

Weed Risk Assessment for *Frangula alnus* Mill. (Rhamnaceae) – Glossy buckthorn

Michigan
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Top left: *Frangula alnus* leaves with distinct venation and fruit ripening from red to black (source: David Nicholls, naturespot.org). Top right: Brownish gray bark of *F. alnus* with speckled lenticels (source: David Nicholls, naturespot.org). Bottom left: Infestation of multiple *Frangula alnus* seedlings (source: Saxifraga-Hans Boll). Bottom right: *F. alnus* 5-petaled yellow, to whiteish-green flowers (source: Saxifraga-Rutger Barendse).

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Introduction

The Michigan Department of Agriculture and Rural Development (MDARD) regulates terrestrial species through a Prohibited and Restricted species list, under the authority of Michigan's Natural Resources and Environmental Protection Act (NREPA), Act 451 of 1994, Part 413 (MCL 324.41301-41305). Prohibited species are defined as species which "(i) are not native or are genetically engineered, (ii) are not naturalized in this state or, if naturalized, are not widely distributed, and further, fulfill at least one of two requirements: (A) The organism has the potential to harm human health or to severely harm natural, agricultural, or silvicultural resources and (B) Effective management or control techniques for the organism are not available." Restricted species are defined as species which "(i) are not native, and (ii) are naturalized in this state, and one or more of the following apply: (A) The organism has the potential to harm human health or to harm natural, agricultural, or silvicultural resources. (B) Effective management or control techniques for the organism are available." Per a recently signed amendment to NREPA (MCL 324.41302), MDARD will be conducting reviews of all species on the lists to ensure that the lists are as accurate as possible.

We use the United States Department of Agriculture's, Plant Protection and Quarantine (PPQ) Weed Risk Assessment (WRA) process (PPQ, 2015) to evaluate the risk potential of plants. The PPQ WRA process includes three analytical components that together describe the risk profile of a plant species (risk potential, uncertainty, and geographic potential; PPQ, 2015). At the core of the process is the predictive risk model that evaluates the baseline invasive/weed potential of a plant species using information related to its ability to establish, spread, and cause harm in natural, anthropogenic, and production systems (Koop et al., 2012). Because the predictive model is geographically and climatically neutral, it can be used to evaluate the risk of any plant species for the entire United States or for any area within it. We then use a stochastic simulation to evaluate how much the uncertainty associated with the risk analysis affects the outcomes from the predictive model. The simulation essentially evaluates what other risk scores might result if any answers in the predictive model might change. Finally, we use Geographic Information System (GIS) overlays to evaluate those areas of the United States that may be suitable for the establishment of the species. For a detailed description of the PPQ WRA process, please refer to the PPQ Weed Risk Assessment Guidelines (PPQ, 2015), which is available upon request.

We emphasize that our WRA process is designed to estimate the baseline—or unmitigated—risk associated with a plant species. We use evidence from anywhere in the world and in any type of system (production, anthropogenic, or natural) for the assessment, which makes our process a very broad evaluation. This is appropriate for the types of actions considered by our agency (e.g., State regulation). Furthermore, risk assessment and risk management are distinctly different phases of pest risk analysis (e.g., IPPC, 2015). Although we may use evidence about existing or proposed control programs in the assessment, the ease or difficulty of control has no bearing on the risk potential for a species. That information could be considered during the risk management (decision making) process, which is not addressed in this document.

Plant Information and Background

PLANT SPECIES: *Frangula alnus* Mill. (Rhamnaceae) (GBIF, 2021).

SYNONYMS: *Frangula alnus* f. *angustifolia* W.R.Franz, *Frangula alnus* var. *elliptica* Meinhardt, *Frangula dodonei* Ard. ex Soldano, *Frangula vulgaris* var. *parvifolia* Beck, *Frangula vulgaris* var. *subrotunda* (Rouy & Foucaud) Beck, *Rhamnus autumnalis* Gand., *Rhamnus frangula* subsp. *Columnaris*, *Rhamnus frangula* var. *subrotunda* Rouy & Foucaud, *Rhamnus sibirica* G.Nicholson (GBIF, 2021).

COMMON NAMES: Glossy buckthorn, alder buckthorn, breaking buckthorn, European alder buckthorn, glossy false buckthorn, frangula (GBIF, 2021), columnar buckthorn, fen buckthorn (Converse et al., 2014), persian berries, tall hedge buckthorn, black dogwood (CABI, 2019).

BOTANICAL DESCRIPTION: *Frangula alnus* is a non-spiny deciduous tree or shrub 6-7 m tall, with oval, smooth-edged leaves that have parallel veins curving towards the leaf tip. It produces clusters of 2-8 bell-shaped flowers with five yellow or whiteish green petals, and drupes that ripen from red to black. The bark is brownish gray speckled with lenticels (Sturtevant et al., 2022). For a full botanical description see World Flora Online (2022).

INITIATION: In accordance with the Natural Resources and Environmental Protection Act Part 413, the Michigan Department of Agriculture and Rural Development was tasked with evaluating the species currently on Michigan's Prohibited and Restricted Species List (MCL 324.41302). USDA Plant Epidemiology and Risk Analysis Laboratory's (PERAL) Weed Team worked with MDARD to evaluate and review this species.

WRA AREA¹: United States and Territories.

FOREIGN DISTRIBUTION: *Frangula alnus* is native to most of Europe (WFO, 2022), northern Africa (Algeria, Morocco, Tunisia), and western Asia (CABI, 2019; Converse et al., 2014). It primarily inhabits calcareous wetlands or forest understories in heath oak, pine, and spruce stands (Converse et al., 2014). This species was introduced to Uzbekistan (Kew, 2022). It is also present throughout Canada, from Nova Scotia to Manitoba (Converse et al., 2014), where it is considered invasive (CABI, 2019).

U.S. DISTRIBUTION AND STATUS: *F. alnus* was introduced to the United States before 1800, however did not become naturalized until the 1900's (Converse et al., 2014). It is now present in half of the U.S., though mostly concentrated in the northeast and Great Lakes Region. Its range has also extended west to Idaho, Wyoming, Colorado, and Nebraska (USDA NRCS, 2022). This species is considered a noxious weed in Minnesota (Minnesota Department of Agriculture, 2022),

¹ The "WRA area" is the area in relation to which the weed risk assessment is conducted (definition modified from that for "PRA area") (IPPC, 2017).

Vermont (Class B) (Vermont Agency of Agriculture, Food and Markets, 2022), Maine, and Pennsylvania (Class B) (Pennsylvania Department of Agriculture, 2022), and is prohibited in Massachusetts, New York, and New Hampshire (Lower Hudson PRISM, 2022; USDA NRCS, 2022). Illinois also considers *F. alnus* an exotic weed and it cannot be sold within the state (Sturtevant et al., 2022); it is also considered invasive in Tennessee (CABI, 2019).

Analysis

ESTABLISHMENT/SPREAD POTENTIAL: *Frangula alnus* forms dense thickets from lateral crown spread and is also a prolific seed producer at around 1,500 seeds per plant (Converse et al., 2014; Lower Hudson PRISM, 2022). These seeds mainly fall below the mother plant, aiding in the formation of monocultures, but are also readily dispersed by birds and other mammals that feed on the fruits (Bolmgren and Eriksson, 2015; Illinois Wildflowers, 2022; Sturtevant et al., 2022). Ripe fruits also float in water for up to two weeks (Sturtevant et al., 2022), aiding in dispersal especially when established near wetlands. The seeds remain viable between 3-6 years (Lanzer et al., 2017; Sturtevant et al., 2022). *F. alnus* can grow in a variety of habitats, is partially shade-tolerant and is also able to regenerate after fire or cultivation (CABI, 2019; Sturtevant et al., 2022). Vigorous resprouting occurs from the root crown promoting thicket formation (Converse et al., 2014). We had very low uncertainty for this risk element.

Risk score = 11.0

Uncertainty index = 0.04

IMPACT POTENTIAL: *F. alnus* negatively impacts natural systems by outcompeting native species, altering nutrient cycling, and reducing the habitat for birds and insects. Its leaf litter is high in nitrogen therefore impacts N cycling where established (Lanzer et al., 2017) and increases the presence of exotic earthworms (Sturtevant et al., 2022). It also reduces the density and diversity of herbaceous plants and insects by creating a monoculture that prevents further succession (Bibaud et al., 2020; CABI, 2019; Fagan and Peart, 2004). *F. alnus* invasions also promote soil erosion of the forest floor (Cunard and Lee, 2009; Sturtevant et al., 2022). Fruits falling from these shrubs can stain sidewalks, cars, patio furniture, and houses (Sturtevant et al., 2022) and make vistas less visually appealing (CABI, 2019). The dense stands may limit access to certain sites which could limit amenity values. (CABI, 2019). Infestations of *F. alnus* are difficult and costly to control, as a combination of methods need to be employed. These include chemical herbicides, cutting, top killing by fire, and altering water levels to drown the plants (CABI, 2019; Sturtevant et al., 2022). We had very low uncertainty for this risk element.

Risk score = 2.9

Uncertainty index = 0.04

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GEOGRAPHIC POTENTIAL: Using the PPQ climate-matching model for weeds (Magarey et al., 2017), we estimate that about 83.0% percent of the United States is suitable for the establishment of *F. alnus* (Fig. 1). This area represents the joint distribution of Plant Hardiness Zones 2a-11a, areas with 10-100+ inches of annual precipitation, and the following Köppen-Geiger climate classes: cold arid steppe, temperate dry-summer hot and warm-summers, temperate no dry season hot and warm-summers, cold dry-summer warm-summer, cold no dry season hot, warm and cold-summers, polar tundra (app. A). The area of the United States shown to be climatically suitable was determined using only these three climatic variables. Other factors, such as soil, hydrology, disturbance regime, and species interactions may alter the areas in which this species is likely to establish. *F. alnus* is commonly found in wetlands, forest gaps, roadsides, pastures, and old fields.

Reported Occurrences and Climatic Suitability for *Frangula alnus*

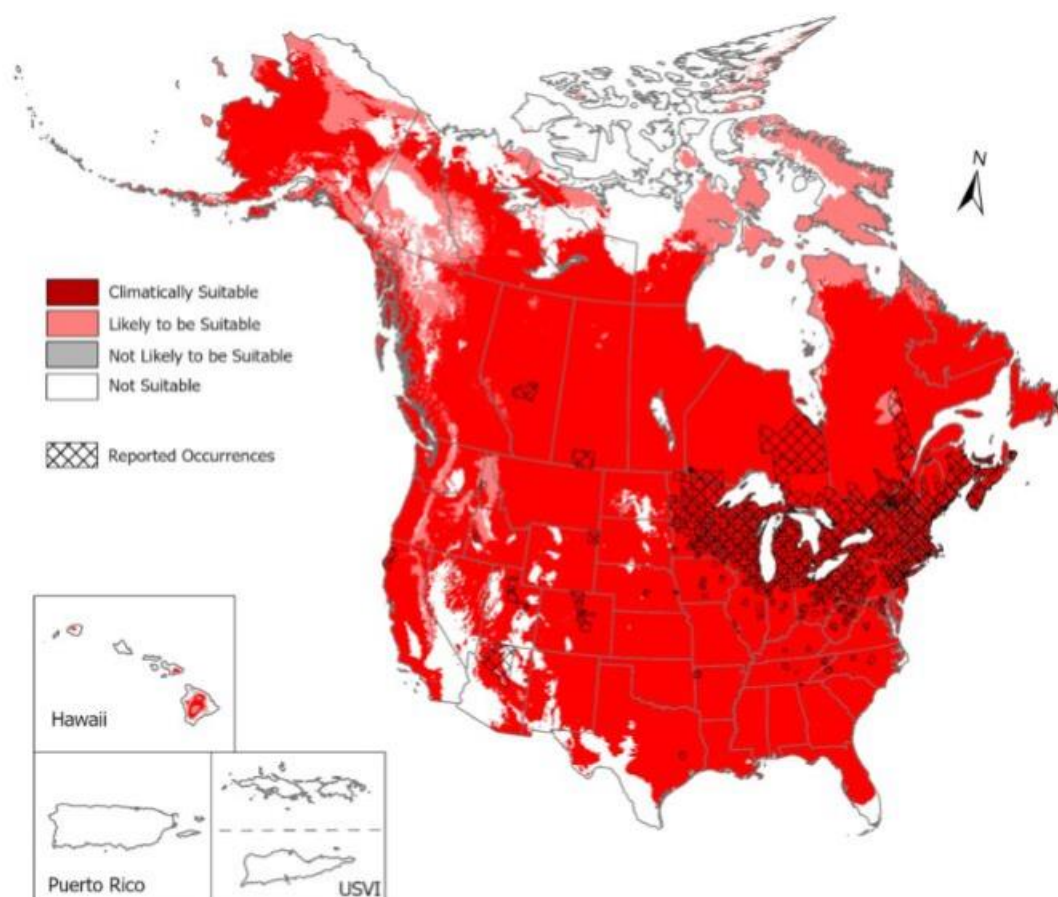


Figure 1. Current and potential distribution of *Frangula alnus* in the United States. Climatic suitability was determined using the APHIS-PPQ climate matching tool for invasive plants (Magarey et al., 2017). The known distribution of *F. alnus* was based on county distribution records from online databases and other sources (see text). Map components are shown at different scales

ENTRY POTENTIAL: We did not assess the entry potential of *Frangula alnus* because it is already present in the United States (GBIF, 2019) (Fig. 1).

Risk Model Results

Model Probabilities: P(Major Invader) = 55.0%
P(Minor Invader) = 42.6%
P(Non-Invader) = 2.4%

Risk Result = High Risk

Risk Result after Secondary Screening = N/A

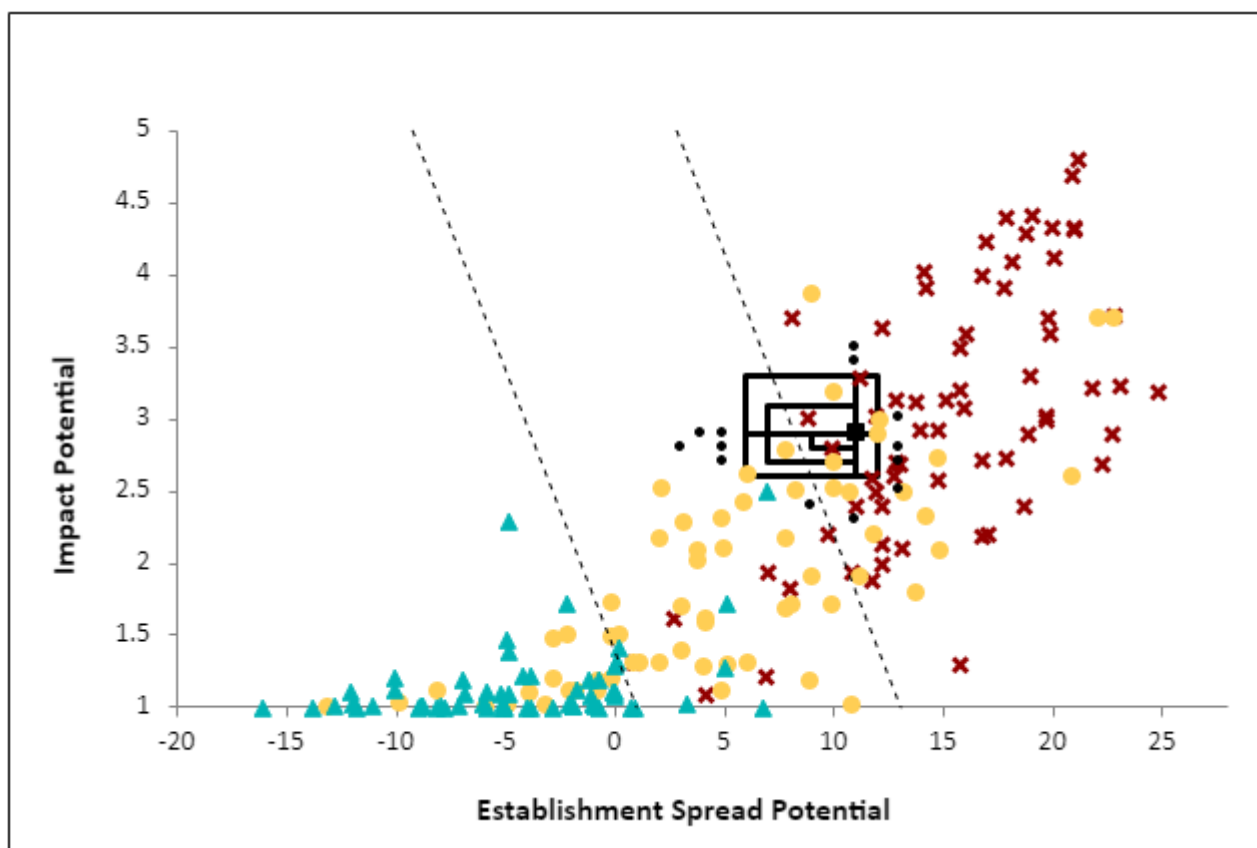


Figure 2. Risk and uncertainty results for *Frangula alnus*. The risk score for this species (solid black symbol) is plotted relative to the risk scores of the species used to develop and validate the PPQ WRA model (Koop et al., 2012). The results from the uncertainty analysis are plotted around the risk score for *Frangula alnus*. The smallest, black box contains 50 percent of the simulated risk scores, the second 95 percent, and the largest 99 percent. The black vertical and horizontal lines in the middle of the boxes represent the medians of the simulated risk scores (N=5000). For additional information on the uncertainty analysis used, see Caton et al. (2018).

Discussion

The result of the weed risk assessment for *Frangula alnus* is high risk, which is well supported by the uncertainty analysis (Fig. 2). This non-spiny deciduous shrub primarily inhabits calcareous wetlands, forest understories, or other disturbed land where it outcompetes native species for resources (Bibaud et al., 2020; Converse et al., 2014). Its prolific seed production, long-term seed viability, and long-distance dispersal via birds and other mammals enables this species to rapidly spread (Converse et al., 2014; Lanzer et al., 2017; Sturtevant et al., 2022). Additionally, its ability to resprout through lateral crown growth enables *F. alnus* to form dense thickets that are difficult and costly to control since a combination of methods are required to be effective (CABI, 2019; Converse et al., 2014). *F. alnus* is currently naturalized throughout half of the U.S., but mostly concentrated in the northeast and Great Lakes Regions, where it is regulated as a noxious weed or prohibited in multiple states (CABI, 2019; Lower Hudson PRISM, 2022; Minnesota Department of Agriculture, 2022; Pennsylvania Department of Agriculture, 2022; Sturtevant et al., 2022; USDA NRCS, 2022; Vermont Agency of Agriculture, Food and Markets, 2022). About 83.0% of the U.S. is suitable for growth of *F. alnus*. Available in a few different cultivars, this species is still being sold in nursery trade despite the negative impacts of infestations on species richness (Bibaud et al., 2020; CABI, 2019; Fagan and Peart, 2004), soil erosion, (Cunard and Lee, 2009), and the visual appearance of anthropogenic systems caused by fruit staining (Sturtevant et al., 2022).

Literature Cited

- Bibaud, H. A., Ducey, M. J., Simmons, M. J., McCarthy, H. C., Bibaud, R. N., & Lee, T. D. (2020). Factors limiting the success of invasive glossy buckthorn (*Frangula alnus*) in New Hampshire's eastern white pine – hardwood forests. *Forest Ecology and Management*, 474, 118345. <https://doi.org/10.1016/j.foreco.2020.118345>
- Bolmgren, K., & Eriksson, O. (2015). Are mismatches the norm? Timing of flowering, fruiting, dispersal and germination and their fitness effects in *Frangula alnus* (Rhamnaceae). *Oikos*, 124(5), 639–648. <https://doi.org/10.1111/oik.01491>
- Brkanac, S. R., Gerić, M., Gajski, G., Vujčić, V., Garaj-Vrhovac, V., Kremer, D., & Domijan, A.-M. (2015). Toxicity and antioxidant capacity of *Frangula alnus* Mill. bark and its active component emodin. *Regulatory Toxicology and Pharmacology*, 73(3), 923–929. <https://doi.org/10.1016/j.yrtph.2015.09.025>
- Burnham, K. M., & Lee, T. D. (2010). Canopy gaps facilitate establishment, growth, and reproduction of invasive *Frangula alnus* in a *Tsuga canadensis* dominated forest. *Biological Invasions*, 12(6), 1509–1520. <https://doi.org/10.1007/s10530-009-9563-8>
- Caton, B. P., A. L. Koop, L. Fowler, L. Newton, and L. Kohl. (2018). Quantitative uncertainty analysis for a weed risk assessment model. *Risk Analysis* 38(9):1972-1987.
- Center for Invasive Species and Ecosystem Health. (2022). *glossy buckthorn Frangula alnus* Mill. Invasive.Org. <https://www.invasive.org/browse/subinfo.cfm?sub=5649>
- Converse, C. K., Global Invasive Species Team, & The Nature Conservancy. (2014). *Frangula alnus*. BugwoodWiki. https://wiki.bugwood.org/Frangula_alnus
- Cunard, C., & Lee, T. D. (2009). Is patience a virtue? Succession, light, and the death of invasive glossy buckthorn (*Frangula alnus*). *Biological Invasions*, 11(3), 577–586. <https://doi.org/10.1007/s10530-008-9272-8>
- Fagan, M. E., & Peart, D. R. (2004). Impact of the invasive shrub glossy buckthorn (*Rhamnus frangula* L.) on juvenile recruitment by canopy trees. *Forest Ecology and Management*, 194(1–3), 95–107. <https://doi.org/10.1016/j.foreco.2004.02.015>
- Fiedler, A. K., & Landis, D. A. (2012). Biotic and Abiotic Conditions in Michigan Prairie Fen Invaded by Glossy Buckthorn (*Frangula alnus*). *Natural Areas Journal*, 32(1), 41–53. <https://doi.org/10.3375/043.032.0106>
- Findura, P., Hara, P., Szparaga, A., Kocira, S., Czerwińska, E., Bartoš, P., Nowak, J., & Treder, K. (2020). Evaluation of the Effects of Allelopathic Aqueous Plant Extracts, as Potential Preparations for Seed Dressing, on the Modulation of Cauliflower Seed Germination. *Agriculture*, 10(4), 122. <https://doi.org/10.3390/agriculture10040122>

- Finlay, C. M. V., Bradley, C. R., Jane Preston, S., & Provan, J. (2017). Low genetic diversity and potential inbreeding in an isolated population of alder buckthorn (*Frangula alnus*) following a founder effect. *Scientific Reports*, 7(1). <https://doi.org/10.1038/s41598-017-03166-1>
- Frappier, Brian, R. T., & Lee, T. D. (2003). POTENTIAL IMPACTS OF THE INVASIVE EXOTIC SHRUB RHAMNUS FRANGULA L. (GLOSSY BUCKTHORN) ON FORESTS OF SOUTHERN NEW HAMPSHIRE. *Northeastern Naturalist*, 10(3), 277–296. <https://doi.org/https://doi.org/10.1656/1092-6194>
- GBIF. (2021). *Frangula alnus* Mill. in GBIF Secretariat. GBIF Backbone Taxonomy. Checklist dataset <https://doi.org/10.15468/39omei> accessed via GBIF.org on 2022-08-17.
- Illinois Wildflowers. (2022). *Glossy Buckthorn*. https://illinoiswildflowers.info/trees/plants/gl_buckthorn.html
- IPPC. (2015). International Standards for Phytosanitary Measures No. 2: Framework for Pest Risk Analysis. Food and Agriculture Organization of the United Nations, Secretariat of the International Plant Protection Convention (IPPC), Rome, Italy. 18 pp.
- IPPC. (2017). International Standards for Phytosanitary Measures No. 5: Glossary of Phytosanitary Terms. Food and Agriculture Organization of the United Nations, Secretariat of the International Plant Protection Convention (IPPC), Rome, Italy. 34 pp.
- Kew. (2022). The International Plant Names Index and World Checklist of Vascular Plants. Published on the Internet at <http://www.ipni.org> and <https://powo.science.kew.org/>
- Koop, A., L. Fowler, L. Newton, and B. Caton. (2012). Development and validation of a weed screening tool for the United States. *Biological Invasions* 14(2):273-294.
- Kovacevic, N., Subotic, A., Budimir, S., & Grubišić, D. (2000). Comparative Study Of Anthraquinones From Embryogenic Callus Tissue And Zygotic Embryos Of *Frangula Alnus* And *Rhamnus Catharticus*. *Pharmaceutical Biology*, 38(5), 321–325. <https://doi.org/10.1076/phbi.38.5.321.5965>
- Lanzer, N. B., Lee, T. D., Ducey, M. J., & Eisenhaure, S. E. (2017). Sapling white pine (*Pinus strobus* L.) exhibits growth response following selective release from competition with glossy buckthorn (*Frangula alnus* P. Mill) and associated vegetation. *Forest Ecology and Management*, 404, 280–288. <https://doi.org/10.1016/j.foreco.2017.08.049>
- Lower Hudson Partnership for Regional Invasive Species Management. (2022). *Frangula alnus* (*Rhamnus frangula*). <https://www.lhprism.org/species/frangula-alnus-rhamnus-frangula>
- Magarey, R., L. Newton, S. C. Hong, Y. Takeuchi, D. Christie, C. S. Jarnevich, L. Kohl, M. Damus, S. I. Higgins, L. Millar, K. Castro, A. West, J. Hastings, G. Cook, J. Kartesz, and A. L. Koop. (2017). Comparison of four modeling tools for the prediction of potential distribution for non-indigenous weeds in the United States. *Biological Invasions* 20(3):679–694.

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- MCL 324.41301. Natural Resources and Environmental Protection Act Part 413. Michigan Compiled Law 324.41301.
- MCL 324.41302. Natural Resources and Environmental Protection Act Part 413. Michigan Compiled Law 324.41302.
- Medan, D. (1994). mPlant Systematics and Evolution Reproductive biology of *Frangula Mnus* (Rhamnaceae) in southern Spain. In *P1. Syst. Evol* (Vol. 193).
- Minnesota Department of Agriculture. (2022). *Noxious Weed List*.
www.dot.state.mn.us/roadsides/vegetation/pdf/noxiousweeds.pdf
- Native Plant Trust. (2022). *Frangula alnus* — *glossy false buckthorn*. Go Botany.
<https://gobotany.nativeplanttrust.org/species/frangula/alnus/>
- Oregon State University College of Agricultural Sciences - Department of Horticulture. (2022). *Frangula alnus*. Landscape Plants. <https://landscapeplants.oregonstate.edu/plants/frangula-alnus>
- Pennsylvania Department of Agriculture. (2022). *Controlled Plant & Noxious Weeds*.
https://www.agriculture.pa.gov/Plants_Land_Water/PlantIndustry/NIPPP/Pages/Controlled-Plant-Noxious-Weed.aspx
- Sturtevant, R., L. Berent, and A. Fusaro. (2022). *Frangula alnus* Mill.: U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, and NOAA Great Lakes Aquatic Nonindigenous Species Information System, Ann Arbor, MI,
https://nas.er.usgs.gov/queries/greatlakes/FactSheet.aspx?Species_ID=2697&Potential=N&Type=0, Revision Date: 7/28/2022, Access Date: 8/24/2022
- USDA NRCS National Plant Data Team. (2022). *Frangula alnus* Mill. USDA Plants Database. Retrieved August 17, 2022, from <https://plants.usda.gov/home/plantProfile?symbol=FRAL4>.
- Vermont Agency of Agriculture, F. and M. (2022). *Designated Noxious Weeds*.
<https://agriculture.vermont.gov/public-health-agricultural-resource-management-division/plant-health-and-pest-management/plant-0>
- WFO. (2022). *Frangula alnus* Mill. Published on the Internet;<http://www.worldfloraonline.org/taxon/wfo-0000691852>. Accessed on: 24 Aug 2022

Appendix A. Weed risk assessment for *Frangula alnus* Mill. (Rhamnaceae)

The following table includes the evidence and associated references used to evaluate the risk potential of this taxon. We also include the answer, uncertainty rating, and score for each question.

Question ID	Answer - Uncertainty	Score	Notes (and references)
ESTABLISHMENT/SPREAD POTENTIAL			
ES-1 [What is the taxon's establishment and spread status outside its native range? (a) Introduced elsewhere =>75 years ago but not escaped; (b) Introduced <75 years ago but not escaped; (c) Never moved beyond its native range; (d) Escaped/Casual; (e) Naturalized; (f) Invasive; (?) Unknown]	e - negl	2	<i>Frangula alnus</i> is native to most of Europe (WFO, 2022), as well as northern Africa (Algeria, Morocco, Tunisia) and western Asia (CABI, 2019; Converse et al., 2014). They primarily inhabit calcareous wetlands or forest understories in heath oak, pine, and spruce stands (Converse et al., 2014). This species was introduced to Uzbekistan (Kew, 2022). It is also present throughout Canada, from Nova Scotia to Manitoba (Converse et al., 2014), where it is considered invasive (CABI, 2019). <i>F. alnus</i> was introduced to the United States before 1800, however did not become naturalized until the 1900's (Converse et al., 2014). It is now present in half of the U.S., though mostly concentrated in the northeast and Great Lakes Region. Its range has also extended west to Idaho, Wyoming, Colorado and Nebraska (USDA NRCS, 2022). It is considered invasive in Connecticut, prohibited in New York (USDA NRCS, 2022), restricted in Wisconsin, considered an exotic weed in Illinois and a noxious weed in Minnesota (Sturtevant et al., 2022).
ES-2 (Is the species highly domesticated)	n - low	0	It is cultivated to some degree and is commercially available, cultivated by bare root, container and cutting (USDA NRCS, 2022). There are three cultivars; 'Asplenifolia' which has thin, fern-like leaves, 'Columnaris' (syn. 'Tallhedge') which is compact and used for hedges, and FineLine® (syn. 'Ron Williams') with feathery foliage. FineLine® is a cross between 'Columnaris' (female) and 'Asplenifolia' (male) which has low seed set and does not produce viable seed (Oregon State University, 2022).
ES-3 (Significant weedy congeners)	y - negl	1	This species was previously classified as <i>Rhamnus frangula</i> , and <i>Rhamnus cathartica</i> is considered a significant invasive weed in natural systems (BONAP, 2014).
ES-4 (Shade tolerant at some stage of its life cycle)	n - low	0	Studies have shown that <i>Frangula alnus</i> mortality is associated with competition with shade tolerant species, signifying it is not very shade tolerant itself (Cunard and Lee, 2009). It is also 96 times more abundant in forest gaps than undisturbed forest (Burnham and Lee, 2010).

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Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-5 (Plant a vine or scrambling plant, or forms tightly appressed basal rosettes)	n - negl	0	See next question.
ES-6 (Forms dense thickets, patches, or populations)	y - negl	2	Can form dense thickets due to lateral crown spread which can establish in both wetlands and forest understories (Converse et al., 2014). It may take 20 years for an invaded area to become continuous <i>F. alnus</i> .
ES-7 (Aquatic)	n - negl	0	This species a shrub or small tree (WFO, 2022).
ES-8 (Grass)	n - negl	0	This species a shrub or small tree (WFO, 2022).
ES-9 (Nitrogen-fixing woody plant)	n - negl	0	Not in a plant family known for this (USDA NRCS, 2022).
ES-10 (Does it produce viable seeds or spores)	y - negl	1	Yes, this species primarily reproduces sexually, forming drupes containing two to three seeds each (Converse et al., 2014). Each tree may produce 1,500 seeds (Lower Hudson PRISM, 2022).
ES-11 (Self-compatible or apomictic)	n - negl	-1	Although self-pollination can occur, it accounts for such a low percentage of fruitset that some self-incompatibility is suspected (Medan, 1994). Cross pollination is needed for fruitset.
ES-12 (Requires specialist pollinators)	n - negl	0	One study reported 45 different insects visiting <i>F. alnus</i> flowers, with 21 being pollinators (Medan, 1994).
ES-13 [What is the taxon's minimum generation time? (a) less than a year with multiple generations per year; (b) 1 year, usually annuals; (c) 2 or 3 years; (d) more than 3 years; or (?) unknown]	d - mod	-1	The generation time could be between 5-20 years depending on location in Europe (Finlay et al., 2017). We could not find other studies defining time to maturity in other areas.
ES-14 (Prolific seed producer)	y - mod	1	Can produce 430 to 1560 offspring per year (Medan, 1994). Seed production might be around 1,500 seeds per plant (Lower Hudson PRISM, 2022). "Prolific seed production" reported in multiple sources (CABI, 2019; Converse et al.).
ES-15 (Propagules likely to be dispersed unintentionally by people)	n - negl	-1	Plants have been moved intentionally by human plantings, however, there is no direct evidence of unintentional movement (CABI, 2019).
ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers)	n - negl	-1	No parts of the plant have been reported to be unintentionally moved in trade (CABI, 2019).
ES-17 (Number of natural dispersal vectors)	4	4	0
ES-17a (Wind dispersal)	n - negl		Most of the seeds fall directly below the mother plant (Converse et al., 2014).
ES-17b (Water dispersal)	y - mod		The seeds do not dry out and therefore have been reported to sink in water (CABI, 2019). However, another source indicates that ripe fruits float in water for up to two weeks (Sturtevant et al., 2022).
ES-17c (Bird dispersal)	y - negl		Many bird species feed on the fruits and aid in seed dispersal including starlings, blackbirds, woodducks, cedar waxwings, robins and blue jays (Sturtevant et al., 2022).
ES-17d (Animal external dispersal)	y - mod		The seeds are carried and stored by small animals in caches which may facilitate long distance dispersal (Illinois Wildflowers, 2022).

Weed Risk Assessment for *Frangula alnus* Mill. (Glossy buckthorn)

Question ID	Answer - Uncertainty	Score	Notes (and references)
ES-17e (Animal internal dispersal)	y - low		There is evidence of mouse predation of the seeds (Converse et al., 2014) as well as elk (Sturtevant et al., 2022). They spend little time in the digestive track and likely remain viable (Sturtevant et al., 2022). Roe deer and moose also feed on this species, but whether or not the seeds can pass through their digestive system and survive for long-term dispersal has not been studied (Bolmgren and Eriksson, 2015).
ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed)	y - negl	1	Seeds remain viable for upwards of 3 years (Lanzer et al., 2017), even up to 5-6 years (Sturtevant et al., 2022).
ES-19 (Tolerates/benefits from mutilation, cultivation or fire)	y - low	1	Can regenerate after both fire and cultivation (CABI, 2019; Sturtevant et al., 2022).
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	n - negl	0	Not listed on weedscience.org (Heap, 2022).
ES-21 (Number of cold hardiness zones suitable for its survival)	8	0	
ES-22 (Number of climate types suitable for its survival)	6	2	
ES-23 (Number of precipitation bands suitable for its survival)	6	0	
IMPACT POTENTIAL			
General Impacts			
Imp-G1 (Allelopathic)	n - high	0	Not listed as an allelopath on the PLANTS database (USDA NRCS, 2022), and extracts from <i>F. alnus</i> actually increased germination of cauliflower seeds (Findura et al., 2020). However, Sturtevant et al., state that this species uses allelopathy to alter the surrounding plant community (2022). Therefore, answering no with high uncertainty.
Imp-G2 (Parasitic)	n - negl	0	Not known to be parasitic.
Impacts to Natural Systems			
Imp-N1 (Changes ecosystem processes and parameters that affect other species)	y - negl	0.4	Leaf litter is high in nitrogen therefore impacts N cycling where established (Lanzer et al., 2017). The presence of exotic earthworms also increases with <i>F. alnus</i> invasions, which can have dramatic effects on soil pH, moisture, and carbon and nitrogen cycling (Sturtevant et al., 2022).
Imp-N2 (Changes habitat structure)	y - negl	0.2	<i>F. alnus</i> reduces the density of herbaceous plants due to its ability to shade out understory plants (CABI, 2019; Fagan and Peart, 2004) and reduces the habitat available for birds (Sturtevant et al., 2022). It creates monocultures of dense stands and may prevent further succession in forests and promote soil erosion of the forest floor (Cunard and Lee, 2009; Sturtevant et al., 2022).
Imp-N3 (Changes species diversity)	y - negl	0.2	Reduces the abundance and diversity of insects (Bibaud et al., 2020). Additionally, due to its ability to outcompete native species for resources, it reduces plant density and diversity of species

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			(CABI, 2019). It was associated with low species richness in a study done in New Hampshire Pinus-mixed hardwood forests (Frappier et al., 2003).
Imp-N4 (Is it likely to affect federal Threatened and Endangered species?)	y - low	0.1	Oak savannas are an endangered ecosystem by which <i>Frangula alnus</i> is threatening the native species within. It is also commonly found in wetlands which are typically home to threatened and endangered species (Sturtevant et al., 2022).
Imp-N5 (Is it likely to affect any globally outstanding ecoregions?)	y - low	0.1	Oak savannas are an endangered ecosystem by which <i>Frangula alnus</i> is threatening the native species within. It is also commonly found in wetlands which are especially fragile environments susceptible to the negative impacts of aggressive invasives (Sturtevant et al., 2022).
Imp-N6 [What is the taxon's weed status in natural systems? (a) Taxon not a weed; (b) taxon a weed but no evidence of control; (c) taxon a weed and evidence of control efforts]	c - negl	0.6	Within natural systems, <i>Frangula alnus</i> is a fierce competitor with native plant species, leafing out earlier in the spring and keeping its leaves later in the fall (Sturtevant et al., 2022). It shades out the understory plants and changes habitat structure (CABI, 2019; Cunard and Lee, 2009; Fagan and Peart, 2004). It is difficult and costly to control since multiple methods need to be employed, including any combination of herbicides, cutting, topkilling by fire, and altering water levels (CABI, 2019; Sturtevant et al., 2022).
Impact to Anthropogenic Systems (e.g., cities, suburbs, roadways)			
Imp-A1 (Negatively impacts personal property, human safety, or public infrastructure)	y - high	0.1	Fruits falling from <i>F. alnus</i> can stain sidewalks, cars, patio furniture, and houses (Sturtevant et al., 2022). This seems to be the only direct impact. Answering yes with high uncertainty.
Imp-A2 (Changes or limits recreational use of an area)	y - high	0.1	Infestations can make vistas less visually appealing and the dense stands may limit access to sites, perhaps limiting amenity values. Although, direct evidence of this is limited (CABI, 2019). Therefore, answering yes with high uncertainty.
Imp-A3 (Affects desirable and ornamental plants, and vegetation)	n - low	0	No direct evidence of this could be found.
Imp-A4 [What is the taxon's weed status in anthropogenic systems? (a) Taxon not a weed; (b) Taxon a weed but no evidence of control; (c) Taxon a weed and evidence of control efforts]	a - low	0	Although there are some minor negative impacts to anthropogenic areas, such as staining from the fruits and unsightly thickets, this is not a primary reason cited for control methods. Therefore, we are answering "a" with alternate answers of "b".
Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Reduces crop/product yield)	n - low	0	It is an alternate host for crown rust and Alfalfa mosaic virus, though direct evidence of nay impact to commodity yield from this is not present (CABI, 2019).
Imp-P2 (Lowers commodity value)	n - negl	0	Not known to impact commodity value in any way.
Imp-P3 (Is it likely to impact trade?)	n - negl	0	Has not been shown to impact trade (CABI, 2019).

Weed Risk Assessment for *Frangula alnus* Mill. (Glossy buckthorn)

Question ID	Answer - Uncertainty	Score	Notes (and references)
Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water)	n - negl	0	This species is commonly found near wetlands, but thrives in drier soils. Too much water may flood and kill the plants, therefore <i>F. alnus</i> will not be a strong competitor for water (Sturtevant et al., 2022).
Imp-P5 (Toxic to animals, including livestock/range animals and poultry)	y - low	0.1	Poisonous to horses and has diarrheic qualities which result in net energy losses for animals that feed on the berries (Sturtevant et al., 2022). It produces the compound emodin, which extracts from <i>Rhamnus cathartica</i> have been shown to cause malformations and mortality in invertebrates, fish and amphibian larvae (Brenes et al., 2022; Kovacevic et al., 2000). Emodin has been shown to have cytotoxic effects, but direct evidence of these effects from <i>F. alnus</i> to animals still needs to be researched (). It is cytotoxic to humans (Brkanac et al., 2015).
Imp-P6 [What is the taxon's weed status in production systems? (a) Taxon not a weed; (b) Taxon a weed but no evidence of control; (c) Taxon a weed and evidence of control efforts]	a - negl	0	There is no evidence of direct impacts to production systems.
GEOGRAPHIC POTENTIAL			Unless otherwise indicated, the following evidence represents geographically referenced points obtained from the Global Biodiversity Information Facility (GBIF).
Plant hardiness zones			
Geo-Z1 (Zone 1)	n - negl	N/A	No points referenced in GBIF.
Geo-Z2 (Zone 2)	y - high	N/A	(Dave's Garden, 2022).
Geo-Z3 (Zone 3)	y - low	N/A	Canada, Russia (Dave's Garden, 2022).
Geo-Z4 (Zone 4)	y - negl	N/A	Wisconsin, Minnesota, (Dave's Garden, 2022).
Geo-Z5 (Zone 5)	y - negl	N/A	Wisconsin, Michigan, (Dave's Garden, 2022).
Geo-Z6 (Zone 6)	y - negl	N/A	Michigan, Eastern Europe (Dave's Garden, 2022).
Geo-Z7 (Zone 7)	y - negl	N/A	Michigan, parts of Europe (Dave's Garden, 2022).
Geo-Z8 (Zone 8)	y - negl	N/A	Europe (Dave's Garden, 2022).
Geo-Z9 (Zone 9)	y - low	N/A	Parts of Europe, Spain.
Geo-Z10 (Zone 10)	n - negl	N/A	No points referenced in GBIF.
Geo-Z11 (Zone 11)	n - negl	N/A	No points referenced in GBIF.
Geo-Z12 (Zone 12)	n - negl	N/A	No points referenced in GBIF.
Geo-Z13 (Zone 13)	n - negl	N/A	No points referenced in GBIF.
Köppen -Geiger climate classes			
Geo-C1 (Tropical rainforest)	n - negl	N/A	No points referenced in GBIF.
Geo-C2 (Tropical savanna)	n - negl	N/A	No points referenced in GBIF.
Geo-C3 (Steppe)	n - negl	N/A	No points referenced in GBIF.
Geo-C4 (Desert)	n - negl	N/A	No points referenced in GBIF.
Geo-C5 (Mediterranean)	y - negl	N/A	Spain.
Geo-C6 (Humid subtropical)	y - low	N/A	Parts of the U.S., however only a few points.
Geo-C7 (Marine west coast)	y - negl	N/A	Europe.
Geo-C8 (Humid cont. warm sum.)	y - negl	N/A	Michigan, midwestern U.S.

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Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-C9 (Humid cont. cool sum.)	y - negl	N/A	Michigan, northeastern U.S., Europe, Russia.
Geo-C10 (Subarctic)	y - negl	N/A	(Dfc) Sweden, Finland.
Geo-C11 (Tundra)	n - negl	N/A	No points referenced in GBIF.
Geo-C12 (Icecap)	n - negl	N/A	No points referenced in GBIF.
10-inch precipitation bands			
Geo-R1 (0-10 inches; 0-25 cm)	n - negl	N/A	No points referenced in GBIF.
Geo-R2 (10-20 inches; 25-51 cm)	n - mod	N/A	Possibly a few points referenced.
Geo-R3 (20-30 inches; 51-76 cm)	y - negl	N/A	Michigan, most of Europe, Great Lakes Region.
Geo-R4 (30-40 inches; 76-102 cm)	y - negl	N/A	Michigan, most of Europe, Great Lakes Region.
Geo-R5 (40-50 inches; 102-127 cm)	y - negl	N/A	Parts of northeeastern U.S. and Europe.
Geo-R6 (50-60 inches; 127-152 cm)	y - negl	N/A	Parts of northeeastern U.S. and Europe.
Geo-R7 (60-70 inches; 152-178 cm)	y - negl	N/A	Parts of northeeastern U.S. and Europe.
Geo-R8 (70-80 inches; 178-203 cm)	y - negl	N/A	Parts of northeeastern U.S. and Europe.
Geo-R9 (80-90 inches; 203-229 cm)	n - negl	N/A	No points referenced in GBIF.
Geo-R10 (90-100 inches; 229-254 cm)	n - negl	N/A	No points referenced in GBIF.
Geo-R11 (100+ inches; 254+ cm)	n - negl	N/A	No points referenced in GBIF.
ENTRY POTENTIAL			
Ent-1 (Plant already here)	y -	1	0
Ent-2 (Plant proposed for entry, or entry is imminent)	-	N/A	
Ent-3 [Human value & cultivation/trade status: (a) Neither cultivated or positively valued; (b) Not cultivated, but positively valued or potentially beneficial; (c) Cultivated, but no evidence of trade or resale; (d) Commercially cultivated or other evidence of trade or resale]	-	N/A	
Ent-4 (Entry as a contaminant)			
Ent-4a (Plant present in Canada, Mexico, Central America, the Caribbean or China)	-	N/A	
Ent-4b (Contaminant of plant propagative material (except seeds))	-	N/A	
Ent-4c (Contaminant of seeds for planting)	-	N/A	
Ent-4d (Contaminant of ballast water)	-	N/A	
Ent-4e (Contaminant of aquarium plants or other aquarium products)	-	N/A	
Ent-4f (Contaminant of landscape products)	-	N/A	
Ent-4g (Contaminant of containers, packing materials, trade goods, equipment or conveyances)	-	N/A	
Ent-4h (Contaminants of fruit, vegetables, or other products for consumption or processing)	-	N/A	
Ent-4i (Contaminant of some other pathway)	-	N/A	
Ent-5 (Likely to enter through natural dispersal)	-	N/A	