

Do you want to participate in the world's largest quantitative field study  
of an invasive plant? Join the

# Global Garlic Mustard Field Survey



It is widely believed that invasive species are larger, reproduce more and reach higher densities compared to their native ancestors. However, there are surprisingly few hard data to support this claim, even for some of the most well-known invaders. One of the most problematic invaders in North America is garlic mustard (*Alliaria petiolata*). Does garlic mustard really grow larger and reproduce better in North American populations than in native European populations? Or is this species just as 'invasive' in its native range? How much variation in performance is there among populations within Europe and North America? How does climate affect growth and reproduction? Answers to questions like these will ultimately lead to better understanding and management of invasive species.

We hope you will join our broad network of scientists, students and environmentalists from across Europe and North America to fill an important gap in data on native and introduced plant populations. This project is designed to be simple and achieved with just a few hours of work, once populations have been located (see attached instructions).

For more information, contact us at [GarlicMustard@gmail.com](mailto:GarlicMustard@gmail.com), or visit our website where you can also find a PDF version of these instructions:

<http://www.GarlicMustard.org/>

## GOALS

- Identify populations of garlic mustard. A population is loosely defined as a group of plants that grow in a similar type of habitat and are separated from other groups by at least 1 km. It can be a few scattered individuals, a dense stand that covers hundreds of square meters, or a very long strip of plants along a road. If possible, try to include at least one population in low light (e.g. forest understory), and one in high light (e.g. forest edge or roadside). Multiple populations are ideal, particularly if several populations are small (< 10m diameter). Please use only populations that contain at least 20 plant individuals.
- Collect data on plant sizes and densities.
- Identify and measure first-year rosettes and second-year flowering adults separately (See page 3 for photos).
- Collect seeds for potential future experiments.

## MATERIALS

GPS unit, 2 meter sticks (or yard sticks), tape measure, 20 large paper envelopes (C5 or C4/Letter-sized ones will do), pencil (ink will smear if wet), digital camera. A hand counter is also helpful if you have one. If you do not have access to a GPS unit, you can download and use GoogleEarth (<http://earth.google.de/>) to locate your sites and estimate latitude, longitude and altitude.

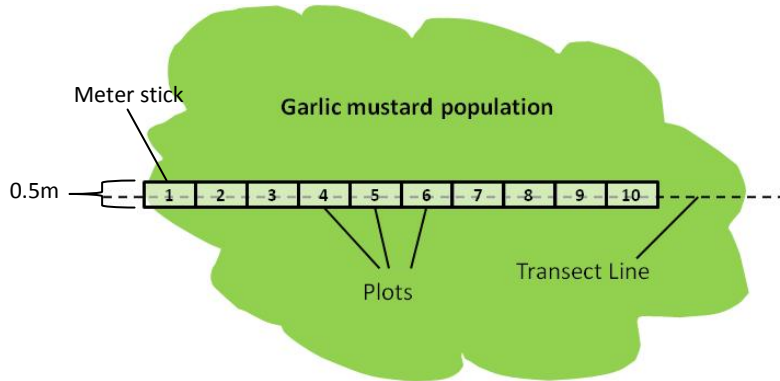
## METHOD

Locate populations in spring/early summer. The species is easily recognized by its distinctive leaf shape and growth form (see next page for pictures), as well as a garlic-like odor from crushed leaves. In North America, county weed agents are an excellent source of locality information. In Europe, garlic mustard is a common road-side and understory plant, and is likely to be encountered when driving around most rural areas. Local naturalists are also likely to be able to provide specific information.

Return to each population in mid to late summer, when plants have ripe fruits and most plants have finished flowering. For each population (using copies of the data collection sheet on page 4):

1. Record your name, email address, and the collection date.
2. Give the population a unique code: your initials and a unique number for each population, as well as a 3-letter code based on the closest town (so if your name is John Doe and you do two populations near New York City, the codes would be JDNYC1 and JDNYC2).
3. Record latitude and longitude from GPS (use degrees/minutes/seconds format as in Google Earth).
4. Record whether the population is understory, forest edge, roadside, or other (specify)
5. Estimate population area – Approximate extent of area with garlic mustard in m<sup>2</sup> (1m<sup>2</sup> = 10.7639ft).
6. Find the widest part of the population (see **Fig. 1**). Following a transect line through the center of the population, create the first plot by laying two parallel meter sticks 50 cm (20") apart, outlining two sides of a 1 m (1 yard) by 50 cm (20") rectangle. Create the next plot end-to-end with the previous one by moving the meter sticks towards the center of the population. Repeat this until either the other side is reached, or 10 plots have been measured.
7. Take one good picture of the population that gives a sense of approximate size and average density. Then take three photographs of the forest canopy/sky (i.e. photograph vertically upwards) while standing at the edge (0m), 5m and 10m along the transect. The purpose of sky photos is to quantify shading by trees. At the 5m plot, visually estimate % of open sky (see **Fig. 3**). If possible, burn photos

to a CD or DVD and mail along with the seed samples. Make sure you include the population code in the file name (and '0m', '5m', or '10m' for the canopy pictures).



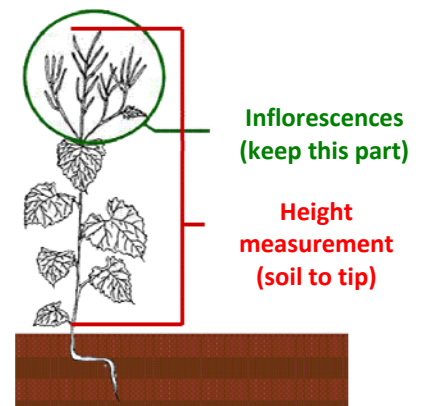
**Fig. 1:** Schematic of the sampling design

8. In each plot, count the total number of rosettes (juveniles) and adult plants, then determine the number of each that have fungus on their leaves. A rosette is a collection of leaves attached to the same spot on the ground (see **Fig. 4**), while an adult plant has a long stem with leaves, flowers or fruits coming out of it (see **Fig. 5**). Fungus looks like a powder on the leaf surface (see **Fig. 6**).
9. In each plot, beginning at 0 cm and every 20 cm (7.2 inches) thereafter up to 80 cm (1 yard) do the following: (i) Find the rosette closest to either meter stick and measure its diameter. (ii) Find the closest adult plant, measure its height (see **Fig. 2**) and count the number of fruits, (a hand-counter is helpful here). (iii) For the adult plant, count the total number of leaves and the number of leaves with significant herbivory damage or fungus growth (i.e. at least 10% of leaf area damaged). Do not enter the same measurements on the same plant more than once; if plants are too sparse in a plot to fulfill all measurements, it is OK to have positions on the datasheet blank.
10. In each population, remove the complete inflorescences (including stem and pods; see **Fig. 2**) of the first 20 adult plants you are measuring, and store them in paper envelopes. Label each envelope with your printed name, and a code that uniquely identifies **year**, population, plot and plant position:

2010 JDNYC1-3-20

Population code from step 2
Plot within population
Plant at 20 cm position within plot

**Fig. 2:** Diagram of adult (2<sup>nd</sup> year)



In small

populations, if there < 20 fruiting adult plants along the transect, collect additional inflorescences from unmeasured plants if available. Label these plants as JDNYC1-x1, JDNYC1-x2, etc.

11. Enter the data online: [http://www.GarlicMustard.org/data\\_entry.html](http://www.GarlicMustard.org/data_entry.html)
12. Keep all seed envelopes together with the datasheet and store in a dry location at room temperature. After drying 1-2 weeks, mail the photos and seeds to either of these addresses:  
**(North America)** Steve Franks, 441 E Fordham Rd, Department of Biology, Fordham university, Bronx, NY 10458  
**(Europe)** Oliver Bossdorf, Institute of Plant Sciences, University of Bern, Altenbergrain 21, CH-3013, Bern, Switzerland
13. Congratulations, once we receive the seeds and verify the data you will be an official Global Garlic Mustard Field Survey contributor!



60% canopy cover

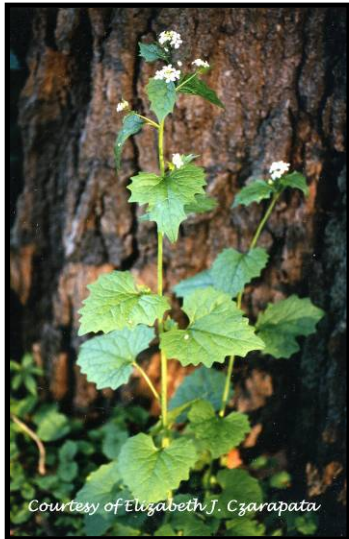


90% canopy cover



**Fig. 3:** Estimating canopy cover

**Fig. 4:** First year rosette diameter



Second-year adult plant,  
flowering



Very ripe pods  
(pod = fruit)

**Fig. 5:** Adult plants  
*left:* too early to sample  
*right:* ready to sample



**Fig. 6:** Scoring leaf herbivory and  
fungus  
*top:* holes made by a herbivore  
*bottom:* white fungus

# Global Garlic Mustard Field Survey - Data Sheet (Use one for each population)

Collector Name \_\_\_\_\_ Collector Email \_\_\_\_\_ Date \_\_\_\_\_ Pop Code \_\_\_\_\_

Lat \_\_\_\_\_ Long \_\_\_\_\_ Alt (m) \_\_\_\_\_ Pop Size (m<sup>2</sup>) \_\_\_\_\_ Estimated % cover in Plot 5: \_\_\_\_\_

Population type:  Forest understory  Forest edge  Roadside  Other (please specify) \_\_\_\_\_

Plot 1		# Adult plants Total:		With Fungus:		
		# Rosettes Total:		With Fungus:		
Pos.	Rosette Width	Adult Height	Adult # Fruits	# Leaves		
				Total	Eaten	Fungus
0 cm						
20 cm						
40 cm						
60 cm						
80 cm						

Plot 6		# Adult plants Total:		With Fungus:		
		# Rosettes Total:		With Fungus:		
Pos.	Rosette Width	Adult Height	Adult # Fruits	# Leaves		
				Total	Eaten	Fungus
0 cm						
20 cm						
40 cm						
60 cm						
80 cm						

Plot 2		# Adult plants Total:		With Fungus:		
		# Rosettes Total:		With Fungus:		
Pos.	Rosette Width	Adult Height	Adult # Fruits	# Leaves		
				Total	Eaten	Fungus
0 cm						
20 cm						
40 cm						
60 cm						
80 cm						

Plot 7		# Adult plants Total:		With Fungus:		
		# Rosettes Total:		With Fungus:		
Pos.	Rosette Width	Adult Height	Adult # Fruits	# Leaves		
				Total	Eaten	Fungus
0 cm						
20 cm						
40 cm						
60 cm						
80 cm						

Plot 3		# Adult plants Total:		With Fungus:		
		# Rosettes Total:		With Fungus:		
Pos.	Rosette Width	Adult Height	Adult # Fruits	# Leaves		
				Total	Eaten	Fungus
0 cm						
20 cm						
40 cm						
60 cm						
80 cm						

Plot 8		# Adult plants Total:		With Fungus:		
		# Rosettes Total:		With Fungus:		
Pos.	Rosette Width	Adult Height	Adult # Fruits	# Leaves		
				Total	Eaten	Fungus
0 cm						
20 cm						
40 cm						
60 cm						
80 cm						

Plot 4		# Adult plants Total:		With Fungus:		
		# Rosettes Total:		With Fungus:		
Pos.	Rosette Width	Adult Height	Adult # Fruits	# Leaves		
				Total	Eaten	Fungus
0 cm						
20 cm						
40 cm						
60 cm						
80 cm						

Plot 9		# Adult plants Total:		With Fungus:		
		# Rosettes Total:		With Fungus:		
Pos.	Rosette Width	Adult Height	Adult # Fruits	# Leaves		
				Total	Eaten	Fungus
0 cm						
20 cm						
40 cm						
60 cm						
80 cm						

Plot 5		# Adult plants Total:		With Fungus:		
		# Rosettes Total:		With Fungus:		
Pos.	Rosette Width	Adult Height	Adult # Fruits	# Leaves		
				Total	Eaten	Fungus
0 cm						
20 cm						
40 cm						
60 cm						
80 cm						

Plot 10		# Adult plants Total:		With Fungus:		
		# Rosettes Total:		With Fungus:		
Pos.	Rosette Width	Adult Height	Adult # Fruits	# Leaves		
				Total	Eaten	Fungus
0 cm						
20 cm						
40 cm						
60 cm						
80 cm						

**After completing this survey, please enter the data online at:  
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Collector Name \_\_\_\_\_ Collector Email \_\_\_\_\_ Date \_\_\_\_\_ Pop Code \_\_\_\_\_

Lat \_\_\_\_\_ Long \_\_\_\_\_ Alt (m) \_\_\_\_\_ Pop Size (m<sup>2</sup>) \_\_\_\_\_ Estimated % cover in Plot 5: \_\_\_\_\_

Population type:  Forest understory  Forest edge  Roadside  Other (please specify) \_\_\_\_\_

Plot 1		# Adult plants Total:		With Fungus:		
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		# Rosettes Total:		With Fungus:		
Pos.	Rosette Width	Adult Height	Adult # Fruits	# Leaves		
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20 cm						
40 cm						
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80 cm						

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Pos.	Rosette Width	Adult Height	Adult # Fruits	# Leaves		
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		# Rosettes Total:		With Fungus:		
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