Title

Automated Analysis of Wildlife-Vehicle Conflict Hotspots Using Carcass and Collision Data

Author
Shilling, Fraser

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Automated Analysis of Wildlife-Vehicle Conflict Hotspots Using Carcass and Collision Data

Fraser Shilling
University of California, Davis
fmshilling@ucdavis.edu

Project Objective

Wildlife-vehicle conflict (WVC) occurs when traffic coincides with a place where animals decide to cross the surface of a roadway. State departments of transportation have a consistent need to understand rates and locations of WVC but inconsistent access to tools to measure statistical significance of clusters of WVC which could need mitigation. The project objective was to develop a standard method for analyzing WVC "hotspots" (areas of concern) that any state could use to identify potential locations for WVC mitigation.

Problem Statement

WVC is a large and growing concern among DOTs, conservation organizations and agencies, and the driving public. It is also a conservation concern for many animal species. Scientists have estimated that between 89 and 340 million birds may die each year in the United States from collisions with vehicles. WVC occasionally causes human injuries or fatalities and frequently causes damage to vehicles and road infrastructure. Many DOTs are trying different methods of reducing WVC, including fencing roadways and providing crossing structures across the right-of-way to allow safe animal passage. For these methods to be effective, DOTs need to understand and prioritize where WVC is occurring. Collisions are often clustered, which often leads to analysis of the causes of clustering for individual species (e.g., road or landscape features). By studying previous collisions, researchers can develop predictive landscape models to find WVC hotspots and "coldspots" (areas with no known issues). To inform these types of predictions and corresponding mitigation on a large scale (e.g., a U.S. state), it becomes necessary to collect and analyze accurate, extensive, long-term WVC data.

Research Methodology

UC Davis researchers followed an iterative process of stakeholder outreach, system development, testing, and revision to develop a tool for mapping and analyzing WVC hotspots.

1) Researchers engaged representatives from nine state departments of transportation and wildlife across the country in a technical advisory group. They discussed sharing their WVC data (e.g., Figure 1), developing the analytical tool, and the desired outputs from the tool. These initial discussions yielded useful insight about barriers to implementing WVC mitigation, including availability of data and accessibility of data analysis.

2) Researchers built a novel web system at https://roadecology.ucdavis.edu/hotspots on which registered users can upload, store, and manage data and analyses.

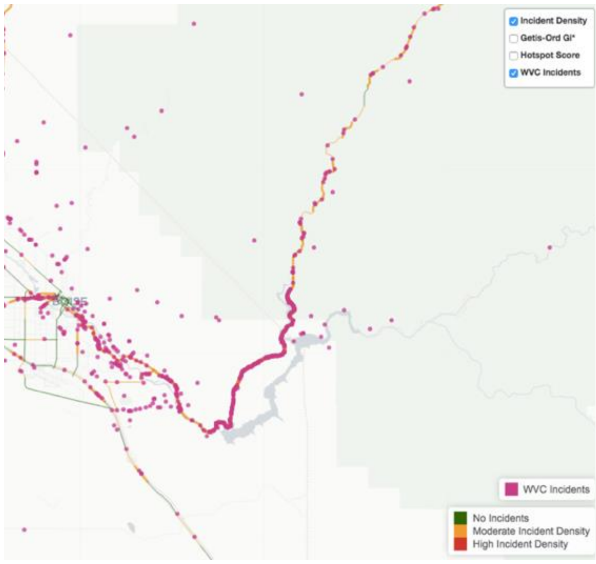

Figure 1. WVC Incidents around Boise, ID.

3) In order to create a uniform unit for analysis, the mapping tool identified one-mile segments for highway networks. Datasets from California State Highway Network (SHN) and the National Highway Planning Network (NHPN) for California were used for the WVC analysis of California, while the NHPN dataset was segmented to create uniform and structurally consistent datasets for all other U.S. states.

4) The tool totals the number of WVC incidents for each segment and adds this information to the segment attribute data. The tool automatically calculates spatial statistics using the incident density per one-mile segment. The statistics are used to create a hotspot/coldspot score for each segment.

5) A dynamic version of the tool places WVC events in real time on a hotspots map for California highways (https://roadecology.ucdavis.edu/hotspots/map, Figure 2).

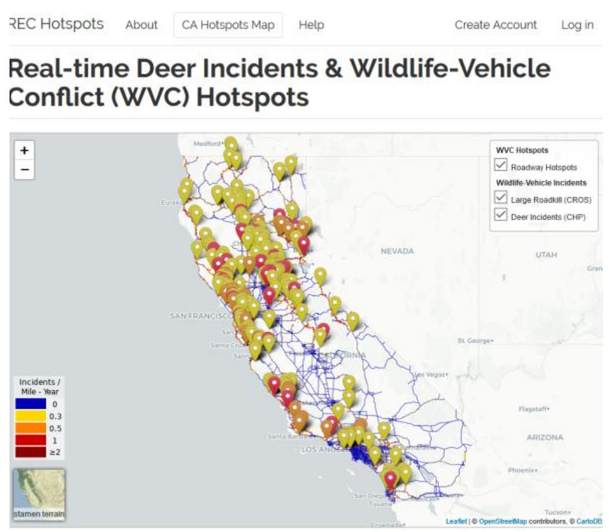

Figure 2. Web-display of California WVCs in real time, overlaid on hotspot map.

Results

Researchers developed and tested several versions of the WVC hotspot tool, including desktop and web-based versions.

Researchers also automated several types of outputs from the analyses. The first product is an image file (jpeg) of the map output (Figure 2), which is intended to show users a graphical representation of the results. The second is an html file (a map using the software "Leaflet"), which shows quickly in a browser view what the map dataset contains (Figure 3). The Leaflet map provides users with a "mini-GIS" where they can click on different check boxes and see different analysis products.

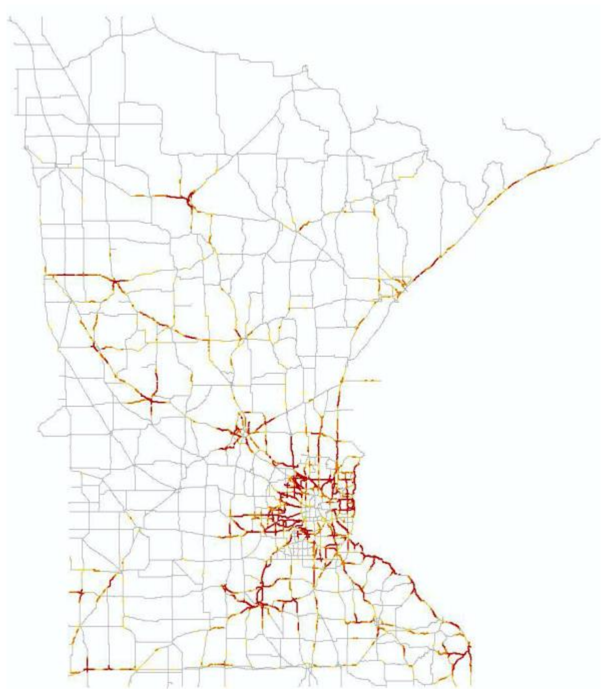

Figure 3. Image file output for WVC incident density in Minnesota. Darker red indicates greater incident density.

As of December 1, 2019, staff from 41 local, state, federal, and private organizations in 15 states had registered in the system and used the analysis tool to carry out more than 100 local and state-scale hotspot analyses. The tool has helped to distinguish several WVC patterns, including specific hotspots and coldspots, in terms of density and clustering, and temporal variations. These analyses can inform transportation infrastructure design decisions and efforts to mitigate WVCs. Given that running individual analyses like those described here would cost tens of thousands of dollars in staff or consultant time, this tool represents a considerable savings to state DOTs and their partners.

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