Physiological Study of Common and Glossy Buckthorn's Ability to Outcompete Native Species

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Non-native invasive species are organisms that are not historically from a certain ecosystem but have been moved there, intentionally or not, and are able to outcompete native species due to physiological advantages and lack of natural predators and diseases. In the Midwest, two such species are Common Buckthorn (*Rhaminus cathartica*) and Glossy Buckthorn (*Rhaminus frangula*). Common and Glossy Buckthorn are woody shrubs, native to Eurasia, that were brought to the United States in the 1800s as ornamental plants. Soon after arriving, however, buckthorn invaded ecosystems and overtook native species throughout the Midwest. Today, Common and Glossy Buckthorn are prevalent on Calvin's campus but can be found as far east as the Atlantic coast, as far west as the Rocky Mountains, as far north as mid-Michigan, and as far south as Tennessee. Through observation, Common Buckthorn has been categorized as a sun-loving plant which thrives in open fields and forest edges, while Glossy Buckthorn seems to prefer shaded, moist areas such as forest understories.

The goal of our research is to identify Common and Glossy Buckthorn's ideal habitats using concrete data, not just observation, and to identify physiological traits that explain their impressive rates of growth. Our results will be used to confirm or disprove the popular belief about buckthorn's ideal habitats. Our research may also be helpful in the restoration of habitats that have been affected by buckthorn and in the protection of habitats that have not.

Data was collected at four sites on Calvin's campus. Each site consisted of an area that was exposed to open sunlight and an area that was well shaded. At each location, Common and Glossy Buckthorn were present, as well as Gray Dogwood and Hawthorn, both of which are native to the area. Gray Dogwood and Hawthorn were included in the study to serve as native references to which we could compare the buckthorns. This allowed us to identify the unique traits that give Common and Glossy Buckthorn a competitive advantage over native species.

Using a LI6400-XTR Portable Photosynthesis System, we measured the rate at which each species performed photosynthesis as a function of increasing light level and increasing CO2 concentration. We also measured the concentration of chlorophyll, the molecule responsible for capturing light energy, in the leaves of each species. Lastly, the density and total area of stomata, pores in which CO2 enters leaves and oxygen exits, were determined for each species by looking at leaf peels under microscopes.

At this point, we are limited in the results we can announce as we have yet to run a statistical analysis of our data. However, the data collected last summer by Philip Simonton showed that despite popular belief, Glossy Buckthorn competes effectively with Common Buckthorn in both shaded and sun exposed habitats. We attribute this, in part, to the fact that Glossy Buckthorn has the smallest stomata and highest stomatal density of all measured species, allowing it to control its gas exchange in a unique and efficient manner.

I have benefited from this research project in many ways. First, it has helped me gain a better understanding of the research process and has given me a taste of what a future career in research could look like. Secondly, it will be a great experience to put on future job and/or graduate school applications, as knowing how to ask good questions and creating a plan to answer them are valuable skills. Lastly and most significantly, I benefited from the relationship I developed with Professor Dornbos. I had taken classes with him previously but getting to know him outside the classroom has been great. His consistent encouragement and guidance have been greatly appreciated.