Identifying White-Tailed Deer Travel Routes in Portland Urban Neighborhoods using Least Cost Path Analysis

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Introduction

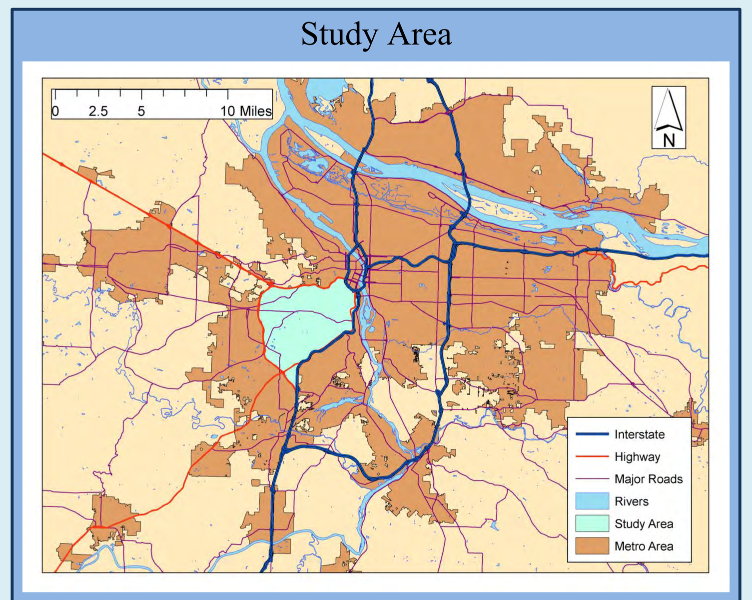
As urban growth and population densities increase, accessing safe travel routes in urban areas has become more difficult for wildlife. Their native habitats have been fragmented, which forces deer and other animals into roads and highways while seeking food, prey, mates, nesting habitats and migration paths. In addition to endangering animal populations, Wildlife Vehicle Collisions (WVC) are a threat to human safety. The Oregon Department of Transportation (ODOT) reports that there have been more than 9,400 reported wildlife-involved collisions in Oregon, thirty of which resulted in human fatalities between 2003 and 2013.

While WVCs have gained recognition as an important public safety issue, most of the studies related to WVCs focus on highway collisions. This has left a need for further studies on urban wildlife travel routes and habitats in non-highway locations. The purpose of this study is to identify white-tailed deer travel routes and areas with potentially high risk factors for WVCs in the Southwest Portland urban area using weighted multi-criteria analysis and a least cost path analysis.

Site Selection

To complete this study we performed a weighted multi-criteria analysis of the Southwest Portland/ Beaverton area. Our study area is bounded by Highway 26 to the north, I-5 to the east, and by highway 217 to the west. The study area was selected based on the location of known WVCs, and the authors' knowledge of the area.

Study Area



Methods

Cost Surface Classification

The travel cost path surface for white-tailed deer was based on:

- Portland Metro Taxlots
- Outdoor Recreation and Conservation Area (ORCA) sites
- Roads
- Trails
- Streams
- Slope
- Vegetation and canopy cover

The taxlots, ORCA sites, trails, and roads were classified as land cover classes and merged into a single shapefile. Each class was then given a weight value based travel corridor suitability. Slope, canopy cover, and streams were classified as subclasses, and were later added or subtracted from the land class values using the ArcGIS Map Algebra tool.

The roads shapefiles were inversely extracted form the Portland Metro tax lot data. The roads attributes were derived form RLIS polyline street files by buffering according to rank class.

Weighting Values for Least Cost Surface

Class	Weight
Land Classes	
Buildings	350
Industrial	200
Highways	200
Freeways	200
Major Roads	190
Commercial	180
Multi Family Residential	170
Home Owners Association	170
Single Family Residential	160
Minor Roads	150
Vacant	140
Park	130
School	130
Public	130
Golf Course	130
Cemetary	130
Trails	120
Rural	110
Ariculture	110
Natural Area	100
Forrest	100
Land Subclasses	
Slope	
<45°	0
≥45°	25
Vegetation Canopy Cover	
Forrest	-25
Wooded Shrubland	-15
Grassy Open Fields	-5
Streams	
All	-50

Least Cost Path

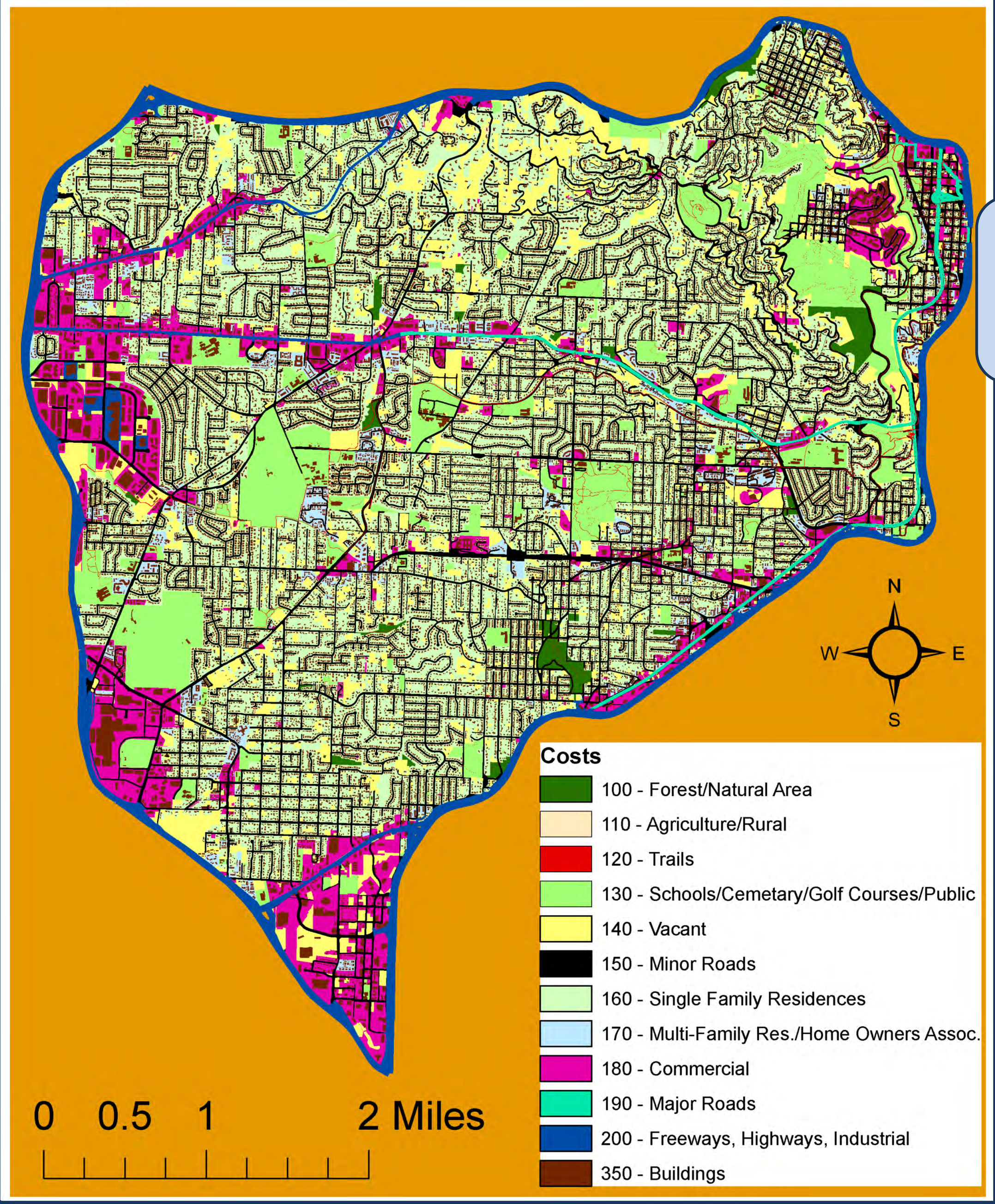
A network of least cost travel paths was created to identify a series of likely white-tailed deer urban travel routes. Each of the starting points of the least cost path were generated from randomly spaced buffered polylines around the perimeter of the study area. This allowed the computer to select multiple least cost starting points distributed around the study area. The destination points were selected based on known WVC locations and areas with low travel cost values where deer traffic is most likely to occur. The least cost path was generated using the ArcGIS least cost path tool.

Validation of Model

The values for our model are based on species and land cover data from the corridor builder toolset. Site selection and cost path destinations were based on actual WVC locations. After the model was completed, areas with high cost values on the cost path network, or 'trouble spots', were selected from the map and visually verified in the field.

Maps

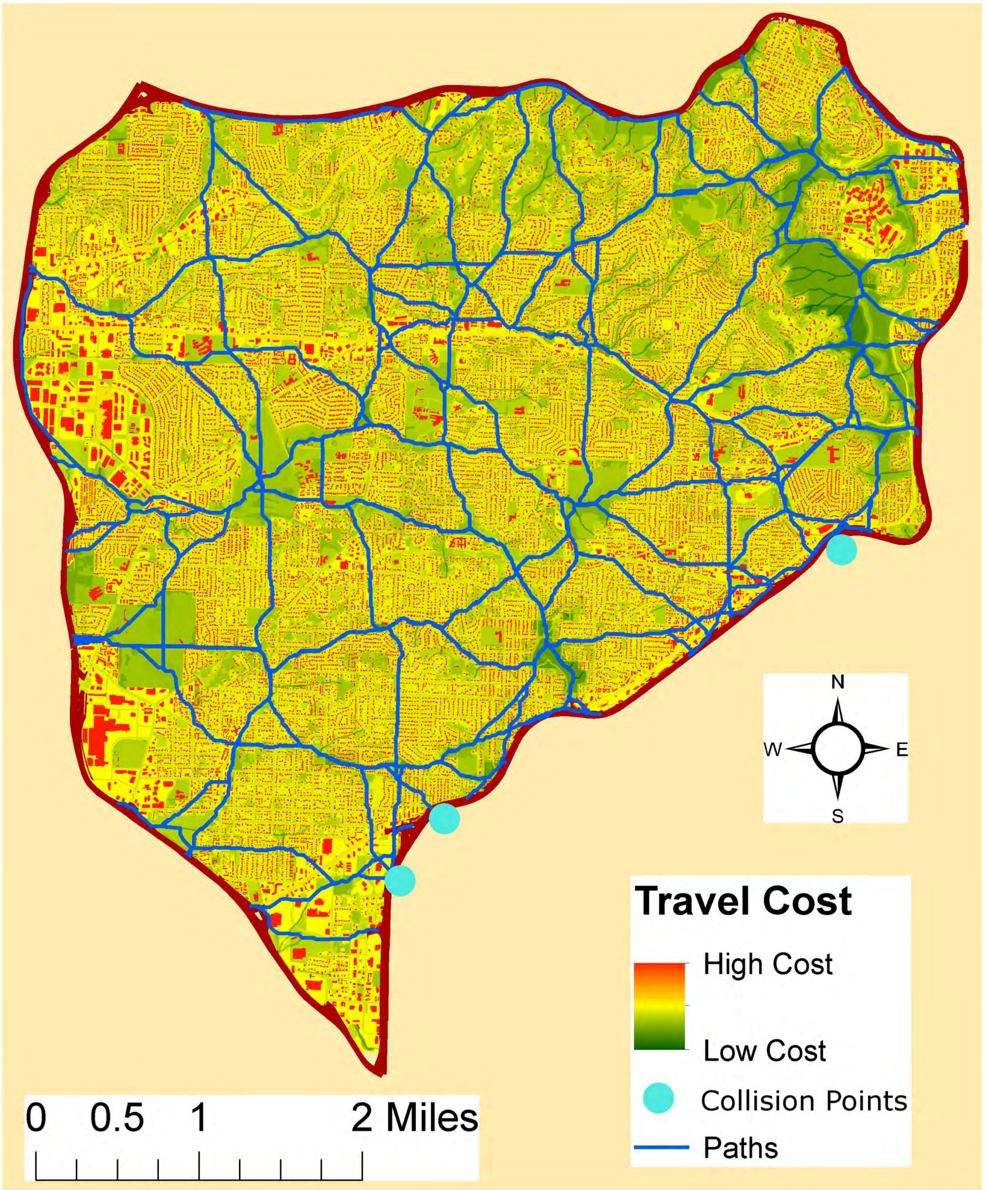
SW Portland Land Coverage Classification:
Weighted for White-tail Deer Travel in an Urban Environment



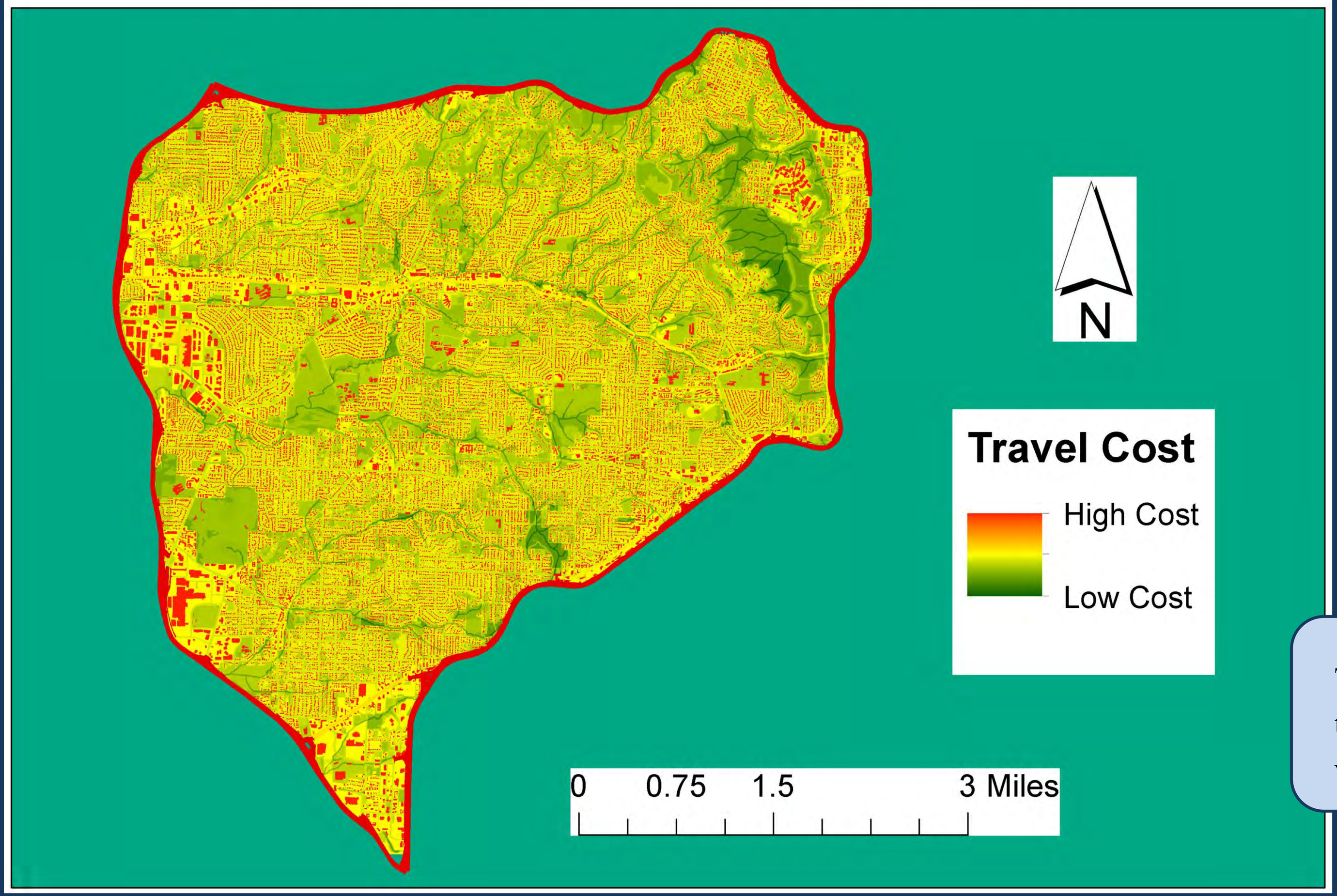
The Land Coverage Classification Map is a composite of the taxlots, ORCA sites, trails, and roads shapefiles merged into a single shapefile The land subclass values have not been applied to this map.

The Cost Raster Surface Map shows the final land class values after the land subclass values have been applied to each cell. The location of known WVCs are also included.

SW Portland Least Cost Path Network



SW Portland Cost Raster Surface



The Least Cost Path Network Map shows the predicted white-tailed deer travel routes within the study area.

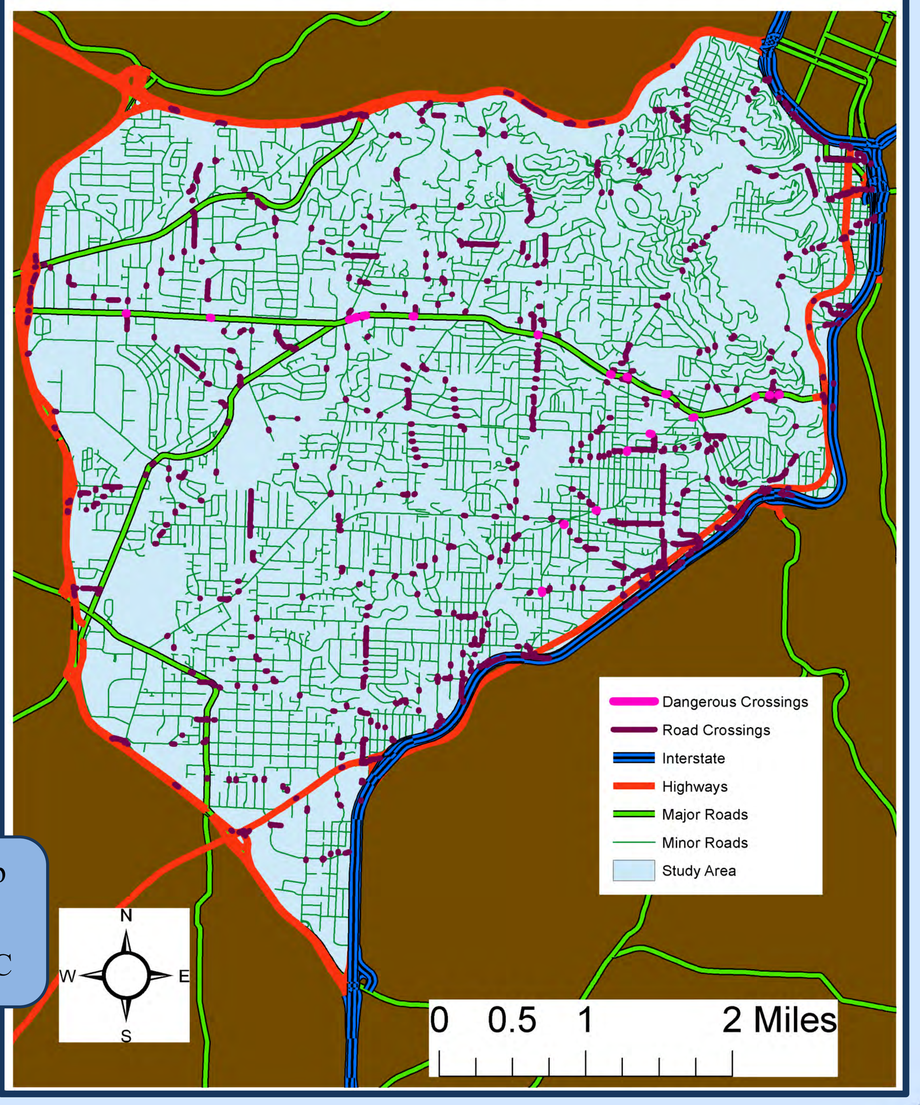
Results

The results of this study show that there are several trouble spots where the modeled travel routes intersect with major roads such as the Beaverton-Hillsdale highway and Canyon Road. In many locations, these trouble spots coincide with the intersection of Creeks and Major Roads. This may be a result of creeks having too much influence over the cost path values. However, the weighting scale for the land classes and subclasses was based on species specific data, which ranked creeks as a highly desirable class for white-tailed deer travel routes.

There also seems to be fewer high risk areas near the edges of the study area than in the center. This seems unlikely due to the site being bound by high risk highways and freeways which intersect with creeks. This phenomena may be due to the location of the starting and destination point nodes being located along the perimeter of the study area. The cost path routes were generated across the study area rather than around it. This effect may be reduced by adding additional travel nodes outside of the study area, which would allow the model to predict travel routes along the perimeter of the study area.

The model identified an area where a small creek intersects Beaverton-Hillsdale Highway, near the corner of Dosch road, as a WVC high risk area.

Potential Deer Road Crossings in SW Portland



The Potential Deer Road Crossings Map shows the locations along the cost path network which have a high risk for WVC

Conclusions

After going out into the field to verify the results of the model, the least cost path analysis technique seems to have accurately predicted areas which have a high risk for wildlife vehicle collisions. The results of the least cost path analysis were adequate for the identifying potential high risk locations of deer crossings in the Southwest Portland Metro area.

Future studies on wildlife vehicle crossings using least cost path analysis, should include travel point nodes outside of the work area to accurately predict travel routes along the perimeter of the study area. To enhance the accuracy of our study, actual deer movement data should be collected and used to assess the validity of the methods in this study.

Data Source:

Oregon Metro's Regional Land Information System (RLIS): ORCA sites, City limits polygon, 2014 Taxlots polygon, Rivers Polygon, Streets, Streams, Canopy cover, Vegetation, Slope DEM
Oregon Department of Transportation: Animal Vehicle Collision Data. 2012
Oregon Department of Fish and Wildlife: Wildlife collision Hotspots data. 2009
Corridordesign.org. All species and land cover class data values. 2007.

References:

Barnum, S. A. (2003). Identifying the best locations along highways to provide safe crossing opportunities for wildlife. *Final report, Colorado Department of Transportation Research Branch*.
Holland, T. D., Kociolek, A. V., Barkdoll, A. M., & Schwalm, J. D. (2009). *Animal-vehicle Crash Mitigation Using Advanced Technology: Phase II: System Effectiveness and System Acceptance* (No. FHWA-RD-TPF-09-14). Oregon Department of Transportation, Research Unit.
Iverson, A. L., & Iverson, L. R. (1999). Spatial and temporal trends of deer harvest and deer-vehicle in Ohio.
Lloyd, J., Casey, A., & Trask, M. (2005). Wildlife hot spots along highways in Northwestern Oregon. *Road Ecology Center*.