NHDOT SPR2 PROGRAM
RESEARCH PROGRESS REPORT

Project #	Report Period Year 2022	
SPR 42372I	X Q1 (Jan-Mar) ☐Q2 (Apr-Jun) Q3 (Jul-Sep) ☐Q4 (Oct-Dec)	
Project Title: **Wildlife Vehicle Collisions Data Gathering and Best Management Practices**		
Project Investigator: Amy Villamagna **Phone:**	**E-mail:** amvillamagna@plymouth.edu	
Project Start Date: 5/19/2021	**Project End Date:** 12/31/2022	**Project schedule status:** X On schedule ☐ Ahead of schedule ☐ Behind schedule

Brief Project Description:

Currently we do not understand the scope or the cost of wildlife vehicle collisions (WVCs) in New Hampshire. Citizens die every year in New Hampshire in collisions with wildlife. There is also a cost in terms of emergency response and property damage from the collisions. Records of collisions with wildlife are not held in one easy to access central location. A better understanding of where these collisions are happening and how often could allow future projects to incorporate more wildlife crossing structures during project development and design to reduce wildlife vehicle conflict.

The proposed project will include a review of the sources of information available about WVCs in NH including the Department of Safety data that is shared with the Highway Design Bureau, the roadkill and accident data collected by the various NHDOT Districts and the NH Fish and Game roadkill data. Data from the NH Fish and Game wildlife sightings database may also be pertinent.

Based on the results of this review process, the project deliverables will include a mapping interface that would identify hot spots of WVCs, a review of WVC mitigation measures, and a summary of best management practices that have been found to effectively reduce WVCs in the Northeast. Development of educational material for NHDOT staff about the cost and prevention of WVCs is also planned.

Progress this Quarter (include meetings, installations, equipment purchases, significant progress, etc.):

- Analyzed combined WVC data from 2002-2019 to summarize annual, seasonal, and spatial trends.
- Summarized and mapped the number of WVCs by unique road segment ID and calculated WVC density (WVCs per mile) over the data period (2002-2019); 9,582 Unique road segments have at least 1 WVC record; the maximum WVCs per unique road segment was 72, mean (with WVCs) = 2; highest 20 percentile of WVC density ranged between 12 and 1800 WVCs per mile. See Figure 1 map at the end of the report
- Summarized WVC collisions by season (Fall=Oct-Nov, Spring=May-June, Other), day (weekend, weekday), and time of day to identify peaks. WVCs were standardized to WVC per day for comparison (see Figure 2 graph provided at the end of the report)
- Integrated various spatially explicit data into the WVC database, including:

  - Road attributes from the 2022 Roads layer (roads within 200ft of WVCs)
  - AADT from 2015 roads layer (for those WVCs without 2022 AADT records)
  - Priority Habitat Blocks (within 400ft of a WVC)- From NH Dept Fish and Game Wildlife Corridors modeling efforts
  - Primary and Secondary wildlife corridors (within 400ft of a WVC)- From NH Dept Fish and Game Wildlife Corridors modeling efforts
  - Wildlife Habitat Type (within 400ft of a WVC)- From Wildlife Action Plan, NH Dept Fish and Game
  - Wildlife Habitat Vulnerability- classified into high and low vulnerability[1] based on habitat likelihood to support larger wildlife (moose, bear, turkey, deer) and species of conservation concern (e.g. amphibians)
  - Bear and Moose density (relative measure calculated by subtracting goal from 2020 estimated density)- From NH Dept of Fish and Game with assistance from Katie Callahan.
- Applied a proxy to estimate posted speed using functional system for WVCs without speed data recorded (posted speed is not a field in the roads GIS layer). See Table 1 provided at the end of this report to review the speed to functional System crosswalk applied.
- Adopted and applied a (zero inflated negative binomial) statistical approach to analyzing factors that explain the observed variability in WVC data. Factors included in the statistical model:
  - Temporal factors
    - Day of week: weekday/weekend
    - Season: fall/spring/other
    - Time of Day: morning/evening/other
    - Weather: clear/not clear
    - Light: light/dark
  - Road attributes
    - Speed
    - AADT
    - Shoulder width (mean of left and right)
    - Road curvature: straight/ curvy
  - Wildlife influences
    - Wildlife vulnerability: low/high based on habitat types[1]
    - 2020 Moose density relative to goal density
    - 2020 Bear density relative to goal density
    - ?Deer density? (waiting on data from NH Fish and Game
- Submitted abstract for a poster presentation at the 2022 Ecological Society of America Conference in Montreal, Quebec [CA] in August 2022. See abstract included at the end of the report.
- Reconfigured StoryMap structure and revising based on feedback from Rebecca.
- Developed the ArcGIS Online viewer for processed data layers that will be embedded within the StoryMap.
- *Supplemental to this project, Villamagna has co-led a group of PSU seniors to develop a field camera protocol for assessing wildlife near WVC hotspots. The team is piloting the camera study at a “hotspot” in Plymouth along Tenney Mtn Highway (Rt 25).

[1] *High vulnerability*: northern hardwood conifer, lowland spruce-fir, high elevation spruce-fir, hemlock hardwood pine, Appalachian Oak Pine, shrublands, floodplain, marsh and shrub wetlands, northern swamps, temperate swamps; developed; *low vulnerability:* all else

NHDOT SPR2 PROGRAM
RESEARCH PROGRESS REPORT

Items needed from NHDOT (i.e., Concurrence, Sub-contract, Assignments, Samples, Testing, etc…):

Nothing is needed from NHDOT at this point.

Anticipated research next three (3) months:

- Complete the statistical analysis of WVCs to identify and rank factors of influence.
- Populate the ArcGIS online viewer with WVC point data (full compilation with additional data referenced above), WVC density by road segment, the WVC kernel density and hotspot maps.
- Continue efforts on the WVC StoryMap, including embedding the ArcGIS online viewer
- Begin poster presentation preparations
- Begin drafting report/manuscript for peer review

Circumstances affecting project:

At this point in time, we feel like we are on track to complete the project within the previously defined period.

Tasks (from Work Plan)	**Planned % Complete**	**Actual % Complete**
Collect WVC data for NH (2021 Q3)	*100%*	*100%*
Create series of static maps (2021 Q3 -Q4)	*100%*	*80%*
Conduct literature review and synthesis (2021 Q3-Q4)	*50%*	*90%*
Collect ancillary data (2021 Q4 – 2022 Q1)	*100%*	*100%*
Creation of ArcGIS Online viewer for WVC data (2021 Q3-Q4)	*50%*	*50%*
Statistical analysis of WVC data (2022 Q1-Q2)	*50%*	*50%*
Development of ArcGIS StoryMap (2022 Q1)	*50%*	*75%*
Write technical report (2022 Q1-Q4)	*0%*	*25%*
Develop short videos (2022 Q2)	*0%*	*0%*
Present results (2022 Q4)	*0%*	*0%*

Barriers or constraints to implementing research results

As described in earlier progress reviews, there are inconsistencies in how WVC are reported since 2002. Some inconsistencies relate the specificity of the animal involved and others to the spatial precision of the collision location record. During the past 3 months we also identified a subset of 923 WVCs that were more than 200ft from a roadway and 35 WVCs that were not linked to a set of coordinates (i.e. unmappable). We assessed the proximity of WVCs to roadways and found maximum distance to be 813 ft and the mean distance to be ~18 ft. There are also ~2348 WVC records that, when spatially joined with roads layers from 2022 and 2015, do not have AADT data. All records can be queried in the final WVCs data layer that will be shared with NHDOT.

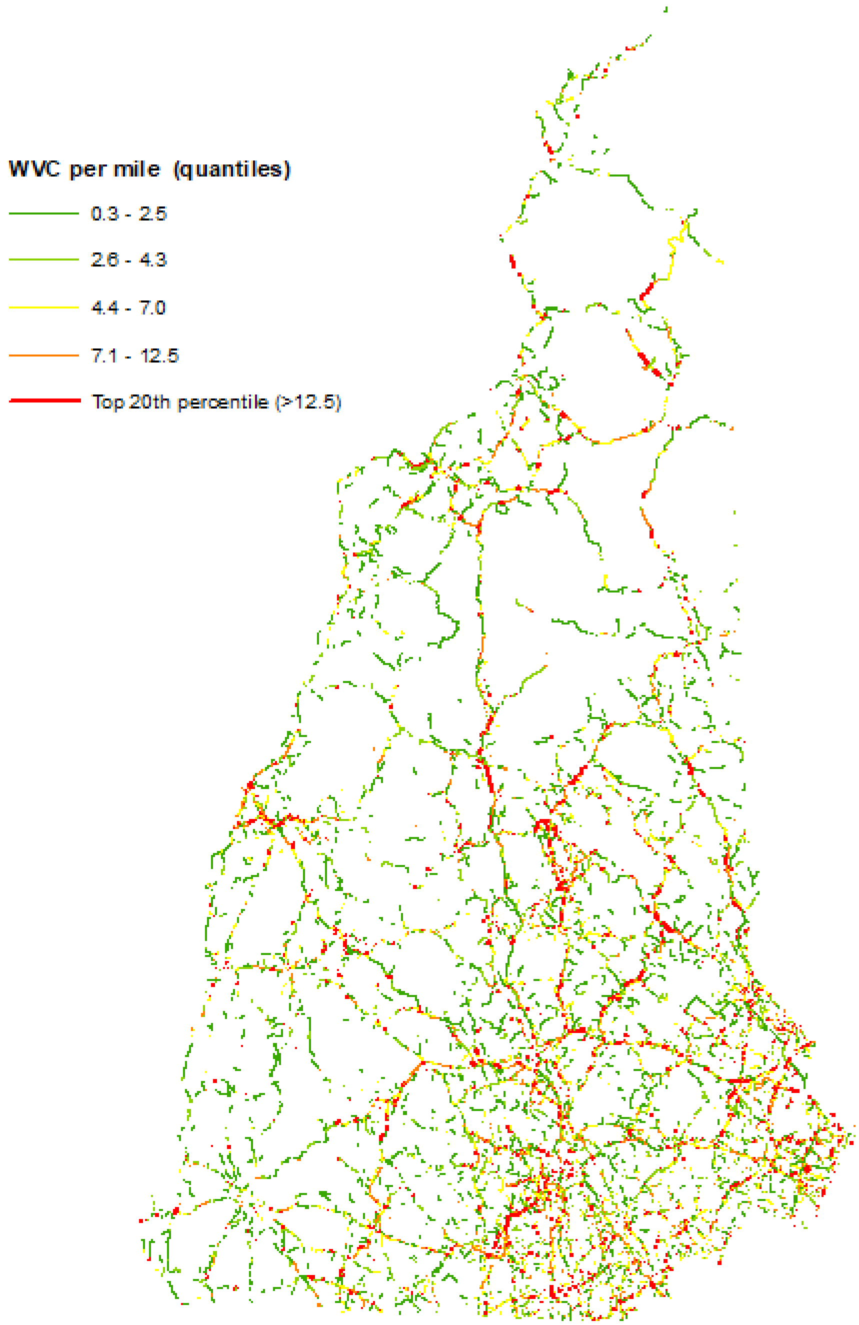

Figure 1: WVC density (per mile) on NH Roads by unique road segment ID. The top 20th percentile of roads is illustrated with thicker red lines.

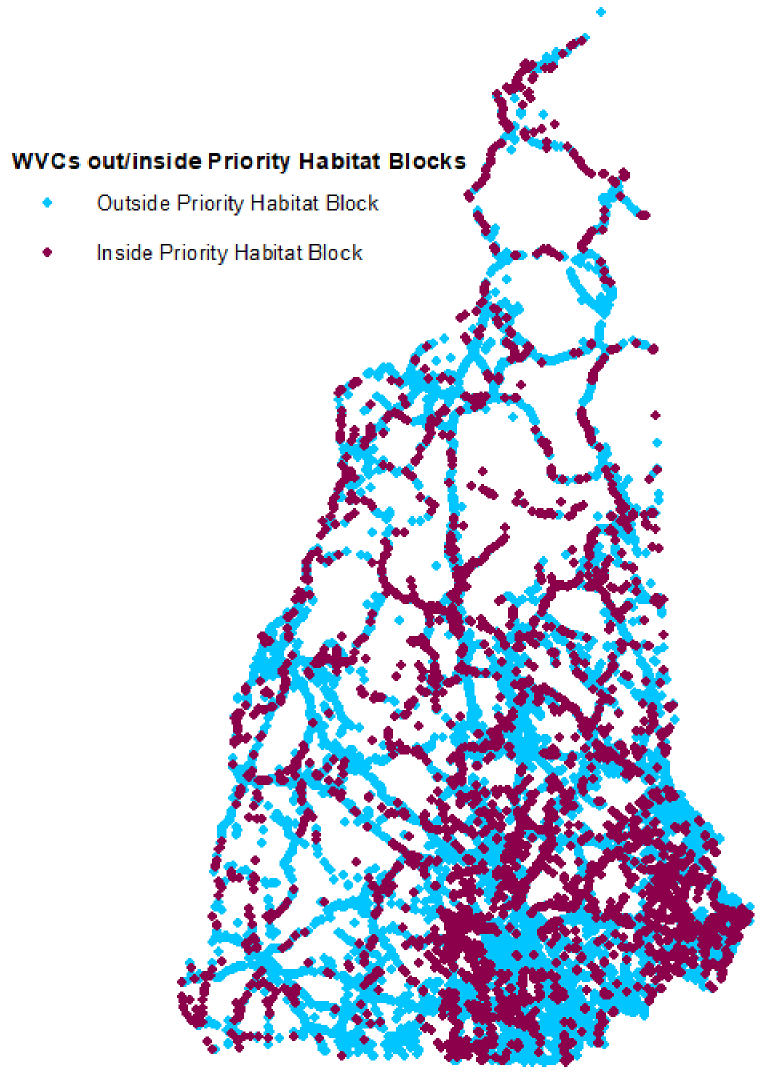

Figure 2: 5,796 of 20,577 WVCs were within 400 ft of NH Dept of Fish and Game delineated priority habitat block.

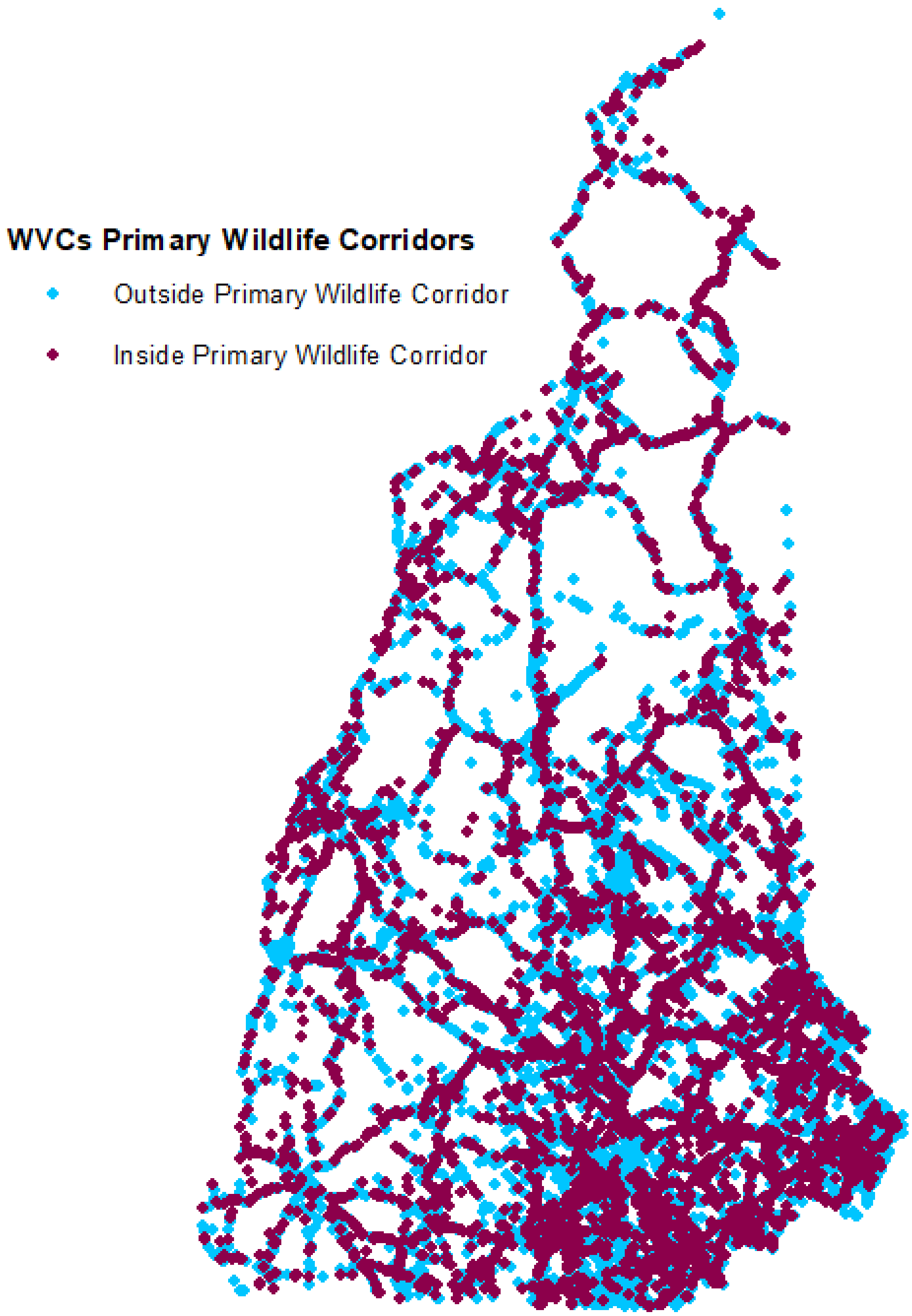

Figure 3: 8,228 of 20,577 WVCs were within 400 ft of NH Dept of Fish and Game delineated primary wildlife corridors.

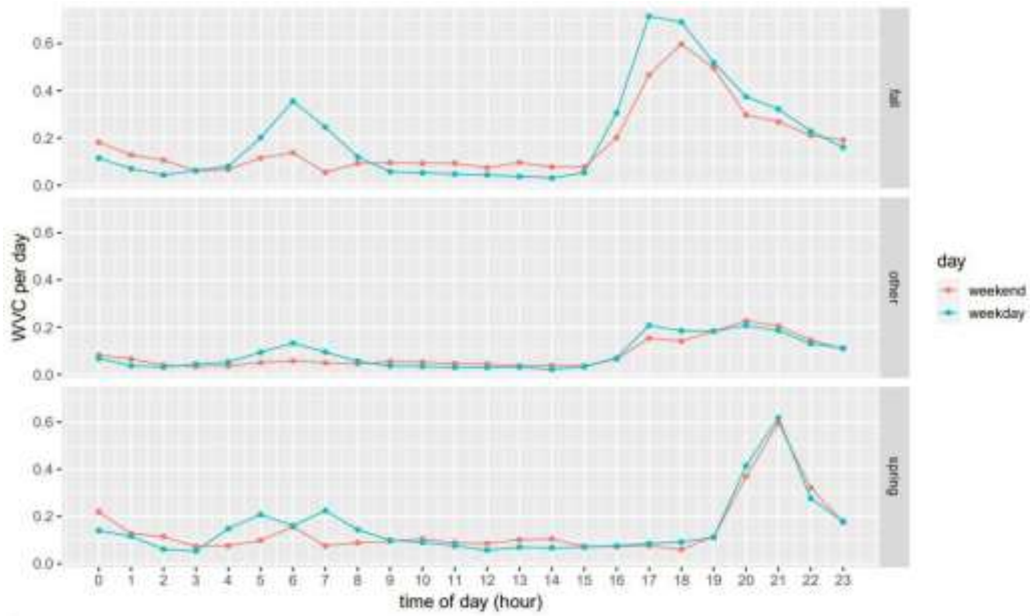

Figure 4: Temporal trends of WVCs (standardized by WVCs per day) by season, day of the week, and time of day. Substantially more WVCs occur during Fall (October - November) and Spring (May - June) and during dusk to evening hours in both seasons. A lesser peak is observable during morning commuting periods in all seasons, but still greatest in Fall. The disparity in WVCs between weekday commuting and weekend days is consistent for all seasons, but more obvious in fall and spring mornings.

Table 1: Functional System proxy for estimating speed for WVCs without speed in collision record.

Func_Syst	**Func_Syst_1**	**Proxy speed**
7	"Local"	30
0	"No Func"	50
4	"Minor Arterial"	50
6	"Minor Collector"	40
5	"Major Collector"	40
3	"Principal Arterial-Other"	60
2	"Principal Arterial- Other Freeways and Expressways"	55
1	"Interstate"	65

NHDOT SPR2 PROGRAM
RESEARCH PROGRESS REPORT

Poster Abstract submitted for Ecological Society of America Conference August 2022

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

Amy Villamagna, Hyun Joong Kim, Eric Laflamme, Olivia Boyer, Stephen DeBisschop

Background/Questions/Methods: 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. For some species, a road is a fully impassible landscape feature which is avoidable. Others may attempt to cross roads with variable degrees of success, ranging from outright failure (mortality) to temporary success (crossing without harm). Mitigating the negative effects of WVCs in the USA largely fall to state departments of transportation with guidance from the Federal Highways Agency and local municipalities, largely driven by concerned citizens. Until now, WVCs were not evaluated in New Hampshire where human population, traffic volume, and road density are increasing. Our objectives were to map, summarize, and analyze records of WVCs; to use the data to recommend locations and strategies for mitigation; and to identify a suite of risk parameters that could be considered during new road construction. To that end, we analyzed statewide WVC records from 2002-2019 to visualize spatiotemporal patterns and to identify potential predictors of WVCs (e.g., adjacent habitat) that could be used to inform mitigation efforts.

Results/Conclusions: There were more than 27,000 reported WVCs between 2002-2019, with an average of ~1,500 WVCs per year in New Hampshire. At least 62% of these WVCs were reported to occur on roads with posted speed greater than 40mph. We found positive relationships between WVCs and local road density, which corresponds to population centers within the state. WVCs occurred on roads of all size and functional class, with the largest proportion (33%) occurring on "local" roads. We identified WVC hotspots and assessed road characteristics within these road segments to make WVC reduction recommendations, including enhancements to existing culvert road crossings. Nearly 25% of the WVCs were not accompanied with reliable spatial data and therefore were removed from spatial and statistical analysis. More than 12% WVCs had no posted speed associated with them. Using a combination of statistical approaches (e.g. GAMs), we identified collision, road, and adjacent wildlife habitat attributes that explained observed variability in WVC occurrence. Together these provide the transportation and wildlife departments with data to help inform future road planning and infrastructure decisions. The need for higher accuracy and finer resolution data are among the most important conclusions from this first statewide assessment.