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Research Note

Suburban gardening in Rochester, New York: Exotic plant preference and risk of invasion

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ABSTRACT

Horticulture has long been an important source of exotic plant species that may naturalize and become invasive. To analyze the extent of exotic plant species and their possible preference in modern landscaping in Rochester, New York, USA, we inventoried 101 randomly chosen suburban (peri-urban) house gardens. On average, 72% of plants per property were not native to the Eastern United States. Of the exotic species present in gardens, 44% have naturalized in New York State. Additionally, invasive plants were often intentionally planted, such as Japanese barberry (*Berberis thunbergii*), which was found in nearly half of the gardens. We also sought to ascertain if garden diversity could be correlated with the age, size, or cost of properties. Although our findings were not as distinct as previous garden inventories, property size and mortgage value correlated positively with species richness. Overall, landscape trends across all property types favored exotic over native garden plants.

1. Introduction

Exotic invasive species are considered one of the most significant threats to native species diversity and ecosystem function. Invasive plants have many demonstrated impacts in ecosystems, affecting their ability to provide ecosystem services including, but not limited to, water purification, pollination, and soil stabilization (Pejchar & Mooney, 2009). Invasive plants come at the economic cost of approximately 34.6 billion US dollars per year (Pimentel, Zuniga, & Morrison, 2005). Certain plant species, such as Melaleuca, are considered ecological villains, costing the state of Florida upward of $6 million per year in control measures (Pimentel, Lach, Zuniga, & Morrison, 2000).

At least 50% of the naturalized flora in the United States were deliberately introduced (Mack & Erneberg, 2002), while 82% of the current invasive woody taxa were introduced strictly for horticultural purposes (Reichard & White, 2001). Plant species have been grown and traded for ornamental purposes dating as far back as the 20th century BCE China (Zhou, 1994). In North America, nurseries were initiated as early as 1737 (Manks, 1968), with concerted efforts by nurserymen and plant explorers to introduce exotic plants in the 18th and 19th centuries (Manks, 1968). Only recently have invasive species been targeted for enforcement and regulation in some areas of the US, such as New York. Regulation 6 NYCRR Part 575 (NYCRR, 2017) now prohibits the sale of 70 plant species and regulates six. Such regulations are needed to slow the influx of potentially invasive species, as plant traits that are desirable to both horticultural and consumer groups such as drought tolerance, hardiness, ease of propagation, and rapid growth also make species formidable invaders in natural areas (Bell, Wilen, & Stanton, 2003).

Despite efforts to decelerate introduction of new species, it is likely that gardens in New York are already a reservoir of potentially exotic invasive species. Garden inventories in the United Kingdom (Smith, Thompson, Hodgson, Warren, & Gaston, 2006), France (Marco et al., 2008), and Burundi (Bigirimana, Bogaert, De Cannière, Bigendako, & Parmentier, 2012) showed that exotic species constituted anywhere from 70 to 88% of the flora within private household gardens, with some species representing a high risk for naturalization and invasion. However, not all gardens may house the same types of species. These inventories demonstrated that species assemblages often correlated with socioeconomic standing and garden area. Furthermore, a "luxury effect" has been used to describe the apparent link between wealth status and plant diversity in urban areas (Hope et al., 2003). Additionally, decreased economic resource availability can shape garden diversity, shifting ornamental dominance to that of a utilitarian use of agronomic plants (Bigirimana et al., 2012). Given the varying findings of garden inventories across broad geographical areas, we sought to determine how gardens in a major metropolitan region of upstate New

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York compared.

Our objectives were two-fold. First, we sought to evaluate the preference for exotic species in the garden flora of an upstate New York State metropolitan area, with a focus on species that have recently become state regulated or are potentially invasive. Second, we sought to quantify relationships between garden characteristics and diversity, hypothesizing that larger and more affluent properties would contain higher plant diversity.

2. Methods

In the summer of 2015, we sampled 101 suburban gardens (Appendix C) within the third-largest metropolitan area of New York State: Rochester, NY, with a population of approximately 1.08 million residents (U.S. Census Bureau, 2015). It comprises five counties and is located along the southwestern shore of Lake Ontario in upstate New York. We sampled 101 gardens split across two neighborhood types: suburban and mobile home developments. Sampling occurred primarily in Monroe and Ontario Counties. Suburban homes in this study refer to houses that were typically larger and built on site, whereas mobile (or manufactured) homes were typically smaller, prefabricated, and transported to the site of residency. Houses were initially chosen at random; however, if property owners were absent or they did not grant permission we sampled the next closest available residence. Less than 10% of all homeowners did not grant permission to sample properties. A total of 101 properties were sampled, representing a range of property values from 120,000 to 1,056,440 US dollars, which were approximated via Zillow estimates (Zestimate, 2015). These data were only available for 87 of 101 properties (Zestimate, 2015); therefore, 14 properties were not used in the analyses concerning property characteristics. For NMDS ordination, mortgage values were split equally into four categories across the range of values with group one representing the lowest mortgage values and group four representing the highest values. Property sizes ranged from 404.7 m^2 to 18,575.1 m^2 (0.1 acres–4.59 acres), and property age ranged from one to 61 years since construction. To collect inventories, we followed all edges of the cultivated ornamental portions of gardens, noting all species that had been clearly planted in gardens and trees planted within lawns. Species were then identified to the lowest possible taxonomic level; however, only those species that were confidently identified to genus, species, or cultivar (cultivated variety) level were included in analyses.

Species origin for all woody taxa (tree, shrub, and vine) were determined via Dirr (2009), naturalizations via The New York Flora Atlas (Weldy, Werier, & Nelson, 2018), and updated taxonomy and taxonomic authority determined via The Plant (2013). For herbaceous species, only accepted names for species and family were used via The Plant (2013), eFloras (2008) and WCSP (2018). Species were considered non-native to the Eastern United States if any of their historical range did not include some area east of the Mississippi river (Missouri Botanical Garden, 2018; Dirr, 2009; eFloras, 2008; Gleason & Cronquist, 1991; WCSP, 2018; Weldy et al., 2018). Species were determined native or non-native and naturalized to New York based upon The New York Flora Atlas (Weldy et al., 2018). Origin of exotic herbaceous species was determined via Flora of China and Flora of North America (eFloras, 2008), or Missouri Botanical Garden (2018) and WCSP (2018) if information was unavailable. Certain genera (e.g. *Hosta*, *Hemerocallis*, *Paeonia*) were considered exotic because, of these three genera, only *Paeonia* has representatives in the US; however, these ranges fall far west of the Eastern native boundaries set (eFloras, 2008). Hybrid cultivars with parent species from both native and exotic origins (e.g. *Taxus x media*; *Rhododendron* '*P.J.M.*') were considered exotic. Several genera (e.g. *Rosa*, *Malus*, *Clematis*, *Iris*, *Geranium,* etc…) did not have a known origin due to the extensive history of horticultural hybridization; thus, origin was listed as unknown. If cultivar could be determined, it was recorded and listed after taxonomic authority in single quotes (Appendix A).

Table 1
Twenty-five most frequently planted ornamental plant taxa of gardens in Rochester, NY. F refers to frequency of planting for 101 total gardens. Taxonomic family associated with species is denoted by Family, Strata refers to species growth type, and Origin refers to the area where species is native to. Bolded lines of text represent species native to the Eastern United States (E. US). W. US refers to Western United States. Total number of distinct taxa is 356; however, origin was only determined for 344. See Appendix A for taxonomic notes, corresponding footnote text, and full taxa list.

Taxa	F	Family	Strata	Origin
Hemerocallis sp.[10]	62	Asphodelaceae	Herb	Eurasia
Hosta sp.[11]	61	Asparagaceae	Herb	Asia
Acer palmatum Thunb.	57	Sapindaceae	Tree	Asia
Berberis thunbergii DC.	48	Berberidaceae	Shrub	Asia
Spiraea japonica L.f.	46	Rosaceae	Shrub	Asia
Hydrangea macrophylla (Thunb.) Ser.	44	Hydrangeaceae	Shrub	Asia
Miscanthus sinensis Andersson	40	Poaceae	Graminoid	Asia
Buxus microphylla Siebold & Zucc.	39	Buxaceae	Shrub	Asia
Euonymus alatus (Thunb.) Sieb.	38	Celastraceae	Shrub	Asia
Picea pungens Engelm.	38	Pinaceae	Tree	W. US
Chamaecyparis pisifera (Sieb. & Zucc.) Endl.	36	Cupressaceae	Tree	Asia
Syringa vulgaris L.[38]	36	Oleaceae	Tree	Europe
***Thuja occidentalis* L.**	**34**	**Cupressaceae**	**Tree**	**E. US**
Syringa pubescens Turcz.[37]	33	Oleaceae	Shrub	Asia
Malus sp. (crabapple)[21]	32	Rosaceae	Tree	Unknown
Rosa sp.[30]	31	Rosaceae	Shrub	Unknown
Taxus xmedia Rehder[39]	31	Taxaceae	Shrub	Eurasia
Acer platanoides L.	30	Sapindaceae	Tree	Europe
Rhododendron 'P.J.M.'[29]	28	Ericaceae	Shrub	Asia
Hibiscus syriacus L.	27	Malvaceae	Shrub	Asia
Juniperus chinensis L.	27	Cupressaceae	Shrub	Asia
Weigela florida (Bunge) A. DC.	27	Caprifoliaceae	Shrub	Asia
Paeonia sp.[24]	25	Paeoniaceae	Herb	Eurasia
Picea abies (L.) H. Karst.	25	Pinaceae	Tree	Europe
***Picea glauca* (Moench) Voss[28]**	**25**	**Pinaceae**	**Tree**	**E. US**

Property characteristic data failed the Anderson-Darling tests for normality, thus Spearman-rank correlations were performed. Correlations were determined between taxa richness and the following property characteristics: property mortgage (US Dollars), property size (log acreage), and property age (years since construction). Correlations were analyzed using Minitab version 17.0 (Minitab 17 Statistical Software 2010). Ordinations were performed in PC-ORD 5.0 and have been shown to be an effective method for analyzing multivariate community structure (McCune & Grace, 2002). Taxa were not included within the ordination if they were found at less than 10% of all properties to account for the high level of absence data and to reduce ordination stress.

3. Results

We identified 356 distinct taxa across 101 total gardens sampled, of which 344 had discernible origins (Appendix A). Of the 25 most planted taxa across all garden properties, at least 21 originated from regions outside of the Eastern United States and only two species were considered native (Table 1). These species were Eastern white-cedar (*Thuja occidentalis*) and white spruce (*Picea glauca*) and were found at 34 (33.6%) and 25 (24.7%) of 101 properties, respectively. Most of the individuals of *Picea glauca* were found planted as the cultivated variety 'Conica'. The most abundant exotic taxon was daylily (*Hemerocallis* sp.). Rank curves indicated that the most abundant native plants were found at an approximately two-fold rate lower than the most abundant exotic plants (Fig. 1).

Exotics consistently represented more of the total richness as well as relative abundance in gardens, with 209 exotic taxa representing approximately 72% of total abundance compared to 135 native species representing approximately 28% of total abundance (Table 2). While native plant species were present and readily planted within gardens,