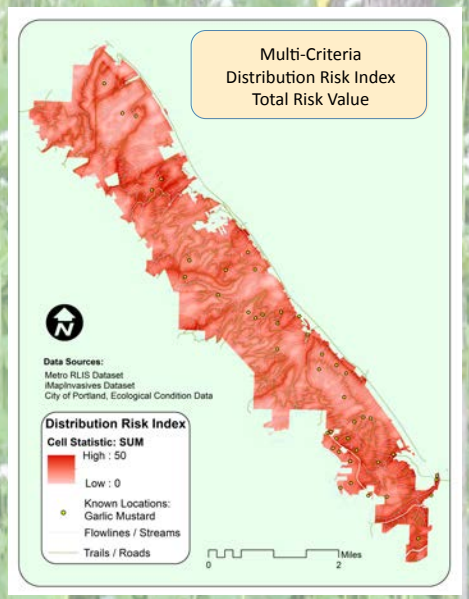
Modeling a Distribution Risk Index for the Spread of Garlic Mustard, *Alliaria petiolata*, in Forest Park

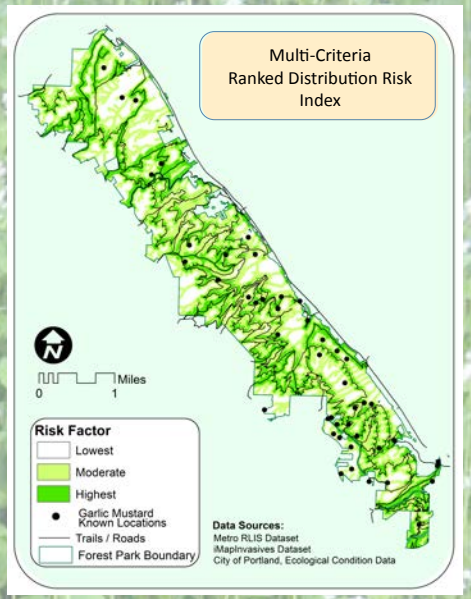
Background:

Pristine forests with flowing streams and waterfalls; the image of Forest Park, the largest urban forest in the United States. However this is not the reality. Due to the spread of non-native invasive species, like Garlic Mustard, *Alliaria petiolata*, the beauty of the park is at risk.

Garlic Mustard, a European transplant that has many culinary uses as well as the ability to make a yellow dye, spreads via seeds which can remain dormant for years. They are small enough to fall in between unseen spaces in fabric and shoes. Equipment from road maintenance vehicles to simple shovels need to be cleaned to ensure control of the tenacious plant.

While efforts to eradicate this species are ongoing, to have a model indicating at risk areas of the park most conducive to seed transportation would save time and money.

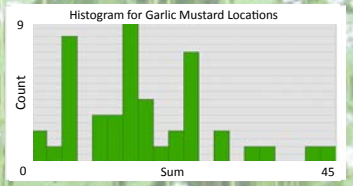




Model of Distribution Risk Index

Dispersion Risk Model Criteria:

- Human transit through the park on existing trail networks
- Vehicle transit via roads through the park
- Streams and creeks through the park
- Current ecological condition of park areas could influence risk and prioritization of mitigation efforts
- Proximity of park areas to trailheads



Methodology and Validation:

Using a multi-criteria evaluation model, a series of multi-ring buffers were created at 100, 200, 300, 400 & 500 feet from line features to establish a weighted categorical risk index ranging from 1 to 10. Ten being the highest risk of dispersal and 1 the lowest. In addition, trail head point features were used as the source for another multi-ring buffer however it used quarter mile distance increments for each buffer ring. Use of the trailheads as a buffer zone source assumes that human traffic would originate from trailheads and that the quantity of traffic would exponentially decrease as distance increased. Finally, a vegetation polygon feature layer was used to rate the current ecological status of the areas as well as generate an ecological weight values again from 1 to 10 for areas of severely degraded, poor, fair, good, & healthy.

The weighting method employed was to categorize each factor into the scale of 1 to 10 though each variable had between five and six individual levels of risk. For example, each line feature had buffer increments of 100, 200, 300, 400 and 500 feet and were weighted at varying increments between 10 and 1 under the assumption that as the distance increased the risk of dispersal would exponentially decrease. For example, the trail network was weighted the most heavily with the highest risk factor of 10 for areas within 100 feet of a trail, then decreasing at the following increments, 8 at 200 feet, 6 at 300 feet, 3 at 400 feet and 1 at 500 feet.

Each feature was rasterized and reclassified into a common dispersal risk index. Finally the cell statistics tool was used to create a dispersion risk output for all areas of the park. Validation was performed by utilizing the zonal statistics tool to measure the correlation between known garlic mustard sites and the risk index output. Several iterations of the model were created using a range of weighted values for each variable in order to more accurately predict the known Garlic Mustard locations.

Analysis:

We used the Zonal Statistics to Table tool with the known location data points for Garlic Mustard in Forest Park and the output from our cell statistics tool. The Zonal Statistics tool outputs a table that allowed us to tally the risk value using the associated risk-potential layer we created. Initially our results were completely random, managing approximately 50% in high-risk and 50% in low-risk areas. This was due to either, our model being flawed and not including the proper variables, or the variable weights we had chosen being poorly calibrated.

After several trials and iterations, tweaking the variables weights to better mimic reality, we came to a conclusion that we are missing a key variable all together. When looking at the area near to Washington Park and the Portland Zoo in the southern most portion of the park, there is a concentration of Garlic Mustard colonies that are obvious outliers from our model. We feel the shear concentration of people in this section of the park, versus the north-western end, indicates a higher overall exposure to invasive species, like Garlic Mustard.

Perhaps including a multi-distance buffer around nearby cultural features like the Portland Zoo, Washington Park, the Rose Garden or the Japanese Gardens, would allow our model to include the areas mentioned above.

We also see a potential limitation from our validation dataset. The size of the sample for Forest Park, at fewer than 50, might not represent the true extent of Garlic Mustards potential spread. By collecting more location data points we might be able to indicate a stronger relationship between our model and reality.

Data Sources:

Portland Metro, Portland Regional Land Information System GIS Data 2015

City of Portland , Parks and Recreation , Vegetation Survey

Oregon Biodiversity Information center. *i*MapInvasives. May 2015.

Environmental Systems Research Institute, Basemap

Google Images.

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