Determining the Significance of Various Variables on Wildlife Poison Exposure in Canada using GIS Spatial Analysis Tools

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Introduction

Ecosystem health, which is dependent on high levels of biodiversity², is threatened by wildlife poisoning. Many human activities, such as agriculture, resource extraction, and technological advancement, expose wildlife to poisons. However, there has been little research into the spatial relationship of poisoning events.

Purpose

The purpose of this research is to develop and utilize a GIS-model to determine what variables affect poison exposure of birds and mammals in Canada, as well as the strength of these relationships.

Study Area

Canada is a biodiverse country with 1,449 native vertebrate species. These species are at risk of poisoning. Figure 1 shows wildlife mortality across Canada. Canada is a growing country, with 2,233,140 road networks, 277 agricultural areas, 14,000 PRFs, and 9,007 protected areas.

Objective 1

Identify variables that could explain the spatial distribution of wildlife mortality in Canada.

We performed a literature review to accomplish this objective. The variables were road networks, agricultural areas, pollutant-release facilities (manufacturing, chemical, metal, wood producing, electrical, and waste removal sites), and protected areas.

Objective 2

Identify areas of focus with the greatest proportion of bird and mammal mortalities due to poisoning in Canada.

To accomplish this objective, we divided the wildlife data into bird and mammal mortality points. Then, we performed an optimized hotspot analysis on both datasets. This identified two areas of focus: southern Ontario and southern Saskatchewan. We then isolated variables and wildlife data to these extents (Figure 2).

Objective 3 & 4

Develop a GIS-based model and perform statistical analysis to assess the spatial relationship of wildlife mortality with the selected variables and their significance on wildlife poisoning.

We developed a GIS-model in model builder. This involved multiple steps, summarized in Figure 3, including creating a random distribution of points. The output of this model produced the amount of wildlife found within a buffer area of each variable (Figure 4). This value was used to calculate a Chi-square statistic and a p-value.

Research Findings

The following research results demonstrate the strength of correlation (displayed as chi-square value) between variables and: birds in southern Ontario (Figure 5); mammals in southern Ontario (Figure 6); mammals in southern Saskatchewan (Figure 7); and mammals in southern Canadian (Figure 8). Orange indicates a direct correlation with wildlife mortality and blue indicates an indirect correlation.

Strengths / weaknesses

There was bias and inconsistencies in this research through the data collection. The data was collected by laypeople, using different techniques from accurate GPS coordinates to generalized landmarks. This means that the points were not necessarily accurate. Additionally, public lands and populated areas were more likely to have points, since these are areas the laypeople had access to.

Despite this weakness, this research provides a strong foundation for understanding the spatial relationships involved in wildlife poisoning.

Future Research

Future research should develop a deeper understanding of the spatial patterns explored in this study. Future research could also expand into other areas of Canada, as well as to aquatic and marine species, amphibians, and reptiles. Finally, future research could actively sample wildlife mortality events in order to minimize the reporting bias of passively collected data.

Conclusion

The variables with the greatest effect across both species and study areas are waste removal sites, manufacturing sites, and chemical sites.

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References