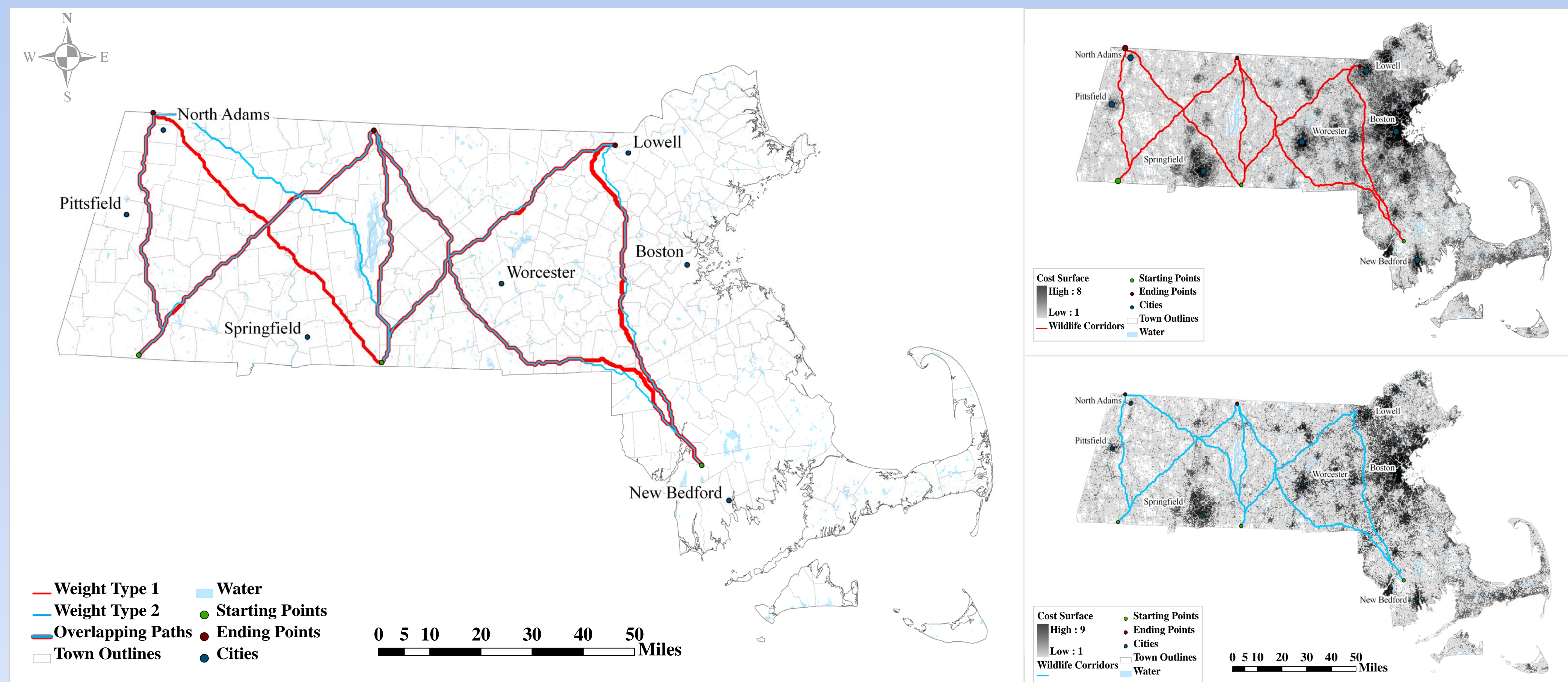


# Identifying potential wildlife corridors in Massachusetts: Planning for migratory response to climate change

~ Cartographer: Abby Hardy ~ Data Sources: Mass GIS, 2000, 2002; Census 2000, National Land Cover 2001 ~ Projection: NAD 1983 State Plane Massachusetts Mainland FIPS 2001 ~  
~ Department of Urban and Environmental Policy and Planning ~ April 30, 2008 ~



The maps above show wildlife corridors travelling from three points in the south of the state to three points in the north of the state. The red corridors weight population density as 50% of the calculation whereas the blue corridors weight land cover as 50% of the calculation. The smaller maps display the cost surfaces that were used to derive the corridors. While the paths are often extremely similar they do differ in a number of places, such as the two paths travelling from the south-central point to the north-western point, which are extremely different.

**Background:** According to the Intergovernmental Panel on Climate Change's (IPCC) fourth assessment report the climate has been warming consistently, with eleven of the twelve years from 1995-2006 ranking among the highest global temperatures in recorded history (since 1850) (IPCC, 2007). Changes have already been seen in many species throughout the globe. Birds are shifting their ranges northward (Valiela & Bowen, 2003), and a 2006 study showed that a large scale warming, driven by climate change, was a key factor in a mass amphibian extinction that started with the harlequin frog and the golden toad and eventually wiped out 67% of the 110 species of the genus *Atelopus* (Pounds, et al., 2006). Poleward migration of species seeking climate appropriate habitat has already been observed, and is expected to increase as the climate continues to warm (Parmesan et al. 1999; Thomas et al., 2006). As species shift and the climate changes, developing effective mapping techniques will be essential for land managers to conserve vital habitat. A number of recent studies use the least cost path analysis tool to perform habitat suitability modeling in order to locate the best route from one important habitat area to another (Haines et al., 2006; LaRue & Nielsen, 2008).

**Objective:** The objective of this project is to use the least cost tool to identify wildlife corridors in Massachusetts and to evaluate the methods involved.

**Methods:** Three cost surfaces were created using the weighted overlay tool. The contributing layers were land cover, population density, distance to major roads, distance to minor roads, distance to water, and lakes. This tool allows each layer to be weighted individually as well as each attribute to be ranked individually. The resulting layers were used to map possible corridors by using the least cost path tool. Three starting points were identified along the southern border of Massachusetts, all of which are located in open space areas that are protected in perpetuity. The three destination locations were also located in protected parcels, but are also just south of areas of conservation interest. The western end point is just south of the Green Mountain National Forest located in southern Vermont, the central point is just south of Pisgah State Park in Western New Hampshire, and the eastern point is located south of a strip of land leading north to the White Mountains that has been identified by the New Hampshire Wildlife Action Plan as part of the most ecologically important habitat in New Hampshire (NHWAP, 2005).

The first set of maps (pictured above) rank the attributes the same but weigh the layers differently. The red paths weighted population density as 50%, land cover as 30%, and the rest of the

layers as 5% of the total. The blue paths reversed this weighting trend and gave land cover a 50% weighting, population density 30%, and the other attributes 5%.

**Results:** The difference in weights did not produce noticeable differences in most instances although the corridors travelling from the central starting point to the western ending point were very different.

The second set of maps (pictured below) weight the layers the same but rank the attributes differently. In these maps the red corridors used a rating scale of 1-10 with 10 restricting bodies of water, and high and medium intensity development. The three middle weights were 8,7, and 6, which were used as mid values and 3, and 1 were used as low, or least cost values. The blue corridors also used 10 to restrict water bodies and medium and high intensity development, but instead used 8-6 as the only rankings with 1 being used for no data.

**Results:** The different cost surfaces produced by the two ranking systems produced highly variable results. The second ranking system produced straighter corridors that tended to go closer to large urban centers. One notable difference is that the first ranking system routed the corridor far to the west of the City of Worcester while ranking type 2 routed it to the east.

**Limitations:** There were a number of limitations including inaccuracies in the data and lack of information regarding appropriate data sources and methods for using them. The greatest limitations, however, were the methods and results themselves. Clearly, the values used to rank and weight corridors can have a major effect on the resulting paths. While using data that is species or project specific could help to improve the result, greater attention and research is needed to identify more accurate methods to use while mapping wildlife corridors.

- References: Intergovernmental Panel on Climate Change (IPCC) (2007). IPCC Fourth Assessment Report. Climate Change 2007: Synthesis Report. Retrieved March 1, 2008 from [http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4\\_syr\\_introduction.pdf](http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_introduction.pdf)
- Haines, A.M., Tewes, M.E., Laack, L.L., Home, J.S., & Young, J.H. (2006). A habitat based population viability analysis for ocelots (*Leopardus pardalis*) in the United States. *Biological Conservation*. 132: 424-436.
- LaRue, M.A., & Nielsen, C.K. (2008). Modeling potential dispersal corridors for cougars in mid-western North America using least-cost path methods. *Ecological Modelling*. 212: 372-381.
- New Hampshire Wildlife Action Plan (NHWAP). (2005). Wildlife habitat ranked by ecological criteria. Produced by the New Hampshire Fish and Game Department. Accessed online April 28, 2008 at [F:\GIS Data\Open Space\New Hampshire\wap05\\_tiers.html](F:\GIS Data\Open Space\New Hampshire\wap05_tiers.html)
- Parmesan, C. (1999). Ecological and evolutionary responses to climate change. *Annual review of Ecology, Evolution, and Systematics*. 37: 637-639.
- Pounds, J.A., Bustamante, M.R., Coloma, L.A., Consuegra, J.A., Fogden, M.P.L., Foster, P.N., La Marca, E., Masters, K., Merino-Viteri, A., Puschendorf, R., Ron, S.R., Sa'nchez-Azofeifa, A., Still, C.J., & Young, B.E. (2006). Widespread amphibian extinctions from epidemic disease driven by global warming. *Nature*. 439:161-167.
- Thomas, C.D., Franco, A.M.A., & Hill, J.K. (2006). Range retractions and extinction in the face of climate warming. *Trends in Ecology and Evolution*. 21:8. Retrieved March 9, 2008 at [www.sciencedirect.com](http://www.sciencedirect.com)

The maps below use two different ranking systems, the red paths used ranks distributed through 1-10 whereas the blue paths used a ranking system with the ranks clustered around 8-3. The resulting paths varied from each other greatly, most notable in the routing around the City of Worcester.

