Factors affecting the presence of invasive buckthorn (*Rhamnus cathartica & Frangula alnus*) in Wisconsin school forests
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Introduction

Invasive species are of growing concern in the mid-west. Buckthorn is a woody perennial invasive species that outcompetes native understory plants for light and resources and greatly reduces regeneration of native tree species. Dense buckthorn patches reduce diversity of plants and insects. Previous studies have linked higher housing densities and landscape fragmentation to an increased chance of buckthorn being present in a forest. Our study looked at the presence of buckthorn in school forests and the relationship to five variables: housing density, road density, distance to nearest house, and distance to edge.
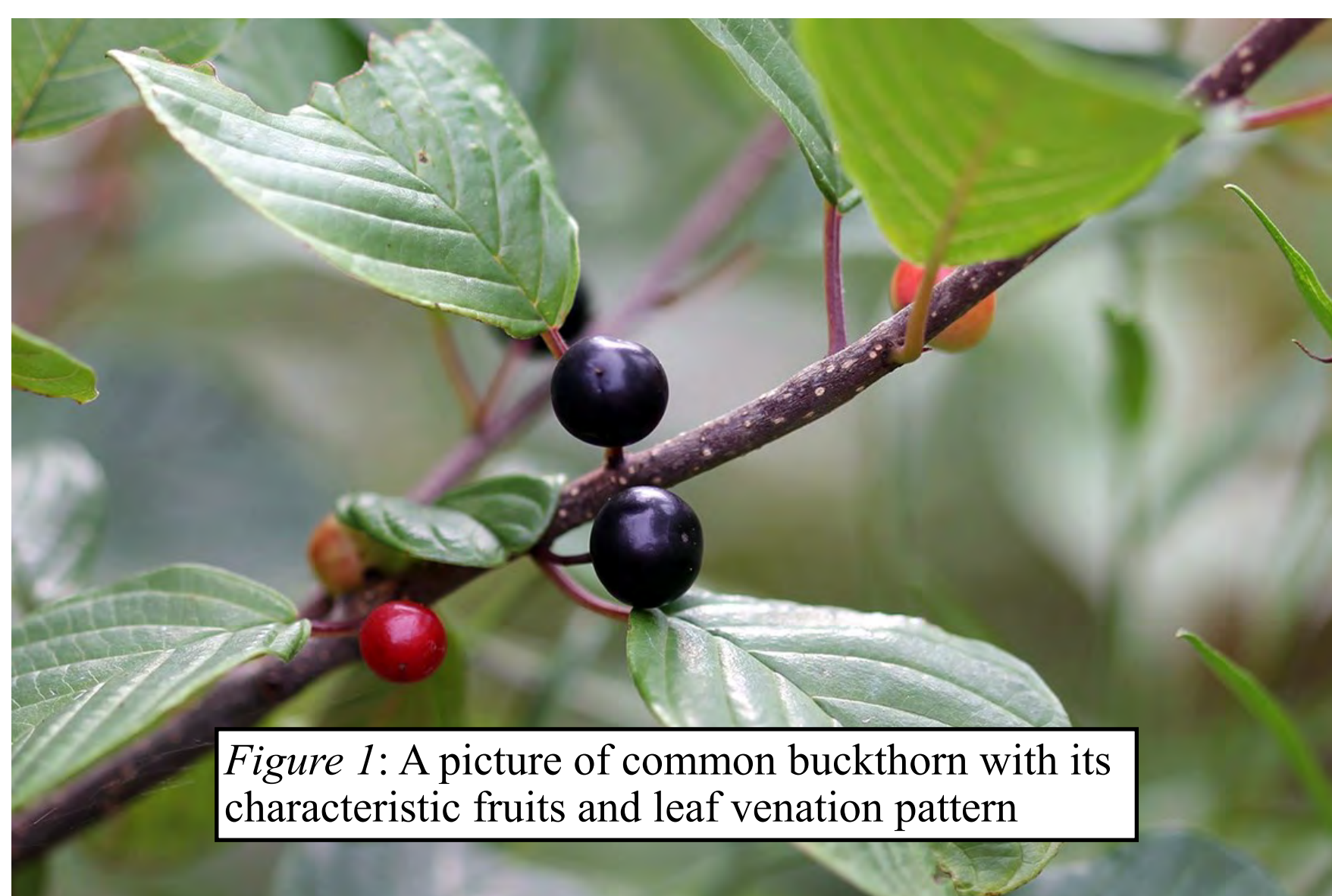
Figure 1: A picture of common buckthorn with its characteristic fruits and leaf venation pattern

Methods

We sampled 3 meter and 7 meter radius plots in 44 school forests in Wisconsin (figure 3). In the 3 meter plot we counted all buckthorn stems shorter than 1 meter, measured the diameter of all buckthorn stems taller than 1 meter, and measured the diameter of all woody species taller than 2 meters but less than 10 centimeters in diameter. In the 7 meter plot we measured the diameter of all woody plants larger than 10cm in diameter. After collecting the data we used ArcGIS Pro to analyze the data. For the average road density we used the Wisconsin Department of Transportation road data to measure the length of all roads within a 1km radius of each plot center. For the average distance to edge we used the measurement tool to measure the distance from each plot center to the perceived nearest edge of the forest. For housing density we created a point for each house that was in a parcel zoned as a "dwelling" that was within a 1km radius of each plot center. We then calculated the sum of those points. For distance to the nearest house we used the previously created dwellings data and the "near" function to find the distance to the nearest point. This data was then averaged for each school forest and separated into forests with or without buckthorn.
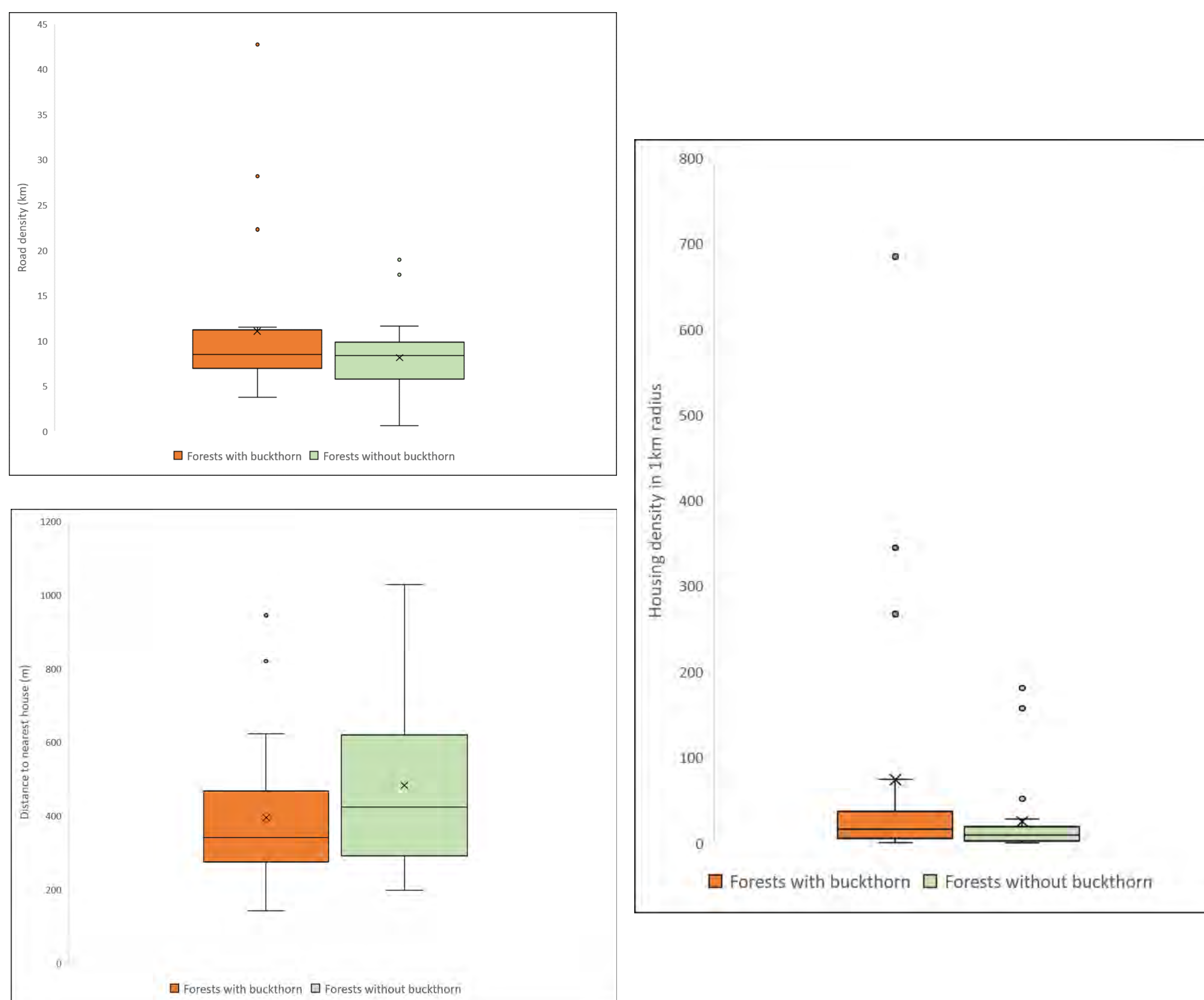
Figure 2: Box plots comparing forests with buckthorn and forests without buckthorn for four of the five variables: housing density, road density, distance to the nearest house, and solar irradiation.

Table 1: Descriptive statistics for the forests with buckthorn calculated using Microsoft Excel

	Average of Road density (km)	Average of Distance to edge (m)	Average of Distance to nearest house (m)	Average of Housing density
Mean	11.05	109.32	395.47	73.49
Median	8.46	79.54	340.45	15.92
Standard Deviation	9.03	86.22	195.43	162.18
Confidence Level(95.0%)	4.00	38.23	86.65	71.91

Table 2: Descriptive statistics for the forests without buckthorn calculated using Microsoft Excel

	Average of Road density (km)	Average of Distance to edge (m)	Average of Distance to nearest house (m)	Average of Housing density
Mean	8.12	113.27	482.83	25.00
Median	8.36	100.10	424.29	8.54
Standard Deviation	4.35	71.89	248.29	48.19
Confidence Level(95.0%)	1.93	31.87	110.08	21.37

Results

In forests with buckthorn we found that there was higher average housing density, road density, and a lower average distance to the nearest house. The distance to the nearest edge was relatively the same (109m for those with and 113m for those without).
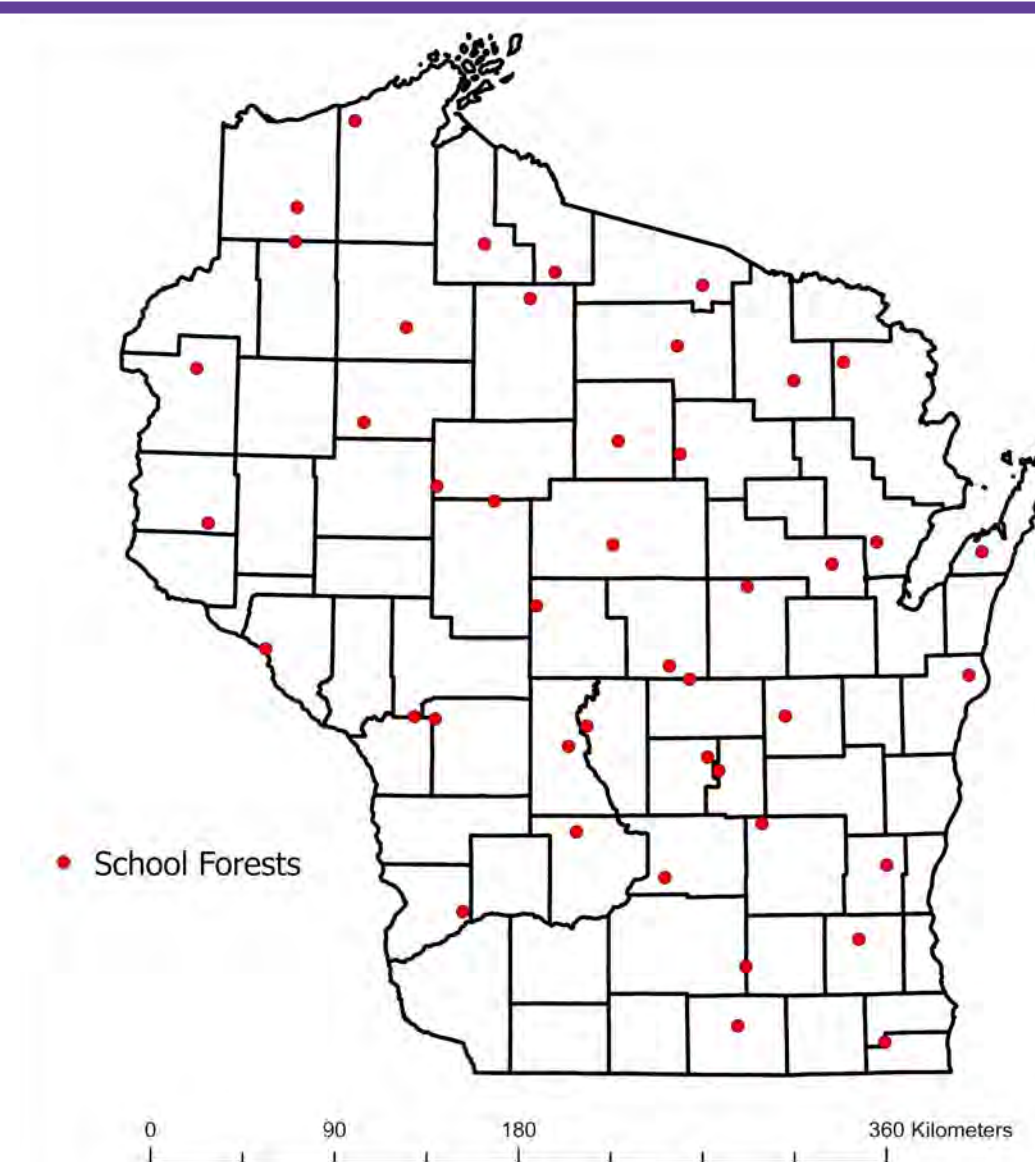
Figure 3: Map of all the school forests that were sampled for our study

Discussion and Conclusion

In forests with buckthorn four variables showed some significant difference compared to those without buckthorn: housing density, road density, and distance to the nearest house. Forests with buckthorn and the highest road and housing densities had higher amounts of buckthorn. Our results are not statistically conclusive however, they do indicate trends similar to previous studies. Future studies could collect data from forests other than school forests, conduct a regression analysis, or include more invasive species.

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