimbabwe. The Nile crocodile is widely disliked and feared (McGregor 2005, Pooley 2016) because it is perceived as being involved in the most fatal attacks on humans (Pooley 2016; Figure 1).

In Africa, the African hippopotamus (*Hippopotamus amphibius*; hippo) has also been implicated in increased HWCs near water bodies where humans are concentrated (Cerling et al. 2008; Figure 2). The hippo, unlike the crocodile, which is a predator, is in the class of megaherbivores together with elephants (*Loxodonta africana*). These megaherbivores are more problematic in areas where humans are dependent on subsistence activities and lie at the heart of HWCs in Africa (Kanga et al.

2011). The hippo has a dual requirement of daily living space in water and grazing range (Cerling et al. 2008). This affects the manner in which hippos utilize resources and survive in areas with a high density of human population and continuous land use changes (Kanga et al. 2011). The differences in the use of space of the 2 animals shape the ways in which they come into conflict with people.

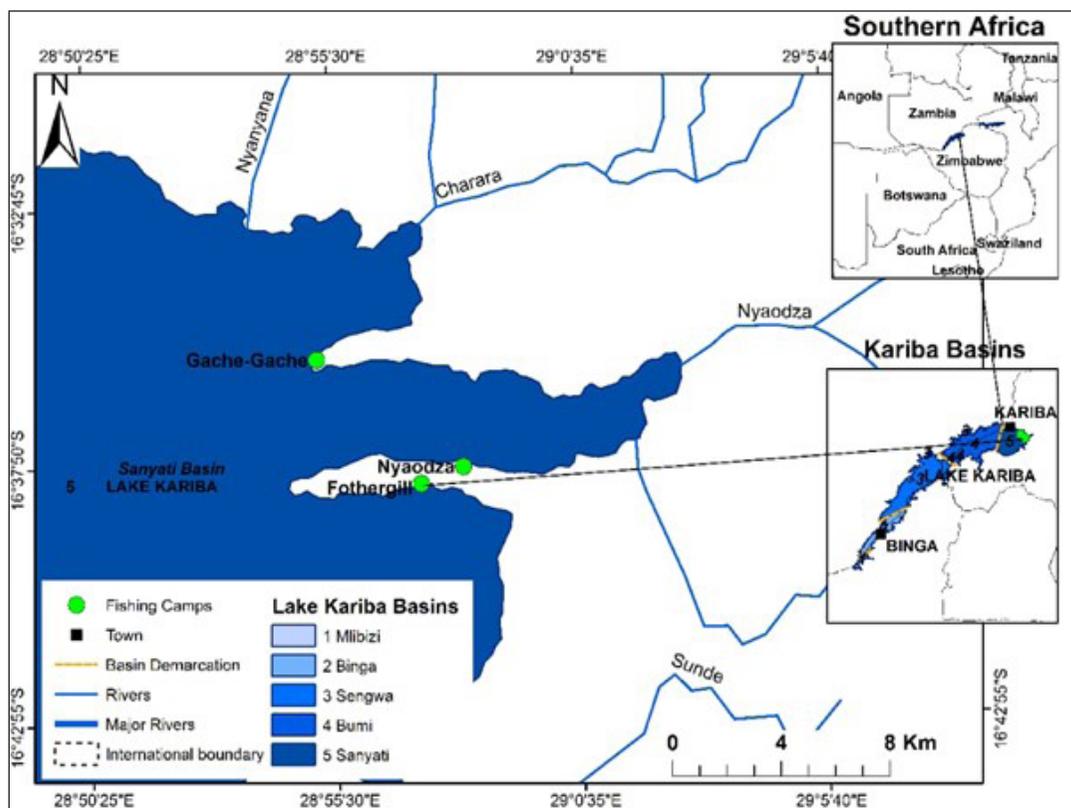
In this paper, we document HWCs involving crocodiles and hippos that are occurring in Lake Kariba, Zimbabwe. We describe the nature and impacts of these HWCs in the context of the current economic crises and how human responses to these animal attacks also threaten animal welfare.

### Study area

We conducted research between December 2018 and August 2019 in the fishing camps lying along Lake Kariba. Lake Kariba is located approximately 365 km northwest of Zimbabwe's capital city, Harare (Muringai et al. 2019). We studied the fishing camps of Nyaodza, Gache-Gache, and Fothergill, located in the immediate vicinity of the Kariba town. The fishing camps are in the Sanyati Basin (Basin 5; Figure 3).

Lake Kariba was constructed by the damming of the Zambezi River in 1956. It is the second largest manmade lake in the world (Ndhlovu et al. 2017) and is also the border between Zambia and Zimbabwe (Figure 3). The lake floods >5500 km<sup>2</sup> of surface area (Hughes 2006). The climate of Lake Kariba is typically tropical and semi-arid (Muchuru et al. 2015). The annual mean air temperature ranges from 24.4–24.8°C. The area is characterized by an average of 30.7°C, with maximum temperatures during the hot dry seasons. Cold winter seasons have an average maximum temperature of 21.7°C. Average annual rainfall for Lake Kariba catchment is approximately 700 mm, and higher volumes of rainfall are recorded during the rainy season from October to March (Muringai et al. 2019).

The fishing camps studied are regulated by the Zimbabwe Parks and Wildlife Management Authority and are registered with the Ministry of Small and Medium Enterprises and Cooperative Development (Figure 3). The regulations only allow for those practicing fishing from fishing camps to fish for limited periods and regularly travel back to their communal



**Figure 3.** Map showing the study locations of Gache-Gache, Nyaodza, and Fothergill along Lake Kariba, Zimbabwe, August 2019.

areas where their families are based. Fishermen are not allowed to build any permanent housing structures. The majority of livelihood sustenance in these areas is based on small-scale fishing, as all camps and villages fall within the wildlife safari area and national park. Farming and livestock rearing are not permitted by law in the area (Ndhlovu et al. 2017).

The locals believe the main source of neglect of these camps by national parks is because the camps are regarded as temporary. These people have been living in the camps for >4 decades, but their habitation of the areas is not considered permanent. Some young men in these camps were born there, and their parents, whether living or deceased, were the pioneers of the fishing camps. Their temporary state makes them vulnerable to animal attacks, especially by big mammals such as elephants and African buffalo (*Syncerus caffer*), as their houses are poorly constructed. Fishermen and other fish camp dwellers frequently visit the lake to fetch water and sometimes to bathe, thereby

increasing their chances of interacting and coming into conflict with crocodiles and hippos.

The study focuses on marginalized fishing camps surrounded by poor infrastructure development and inefficient transport and communication networks. The majority of people live under the poverty datum line. Their poverty-stricken situation is worsened by the current economic crises in Zimbabwe that commenced in the year 2000 (Kadenge and Mavunga 2011, Muruviwa and Dube 2016, Southall 2017). These economic crises pushed some people into fishing, where they are experiencing conflict with crocodiles and hippos.

## Methods

### Data collection

This research was mainly qualitative because we focused largely on people's opinions and experiences. We collected our data using various research methods that included questionnaires, participant observation, focus group discussions, and face-to-face interviews. Prior

**Table 1.** The composition of the participants in the 5 focus group discussions (FGDs) carried out at the 3 fishing camps (Gache-Gache, Nyaodza, and Fothergill) in Lake Kariba, Zimbabwe, December 2018 to August 2019.

Fishing camps	FGDs	No. of participants	Males	Females
Fothergill	1	9	5	4
	2	7	4	3
Nyaodza	3	8	8	0
	4	10	10	0
Gache-Gache	5	6	6	0

to conducting interviews, we obtained consent from potential research participants.

In December 2018, we conducted face-to-face (or semi-structured) interviews with 4 national parks high-ranking officials in Kariba town and 1 detective from the Mineral, Flora and Fauna Unit regarding HWCs (including those conflicts resulting from crocodiles and hippos) in Lake Kariba. These interviews lasted an average of 50 minutes. These were divided between semi-structured and unstructured interviews, and the following were some of the research questions: (1) Do people conflict with animals in and/or around Lake Kariba? (2) Can you explain the occurrence of these conflicts? (3) Do people report HWC incidents to your office? (4) How promptly do you respond to HWC reports, and are there any challenges that you face? (5) Are there any measures you take to manage HWC in and/or around Lake Kariba? (6) What are the causes of conflict among humans, crocodiles, and hippos in Lake Kariba?

These questions were only used as a guide, and probing questions emerged during the discussion. Individual interviews were conducted with members from the fishing camps within the study. Some of the participants or their relatives were victims who experienced HWCs. Other victims of HWCs were identified through the snowball sampling technique (Dragan and Isaic-Maniu 2013). Victims of HWCs were mainly asked to narrate their encounter of HWC, the specific animal they conflicted with, how they were attacked, how they dealt with the attack, and their situation in the post-incident period. The questions were framed in such a way that gave room for the respondent to speak and elaborate at length, thereby capturing a “thick description” of each situation. The face-to-face interview guides involved

questions such as: (1) Do people in these camps conflict with wild animals? (2) Which particular wild animals do you conflict with? (3) What are the specific problems caused by each wild animal (i.e., hippos and crocodiles) to the lives and livelihoods of the people in these camps? (4) Do you report any HWC incidents in this community? Can you explain the reasons for your actions (reporting or not reporting)? (5) Do you have any comments regarding the reactions of the officials? (6) How do you rate the response of the authorities to your reports? (7) What do you think must be done to mitigate conflicts among people and crocodiles and hippos?

Apart from personal interviews, data was also obtained from 5 focus group discussions (FGD) completed at each fishing camp (Figure 3). Two of the focus groups conducted in Fothergill camp included male and female participants. The other 3 focus groups (i.e., Nyaodza and 2 in Gache-Gache camps) were comprised exclusively of male participants (Table 1). Each focus group lasted as average of 50–70 minutes. Both personal interviews and FGDs were audio-recorded.

The questions we asked during the FGDs were aimed at understanding HWCs at the community level. The broad questions we asked were somewhat similar to those that had been asked of individuals at face-to-face interviews. The aim was to achieve the study’s objective of understanding the impact of crocodiles and hippos on the lives and livelihoods of the people. People were asked: (1) Do you conflict with any animals in this camp? (2) If yes, what are these animals? (3) Are there any negative impacts caused by these animals to your livelihoods? (4) Are there any negative impacts caused by these animals to your lives? (5) What do you think must be done to reduce

**Table 2.** Participant observation details for the 3 fishing camps (Gache-Gache, Nyaodza, and Fothergill) studied at Lake Kariba, Zimbabwe, December 2018 to August 2019.

Fishing camp	Observations	Details	Dates of observation	Lessons learned per observation
Gache-Gache, Nyaodza, and Fothergill	People's homesteads	These are temporary structures.	December 2018; and April, July, and August 2019 visits	Houses are easily destroyed by elephants ( <i>Loxodonta spp.</i> ) and baboons ( <i>Papio spp.</i> ).
		They have no ablution blocks and tap water.	Same as above	They visit the lake more frequently fetching water and bathing, which increases their risks of attacks from crocodiles ( <i>Crocodylus spp.</i> ) and hippos ( <i>Hippopotamus amphibius</i> ).
	Homestead proximity to the lake	All homesteads in the 3 fishing camps are from 50–100 m from the water.	Same as above	Hippos easily roam around the homesteads, especially at night. Children play along the Lake shore where there are good grounds.
Nyaodza	Nyaodza river estuary	The river enters the lake from the east of the camp. People fish in the river. People catch plenty of fish in rivers compared to other places.	July and August 2019	It is a high-conflict zone where many people are attacked by female crocodiles in summer when they are hatching in those areas.
Nyaodza	Shown men in fishing canoes	Canoes are made of poles and iron sheets.		Easily destroyed by hippos
Gache-Gache	Charara river estuary nearer to the camp	People fish in the river. The river has more caches.		It is a high-conflict zone where many people are attacked by female crocodiles in summer when they are hatching in those areas.
Gache-Gache, Nyaodza, and Fothergill	Crocodile and hippos lying on the shores	Sun basking, or floating in the water		People encroach the shores to fetch water and for bathing and fishing and can be attacked by these predators.
Nyaodza	Man injured by hippo	Walking with crutches	August 2019	He was injured canoeing in the lake from a fishing expedition.

conflicts between people and animals (i.e., crocodiles and hippos) in this camp? (6) Where do you report problem animal cases? (7) What can you say about the reaction of these authorities or officials?

Questionnaires were administered with the help of 8 research assistants (6 students on industrial attachment and 2 technicians) from

the University of Zimbabwe Lake Kariba Research Station. We distributed and collected 60 questionnaires from different fishing camp dwellers. The people to whom the questionnaires were given were not the selected research participants, but were those whose opinions were needed to enrich the findings of the study. Information from the questionnaires was used

**Table 3.** Assessment of problem wild animals from 60 questionnaires administered in the Lake Kariba fishing camps, Zimbabwe, December 2018 to August 2019.

Problem animal	No. of times each animal was mentioned	%
Lions ( <i>Panthera leo</i> )	7	4
Foxes ( <i>Vulpes</i> spp.)	2	1
Hippos ( <i>Hippopotamus amphibius</i> )	46	25
Crocodiles ( <i>Crocodylus</i> spp.)	51	28
Elephants ( <i>Loxodonta</i> spp.)	53	29
Water buffalo ( <i>Bubalus bubalis</i> )	10	5
Baboons ( <i>Papio</i> spp.)	14	8

to design descriptive statistics on certain issues regarding the occurrence and people's experiences with crocodiles and hippos in the fishing camps.

In addition, we relied on participant observation. Research teams visited the fishing camps at different times between December 2018 and August 2019 (Table 2). The visits were meant to familiarize the research team with conflict zones (river estuaries) for both crocodiles and hippos. Participant observations were particularly important, as they informed our own evaluation of the occurrence in direct comparison to gathered data from formal discussions.

### Data analysis

We analyzed descriptive numerical data obtained from questionnaires using SPSS version 16.0 software to obtain percentages and frequencies to identify the most problematic animals. We used thematic content analysis to interpret qualitative data. We first transcribed audio-recorded interviews and then categorized them according to emerging themes. Anderson (2007) found that thematic content analysis can accurately portray the thematic content of interview transcripts (or other texts) by identifying common themes. These themes were categorized into specific categories that were used to present the results below.

## Results

### Wildlife species implicated in human-wildlife conflicts

Information presented below is from responses obtained through questionnaires,

interviews, FGDs, and participant observation on the main problem animals in the fishing camps. Hippos (25%), crocodiles (28%), and elephants (29%) were the wildlife species most frequently implicated in HWCs (Table 3). The other noted animals' frequencies fall below 10%, which means they are less of a problem as compared to hippos, crocodiles, and elephants.

The data obtained from questionnaires administered to fishing camp residents listed both land mammals and aquatic wildlife because the questions did not prescribe limitations to responses (Table 4). We were interested in gathering general information on problematic wild animals to assess how hippos and crocodiles ranked in HWCs (see Tables 4 and 5).

### Human-crocodile conflicts

*Interview with the officials.* National parks officials in general stated that elephants, hippos, and crocodiles were the main problematic animals in communities living along Lake Kariba. One official from the national parks department stated that the majority of the complaints they received from fishing camps were of crocodiles and hippos. National parks officials reiterated that they often go to these fishing camps to attend to these reports. Fishing camp dwellers, on the other hand, complained that national parks officials took too long to respond to problem animal reports.

*Questionnaires.* Crocodiles were mentioned 47 times as killing and eating people, 41 times as injuring people, 2 times as eating fish from nets, 11 times as disturbing people from fetching water, 3 times as drowning nets, 4 times as

**Table 4.** Frequency of incidences involving the crocodile (*Crocodylus niloticus*) and the impacts on people in Lake Kariba, Zimbabwe, December 2018 to August 2019.

Impacts of livelihoods	Frequency	%	Impacts on lives	Frequency	%
Disturb laying of nets	1	1.6	Kill and eat people	47	78.3
Destruction of nets	4	6.6	Injure people	41	64.3
Drowning of nets	3	5.0			
Fear of fetching water	11	18.3			
Eating fish in the nets	2	3.3			

**Table 5.** Frequency of incidences involving the hippopotamus (*Hippopotamus amphibius*) and the impacts on people in Lake Kariba, Zimbabwe, December 2018 to August 2019.

Impacts on livelihoods	Frequency	%	Impact on lives	Frequency	%
Disturb the laying of nets	3	5.0	Kill people	36	60.0
Drown boats	10	16.6	Injure people	20	33.3
Destroy boats	18	30.0	Chase people	2	3.3

destroying nets, and once as disturbing the laying of nets.

*Focus groups.* During the FGD sessions, the top concern expressed by most participants was that national parks authorities do not take their problems seriously. Participants were more concerned about problems with crocodiles and hippos than elephants, lions (*Panthera leo*), baboons (*Papio spp.*), and African buffalo (*Syncerus caffer*). According an FGD participant, "...crocodiles and hippos have increased in numbers more than other animals. These animals are our major problem. They disrupt our livelihoods, kill and eat us."

Participants were concerned that crocodile populations were increasing in Lake Kariba. They also believed the increase in crocodiles was also impacting fish populations and causing them to prey on people. One elder stated, "national parks must reintroduce egg collection along the lake shore, as they used to do before. If they resume egg collection, they could save us from perishing from crocodile attacks."

A similar observation was made by research FGD participants at Fothergill fishing camp. They believed egg collection helps to sustain and control crocodile populations. The fishermen also stated that adult (or aged) crocodiles need culling largely because they are the ones causing many attacks in Lake Kariba. These adult crocodiles that were preying on humans were believed to be too old to catch other prey,

so they reside in bays where humans are easy prey. Men interviewed at 2 different FGDs in Nyaodza and Gache-Gache indicated that the difficulty to detect the crocodile is the major reason people fall prey to them.

Participants in the FGDs indicated that more incidents occur in the morning when many people visit the harbor for various reasons, such as buying fish and bathing. Not only are the fishermen attacked by crocodiles, but women and children are also attacked. School children from Nyaodza and Fothergill camps visit the lake every morning to bathe as they prepare to go to school. But according to the locals, more men are exposed to human–crocodile conflict than women.

*Participant interviews.* The people in the fishing camps we interviewed in person described the many problems caused by crocodiles to their lives and livelihoods. Gillnet fishers, who make a living solely on fish, explained that they compete for fish with crocodiles, and crocodiles often eat fish caught in their nets. The main source of their frustration is the destruction of their nets and boats by crocodiles and hippos, respectively. Given the current economic crises in Zimbabwe, the gillnetters described the difficulties they endured in mobilizing the increasingly scant resources (and money) to purchase new nets from Lusaka, Zambia. Buying new nets from Zambia requires foreign currency, which they do not have because of liquid-

ity challenges in Zimbabwe's cash economy. Because they import nets, the entire process of acquiring new nets is difficult and expensive for them. The costs of nets are also increased by import duties at the Zimbabwe-Zambia border in Kariba.

The fishermen indicated that crocodiles attack people in 2 different ways and spaces: in the lake and along the shores (i.e., in the very shallow water that reaches a person's knees). In Kariba fishing camps, crocodiles clandestinely attack people in areas where there is much human activity. It was locally believed that crocodiles have no power on the shores or shallow water, and thus they drag their prey into the deeper water where they assume more power and energy to kill and eat prey.

An official with national parks explained that "areas of the lake shore with much human activities are avoided by larger mammals; thus, crocodiles end up preying on people who are always at the harbors." At all the fishing camps, people virtually live facing the water, and when attacks occur, they are witnessed by others in the camps. Another national parks official concurred: "people become the meat of the crocodiles."

People also described the unusual behavior of crocodiles attacking people inside the boats and canoes. It is mostly fishermen who are attacked in this way; thus, there is a significant relationship between gender and activity when attacked. To some extent, women and children are also at risk of being attacked in this way, as they also canoe to fetch clean-deep water. One man explained that "a crocodile can jump 1 to 2 meters high to catch its prey...if it manages to bite you it drags you straight into the water."

There are some crocodiles that people easily identify as problem crocodiles, and they sometimes nickname them. At Fothergill fishing camp, there was 1 big crocodile that people believe ate 2 members of the community (an old man and a child). It was nicknamed "mutumba," a Shona word that metaphorically refers to something "extraordinarily huge." In the same camp, there is fishing ground that is nicknamed "Macheni Bay." This was largely because there was a huge crocodile that used to attack men and eat their genitals, leaving the entire body untouched, which was unusually strange. Local beliefs have associated such

behavior with witchcraft.

The painful part of crocodile deaths is that sometimes the bodies fail to be recovered. In instances that the bodies are recovered (in rare cases that national parks officials shoot the problem animal to retrieve bones from the crocodile's stomach), relatives will only bury some parts of the body. This has a psychological impact on the families of the dead who have to live their entire lives knowing that they never had a chance to properly bury their relative. Graves are crucial in African societies, as they are a tangible platform that connects the dead with the living. In the absence of a grave, rituals cannot be performed. Rituals help with healing, whereas the absence of graves has psychological impacts on the living. In terms of direct effect, the death of a single person is a major hardship for a family, but indirect effects impact entire communities in terms of psychological stress and disorders.

To prevent death during crocodile attacks, people take several measures to defend themselves. According to an elder from Gache-Gache camp, "at 1 occasion people were canoeing in the shallow waters and the crocodile jumped into the boat and attacked one of them...as the victim was wrestling to come out of the jaw of the crocodile...the other fisherman started hitting the crocodile with *chikwarapuro* [canoe paddles] in its mouth...he hit the crocodile until it left the victim and inundated itself...the victim survived with minor injuries on his hand."

Some men explained that if a person blocks the crocodile nose or eyes and/or presses its tail down, the crocodile can let go. People explained that the crocodile is a very sensitive animal that does not want certain parts of its body to be tampered with. However, such actions are against the conservation efforts of animals by national parks and many stakeholders of crocodile farming in Zimbabwe.

*Participant observation.* Our observation of crocodiles and hippos resting along the Lake Kariba shoreline made us understand that interaction between them and the human population posed a huge threat. We observed children avoiding areas where crocodiles were laying as they fetched water or taking a bath from the lake. Similarly, women did the same when they came to fetch water. The fact that hippos and crocodiles hide and move underwater certainly

puts the lives of lake users, particularly women and children, at high risk. These predators are capable of mounting a clandestine attack whenever possible.

We also interviewed survivors of crocodile attacks during fieldwork as part of participant observation. These interviews provided first-hand experience with crocodile conflicts and subsequent impacts. Living with victims who are disabled due to crocodile attacks instilled fear of the predator for other members of the community.

As part of participant observation, in August 2019, we visited a young man who had been attacked by a crocodile and was recovering from the wounds at the Kariba hospital. He had been attacked by a crocodile at Nyaodza fishing camp. His ribs had been wounded. He described that he was attacked while harvesting fish from his nets. We also observed that there are no clinics in the camps except for first-aid trained personnel at Nyaodza and Fothergill, while there is no first-aid trained person at Gache-Gache camp. The first-aid advantage, however, is not of much help because the trained persons at Nyaodza and Fothergill often have no basic medicine and equipment to assist the injured.

### Human–hippo conflicts

*Interview with officials.* The national parks authority interviewed about the occurrence of HWCs in the fishing camps indicated that these fishing dwellers come into conflict with hippos. He mentioned that each time a person is attacked by a hippo, they go and assist the victim. He admits that sometimes they are delayed getting to the conflict scene due to lack of resources, such as fuel. He stated that hippos (and crocodiles) are the most problematic animals in the lake and affect the fishing populations and camp dwellers. Another national parks official also stated that “people are attacked by hippos mainly because there is now increase in human’s encroachment to Lake Kariba for fishing, as there is high unemployment in Zimbabwe.”

*Questionnaires.* Hippos were mentioned 36 times as killing people, 20 times as injuring people, and 2 times as chasing people. Regarding the impact on livelihoods, hippos were mentioned 3 times as disturbing the laying of nets, 10 times as drowning boats, and 18 times as destroying

boats. Thus, people mentioned the impacts of hippos on wellbeing more than on their livelihoods. This is partly because impacts on lives are irreplaceable as compared to livelihoods.

*Focus groups.* During our FGDs, participants stated that hippos have a reputation of capsizing boats in these fishing camps. Capsizing of boats has serious negative results on the lives and livelihoods of the people, as they are injured and their boats are destroyed. People stated that when the boat is capsized, the hippos attack and injure fishermen, and sometimes if the fishermen are unable to swim, they drown. Some women indicated that even if someone can swim, they might be attacked by the crocodiles while trying to reach the shores.

Unlike crocodiles that mainly attack people in the water and in immediate proximity to the lake shore, hippos attack people on land far from Lake Kariba, especially at night as they graze. In Gache-Gache, a story was told of a man who was killed by a hippo in Charara, 500 m away from the lake. Narrating the incident at an FGD, some elders in Gache-Gache explained that “2 men were coming from regular fishing work and decided to rest far from the shore, that is when the hippo came running from behind them and 1 of them was bitten and died.” Hippos, unlike crocodiles, do not eat people. This partly explains why people fear crocodiles more than hippos in these fishing camps.

*Participant interviews.* During face-to-face interviews, we learned that hippos, like crocodiles, can also attack people while bathing or fetching water in shallow areas. There were numerous reports of people who were either injured or killed by hippos in fishing camps. A young man aged 25 years explained in an interview how he was attacked by a hippo at Nyaodza fishing camp: “I was attacked in May 2018. I went into the lake to fetch water alone in a canoe. I was sitting on the edge of the canoe and the hippo attacked me from there and it bit me on my right limb. I now use walking clutches. I visit the doctors for check-ups in Harare...I no longer have money to fund my health bills. I was not compensated by national parks. I am no longer fishing, and I do not have money. Life is now difficult for me.”

Based on this interview and others, it was clear that hippos can impact the lives and livelihoods of the people, causing unbearable

**Table 6.** Ratings of the Zimbabwe National Parks and Wildlife Management Authority's reactions to problem animal reports in the fishing camps during the study period, Lake Kariba, Zimbabwe, December 2019 to August 2019.

Rate	Number of people	Percentage (%)
Poor	48	80
Average	9	15
Good	3	5
Excellent	0	0

memories and destroyed futures. The young man interviewed above sustained injuries from the hippo attack, and he is now physically challenged. He is not fishing anymore because he is paralyzed. Thus, he no longer has a source of livelihood, which has made life more difficult for him. He cannot pay his hospital bills, and he sometimes misses doctors' appointments for check-ups due to lack of funds.

Women are also at risk of being attacked by hippos because they also use canoes to fetch clean drinking and cooking water, as they do not have running water, boreholes, and wells in their fishing camps. When boats are hit by hippos, they are damaged and the fishermen often have no resources to repair them. One fisherman described their ordeal as follows: "our boat was hit by a hippo when we were coming from fishing, and we were thrown into the water. Luckily, both of us were able to swim. [Neither] of us was injured, but our boat was destroyed beyond repair. It took us time to find a new boat. When the boat is destroyed, you must know that you will not eat until you get another one."

Fishermen may struggle to lay their fishing nets whenever hippos roam around their operational areas in the lake. They identified areas in the lake where they catch big fish, but if the area happens to have a high concentration of hippos on a particular day, they are forced to lay their nets on those with low catches. People in the fishing camps described the various methods they employ to retaliate from hippo attacks. People attack the hippos with stones whenever they come close to the harbor, even if they are not attacking anyone.

*Participant observation.* We observed that hippos virtually live with the people and victimized them. During our fieldwork, we witnessed

many hippos roaming around the lake shore close to people's homesteads. This increased contact between people and hippos. Hippos do not attack people in the water only; they also attack people on the shore, as indicated above. We were also shown another area close to the homesteads where a young man was attacked by a hippo.

### **Perceptions of the authorities' response to HWCs**

*Interview with officials.* Our results indicate that national parks authorities delay responding to problem animal reports in the fishing camps. The national parks officials we interviewed often mentioned lack of resources on their part as their main reason why they do not effectively react to problem animal reports. National parks now mainly rely on aid from non-governmental organizations (NGOs) such as Zambezi Society and Kariba Animal Welfare Fund Trust (KAWFT). Commenting on aid received from NGOs, 1 national parks official stated the aid received from KAWFT allows them to operate. They work with KAWFT to heal sick animals and remove snares. However, KAWFT only donates aid in relation to protecting the welfare of animals and not humans. Thus, there is a need for the establishment of NGOs that protect the welfare and wellbeing of both humans and wildlife.

*Questionnaires.* Eighty percent of respondents to our questionnaire evaluated the national parks officials' reaction to reports of attacks by hippos or crocodiles as poor, 15% rated their reaction as average, and 5% regarded their reaction as good (Table 6). From the perspective of the respondents, national parks officials are underperforming in their duties, and that is a source of frustration for those who require their services. Respondents also lamented the absence of compensation schemes for the injuries, deaths, or damages caused by both hippos and crocodiles.

*Focus groups.* Although FGD participants reported problem animals to national parks officials, they were unhappy with the way the authorities handled HWCs. They were concerned that officials do not take their reports seriously. Camp dwellers have to take the initiative to mobilize resources and save the injured person(s) through traditional means or rushing

them to the hospital when possible. One interviewee stated that “we contribute dollar-dollar per person [each person contributes \$1 USD] in the fishing camp to assist victims.” These contributions were inadequate to transport the victim and to pay bills at the hospital. The situation is even worse in instances where the injured are referred to hospitals in Karoi or Harare that are far away, thereby increasing the expenses against their meager incomes.

As an alternative, they contact the army barrack at Wafa-Wafa for assistance. It was emphasized that in circumstances of wild animal attacks, the dwellers actually receive help from the soldiers rather than from national parks. Many (if not all) locals own canoes (and not engine boats), which makes it difficult for them to ferry a victim to Kariba town. Hiring a speed boat in the current economic situation is beyond the reach of many. These people hardly have savings because of low catches of fish that occur mainly in the winter season and also due to destruction of nets.

*Participant interviews.* Research participants we personally interviewed described numerous occasions during which people were killed by either hippos or crocodiles, and national parks rangers were called, but they did not kill the problem animals. One participant lamented that “when they come here after a person has been killed they take no action...they just shoot in the sky to threaten the crocodiles and that does not help us at all.” The general feeling is that an animal that has killed a person should be killed as well. It is believed that “once an animal has tasted human blood...it may continue hunting humans on the same spot.”

The same views were expressed in Kariba town where people are in conflict with elephants, lions, and baboon. The fact that authorities do not seem keen to take effective action against crocodiles has deepened the perception that “wildlife is more important than human beings.” Due to this thinking, people tend to resort to lethal ways of retaliation to animal attacks. Thus, national parks must actively and efficiently address the concerns of the people living in Nyaodza, Fothergill, and Gache-Gache fishing camps and other such camps.

The rage of the people felt toward national parks rangers was intensified by the absence of a satellite station of national parks in these

areas. The locals believed that the temporary status of their communities makes these authorities not care about their welfare. They say that they have been living in those sites for several decades, but they are not given a permanent status of residence, which further leads to their marginalization. Failure of establishing a satellite station also leads to under-recording and mismanagement of conflict situations.

*Participant observation.* We did not observe any national parks sub-stations in the fishing camps. The national parks stations were far removed from the people who are in conflict with animals every day. These observations may explain why it takes long for the authorities to respond to problem animal reports. As such, minor incidents of attack are likely to go unreported, leading to under-reporting of human–wildlife conflicts.

## Discussion

The research discovered that crocodiles and hippos conflict with fishing villagers to a greater extent as compared to other animals. Crocodile attacks affect the lives of the people as they injure and kill people. They also affect their livelihoods through destroying nets and stealing fish caught in the nets. Hippo attacks also impact the lives of the people they injure and kill, and they also disturb people’s livelihood through destroying boats and nets. When such conflicts occur, people report them to the national parks authorities. However, people say the authorities do not respond to these reports swiftly, and this has resulted in their anger toward the authorities.

### Human–crocodile conflicts

The treatment of the crocodile as an endangered species led to the rapid growth of its populations at Lake Kariba (Cott and Pooley 1972, Hutton and Child 1989, McGregor 2005), and this has resulted in considerable conflict between humans and crocodiles. These huge crocodiles can be 4–5 m in length, preying on large animals such as wildebeest (*Connochaetes* spp.) and buffalo (Pooley et al. 2020). Crocodiles were mentioned more frequently in the distributed questionnaires because life in the fishing camps revolves around Lake Kariba. People fetch water from the lake for domestic and construction purposes, and they rely on water

transport to travel to islands located in the lake and surrounding towns like Kariba.

The continued negative impacts of crocodiles on the lives and livelihoods of the local inhabitants exacerbate the impoverishment of the locals. This impoverishment can best be understood in the context of the current economic crises in Zimbabwe. When nets are destroyed, people may lack resources to replace them quickly. This leaves people with no income to buy food, clothing, and health care in urban Kariba. These communities are already impoverished and underdeveloped and the perpetuation of human–wildlife conflicts will only serve to worsen their situation. Impoverishment also results from the failure of the fishermen to complete their fishing trips because of wildlife attacks in the lake or on the lake shore (Ndhlovu et al. 2017). However, most people are mainly concerned with the harm and deaths associated with crocodile attacks than the impacts on livelihoods. This is presumably because there are alternatives with livelihoods, but impacts on lives and wellbeing cannot be replaced.

Due to the current high unemployment rates, there is an increase in fishing pressure (Ndhlovu et al. 2017). Hence, many people encroach the fishing camps either as fishers or as fish buyers, and they are often preyed on by crocodiles. The other cause of human–crocodile conflict in Kariba is the decrease in water levels that commenced during the fall of 2015. Ndhlovu et al. (2017) identified that low water levels amplify sensitivity as fishers reported that their fishing grounds were reduced as a result. Furthermore, fishers compete with wild animals, including hippos and crocodiles, for the remaining fishing grounds. This increases the risk of wildlife attacks as well as the distance to the lake.

Crocodile attacks are also associated with witchcraft in the fishing camps, as is the case in other parts of Africa (Chihona 2014, Zakayo 2014). The interconnections between crocodile attacks and witchcraft also make evident that crocodiles are entangled in African cultural beliefs and perceptions (Eniang et al. 2020).

Serious, mysterious crocodile attacks engender the association of human–crocodile conflict with witchcraft in many communities in Africa (McGregor 2005, Pooley 2016). Witches are said to be able to move about in the form of a crocodile or have powers to send them in

attacks against others (Colson 2000, as cited in McGregor 2005). Witches can choose to either kill or injure the victim.

The nature of crocodile attacks we gathered in the fishing camps correlates with what Pooley (2016) discovered in Eswatini (formerly Swaziland). Describing how people are attacked close to the shores, Pooley (2016) noted that crocodiles observe where animals (including humans) regularly cross watercourses or go to drink or bathe, and when hungry, they will wait patiently near these places for the prey to approach. After crocodiles see prey, they submerge, approach silently and invisibly, lunging with great speed and power at the last moment to seize the victim in their powerful jaws. Victims are usually dragged into deeper water and drowned (Pooley 2016).

### Human–hippo conflicts

We have also presented data on the impacts of hippos on the lives and livelihoods of the people. Hippos attack people differently from the crocodiles. This means that people also employ different strategies of avoiding attacks from these animals. Hippos cause more damages to people's livelihoods as compared to crocodiles through destroying boats, though they do not eat people as crocodiles do. Though hippos cause more damages than crocodiles, it is crucial to note that crocodiles are feared more than hippos, partly because crocodiles eat humans.

The fishermen normally work for other people with boats until they have money to purchase or make their own boat. Nyikahadzoi (1995) noticed that the loss of nets because of destruction by crocodiles (and hippos) is known to have forced some small-scale fishers from Lake Kariba into circumstances where they depend on friends or relatives for support or into employment by larger and well-established fishermen. This indicates the importance of social capital and networking in the fishing camps. Current economic crisis in Zimbabwe makes it even more difficult for them to acquire new boats in time, thereby resulting in cuts on their weekly budgets for their family upkeep. There are vendors who sell food stuff at high costs, which forces fishermen to reduce their diet. Such reduction results in malnutrition, leading to *kwashiorkor* (severe malnutrition

from protein deficiency) among children of 5 years and below.

Human–hippo conflicts are increasing in Africa and other parts of the world, but little is known about the factors contributing to the increased conflicts for application to their mitigation (Kanga et al. 2011). Thus, this study contributes to the minimal literature that focuses on human–hippo conflicts in Africa. The impacts of hippos on people’s lives and livelihoods can also be understood in the context of the economic crises as indicated above.

### **Responses to human–wildlife conflicts with crocodiles and hippos**

Although humans are largely impacted by crocodiles and hippos, it is worth noting the human actions that also impact the welfare of these animals, particularly the crocodile. For example, crocodiles are often trapped in the nets in Lake Kariba, which affects the well-being of the animals, as it might injure itself as it wrestles to come out of the net. But, of course, these human impacts on the animal are “unintentional.”

Similarly, “in other African contexts, the introduction of gillnetting has had a destructive effect on crocodile populations” (McGregor 2005, 361, citing J. Hutton, personal communication). Gillnetting is a threat to the wellbeing and survival of the Nile crocodile in Lake Kariba (McGregor 2005). Results from other research on HWCs in Tanzania indicated that these conflicts have significant impacts on crocodile populations (Zakayo 2014). Sometimes angry fishermen poison or attack crocodiles with spears, as McGregor (2005) found among the Batonga people of Binga Rural District. The ways in which people wrestle themselves from the jaws of the crocodile, like blocking its nose, can have health consequences on the involved crocodile, which further threatens crocodile survival. The crocodile needs to be conserved largely because it plays an important role in maintaining the productivity and diversity of wetland ecosystems on which people depend (Van der Ploeg et al. 2011, Sai et al. 2016).

Hippos also contribute to both wetland and terrestrial ecosystems; thus, throwing stones at them, as people do along the harbors in the fishing camps, also threatens their health and survival.

Many people wonder where huge sums of

money collected (from wildlife criminal offenders) as fines by national parks in and around Lake Kariba go when officials fail to respond to genuine threats to human existence. They say that demonstrates the serious embezzlement of funds on the part of the government to which Zimparks (Zimbabwe National Parks and Wildlife Authority) is affiliated.

### **Subsistence economy at a crisis**

We reported the impacts caused by both crocodiles and hippos on the people residing in the fishing camps. We argued that the severity of these impacts is heightened by the current economic crises in Zimbabwe. McGregor (2005) found similar interconnections between economic crises and HWCs.

The response or reaction to HWCs reported to national parks reflects the level of availability of resources in a country facing serious economic hardships and shortage of fuel. The national parks authorities interviewed were not addressing the HWCs occurring in the fishing camps, partly because of limited resources. Their lack of response can impact efforts to conserve crocodiles and hippos. Van der Ploeg et al. (2011) argued that in a developing world, rural poverty, weak governance, and scarce financial resources hamper the conservation efforts on the ground.

As indicated above, the locals highlighted that when the authorities visit the camps after a conflict, they rarely kill the problem animal. Thus, the authorities are viewed as very incompetent by the locals. Incompetence and incapability of the national parks can arguably be regarded as a threat to conservation of the endangered species. Madden and McQuinn (2014, 97) observed “unaddressed or poorly addressed conflicts present increasingly difficult obstacles of effective conservation and management of many wildlife species around the world.” We have also indicated that the locals believe that they are being neglected by the authorities, largely because the camps are regarded as temporary by these authorities. But we argue that whether people are settled at an area temporarily or permanently, their welfare should be promoted at the same level with that of hippos and crocodiles. When people feel their needs and welfare are recognized by conservationists, they are likely to develop positive attitudes toward wild

animals (Yang et al. 2010).

The fact that the locals interviewed were adamant that national parks must resume crocodile egg collection and selective hippo culling indicated that they did not want to resort to wide-scale lethal methods in resolving HWCs. It is advisable that parks pay attention to such calls because their continued avoidance can cause the locals to resort to killing the animals, which threaten the conservation of these endangered species. These fishing camps must also benefit from the revenue accrued by national parks from egg collections and hunting through improvement of infrastructure in their communities. Thus, the revenue can be used to construct boreholes and Blair toilets for the people in these camps. This strategy can also cultivate positive attitudes in the people toward animals. Hutton and Child (1989) argued it is impractical to attempt to safeguard a species through legislation and law enforcement unless people are at least tolerant toward it.

### Management implications

Our results reaffirmed the need for conservationists and managers to better understand the nature and dynamics of HWCs involving crocodiles and hippos. There is also a need to consider local beliefs in witchcraft and crocodiles in conservation planning as another way of managing conflicts effectively. Local authorities should initiate infrastructure development in all the fishing camps. For example, the construction of temporary toilets and bathing facilities for these communities would minimize the need to go into the tall grasses along the Lake Kariba shores and can mitigate crocodile attacks. Mobilized resources for borehole construction would minimize children and women visiting the lake shore where they are prone to attacks from crocodiles. We also suggest that the fishing camps be regarded as permanent residences of fishermen and that new infrastructure be built there, which creates employment for the locals. Lake Kariba is strategically located; thus, the construction of hotels and lodges where there is abundant water for tourism and recreation may provide alternative sources of income to abate HWCs and provide new income sources to bolster the existing subsistence economy.

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