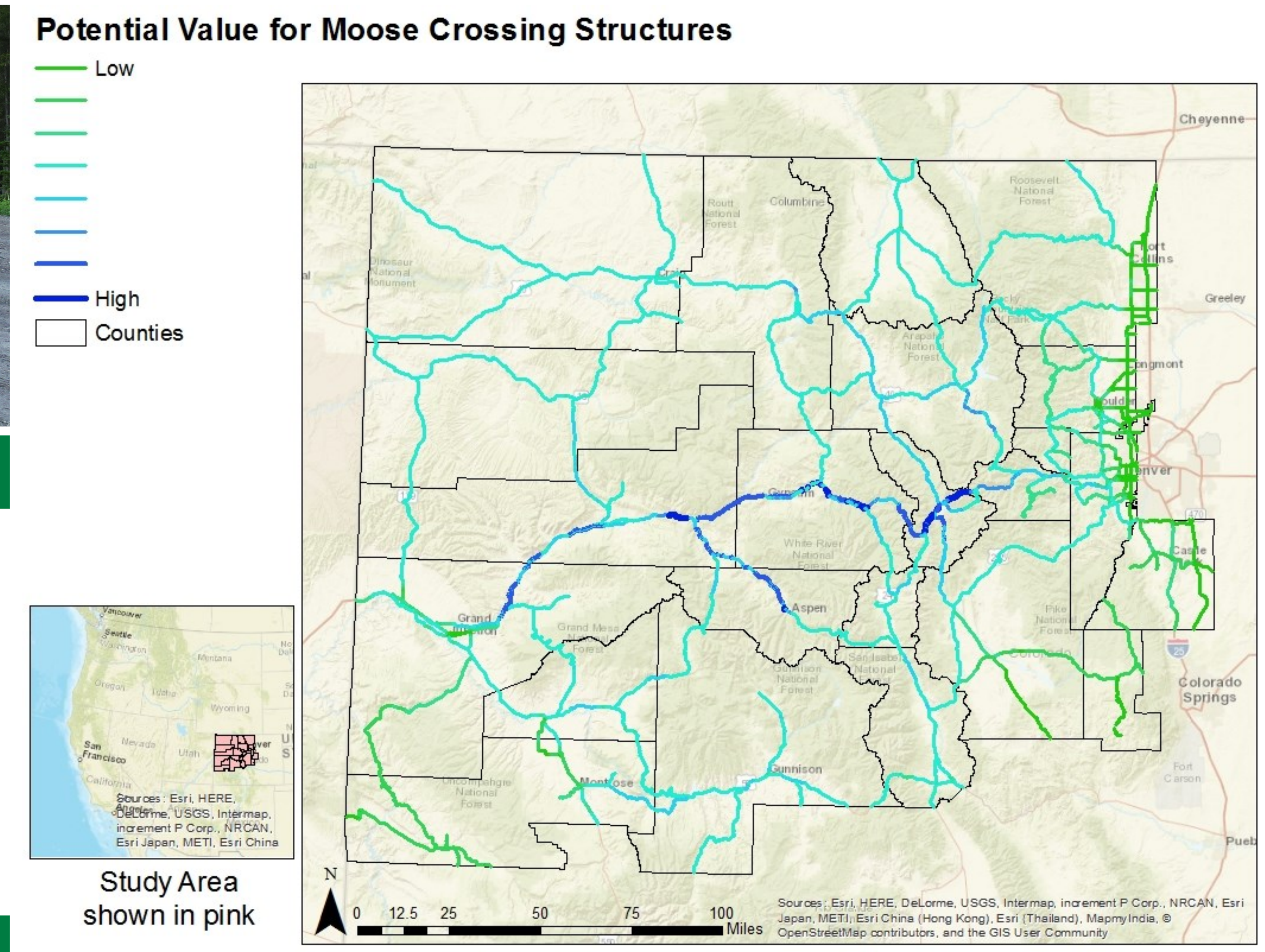
Identifying Locations for Road Crossing Structures for Moose in Northwest Colorado

Introduction

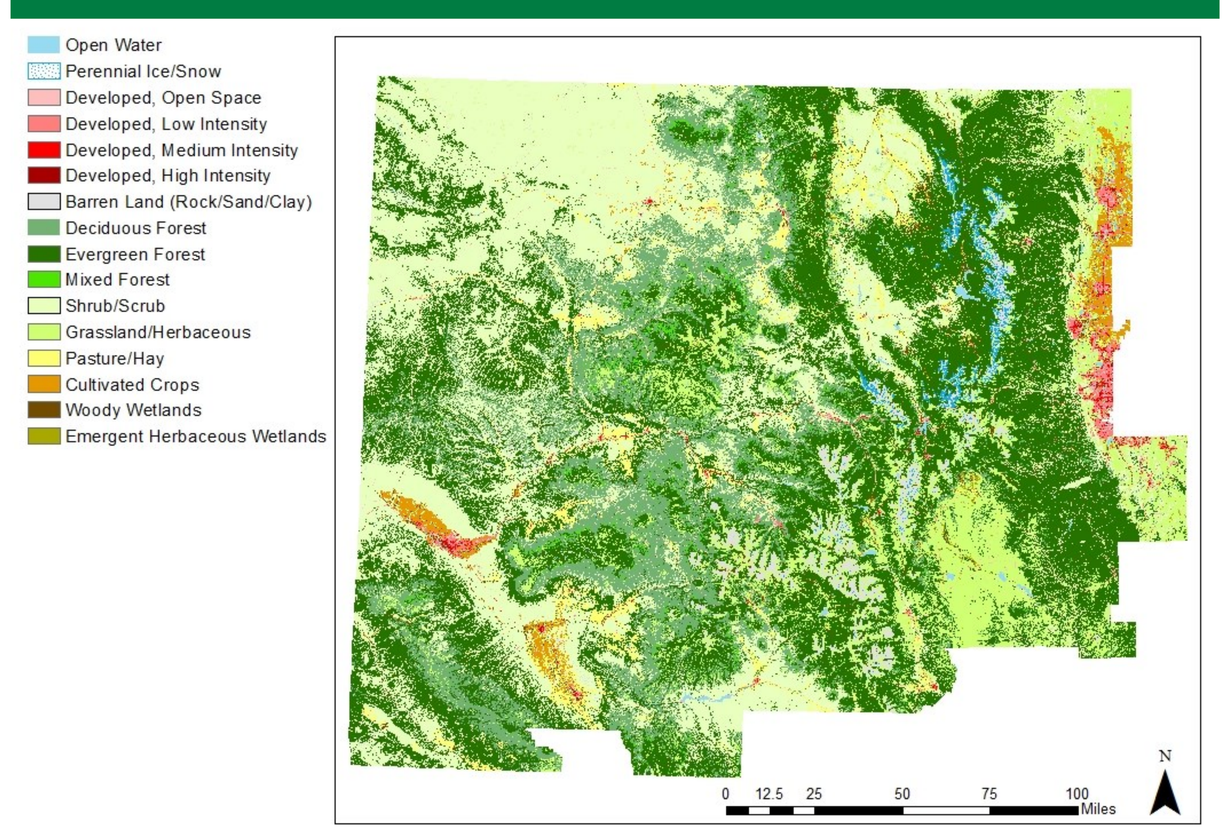
One of the foremost topics in wildlife conservation today is the fragmentation of habitat. Fragmentation reduces population connectivity by restricting movement either through change of habitat type over an area, making species unwilling to pass through or increasing barriers to movement that physically or psychological restrict movement (Bisonette and Adair, 2008). This can have significant effects on populations (Bissonette and Adair, 2008). One notable barrier to movement are major roads and highways since wildlife may be either reluctant to cross or in danger from collisions with vehicles if they do cross (Bissonette and Adair, 2008; Laurian et al., 2008). Recently, efforts have been put in place in some locations to facilitate wildlife movement across roads through crossing structures such as bridges or underpasses (Clevenger and Waltho, 2000). Notably, the area around Banff National Park in Alberta, Canada has had success with such a program. In moose (*Alces alces*) habitat fragmentation and disturbance from roads has been studied in the past (Bartzke et al., 2015; Laurian et al., 2008). Since moose may avoid roads, implementing crossing structures may be especially important in their habitat (Bartzke et al., 2015). In this study, I attempted to determine locations where wildlife crossing structures for moose may be especially useful in Northwest Colorado.

Methods

The central analysis of this study was done using the Linkage Mapper and Gnarly toolkits (McRae and Kavanaugh, 2011; McRae et al. 2013). The Gnarly toolkit produced a raster depicting resistance to movement for moose based on my determination of how much each land cover category (see "Land Cover" map) affected movement of moose. With this resistance raster, in conjunction with noted core areas of Moose populations (determined by Colorado Division of Wildlife) Linkage Mapper created a raster of habitat connectivity. After reclassifying this connectivity raster from 2 (very little connectivity value) to 64 (high connectivity value) it was added to a raster of Average Annual Daily Traffic (Vehicles/Day) ranked from 1 (low traffic) to 9 (high traffic). From this, I found the locations that combined both high traffic and high connectivity value for moose.



Land Cover



Conclusions and Future Directions

From this analysis, we can see that high potential value for moose crossing structures exists mainly along Interstate 70 and State Highway 82 between Aspen and Interstate 70. This area seems to have both more human impact and traffic in addition to being an important connective area between core moose areas. In these areas crossing structures could be placed every 2.2 miles, as suggested for moose by Bissonette and Adair (2008). Future analyses should perform this analysis for multiple species, especially those that may have different ecological niches to find optimal crossing locations for the wildlife community. It should be noted that this analysis uses only some of the potential approaches to modeling landscape connectivity, which is described in depth by Beier et al. (2011). Land cover is far from the only factor affecting wildlife movement, so utilizing other ways of measuring wildlife movement and resistance may be useful.

Prepared by Ethan Freedman

GIS 102: Advanced GIS, Spring 2016

Data from Colorado Department of Local Affairs (Counties), USGS (Land Cover), Colorado Division of Wildlife (Moose Core Areas) and Colorado Department of Transportation (Highways). Downloaded from ColoradoView (coloradoview.org), Data Basin (databasin.org) , and Colorado Information Marketplace (data.colorado.gov). Basemaps provided by ESRI.

Moose Photo: Ronkos, V. (2011, July 22). *Moose mother and calf on road*. Retrieved from https://commons.wikimedia.org/wiki/File:Moose_mother_and_calf_on_road.jpg (Originally photographed 2011, July 20)

Bartzke, G. S., May, R., Solberg, E. J., Rolandsen, C. M., & Røskaft, E. (2015). Differential barrier and corridor effects of power lines, roads and rivers on moose (Alces alces) movements. Ecosphere, 6(4). doi:10.1890/es14-00278.1

Bissonette, J., & Adair, W. (2008). Restoring habitat permeability to roaded landscapes with isometrically-scaled wildlife crossings. *Biological Conservation, 141*(2), 482-488. doi:10.1016/j.biocon.2007.10.019

Beier, P., Spencer, W., Baldwin, R. F., & Mcrae, B. H. (2011). Toward Best Practices for Developing Regional Connectivity Maps. Conservation Biology, 25(5), 879-892. doi:10.1111/j.1523-1739.2011.01716.x

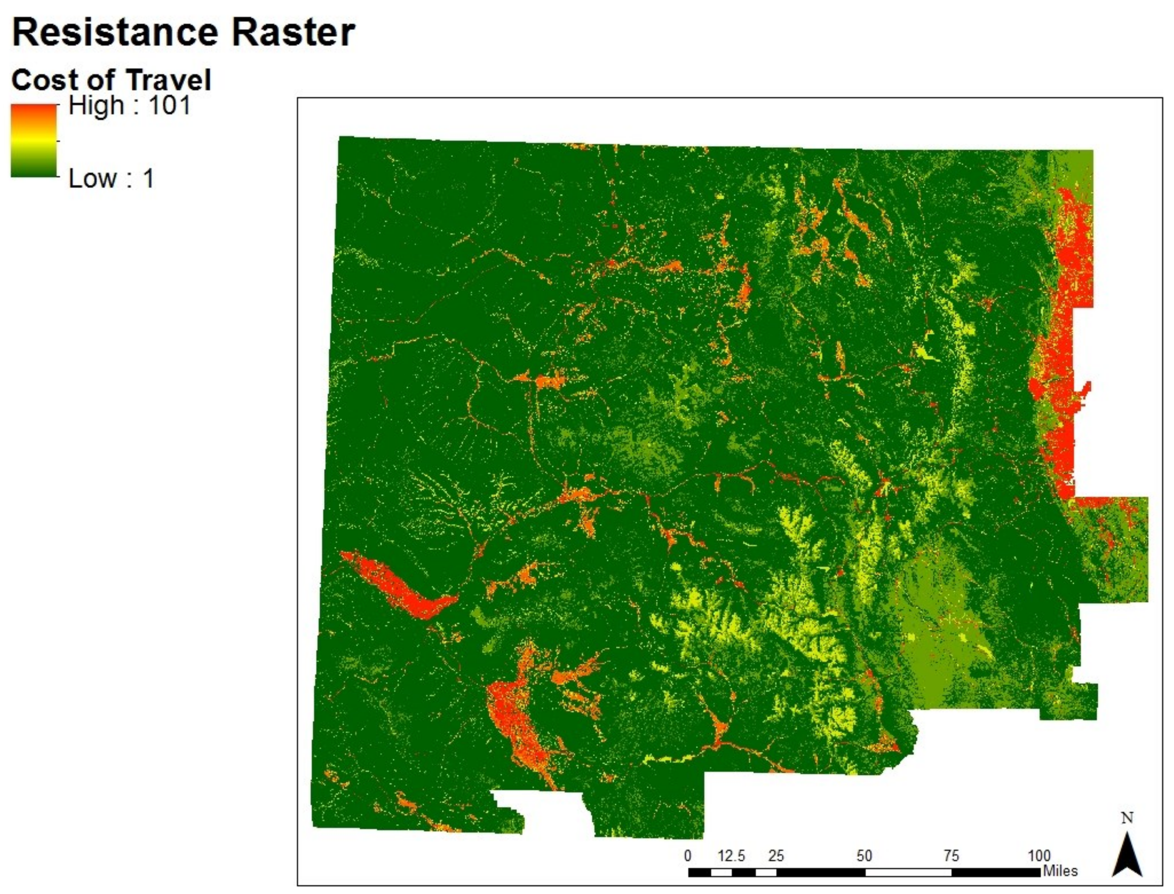
Clevenger, A. P., & Waltho, N. (2000). Factors Influencing the Effectiveness of Wildlife Underpasses in Banff National Park, Alberta, Canada. *Conservation Biology, 14*(1), 47-56. doi:10.1046/j.1523-1739.2000.00099-085.x

Laurian, C., Dussault, C., Ouellet, J., Courtois, R., Poulin, M., & Breton, L. (2008). Behavior of Moose Relative to a Road Network. Journal of Wildlife Management, 72(7), 1550-1557. doi:10.2193/2008-063

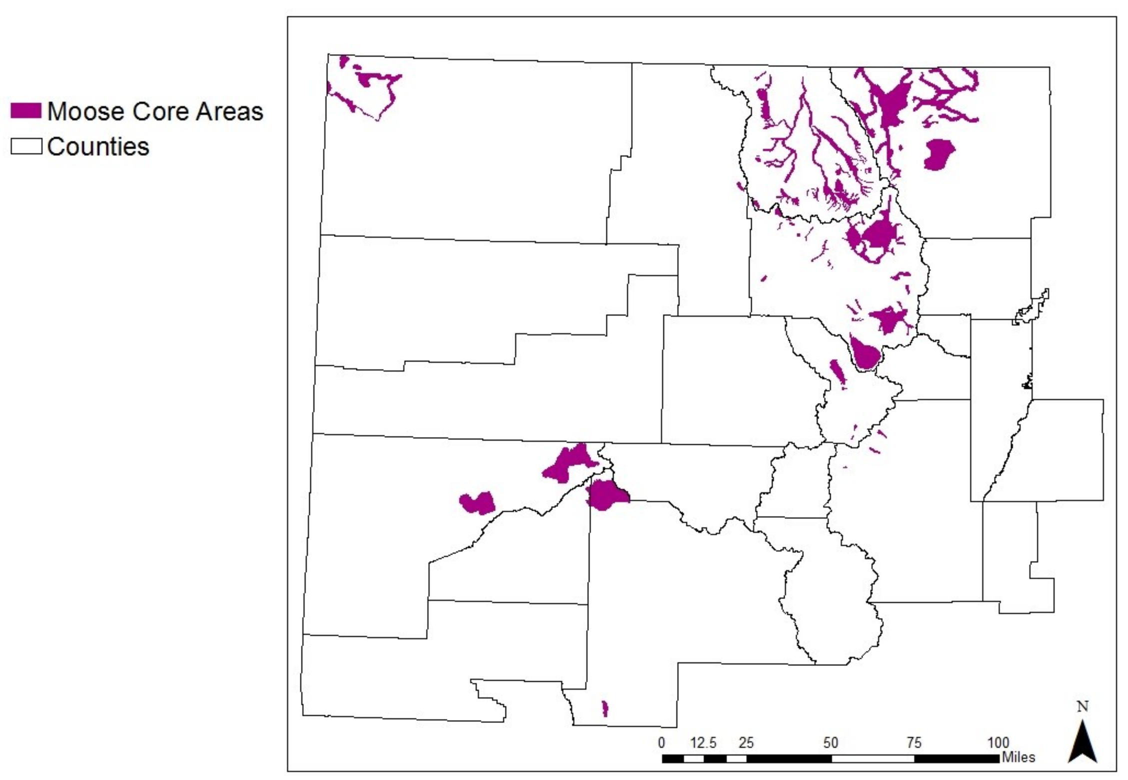
McRae, B.H. and D.M. Kavanagh. 2011. Linkage Mapper Connectivity Analysis Software. The Nature Conservancy, Seattle WA. Available at: http://www.circuitscape.org/linkagemapper.

McRae, B.H., A.J. Shirk, and J.T. Platt. 2013. Gnarly Landscape Utilities: Resistance and Habitat Calculator User Guide. The Nature Conservancy, Fort Collins, CO. Available at: http://www.circuitscape.org/gnarly-landscape-utilities.

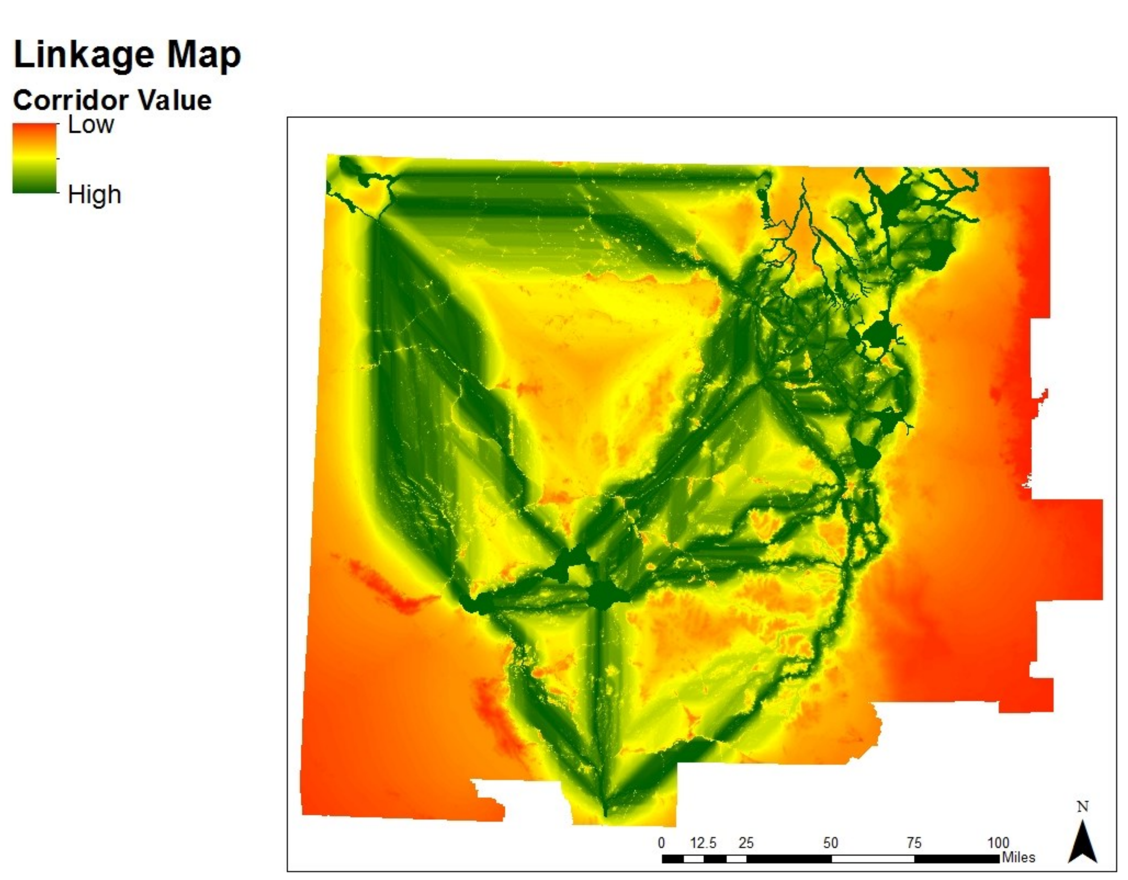
Resistance



Moose Cores



Linkage Map



Highway Traffic