

Effect of Garlic Mustard on native species' richness in southwestern Ontario

By: Harsimrat Rataul



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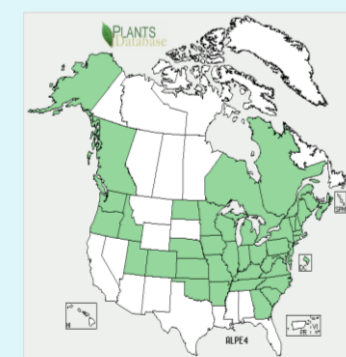
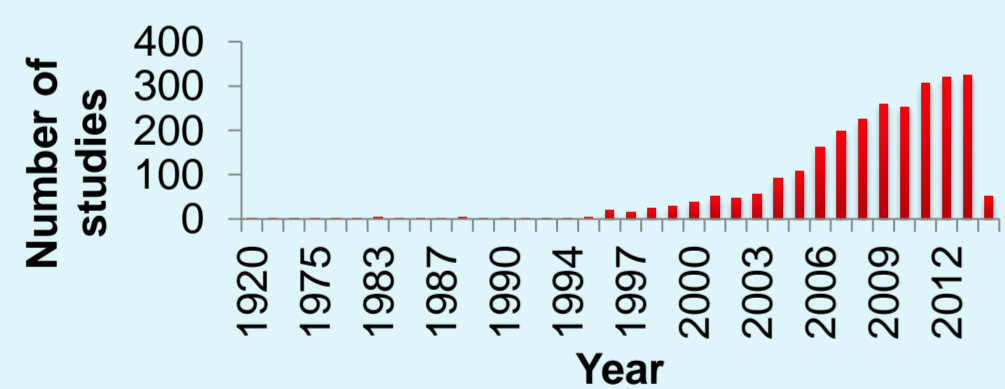
Abstract

Garlic Mustard (*Alliaria petiolata*) is an invasive plant species known for its direct and indirect impacts on the **diversity and richness of native species** in North American forests. My paper aims to assess the evidence for **whether the presence of garlic mustard is likely to be the sole or major cause of declines in native plant species richness and diversity**. Through literature review, I found that only 11 studies out of a sample of 100 studies focused on garlic mustard's long term impacts. The long term case study **data set from 1995-2009** shows correlation between garlic mustard density and plant species richness in two parks in Southwestern Ontario. The goal of this case study was to compile previous field data and to assess **whether garlic mustard density was negatively correlated with native plant species richness**.

Introduction

What is garlic Mustard and where is it located?

- Biennial flowering plant, first year = non-flowering rosette and second year = flowering plants
- Brought to North America from Europe for culinary and medicinal purposes
- First reported in Long Island, New York and at present it can be found in 34 U.S. States and 5 Canadian Provinces (see map)
- **Interest in Topic** based on Scopus database search terms: "*Alliaria petiolata*" OR "garlic mustard"



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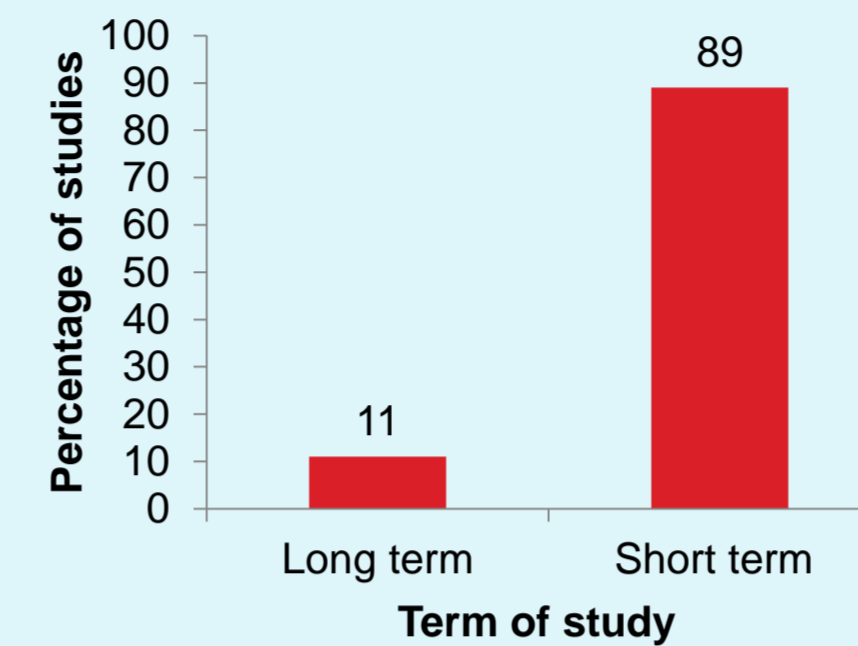
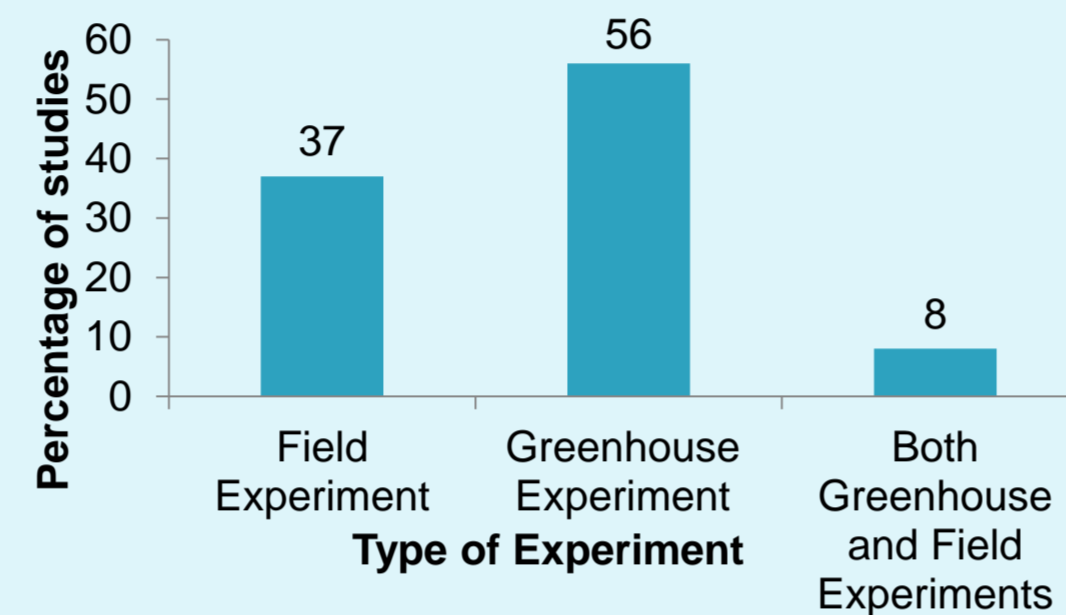
Purpose: To assess the effects of garlic mustard (*Alliaria petiolata*) on native species richness and diversity, and to quantify the relative number of long term and short term studies present in the literature.

Research Questions

1. What are some direct and indirect mechanisms used by garlic mustard to invade a forest area?
2. Is garlic mustard the sole cause of declines in the native plant species' richness and diversity?
3. Is garlic mustard density significantly correlated with native plant species richness and if so, what mechanisms described in the literature may be involved?

Methods and Results

Percentage of Long Term studies found using Web of Science™ Keywords: "Garlic Mustard" OR "*Alliaria petiolata*"



Percentage of Field Studies found using Web of Science™ Keywords: "Garlic Mustard" OR "*Alliaria petiolata*"

Literature Review Findings

- Garlic Mustard is self pollinating, has fast dispersal and habitat expansion rates
- **Enemy Release Hypothesis:** Garlic mustard left its natural predators and its generalist herbivores when it arrived in its new range
- Waller and Mass (2013) found that garlic mustard produces secondary allelochemicals that suppresses nearby native plants
- Hewins and Hyatt (2010) pointed that garlic mustard's allelochemicals disrupt belowground mutualistic relationships between mycorrhizal fungi and native plant species
- Rooney and Waller (2003) found that higher abundance of garlic mustard is associated with a decrease in nesting rate of birds that prefer to nest in the understorey habitats of forests
- Morrison and colleagues (2007) found that in areas where both garlic mustard and Japanese stilt grass were present, Japanese stilt grass outcompeted garlic mustard, with greater photosynthesis rates and overall abundance
- Control of Garlic mustard is done using herbicides containing glyphosate, prescribed burning, cutting and manual removal, use of weevils
- Deer herbivory and earthworm eruptions also facilitate GM growth

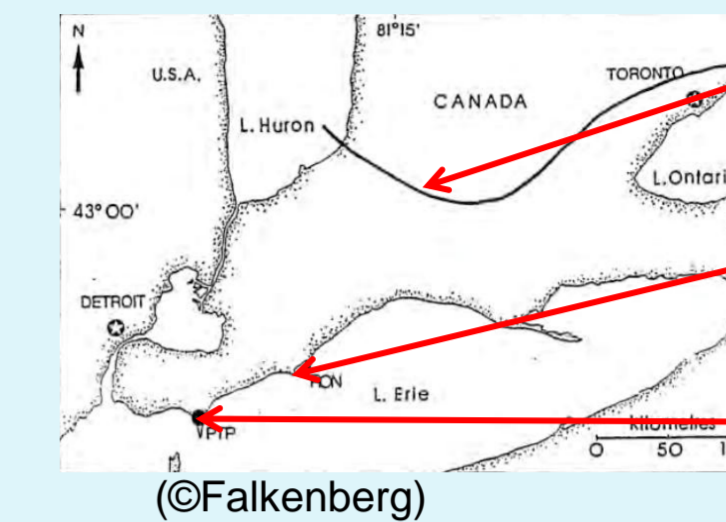


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Case Study Results



Northern Edge of the Carolinian Forest Zone

Rondeau Provincial Park

Point Pelee National Park

• **Past research** by Nancy Falkenberg (1996), Carrie Firanski (2001) shows the presence of other factors causing a decline in native species' richness. Netta Untershtats (2013) long term results show that % of plots containing garlic mustard have decreased from 1995 to 2009. No difference in the species richness of plots where garlic mustard was present and where it was absent

Table 1: Long term effect of Garlic Mustard Density on species richness at Rondeau Provincial Park and Point Pelee National Park.

Year	Correlation with species richness per m ²			
	Garlic Mustard (Rosette) Density per m ²		Garlic Mustard (Adult) Density per m ²	
	Rondeau	Point Pelee	Rondeau	Point Pelee
1995	Negative (p<0.05, r ² =0.06)	Negative (p<0.05, r ² =1.71×10 ⁻⁴)	Negative (p<0.05, r ² =0.05)	Negative (p<0.05, r ² =7.18×10 ⁻³)
1996	Negative (p<0.05, r ² =0.02)	Positive (p<0.05, r ² =7.74×10 ⁻²)	Negative (p<0.05, r ² =1.46×10 ⁻³)	Positive (p<0.05, r ² =3.83×10 ⁻³)
1997	Positive (p<0.05, r ² =4.66×10 ⁻⁴)	Negative (p<0.05, r ² =0.02)	Negative (p<0.05, r ² =2.92×10 ⁻³)	Negative (p<0.05, r ² =0.03)
2001	Negative (p<0.05, r ² =1.75×10 ⁻⁴)	Negative (p<0.05, r ² =0.05)	Negative (p<0.05, r ² =0.02)	Negative (p<0.05, r ² =4.66×10 ⁻⁴)
2009	Positive (p<0.05, r ² =0.03)	Positive (p<0.05, r ² =0.03)	Negative (p<0.05, r ² =0.03)	Positive (p<0.05, r ² =0.02)

• **Current results:** Fluctuation in correlation between garlic mustard density and species richness points towards intra-specific competition as found by Davies et. al., 2012

Conclusions

- Factors such as other invasive species also impact native species richness. Therefore, impact of other invasive species in the area should also be measured.
- There is a lack of long term, field studies and interdisciplinary studies in the literature

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