A GIS-Based Model of Exotic Invasive Plant Restorability in National Capital Region Parks

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The Problem

The threat of exotic invasives and their effect on natural ecosystems is one of the most pressing challanges facing park management. The picture to the left shows *Ailanthus altissim*a, an invasive tree prevalent in this region.

Decision Making Framework

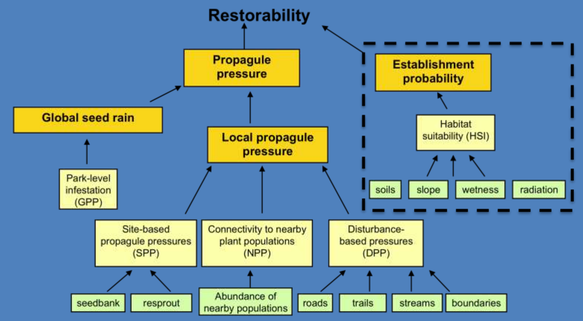
Components of the Decision Support System
(Cost-effectiveness analysis)

	Treatment Costs	Restorability	Benefits
Outputs	Cost of treatment	Risk of treatment failure	Net benefits of proposed strategy
Calculations	Cost = *f*(size, weed density, treatment type)	Restorability = *f*(disturbance, habitat suitability)	Net benefits = *f*(goals, potential impact)
User Inputs	Selects sites and treatment strategies	Select type of seed dispersal	Selects services at risk, weights priorities

To best address this issue, a decision making framework has been developed for park managers. An important part of this framework is informing the economic analysis with environmental analysis of the likelihood a species will reinvade a site after treatment (**restorability**). This allows the economic model to take into account the probability of success of actions taken to mitigate exotic invasion.

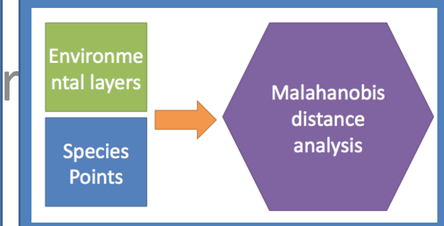
$$\text{Cost - Effectiveness} = \frac{\text{Risk-Adjusted Benefits}}{\text{Costs of Treatment}} = \frac{\Delta\text{Benefits} * \text{Probability of Success}}{\text{Costs of Treatment}}$$

Restorability



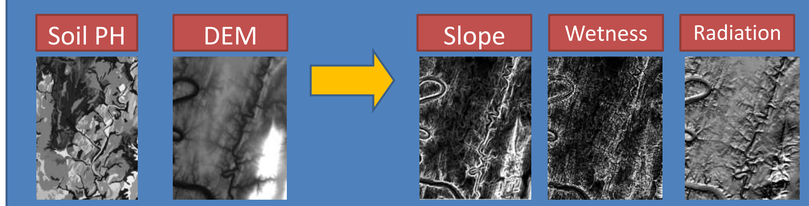
Estimating restorability requires information on a number of factors. One of the most important of which is the risk that a new plant would successful establish from any seed reaching the site (**re-establishment probability**).

Re-Establishment Probability



To predict re-establishment risk, a habitat suitability map was generated using GIS tools and a Mahalanobis distance analysis, which is a statistical model for determining where a species is most likely to grow.

Model Input Environmental Layers

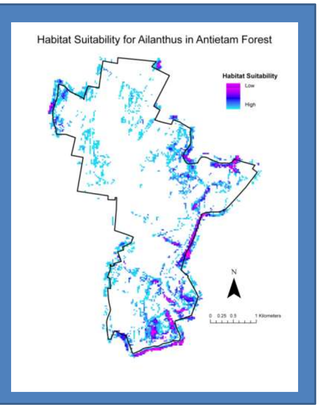


GIS Automation

The process of creating this map has been automated with GIS ModelBuilder, so that this analysis can be run quickly and by individuals who may not have expertise with GIS.

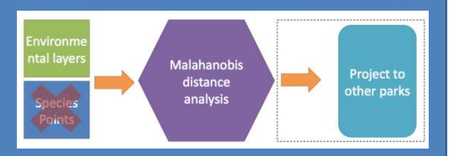
Antietam Model

This is an application of the model to Antietam Battlefield Park. From the data layers, the computer was able to generate a map that suggests where *Ailanthus altissima* is likely to exist by applying the statistical model to the continuous GIS surfaces. This allows significant decision making potential from relatively few actual observations of the species' distributions.



Further Application

Sometimes there is not any point data on where a species is within a park. It is still potentially possible to create a habitat suitability map by applying the information about where a species grows from another location to the environmental layers of the park in question. This has the potential to allow parks such throughout the region to use this model without having to spend money on data collection.



Model validation

To ensure that applying this model to another park will work, we have applied the habitat model built from Antietam data to predict *Ailanthus altissima* in Monocacy Battlefield Park. The map to the left compares the model output to observations of the species' presence and absence from plant inventory data.