Moving Window Based Habitat Suitability Map for the Eastern Ratsnake *(Elaphe obsolete)* In Eastern Ontario

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prepared by
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1 Summary

This report accompanies three habitat suitability maps for the Eastern Ratsnake in Eastern Ontario. These maps were produced based on a habitat suitability model developed by Jeff Row in collaboration with Gabriel Blouin-Demers. A moving window algorithm was implemented and used to improve and enhance those maps produced earlier based on a static grid approach. The moving window algorithm allows identifying habitat suitability for each single cell in a raster-based landscape format and produces a surface map with continuous habitat suitability changes across the landscape. The resulting maps also depict a more precise habitat suitability value for each grid cell (one ha), based on the evaluation of the surrounding landscape characteristics of approx. 540 ha, i.e. the estimated habitat area for a viable population. The resulting habitat suitability maps confirm and enhance the existing maps, but also identify higher habitat suitability in the north-western region of the landscape.

Table of Contents

2 Habitat Suitability Model

The habitat suitability model for the Eastern Ratsnake was developed by Jeff Row. This section summarizes the landcover associations and assumptions of this HS model, but does not explain its derivation (see Jeff Row, unpublished report).

Habitat of the Eastern Ratsnake was found to be dependent on 3 landcover types: forest, marsh and forest edge. It was found that the Eastern Ratsnake prefers areas with large proportions of forest edge, about 50 percent of forest cover and low percentages of marsh. Furthermore, road density has a negative effect on species occurrence. The habitat suitability functions are shown in Figures 1 to 4.

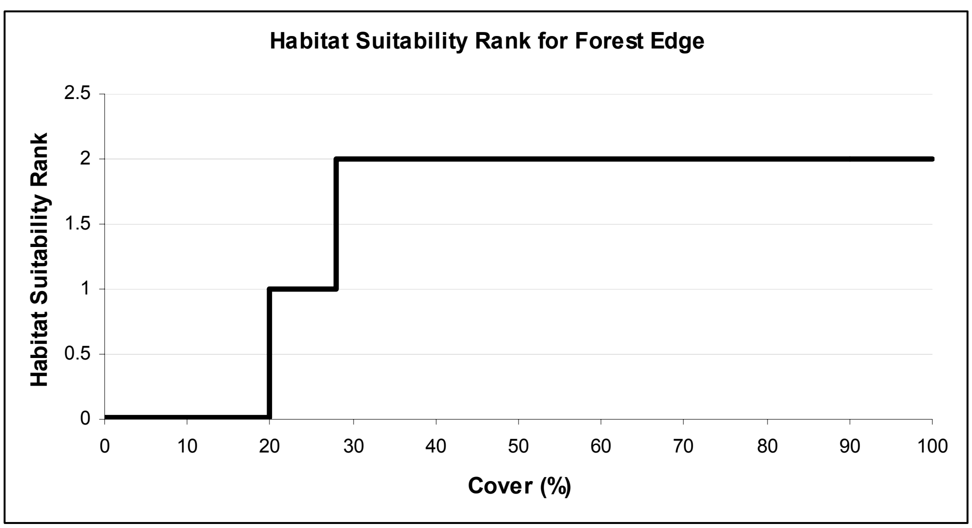

Figure 1: Habitat suitability rank as a function of forest edge

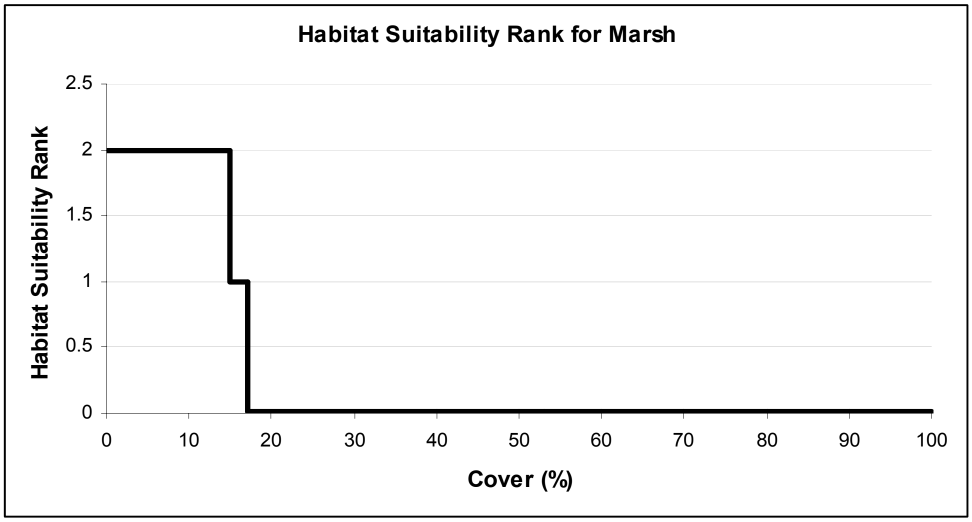

Figure 2: Habitat suitability rank as a function of Marsh

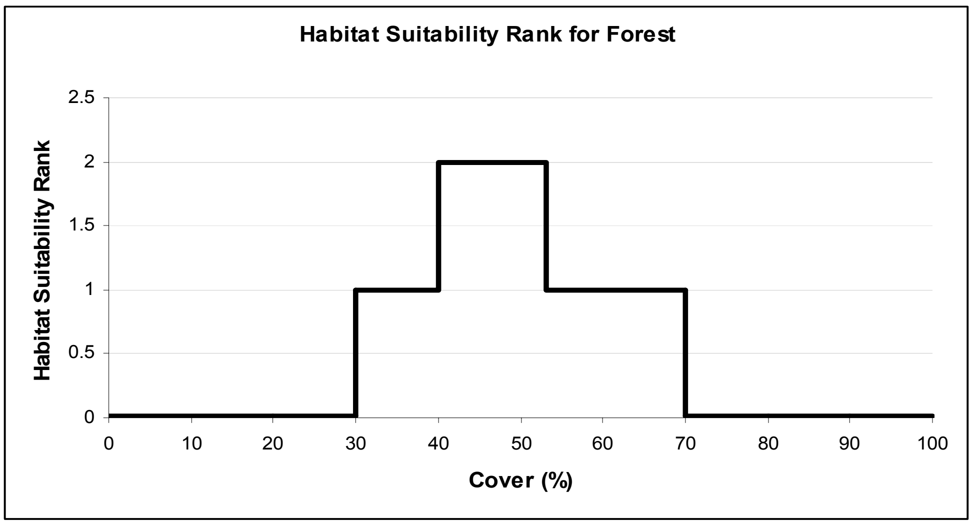

Figure 3: Habitat suitability rank as a function of Forest

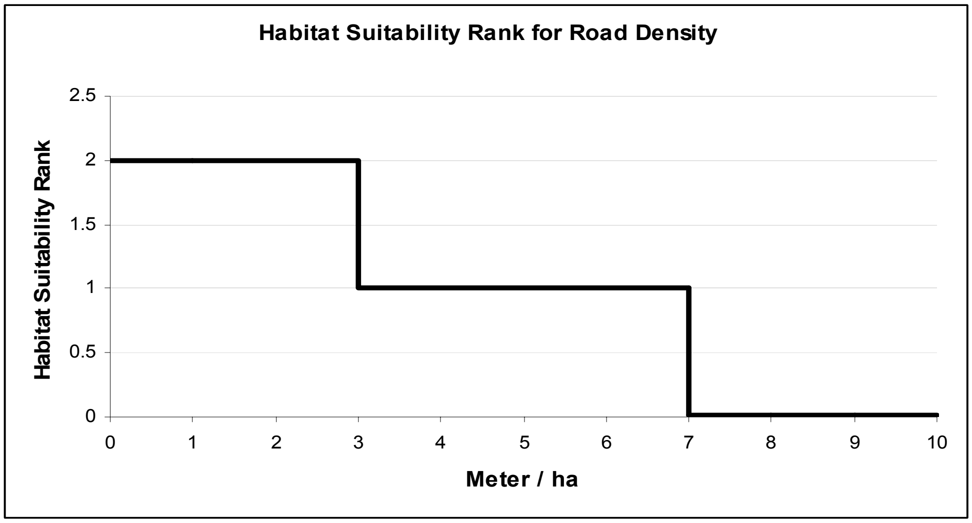

Figure 4: Habitat suitability rank as a function of road density

The habitat suitability index for the area covered by the moving window (see 3.) was calculated by adding the rank values for forest edge, marsh, forest and road density and dividing the sum by the maximum possible rank value of 8. The resulting relative habitat suitability index could range between 0 and 1.

3 Moving Window Analysis

Moving window analysis requires data in raster format. The data layers forest, marsh and edge as provided by Jeff Row were transformed from a vector based format (shape file) into a grid with a cell size of 1ha (100 x 100 m)[1]. The road network was transformed into a road density grid at the same resolution and extent as the other transformed grids. A moving window algorithm was implemented to calculate the habitat suitability index for each cell. The size of the moving window was 23x23 cells (529 ha). This size corresponds closely to the cell size of the original habitat suitability grid of 540 ha – the estimated area to support a viable population (see Jeff Row unpublished report). The moving window was moved across the entire grid and habitat suitability was calculated for each cell based on the habitat suitability ranks calculated within the area of the moving window.

[1] Note that forest edges of 10m as provided in the edge data layer were projected to the larger resolution of 1 ha cells. Although forest edge in the 1ha grid was not delineated precisely as in the vector based data format, amount and spatial distribution of forest edge was preserved across the forest edge grid, allowing to use this resolution for calculating a forest edge rank based on percentage of cover within the moving window area.

4 Data – Landcover Map

The following data layers were used to produce the habitat suitability maps.

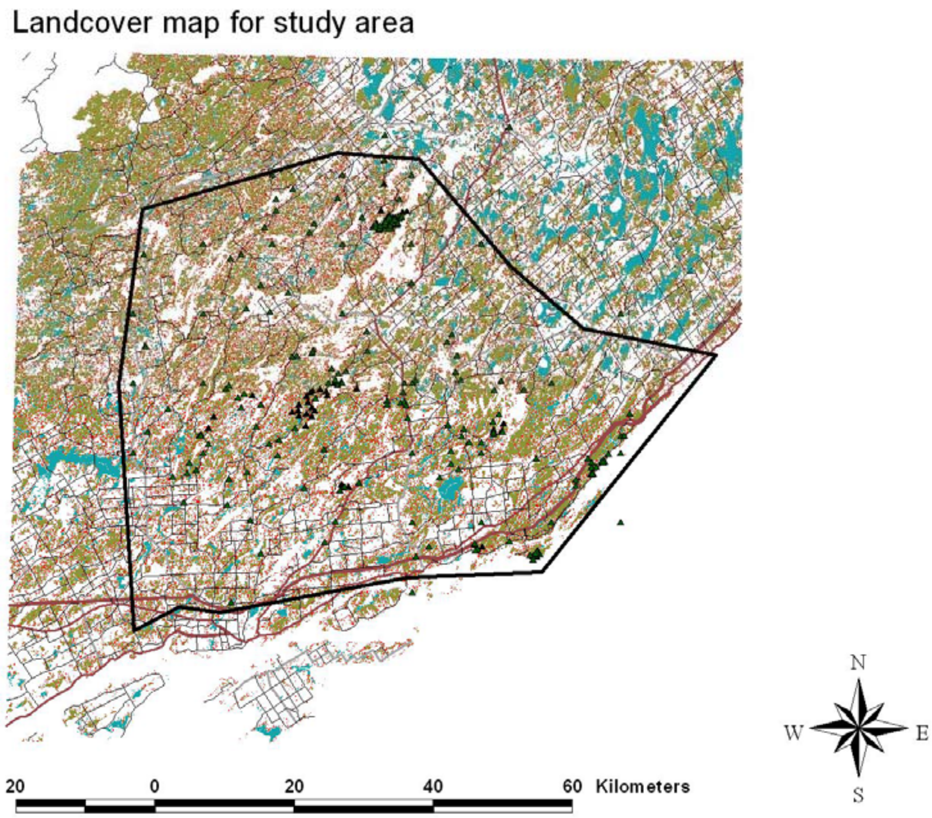

Figure 5: Land-cover map for study area, forest in green, edge in red and marsh in blue

5 Results

Three habitat suitability maps were generated. The first map was based on calculating the habitat suitability ranks as shown in Figure 1 to 4. The second map was calculated using an extended window area of 69x69 cells. This approach considers habitat suitability of adjacent areas and is comparable to the neighbourhood size used in (Jeff Row unpublished report). The third map adds hibernacula occurrences to the calculation of the habitat suitability index. If a known hibernacula was present within the moving window area, a habitat suitability rank of 2 was issued. Similarly, if a post 1985 hibernacula occurrence was found within the area of the moving window, a habitat suitability rank of 1 was used. For window areas without a hibernacula the habitat suitability rank was set to zero. This occurrence based rank value was added to the sum of the four other rank values (see 2.) and divided by the maximum possible rank value of 10.

5.1 Original habitat suitability map based on a static 540 ha grid

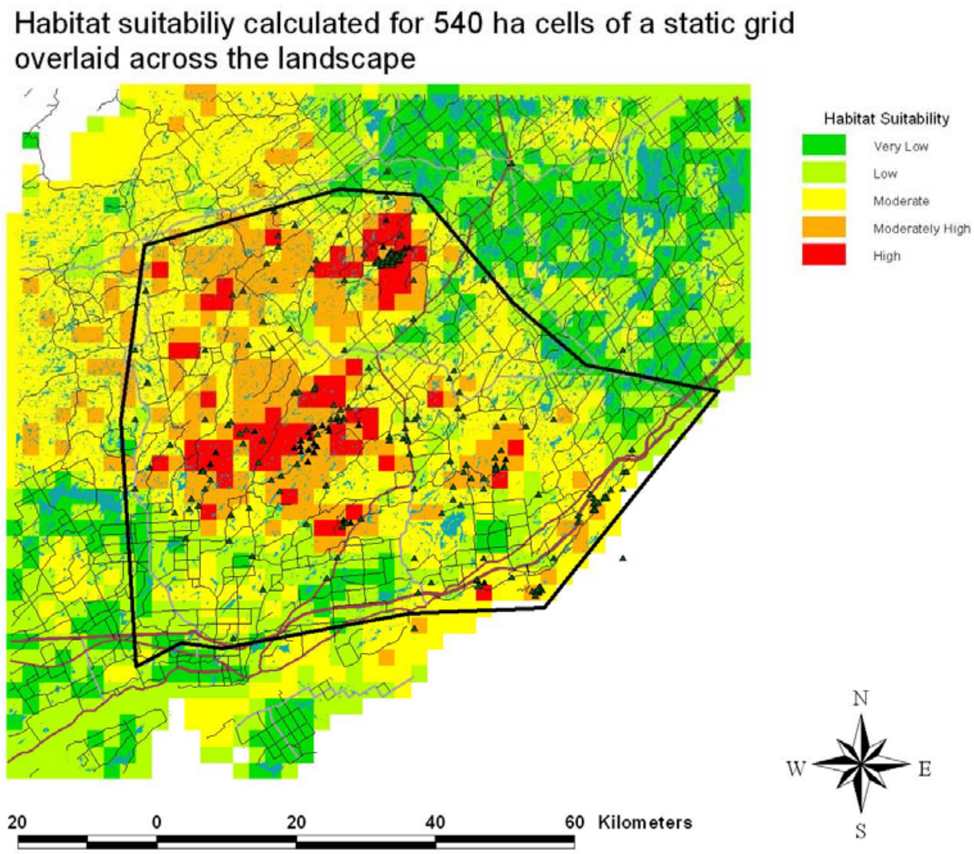

Figure 6: Original habitat suitability map based on a 540 ha grid overlaid across the landscape. This map considers hibernacula occurrence and suitability of adjacent cells.

5.2 Land-cover based habitat suitability map

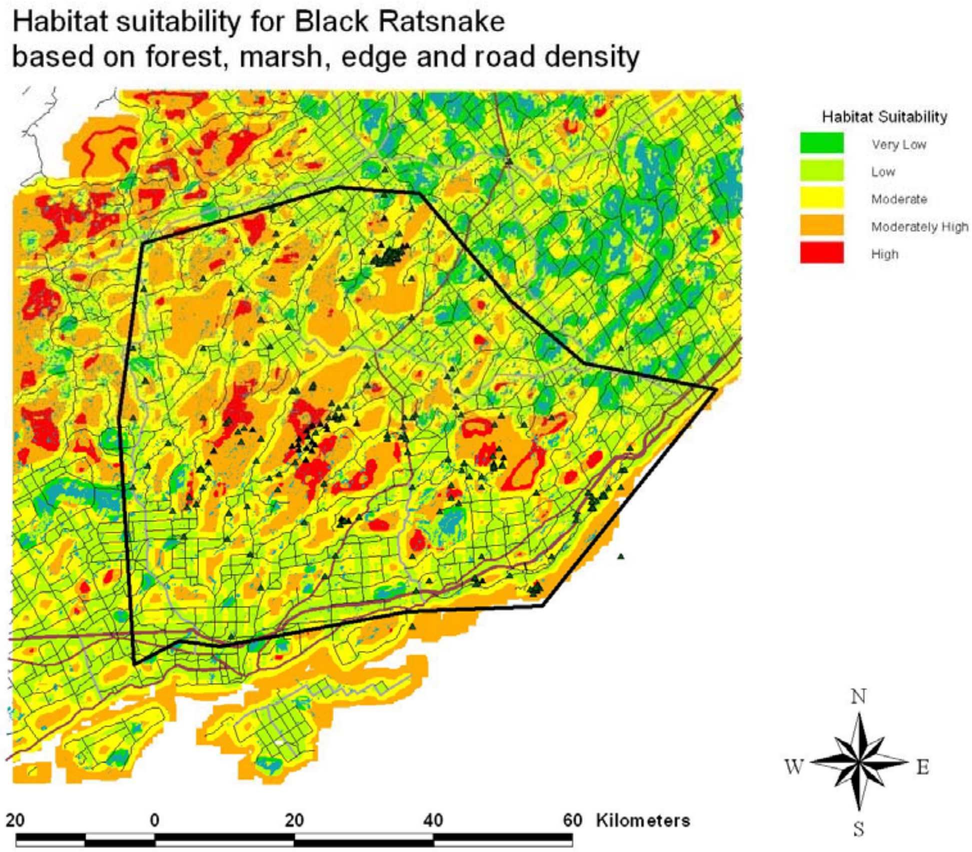

Figure 7: Habitat suitability map based on land-cover and road density rank values

5.3 Neighbourhood based habitat suitability map

This habitat suitability map emphasizes importance of large scale suitability or connectivity between adjacent populations. The north-western part of the study area has the highest suitability based on the adjacency of suitable habitat in this region.

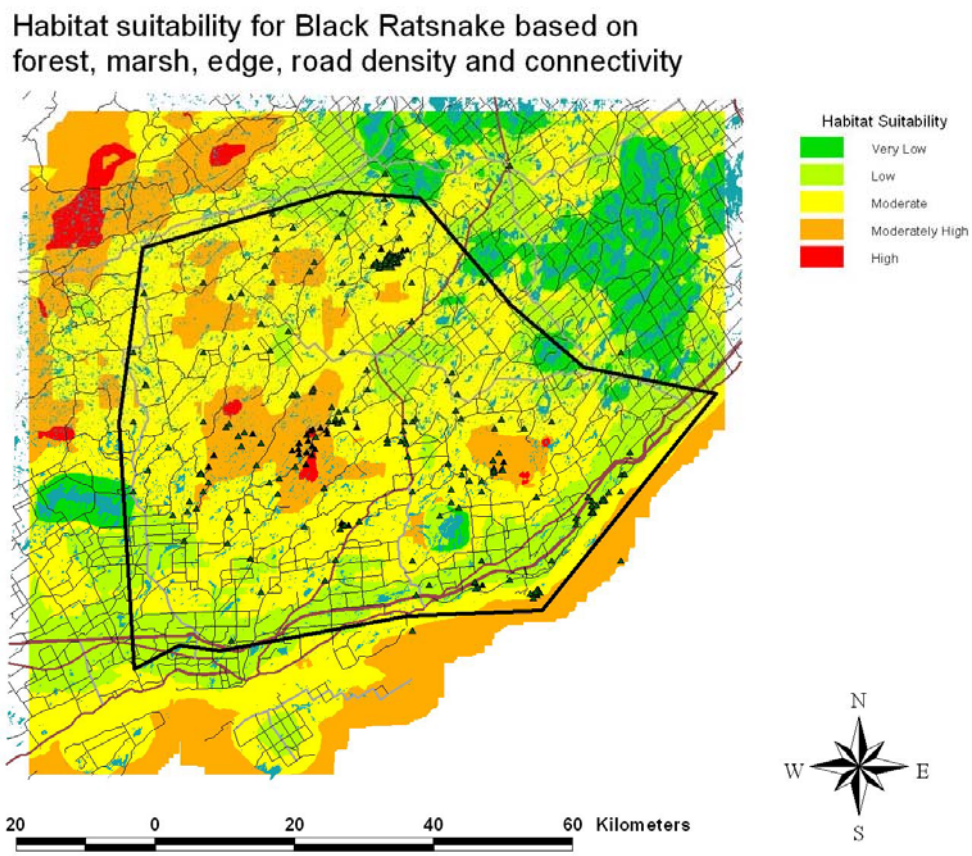

Figure 8: Habitat suitability map based on extended window size

5.4 Occurrence based habitat suitability map

This habitat suitability map considers occurrences of hibernacula's and therefore shows higher habitat suitability in areas with known or post-1985 hibernacula occurrences.

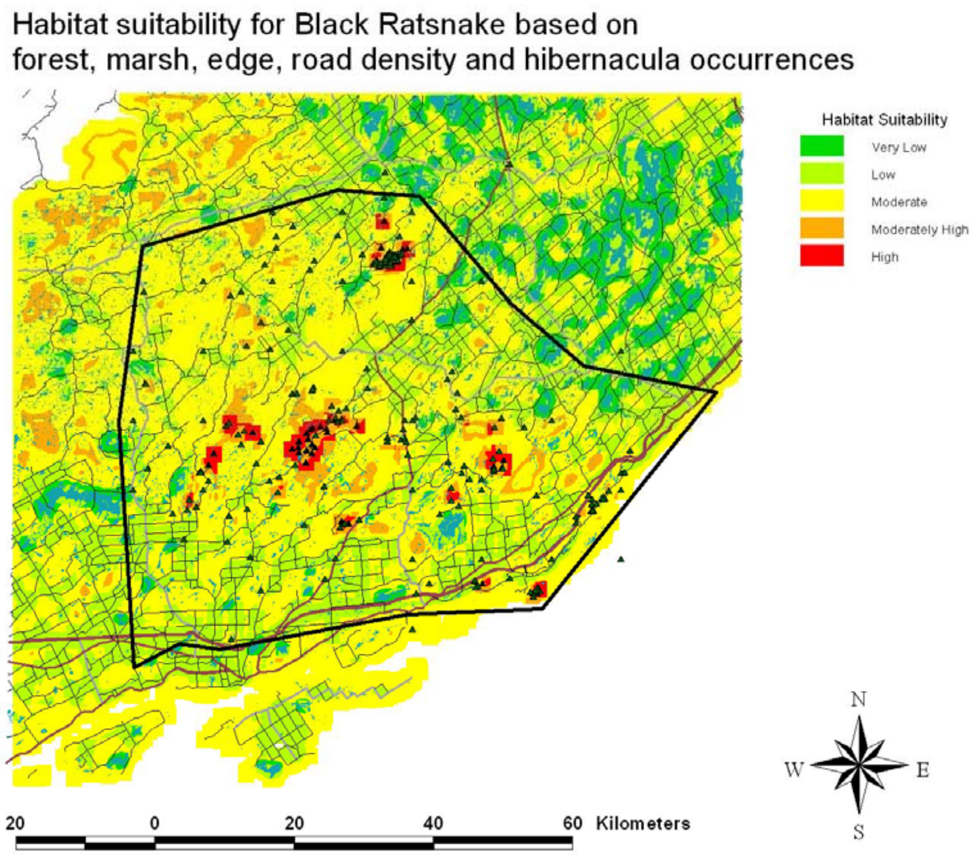

Figure 9: Habitat suitability map based on land-cover and hibernacula occurrence

6 Conclusion

Moving window analysis confirmed and enhanced habitat suitability maps developed by Jeff Row. The resulting maps depict a more detailed habitat suitability distribution across the landscape, but also emphasize suitability in different regions of the study area. In particular the north-western part of the landscape scored higher based on the moving window approach. This difference is likely due to the particular location of the static 540 ha grid and a lack of sensibility toward gradients in the landscape. The three produced maps depict different "hot spots" for habitat suitability. The question of which map to choose depends on agreement with the underlying assumptions. If hibernacula occurrence (or observed occurrence) is of central importance than the map as shown in Figure 9 should be prioritized. Still, all maps show consistently high habitat suitability in the north-western part of the landscape, which supports prioritization of this region in terms of habitat protection. Again, this exercise was proposed to enhance mapping of habitat suitability for the Eastern Ratsnake based on a standard moving window approach – the approach of choice for most habitat suitability maps.