



# Determining the Invasive Capabilities of the Exotic Tree *Phellodendron amurense* Rupr. in Northeastern North America

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**Abstract:** An analysis of the invasive potential of the introduced tree species *Phellodendron amurense* Rupr. which has been used as an ornamental tree over the past century throughout areas of the Northeastern United States. Field studies to document and analyze invasions of the tree into urban and suburban woodlands were performed. Five study sites were chosen after careful survey of the pertinent literature, records of established northeastern herbaria, and responses from a 2008 request sent to botanical organizations and universities. Sites examined include 2 counties in Connecticut, 2 counties in New York, and 1 county in Pennsylvania. Field studies were conducted at each of the five sites using a variation of the Point-Center-Quarter method to determine the importance value of *P. amurense* within the forest. The results of this research indicates that *P. amurense* can invade multiple forest types and forest densities. The work provides evidence of the need for more research on the invasive abilities of *P. amurense*, strict management policies in areas that are already invaded, and nomination of *P. amurense* for listing in invasive plant databases.

**Introduction:** *Phellodendron amurense* Rupr., commonly known as the Chinese or Amur cork tree is a dioecious member of the Rutaceae which is proving to be a relatively widespread and important invasive plant throughout this region. In New York City, Glaeser and Kincaid (2005), reported *P. amurense* as ranking third in overall dominance based upon importance value within a woodland showing the need for further examination of the species. In spite of this there is still very little recognition in the literature of the invasive potential, spread and ecological impact of this species.

*Phellodendron amurense* is currently grown throughout the northeastern United States for its ornamental value. Dirr (1990) describes *P. amurense* as an excellent tree for parks and other large areas. A native of Asia which is very cold tolerant *Phellodendron amurense* has apparently never established itself as a major horticultural species as it is currently only available through specialty nurseries and mail order. This is possibly due to its large adult size of ten to fifteen meters in height and potentially greater spread as described by Dirr (1990). The lack of horticultural availability makes the appearance of reproducing populations of this plant even more important to monitor since they can easily be overlooked until long after they are unable to be removed.



Compound leaf and flowers of *Phellodendron amurense*, a member of this Rutaceae which is often overlooked as a non native member of the flora.

**Methods:** In the summer of 2008 and 2009, field surveys were performed throughout the state of Connecticut, the New York City region, Long Island, New Jersey and the Philadelphia region to locate spontaneous, non horticultural populations of *P. amurense*. These sites were selected based upon author observations, herbarium records, literature reviews and the results of a request for sighting information which was distributed in early 2008 to botanical organizations and universities. Over twenty sites were documented, fourteen of which were found to contain reproducing populations of *P. amurense* with both male and female trees, and were analyzed further to determine the extent of the invasion. Five of these fourteen sites had at least five mature, reproducing trees and were then analyzed to determine the surrounding vegetation types in which *P. amurense* had established itself. These five sites, the Bartlett Arboretum, Fairfield County, CT (41.07N 73.33W); Forest Park, Queens County, NY (40.42N 73.50W); Goodwin State Forest, Tolland County, CT (41.46N 72.05W); Morris Arboretum, Philadelphia County, PA (40.05N 75.13W); The New York Botanical Garden, Bronx County, NY (40.51N 73.52W), were all surveyed further in 2009.

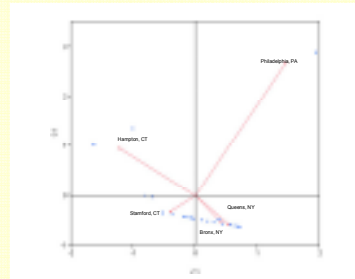
Each site was analyzed to calculate Importance Values for the surrounding vegetation using a variation of the point center quarter method. An individual of *P. amurense* was chosen as the center point and a single measurement made into each quadrant to the nearest non *P. amurense*. If no species other than *P. amurense* was found the quadrant was marked as open space.

| State | County       | Approximate Minimum Population | Source                   | Species                        | LB IV  | UB IV  | IV     |
|-------|--------------|--------------------------------|--------------------------|--------------------------------|--------|--------|--------|
| CT    | Fairfield    | >350                           | Site visit               | <i>Acer rubrum</i>             | 71.43  | 120.41 | 91.14  |
| CT    | Tolland      | 1                              | Site visit               | <i>Betula lenta</i>            | 39.92  | 78.46  | 56.83  |
| CT    | Tolland      | >50                            | Site visit               | <i>Quercus alba</i>            | 9.91   | 41.98  | 22.78  |
| CT    | Fairfield    | 20                             | Site visit               | <i>Carya ovata</i>             | 4.60   | 29.67  | 17.99  |
| CT    | Fairfield    | >20                            | Site visit               | <i>Acer saccharum</i>          | 5.53   | 27.44  | 17.55  |
| CT    | New Haven    | 1                              | Olsen et al              |                                | LB IV  | UB IV  | IV     |
| MA    | Worcester    | 3                              | Berlin et al. 2005       | <i>Prunus serotina</i>         | 60.15  | 114.53 | 75.36  |
| NJ    | Bergen       | Unknown                        | BKL                      | <i>Liriodendron tulipifera</i> | 7.07   | 68.19  | 44.91  |
| NJ    | Mercer       | 8                              | Site visit, BART         | <i>Quercus rubra</i>           | 16.31  | 62.67  | 38.59  |
| NY    | Bronx        | 300                            | Site visit, NY           | <i>Fagus grandifolia</i>       | 9.06   | 41.24  | 26.11  |
| NY    | Bronx        | 1                              | Site visit, NY           | <i>Carya glabra</i>            | 4.12   | 42.44  | 21.74  |
| NY    | Nassau       | >10                            | Site Visit               |                                | LB IV  | UB IV  | IV     |
| NY    | Nassau       | 7                              | Site visit               | <i>Quercus rubra</i>           | 99.35  | 158.71 | 130.59 |
| NY    | Orange       | 25                             | BKL                      | <i>Betula lenta</i>            | 21.44  | 48.41  | 36.15  |
| NY    | Queens       | 100                            | Site visit, Glaeser 2005 | <i>Prunus serotina</i>         | 13.59  | 41.59  | 29.28  |
| NY    | Queens       | 1                              | Site visit               | <i>Liriodendron tulipifera</i> | 15.49  | 41.65  | 25.72  |
| NY    | Queens       | 100                            | Site visit, Glaeser 2005 | <i>Carya glabra</i>            | 5.24   | 30.92  | 19.14  |
| NY    | Richmond     | 1                              | Greller (1977)           |                                | LB IV  | UB IV  | IV     |
| NY    | Suffolk      | >20                            | Site visit               | Open                           | 119.22 | 181.29 | 143.83 |
| NY    | Westchester  | Unknown                        | BKL                      | <i>Acer rubrum</i>             | 49.23  | 101.69 | 72.36  |
| PA    | Philadelphia | 5                              | Site visit               | <i>Hamamelis virginiana</i>    | 3.52   | 48.39  | 23.84  |
| PA    | Philadelphia | >30                            | Site visit               | <i>Prunus serotina</i>         | 0      | 32.65  | 19.84  |
| PA    | Montgomery   | Unknown                        | GH                       | <i>Liriodendron tulipifera</i> | 0      | 29.75  | 11.90  |
| PA    | Philadelphia | 5                              | Site visit               |                                | LB IV  | UB IV  | IV     |
| PA    | Philadelphia | >30                            | Site visit               | <i>Acer negundo</i>            | 70.26  | 200.66 | 141.41 |
| PA    | Montgomery   | Unknown                        | GH                       | <i>Lonicera tatarica</i>       | 34.51  | 156.32 | 86.90  |
| PA    | Montgomery   | Unknown                        | GH                       | Open                           | 21.83  | 118.89 | 71.69  |

Sites of invasion by *P. amurense*

Importance value calculations for five sites of major invasion by *P. amurense*

**Results and Discussion:** Over twenty sites of confirmed invasion by *P. amurense* are documented here with several numbering more than 100 mature individuals. Importance values calculated for the five main sites of invasion reveal vast differences between the sites of invasion. With open space being calculated as a taxon value as is done here, none of the five sites share a similarity among their highest ranked taxa. The New York Botanical Garden and Forest Park, which are also the two closest sites geographically, share four of the top five taxa in importance, however *Quercus rubra* L. ranks first at Forest Park with an IV= 130.6 while at the New York Botanical Garden *Q. rubra* ranks third, IV=38.6, while *Prunus serotina* Ehrh. ranks first (IV = 75.3). The additional three sites are all led in importance values by different species, with the Bartlett Arboretum led by *Acer rubrum* (IV= 93.1), Morris Arboretum by *Acer negundo* L. (IV= 141.4), and Goodwin State Forest by open space (IV= 143.8).



Correspondence analysis performed for the five sites provides further evidence of the differences between sites. Only The New York Botanical Garden and Forest Park sites fall within the same quadrant, which would correspond with the importance value data which shows four of the top five species are the same for both sites, although in different orders of importance. All three additional sites are found in separate quadrants with the Morris Arboretum and Goodwin State Forest showing the greatest deviation from the centroid.

This work shows that *P. amurense* is much more widely escaped than previous literature reports have indicated. With the apparent potential to spread into a variety of forest types, *P. amurense* is deserving of a more significant study, and further consideration by federal, state and local agencies as well as NGO's as a target for removal efforts and commercial restrictions.

## References

- Dirr, M. A. 1990. Manual of Woody Landscape Plants. 4th Ed. Stipes Publishing. Champaign, IL. 1007 pp.
- Glaeser C., & D. Kincaid. 2005. The non-native invasive *Phellodendron amurense* Rupr. in a New York City woodland. *Arbor Jour* 28:151-164