

Deadly roads for frogs and toads

A spatial study of amphibian road mortalities and culvert locations in Elk Island National Park, Alberta, Canada

Author: Michelle Nelms, B.Sc. (Biological Sciences) student, MacEwan University

Co-authors: Ramona Maraj and Mary McConnell, Elk Island National Park

Community partner: Elk Island National Park, Parks Canada



01. Abstract

Elk Island National Park (EINP), located 45 minutes east of Edmonton, Alberta, offers an excellent opportunity to look at the correlation between road mortality incidences and culvert locations. The main parkway receives hundreds of thousands of vehicle visitors annually, and, with culverts already installed throughout the road network, the analysis of the mortality frequency and location of adjacent culverts should be evident. Examining the spatial relationship between road mortality incidences and culvert access we found that there were more mortalities closer to the culvert locations than further away and with this data we hope to find a workable solution for amphibian and reptile populations within EINP.

Keywords: culvert, road mortality, wildlife crossings, migration, population biogeography



02. Introduction

Road mortalities involving amphibians and reptiles are an unfortunate consequence of linear disturbances across landscapes. The installation of culverts is one mitigation effort that may reduce road mortalities among amphibian and reptile populations, which are the group with the highest road mortality rate amongst vertebrates (Beebee, 2013).

We propose that, on average, the frequency of road mortalities increases as the distance from culverts increases.

By analyzing whether there is a relationship between the number of road mortalities and the location of the nearest culvert, mitigation efforts can be made to alleviate the stress linear disturbances such as roads have on local populations in hopes of establishing mitigation efforts to better protect the species within Elk Island National Park.



03. Methodology

Multiple methods were used to obtain the data required for this project including:

- foot and bike GPS surveys for road mortalities
- culvert location GPS mapping on foot
- historical culvert location cross-referencing
- GIS mapping and data integration

Data was shared collaboratively with EINP and the data analysis was completed by the author in conjunction with MacEwan University using SPSS. Digital mapping was used to measure culvert-carcass distances (m).

05. Discussion

There is strong statistical data to support that there is a **negative linear relationship** between frequency of road mortalities and distance from culvert location. That is, the **closer to the culvert, the higher the mortality rates**, which does not align with our hypothesis.

A possible reason for the negative correlation could be, as Cunnington et al. (2014) proposed, that culverts alone are not enough to reduce fatalities. The following variables are factors that may impact the use of culverts by amphibians and reptiles:

- culvert size
- substrate
- location to the nearest waterbody

One proposed method to increase culvert usage is the deployment of exclusion fencing that would effectively funnel the animals into the culvert and away from the road surface.

04. Results and Data Analysis

Our data were normal, therefore we performed a linear regression model. Shown below are the statistical analysis outputs showing the negative linear relationship between the road mortality counts and the distance to the nearest culvert. Distances were grouped in blocks of 10m intervals with a maximum distance of 250m.

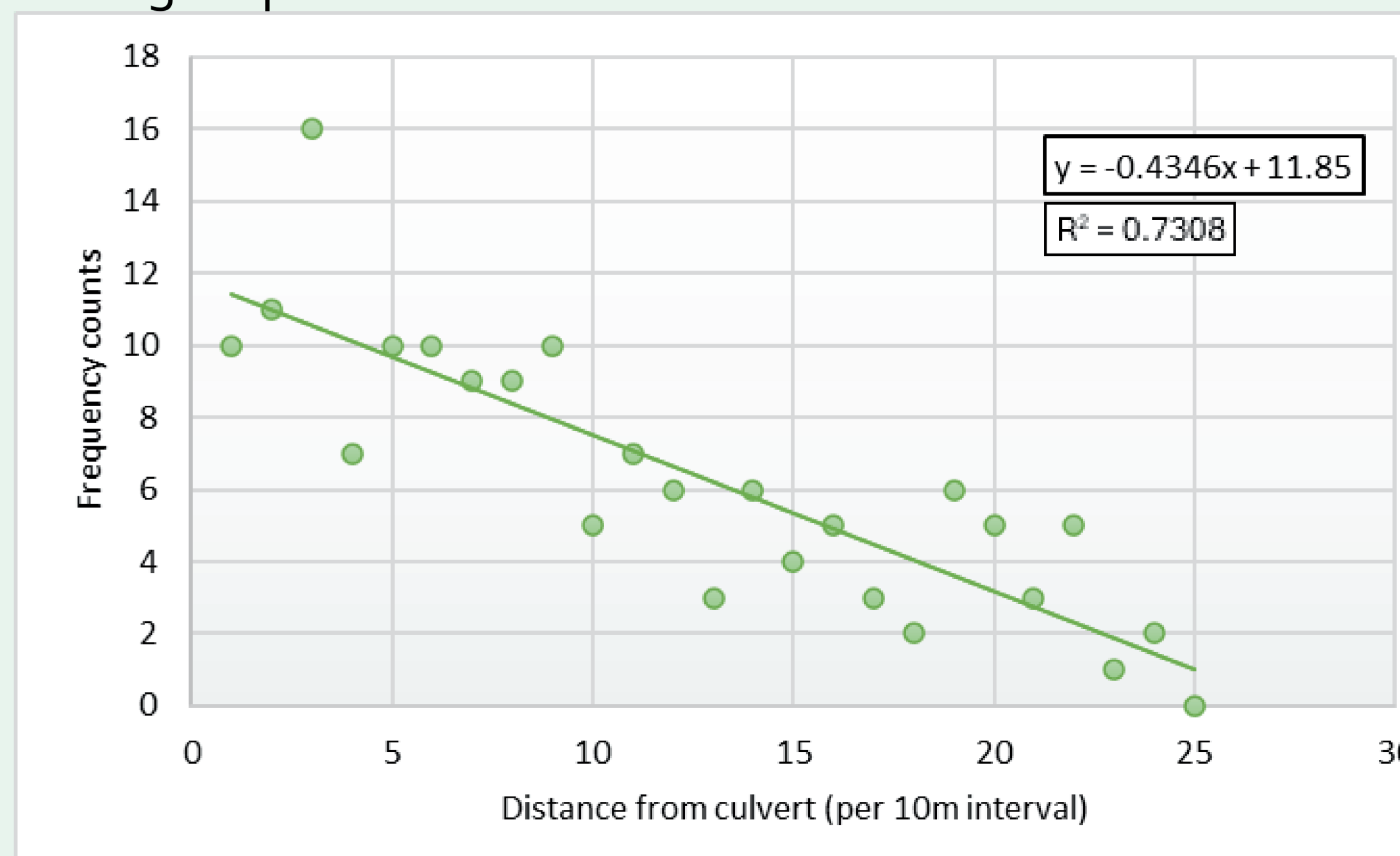


Figure 1 - Relationship between the frequency of road mortalities and the distance from the nearest culvert in 10 m intervals (p -value < 0.01; $y = -0.436x + 11.85$; $R^2 = 0.7308$; $n = 155$)

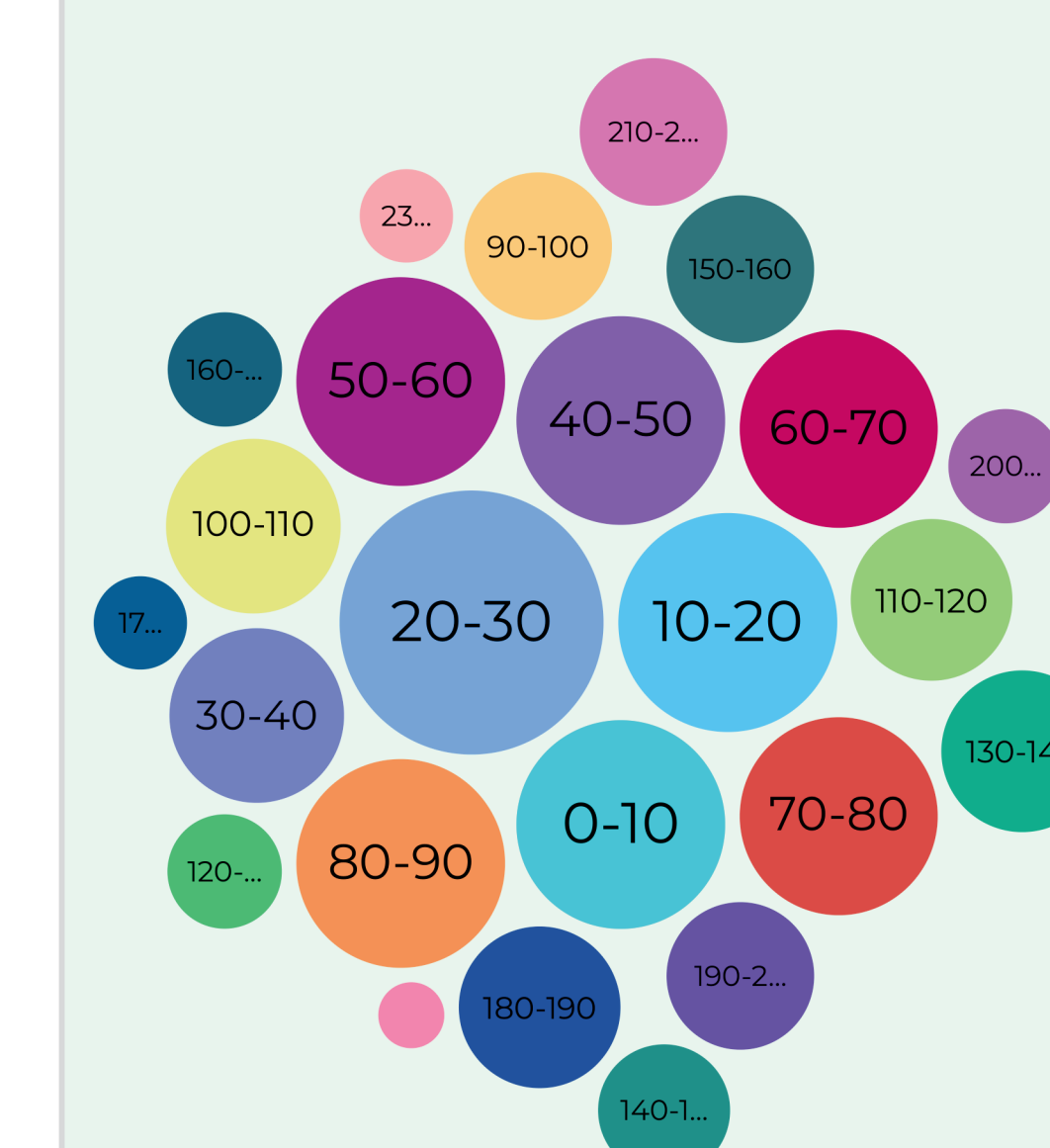
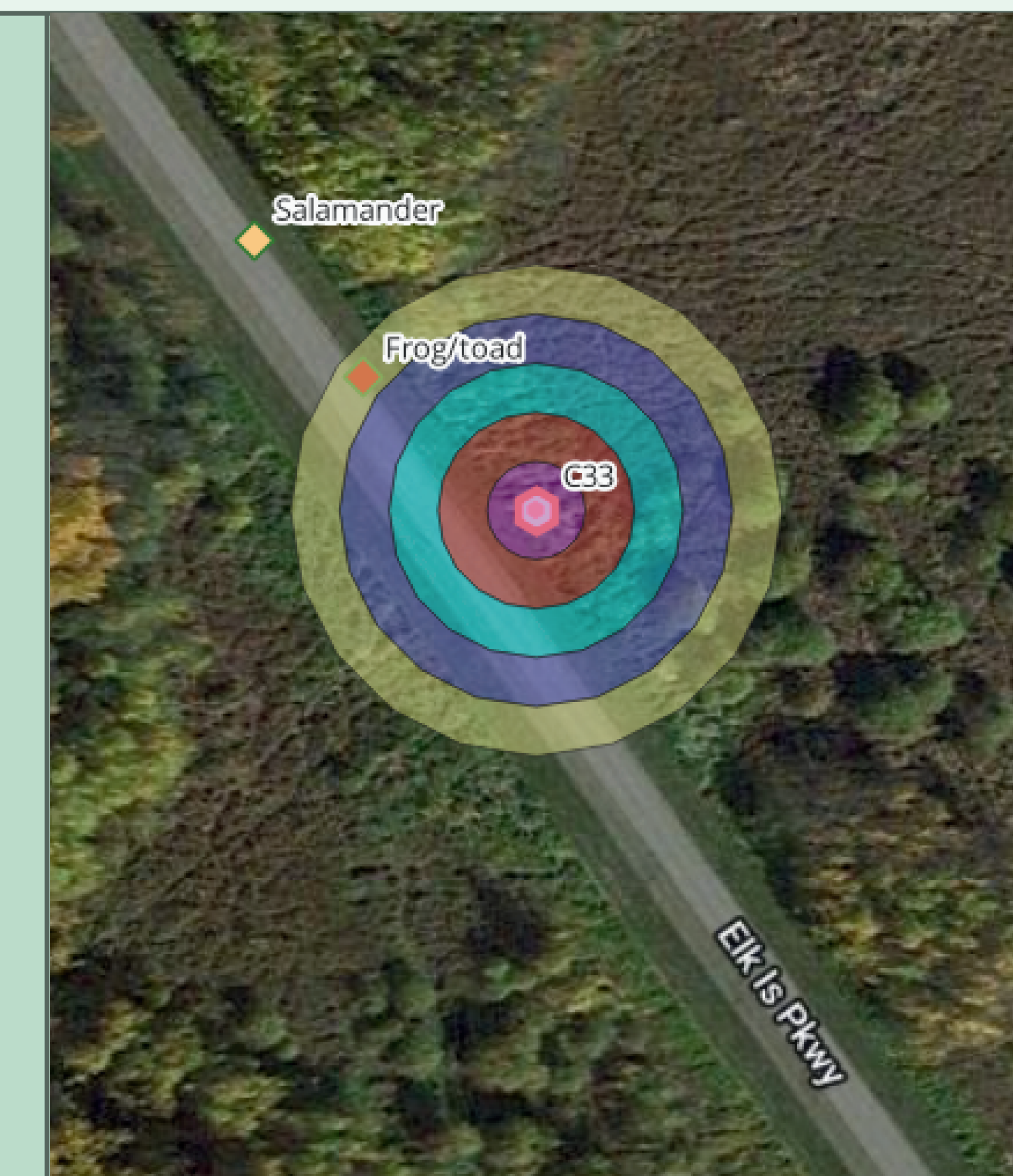


Figure 2 Visual representation of 10m interval blocks and their comparative frequency counts. The larger the bubble the higher the frequency counts in that specific section.



Sample of the GIS data rendering showing two organisms (salamander and frog/toad) and their relation to a nearby culvert (C33).

The concentric rings are 10m intervals from 0-50m for this example.

06. Conclusion and Recommendations

While there is strong statistical evidence showing a negative correlation between road mortality counts and culvert distance, there are a number of limitation that must be addressed. Inconsistencies in road mortality data collection processes, scavenger removal of carcasses, inability to correctly identify deceased species, and incomplete culvert locating should all be explored in further studies.

It should be noted that this research did not take into account the location and type of nearest waterbody nor recent precipitation which may have an effect on migration patterns.

We hope that this research will assist with updating EINP protocols and be used in conjunction with other mitigation efforts for species survival.

References

Beebee, T. J. 2013. Effects of Road Mortality and Mitigation Measures on Amphibian Populations. *Conservation Biology*, 27(4): 657-668. Retrieved from <http://www.jstor.org/stable/23525294>

Cunnington, G. M., Garrah, E., Eberhardt, E., and L. Fahrig. 2014. Culverts alone do not reduce road mortality in anurans. *Ecoscience*, 21(1): 1-33. Retrieved from <https://www.jstor.org/stable/10.2307/26613651>