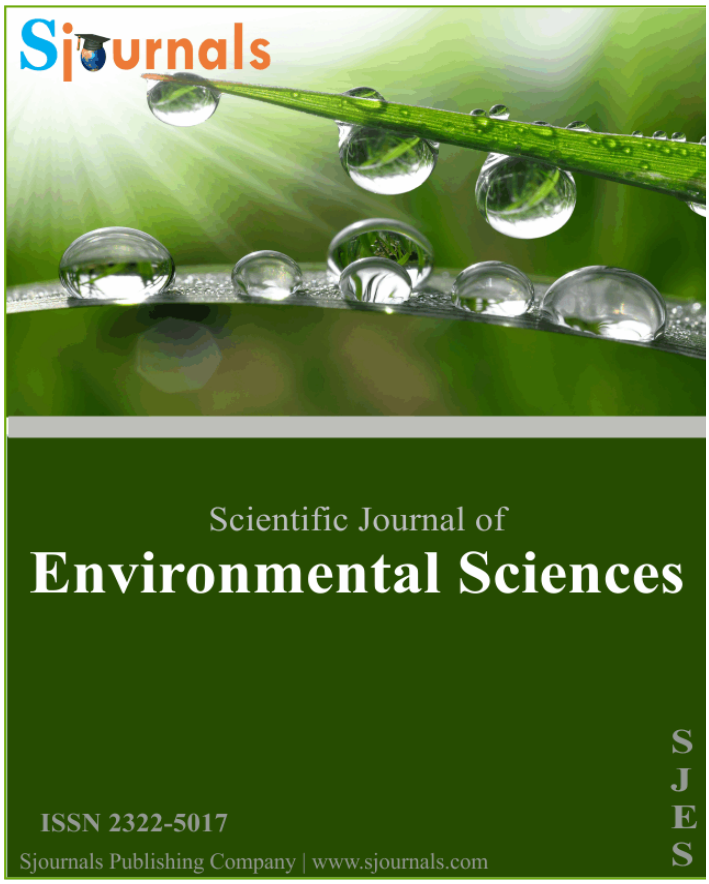

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Short communication

Predicting the factors which significantly predict the presence of elephants

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ABSTRACT

Predicting the factors which determine the probability of elephant presence is critical in land use planning. Such information enables stakeholders to integrate development issues with elephant conservation concerns. This study tested the factors which significantly predict the probability of elephant presence in the resettlement areas of Kalala, Don Rovin and Mubiya near Victoria Falls Airport. To achieve this, elephant presence or absence data and land use were collected using a GPS Garmin. The Logistic Regression function in SPSS was used to test whether there is a significant relationship between human land uses and elephant presence/absence. Results indicate that the probability of elephant presence could be predicted significantly with distance from human settlement and agriculture. These results imply that relevant stakeholders need to take cognisance of the position of settlements and agricultural fields when planning. Such an approach is critical as it can act as a long term solution to the problem of human-elephant conflict.

1. Introduction

Mapping the factors which predict the presence of elephants remains largely unexplored in Zimbabwe. Establishing how elephants respond when agriculture and settlements activities located at the periphery of

elephants sanctuary is considered to be the best way of convincing land use planners to allocate land to settlements and agriculture activities with the understanding of the associated negative consequences. Crop raiding occurs when farmers grow food crops close to areas inhabited by elephants. This situation has been noted in most conservation areas of Zimbabwe, where human-elephant conflict started when agriculture and settlement activities encroached into areas which were formerly reserved for elephants. Therefore, resolving the issue of human-elephant conflict requires land use planners to come up with effective land use planning policies which deal with the problem of human-elephant conflict effectively. Larmaque et al. (2009) suggested that the most practical land use planning techniques for managing human-elephant conflict with farming communities is to remove agriculture from elephant ranges. Moving crop fields from the forest edge close to settlements and reducing settlements encroachment into elephants range by repositioning the boundaries of protected areas or creating buffer zones is considered another strategy to address human-elephant conflict. This means that the best approach to the issue of human-elephant conflict is the clear designation of areas suitable for human activities and areas devoted to elephants.

The major drawback to venture into researches on the spatial analysis of human-elephant conflict has been attributed to technological limitations which made it impossible to collect human-elephant conflict spatial data on human land use and natural variables. The major limitation was the absence of an instrument for collecting spatial data, such human-elephant location and environmental factors. The advent of the satellite linked GPS receiver instrument has made it possible to collect human-elephant conflict data (Forley, 2002). The introduction of the GIS software has allowed spatial data analysis through the integration of human-elephant conflict data and human land use data layers. This has made it possible for elephants ecologists to establish the main factors affecting the distribution of human-elephant conflict across landscapes (Ngene, 2009). The introduction of GIS has made it possible to collect and analyze spatial data and this has seen few researchers venture into spatial analysis of human-elephant conflict. The current study, therefore tested whether and how the probability of elephant presence is related to human land uses. This study demonstrates how the logistic regression model can be used to model the relationship between human land uses and the presence or absence of elephants.

2. Methodology

2.1. Data collection instruments

The GPS receiver was used to map the presence/absence of elephants and land use/cover types in UTM coordinates. GPS is a satellite based technology used for navigation and location of geographic features. The GPS system is made up of a network of 24 satellites placed into orbit by the U.S Department of defence. The GPS satellites circle the earth twice a day and transmit signal information to the earth. The GPS receivers take this information and use trilateration to calculate the user's exact position. The type of GPS receiver which was used for this study is the GPS Garmin Etrex 10 equipment. The location of the human land use and natural variables were obtained through digitizing satellite images made available in Google earth (www.Googleearth.com).

2.2. Elephant data collection using the dung count method

Elephant data was obtained using the index method. The index method is an indirect measurement of the status of animal population in an area (World Wide Fund for Nature, 2000). Examples of index methods include dung counts and spoors. Dung counts were used as surrogates of elephant presence or absence for this research (Beer, 2008).

2.3. Advantages of dung counts

The method is easy to apply and it is cheap and affordable (Barnes, 1996). The advantage of the method is that observers walking on foot through out a wildlife area capture elephant presence/absence indicators (dung). The method is also cheaper compared to the other methods of estimating elephant distributions like aircraft surveys. Dung piles are easier to find than the elephants themselves since they live in concealed habitat types such as forests. They also produce precise estimates compared to direct sighting based surveys such as aero plane surveys (Barnes, 2002).

2.4. Disadvantages of dung counts

Dung counts cannot be conducted in flooded areas so it is unsuitable for permanent swamps. The area where the data was collected, was not flooded. There is need to train and do pilot surveys before data collection. The training and pilot surveys were done prior to the actual data collection in order to address this shortfall. The local dung decay needs to be calculated prior to data collection. The method is not ideal for areas which are greater than 5000km^2. To overcome this shortfall, the study area selected was 305km^2. Dung densities also vary significantly between wet and dry seasons since elephants are seasonal animals (Hedges, 2006). To overcome this problem, dung count based surveys should not span seasons in order to avoid problems caused by seasonal changes in defecation rates (Hedges, 2006).

2.5. Data analysis

2.5.1. Logistic regression model: Determining human land uses which significantly predict elephant distribution

The Logistic Regression function in SPSS was used to test whether there is a significant relationship between human land uses and elephant presence/absence. The slope, the intercept coefficients, as well as the p-values were noted in selecting the human land use factors which significantly predict the probability of elephant presence. The rationale for selecting the logistic regression model for data analysis is that it is the best approach for studying the relationship between a categorical variable and one or more predictor variables. Logistic regression is well suited for describing and testing hypotheses about relationships between a categorical variable and binary predictor variables. For this study, the logistic regression model will be used to test the relationship between the quantitative predictor variables (human land uses) and elephant distribution. The logistic regression model will be used to determine the probability of finding an elephant with distance away from human land uses. The predictor variables will be considered to be significant if $P>0.05$. The type of logistic regression model proposed for the study is the binary logistic regression.

2.5.2. Binary logistic regression

Binary logistic regression is a regression technique which estimates the probability of an event occurring. The binary logistic regression technique describes the relationship between a categorical binary variable and a set of predictor or explanatory variables. The rationale for selecting the binary logistic regression model is that it is the only way in which the relationship between quantitative predictor variables and quantitative binary responses can be modelled (Miller, 1980). In ecology, logistic regression models are used in determining the factors that are related to the presence/absence of wild animals. For this particular research, binary logistic regression will be used to describe the relationship between quantitative predictor variables such as distance of elephant location from human land uses (roads, settlements, mine dumps and crop fields) and quantitative binary variables (presence (1) or absence (0) of elephant presence indicators-dung).

2.5.3. Determining the probability of elephant presence with distance away from human land uses

The following equation was used to predict the probability of elephant presence with distance from human land uses: Elephant = exp [(B0+(B1*Human land use factor)/(1+ exp(B0+(B1*Human land use factor)], Where B0 = Intercept, B1 = Slope (Constant).

3. Results

As shown in Table 1, results indicate that the probability of elephant presence could be predicted significantly with distance from human settlement and agriculture.

Table 1
Logistic regression relationship between elephant presence/absence and distance from land use factors.

Factor	Slope	Intercept	P-value
Distance from settlements	0	3.266	0
Distance from agricultural fields	0	2.344	0

It can be observed that distance away from the fields is positively related to the probability of elephant presence (Table 1). This implies that elephants are not found close to agricultural fields in the resettlement areas of Mubiya, Don Vile and Kalala. The resettlement is situated right in the middle of elephant habitat; hence people guard their crops during the day and night. This prevents elephants from entering the fields. Table 1 illustrates that distance away from the settlements is positively related to the probability of elephant presence. The results mean that elephants are not found close to settlements in the resettlement areas.

4. Conclusion

It can be concluded that the presence of elephants can be predicted reliably using distance from fields and settlements in the resettlement areas of Mubiya, Don Rovin and Kalala.

In light of the conclusion above, the following recommendations are made: The area is situated in the middle of protected areas, implying that human-elephant conflict resolution measures should not focus on chasing elephants away from this area. Rather, mitigatory measures should encourage people to stay with elephants since people were settled in a wetland which used to provide water and food resources for elephants. This implies that this research is critical as it provided possible solutions which might encourage humans and elephants to co-exist with minimum conflict. Human-elephant conflict resolution is crucial as it can improve local support for elephant conservation measures.

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