# Invasive Aquatic Invasion: The Spread of Variable Milfoil in Maine


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### Abstract

Variable leaf milfoil, *Myriophyllum heterophyllum*, has been present in Maine since 1970. We created an analysis area including seventeen infestation sites and all bodies of water within a forty mile buffer. We also eliminated all water locations with a size less than 7,101 $km^2$, the size of the smallest infestation site, Shagg Pond. Within those specifications we randomly selected seventeen un-infested bodies of water and used them as our uncontaminated sample. We looked for relationships between presence and number of boat launches, and proximity to a populated area. Using the Mann-Whitney test, we compared the sample size of non-infested lakes to the infested lakes. We found there was no significant difference in all three variables on the infestation of variable leaf milfoil.


### Introduction

Variable leaf milfoil, (*Myriophyllum heterophyllum*), native to parts of the US South, is a non-native invasive aquatic plant species in Maine. In Maine, it has established itself in neutral to weakly acidic waters in organic mud or silt-covered sand substrates. Its dense growth can negatively impact native plants, fish and other wildlife, as well as congest waterways “and may also provide a breeding ground for mosquitoes” (Maine Natural Areas Program 2009 ). It spreads by the movement of plant fragments and can be established in a water body by a small fragment which can be carried by, among other things, boats, trailers, and fishing gear. Like other aquatic plants, if established variable leaf milfoil can be exceptionally hard to eliminate and have often survived attempts by humans to do so (MNAP 2009). Consequently, efforts are being made by the Maine Department of Environmental Protection, the Lakes Environmental Association, and the Maine Congress of Lake Associations to inspect boats being moved in and out of lakes for milfoil in hopes of preventing its further spread (MDEP 2009).
Since variable leaf milfoil spreads easily by attaching to other objects, we looked at human activities that might have spread this invasive through Maine. In this study, we assessed the relationship of those infestations with the existence and number of a public access boat launches, and proximity to densely populated areas.

### Methods

We used ArcGIS and ArcInfo for our spatial analysis and SPSS for our stastical analysis. We gathered initial data from lakes and ponds since variable milfoil thrives best in slow-moving bodies of water (MNAP 2009). The infestation sites we used have been documented annually by Maine Department of Environmental Protection, giving us up-to-date data through 2009. Designating these locations as our model, we narrowed down our analysis area and selection of sites using ArcGIS. First, to create our analysis area, we used a buffer of forty miles from each infested body of water. This was chosen because it is the largest distance between two locations contaminated with milfoil. Since no infestations were found further than this buffer, we felt confident in limiting our observations to this area. Next, we removed all bodies of water with a smaller area than the smallest infestation, Shagg Pond. This eliminated all sites that were less than 7101 $km^2$. Using a layer showing all public access boat launches in Maine, we selected only the sites found on our remaining lakes. This gave us our analysis area.

To compare the infested sites to the non-infested sites we selected a random sample of seventeen non-infested lakes and ponds. We created a VBA Script Code to randomly assign all water bodies in the analysis area a number. We then selected the first seventeen bodies of water that did not overlap with the infestation sites to use as our control. This way we had seventeen infested and non-infested sites.
To see if proximity of densely populated areas was related to the incidence of variable leaf milfoil infestation, we took census data which gave population density per square mile and broke down the classification into ten natural breaks. This gave us detailed fluctuation throughout the state and allowed us to feel confident in the areas designated as densely populated. We selected the top four natural breaks (4051.3-6216.7, 6216.8-9237.5, 14725.1-28600.0 people per square mile) and decided they signified a high population density. We chose these numbers by observing the top twenty largest cities in Maine and selecting the natural breaks that included all of them. Creating a point for each of these square miles, we created a Network Analysis of thirty, forty five and sixty minutes of driving time. This was done by creating a VBA Script Code and, using the speed limits for all roads, we calculated all roads within each time constraint from densely populated areas (Figure 1).

Using Arc Info, we calculated the time it takes to drive along the roads from the closest populated area to each site using Network Analysis. By doing this we found the exact driving time for each study lake. When there was access to a public boat launch we used that as our ending point. If the body of water did not have a boat launch we created a centroid in the body of water and calculated the fastest way to reach that point.

Each site was observed for multiple characteristics using the Mann-Whitney test, a nonparametric, two-independent sample test, in SPSS. First, if it was infested or not. Second, where each site lay; in a thirty, forty five and sixty minute driving zone. Third, if the lake had a public access boat launch or not. Fourth, the number of boat launches found at infestation and non-infested sites. And fifth, the actual time taken to reach each site. The first, second and third categories were given a binary classification (“0” meaning “no” and “1” meaning “yes”). The others used actual numbers in the test.

### Results

We found that there was no significant difference in all the variables we tested. When testing the presence of a boat launches and infestation, we found no significant difference ($Z = -0.383$, $p = 0.768$). This held true for number of boat launches and possible infestation ($Z = -0.559$, $p = 0.83$). When observing the three driving time buffers from the populated areas it seemed that there was a trend among dense population and infestation sites (Figure 1). However, after finding the exact driving distance to each study lake, the Mann-Whitney test showed that those variables were statistically insignificant ($Z = -0.477$, $p = 0.218$).

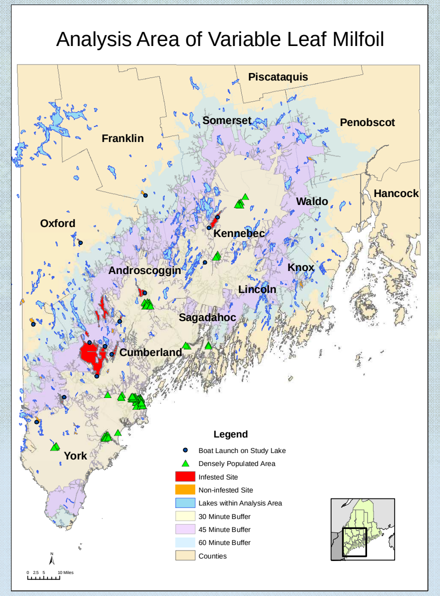


Figure 1. Thirty, Forty-Five and Sixty Minute Drive Buffer Zone From Populated Areas

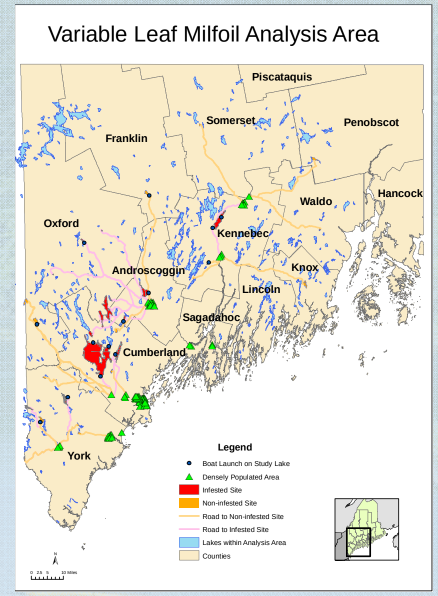


Figure 2. Most Direct Route from a Populated Area to Study Lakes

### Discussion

Our results show that there is no statistically significant correlation between densely populated areas or boat launches to infestation of variable milfoil in Maine. It is possible our sample size was too small to show any significant significance. However, when more information has been collected, there might a relationship between them. We also based our non-infested sites off of one random selection that may not have been a reasonable representation of the area. It is also possible that there may be other factors not tested in this study that contribute to infestations.
It would have been best to compare all other lakes to the infested sites, but the map layer used, ponds_04192006” from the Maine Office of GIS, had unified bodies of water represented by complex polygons with no unifying characteristic besides their proximity to one another, which resisted our attempts to dissolve them into unified bodies. While the “Hydro24” layers did not have these problems the layers did not exists for the entire analysis area. This resulted in us having to do our data gathering on water bodies we wanted to analyze manually and forced us to settle for one small random sample size. Furthermore, we did not consider those bodies of water that may have had a boat launch on connected body of water which may have skewed our analysis.

### Conclusions

Based on our analysis, it appears that waters with public access boat launches are not more likely to be infested with variable leaf milfoil. There also appears to be no correlation between infestation and distance from populated areas. In addition, the format of “ponds_04192006” and “Hydro24” layers from the Maine Office of GIS are not conducive to this type of analysis. We believe improvements in this area will help facilitate higher quality research of this and other lake related issues.


Acknowledgements

We would like to thank Philip Nyhus and Manny Gimond for their help and assistance throughout this project. We would also like to thank Karen Hahnel, Peter Lowell, and Paul Gregory, from Maine Dept. of Environmental Protection as well as George Powell of the Department of Conservation for their advice and providing us with data on the subject. Lastly, we would like to thank Joel Alex for his resources and first interesting us on the topic.


Works Cited


ESRI 9.3 Data and Maps

Maine Department of Environmental Protection. *Courtesy Boat Inspections.* http://www.maine.gov/dep/blwq/topic/invasives/inspect.htm (accessed April 12, 2009)

Maine Department of Environmental Protection. *Documented Infestations of Invasive Aquatic Plants in Maine.* http://www.maine.gov/dep/blwq/topic/invasives/doc.htm (accessed April 13, 2009).

Maine Natural Areas Program. "Bulletin #2530 Variable Leaf Milfoil." *Maine Invasive Plants.* University of Maine Cooperative Extension and Maine Department of Conservation.

Maine Office of GIS, http://megis.maine.gov/ (accessed April 13, 2009)