Assigning Treatments for Woody Invasives and Estimating Treatment Costs

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Abstract

This paper describes the application of geographic information system (GIS) technology for automatically assigning treatment prescriptions to tamarisk and Russian olive infestations. A GIS shapefile of tamarisk presence polygons, including attributes such as percent cover, is used to define a study area. The GIS is used to add additional attributes to the polygons based on topology. A custom PHP program reads data files of the tamarisk polygons, costs for each treatment type, and user specified parameter values. The program uses the parameter values in a decision tree, assigning an appropriate treatment to each polygon.

Background

The woody invasives Tamarisk (*Tamarix* spp.) and Russian olive (*Elaeagnus angustifolia*) occupy hundreds of thousands of acres in the southwest United States (DiTomaso, 1998). Removing these plants is expensive and time consuming; large infestations can be very expensive to treat (McDaniel, 1998). Land managers must choose from multiple treatment methods, with accompanying costs, benefits, and limitations.

Treatment selection for infestations is difficult, because a detailed analysis must be made of terrain and accessibility for each treatment location. A land manager may have multiple infestation sites with multiple combinations of terrain and accessibility. This variability complicates treatment selection when assessing large areas.

Methods

I created a GIS-based spatial model which assigns treatments to polygons describing the extent of tamarisk and Russian olive infestations. The model calculates a costs for each polygon and estimates the total project cost. This estimate can inform the treatment planning process, helping land managers understand the financial scope of a proposed project.

The model uses ArcGIS to process a polygon shapefile. The polygons have attributes such as percent cover, height, and ease of access. ArcGIS is used to add additional attributes to the polygons, such as slope and percent wetland. The polygon data is exported to a text file for further processing.

A custom PHP program reads the text file and assigns treatments based on the infestation attributes. Tamarisk and Russian olive treatments are assigned separately. Some treatments are only practical when applied to large areas, so polygons are grouped together based on proximity and attribute similarity. Treatment assignment is implemented as a decision tree, attempting to assign lower cost treatments first.

The final step of the model is to import the assigned treatments back into ArcGIS for display. This allows for a visual comparison of the assigned treatments with the polygon location and elements. A land manager can then validate the selection, possibly changing parameter values in the model to modify the treatment assignment.

References, Acknowledgements, & Data Sources

The Tamarisk Coalition provided two sources of GIS data files. Their *Colorado Tamarisk Mapping & Inventory Summary Report* (2008) was used as the tamarisk extent layer for the John Martin SWA study area. Their report *Restoration Plans, Colorado River, Mesa County, CO* (2010) was used for the Grand Valley study site. It includes tamarisk and Russian olive coverage data, as well as recommended treatment types and costs for each polygon.

ArcGIS is a registered trademark of ESRI Incorporated

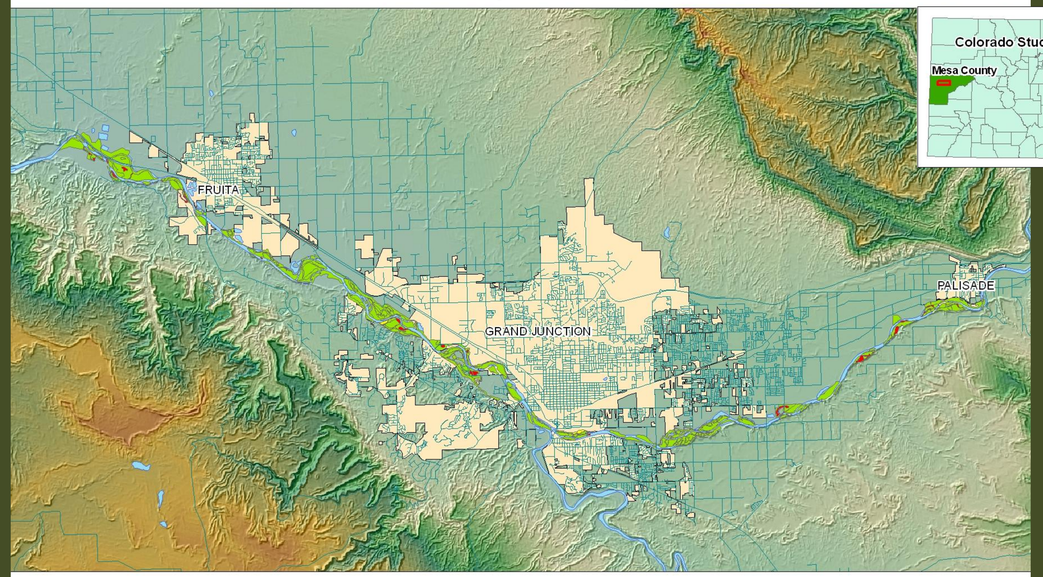
McDaniel, J. P. (1998). Restoration of Saltcedar (Tamarix sp.)-Infested Floodplains on the Bosque del Apache National Wildlilfe Refuge. Weed Technology , 12 (2), 345-352.

DiTomaso, J. M. (1998). Impact, Biology, and Ecology of Saltcedar (Tamarix spp.) in the Southwestern United States. Weed Technology , 12 (2), 326-336.

Data for water bodies, cities, and roads is from the Colorado Department of Transportation.

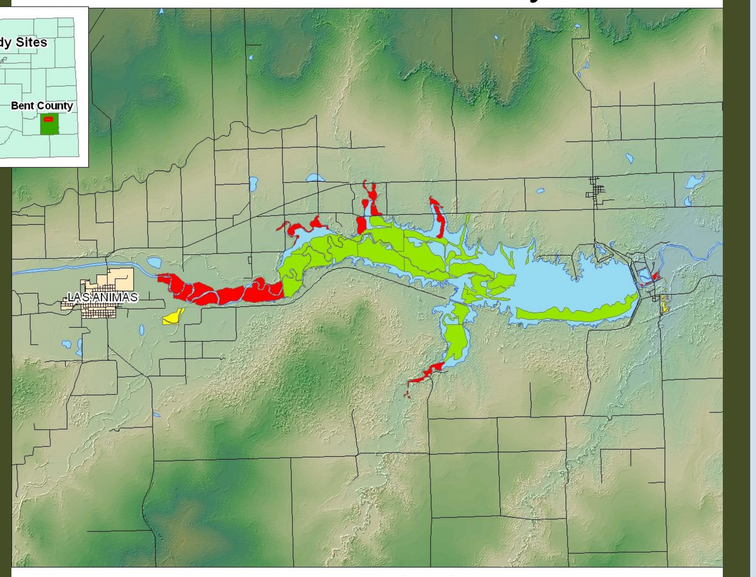
Data for elevation is from the National Map

Grand Valley Study Area



Treatment Type	Auto Tamarisk	Auto RO	Manual Tamarisk	Manual RO
Aerial	0	0	0	0
Mechanical	2	31	8	83
Manual	0	134	0	84
Biological	196	0	192	0
None	27	60	25	58

John Martin SWA Study Area



Treatment Type	Automatic Tamarisk
Aerial	0
Mechanical	12
Manual	3
Biological	23
None	0

Grand Valley Study Area

This site is located along the Colorado River in western Colorado. The site runs from Palisade on the east, through Grand Junction, and ends about 5 kilometers west of Fruita. Most of the terrain is fairly flat, but access is often poor due to being adjacent to the river. In addition, wet soil often restricts the use of mechanical treatment methods.

The Tamarisk Coalition assigned a detailed treatment recommendation for each of the polygons in the study area. The tamarisk leaf beetle is established in the Grand Valley; for this reason the Tamarisk Coalition preferentially uses biological control for tamarisk. They recommend mechanical treatment where biomass reduction is a priority.

The best fit automatically generated treatment prescription agrees with the manually generated tamarisk prescription on 95.56% of the polygons and with the manually generated Russian olive prescription on 73.78% of the polygons. The calculated cost of the automatically assigned treatments, summed over the entire study area, is $3,198,338.92. The treatment cost calculated by the Tamarisk Coalition is $4,291,220.00. The total area of the study site is 3300 acres.

John Martin SWA Study Area

The John Martin State Wildlife Area is located around the John Martin Reservoir in Bent County. The land is mostly flat, with dense (>50% cover) stands of tamarisk. The water level of the reservoir fluctuates seasonally and annually. Much of the surveyed tamarisk is within the potential impoundment area.

Land managers often use aerial herbicide application to treat large dense stands of tamarisk. In this study area, however, the densest stands would be under water when the reservoir is full. Because of concerns about application of herbicide to wetlands, the automatic treatment assignment does not assign aerial treatment to polygons that are within a water body. The automatic assignment program assigned manual treatment to 3 polygons, mechanical treatment to 12 polygons, and biological treatment to 23 polygons. The estimated total treatment cost is $5,031,943.00 to treat the 6777 acres in the study site.