Weed Risk Assessment for *Pyrus calleryana* Decne. (Rosaceae) – Callery pear

Michigan Department of Agriculture and Rural Development

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Version 1

Top left: Example of *Pyrus calleryana*'s rough bark on an older tree and thorny shoot called a "spur" (source: Penn State Extension). Top right: Flowering callery pear (source: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org). Bottom left: Two *P. calleryana* trees in bloom (source: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org). Bottom right: Fruits from *P. calleryana* and its glossy green leaves (source: Chuck Bargeron, University of Georgia, Bugwood.org).

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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 PYRUS CALLERYANA: *Pyrus calleryana* Decne. (Rosaceae) (GBIF, 2021).

SYNONYMS: *Pyrus calleryana* f. *calleryana*, *Pyrus calleryana* f. *graciliflora* Rehder, *Pyrus calleryana* f. *tomentella* Rehder, *Pyrus calleryana* subsp. *dimorphophylla* (Makino) Koidz., *Pyrus calleryana* var. *calleryana*, *Pyrus calleryana* var. *dimorphophylla* (Makino) Koidz., *Pyrus dimorphophylla* Makino, *Pyrus kawakamii* Hayata, *Pyrus mairei* H.Lév., *Pyrus tsiukyoenesis* Koidz., *Pyrus tsiukyoensis* Koidz. (GBIF, 2021).

COMMON NAMES: Bradford pear, Callery pear (GBIF, 2021).

BOTANICAL DESCRIPTION: *Pyrus calleryana* is a deciduous ornamental tree that grows up to 40 feet tall and is usually less than one foot in diameter (Swearingen et al., 2010). It has a pyramidal to round crown shape, with glossy, leathery leaves and produces white flower clusters in early spring. Callery pear produces firm green to brown fruits up to 0.5 inches in size. It can be found in a variety of landscapes ranging from the edges of wetlands to mountain slopes. For a full botanical description see Culley and Hardiman, 2007.

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 AREA[1]: United States and Territories.

FOREIGN DISTRIBUTION: *Pyrus calleryana* is native to China, Japan, Korea, Taiwan and Vietnam where it grows in a range of environments from dry mountain slopes to the edges of pond waters (Culley, 2017; Nesom, 2000). Outside of its native range, it has been introduced to the western Himalayas and Iraq, but its establishment and spread status is unknown (Kew, 2022). Callery pear is deemed a weed in Australia and has been observed in Canada and across Europe (Csurhes and Edwards, 1998; GBIF, 2021; GISD, 2022).

U.S. DISTRIBUTION AND STATUS: *Pyrus calleryana* is distributed throughout most of the eastern United States. It was first planted as an ornamental tree in residential areas beginning as early as the 1950's (Vincent, 2005), and over 300,000 trees were planted by the 1980's (Dirr, 1998). Currently, over 10 cultivars are sold in nurseries, and it is frequently used as rootstock (Culley et al., 2022). Originally thought to be self-incompatible and fairly sterile, the presence of different cultivars allowed for cross pollination, and it has since spread rapidly outside of its intentional plantings

[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).

(Culley and Hardiman, 2007). Callery pear is now listed on the state invasive species list in Alabama, California, Delaware, Georgia, Indiana, Kentucky, Maryland, Pennsylvania, Oregon, Virginia, Rhode Island, South Carolina, Tennessee, and West Virginia (Swearingen and Bargeron, 2016). The Woody Invasives of the Great Lakes Collaborative reports that Callery pear is not regulated in the Great Lakes Region except for in Ohio, where sales were set to be phased out by January 2023 (WIGL, 2022). South Carolina took the next step and banned sales beginning in 2024 (College of Agriculture & Public Service and Agriculture, 2021). It will also be regulated as a noxious weed in Pennsylvania with plans to stop its sale and distribution over the next two years (Pennsylvania Department of Agriculture). A ban has also passed the state House in Missouri and awaits action in the Senate (Missouri Senate, 2025).

Analysis

ESTABLISHMENT/SPREAD POTENTIAL: *Pyrus calleryana* is widely distributed throughout the U.S. and many factors influence its ability to continue spreading. It forms dense thickets from its shallow root system sending up multiple shoots, otherwise known as suckering (Culley and Hardiman, 2007; WIGL, 2022). Cutting down trees, nicking the roots while mowing, and prescribed fire can encourage suckering (Culley and Hardiman, 2007; Warrix and Marshall, 2018). Additionally, although pear trees tend to be self-incompatible, the presence of many different cultivars of *P. calleryana* allow it to cross pollinate and produce viable seed (Culley and Hardiman, 2007). It is commonly used as rootstock for edible pears; if suckers form, they can cross pollinate with the scion wood as well (Culley and Hardiman, 2009). Fruits may contain up to 10 viable seeds, and either drop to the ground to contribute to the thicket growth pattern or are eaten and dispersed greater distances (Culley, 2019). Seeds have varying degrees of dormancy, require a cold period, and remain viable up to 11 years (Dirr, 1990; Serota and Culley, 2019). *P. calleryana* can inhabit a wide range of climates and the effects of climate change may increase its prevalence in the Great Lakes Region (WIGL, 2022). We had Low uncertainty for this risk element.

Risk score 11.0 Uncertainty index 0.08

IMPACT POTENTIAL: In natural systems, *Pyrus calleryana* invades highly disturbed areas such as old fields, roadsides, and restored wetlands (Culley and Hardiman, 2007). It leafs out earlier than native plants in the spring, and keeps its leaves late in the fall, potentially shading out the understory and interrupting succession (GISD, 2022; Johnson, 2018; Missouri Department of Conservation, 2018; WIGL, 2022). The thickets prevent the movement of wildlife (Culley and Hardiman, 2007). Its vegetation is not preferred by specialist or generalist herbivores, which might reduce native vegetation (Hartshorn et al., 2022). There is also less of a food source for birds if insects are not feeding on the leaves (Clemson Cooperative Extension). In residential areas, they are a nuisance due to their weak architecture causing branches to fall, pungent odor, and fruits making sidewalks slippery and unsightly (Culley and Hardiman, 2007; Dirr, 1998: Vincent, 2005). One example of action being taken is the Bradford Pear Bounty program started by Clemson Cooperative Extension, which encourages residents to remove trees and replace them with native species for free (Clemson Cooperative Extension, n.d.). We had Low uncertainty for this risk element.

Risk score 2.8 Uncertainty index 0.12

GEOGRAPHIC POTENTIAL: Using the PPQ climate-matching model for weeds (Magarey et al., 2017), we estimate that about 60.1% percent of the United States is suitable for the establishment of *P. calleryana* (Fig. 1). This area represents the joint distribution of Plant Hardiness Zones 5a-10b, areas with 10-80 inches of annual precipitation, and the following Köppen-Geiger climate classes: cold arid desert, hot arid desert, cold arid steppe, temperate dry summer hot and warm-summers, temperate dry winter hot-summer, temperate no dry season hot and warm-summers, cold dry winter hot-summer, cold no dry season hot and warm-summers (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 *Pyrus calleryana* interactions may alter the areas in which this *Pyrus calleryana* is likely to establish. Callery pear can be found in a variety of landscapes ranging from the edges of wetlands to mountain slopes.

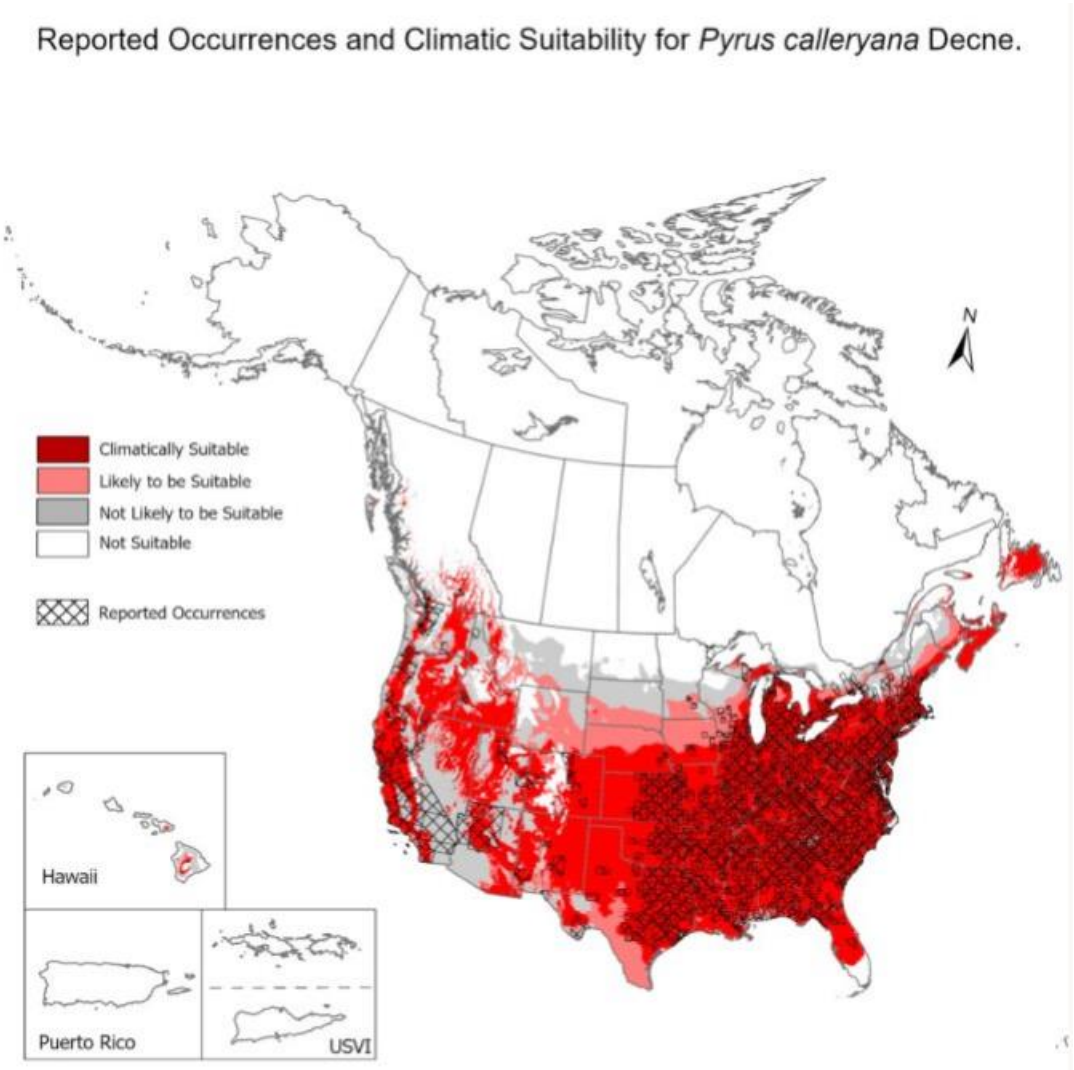

Figure 1. Current and potential distribution of *Pyrus calleryana* in the United States. Climatic suitability was determined using the APHIS-PPQ climate matching tool for invasive plants (Magarey et al., 2017). The known distribution of *P. calleryana* was based on county distribution records from online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

ENTRY POTENTIAL: We did not assess the entry potential of *Pyrus calleryana* because it is already present in the United States (Culley and Hardiman, 2007) (Fig. 1).

Risk Model Results

Model Probabilities: P(Major Invader) 53.5%
P(Minor Invader) 43.9%
P(Non-Invader) 2.6%
Risk Result = High Risk
Risk Result after Secondary Screening = Not applicable

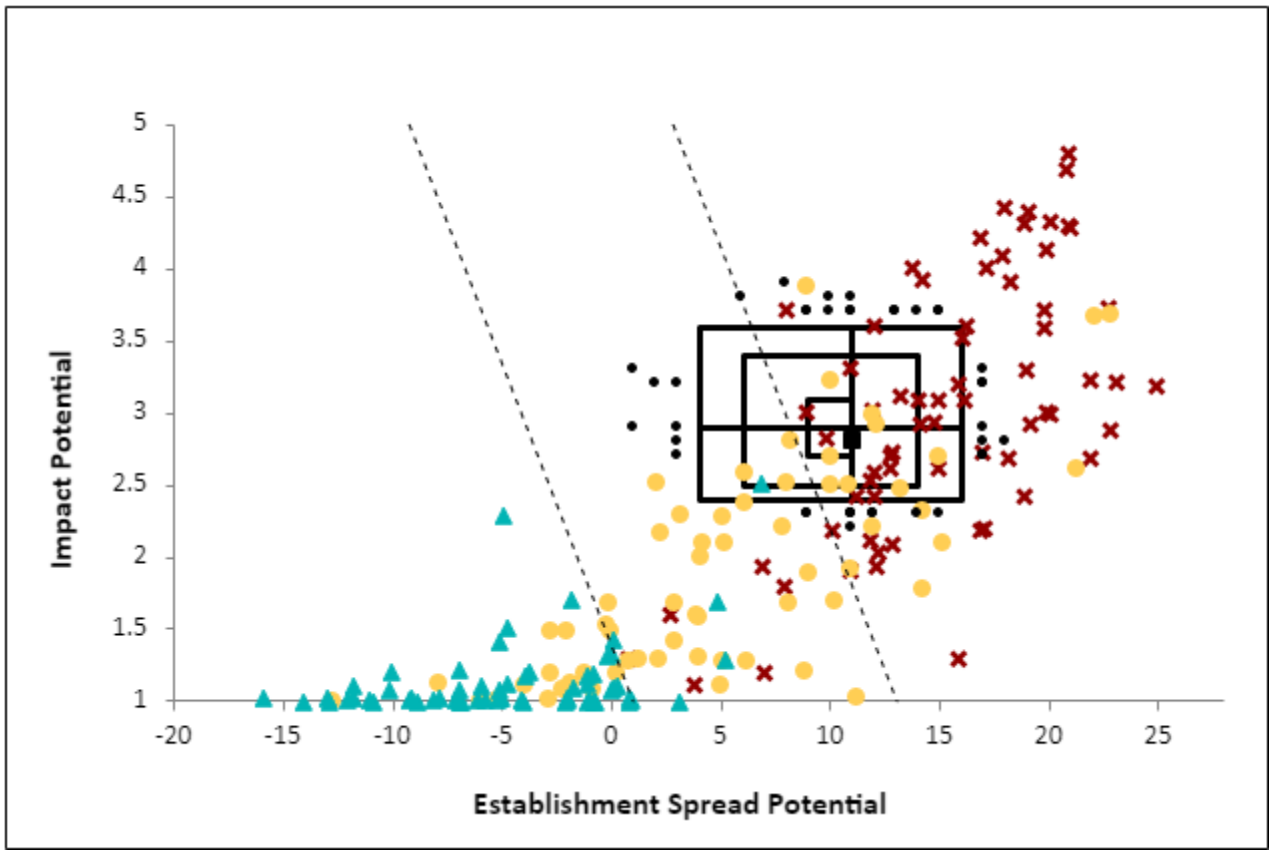

Figure 2. Risk and uncertainty results for *Pyrus calleryana*. The risk score for *P. calleryana* (solid black symbol) is plotted relative to the risk scores of *Pyrus calleryana* used to develop and validate the PPQ WRA model (Koop et al., 2012). The results from the uncertainty analysis are plotted around the risk score for *Pyrus calleryana*. 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 (N5000). For additional information on the uncertainty analysis used, see Caton et al. (2018).

Discussion

The result of the weed risk assessment for *Pyrus calleryana* is High Risk of becoming weedy or invasive in the United States. *P. calleryana* has escaped cultivation and become invasive due to its rapid growth, persistent seed bank that is dispersed by birds, and its ability to form dense thickets through suckering. This tree was once favored as a residential ornamental species and is still commonly sold at garden centers in more than 10 different cultivars (Culley et al., 2022). Usually self-incompatible, the presence of multiple cultivars allows for cross-pollination and hybridization. Callery pear is also used as rootstock for growing edible pears, and can cross pollinate with the scion. This has led to the spread and creation of naturalized populations outside of cultivation. In natural areas it crowds out native vegetation and herbivory actually increases the growth rate and spread of Callery pear, making it an even greater threat (Gawkins, 2019). *P. calleryana* can withstand a variety of climates and its suitable range is projected to spread rapidly according to climate change scenarios (Liu et al., 2018). It is prone to breakage as it ages, posing a threat to cars, buildings, and powerlines in cities. Compared with other ornamental trees in residential areas, Callery pear is also the least cost-effective option for carbon abatement based on its size and relatively short longevity of 25 years (Kovacs et al., 2013). The development of sterile cultivars in recent years may be a viable way for people to enjoy the benefits of pretty, flowering trees in their landscaping without the harmful effects of this invasive (Phillips et al., 2016), provided they are also sterile when crossed with other cultivars. It is already present across the state of Michigan, but preventing further spread from hybridization and escaping cultivation will protect natural lands (GBIF, 2021).

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Appendix A. Weed risk assessment for *Pyrus calleryana* Decne. (Rosaceae)

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]	f - low	5	Callery pear is native to Asia (China, Taiwan, Korea, Vietnam, Japan) where it inhabited a variety of landscapes (Culley, 2017; Nesom, 2000). It was also introduced to Iraq and places in the West Himalaya, but its establishment and spread status is unknown (Kew, 2022). Callery pear is a weed in Australia and has been observed in Canada and across Europe (Csurhes and Edwards, 1998; GBIF, 2021; GISD, 2022). It was introduced to the United States in the early 1900s by plant explorers who observed its rapid growth and resistance to fire blight in China, and were hoping to use it as rootstock to grow common pear. It has been recognized as an invasive across the U.S. (Swearingen et al., 2010). Now it is present in half of the United States including Alabama, Arkansas, California, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Michigan, Mississippi, Missouri, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, and West Virginia (Kew, 2022).
ES-2 (Is the species highly domesticated)	n - mod	0	This species has been propagated and sold as a landscaping tree since the 1960's (Jackson and Wurzbacher, 2020). Cultivars have been selected for vibrant fall colors, increased flowering, or to not produce spurs. Some of the common cultivars are 'Bradford', 'Whitehouse', 'Autumn Blaze', and 'Aristocrat' However, little work has been done to reduce its weediness (Culley and Hardiman, 2007). Researchers at North Carolina State University have developed a triploid variety 'Chastity' which reduces seed production by 99.14%. The viablity of any seeds produced has not been determined (Dirr and Warren, 2019; Phillips et al., 2016).
ES-3 (Significant weedy congeners)	n - mod	0	Although some Pyrus species were listed as weeds, it is unclear if these are significant

Question ID	Answer - Uncertainty	Score	Notes (and references)
			(Randall, 2012). Pyrus communis (common pear) and Pyrus betulifolia Bunge (birch-leaf pear) are both listed in the Invasive Plant Atlas of the U.S. (Swearingen and Bargeron, 2016). Hybridization between theses species has been reported (Nesom, 2000).
ES-4 (Shade tolerant at some stage of its life cycle)	n - negl	0	Callery pear is commonly found in open areas where there is high light. It does not tolerate shade well and even in its native range, will not be found in the forest understory. It grows in areas where it can create a monoculture (Clatterbuck, 2005; Culley and Hardiman, 2007). May tolerate partial shade and invade forest interiors over time (Culley, 2019).
ES-5 (Plant a vine or scrambling plant, or forms tightly appressed basal rosettes)	n - negl	0	Since callery pear is a tree, it does not have these growth habits (GISD, 2022).
ES-6 (Forms dense thickets, patches, or populations)	y - negl	2	P. calleryana has a shallow root system that sends up many shoots, forming dense thickets (Culley and Hardiman, 2007; WIGL, 2022). These patches may have trees of varying ages, where multiple generations are present (Vincent, 2005). Any fruit left uneaten by birds falls to the ground and also contributes to the patches of trees (Culley, 2019).
ES-7 (Aquatic)	n - negl	0	This is a terrestrial species (GISD, 2022).
ES-8 (Grass)	n - negl	0	Family: Rosaceae (GBIF, 2021).
ES-9 (Nitrogen-fixing woody plant)	n - negl	0	There is no evidence that callery pear is nitrogen fixing, nor is there evidence of this trait in the Rosaceae plant family (Martin and Dowd, 1990).
ES-10 (Does it produce viable seeds or spores)	y - negl	1	Through cross-pollination with different cultivars or between individuals with differing self-incompatibility alleles, this species can produce viable seeds. Viability ranges from 68% to 95% between cultivars, averaging 81% (Hardiman & Culley, 2010). Seeds may require a cold period of between 32-36°F (Dirr, 1990).
ES-11 (Self-compatible or apomictic)	n - negl	-1	Pyrus calleryana is self-incompatible meaning it cannot produce viable seeds through self-pollination (Culley and Hardiman, 2007).
ES-12 (Requires specialist pollinators)	n - negl	0	The white flowers of callery pear are attractive to generalist insects including honeybees, bumblebees, hoverflies and other insect pollinators (Farkas et al. 2002).
ES-13 [What is the taxon's minimum generation time? (a) less than a year	c - low	0	Trees may produce seed within 3 years (Culley and Hardiman, 2007). However,

Question ID	Answer - Uncertainty	Score	Notes (and references)
with multiple generations per year; (b) 1 year, usually annuals; (c) 2 or 3 years; (d) more than 3 years; or (?) unknown]			generally pear species produce fruit within 4 years (Bell and Zimmerman, 1990).
ES-14 (Prolific seed producer)	y - high	1	Information on seed production varies. Production from the cultivar 'Aristocrat' was observed to be between 1-4 seeds per fruit, averaging 1.6 (Nesom, 2000). Usually, there will be between 2-6 seeds per fruit, but may be up to 10, and each tree may produce hundreds of flowers (Culley and Hardiman, 2007; Culley and Hardiman, 2009). A previous risk assessment completed by the Maryland Department of Agriculture describes personal observations of prolific seed production (2017). There is not extensive literature to support this as it has not been studied.
ES-15 (Propagules likely to be dispersed unintentionally by people)	n - mod	-1	Humans may mediate spread by sweeping the sidewalk to clear dropped fruit, however this is not a significant source of dispersal. It is unlikely to be moved by human activity.
ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers)	n - low	-1	The nature of the fruits prevents it from being a contaminant in these scenarios.
ES-17 (Number of natural dispersal vectors)	2	0	0
ES-17a (Wind dispersal)	n - low		Due to the size (0.5 in) and weight of the fruits, there is not a good wind dispersal mechanism to aid in this movement (Swearingen et al. 2010; WIGL, 2022).
ES-17b (Water dispersal)	n - mod		Not a likely mechanism of dispersal (Swearingen et al. 2010), seeds are spread primarily through birds, and vegetatively spread through suckering (Culley and Hardiman, 2007).
ES-17c (Bird dispersal)	y - negl		The fruits are readily eaten by birds such as the American robin and European starlings, aiding in seed dispersal (Gilman and Watson 1994, Swearingen et al. 2002).
ES-17d (Animal external dispersal)	n - mod		Could not find evidence for the movement of seeds or fruits by animals externally. Additionally, there doesn't seem to be a mechanism by which this would be possible due to the size and shape of the fruits.
ES-17e (Animal internal dispersal)	y - high		Possibly small mammals but there is no direct evidence in the literature (Miller et al., 2015; OK Invasives, 2020).
ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed)	y - negl	1	Research has shown that seeds are viable and will germinate after 11 years (Serota and Culley, 2019). Germination rates of these 11 year old seeds were between 45-87%. There are varying degrees of seed dormancy among cultivars, with some seeds

Question ID	Answer - Uncertainty	Score	Notes (and references)
			germinating immediately and others over time.
ES-19 (Tolerates/benefits from mutilation, cultivation or fire)	y - negl	1	Trees at least 2 years in age benefit from prescribed fire, becoming multistemmed with the potential to produce more flowers and fruits (Warrix and Marshall, 2018). Mowing has the same effect, where additional sprouts grow up from the root system. If a tree is cut down, systemic herbicides should also be applied to prevent regrowth from cut places in the stem (Culley and Hardiman, 2007).
ES-20 (Is resistant to some herbicides or has the potential to become resistant)	n - negl	0	There are no cases of herbicide resistance reported for this species or Genus (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)	7	2	
ES-23 (Number of precipitation bands suitable for its survival)	10	1	
IMPACT POTENTIAL			
General Impacts			
Imp-G1 (Allelopathic)	n - high	0	Callery pear could be allelopathic, according to an interview given by Dr. Theresa Culley from the University of Cincinatti (Jasch, 2011). However, could not find direct evidence in the literature. Listed as not allelopathic on the USDA PLANTS Database (USDA NRRCS, 2022).
Imp-G2 (Parasitic)	n - negl	0	Callery pear is not known to be parasitic.
Impacts to Natural Systems			
Imp-N1 (Changes ecosystem processes and parameters that affect other species)	n - low	0	There is little research on how Callery pear affects ecosystem processes. It was hypothesized that similar to other invasive woody species, leaf litter decomposition would be accelerated, altering nutrient cycling. However, according to a recent study on P. calleryana leaf litter decomposition, it is not likely to affect invaded forests (Boyce, 2022).
Imp-N2 (Changes habitat structure)	y - mod	0.2	Callery pear trees may interrupt succession (GISD, 2022). It also could shade out native understory plants as it leafs out earlier in the spring and is one of the last species to lose its leaves in the fall (Johnson, 2018; Missouri Department of Conservation, 2018; WIGL, 2022). The thicket patches can be half to multiple acres (Jasch, 2011).
Imp-N3 (Changes species diversity)	y - mod	0.2	The thickets displace native vegetation and may prevent movement of wildlife (Culley

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			and Hardiman, 2007; WIGL, 2022). One study showed that both specialist and generalist herbivores favor native vegetation over Callery pear, which could change multiple trophic levels (Hartshorn et al., 2022). If insects are not feeding on the leaves, then there is even less of a food source for birds (Clemson Cooperative Extension, n.d.). Shading could provide the perfect enviroment for another invasive, honeysuckle, to take over the understory (Johnson, 2018).
Imp-N4 (Is it likely to affect federal Threatened and Endangered species?)	y - mod	0.1	Callery pear invades disturbed areas including old fields, roadsides and restored wetland prairies (Culley and Hardiman, 2007). Though there is no definite evidence of particular Federal threatened and endangered species being affected, if Callery pear is present in their habitat, it can change habitat structure and species diversity in general, as described above.
Imp-N5 (Is it likely to affect any globally outstanding ecoregions?)	y - mod	0.1	P. calleryana is present in a number of ecoregions, and is likely to affect habitat structure and species diversity as described above.
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	Callery pear is found along forest edges, roadsides, in old fields, and hedgerows (Jackson and Wurzbacher, 2020). They form dense thickets that shade out the understory and can prevent the movement of wildlife and may be impenetrable to humans (Culley and Hardiman, 2007; GISD, 2022).
Impact to Anthropogenic Systems (e.g., cities, suburbs, roadways)			
Imp-A1 (Negatively impacts personal property, human safety, or public infrastructure)	y - low	0.1	The 'Bradford' cultivar is prone to breaking as it gets older and cannot longer withstand the weight of its own branches due to the angle of its branch architecture (Dirr, 1998). This means the limbs are a threat to powerlines, homes, and may cause damages in residential areas where they are planted (Vincent, 2005). In addition, the thorns or spurs can be up to 3 inches long in some cases and downed branches can pop tires. It also makes removal efforts difficult. Callery pear trees produce an unpleasant smell when flowering, and the fruits create unsightly and slippery sidewalks (Culley and Hardiman, 2007; Culley, 2017).
Imp-A2 (Changes or limits recreational use of an area)	n - negl	0	There is no direct evidence for callery pear limiting recreational use.

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Imp-A3 (Affects desirable and ornamental plants, and vegetation)	y - high	0.1	If there are nearby Callery pear trees, seeds or suckers may become weeds in lawns and flowerbeds (White et al., 2005).
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]	c - negl	0.4	Cities have been forced to remove trees due to their weak nature (Culley and Hardiman, 2007). Due to this, their pungent odor when flowering, and invasive traits, the Clemson Cooperative Extension has a Bradford Pear Bounty program which encourages residents to remove trees and replace them with native species for free (Clemson Cooperative Extension, n.d.). It is being regulated in Ohio, where sales are set to be phased out by January 2023. South Carolina took the next step and banned sales beginning in 2024 (College of Agriculture & Public Service and Agriculture, 2021). Callery pear is also regulated as a noxious weed in Pennsylvania with plans to stop its sale and distribution over the next two years (Pennsylvania Department of Agriculture).
Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)			
Imp-P1 (Reduces crop/product yield)	n - high	0	Callery pear may serve as an alternate host for pathogens and insects important for food crops. It is a host for quince rust, a major pathogen in apples, chili thrips, and spongy moth and a minor host of the apple aphid, brown marmorated stink bug, powdery mildew of apple and European pear rust (CABI, 2019).
Imp-P2 (Lowers commodity value)	n - low	0	Found no evidence that Callery pear lowers the value of any commodity. It is used as rootstock for common pear for fireblight resistance (GISD, 2021).
Imp-P3 (Is it likely to impact trade?)	n - low	0	Callery pear is not likely to impact trade.
Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water)	n - low	0	This species is fairly tolerant of drought and would not strongly compete with plants for irrigation water (Culley and Hardiman, 2007).
Imp-P5 (Toxic to animals, including livestock/range animals and poultry)	n - high	0	Listed as severely toxic on USDA PLANTS Database (USDA NRCS, 2022). Pear species seeds cause major toxicity if ingested by humans (University of California, 2022). Not listed as toxic to livestock animals (Cornell University, 2022).
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 - low	0	Callery pear is not managed as a weed in production systems.

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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	Will not tolerate temperatures less than -28°C (Culley and Hardiman, 2007).
Geo-Z2 (Zone 2)	n - negl	N/A	Will not tolerate temperatures less than -28°C (Culley and Hardiman, 2007).
Geo-Z3 (Zone 3)	n - negl	N/A	Cultivars cannot withstand temperatures of -36°C (Vincent, 2005).
Geo-Z4 (Zone 4)	n - high	N/A	Will not tolerate temperatures less than -28°C (Culley and Hardiman, 2007).
Geo-Z5 (Zone 5)	y - negl	N/A	Present in US in MI, IL.
Geo-Z6 (Zone 6)	y - negl	N/A	Present in US in OH, KY, NY, PA, VA, WV, MO, MI.
Geo-Z7 (Zone 7)	y - negl	N/A	Present in US in MI, TN, NC, SC, AR, GA.
Geo-Z8 (Zone 8)	y - negl	N/A	Present in US in MS, AL, FL, NC, SC, GA, LA, TX.
Geo-Z9 (Zone 9)	y - negl	N/A	Present in US in TX, LA, FL as well as in China.
Geo-Z10 (Zone 10)	y - low	N/A	Points in San Francisco and L.A., CA as well as in China.
Geo-Z11 (Zone 11)	y - low	N/A	Present in China, places in California may be in this zone as well.
Geo-Z12 (Zone 12)	y - low	N/A	Present in China.
Geo-Z13 (Zone 13)	n - negl	N/A	For the U.S., Puerto Rico is the only place in this zone and there are no recorded points there.
Köppen -Geiger climate classes			
Geo-C1 (Tropical rainforest)	n - negl	N/A	No points referenced.
Geo-C2 (Tropical savanna)	y - high	N/A	Occurrence in Laos.
Geo-C3 (Steppe)	y - low	N/A	Present in China.
Geo-C4 (Desert)	n - negl	N/A	No points referenced.
Geo-C5 (Mediterranean)	y - negl	N/A	Present in California.
Geo-C6 (Humid subtropical)	y - negl	N/A	Most of the southeastern US and China.
Geo-C7 (Marine west coast)	y - negl	N/A	Points in the US in VA, Australia, China, France, Luxembourg, Spain.
Geo-C8 (Humid cont. warm sum.)	y - negl	N/A	Northeastern/Great Lakes Region in the US.
Geo-C9 (Humid cont. cool sum.)	y - negl	N/A	Northeastern/Great Lakes Region in the US.
Geo-C10 (Subarctic)	n - negl	N/A	No points referenced.
Geo-C11 (Tundra)	n - negl	N/A	No points referenced.
Geo-C12 (Icecap)	n - negl	N/A	No points referenced.
10-inch precipitation bands			
Geo-R1 (0-10 inches; 0-25 cm)	n - mod	N/A	Points in Egypt - possibly invalid.
Geo-R2 (10-20 inches; 25-51 cm)	y - low	N/A	California, New Mexico, Texas
Geo-R3 (20-30 inches; 51-76 cm)	y - negl	N/A	California, New Mexico, Texas
Geo-R4 (30-40 inches; 76-102 cm)	y - negl	N/A	Great Lakes Region and Appalachia

Question ID	Answer - Uncertainty	Score	Notes (and references)
Geo-R5 (40-50 inches; 102-127 cm)	y - negl	N/A	Great Lakes Region, Eastern and southeastern US
Geo-R6 (50-60 inches; 127-152 cm)	y - negl	N/A	Eastern and southeastern US
Geo-R7 (60-70 inches; 152-178 cm)	y - negl	N/A	Eastern and southeastern US
Geo-R8 (70-80 inches; 178-203 cm)	y - negl	N/A	Eastern and southeastern US
Geo-R9 (80-90 inches; 203-229 cm)	y - negl	N/A	Eastern and southeastern US
Geo-R10 (90-100 inches; 229-254 cm)	y - mod	N/A	Eastern and southeastern US
Geo-R11 (100+ inches; 254+ cm)	y - low	N/A	Eastern and southeastern US
ENTRY POTENTIAL			
Ent-1 (Plant already here)	y - negl	1	Introduced to the United States in the early 1900's and now widespread.
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	