Uncovering the Mechanism of Plant Invasion by Employing a Comparative Biophysical Traits Study of Exotic *(Lonicera japonica*) and Native (*Lonicera sempervirens*) Honeysuckle Species

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Abstract

Biological invasion, one of the major processes of global change is continuously rising in its intensity in the biota. With an estimated 137 billion dollar annual deficit in the U.S. alone, an urgent need to understand this change and the factors influencing its severity are essential. In this study, we attempted to answer the question of what makes exotic invasive species superior to that of their native counterpart by targeting morphological, physiological, and reproductive traits between the invasive (*Lonicera japonica*) and native (*Lonicera sempervirens*) honeysuckle species. By examining and comparing multiple traits of both species, we were able to test the hypothesis that invasive species outperform native species owing to their possession of suites of advantageous biophysical traits. Our preliminary results indicated that significant differences did exist in both leaf morphological/physiological traits and reproductive characters. We concluded that the combination of advantageous traits enables the invader to perform successfully in the invaded ecosystem. By identifying traits associated with invaders, further conservation methods can employ steps in saving native species from extinction.

Introduction

Biological invasion is considered one of the major component processes of global change; it has been identified as the second greatest threat to biodiversity after habitat loss (Mack et al., 2000; Stohlgren, 2002). Typically, invasion can change the role of native species in their communities, alter the structure and function of ecosystems, and disrupt evolutionary processes (D'Antonio and Vitousek, 1992; Williamson, 1996). How can invasive species be so detrimental? What types of traits can enable species to function this way? In this study, we attempt to answer these questions by targeting morphological, physiological, and reproductive traits of exotic invasive (*Lonicera japonica*) and native (*Lonicera sempervirens*) honeysuckle species. By examining and comparing multiple traits of both species, we are able to test the hypothesis that invasive species outperform native species owing to their possession of suites of advantageous biophysical traits. We anticipate that these advantageous traits, such as, stomatal density, leaf area, and fruit mass will provide the exotic competitor ecological advances lending to a firm establishment into its introduced range. Once established into introduced ecosystems, disruption may occur that further employs biota damage.

Materials and Methods

Leaves of both honeysuckle species were sampled during plant growing season in 2006. Leaf area and size were measured using a CI-202 Portable Leaf Area Meter (CID, Inc). Leaf biomass was determined after drying at 70^0C for 48 hours. Thirty leaf cross-section slides were prepared for each species and leaf photomicrographs were made using an Olympus CX 31 light microscope and a Nikon Coolpix 8400 digital camera. Software SigmaScan was used to quantify leaf thickness and vascular bundle size. Stomatal density was determined by counting number of stomata per m^2 using a stage micrometer for both species. Fruits and seeds of both honeysuckle species were also collected in the fall of 2006. Number of seeds per fruit was counted; fruit mass and seed length were quantified. T-test was used to determine if significant differences exist between morphological and reproductive traits of both honeysuckle species.

Results

Significant differences do exist in plant leaf morphology, and in traits directly related to plant physiology between exotic and native honeysuckle species (Figure 1). Significant differences are also found in reproductive traits including fruit mass, seed production, and seed size (Figure 2).

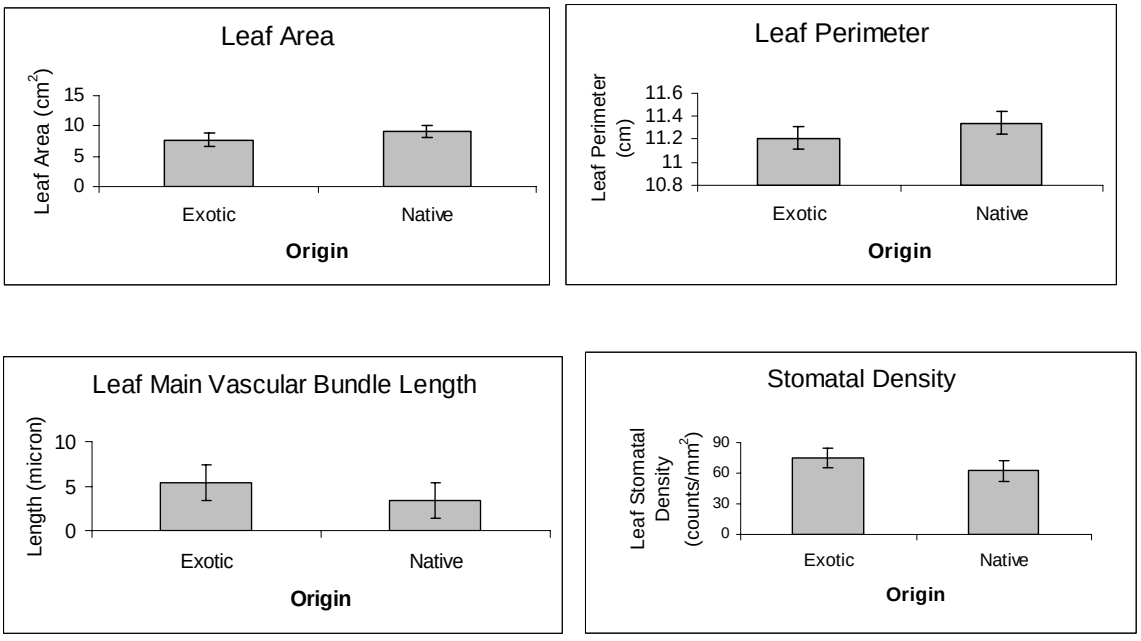

Figure 1. Leaf morphological and physiological traits are compared between exotic and native honeysuckle species. Significant differences are found in leaf area (t-test, p =

0.0067), leaf perimeter (t-test, p = 0.02), leaf main vascular bundle length (t-test, p <0.001), and stomatal density (t-test, p <0.001).

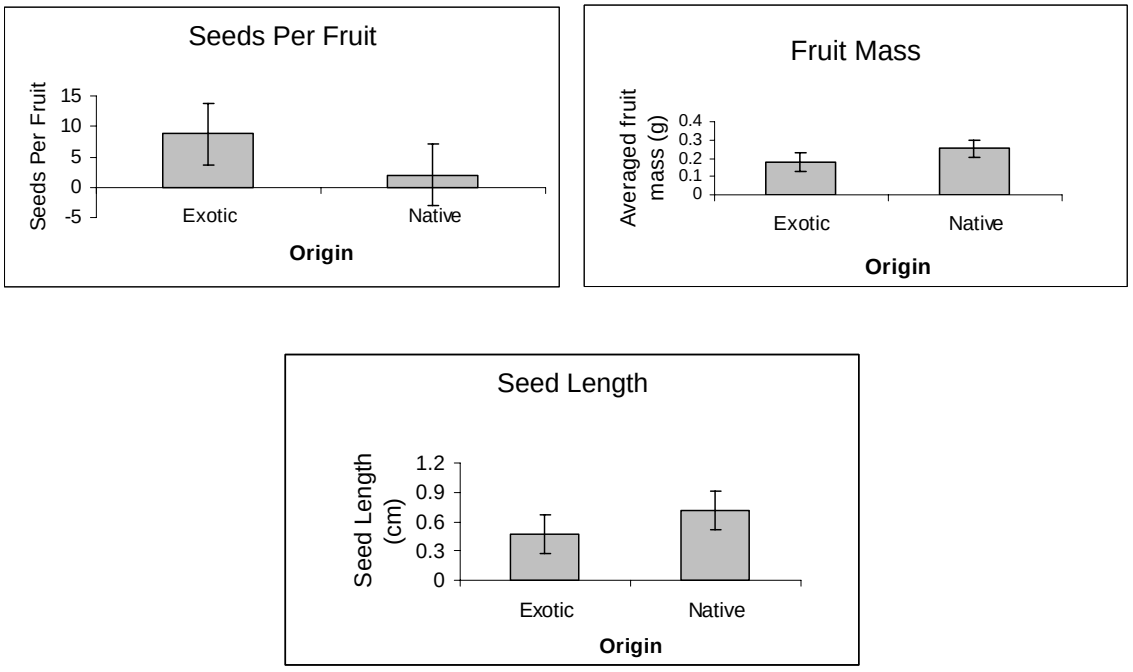

Figure 2. Reproductive traits are compared between the exotic and native honeysuckles. Significant differences are found in fruit mass (t-test, p = 0.006), seed production (t-test, p< 0.001), and seed size (t-test, p = 0.002).

Conclusion

Our results suggest that possession of suites of advantageous biophysical traits enable Japanese honeysuckle to outperform the native honeysuckle in the field. This is clearly indicated in the species' reproductive trait, such as seed production. Japanese honeysuckle has a much higher seed production per fruit than the native species during its life cycle. Results in leaf morphology allude that large leaf vascular bundles, functioning in water and food conduction, are found in Japanese honeysuckle leaves. In addition, a higher stomatal density is associated with the exotic species as well. The latter, in particular, could lead to a faster growth rate, possibly explaining why the invader has been so successful in the invaded habitats. Consequently, it might also delineate the rare occurrences of native honeysuckle in the native ecosystems as a result of interspecific competition. This project will prove valuable for the study of biological invasion and conservation management. Identified advantageous traits associated with invaders could be used as an effective criteria in assessing and predicting invasive potentials in other populations in which are currently in the initiation of introduction or possibly prior to introduction.

Literature Cited

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