USDA United States Department of Agriculture

An Assessment of Japanese Barberry in Northern U.S. Forests

Research Note NRS-249

This publication is part of a series that provides an overview of invasive plant species monitored on an extensive systematic network of plots measured by the Forest Inventory and Analysis (FIA) program of the USDA Forest Service, Northern Research Station (NRS). Each research note features one of the invasive plants monitored on forested plots by NRS FIA in the 24 states of the Midwestern and Northeastern United States.

Background and Characteristics

Japanese barberry (*Berberis thunbergii*), a member of the barberry family (Berberidaceae), is a low-growing perennial shrub. This ornamental shrub (Fig. 1) was sent to Boston from Russia in 1875 as a substitute for common barberry, a nuisance plant that harbors black stem rust (*Puccinia graminis*), which affects several cereal crops (Kaufman and Kaufman 2007).

Japanese barberry has low wildlife value and deer may promote its spread by creating soil disturbance that favor its growth. It can grow in sun or shade. Due to its shade tolerance, this species is of particular concern within forested areas. Japanese barberry can rapidly cover the forest floor, shading out other vegetation (Czarapata 2005, Kaufman and Kaufman 2007).

Figure 1.—Ornamental planting of Japanese barberry cultivars. Photo by Leslie J. Mehrhoff, University of Connecticut, from Bugwood.org.

Description

Growth: forms dense, spiny thickets; alters soil chemistry; typically grows to 2–3 feet but can approach 6 feet.

Flowers: pale yellow; 6-petaled; slender stalked; single or up to 4 per cluster (Fig. 2); late spring.

Leaves: simple, smooth, oval, alternate, clustered above spines; leaf out before natives; cultivars come in various shades of red, purple, and green.

Fruit: attractive small, red, egg-shaped berries (Fig. 3); singular or clustered; remain on stems into winter; frequently dispersed by birds.

Reproduction: seed; plants can root where they contact soil.

Habitat: prefers well drained soils; forests, roadsides, stream banks, disturbed areas.

Control: various mechanical and chemical methods; plants are shallow rooted and can be hand-pulled in moist soil (Czarapata 2005, Kaufman and Kaufman 2007).

Figure 2.—Flowers and spines of Japanese barberry. Photo by Leslie J. Mehrhoff, University of Connecticut, from Bugwood.org

Growth Conditions and Range

Japanese barberry is hardy to -28 ºF, requires a soil pH of 5.5 to 7.2, 30 to 60 inches of precipitation, and an 18 inch rooting depth. It is currently found in 32 states, primarily in the central and eastern regions of the United States (NRCS 2018).

Figure 3.—Japanese barberry with fruit. Photo by Leslie J. Mehrhoff, University of Connecticut, from Bugwood.org

Japanese Barberry Presence on Phase 2 Invasive Plots, 2016

FIA crews visited 4,981 forested Phase 2 (P2) invasive plots across the NRS region for the 2016 inventory. On these plots, 40 invasive plant species[1] (IPS) (39 species and one undifferentiated genus [nonnative bush honeysuckle][2]) are monitored. Various attributes are collected including the occurrence and coverage of IPS as well as the standard forest variables measured on P2 plots (e.g., tree diameter, height). Overall, 52.0 percent of forested plots have one or more of the monitored invasives present.

Japanese barberry is found throughout most of the NRS region. This noxious shrub occurs on 352 plots (7.1 percent) across 20 of the 24 NRS states (Fig. 4). Connecticut has the highest percentage of plots with Japanese barberry (50.0 percent). This invasive shrub is also prevalent in New Jersey (29.1 percent of plots) and Pennsylvania (20.7 percent). Field crews did not observe this invasive shrub in North Dakota, South Dakota, Nebraska, or Kansas, the states furthest from the point of introduction. Detection maps (NRCS 2018) show Japanese barberry in all 24 states of the NRS, but it is important to remember that FIA crews only sample forest land.

For the 2016 inventory, Japanese barberry is the seventh most commonly observed invasive species after multiflora rose (30.5 percent), nonnative bush honeysuckles (19.4 percent), garlic mustard (11.2 percent), Japanese honeysuckle (8.0 percent), autumn olive (7.5 percent), and Japanese stiltgrass (7.3 percent). Additional information about the invasives monitored and county-level occurrence maps for the NRS region from 2005 through 2010 can be found in Kurtz (2013).

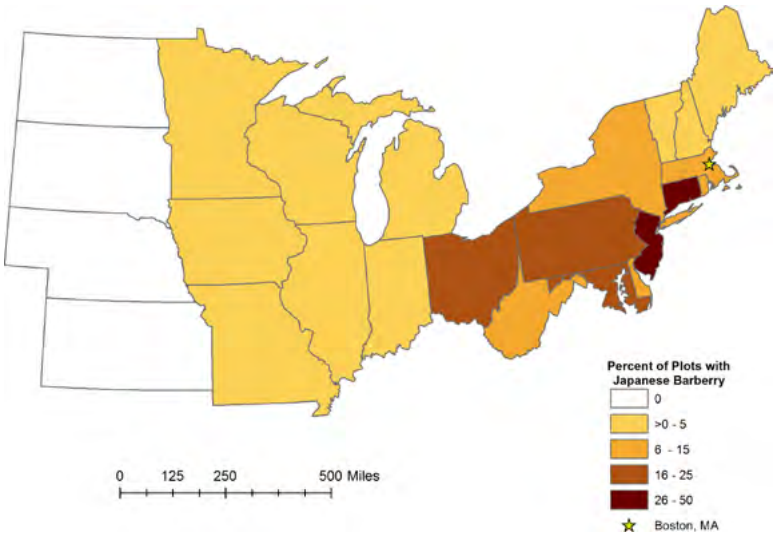

Figure 4.—Percentage of Phase 2 invasive plots with Japanese barberry, 2016. Percentages are rounded to the nearest whole number.

Japanese barberry infestation. Photo by Leslie J. Mehrhoff, University of Connecticut, from Bugwood.org.

[1] Autumn olive (*Elaeagnus umbellata*), black locust (*Robinia pseudoacacia*), Bohemian knotweed (*Polygonum xbohemicum*), bull thistle (*Cirsium vulgare*), Canada thistle (*Cirsium arvense*), Chinaberry (*Melia azedarach*), common barberry (*Berberis vulgaris*), common buckthorn (*Rhamnus cathartica*), common reed (*Phragmites australis*), creeping jenny (*Lysimachia nummularia*), dames rocket (*Hesperis matronalis*), English ivy (*Hedera helix*), European cranberrybush (*Viburnum opulus*), European privet (*Ligustrum vulgare*), European swallow-wort (*Cynanchum rossicum*), garlic mustard (*Alliaria petiolata*), giant knotweed (*Polygonum sachalinense*), glossy buckthorn (*Frangula alnus*), Japanese barberry (*Berberis thunbergii*), Japanese honeysuckle (*Lonicera japonica*), Japanese knotweed (*Polygonum cuspidatum*), Japanese meadowsweet (*Spiraea japonica*), leafy spurge (*Euphorbia esula*), Louise's swallow-wort (*Cynanchum louiseae*), multiflora rose (*Rosa multiflora*), Japanese stiltgrass (*Microstegium vimineum*), nonnative bush honeysuckle (*Lonicera* spp.), Norway maple (*Acer platanoides*), Oriental bittersweet (*Celastrus orbiculatus*), princesstree (*Paulownia tomentosa*), punktree (*Melaleuca quinquenervia*), purple loosestrife (*Lythrum salicaria*), reed canarygrass (*Phalaris arundinacea*), Russian olive (*Elaeagnus angustifolia*), saltcedar (*Tamarix ramosissima*), Siberian elm (*Ulmus pumila*), silktree (*Albizia julibrissin*), spotted knapweed (*Centaurea stoebe* ssp. *micranthos*), tallow tree (*Triadica sebifera*), tree of heaven (*Ailanthus altissima*).

[2] The 39 IPS and one undifferentiated genus (nonnative bush honeysuckle) are hereafter referred to as "invasive species", "invasive plants", "invasives", or "IPS".

The percentage cover of Japanese barberry is shown in two figures, one that illustrates cover by state (Fig. 5) and a second that focuses on plot level data (Fig. 6). It is important to use caution when looking at Figure 5 because in some states the overall averages are driven by a small number of plots. For the states with a low number of observances, Figure 6 is more informative since individual plot values can be assessed. Connecticut is the state with the highest average percent cover of Japanese barberry on plots, 9.8 percent. For the 2016 survey, 25 of the 50 plots within this state have Japanese barberry present. These maps, along with Figure 4, reveal important information related to the presence and abundance of this species in the NRS region. Over time these maps will allow us to assess changes in abundance and spread throughout this region.

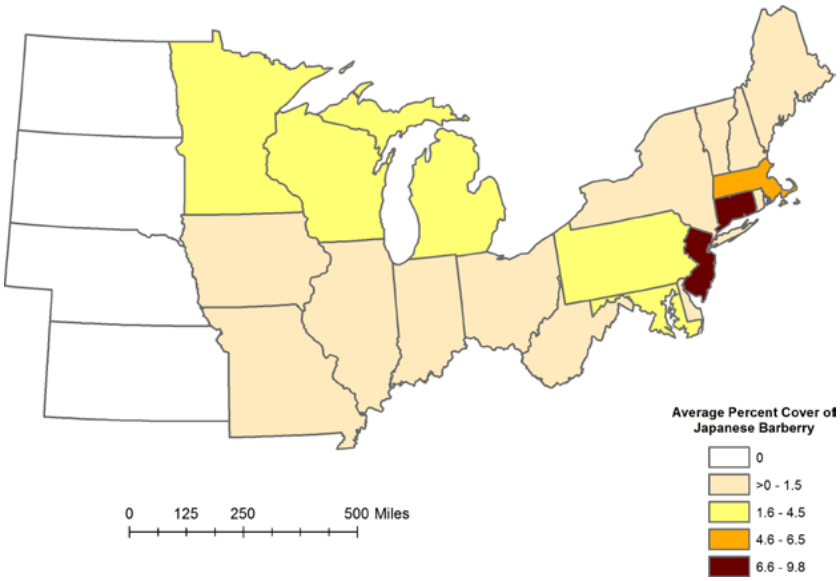

Figure 5.—Average percentage cover[3] of Japanese barberry on Phase 2 invasive plots, 2016. Percentages are rounded to the nearest tenth of a whole number.

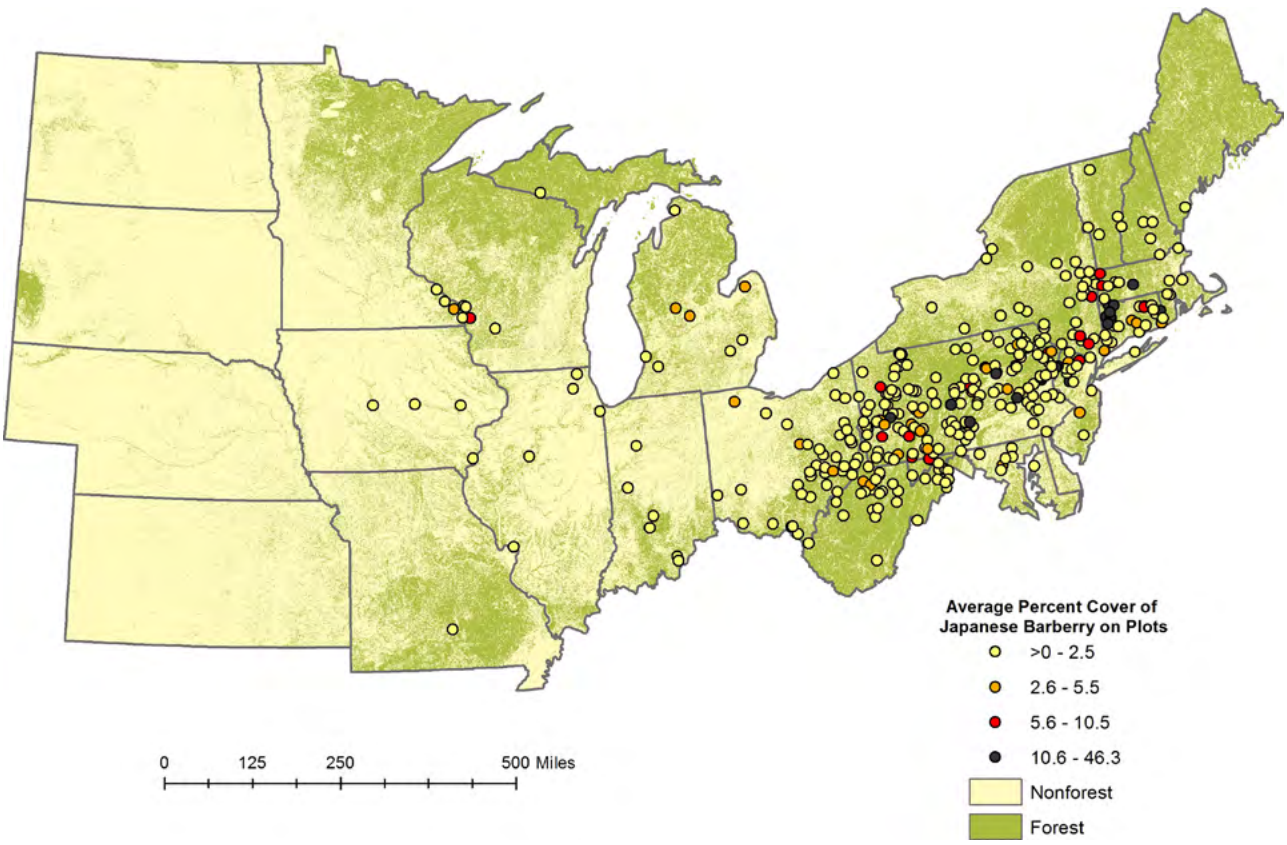

Figure 6.—Average percentage cover[3] of Japanese barberry on Phase 2 invasive plots, 2016. Percentages are rounded to the nearest tenth of a whole number.

[3] Average percentage cover is calculated for plots with Japanese barberry based on subplot data for the portion of the plot that is forested. Each FIA plot consists of four circular 1/24-acre subplots located at the corners and center of an equilateral triangle that is 208 feet on a side.

Characteristics of Plots with Japanese Barberry

The data analysis in this section is limited to the 10 NRS states with Japanese barberry present on greater than 5 percent of plots, resulting in the analysis of 1,907 plots. Of these plots, this noxious shrub was present on 309 plots (16.2 percent). The 10 states in this analysis are Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, and West Virginia.

Data collected on sample plots suggests that Japanese barberry is more common on plots near roads. There is a significant difference (t-test; $p<0.05$) in the distance to the nearest road for plots with and without Japanese barberry (Fig. 7). Several studies have highlighted the effect of roads on the distribution of invasives (Kurtz and Hansen 2013, Lundgren et al. 2004, Predick and Turner 2008). Roads act as a conduit for seed dispersal and alter light and nutrient availability, as well as drainage. Vehicles traveling on roads carry propagules of many exotics which become dispersed along them. Fauna also spread IPS along roads, using them as corridors.

Tree cover also differs for plots with and without Japanese barberry. The 2016 data suggest that there are fewer seedlings and saplings per acre on plots with Japanese barberry (Fig. 8A and 8B; t-test; $p<0.05$). Since the study is relatively new, with complete implementation across all of the NRS region in 2007, it is difficult to assess whether the invasive plants are influencing tree regeneration and growth or if the invasive plants are establishing where there is reduced tree cover and less competition. Continued investigation is important because these plants can outcompete native species and without adequate understory regeneration to replace the aging overstory, the future composition of the forest remains in question (Kurtz 2013).

Further analysis of the tree data suggests that there is not a significant difference in the number of trees 5 inches diameter at breast height (d.b.h.) or greater on plots with or without Japanese barberry (Fig. 9; $p>0.05$). Additionally there is no significant difference in the percentage of the plot that is forested for plots with and without Japanese barberry (Fig. 10; $p>0.05$).

Monitoring IPS offers insight on the status, trends, distribution, and population size, as well as helps to detect new populations. These preliminary investigations are important as they suggest there is a difference between plots with and without Japanese barberry and future studies will help determine the effects these species are causing. As IPS supplant tree species, the carbon budget and timber availability are altered. The trends reported here are important and need to be watched in the future to help elucidate important factors related to the presence of these invasives as well as to find out the impacts these species are causing on ecosystems.

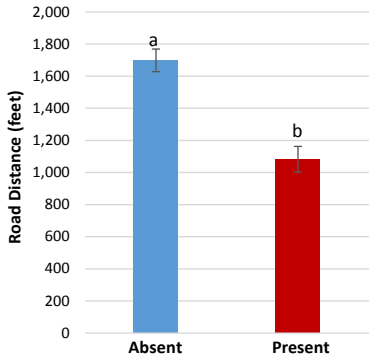

Figure 7.—Average distance to the nearest road for plots with or without Japanese barberry, 2016.[4]

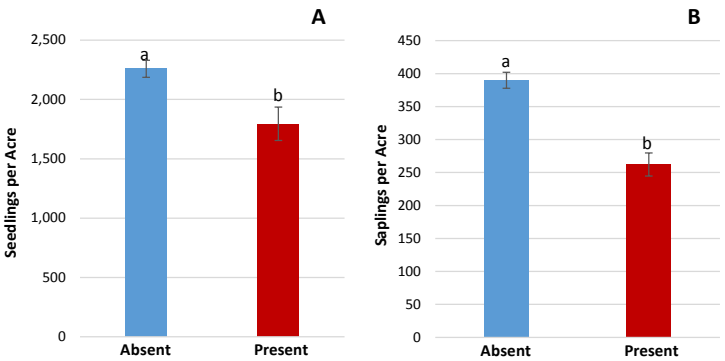

Figure 8.—Number of seedlings (A) and saplings (B) per acre for plots with or without Japanese barberry, 2016.[4]

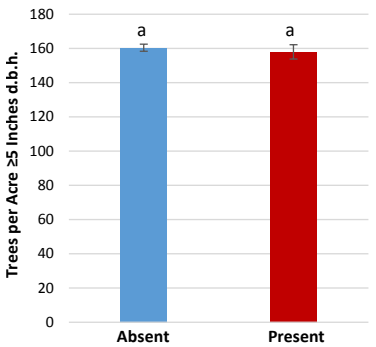

Figure 9.—Trees per acre ≥5 inches d.b.h. for plots with or without Japanese barberry, 2016.[4]

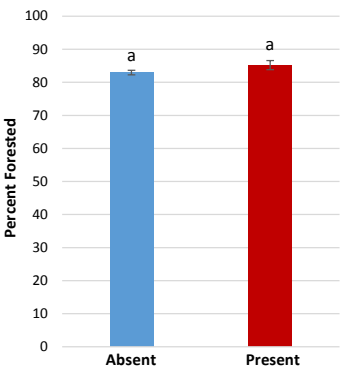

Figure 10.—Percentage of the plot that is forested for plots with or without Japanese barberry, 2016.[4]

[4]The error bars in Figures 7 through 10 show a 68% confidence interval for the observed mean.

Citation for this Publication

Kurtz, Cassandra M.; Hansen, Mark H. 2018. **An assessment of Japanese barberry in northern U.S. forests.** Res. Note NRS-249. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 5 p. https://doi.org/10.2737/NRS-RN-249.

FIA Program Information

Bechtold, W.A.; Patterson, P.L., eds. 2005. **The enhanced Forest Inventory and Analysis Program: national sampling design and estimation procedures.** Gen. Tech. Rep. SRS-80. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 85 p. https://doi.org/10.2737/SRS-GTR-80.

Smith, W.B. 2002. **Forest inventory and analysis: a national inventory and monitoring program.** Environmental Pollution. 116: 233-242. https://doi.org/10.1016/S0269-7491(01)00255-X.

USDA Forest Service. 2018. **Forest inventory and analysis national core field guide, Vol. 1: field data collection procedures for phase 2 plots, ver. 7.1.** www.fia.fs.fed.us/library/field-guides-methods-proc/ (accessed March 19, 2018).

References

Czarapata, E.J. 2005. **Invasive plants of the upper Midwest: an illustrated guide to their identification and control.** Madison, WI: University of Wisconsin Press. 215 p.

Kaufman, S.R.; Kaufman, W. 2007. **Invasive plants: a guide to identification and the impacts and control of common North American species.** Mechanicsburg, PA: Stackpole Books. 458 p.

Kurtz, C.M. 2013. **An assessment of invasive plant species monitored by the Northern Research Station Forest Inventory and Analysis Program, 2005 through 2010.** Gen. Tech. Rep. NRS-109. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 70 p. https://doi.org/10.2737/NRS-GTR-109.

Kurtz, C.M.; Hansen, M.H. 2013. **An assessment of multiflora rose in northern U.S. forests.** Res. Note NRS-182. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 5 p. https://doi.org/10.2737/NRS-RN-182.

Lundgren, M.R.; Small, C.J.; Dreyer, G.D. 2004. **Influence of land use and site characteristics on invasive plant abundance in the Quinebaug Highlands of southern New England.** Northeastern Naturalist. 11(3): 313-332. https://doi.org/10.1656/1092-6194(2004)011%5b0313:IOLUAS%5d2.0.CO;2

Natural Resources Conservation Service (NRCS). 2018. **The PLANTS database.** Greensboro, NC: U.S. Department of Interior, Natural Resources Conservation Service, National Plant Data Team. Available at https://plants.usda.gov (accessed March 21, 2018).

Predick, K.I.; Turner, M.G. 2008. **Landscape configuration and flood frequency influence invasive shrubs in floodplain forests of the Wisconsin River (USA).** Journal of Ecology. 96: 91-102. http://dx.doi.org/10.1111/j.1365-2745.2007.01329.x.

Additional Invasive Plant Information

Invasive and Exotic Plants: http://www.invasive.org/species/weeds.cfm

Invasive Plant Atlas of New England: http://www.eddmaps.org/ipane/

Invasive Plant Atlas of the United States: http://www.invasiveplantatlas.org/index.html

Midwest Invasive Plant Network: http://mipn.org/

Contact

Analyst: Cassandra Kurtz, (651) 649-5149; cmkurtz@fs.fed.us

Page 1 and 5 photo header by Cassandra Kurtz, USDA Forest Service