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

Maryland Department of Agriculture

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Version 2

Left: Trees along a road in spring bloom. (source: Lane Heimer). Top right: A cluster of flowers. Bottom right: fruit and leaves. (source: Sylvan Kaufman).

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**Introduction** The Maryland Department of Agriculture regulates terrestrial ornamental invasive plants under the authority of Md. AGRICULTURE Code Ann. § 9.5-101 et seq. Invasive Plant Prevention and Control. An invasive plant is defined as "a terrestrial plant species that a) did not evolve in the State, and b) if introduced within the State, will cause or is likely to cause, as determined by the Secretary: economic harm; ecological harm; environmental harm; or harm to human health."

Maryland's Invasive Plant Advisory Committee (IPAC) was established by legislative mandate in October 2011. The IPAC's primary responsibility is to advise the Secretary of Agriculture on regulating the sale of invasive plants, and on preventing them from entering Maryland or from spreading further in the state. The IPAC evaluates the risk potential of plants already present in Maryland, newly detected in the Maryland or the United States, those proposed for import, and those emerging as weeds elsewhere in the world.

The IPAC evaluates the potential invasiveness of plants using the weed risk assessment (WRA) process developed by the Plant Protection and Quarantine (PPQ) Program of the US Department of Agriculture's Animal and Plant Health Inspection Service (Koop et al. 2012). PPQ's risk model uses information about a species' biological traits and behavior to evaluate its risk potential (Koop et al. 2012).

Because the PPQ WRA model is geographically and climatically neutral, it can be used to evaluate the baseline invasive/weed potential of any plant species for the entire United States, or for any specific region in the United States. In the PPQ process, the geographic potential of the species is evaluated separately so that risk managers can make decisions appropriate for their regions. With respect to Maryland's evaluation process, we use PPQ's Geographic Information System overlays of climate to evaluate the potential for a plant to establish and grow in Maryland. The PPQ weed risk assessment also uses a stochastic simulation to evaluate how the uncertainty associated with the assessments affects the model's predictions. Detailed information on the PPQ WRA process is available in the document, *Guidelines for the USDA-APHIS-PPQ Weed Risk Assessment Process* (APHIS PPQ 2015), which is available upon request.

The IPAC uses a second tool, the Maryland Filter, to assign plant species that score as highly invasive either Tier 1 or Tier 2 status. Maryland regulations define Tier 1 plants as "invasive plant species that cause or are likely to cause severe harm within the State" and Tier 2 plants as "invasive plant species that cause or are likely to cause substantial negative impact within the State." The Maryland Filter considers the actual and potential distribution of a species in Maryland, its threat to threatened and endangered ecosystems and species in the state, the difficulty of control of the species, and whether added propagule pressure would be likely to increase its persistence and spread significantly. The IPAC then recommends regulations to reduce the risk of the Tiered invasive plants in Maryland.

| | ***Pyrus calleryana* Decne. – Callery pear** |
|---|---|
| **Species Information** | Family: Rosaceae<br>Synonyms: *Pyrus calleryana; Pyrus kawakamii; Pyrus koehnei*<br>Common names: Callery pear, Bradford pear (ARS 2016). 'Bradford' was the name of the first cultivar of Callery pear but is often used to refer to the species.<br>Botanical description: Callery pear is a deciduous tree growing to 30-50 feet tall. Alternate, ovate leaves turn scarlet and purple in fall. Trees have showy clusters of five-petaled white flowers in spring followed by small round pomes that ripen in the fall (Dirr 2009). Trees naturalize in disturbed areas along roadsides and in abandoned lots and fields as well as in areas undergoing restoration (Dirr 2009).<br>Initiation: This plant is listed on the MD Department of Natural Resources (DNR) Do Not Plant List, a policy document available from MD DNR, which lists approximately 90 plant species that may not be planted on DNR land or for DNR projects.<br>Foreign distribution: Callery pear is native to China, Taiwan, Japan, Korea and Vietnam (Culley and Hardiman 2007). Callery pear is present in Australia and is just beginning to naturalize (GBIF 2017, GISD 2016).<br>U.S. distribution and status: Callery pear is distributed from Maine to Florida and west to KS, OK, and TX. It is also naturalized in some parts of Utah and California (Kartesz 2016).<br>WRA area[1]: Entire United States, including territories. |

Summary Statement

*Pyrus calleryana* scored as High Risk under the PPQ WRA model because of its adaptability, rapid growth in sunny conditions, early maturity, ability to set seed despite reported self-incompatibility, aggressive growth, ability to spread through sprouting even after damage, and production of many seeds that are bird dispersed. The species forms dense thickets in natural areas and its progeny sport thorns that can cause damage to machinery tires. The species received a Tier 2 ranking in the Maryland Filter analysis because although it has negative impacts on rare species, Callery pear is already widely distributed in the state, is quite difficult to control, and its continued sale is not expected to increase propagule pressure significantly within the state.

1. *Pyrus calleryana* analysis

**Establishment/ Spread Potential**

Callery pear produces numerous fruits; estimates range from under 200 to 3600 per square meter of tree canopy. Published counts of fruits/tree, however, are not available (Nesom 2000). Fruits are dispersed by birds and possibly by other animals (Culley and Hardiman 2007). It forms dense thickets from seeds and root sprouts of established trees (Culley and Hardiman 2007, Vincent 2005). Damage to roots leads to suckering (Jasch 2011).

Risk score = 11 Uncertainty index = 0.06

[1] "WRA area" is the area in relation to which the weed risk assessment is conducted [definition modified from that for "PRA area"] (IPPC 2012).

**Impact Potential**

Impacts on natural systems have been poorly studied in Callery pear. It does change habitat structure, invading grasslands (Taylor et al. 1996) and prairie wetlands (Culley and Hardiman 2007) as it forms a dense tree thicket (Jasch 2011). Because it forms dense thickets (Heimer 2017) it is likely to change species diversity, but most evidence is based on general observations (Swearingen et al. 2010, Missouri Dept. of Conservation 2012). Callery pears are present in globally outstanding ecoregions and impact State-listed rare, threatened or endangered species. Trees are controlled in natural areas (Maryland DNR 2014, USFS 2005, Missouri Dept. of Conservation 2012). In anthropogenic systems, 'Bradford' cultivars were removed from plantings because poor branching patterns led to breakage, and the fruits created a walking hazard (Culley and Hardiman 2007). We found no evidence for impacts to production systems although the seeds have some toxicity to animals (University of California 2016).

Risk score = 2.9 Uncertainty index = 0.08

**Geographic Potential**

Based on three climatic variables, we estimate that almost 68 percent of the United States is suitable for the establishment of *Pyrus calleryana* (Fig. 1). This predicted distribution is based on the species' known distribution elsewhere in the world and includes point-referenced localities and areas of occurrence. The map for *Pyrus calleryana* represents the joint distribution of Plant Hardiness Zones 5-12, areas with 10 to over 100 inches of annual precipitation, and the following Köppen-Geiger climate classes: Tropical savannah, Steppe, Mediterranean, Humid subtropical, Marine West coast, Humid continental warm summers and Humid continental cool summers.

The occurrence of an apparently temperate tree in the tropical Plant Hardiness Zones 11 and 12, in Taiwan, is explained by the synonymy *of P. calleryana* and *P. kawakamii* (Bell and Itai 2011, ITIS 2017). *Pyrus kawakamii* is an evergreen form of the more commonly known deciduous *P. calleryana.* Wild plants documented in Taiwan are reported under both names (GBIF 2017). In addition, although the GBIF database does not include documented locations of this plant in Vietnam, the USDA Agricultural Research Service indicates the species is native to Vietnam (ARS 2016), which is largely in Plant Hardiness Zones 11 and 12.

The area of the United States shown to be climatically suitable (Fig. 2) for species establishment considered only three climatic variables. Other variables, for example, soil and habitat type, novel climatic conditions, or plant genotypes, may alter the areas in which this species is likely to establish. Callery pear generally grows best in open, sunny conditions, but has wide tolerance for moisture levels and soil conditions (Dirr 2009, Page and Olds 2001). As an escape from cultivation, the plant occurs most frequently in open fields, roadsides and disturbed sites. It is rarely found deep in the interior of intact forest.

**Entry Potential**

We did not assess the entry potential of *Pyrus calleryana* because it is already present in the United States (Kartesz 2016, ARS 2016).

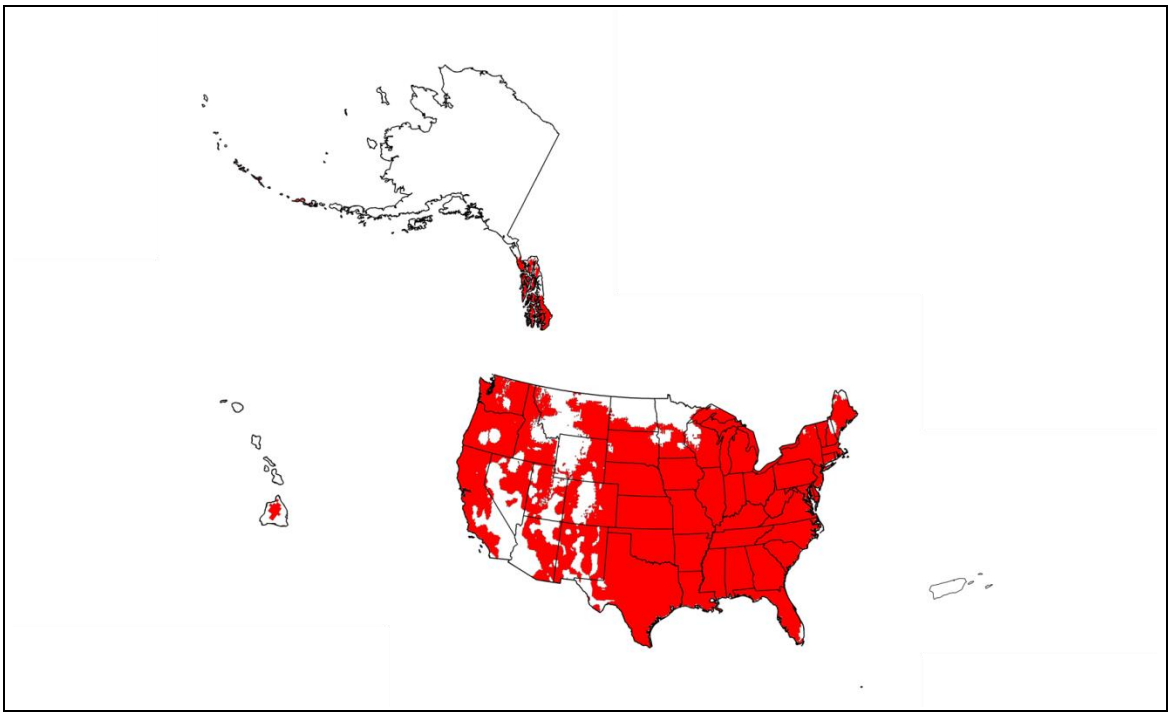

**Figure 1**. Predicted distribution of *Pyrus calleryana* in the United States. Map insets for Alaska, Hawaii, and Puerto Rico are not to scale.

## 2. Results

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

Risk Result = High Risk

Secondary Screening = Not Applicable

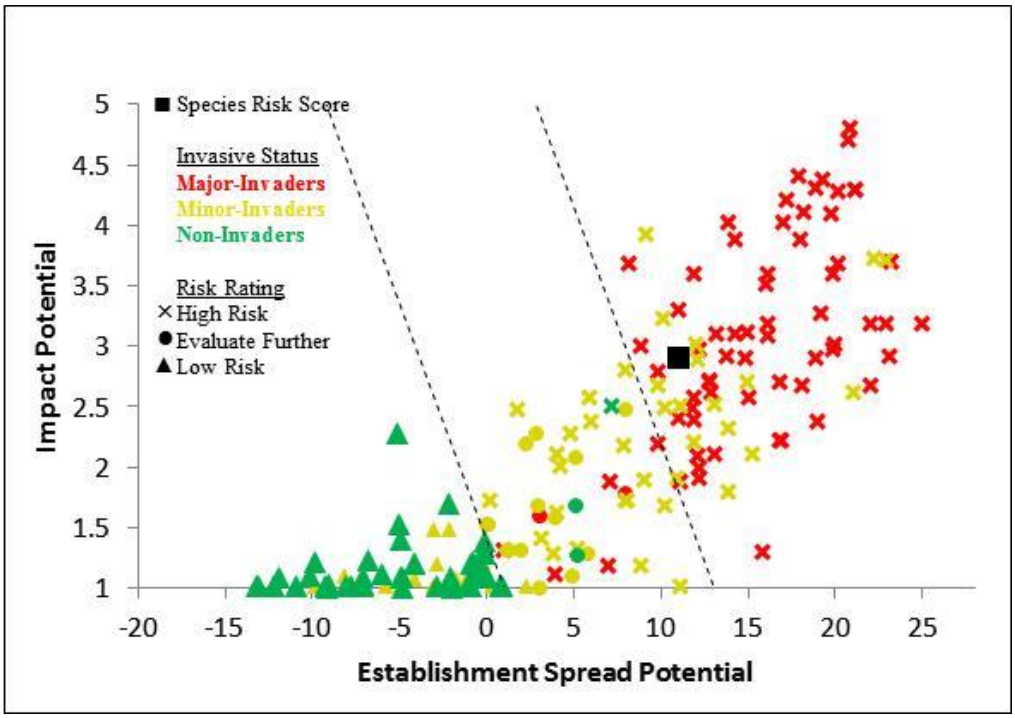


**Figure 2**. *Pyrus calleryana* risk score (black box) relative to the risk scores of species used to develop and validate the PPQ WRA model (other symbols). See Appendix A for the complete assessment.

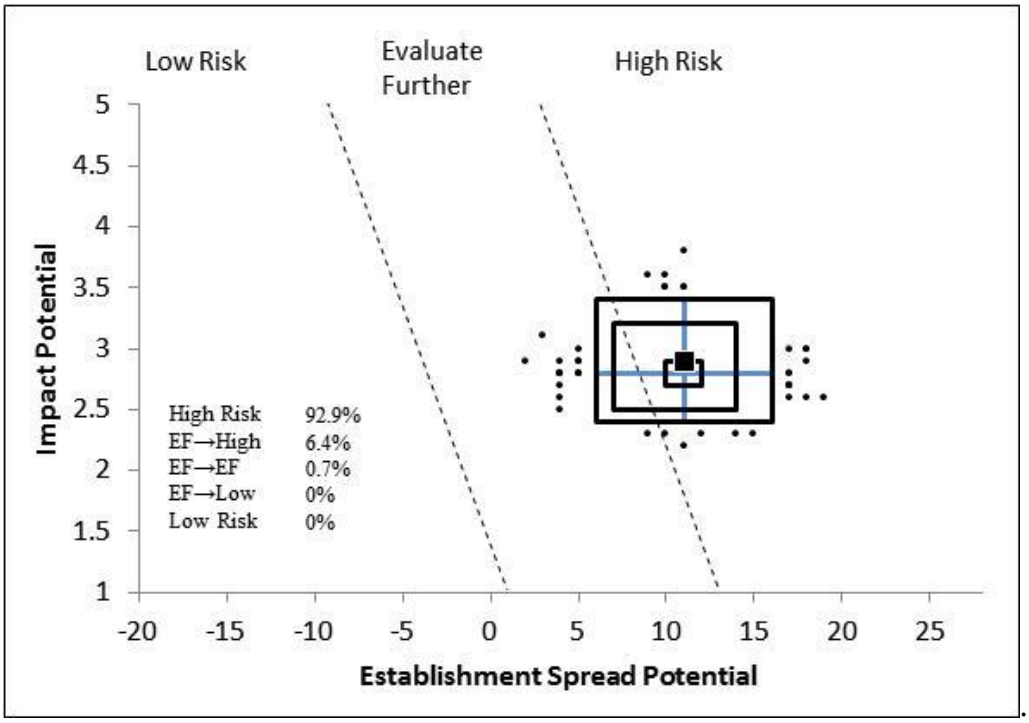


**Figure 3**. Model simulation results (N=5,000) for uncertainty around the risk score for *Pyrus calleryana*. The blue "+" symbol represents the medians of the simulated outcomes. The smallest box contains 50 percent of the outcomes, the second 95 percent, and the largest 99 percent.

## 3. Discussion

The result of the weed risk assessment for *Pyrus calleryana* is High Risk. *Pyrus calleryana* shares traits in common with other major invaders (Fig. 2) used to develop and validate the PPQ WRA model. Almost 93% of the simulated risk scores received a rating of High Risk (Fig. 3), indicating that our assessment is very robust. While the original cultivated variety of Callery pear introduced in the US – 'Bradford' – was not itself invasive due to pears' self-incompatibility, the development of many additional cultivars facilitated cross-pollination and the spread of hybrid offspring. Callery pears and their progeny occur outside of deliberate plantings from Maine to Florida, west to Kansas and Oklahoma, and occur in Washington, Idaho and California. The tree is widely adaptable to moisture, temperature and soil conditions (Page and Olds 2001). The species forms dense copses in sunny conditions, and responds to fire and cutting by producing numerous sprouts (Warrix 2016, White et al. 2005). When cross-pollinated by another cultivar, Callery pears cultivars produce thousands of fruits that are distributed by birds, with seeds that create long-lasting seed banks (Culley and Hardiman 2007). Callery pear is reported to shade out wildflowers and displace native species (Swearingen et al. 2010). In Maryland, Callery pear impacts documented occurrences of threatened or endangered species (Kyde 2017). The tree's tendency to split in wind storms, and the aggressive thorns sported by escaped offspring make it a nuisance as well as a safety hazard in anthropogenic systems, and it is actively controlled as a weed (Maryland DNR 2014, Maryland SHA 2003).

*Pyrus calleryana* ranks as a Tier 2 plant in the Maryland Filter (Appendix B). The species can affect native species diversity and does threaten rare native species. However, it has been present in the state for more than 100 years, sold commercially for more than 50, and is widely distributed outside formal plantings throughout the state. Substantial effort is required to control or manage these populations. Continuing sales would not be expected to increase the potential for this species' persistence and spread significantly.

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**Appendix A**. Weed risk assessment for *Pyrus calleryana* Decne. (Rosaceae). The following information came from the original risk assessment, which is available upon request (full responses and all guidance). We modified the information to fit on the page.

| 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 China, Taiwan, Japan, Korea and Vietnam. Seeds were introduced multiple times from 1916-1918, mostly from China, to agricultural experiment stations in Glendale, MD and Medford, OR. Callery pear was initially used as a rootstock for fruit production but the first ornamental cultivar was for sale by 1962 (Culley and Hardiman 2007). One reference indicates "Seedlings have begun to appear in many natural areas in the eastern United States," and "found in natural areas in at least 26 states" (Culley and Hardiman 2007). Vincent (2005) documented rapid spread in the United States based on herbarium specimens. Callery pear is present in Australia and is beginning to naturalize (GBIF 2017, GISD 2016). Alternative answers are "e" and "d." |
| ES-2 (Is the species highly domesticated) | n - low | 0 | Numerous cultivars of *Pyrus calleryana* have been selected, however they were selected for traits such as better branching structure and fall color, not for any traits reducing weed potential (Culley and Hardiman 2007; Kuser et al. 2001). Triploid Callery pears are under development (Phillips et al. 2016, Jasch 2011). |
| ES-3 (Weedy congeners) | n - high | 0 | *Pyrus communis* is a widespread and locally abundant escapee in Ontario, Canada but is not considered a major threat to biodiversity (Catling and Mitrow 2008). *Pyrus communis* was introduced into Japan and has hybridized with native *Pyrus* species in the wild (Iketani and Katayama 2012). Several other species of *Pyrus* are listed as weedy by Randall (2012) including *P. angustifolia, P. arbutifolia, P. coronaria, P. ioensis,* and *P. ussuriensis*. It is not clear that these species are considered significant weeds. |
| ES-4 (Shade tolerant at some stage of its life cycle) | n - mod | 0 | Described as intolerant of shade (Clatterbuck 2005). Can tolerate part shade (GISD 2016). |
| ES-5 (Plant a vine or scrambling plant, or forms tightly appressed basal rosettes) | n - negl | 0 | No, this plant is a tree and is not a vine or herbaceous plant (ARS 2016). |
| ES-6 (Forms dense thickets, patches, or populations) | y - negl | 2 | Forms dense, thorny thickets (Culley and Hardiman 2007; Vincent 2005). Formed "dense, impenetrable thickets" in Illinois (White et al. 2005).MD Dept. of Agriculture weed control teams report extensive thickets at roadside interchanges (Heimer, pers. comm). Seedling thickets spread extensively along state highways and into forest edges (Authors' observations). |
| ES-7 (Aquatic) | n - negl | 0 | Callery pear is not an aquatic plant; it is a terrestrial tree (Culley and Hardiman 2007). |
| ES-8 (Grass) | n - negl | 0 | Callery pear is in the Rosaceae family and therefore not a grass (ARS 2016). |
| ES-9 (Nitrogen-fixing woody plant) | n - negl | 0 | We found no evidence that it fixes nitrogen. Furthermore, plants in the Rosaceae are not known to fix nitrogen (Martin and Dowd 1990, Santi et al. 2013) |
| ES-10 (Does it produce viable seeds or spores) | y - negl | 1 | Seed viability averaged 81% in a study examining fruits of different cultivars and cultivar hybirds (Hardiman and Culley 2010). |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| ES-11 (Self-compatible or apomictic) | n - negl | -1 | Callery pear is not self-compatible as it has gametophytic self-incompatibility (Culley and Hardiman 2007, Hardiman and Culley 2010), "Most pear culivars have been classified as self-incompatible...gametophytic self-incompatibility is controlled by a single polymorphic gene locus" (Bell and Itai 2011). |
| ES-12 (Requires specialist pollinators) | n - negl | 0 | No, Callery pear is pollinated by generalist insects (Culley and Hardiman 2007). |
| 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] | c - negl | 0 | Trees can flower as early as three years (Culley and Hardiman 2007, Vincent 2005, Bell and Zimmerman 1990). Pear species generally flower after 4 years of growth (Bell and Zimmerman 1990). Answering "c" with alternative answers both "d." |
| ES-14 (Prolific seed producer) | y - high | 1 | Seed numbers per fruit are variously reported as 1-4 (Vincent 2005) and 6-10 (Cuizhi and Spongberg 2003 cited in Culley and Hardiman 2007). Nesom (2000) found an average of 1.6 seeds in a sample of 30 fruits. Using the range of seed numbers reported, the range of numbers of blossoms in an inflorescence, and a count of at least 30 inflorescences per square meter of canopy (Authors' observations), the estimate of viable seeds per square meter of canopy can range from a low of 150 to 3600. Because copious quantities but undocumented numbers of fruit and seeds are produced, we are answering "yes" with high uncertainty. |
| S-15 (Propagules likely to be dispersed unintentionally by people) | n - mod | -1 | We found no evidence that propagules are likely to be dispersed by human activity, although fruits swept off sidewalks or discarded with brush could lead to dispersal. |
| ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers) | n - low | -1 | We found no evidence that propagules would be dispersed as contaminants or hitchhikers in products and it seems unlikely the fruits would come in contact with any products. |
| ES-17 (Number of natural dispersal vectors) | 2 | 0 | Fruit is spherical to oblong, 1 - 1.5 cm wide, brownish in color. Each fruit contains 1 - 10 seeds (Vincent 2005, Culley and Hardiman 2007). |
| ES-17a (Wind dispersal) | n - low | | Fruits are too heavy to be wind-dispersed. |
| ES-17b (Water dispersal) | n - mod | | We found no evidence that seeds or fruits are water dispersed. Trees are often planted along waterways and the fruits could float (Author, personal observation). |
| ES-17c (Bird dispersal) | y - low | | "Seeds are spread by birds" (Vincent 2005). Dispersed by birds including starlings and American robins (Culley and Hardiman 2007). |
| ES-17d (Animal external dispersal) | n - low | | Fruits have no means for external dispersal by animals. |
| ES-17e (Animal internal dispersal) | y - mod | | Fruits are dispersed by animals (Miller and Manning 2008, Culley and Hardiman 2007). |
| ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed) | y - low | 1 | There is a long-lasting seed bank; seeds exhibit secondary dormancy when exposed to high temperatures in late winter (Culley and Hardiman 2007). We found no details on how long the seed bank persists, but in 2016, refrigerated seed stored since 2005 had between 5-10% germination (Culley pers. comm). |
| ES-19 (Tolerates/benefits from mutilation, cultivation or fire) | y - low | 1 | Spreads by root sprouts (White et al. 2005). Roots nicked by mowers send up sprouts (Jasch 2011). Invasive trees top-killed by prairie restoration fires produced multiple epicormic shoots (Warrix 2016). |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| ES-20 (Is resistant to some herbicides or has the potential to become resistant) | n - low | 0 | We found no evidence for herbicide resistance and the genus is not listed by Heap (2016). |
| 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 | One test of fruit and seed extracts on lettuce seed germination showed some germination inhibition (Phillips et al. 2011). Trees may be allelopathic (Jasch 2011). Fruits of *Pyrus calleryana* emit ethylene that can affect nearby plant growth (Rice 2012). We are answering "no" with high uncertainty because allelopathy for this species has not been tested in the field. |
| Imp-G2 (Parasitic) | n - negl | 0 | There is no evidence that Callery pear is parasitic from botanical descriptions (Nickrent 2016, Walker 2016). |
| **Impacts to Natural Systems** | | | |
| Imp-N1 (Changes ecosystem processes and parameters that affect other species) | n - low | 0 | We found no evidence that Callery pear changes ecosystem processes. |
| Imp-N2 (Changes habitat structure) | y - low | 0.2 | The species invades wetland prairies (Culley and Hardiman 2007) and grasslands in Oklahoma (Taylor et al. 1996). Dense thickets can cover 1/2 to several acres (Jasch 2011). |
| Imp-N3 (Changes species diversity) | y - high | 0.2 | We found no published studies that demonstrate changes to species diversity. The dense thickets that Callery pear creates are likely to reduce species diversity through competition. State fact sheets and one regional invasive species guide contend that Callery pear shades out spring wildflowers because the trees leaf out earlier than native tree species (Missouri Dept. of Conservation 2012), and displaces natives (Swearingen et al. 2010). We are answering "yes" with high uncertainty. |
| Imp-N4 (Is it likely to affect federal Threatened and Endangered species?) | y - mod | 0.1 | Outside of deliberate plantings, Callery pear generally grows in disturbed habitats, abandoned fields and along roadsides. We found no evidence that it is directly affecting Federal threatened and endangered species. However, is it documented in Maryland within at least one S1 community and within the habitats of seven State-listed Threatened or Endangered species, including starflower Solomon's plume and the recently rediscovered racemose goldenrod. Because of these proximities, we consider the potential to affect Federal TES significant, and thus are answering "yes" with moderate uncertainty. |
| Imp-N5 (Is it likely to affect any globally outstanding ecoregions?) | y - mod | 0.1 | Callery pear generally grows in disturbed habitats and along roadsides and has seldom been found in healthy forest interiors (Culley and Hardiman 2007), However, it is widely distributed through five different globally outstanding ecoregions, and is present in a sixth, California Interior Chaparral. Because Callery pear does have the capacity to change habitat structure, |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| | | | and likely changes species diversity, we are answering "yes" with moderate uncertainty. |
| 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 | Maryland Department of Natural Resources units actively control pear thickets in state parks and on state forests (Maryland DNR 2014). Trees form dense thickets (Jasch 2011). Trees are controlled in natural areas (USFS 2005; Missouri Dept. of Conservation 2012). Alternative answers are both "b." |
| **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 cultivar 'Bradford' and some others have a weak branching structure, making them prone to breaking in storms (Gilman and Watson 2015). Some cities and towns removed Callery pear street trees to avoid liability from falling branches (Culley and Hardiman 2007). Fallen fruits can be a danger to foot traffic (Culley and Hardiman 2007). Naturalized offspring sport long thorns that "will shred John Deere tractor tires" (Ashmore 2016). |
| Imp-A2 (Changes or limits recreational use of an area) | n - low | 0 | We found no evidence that Callery pear limits recreational use of an area. |
| Imp-A3 (Affects desirable and ornamental plants, and vegetation) | y - mod | 0.1 | Gardeners report various instances of Callery pear negatively impacting desirable plants. "Naturalized plants abundant in lawns and flowerbeds close to planted parent trees" (White et al. 2005). "These alien pears DO spread by seed because I now have them sprouting as weeds in gardening beds all over my yard" (Daves Garden 2017). Prevents grass from growing (WellnessMama 2017) |
| 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 | Maryland State Highway Administration actively controls Callery pear seedling patches along state highways (Maryland SHA 2003).Based on the removal of Callery pear in some municipalities due to the tree's weak architecture (Culley and Hardiman 2007) and weedy spread in gardens (White et al. 2005, Columbia Missouri undated), we are answering "c." Alternative answers are both "b." |
| **Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)** | | | |
| Imp-P1 (Reduces crop/product yield) | n - low | 0 | Callery pear is used as a blight resistant rootstock for ornamental pears (Hardiman and Culley 2010) and is not known to reduce crop or commodity yields. |
| Imp-P2 (Lowers commodity value) | n - low | 0 | We found no evidence that Callery pear lowers commodity value. |
| Imp-P3 (Is it likely to impact trade?) | n - low | 0 | We found no evidence that Callery pear is likely to impact trade. |
| Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water) | n - low | 0 | We found no evidence that this taxon affects irrigation or competes strongly for water. |
| Imp-P5 (Toxic to animals, including livestock/range animals and poultry) | y - high | 0.1 | Pear seeds contain glycosides that can be poisonous to animals (University of California 2016), however most other sites on poisonous plants do not list Callery pear as toxic to animals (Cornell University 2016, ASPCA 2016). |
| 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 | We found no evidence that Callery pear is considered a weed in production systems, nor is it controlled in production systems. Alternative answers are both "b." |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| **GEOGRAPHIC POTENTIAL** | | | Unless otherwise indicated, the following evidence represents geographically referenced points obtained from the Global Biodiversity Information Facility (GBIF), accessed in March 2017. Non-georeferenced locations from GBIF and other sources are noted as occurrences (occ). |
| **Plant hardiness zones** | | | |
| Geo-Z1 (Zone 1) | n - negl | N/A | We found no evidence that this species occurs in this zone. |
| Geo-Z2 (Zone 2) | n - negl | N/A | We found no evidence that this species occurs in this zone. |
| Geo-Z3 (Zone 3) | n - negl | N/A | We found no evidence that this species occurs in this zone. |
| Geo-Z4 (Zone 4) | n - high | N/A | Points reported at multiple suburban street addresses in Fort Collins, CO, are clearly cultivated, so they were removed from Geopotential analysis. |
| Geo-Z5 (Zone 5) | y - negl | N/A | Points in US in IL, IN, WI |
| Geo-Z6 (Zone 6) | y - negl | N/A | China, Japan, South Korea (occ.), US: CT, ID, IL, KS, MA, MI, MO, NC, OH, PA, WA |
| Geo-Z7 (Zone 7) | y - negl | N/A | China, Japan, Kyrgyzstan, Luxembourg, South Korea, US: AL, AR, CT, GA, IL, KS, MD, MO, NJ, NC, TN, VA. |
| Geo-Z8 (Zone 8) | y - negl | N/A | Australia, China, France, Japan, Spain, South Korea,Taiwan and US: AL, GA, NC, SC, TX, VA. |
| Geo-Z9 (Zone 9) | y - negl | N/A | Australia, China, France, South Africa, US: CA, FL, GA, TX, WA. |
| Geo-Z10 (Zone 10) | y - low | N/A | Australia, China, Laos (occ.) Taiwan, US: CA |
| Geo-Z11 (Zone 11) | y - low | N/A | Two points in Australia for which observers noted the specimen as a escape and a third point in a natural conservation park, and several in Taiwan. |
| Geo-Z12 (Zone 12) | y - low | N/A | Several points in Taiwan, listed under the synonym *P. kawakamii.* |
| Geo-Z13 (Zone 13) | n - negl | N/A | We found no evidence that this species occurs in this zone. |
| **Köppen -Geiger climate classes** | | | |
| Geo-C1 (Tropical rainforest) | n - negl | N/A | We found no evidence that this species occurs in this zone. |
| Geo-C2 (Tropical savanna) | y - high | N/A | Occurrence data in Laos. |
| Geo-C3 (Steppe) | y - low | N/A | Two points in China. |
| Geo-C4 (Desert) | n - negl | N/A | We found no evidence that this species occurs in this zone. |
| Geo-C5 (Mediterranean) | y - negl | N/A | Points are documented in the US in CA and WA. |
| Geo-C6 (Humid subtropical) | y - negl | N/A | The largest number of points occurs in this climate class, with points in Australia, China, Japan, South Korea (occ.), Taiwan, and in the southeastern US: AL, AR, DC, DE, FL, GA, KS, KY, LA, MD, MO, NC, NJ, SC, TX, VA. |
| Geo-C7 (Marine west coast) | y - negl | N/A | Australia, China, France, Luxembourg, Spain, and in the US in VA. |
| Geo-C8 (Humid cont. warm sum.) | y - negl | N/A | China, Japan (occ.), one point in Kyrgyzstan, South Korea, and the US: CT, IL, IN, KS, MA, MI, MO, NJ, OH, PA, WI. |
| Geo-C9 (Humid cont. cool sum.) | y - negl | N/A | Points in China, occurrence in this class in Japan, and points in the US: CT, ID, MA, MI, NJ. |
| Geo-C10 (Subarctic) | n - negl | N/A | We found no evidence that this species occurs in this zone. |
| Geo-C11 (Tundra) | n - negl | N/A | We found no evidence that this species occurs in this zone. |
| Geo-C12 (Icecap) | n - negl | N/A | We found no evidence that this species occurs in this zone. |
| **10-inch precipitation bands** | | | |
| Geo-R1 (0-10 inches; 0-25 cm) | n - mod | N/A | Three points are documented from Egypt but the country in the GBIF records was derived from coordinates and the records are tagged as invalid. |
| Geo-R2 (10-20 inches; 25-51 cm) | y - low | N/A | Points in Australia, China, Kyrgyzstan and South Africa |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| Geo-R3 (20-30 inches; 51-76 cm) | y - negl | N/A | Australia, China, France, and US: CA, CO, ID, KS, WA. |
| Geo-R4 (30-40 inches; 76-102 cm) | y - negl | N/A | Australia, China, France, Luxembourg, South Korea (occ.), Taiwan, and US: AR, IL, KS, MI, MO, OK, TX, WI. |
| Geo-R5 (40-50 inches; 102-127 cm) | y - negl | N/A | China, Japan (occ.), South Korea, Taiwan, and the US: AR, CT, DC, DE, GA, IL, IN, MA, MD, MI, MO, NC, NJ, OH, OK, PA, SC, TX, VA. |
| Geo-R6 (50-60 inches; 127-152 cm) | y - negl | N/A | China, Japan (occ.), France, South Korea, Spain and the US: AL, AR, GA, IN, KY, NC, TN, WA. |
| Geo-R7 (60-70 inches; 152-178 cm) | y - negl | N/A | China, Japan (occ.), South Korea, Taiwan, and the US: AL, FL, KY, NC. |
| Geo-R8 (70-80 inches; 178-203 cm) | y - negl | N/A | Japan, Taiwan, and in the US in AL. |
| Geo-R9 (80-90 inches; 203-229 cm) | y - mod | N/A | Occurrence data in Japan. |
| Geo-R10 (90-100 inches; 229-254 cm) | y - mod | N/A | Occurrence data in Japan. |
| Geo-R11 (100+ inches; 254+ cm) | y - low | N/A | One point is recorded from Taiwan, at a local high school, so this is likely a deliberately planted specimen. Two other Taiwan points are noted as the synonym *P. kawakamii*. |
| **ENTRY POTENTIAL** | | | |
| Ent-1 (Plant already here) | y - negl | 1 | Yes, Callery pear is widespread in the eastern, southern, and midwestern United States as well as a few occurrences in the western US (Kartesz 2016). |
| Ent-2 (Plant proposed for entry, or entry is imminent ) | - | N/A | |
| Ent-3 (Human value & cultivation/trade status) | - | 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 | |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|

**Appendix B.** Maryland Filter assessment for *Pyrus calleryana* Decne (Rosaceae).

| Maryland Filter questions | Answer | Instructions/Result | Notes |
|---|---|---|---|
| | | | |
| 1. Is the plant currently naturalized in Maryland? Yes OR no | yes | Go to question 2 | *Pyrus calleryana* has naturalized extensively in the coastal plain and piedmont regions (Maryland Plant Atlas 2016). |
| 2. What is the species' potential distribution in Maryland? wide OR narrow | wide | Go to question 4 | *Pyrus calleryana* occurs in the Piedmont, Coastal Plain and Ridge and Valley provinces (MD Plant Atlas 2016), in well over 20 documented sites outside cultivation (EDDMapS 2017). |
| 3. Does or could the species harm threatened or endangered Maryland species or community types or CITES listed species occurring in MD? yes OR no | | | (See Question ImpN4 in Appendix A for complete information.) |
| 4. How feasible is control of the species? easy OR difficult | difficult | Go to Question 5 | *Pyrus calleryana* does not display herbicide resistance (Heap 2016). The seedbank is described as long-lasting (Culley and Hardiman 2007), but no published information on number of years could be found. Callery pear does send up root sprouts when the main trunk is cut or roots are damaged (White et al. 2005), or the trees are damaged by fire (Warrix 2016). |
| 5. Is added propagule pressure from sales significantly increasing potential of the species to persist and spread? yes OR no | no | **Tier 2** | Callery pear was introduced to Maryland in 1916 and was sold commercially in the state in the 1960s (Culley and Hardiman 2007). |