Why the moose crossed the road: A spatiotemporal assessment of wildlife-vehicular collisions in New Hampshire

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Wildlife-Vehicular Collisions

Wildlife vehicular collisions (WVCs) pose inherent threats to wildlife populations and human safety worldwide. Road density is increasing in response to increasing traffic volume and new roads increase fragmentation of wildlife habitats. Roads create barriers that range in permeability to wildlife movement between outright failure (mortality) to temporary success (crossing without harm). Mitigating the negative effects of WVCs in the USA largely falls to state departments of transportation (DOT) and local municipalities with guidance from the U.S. Federal Highways Agency. Until now, WVCs have not been evaluated in New Hampshire (USA) where human population is increasing (~9% expected between 2010-2040[1]), driving increases in traffic volume and road density in a landscape still largely forested with large tracts of undisturbed wildlife habitat[2].

Project Objectives

In partnership with the New Hampshire (NH) DOT, the objectives of our project were to:

- **map**, **summarize**, and **analyze records of WVCs throughout NH**;
- **recommend locations and strategies for mitigation**;
- **identify risk parameters** for consideration during **project evaluation**.

Data Analysis

Two datasets of vehicular collisions from 2002-2019 were received from NH DOT. These data were filtered and combined with publicly available data in the steps described in Fig. 1 below.

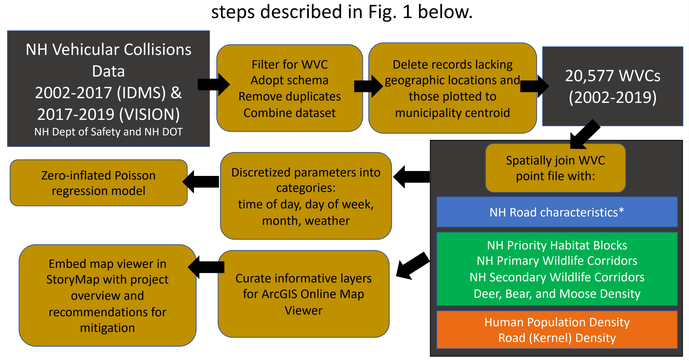

Fig. 1 Conceptual overview of data analysis. ☐ denote datasets; ☐ analytical processes.
*20,339 of the total WVC records were located within 200ft of a road feature in NH Roads database [3].

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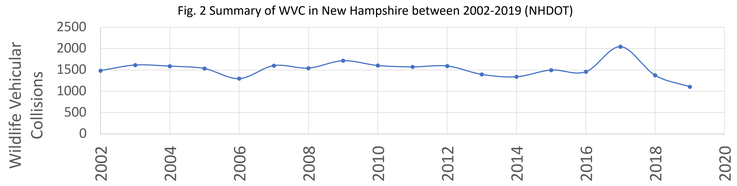
Where are the WVCs?

A total of 27,383 WVCs were documented in NH between 2002-2019.



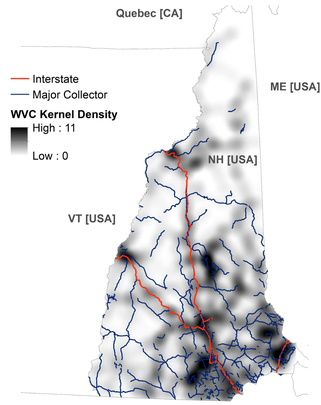


Fig. 3 WVC Kernel Density and highly traveled road corridors[3] (2002-2019)

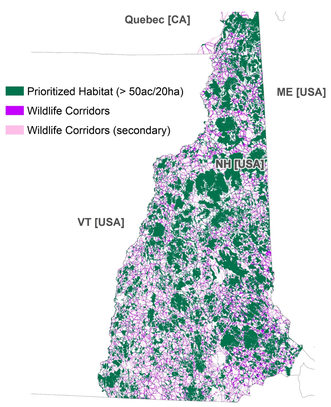


Fig. 4 Priority habitat blocks (> 50ac/20ha), primary and secondary wildlife corridors[4]

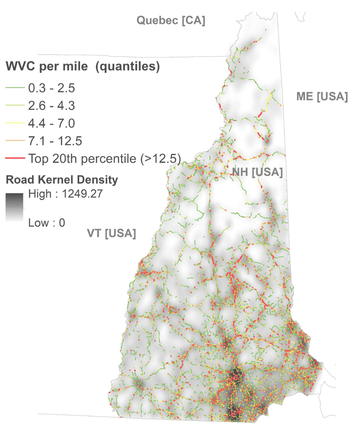


Fig. 5 NH statewide WVCs between 2002-2019 summarized by Unique Road Segment[3] and calculated Road Kernel Density

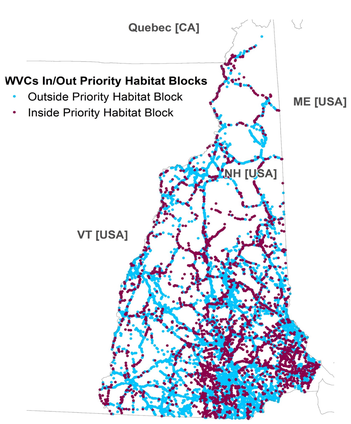


Fig. 6 NH statewide WVCs between 2002-2019 located within and outside of "priority habitat blocks"[4]

Literature Cited
[1] NH Office of Energy & Planning. 2016. State of NH State and County Population Projections https://www.nh.gov/osi/data-center/documents/2016-state-county-projections-final-report.pdf [2] The Society for the Protection of NH Forests and The Nature Conservancy, NH Chapter. 2014. Land Conservation in NH: A Snapshot of Progress & Opportunities. https://forestsociety.org/sites/default/files/SB_388_SPNHF_TNC_Report_10-31-14.pdf [3] NH Dept of Transportation. 2022. Roads. https://nhgeodata.unh.edu/nhgeodata/rest/services/Topical/GV_BaseLayers/MapServer/18
[4] NH Fish & Game. Wildlife Corridor Map. 2020. https://arcg.is/0OC0qX [5] The Nature Conservancy-NH. 2019. Connect the Coast Report. https://www.nature.org/content/dam/tnc/nature/en/documents/nh-connect-the-coast-report.pdf

What influences WVC likelihood?

Summary of WVC Analysis

90% (18,447 of 20,577) of WVCs occurred during non-adverse conditions (clear or cloudy) conditions. 85% of WVCs occurred on roads reported as "dry". More collisions occurred during the morning (4-8am) and afternoon/evening hours (3pm-12am), corresponding with wildlife and human movement patterns. The magnitude of these differences varied by season (Fig. 7).

More than 300,000 observations were included in the zero-inflated Poisson regression model as a result of discretizing continuous parameters for more informative analysis. We used effect sizes (exponentiated regression parameters) that were larger than 2 or 3 (i.e., 2 or 3-fold increase in WVCs) to identify significant parameters of practical influence.

We found that WVCs more commonly occurred when weather conditions were clear and that the frequency of WVCs varied on clear days by time of day.

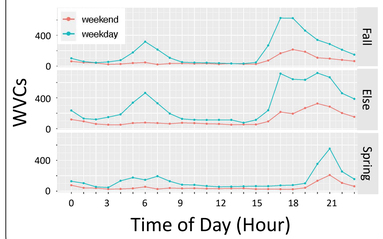


Fig. 7 WVCs by day of week, season, and time of day (2002-2019)

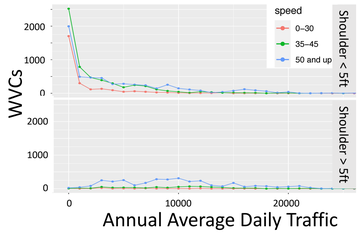


Fig. 8 WVCs by speed, shoulder width, and annual average daily traffic (2002-2019)

What comes next?

The data analysis suggests a spatial correlation between human population density and WVCs (Figs. 3 & 5). While logical, the lack of statistically significant road characteristics, like traffic volume (Fig. 8) or road type (Fig. 9), make it challenging to predict where WVCs are more likely to occur.

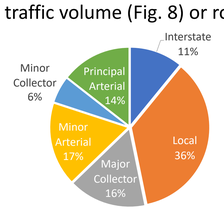


Fig. 9 Proportional abundance of WVCs by road functional system classifcaition

To address existing WVC concerns, culverts within high WVC areas are being assessed for retrofitting that would provide aquatic and terrestrial wildlife passage (Fig. 10).

New road projects will be reviewed by NH DOT using suite of data layers integrated into an ArcGIS Online Map Viewer to help inform planning and mitigation practices.

Fig. 10 Retrofitted road crossing to support aquatic and terrestrial wildlife passage[5]

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