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Short communication

Temporal determinants of human–elephant conflict in Victoria Falls

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ABSTRACT

This study established the temporal determinants of human–elephant conflict in Victoria Falls town, Hwange West communal area and the resettlement areas of Don Rovin, Mubiya and Kalala. Interviews were the main instruments adopted for the study. Results indicate that, elephants which cause conflict in Hwange communal areas come from the Fuller forest concession area. During the cropping season elephants come to this area to raid food crops. The elephants stay in the Fuller forest during the day. As night falls elephants wait until it gets dark, then enter human settlements where they cause different human–elephant conflict manifestations. During the day, elephants seek refuge in the protected areas where they avoid contact with people. People in the area sleep in fields guarding crops to prevent elephants raids. During the dry season elephants come to drink water from the perennial streams in the Hwange communal area. The riparian vegetation and fruits in the perennial streams also attract elephants to the communal areas. Elephants are attracted to these areas during the dry season by the availability food and water. The perennial streams sustain fruits such as savanna dwala berry, monkey finger and wild medra. Mopane and acacia vegetation which is elephants's favourite also attract elephants to this area during the dry season. The bark of mopane trees is eaten by elephants during the dry season. Elephants opportunistically raid crops from fields at the fringes of rivers when they enter the settlements. Some elephants also hide in the forest remnants and

attack people during the night. It is therefore recommended that there is need for participation of all stakeholders such as scientists, elephant managers, policy makers and local communities in addressing the issues of human-elephant conflict effectively.

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1. Introduction

Conflict between humans and elephants is one of the greatest challenges currently facing biodiversity conservation. The conflict is a global problem and occurs in situations where agriculture and settlements are located close to elephant sanctuaries (Gandiwa, 2013). Human-elephant conflict refers to the interactions which lead to negative implications for human livelihoods and elephant conservation (Nyirenda et al., 2012). Interactions between humans and elephants become a conflict when people begin to experience negative effects, such as crop raiding, human injury or death or when elephant deaths occur as a result of poisoning and snaring.

While the major drivers of human-elephant conflict and its associated negative socio-economic effects are well understood, the spatial determinants of human-elephant conflict remains little understood. Spatial determinants of human-elephant conflict have received little attention from previous studies in Zimbabwe, particularly Hwange. This is despite the fact that the problem of human-elephant conflict has been observed to be increasing in Hwange. Hence, the major issue which triggered this research was the marked increase in the reports of human-elephant conflict in the area. Reported negative ecological implications of human-elephant conflict include elephants deaths through road accidents, capture in snares, and retaliatory shooting and poisoning. The 2015 incident where elephants died from poisoning in Hwange National Park is one indicator of human-elephant conflict. Such human induced mortality affects ecosystem equilibrium and biodiversity conservation.

Beneficiaries of the land reform programme are yet to benefit from the exercise following repeated invasion of their fields by elephants. Villagers in Rural Victoria falls reported that the Ndlovu area was hard hit by elephants from the Fuller forestry concession. Elephants coming from the National Park invade fields in areas along the Victoria Falls highway. Currently, the greatest dilemma in Hwange is developing management strategies that limit the interactions between human land use and elephants to prevent conflict. Faced with negative ecological and socio-economic effects of human-elephant conflict, the greatest dilemma is to provide strategies which ensure persistence of elephants in landscapes dominated by expanding human land use. Knowledge gained from this research can be used by wildlife managers and land use planners in Victoria Falls and other human-elephant conflict zones in their effort to mitigate the issue of human-elephant conflict. Such an approach is critical as it ensures the co-existence of humans and elephants with minimal conflict. Minimizing human-elephant conflict is mandatory as it is a major threat to the future survival of elephants in human landscape where agriculture and settlements continue to encroach into elephant habitat. Human-elephant conflict also undermines the support for elephant conservation.

2. Population and sampling procedures

2.1. Population

Population is a set of all possible items that possess the same characteristics or that have the knowledge of the phenomenon being investigated (Umaru, 2009). In this study the target population included the Victoria Falls Wildlife Trust, which provided information on the historical records of human-elephant conflict sites and the community members who assisted with the verification of the occurrence of human-elephant incidents to ensure data reliability.

2.2. Sampling procedure for selecting the study area

Spatial data on human-elephant conflict presence or absence and the spatial predictive factors were drawn from an elephant range of 4377km². In elephant ecology, results can be generalized to other contexts if the study

was carried out in an area which is bigger than that of the elephants range. The size of the range where this study was carried out is 4377km², which is more or equal to the average size of a home range of an African elephants (*Loxodonta Africana*) which is estimated to be between 14km² - 3120km² (Macdonald, 2001). This makes the sample representative.

The sample of the study area was selected from the settlements and agricultural areas located at the periphery of national parks and protected areas such as forests. Human-elephant conflict was observed to be common where human land use, such as settlements and cultivation, are located at the periphery of the park (Hoare, 1999). The sample included areas such as Victoria Falls town, Hwange West communal area and the Resettlement area. The study area was selected using the technique of digitizing satellite images available from Google earth.

2.3. Purposive sampling procedure for selecting the research subjects

A sample is a subset of the population. The sample size is the number of population elements that are selected for investigation (Umaru, 2009). In this study purposive sampling was employed to select the survey team since the researcher needed to work with the people who supply information. This type of sampling is non-probability sampling method in which the investigator does not necessarily have a quota to fill from various strata in quota sampling. In this case the researcher uses his/her own judgment about which respondents to select and identify only those who can give the relevant information (Umaru, 2009). This method is used to try to obtain a representative sample by directing the area from which the choice is made. The sampling method is purposive in that a certain proportion of the sample must come from a certain group. Purposive sampling seeks to gain access to the individuals with the necessary information and then select a sample that is appropriate for a particular study. Purposive sample is biased, but more likely to be represented.

In some instances purposive sampling is sometimes mixed with random sampling to avoid bias. However, for this study it was not necessary to use random sampling since there was need to select the respondents who assist with relevant information on records of human-elephant conflict data in order to fulfil the objectives of the study. The only advantage of this type of sampling is that the researcher can use his/her own skills to choose respondents. This technique was used to select the people who could provide the relevant information of human-elephant conflict location in the study area. The Victoria Falls Wildlife Trust was identified as a source of information for the historical records of human-elephant conflict. This organization runs a human-elephant conflict project. The project involves monitoring the conflict hotline and working with local communities to address the human-elephant conflict problem. One of the members from the Victoria Falls Wildlife research trust showed the researcher around the areas where human-elephant conflict had been reported.

The research assistant helps with managing the human-elephant conflict hotline and responding to the local community reports of conflict incidents at the wildlife research trust. The researcher also conveniently or purposively selected community members used for verifying the human-elephant conflict which were recorded by Victoria Falls Elephants. In this case locals selected are the adults who have been staying in the area for more than 20 years. The assumption in this case was that these people could assist in identifying elephants routes based upon their local knowledge. This criterion is supported by Smith and Kasiki (2000) who suggested that experience from Taita Taveta shows that a great deal of information on traditional elephants routes can be obtained by consulting with long term local residents.

3. Data collection

3.1. Video camera data collection instrument

Data collection instrument is a device for collecting data or measuring the variables which have been isolated for investigation or used for answering research questions (Umaru, 2009). The main research instrument used for the study was the video camera. The video camera was used to capture the responses of people who were selected conveniently. For this research, the video was used to capture the temporal determinants of human-elephant conflict based upon local people's knowledge. The major advantage of this technique is that it improves information sharing between the outsiders and local people.

3.2. Temporal determinants of human-elephant conflict in Victoria Falls town

The temporal factors greatly influence human-elephant conflict in the town of Victoria Falls town. The elephants, which cause conflict come from Zambezi and Victoria Falls national park. The local people selected conveniently indicated that as early as 05:00pm, elephants come close to the settlements. They usually hide in the buffer zone between the park and the settlements. Elephants usually hide in the buffer zones and wait until night falls. Around 09:00pm, elephants enter humans settlements and cause different human-elephant conflict manifestations. As they pass through the settlements elephants destroy infrastructure such as water pipes, durawall of houses and sewer pipes. Elephants also hide in the bushes in areas such as Mkhosana and Chinotimba and attack people resulting in death or injuries. The elephants also cross the residential areas in Victoria Falls town to drink water from the upper sections of the Victoria Falls where Zambezi River is not very steep. As early as 04:00am elephants leave the settlements and go to the national parks where they hide during the day to avoid contacts with people. As they cross the roads to drinking water, elephants also cause vehicle accidents.

3.3. Temporal determinants of human-elephant conflict in Hwange communal area

The researcher discovered that elephants which cause conflict in these areas come from the Fuller forest concession area. During the cropping season elephants come to this area to raid food crops. The elephants stay in the Fuller forest during the day. As night falls elephants wait until it gets dark, then enter human settlements where they cause different human-elephant conflict manifestations. Crop raiding and human injuries and death are some of the human-elephant conflict manifestations observed in the communal areas of Hwange. During the day, elephants seek refuge in the protected areas where they avoid contact with people. People in the area sleep in fields guarding crops to prevent elephants raids. During the dry season elephants come to drink water from the perennial streams in the Hwange communal area. The riparian vegetation and fruits in the perennial streams also attract elephants to the communal areas. These perennial streams are mainly found in the Monde area. The Monde area is located in the Zambezi escarpment.

The basaltic rocks in the area support the development of streams. Elephants are attracted to these areas during the dry season by the availability food and water. The perennials streams sustain fruits such as savanna dwala berry, monkey finger and wild medra. Mopane and acacia vegetation which is elephants's favourite also attract elephants to this area during the dry season. The bark of mopane trees is eaten by elephants during the dry season. Elephants opportunistically raid crops from fields at the fringes of rivers when they enter the settlements. Some elephants also hide in the forest remnants and attack people during the night.

3.4. Temporal determinants of human-elephant conflict in the resettlement area

The historical records and the respondents selected conveniently from each study area provided data on the temporal determinants of human-elephant conflict. Elephants which come to raid crops from the resettlement area come from the Fuller forests and the national parks. This is because the resettlement area is situated between the Fuller forest and the national parks. The researcher discovered that elephants do not come to the resettlement areas during the rainy season. The area is characterised by the clay soils which become slippery during the rainy season. This prevents elephants from raiding crops from the resettlement areas during the rainy season. Elephants avoid slippery areas as they find it difficult to walk on the slippery soils. People in the resettlement area indicated that they do not guard their crops during the rainy season.

During the dry season elephants come to this area in search of water and opportunistically raid vegetables from gardens. The area is characterised by wetlands. Hence elephants come to drink water from the perennial water points in the area. The rich soils in the area are characterised by mopane and acacia which is the elephant's favourite. The rich soils and the wetlands in the area are the key factors which attracted people to settle in this area. Hence elephants and people compete for the same resources in the area. Elephants also raid stored food during the dry season.

4. Results and discussion

4.1. Temporal determinants of human-elephant conflict

Results indicated that as early as 05:00pm, elephants come close to the settlements in Victoria Falls town. They usually hide in the buffer zone between the park and the settlements. Elephants usually hide in the buffer

zones and wait until night falls. Around 09:00pm, elephants enter human settlements and cause different human-elephant conflict manifestations. Around 04:00am elephants leave the settlements and go to the national parks where they hide during the day to avoid contacts with people. Results also show that during the cropping season elephants come to the villages in Hwange communal area to raid food crops. The elephants stay in the Fuller forest during the day. As night falls elephants wait until it gets dark, then enter human settlements where they cause different human-elephant conflict manifestations. During the day, elephants seek refuge in the protected areas where they avoid contact with people. During the dry season elephants come to drink water from the perennial streams in the Hwange communal area.

These findings agree with Parker (2007) who noted that crop raiding increase during the cropping season. Crop raiding incidents usually reaches peak when crops mature. Elephants prefer to raid mature crops since their bodies and seeds are highly nutritious. In some situations, crop raiding occurs during the rainy season and the dry season. During the rainy season elephants raid crops from the fields. In areas where the presence of wetlands allows cultivation of vegetables during the dry season, elephants also raid these gardens opportunistically when they come to drink water from the water points. As noted by Parker (2007), the majority of elephants crop raiding occurs during the hours of darkness. In Trans Mara, Kenya, all recorded crop raids occurred between 19:00 and 05:00, with a peak of activity at 20:00 hours. Elephant raid during the night when they advantage of using the darkness and cover which makes it difficult for people to detect them.

5. Conclusion

The main objective of the study was to identify the temporal determinants which determine the vulnerability of an area to experiencing human-elephant conflict incidents in Victoria Falls town, Hwange communal area and the resettlement area. These results suggest that, the most important predictor of human-elephant conflict on this particular landscape is distance from protected areas. For Victoria Falls town, it can be concluded that vulnerability to human-elephant conflict is determined by the location of a place in relation to the park boundary and the urban settlements. The main reason is that human-elephant conflict probability was significantly and negatively related to distance from the park boundary and distance from urban settlements.

This implies that the whole town of Victoria Falls is a human-elephant conflict hot spot as it shares a boundary with two national parks. It can also be concluded that the chances of human-elephant conflict occurrence are determined by the location of a place in relation to the distance from the forest and elephants routes in Hwange West communal area. This is because the distance from the forests and elephants routes was significantly and negatively related to the probability of human-elephant conflict. Hence, all the areas like Mvutu, Ndlovu, Chikandakubi and Chenamisa are human-elephant conflict hot spots as they share a boundary with the forest protected area. In the resettlement areas, it can be concluded that distance from the forest determines vulnerability to the human-elephant conflict incidents. The reason behind this is that human-elephant probability could be predicted significantly with distance from the forest. All the resettlement areas of Don Rovin, Mubiya, Kalala and Masikiri are human-elephant conflict hot spots as they share a boundary with the Fuller forest protected area. Hence solutions to human-elephant conflict require land use planners should take into cognisance human-elephant conflict issues each time they allocate land to different projects. Such an approach may help address human-elephant conflict in the long term.

In light of the conclusion above, the following are the recommendations for addressing the problem of human-elephant conflict in all the three human-elephant conflict zones. For Hwange communal area, Victoria Falls town and Resettlement areas, it is crucial to suggest human-elephant conflict management options based upon the main research findings. There is need for participation of all stakeholders such as scientists, elephant managers, policy makers and local communities in addressing the issues of human-elephant conflict effectively. Implementation of conflict resolution measures in the areas should consider that the area of Hwange is designated for wildlife. This implies that any human-elephant conflict management method should encourage the coexistence of elephants and humans. Driving the elephants away is not possible as the area is designated for wildlife.

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