A GIS Suitability Analysis of Wolf Habitat in Maine

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ES212: GIS and Remote Sensing

Abstract: The range of the Gray Wolf (*Canis lupus*), once covering most of North America, has been drastically reduced by an estimated 95% due to habitat loss and extermination by humans. The wolf was extirpated from Maine in the 1800's. Wolf reintroductions have been suggested for Maine, but there is some debate about how much land is suitable for wolves. I developed a wolf habitat suitability analysis using ArcGIS and data from the Maine Office of GIS and the United States National Atlas. The model incorporates land cover, presence of major roads and railways, conservation land, industrial, non-industrial, and public woodlot ownership, and distance from major points of population. The model results show areas of high and low wolf suitability in Maine. The model suggests that the best potential habitat for wolves in Maine is situated in the northern half of the state, away from roads and areas of high population. The area of high suitability is 9,387,332 square kilometers (value of 8.31 to 8.94). Possible future reintroductions or natural colonization from other areas would have the highest likelihood of survival in these areas of high suitability shown by the model.

Introduction: The Gray Wolf (*Canis lupus*) is well-populated in Canada and Alaska, but was extirpated from most of the United States in the early-mid 20th century (Kay, 1996). Busch (1995) reported a ninety-five percent wolf range reduction in the United States and extermination from fifteen percent of its range in Canada. Wolf reintroductions have taken place in Yellowstone National Park in 1995 and in the Northern Rockies of the United States, resulting in successful population growth to sustainable levels (U.S. Fish and Wildlife, 1999). Many biologists and conservationists are eager to see the wolf return to its historic range, including Maine and other parts of the Northeast. A study done by Paquet et al. (1999) found that a reintroduction in the Adirondack Park of New York is not a possibility due to anthropogenic and natural features of the area. Maine contains large forested tracts of land with low densities of major roads and human populations, making it a strong possibility for colonization by wolves from Canada or organized reintroductions. I used a Geographic Information System (GIS) to create a wolf habitat suitability analysis for Maine. Some variables that are important in determining an area's suitability for wolves are road density, prey density, human populations, land cover, land ownership, and slope (Paquet et al., 1999). These components have different importance in habitat selection for wolves and are therefore weighted differently in the analysis. This model predicts areas where habitat is most favorable for wolves in Maine and could be used for potential future reintroductions or for naturally colonizing populations.

Methods: Data were acquired from the Maine Office of GIS and the United States National Atlas, converted to layers, and applied to an ArcGIS Map. Many of the data layers were then converted from shapefile to raster using Spatial Analysis tools. Raster layers were then reclassified with numerical values ranging from 0 to 10 to represent their level of suitability for wolf habitat, 10 representing the most suitable areas.

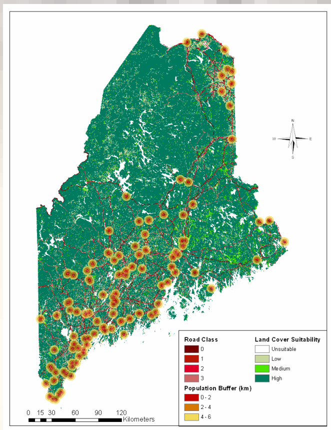

Figure 1. This map shows the Land Cover Suitability, a raster of major roads, and a distance buffer around major population points for the State of Maine.

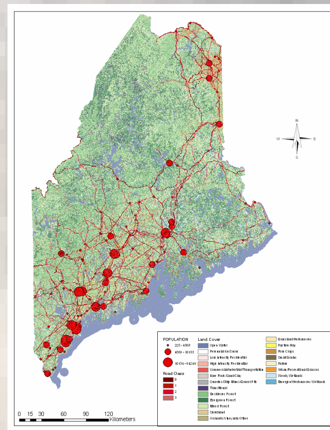

Figure 2. A map showing Land Cover and human disturbance, including the raster used to analyze road presence and the boundary suitability classification of distance from population points.

Layer	Weight Value
Conservation Land	0.07
Land Cover Suitability	0.16
Woodlot Ownership	0.20
Population Point Boundaries	0.22
Road Presence/Absence	0.35

Table 1. A table of values assigned to each variable used in the model to give each weighted value based on Paquet et al. 1999 a different relative importance.

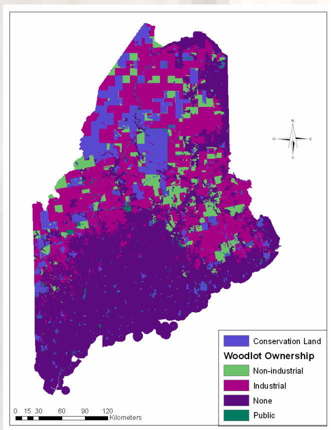

Figure 3. A map showing areas of woodlots, areas without woodlots, and conservation land.

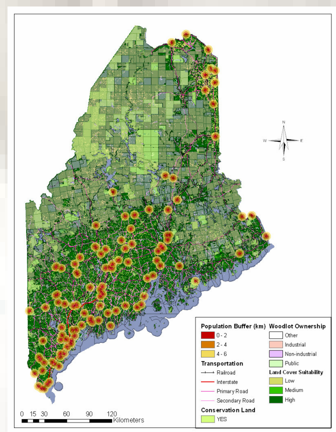

Figure 4. A combination of the layers that were used to perform the analysis and create the output model.

Works Cited
Busch, Robert H. 1995. *The Wolf Almanac*. New York: Lyons & Burford Publishers.
Kay, Charles E. 1996. Wolf Recovery, Political Ecology, and Endangered Species. The Independent Institute. Used by permission Oct. 8, 2001 by Natures Wolves. http://www.natureswolves.com/fraud/wolfrecovery.htm Accessed 2/28/05
Paquet, Paul C., Strittholt, James R., and Staus, Nancy L. Wolf Reintroduction Feasibility in the Adirondack Park. Unpublished study, Conservation Biology Instititute, Corvallis, OR. October, 1999.
U.S. Fish and Wildlife Service. Gray Wold Recovery Status Reports. Last updated week of 2/11-18 1999. http://mountain-prairie.fws.gov/wolf/wk02182000.htm Accessed 2/27/05

Methods continued: Land Cover was converted to show the most and least suitable areas of land cover (Figure 1). Road classes were classified to show that larger, more traveled roads are least suitable for wolves and no roads are most suitable (Figure 2). Points of high human population were assigned a 6 km boundary that classified increasing suitability every 2 km away from the point's center (Figure 1 and Figure 2). The Land Cover classification can be seen clearly in Figure 2. A layer containing information on the ownership of public, industrial, and non-industrial woodlots was reclassified to show woodlot areas potentially available for wolves, and a layer showing conservation land was added to show ownership that made areas more suitable for wolves (Figure 3). The reclassified layers were then combined and given different weight in the analysis according to their importance in the suitability of the habitat model (Table 1). Each value is a part of 100%, adding up to 1.0 (100%) on the raster calculator. The model results show high and low suitability within the areas chosen as suitable wolf habitat (Figure 5). Area of suitable habitat was derived from the attribute table by calculating the number of grid cells with given values multiplied by the cell size.

Results and Conclusions: The model output (Figure 5) shows potential suitable wolf habitat mostly in the northwest of Maine. This area is substantial in size, although some of the blocks are very fragmented. An additional analysis is suggested to try different weight on the components of the model, and to incorporate fragmentation, slope, and prey density as a factor affecting successful wolf colonization. Prey density is one of the most important factors affecting successful wolf survival (Paquet et al. 1999) but unfortunately it was not possible to incorporate prey into this particular model. Based on the available model, Maine provides 9,387,332 square kilometers of high suitability habitat (value of 8.31 to 8.94), and 40,322,877 square kilometers of additional habitat of medium suitability (value of 8.24). This amount is sufficient suitable habitat to allow for recolonization of natural or reintroduced wolf populations.

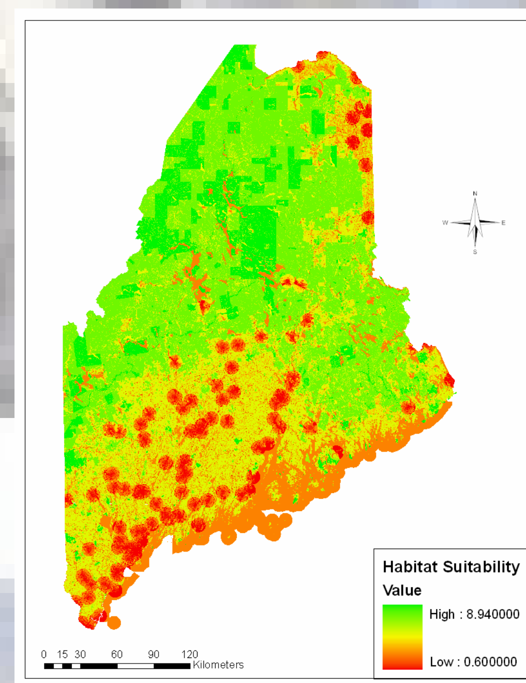

Figure 5. A map of the completed habitat suitability analysis, containing layers displaying roads and railways, land cover suitability, population points distance buffer, land cover classification, woodlot ownership, conservation land, and the analysis calculation output.