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Russian Olive Report

rEPORT ON THE CURRENT AND FUTURE STATUS OF RUSSIAN OLIVE IN MISSOULA COUNTY

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# Introduction

The Russian Olive project originated from my interest in native plants and their ecological importance in Missoula and the surrounding Montana area. This interest was sparked by personal experiences, such as planting native species in my yard, and grew into a desire to contribute to local conservation efforts. While I initially sought a project directly related to native plants, I realized that supporting native ecosystems also involves addressing the spread of invasive species. This led me to focus on invasive species management, specifically the Russian Olive, which was recently listed as a new invasive species in Missoula County in 2024.

To narrow the scope of the project, I chose to concentrate on Missoula County, as statewide efforts, such as those led by the Montana Natural Heritage Program (MTNHP) and Bryce Maxwell, have already made significant progress in this area. After reaching out to the Missoula County Ecology Extension, I learned about their ongoing field surveys and concerns regarding the Russian Olive. They provided valuable data and context, which became the foundation for this project. This report aims to support their efforts by identifying areas most susceptible to Russian Olive invasion and providing actionable insights for mitigation and removal strategies.

This report is intended for the staff of the Missoula County Ecology Extension, the Missoula County Weed Board, and other interested parties, including the public. Its goal is to inform decision-making around resource allocation and mitigation efforts, ensuring that limited resources are used efficiently to combat the spread of Russian Olive.

The primary question this project addresses is: Which areas in Missoula County are most susceptible to invasion by Russian Olive? By answering this question, the report provides critical information about the current distribution of Russian Olive and identifies potential areas for future management efforts.

# Background

Russian Olive (*Elaeagnus angustifolia*) is a small tree native to southern Europe and western Asia. Introduced to North America during colonial times, it was initially planted for practical purposes, such as windbreaks, and for its ornamental appeal. However, it has since escaped cultivation and is now considered an invasive species, particularly in riparian zones—areas along riverbanks where it thrives and spreads rapidly. In Montana, Russian Olive was first planted as a windbreak as early as 1953, but its unchecked spread has led to significant ecological concerns. As of 2010, the Olive is listed as State Regulated by the Montana Department of Agriculture, which means it is illegal to intentionally spread or sell.

One of the main issues is the overcrowding and eventual overtaking of native species within the ecosystem. Native species such as the cottonwood and willow occur in the same environment as the Russian Olive, causing competition between the species. This is an issue due to certain characteristics that give Russian Olive an advantage in this competition. Unlike the native Cottonwood the Russian Olive can reproduce in the shade[[1]](#endnote-1), as the Cottonwood’s die off the Russian Olive lives on. Since the cottonwood can’t reproduce in the shade, the Russian Olive begins to take over as the dominant species.

Another advantage is the aversion of Beavers to Russian Olive, researchers found that Beavers tended to damage 57 to 78 percent of cottonwood trees, while only damaging a mere 15 to 18 percent of Russian Olive Trees[[2]](#endnote-2). Furthermore, the damage to Russian Olive tended to be primarily the limbs, while damage to the Cottonwood tended to be at the trunk or base of the tree.

Additionally, Russian Olive thrives in areas with regulated river flows, such as those impacted by dams or irrigation systems. These human-altered environments create ideal conditions for their growth, allowing them to spread more aggressively. As a result, Russian Olive not only disrupts natural ecosystems but also exacerbates the challenges of managing riparian areas in the face of human activity.

The loss of native species like the Cottonwood also means the loss of habitat for native animal species, for example cavity-nesting birds that rely on the Cottonwood to reproduce do not appear to use Russian Olive as a replacement. Ungulates such as the White-Tailed Deer prefer to forage near cottonwood trees at a much higher proportion when compared to the Russian Olive. Preserving these fragile ecosystems is an important step in combatting climate change at the local level, this is something I hope my project can aid in.

Several studies have examined the distribution of Russian Olive in Montana, including a notable study by Lesica and Miles, which tracked its spread along the Marias and lower Yellowstone rivers in eastern Montana. More recently, researchers used NAIP imagery and a random forest model to create a land cover map of valley bottoms for ten eastern Montana rivers, with Russian Olive included as one of the mapped land cover types. These studies have provided valuable insights into the species’ behavior and impact in eastern Montana.However, fewer studies have focused on the western part of the state, particularly in Missoula County. According to data from the Montana Natural Heritage Program (MTNHP), observations of Russian Olive in Missoula County have increased in recent years, as shown in Figure 1 below. This uptick in observations underscores the need for localized research to understand the current distribution of Russian Olive and predict areas where it may spread in the future.

**Figure 1: Increase in Russian Olive Observations in Missoula County (MTNHP Data)**

(Placeholder for visualization)

Given that Russian Olive was recently added to Missoula County’s watch list of invasive species, this project seeks to fill critical gaps in knowledge about its spread in the region. By identifying areas most susceptible to invasion, the findings can inform targeted mitigation efforts and help allocate resources more effectively to protect native ecosystems.

# Methodology

There are several approaches available for species mapping, for my specific project I decided to do a habitat suitability model. This model predicts how an area is suited to accommodate a given animal or plant. It takes numerous variables the tricky part is deciding which ones are the most important to your species of plant or animal. My project I tried to build off the efforts of previous ones such as the 2017 paper or the MTNHP’s statewide habitat suitability model. The Findings conclude that the following environmental variables are critical in developing a model for Russian olive.

**Figure 3: the variables**

I used two distinct sets of data for the Russian olive locations; one set was field survey data from Missoula County ecology extension. The other set of data comes from the Montana natural heritage program, this data is less reliable because it has not all been confirmed. For the environmental variables above, I went through the Montana State library MSDI framework.

There are a couple ways to combine all this data, it can be done programmatically in R or Python, or it can be done in arc GIS or similar software. I used ArcGIS to simplify the modeling in R and resulting output into ArcGIS. To begin the process, I had to combine the data points given to me from Missoula County with the data points from the state. To speed up this process I clipped the data points from the state to only in cloud include the data points for Missoula County. And then I had to filter the state data set to only include data points that had a spatial precision under 800m, as recommended in the model from MTNHP.

Now that I have two datasets, I wanted to preserve the data included with both. This was done via a left-join between the two datasets and preserving all the late columns from the State dataset. I also had to consider any overlapping data points between the two datasets, **I used blank function in arc gas which allows you to select random points between two similar points**. Next, I had to consider the fact that the combined dataset contains only points where Russian olive is found. There are methods such as Maxent which use presence only data to create a model. However, for my random forest model, I also required pseudo-absence points or points where Russian Olive is not found.

To do this I used ArcGIS to generate pseudo-absence points around Missoula County specifically I tried to have around double the number of presence points as recommended to help increase model accuracy. Once I finally have the combined data set including Missoula County points, State Data Points and the pseudo-absence points I could introduce environmental variables. I began to overlay each layer from the variables listed above *figure 3* onto the point data set. Once this is done, I can extract all the data from each point into a single table that contained in point and all the environmental values four said point.

Using the table I can import it into R where I can begin preparing it for modeling. Some important steps in this preparation include converting the presence absence column to a factor and converting all text columns such as land cover to a factor as well. This also involved dropping several columns that were either an ID or have so many factors that they couldn't be used.

Finally, I need to split the data into training and testing sets, this split needs to consider spatial autocorrelation. To account for this, I used the block CV package in R, this allows for a separation of data in generation of training in testing folds. These folds are then used to reference the data set randomly in the random forest model.

**Other potential processing steps?**

# Analysis

## Initial Analysis

Before getting to the model output, I first want to answer a couple of questions that can help provide more context regarding the current distribution of Russian Olive in Missoula County.

Looking at the current distribution of datapoints, we can see that they tend to be concentrated in town near a river or stream. **There are several areas where there is no visible water source nearby however, including X Y and Z.**

*Insert Figure: Russian Olive in Missoula*

The next topic I want to investigate is the setting in which the data point was recorded. There are 4 possible settings including:

* **Ornamental**: Planted by someone
* **Escaped:** Grown via seed from another plant
* **Windbreak:** ??
* **Other:** Not in any other category or NA

*Insert Figure: Russian Olive Categorized by Setting*

Last, I want to know what growth stage the observed plant is at. Similar to the woody setting there are several different stages that are observed, including:

* **Immature:** not full grown
* **Mature:** Full grown
* **Seedling:** Just sprouting
* **Senescent:** ??
* **Other: NA or other value**

*Insert Figure: Russian Olive by Growth Stage*

One issue with both maps is there are many values that have NA or others, this is due to the datasets being used. The state dataset does not keep a record of setting or growth stage for a given data point.

Another topic that I want to address is who owns the land where Russian olive is found. Russian Olive trees tend to be planted ornamentally which means many of the infestations could be found on private property, which introduces some red tape surrounding remediation. To take this into account I first just want to display a chart that shows where it is most prevalent based on to the land ownership.

*Insert Figure: Russian Olive by Land Ownership*

## Random Forest Results

The Random Forest found that the following variables had the most significant impact on the chance of Russian olive having presence at said location.

*Table: Significant Variables*

Taking these variables into account, we can now produce the habitat suitability map for Missoula County.

*Figure: Habitat Suitability Map*

The model accuracy is close to X%, there are several limitations to this model one limitation is that it is based on the data fed to it and relies on preprocessing heavily.

*Figure: ROC Curve or other accuracy measures*

# Recommendations

Based on the model findings I think these specific areas are of interest regarding immediate action.

*Figure 5: Areas of Interest*

I am not an expert on removing invasive plant or trees species, my father was an arborist in the city for a long time so my only experience with removal is cutting them down and removing the stump. However, the Russian olive, despite being invasive species, can also harbor native animals such as birds or bugs which complicates drastic removal without replacement.

My recommendation is solely focused on areas where removal or other treatment would be most beneficial. In Lusaka and miles 2001 they recommend medicating mature Russian olive trees every 10 years were all trees every 30 years as an effective strategy to control population and mitigate effects on native wildlife and plants.

I also would recommend replacing any removals with a native species such as the Cottonwood or Green Ash. These generally deemed as the best replacement as that is the native species that Russian olive tends to overcrowd.

# Conclusion

This project can provide a significant boost to the knowledge of Russian olive in western Montana in primarily Missoula County. Providing the Missoula County ecology extension and Missoula County weed board with information that can help with the management of the Russian olive in Missoula County. I realize that this task of managing and eradicating invasive species in the county is a large one, I hope that this report and project can provide support to This task in potentially pave the way for future efforts with other invasive species in the area.

When creating this project I want to have the ability to change or alter the species of interest without completely rebuilding the program from the ground up. The Montana natural heritage program seems to have a similar system in place where they can plug in a species and spit out a model like this. Having this ability would have large benefits in invasive species control in the county, savings staff time and resources that can be dedicated elsewhere.

# Appendices

Technical details including technical information, code snippets, or any related table slash figures.

# References

[**https://mtaudubon.org/wp-content/uploads/2017/09/Lesica-Miles-1999.pdf**](https://mtaudubon.org/wp-content/uploads/2017/09/Lesica-Miles-1999.pdf)

[**https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDELG01010**](https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDELG01010)

[**https://archive.org/details/Predictingthedi100**](https://archive.org/details/Predictingthedi100)

[**https://mtnhp.org/models/files/Elaeagnus\_angustifolia\_PDELG01010\_20230314.pdf**](https://mtnhp.org/models/files/Elaeagnus_angustifolia_PDELG01010_20230314.pdf)

1. [↑](#endnote-ref-1)
2. Lesica [↑](#endnote-ref-2)