



## Norway maple (*Acer platanoides*) invasion of a natural forest stand: understory consequence and regeneration pattern

Patrick H. Martin

Department of Natural Resources, Fernow Hall, Cornell University, Ithaca, NY 14853, USA  
(e-mail: phm3@cornell.edu; fax: +1-607-255-0349)

Received 12 March 1999; accepted in revised form 9 September 1999

**Key words:** *Acer platanoides*, *Acer saccharum*, biodiversity, competition, invasive species, regeneration, understory

### Abstract

Norway maple (*Acer platanoides*) is invasive in a natural stand in suburban Ithaca, NY. To determine the understory pattern and consequences of a Norway maple invasion, I compared density and species richness under Norway maples and sugar maples (*Acer saccharum*). Mean sapling density was significantly lower ( $P < 0.0027$ ) under Norway maples ( $3.64/100 \text{ m}^2 \pm 1.6 \text{ SE}$ ) than under sugar maples ( $19.4/100 \text{ m}^2 \pm 4.4 \text{ SE}$ ). Mean sapling species richness was significantly lower ( $P < 0.0018$ ) under Norway maples ( $0.7/32 \text{ m}^2 \pm 0.18 \text{ SE}$ ) than under sugar maples ( $2.6/32 \text{ m}^2 \pm 0.48 \text{ SE}$ ). Likewise, Norway maple regeneration is more frequent under sugar maples than sugar maple regeneration: 57% of sugar maple plots had Norway maple saplings while 0% of Norway maple plots had sugar maple saplings. Two significant plot effects were found for presence–absence: Norway maple saplings grow under Norway maples with a significantly lower frequency ( $P < 0.03$ ) than under sugar maples; sugar maple saplings grow under Norway maples with a significantly lower frequency ( $P < 0.000$ ) than under sugar maples. Across the site, Norway maple saplings were the most abundant (29 saplings for  $480 \text{ m}^2$ ). The success of Norway maple regeneration and the reductions in total stem density beneath Norway maples is most likely the result of its strong competitive abilities, notably its high shade tolerance and abundant seed crops.

Plant invaders can alter community structure and composition (Cronk and Fuller 1995). One invader, the exotic Norway maple (*Acer platanoides*), has been shown to be a problematic tree, capable of dominating some forest stands (Sachse 1988; James and McFadden 1993; Webb and Kaunzinger 1993). Norway maple combines robust growth with a high shade tolerance (Nowak and Rowntree 1990; Kloeppel and Abrams 1995) making its potential impacts considerable. Indeed, it may displace native flora as it invades, especially in the understory where it casts deep shade (Webb and Kaunzinger 1993; Wyckoff and Webb 1996). Only one study (Wyckoff and Webb 1996), however, has examined the potential community impacts or understory pattern of a Norway maple invasion. Given such limited research, uncertainty remains over

the seriousness of Norway maple (George Safford Torrey Herbarium 1996). Further evidence of deleterious changes in community structure and composition from Norway maple invasions may help resolve this uncertainty. Establishing to what degree Norway maple lowers biodiversity is important especially as ecological functions (e.g., decomposition) are thought associated with species richness (Mooney et al. 1996). This study aims to bolster our understanding of how a Norway maple invasion can impact plant communities and examine the pattern in which it spreads. Such knowledge may inform our conservation priorities and improve our predictive ability of Norway maple's potential impact on forest communities.

Understory dynamics are where future community development is primarily shaped (Pacala 1996) and

where many community changes may first be detected, like shifts in seedling abundance and diversity. To examine the impacts of a Norway maple invasion, I compared the distribution, abundance and species richness of the understory – seedlings and saplings – beneath the exotic Norway maple and the native sugar maple (*Acer saccharum*). I tests for differences in: (1) total understory densities (# stems/area) in Norway maple understory plots vs sugar maple understory plots, (2) total species richness (# species/area) in Norway maple understory plots vs sugar maple understory plots, and (3) species-specific regeneration patterns in Norway maple understory plots vs sugar maple understory plots. If significant differences between Norway maple and sugar maple understories can be detected, it will suggest that Norway maple is not only invasive but can influence community-level structure and composition as well. Comparison between Norway maple and sugar maple regeneration success is important too, for concern exists that Norway maple displaces sugar maple as it invades (Webb and Kaunzinger 1993).

### Site description

The study site is a small wooded area (5 ha) on a west-facing slope in suburban Ithaca, New York. The site is surrounded by street trees comprised primarily of Norway maple, sugar maple, honey locust (*Gleditsia triacanthos*) and tree-of-heaven (*Ailanthus altissima*) as well as common yard shrubs (e.g., *Ligustrum vulgare*, *Lonicera* spp., *Euonymus alata*). The site is moderately to steeply sloped, approximately 15°. The soils are excessively drained, slight acidic, very rocky shale with an irregular leaf litter (USDA Soil Survey 1965).

To survey the site composition, 15 circular 100 m<sup>2</sup> plots were spaced at a 50 m interval on a 180° bearing started at random coordinates. Only the site interior was sampled; all area within 25 m of the edge was excluded to lessen edge effects. In each plot, all live trees ( $\geq 5$  cm DBH) were identified and measured and all canopy Norway maples and sugar maples were cored with an increment borer at 25 cm above the ground to estimate age. A canopy individual is defined as a tree which has at least part of its top foliage (the crown) in direct sunlight. In plots with less than three Norway maples and sugar maples combined, the largest diameter trees of other species were cored. In addition, the ten largest Norway maples and sugar maples across the site were cored to estimate initial time of establishment. In circular 32 m<sup>2</sup> nested subplots, all saplings ( $\geq 50$  cm in height,  $< 5$  cm DBH) were identified and counted.

### Site characteristics

A total of ten tree species were sampled. Other species noted but not present in the sample area: *Ailanthus altissima*, *Prunus avium*, *Quercus rubra* and *Ulmus americana*. Eleven species of saplings were sampled. Mean basal area for the site was 23.2 m<sup>2</sup>/ha ( $\pm 5.76$  standard error (SE)) and mean density was 893 stems/ha ( $\pm 199$  SE). Norway maple was the most prominent species in the site, comprising 40% of stem density (353/ha) and 36% of basal area (8.22 m<sup>2</sup>/ha), while sugar maple was second with 29% of stem density (260/ha) and 24% of basal area (5.59 m<sup>2</sup>/ha) (Table 1). For the total sample area (1500 m<sup>2</sup>), size class distribution was similar between Norway maple

Table 1. Forest composition for 5 ha hillslope forest: density and dominance information for live stems DBH  $\geq 5$  cm from 15 random sampled circular 100 m<sup>2</sup> plots.

Species	Density (#/ha)	Relative density (%)	Mean DBH (cm)	Basal area (m <sup>2</sup> /ha)	Relative dominance (%)	Importance value (%)
<i>Acer negundo</i>	20	2	16.9	0.60	3	2
<i>Acer platanoides</i>	353	40	14.9	8.22	36	38
<i>Acer saccharum</i>	260	29	13.4	5.59	24	27
<i>Celtis occidentalis</i>	93	11	13.8	1.56	7	9
<i>Fraxinus americana</i>	20	2	26.3	1.33	6	4
<i>Gleditsia triacanthos</i>	27	3	32.3	2.28	10	6
<i>Prunus serotina</i>	27	3	29.6	2.02	9	6
<i>Rhamnus catharticus</i>	67	8	10.2	0.58	2	5
<i>Robinia pseudoacacia</i>	13	2	24.1	0.46	2	2
<i>Tilia americana</i>	7	1	28.9	0.44	2	1
Total	887	100	21.0	23.07	100	100

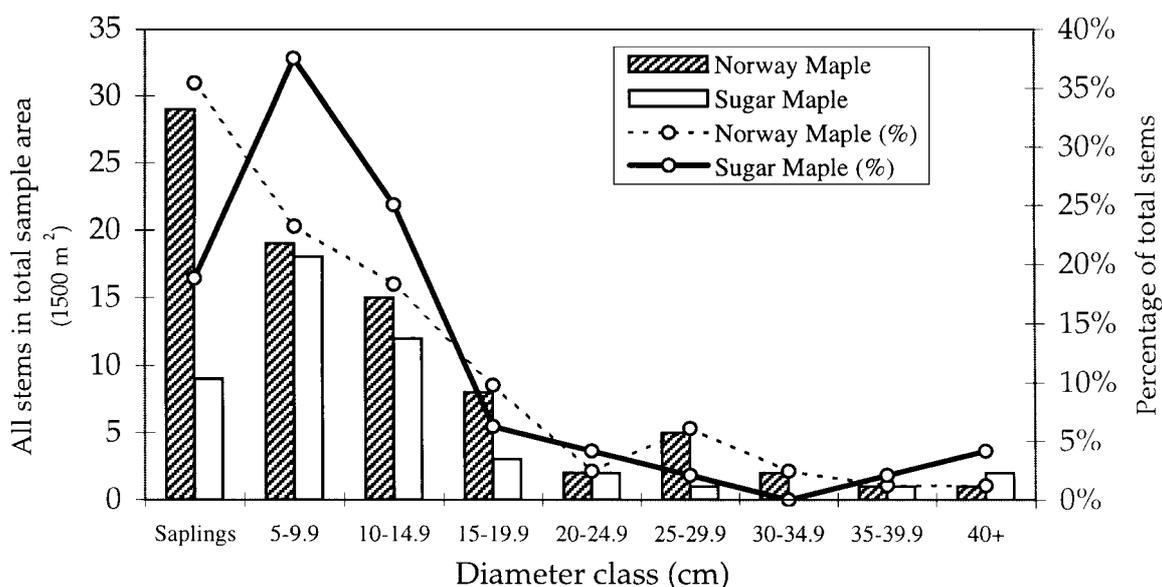


Figure 1. Size class distribution comparison between Norway maple and sugar maple. Bar graphs represent stem totals by size class and species. Line graphs represent the percentage of total by size class and species.

and sugar maple except for saplings where Norway maple had 29 saplings (31% of total) to sugar maple's 9 saplings (10%) (Figure 1). Other notable species were hackberry with 28 saplings (*Celtis occidentalis*), black cherry (*Prunus serotina*), honey locust, and white ash (*Fraxinus americana*). Tree cores suggest that the oldest trees in the site are approximately 100 years old. The three oldest trees were sugar maples (91, 96, 99), the oldest with a DBH of 102 cm. The average age of canopy sugar maples was 79 years ( $\pm 7.6$  SE) and canopy Norway maples averaged 59 years ( $\pm 6.3$  SE).

## Methods

To sample the understory, a second set of circular 100 m<sup>2</sup> plots was placed. All canopy-level Norway maples in the site were identified and numbered, and a random sample of seven were selected to be Norway maple plots. Plots were centered on the trunk of the tree. All live trees ( $\geq 5$  cm DBH) in the plot were identified and measured. Saplings were sampled as above. Three circular 3.14 m<sup>2</sup> nested subplots were placed 3 m from the plot center on radii at 90°, 210°, and 330° to identify and to count seedlings (< 50 cm height). The time of year (November) precluded sampling herbaceous

plants. Sugar maples were used as the comparison to Norway maples. Seven sugar maples were sampled identically, except that sugar maple plots which contained canopy Norway maples were excluded to isolate effects. Sugar maples were selected for comparison to reduce the likelihood of detecting understory shifts due to natural successional processes (i.e., understory densities under a classic 'early successional' tree such as *Liriodendron tulipifera* are normally higher than under a native shade-tolerant tree (Oliver and Larson 1996)). Rather, the understory patterns of the exotic Norway maple are highlighted against a native species, sugar maple, with similar life-history traits (e.g., longevity, shade tolerance) providing a good standard with which to compare understory patterns. Moreover, it is thought that Norway maple displaces sugar maple as it invades (Webb and Kaunzinger 1993); if true, this comparison provides a realistic estimate of the quantitative changes in understory pattern accompanying the displacement of sugar maple with Norway maple. Another study (Wyckoff and Webb 1996) also used *Fagus grandifolia* to compare with Norway maple, but it was not used here for it does not occur at this site. The data were analyzed using two-sample independent *t*-tests ( $P < 0.05$ ) and chi-square test-of-independence ( $P < 0.05$ ) with the statistical software Minitab (1998).

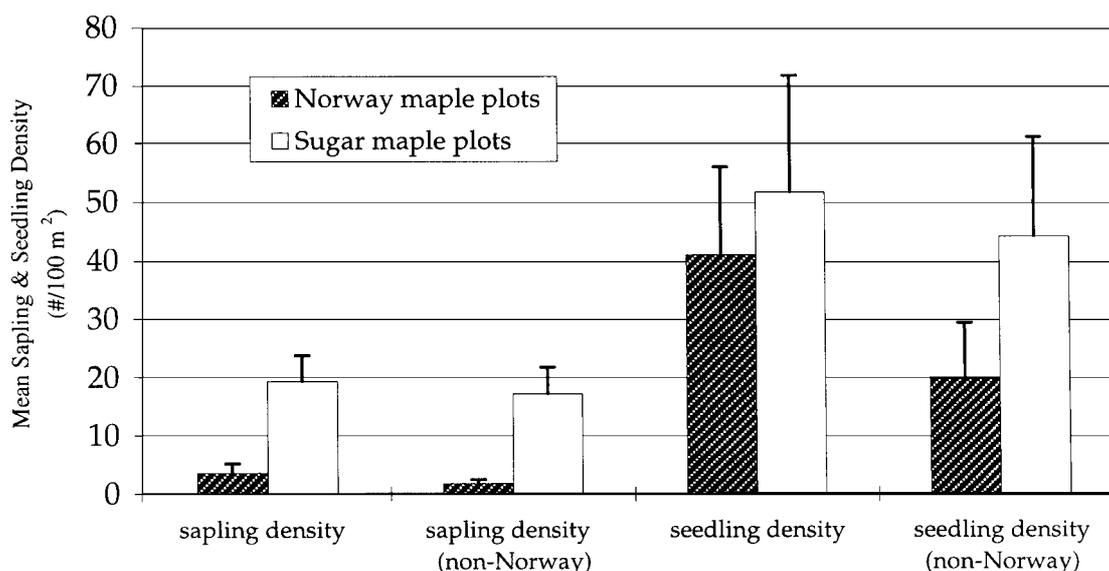


Figure 2. Comparison of mean understory densities (#/100 m<sup>2</sup>) in Norway maple and sugar maple subplots. Bars represent one standard error. 'Non-Norway' categories are calculated with Norway maple data removed.

## Results

Mean basal area per plot was much higher in sugar maple plots (29.7 m<sup>2</sup>/ha ± 3.3 SE) than Norway maple plots (15.8 m<sup>2</sup>/ha ± 3.0 SE). Calculations of density for saplings and seedlings were expanded to 100 m<sup>2</sup> to aid comparison. Mean density (# stems/100 m<sup>2</sup>) of saplings was significantly lower ( $P < 0.0027$ ) in Norway maple plots (3.64/100 m<sup>2</sup> ± 1.6 SE) than sugar maple plots (19.4/100 m<sup>2</sup> ± 4.4 SE) (Figure 2; Table 2, #1). Seedling density was insignificantly lower ( $P < 0.34$ ) in Norway maple plots (40.9/100 m<sup>2</sup> ± 14.5 SE) than sugar maple plots (51.6/100 m<sup>2</sup> ± 19.8 SE). When densities of all non-Norway maple seedlings are compared, the mean drops to 19.7/100 m<sup>2</sup> under Norway maple 44.0/100 m<sup>2</sup> under sugar maple, but the comparison remains insignificant ( $P < 0.12$ ).

A total of seven understory woody plant species were encountered in all Norway maple and sugar maple subplots (Table 3). For saplings, a total of only two species (29%) grew in Norway maple plots while a total of seven species (100%) grew in sugar maple plots. For seedlings, a total of three species (43%) grew in Norway maple plots while a total of seven species (100%) grew in sugar maple plots. Mean sapling species richness was significantly lower ( $P < 0.0018$ ) in Norway maple plots (0.7/32 m<sup>2</sup> ±

Table 2. Comparisons of mean understory density and species richness in Norway maple plots and sugar maple plots. Density units # stems/100 m<sup>2</sup>. Sapling species richness units: # species/32 m<sup>2</sup>. Seedling species richness units: # species/9.4 m<sup>2</sup>.  $P$ -values calculated with two-sample independent  $t$ -tests ( $P < 0.005$ ). 'Non-Norway' categories are calculated with Norway maple data removed

	Norway plots	Sugar plots	$P$ -values ≤
1a. Sapling density	3.6	19.5	0.0027
1b. Sapling density (non-Norway)	1.8	17.2	0.003
2a. Seedling density	40.9	51.6	0.34
2b. Seedling density (non-Norway)	19.7	44.0	0.12
3a. Sapling species richness	0.7	2.6	0.0018
3b. Sapling species richness (non-Norway)	0.6	2.0	0.0058
4a. Seedling species richness	1.3	2.1	0.17
4b. Seedling species richness (non-Norway)	0.7	1.6	0.061

0.18 SE) than in sugar maple plots (2.6 species/32 m<sup>2</sup> ± 0.48 SE) (Figure 3). Mean seedling species richness was insignificantly lower ( $P < 0.17$ ) in Norway maple plots (1.28 species/9.4 m<sup>2</sup> ± 0.36 SE) than sugar maple plots (2.14 species/9.4 m<sup>2</sup> ± 0.62 SE) (Figure 3; Table 2, #4a). When only non-Norway maple

Table 3. Understory composition and percentage of understory subplots with at least one (presence-absence) species-specific individual. Sapling subplots each 32 m<sup>2</sup>. Seedling subplots each 9.4 m<sup>2</sup>.

All species	Saplings (%)		Seedlings (%)	
	Norway maple subplots	Sugar maple subplots	Norway maple subplots	Sugar maple subplots
<i>Acer platanoides</i>	14	57	57	43
<i>Acer saccharum</i>	0	86	14	43
<i>Celtis occidentalis</i>	56	14	29	14
<i>Fraxinus americana</i>	0	13	0	14
<i>Ligustrum vulgare</i>	0	12	28	40
<i>Prunus serotina</i>	0	28	0	43
<i>Rhamnus catharticus</i>	0	42	0	0

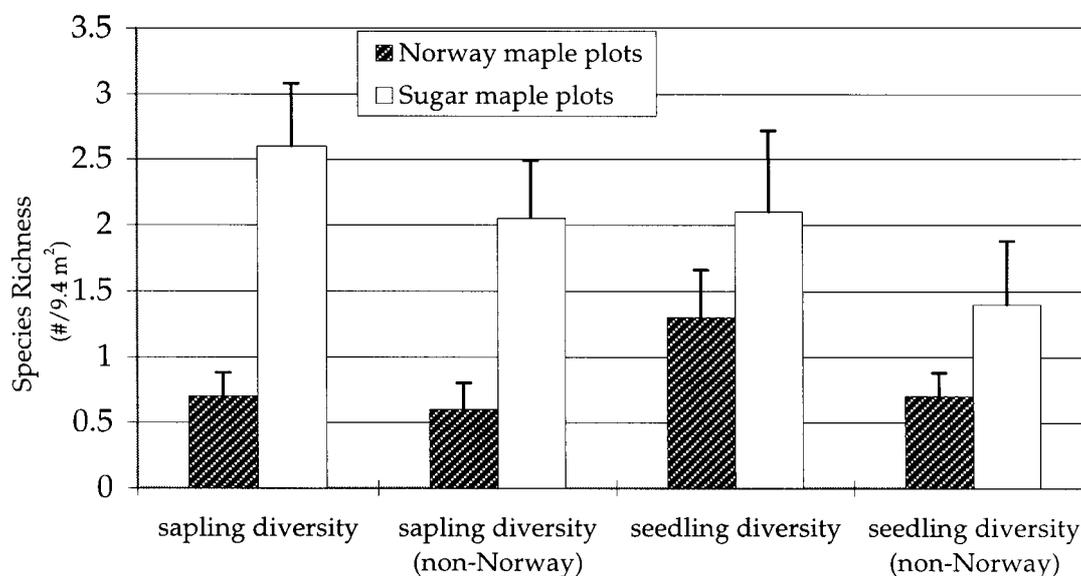


Figure 3. Comparison of mean species richness in Norway maple subplots and sugar maple subplots. Saplings units: # species/32 m<sup>2</sup>. Seedling units: # species/9.4 m<sup>2</sup>. Bars represent one standard error. 'Non-Norway' categories are calculated with Norway maple data removed.

seedling species are compared, the results are stronger (0.7 species/9.4 m<sup>2</sup> ± 0.18 SE to 1.6 species/9.4 m<sup>2</sup> ± 0.48 SE) but remain insignificant ( $P < 0.061$ ). These results suggest that sugar maple supports a more species rich sapling understory.

The pattern of Norway maple and sugar maple understory colonization was pronounced (Figure 4). Norway maple saplings occurred far more frequently under sugar maples than sugar maple did under Norway maples: 57% of sugar maple plots had at least one (presence-absence) Norway maple sapling (mean 2.2 saplings/100 m<sup>2</sup> ± 0.87 SE; Table 4) while no sugar maple saplings were found in any Norway maple plots

(Table 3). This was similar for seedlings: 43% of sugar maple plots has at least one Norway maple seedling (mean 7.6 seedlings/100 m<sup>2</sup> ± 3.8 SE) while only 14% of Norway maple plots had at least one sugar maple seedling (mean 1.5 seedlings/100 m<sup>2</sup> ± 1.5 SE). Intraspecifically, sugar maple regeneration occurred more frequently under itself than Norway maple regeneration under itself: 86% of sugar maple plots had at least one sugar maple sapling (mean 8.5 saplings/100 m<sup>2</sup> ± 2.6 SE) while only 14% of Norway maple plots had at least one Norway maple sapling (mean 1.8 saplings/100 m<sup>2</sup> ± 1.8 SE) (Table 3). Two significant plot effects were found for

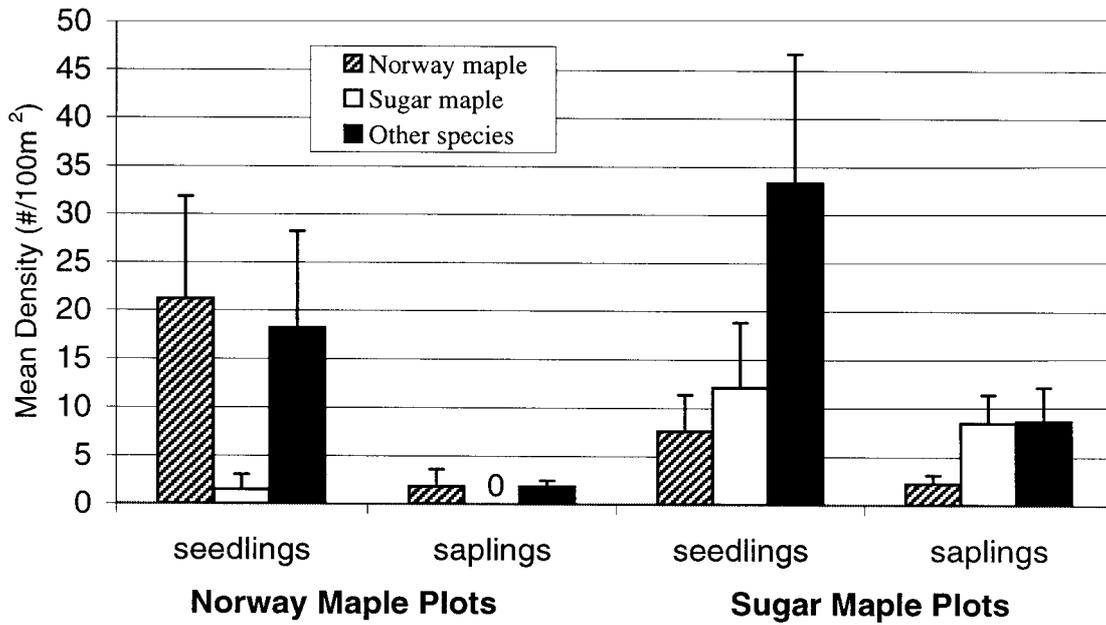


Figure 4. Species-specific regeneration patterns under Norway maple and sugar maple plots. Sapling and seedling densities are expanded to # stems/100 m<sup>2</sup> to aid comparison.

Table 4. Comparison of mean species-specific understory densities (#/100 m<sup>2</sup>) in Norway maple subplots and sugar maple subplots. Sapling and seedlings densities are expanded to # stems/100 m<sup>2</sup> to aid comparison. *P*-values calculated with two-sample independent *t*-tests (*P* < 0.005).

	Norway maple plots	Sugar maple plots	<i>P</i> -values
<b>Seedlings</b>			
Norway maple	21.2	7.6	0.12
Sugar maple	1.5	12.1	0.075
Other species	18.2	33.3	0.19
<b>Saplings</b>			
Norway maple	1.8	2.2	0.59
Sugar maple	0	8.5	0.007
Other species	1.8	8.7	0.043

presence-absence: Norway maple saplings grow under Norway maples with a significantly lower frequency (*P* < 0.03) than under sugar maples; sugar maple saplings grow under Norway maples with a significantly lower frequency (*P* < 0.000) than under sugar maples. If the seedling-to-sapling ratio is assumed constant inter-annually, mortality in Norway maple plots of Norway maple seedlings is a high 92% but higher for sugar maple seedlings (100% mortality). In sugar maple plots, mortality of Norway maple seedlings is

71% while only 28% for sugar maple seedlings. For Norway maple and sugar maple plots combined, mean sapling density was insignificantly lower (*P* < 0.29) for Norway maple (mean 1.9 saplings ± 0.9 SE) than sugar maple (mean 4.2 saplings ± 1.9 SE). Likewise, mean seedling density averaged across both plot types was insignificantly lower (*P* < 0.27) for Norway maple (14.4 ± 5.7 SE) than sugar maple (6.8 ± 3.6 SE).

**Discussion**

*Understory consequences*

In this site, the evidence indicates that Norway maple’s invasion has had measurable impacts on understory stem density and species richness. These impacts were independent of Norway maple basal area, suggesting that the size of a canopy Norway maple was not a significant driver of understory pattern. Instead, changes in the Norway maple understory are more likely a product of greater competition for resources driven by the physiological traits of Norway maple (e.g., rapid growth). These impacts may have adverse effects on the decomposer and invertebrate communities dependent on forage and habitat found under sugar maples. Likewise, if the changes in the understory are eventually

reflected in the canopy, the site's overall structure may experience a thinning due to reduced stem densities. A less stratified stand architecture may also develop if plant diversity diminishes. Nevertheless, these conclusions should be viewed with caution when applied beyond this site as this study was conducted in only one location and inter-annual variation in regeneration mortality was not monitored. The single replication is Wyckoff and Webb (1996) who had similar results suggesting that broader patterns may be at work.

#### *Regeneration competition*

Patterns in understory abundance and distribution indicate how sugar maple, the native tree most similar to Norway maple (Webb and Kaunzinger 1993; Kloepfel and Abrams 1995), is holding-up in regeneration competition with Norway maple. When comparing the distribution of saplings at this site, Norway maple seems to outperform sugar maple, occurring under itself and sugar maples. Sugar maple saplings do not seem able to persist under Norway maples. Hence, if Norway maple continues to expand in importance at the site, sugar maple's ability to replace itself seems in doubt. Norway maple's prevalence in regeneration over sugar maple is particularly striking for sugar maple is considered a 'late successional' species in the region and typically persists as regeneration in abundance (Marks and Gardescu 1998). In general, other species were more abundant under sugar maples, with the exception of *Celtis occidentalis* which occurred more abundantly under Norway maples. Here, such an exclusionary effect by Norway maples may be attributable in part to its high shade tolerance: it casts enough shade to deter sugar maple and other species, and to a lesser extent, its own regeneration. Similarly, its regeneration receives sufficient light to survive under sugar maples. This does not seem an adequate explanation alone, however, given the total absence of any sugar maple saplings under Norway maples. Several studies suggest that Norway maple allelopathic exudates may suppress native regeneration (Webb and Kaunzinger 1993; Wyckoff and Webb 1996). Its abundant seed crops (Matlack 1987) could also translate into greater numbers of seedlings and its less palatable foliage (Webb and Kaunzinger 1993) may provide some measure of protection against herbivory. The northeastern climate may favor Norway maple; its leaf expansion begins up to a week earlier and senescence

two weeks later than native trees (Kloepfel and Abrams 1995).

Alternatively, the success of Norway maple regeneration *vis-à-vis* sugar maple may be only a reflection of its dominance at this site, rather than a general competitive advantage. Indeed, more Norway maple trees may mean more seeds and thus more seedlings. The tree core estimates of age, however, indicate that sugar maple colonized the site before Norway maple. This suggests that at some point sugar maple was less successful than Norway maple despite a head-start. Norway maple's success seems to include understory patches not specifically under Norway maples nor sugar maples: it had more than three times as many saplings as sugar maples in the general forest composition plots. The scarcity of Norway maple seedlings under itself ( $21.2/100\text{ m}^2$ ) is interesting as this differed from other findings (Wyckoff and Webb 1996). Their study found an average of 67.1 Norway maple seedlings per  $8\text{ m}^2$  under Norway maples. Such strong variation may reflect site differences. Also, overstory Norway maples were much less important in their study ( $2.1\text{ m}^2/\text{ha}$  and 161 stems/ha). This might imply that as Norway maple becomes increasingly dominant, its exclusionary influence on the understory becomes more pronounced, limiting even its own regeneration.

For the near future at least, Norway maple will continue in prominence at the site. Its saplings abundance is particularly noteworthy as saplings are a good indicator of future stand composition (Pacala 1996). Barring extensive mortality to Norway maple saplings as they mature, it may even attain greater dominance. It appears for now that sugar maple and hackberry will persist in the understory. At this site, Norway maple can be described as a successful invader, one that will in all likelihood increase its importance over time. Given current conditions, its abundant regeneration and its rapid height growth will enable it to capitalize on canopy openings and its high shade tolerance will permit its regeneration to persist in the understory.

Further study is necessary to establish if Norway maple has a similar impact throughout the northeast. Inter-annual studies replicated in multiple sites and evidence for controlling Norway maple's spread are particularly needed. Studying light levels under Norway maples and sugar maples, decomposition rates, seed abundance, and allelopathy would improve our understanding of the mechanisms which make Norway maple a successful invader.

### Acknowledgements

I would like to thank Peter Marks, Brian Traw, Marianne Krasny and two reviewers for improving this manuscript with helpful comments, and Jocelyn Forbush for assistance with fieldwork.

### References

- Cronk QCB and Fuller JL (1995) *Plant Invaders: The Threat to Natural Ecosystems*. Chapman & Hall, London, 233 pp
- Dahlsten DL and Garcia R (eds) (1992) *Eradication of Exotic Pests*. Yale University, New Haven, Connecticut, 287 pp
- George Safford Torrey Herbarium (1996) List of non-native invasive vascular plants in Connecticut. Department of Ecology and Evolutionary Biology, University of Connecticut, Storrs, Connecticut
- James PD and McFadden DA (1993) Norway Maple as biological invader of beech-sugar maple-oak forest. *Bulletin of Ecology Society of America* 74 (2nd Suppl): 300–302
- Kloeppel BD and Abrams MD (1995) Ecophysiological attributes of the native *Acer saccharum* and the exotic *Acer platanoides* in urban oak forests in Pennsylvania, USA. *Tree Physiology* 15(11): 739–746
- Marks PL and Gardescu S (1998) A case study of sugar maple (*Acer saccharum*) as a forest seedling bank species. *Bulletin of the Torrey Botanical Club* 125 (4): 287–296
- Matlack GR (1987) Diaspore size, shape, and fall behavior in wind-dispersed plants. *American Journal of Botany* 74: 1150–1160
- McKnight BN (ed) (1993) *Biological Pollution: The Control and Impact of Invasive Exotic Species*, Proceedings of a Symposium held at the University Place Conference Center, Indiana University-Purdue University, Indianapolis, Indiana, 25–26 October 1991, 253 pp
- Minitab Inc. (1998) *Minitab for Windows*, Release 12
- Mooney HA, Cushman JH, Medina W, Sala OE and Schulze ED (eds) (1996) *Functional Roles of Biodiversity: A Global Perspective*. John Wiley & Sons, New York, 325 pp
- Nowak DJ and Rowntree RA (1990) History and range of Norway maple. *Journal of Arboriculture* 16(11): 291–296
- Pacala SW (1997) Dynamics of plant communities. In: Crawley M (ed) *Plant Ecology*, pp 532–555. Blackwell Scientific, Oxford
- Sachse U (1988) The anthropogenic spread of Sycamore and Norway maple and their ecological requirements with special reference to Berlin. PhD Thesis, Berlin Technical University, Berlin, Germany, 150 pp
- Soil Conservation Service (1965) *Soil Survey: Tompkins County New York*. United States Department of Agriculture, Washington, DC, 119 pp
- Webb SL and Kaunzinger CK (1993) Biological invasion of the Drew University New Jersey Forest Preserve by Norway Maple (*Acer platanoides* L.). *Bulletin of the Torrey Botanical Club* 120: 343–349
- Wyckoff PH and Webb SL (1996) Understorey influence of the invasive Norway maple (*Acer platanoides*). *Bulletin of the Torrey Botanical Club* 123(3): 197–205