

Key Words: High Risk, Naturalized, Thorny Tree, Ornamental, Bird-Dispersed, Thicket-forming

Family: *Rosaceae*

Taxon: *Pyrus calleryana*

Synonym: *Pyrus calleryana* f. *graciliflora* Rehder
Pyrus kawakamii Hayata
Pyrus calleryana f. *tomentella* Rehder

Common Name: Bradford pear
 Callery pear

Questionnaire :	current 20090513	Assessor:	Chuck Chimera	Designation:	H(HPWRA)
Status:	Assessor Approved	Data Entry Person:	Chuck Chimera	WRA Score	9
101	Is the species highly domesticated?		y=-3, n=0		n
102	Has the species become naturalized where grown?		y=1, n=-1		
103	Does the species have weedy races?		y=1, n=-1		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"		(0-low; 1-intermediate; 2-high) (See Appendix 2)		High
202	Quality of climate match data		(0-low; 1-intermediate; 2-high) (See Appendix 2)		High
203	Broad climate suitability (environmental versatility)		y=1, n=0		y
204	Native or naturalized in regions with tropical or subtropical climates		y=1, n=0		y
205	Does the species have a history of repeated introductions outside its natural range?		y=-2, ?=-1, n=0		y
301	Naturalized beyond native range		y = 1*multiplier (see Appendix 2), n= question 205		y
302	Garden/amenity/disturbance weed		n=0, y = 1*multiplier (see Appendix 2)		y
303	Agricultural/forestry/horticultural weed		n=0, y = 2*multiplier (see Appendix 2)		n
304	Environmental weed		n=0, y = 2*multiplier (see Appendix 2)		
305	Congeneric weed		n=0, y = 1*multiplier (see Appendix 2)		
401	Produces spines, thorns or burrs		y=1, n=0		y
402	Allelopathic		y=1, n=0		
403	Parasitic		y=1, n=0		n
404	Unpalatable to grazing animals		y=1, n=-1		n
405	Toxic to animals		y=1, n=0		
406	Host for recognized pests and pathogens		y=1, n=0		n
407	Causes allergies or is otherwise toxic to humans		y=1, n=0		
408	Creates a fire hazard in natural ecosystems		y=1, n=0		n
409	Is a shade tolerant plant at some stage of its life cycle		y=1, n=0		n
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)		y=1, n=0		y

411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	y
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally	y=1, n=-1	y
604	Self-compatible or apomictic	y=1, n=-1	n
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	3
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	n
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed	y=1, n=-1	n
706	Propagules bird dispersed	y=1, n=-1	y
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	y
801	Prolific seed production (>1000/m2)	y=1, n=-1	
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	y
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	y
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	y=-1, n=1	

Designation: H(HPWRA)

WRA Score 9

Supporting Data:

101	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Is the species highly domesticated? No] "Furthermore, some traits of the Callery pear that were specifically selected during its development as an ornamental tree could also promote invasiveness. These include rapid growth, abundant flowering, and wide environmental tolerance. Many of these characteristics of <i>P. calleryana</i> are typical of an ideal weed (Baker 1974, Newsome and Noble 1986, Roy 1990, Shiffman 1997, Sakai et al. 2001)."
102	2012. WRA Specialist. Personal Communication.	[Has the species become naturalized where grown? NA]
103	2012. WRA Specialist. Personal Communication.	[Does the species have weedy races? NA]
201	2012. USDA ARS National Genetic Resources Program. Germplasm Resources Information Network - (GRIN). http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl	[Species suited to tropical or subtropical climate(s) 2-High] "Native: ASIA-TEMPERATE China: China - Anhui, Fujian, Guangdong, Guangxi, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi [s.], Shandong, Zhejiang Eastern Asia: Korea; Taiwan ASIA-TROPICAL Indo-China: Vietnam [n.]"
202	2012. USDA ARS National Genetic Resources Program. Germplasm Resources Information Network - (GRIN). http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl	[Quality of climate match data 2-High]
203	2003. Wu, Z.Y./Raven, P.H./Hong, D.Y. (eds.). <i>Flora of China</i> . Vol. 9 (Pittosporaceae through Connaraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	[Broad climate suitability (environmental versatility)? Yes] "Slopes, plains, mixed valley forests, thickets; 100-1800 m. Anhui, Fujian, Guangdong, Guangxi, Henan, Hubei, Hunan, Jiangsu, Jiangxi, S Shaanxi (Qin Ling), Shandong, Taiwan, Zhejiang [Japan, Vietnam]." [Elevation range exceeds 1000 m, demonstrating environmental versatility]
203	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Broad climate suitability (environmental versatility)? Yes] "An introduced species that is in the early stages of spread in the United States is <i>Pyrus calleryana</i> Dcne. (Rosales: Rosaceae), an ornamental tree frequently planted in urban residential and commercial areas. This species is native to China, Taiwan, Korea, Vietnam, and Japan, where it has a broad ecological range, inhabiting slopes, plains, mixed valley forests, and thickets (Cuizhi and Spongberg 2003)." ... "Callery pear cultivars are known for their ability to tolerate a wide range of environmental conditions, including moisture, disease, and pollution. Consequently, these cultivars are ideal street trees for urban locations, where such conditions often prevail."
203	2009. Culley, T.M./Hardiman, N.A.. The role of intraspecific hybridization in the evolution of invasiveness: a case study of the ornamental pear tree <i>Pyrus calleryana</i> . <i>Biol Invasions</i> . 11: 1107-1119.	[Broad climate suitability (environmental versatility)? Yes] "Some introduced species also may possess preadaptive traits that are not a product of hybridization per se but rather act to enhance invasiveness once hybridization produces recombinant genotypes. For example, <i>P. calleryana</i> in its native Asian range is tolerant of diverse soil moisture conditions, which is consistent with its ability to invade wet, mesic or dry sites in the United States (Culley and Hardiman 2007)."
204	2005. Vincent, M.A.. On the Spread and Current Distribution of <i>Pyrus calleryana</i> in the United States. <i>Castanea</i> . 70(1): 20-31.	[Native or naturalized in regions with tropical or subtropical climates? Yes] "The species originated in a region with relatively mild winters (subtropical), and is best adapted to warmer regions, perhaps even having low tolerance for colder temperatures (Bell 1990). McNamara and Pellett (1994) showed that <i>P. calleryana</i> can survive temperatures of -24°C to -34°C, depending on the cultivar, but that all cultivars were killed at a temperature of -36°C."
204	2012. USDA ARS National Genetic Resources Program. Germplasm Resources Information Network - (GRIN). http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl	[Native or naturalized in regions with tropical or subtropical climates? Yes] "ASIA-TROPICAL Indo-China: Vietnam"
205	2009. Culley, T.M./Hardiman, N.A.. The role of intraspecific hybridization in the evolution of invasiveness: a case study of the ornamental pear tree <i>Pyrus calleryana</i> . <i>Biol Invasions</i> . 11: 1107-1119.	[Does the species have a history of repeated introductions outside its natural range? Yes] " <i>Pyrus calleryana</i> was originally introduced to breed fire blight resistance and provide compatible rootstock for <i>Pyrus communis</i> , the common edible pear (Culley and Hardiman 2007). The species was imported into the United States beginning in the early 1900s, primarily by the USDA plant explorer, Frank Meyer and plant breeder Frank Reimer, both of whom collected seed in various regions in China, Japan and Korea in 1918. According to Meyer's (1918) correspondence, the species was found growing in a wide variety of habitats in China where it had a thorny phenotype and sparsely occurred in small populations."

205	2010. Hardiman, N.A./Culley, T.M.. Reproductive success of cultivated <i>Pyrus calleryana</i> (Rosaceae) and establishment ability of invasive, hybrid progeny. <i>American Journal of Botany</i> . 97(10): 1698–1706.	[Does the species have a history of repeated introductions outside its natural range? Yes] " <i>Pyrus calleryana</i> has experienced multiple types of introductions in its history (Culley and Hardiman, 2007), including primary introductions from across Asia in the early 1900s, commercial development and availability of various cultivars over the last few decades, and the increased establishment of cultivated genotypes into residential and commercial areas. These different introductions serve to increase the overall inoculum size, a factor that is positively correlated with an increased rate of invasion (Roman and Darling, 2007 ; Cohen and Carlton, 1998). Therefore, the relatively recent emergence from the lag period in <i>P. calleryana</i> is most likely explained by increased propagule pressure due to the introduction of various cultivar types. This could have provided enough genetic variation to overcome the reproductive limitation of self incompatibility and its associated Allee effect, resulting in hybrid populations that are self-sustaining. Additionally, widespread ornamental plantings comprising multiple cultivar types function to increase the inoculum size to the point at which rate of invasion could rapidly increase. Subsequent introductions, either as new cultivars or additional plantings of this species in large numbers, are expected to continue to facilitate an accelerated rate of spread of the Callery pear in the United States."
301	2005. Vincent, M.A.. On the Spread and Current Distribution of <i>Pyrus calleryana</i> in the United States. <i>Castanea</i> . 70(1): 20-31.	[Naturalized beyond native range? Yes] " <i>Pyrus calleryana</i> , a very commonly planted ornamental tree species, is documented as an escape from cultivation in the District of Columbia and 152 counties or parishes in 25 states, and is reported as new to California, Michigan, Missouri, New Jersey, and West Virginia. Evidence is presented that the species is rapidly becoming invasive in much of its horticultural range in at least the eastern United States."
301	2009. Culley, T.M./Hardiman, N.A.. The role of intraspecific hybridization in the evolution of invasiveness: a case study of the ornamental pear tree <i>Pyrus calleryana</i> . <i>Biol Invasions</i> . 11: 1107–1119.	[Naturalized beyond native range? Yes] " <i>Pyrus calleryana</i> is an ornamental tree species from Asia that is in the early stages of spread in the United States (Vincent 2005; Culley and Hardiman 2007; Hardiman and Culley 2007)." ... "Until recently, the species was considered unable to escape from cultivation or to naturalize because of self-incompatibility, vegetative propagation, and rare fruit production (Gilman and Watson 1994). The species is currently recognized as invasive because volunteer populations have been reported with increasing frequency over the last 5 years in at least 26 states (Vincent 2005; Culley and Hardiman 2007), concurrent with recent observations of abundant fruit set in cultivated and escaped individuals. Because of its present spread, the species is now listed by the United States Fish and Wildlife as a plant invader of Mid-Atlantic natural areas (Swearingen et al. 2002) and is considered either invasive or watch-listed in ten states (Culley and Hardiman 2007)."
302	2005. Vincent, M.A.. On the Spread and Current Distribution of <i>Pyrus calleryana</i> in the United States. <i>Castanea</i> . 70(1): 20-31.	[Garden/amenity/disturbance weed? Yes] " <i>Pyrus calleryana</i> escapes frequently in areas where it has been in cultivation for about 10 years or longer, judging by the sizes of cultivated trees in the areas where escapes were observed. In places where it is cultivated, it escapes freely as its seeds are spread by birds, and is found in disturbed areas such as fence rows, fallow fields, weedy ground, and disturbed woodlots."
302	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Garden/amenity/disturbance weed? Yes] "Wild populations of <i>P. calleryana</i> can now be found throughout the United States (figure 1; Vincent 2005) in disturbed sites with high light, including transportation corridors, park boundaries, and restored wetland prairies." [A disturbance weed of unspecified impacts, but with the potential to become an environmental weed]
303	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Agricultural/forestry/horticultural weed? No, but possesses undesirable horticultural traits] "From a horticultural standpoint, <i>P. calleryana</i> also exhibits some undesirable traits that offset its widespread popularity. The susceptibility of certain Callery pear cultivars to breakage has led some towns and cities to stop planting them, or even to remove them along streets, to avoid liability from falling limbs (Fulcher 2002). Callery pears can also drop soft fruits on the ground in some areas, causing unsightly litter and posing a danger to foot traffic (Fulcher 2002). The widespread planting of Callery pears in some areas also results in unpleasing aesthetic effects because of their overuse in the urban landscape (Dirr 1998)."

304	2005. Vincent, M.A.. On the Spread and Current Distribution of <i>Pyrus calleryana</i> in the United States. <i>Castanea</i> . 70(1): 20-31.	[Environmental weed? Potentially] " <i>Pyrus calleryana</i> has recently been listed in a "Rogues Gallery" of invasives (Anonymous 2000), and is known to be invading natural areas in the mid-Atlantic states (Swearingen et al. 2002). The species is listed in an international compendium of weeds because of its invasive potential and documented escape (Randall 2002)." ... " <i>Pyrus calleryana</i> seems almost a textbook example of a plant designed for invasion (Reichard 2001, Reichard et al. 2001, Reichard and Hamilton 1997, Rejmanek 2001). While callery pear was introduced with the best of intentions, it now seems that a plague is truly upon us. Touted by some as a sterile plant and promoted widely, it has become proof that one can indeed have too much of a good thing. Dirr (1990) was correct in more ways than he realized when he voiced his concern that the tree was approaching "epidemic proportions"! It seems quite evident that callery pear will continue to spread from cultivation anywhere in the United States where it is not limited by extreme cold, or extreme drought, or extreme heat." ... "It remains to be seen the extent to which <i>P. calleryana</i> will invade into natural areas. Most of the collections examined to date are from marginal areas, such as fence rows, fallow fields, vacant lots, railroad beds, and edges of disturbed forests. No collections have been seen from what might be considered undisturbed woods, so the species may not become as prevalent as some other Asian invasive woody plants, such as <i>Lonicera maackii</i> (Amur honeysuckle; Luken and Thieret 1996)."
304	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Environmental weed? Potentially] "In 1994, 'Bradford' and related cultivars were considered to have little invasive potential (Gilman and Watson 1994), but more than 10 years later, wild <i>P. calleryana</i> is found in natural areas in at least 26 states (figure 3; Vincent 2005). The 'Bradford' cultivar is currently listed by the US Fish and Wildlife Service as a plant invader of mid Atlantic natural areas (Swearingen et al. 2002). <i>P. calleryana</i> itself or the cultivar 'Bradford' is listed as invasive on plant lists in six states (Alabama, Georgia, North Carolina, Maryland, New Jersey, and Pennsylvania) and is on watch lists in four others (Tennessee, New York, South Carolina, and Oklahoma). Callery pears are also spreading from cultivation in Delaware and Arkansas, and in southwestern Ohio. Callery pear saplings and trees have been found in several urban parks that adjoin residential areas where cultivated ornamental pears are widely planted. In Australia, Callery pear is considered a potential environmental weed (Csurhes and Edwards 1998)." ... "The environmental and ecological effects of <i>P. calleryana</i> have yet to be thoroughly examined, but evidence thus far points to several detrimental impacts. Because of its rapid growth and preference for highlight environments, <i>P. calleryana</i> can potentially impede the establishment of late- to middle-stage successional species in disturbed sites." ... "Wild pears are an unwanted addition in newly restored wetland prairies, where they sprout readily and compete with planted native species. The removal of wild <i>P. calleryana</i> is often hampered by the thorny phenotype of some individuals."
305	2007. Randall, R.P.. Global Compendium of Weeds - Index. http://www.hear.org/gcw/	[Congeneric weed? Potentially] Multiple <i>Pyrus</i> species listed as naturalized and/or invasive [Most literature refers to <i>P. calleryana</i> when discussing negative impacts of <i>Pyrus</i>]
401	2005. Vincent, M.A.. On the Spread and Current Distribution of <i>Pyrus calleryana</i> in the United States. <i>Castanea</i> . 70(1): 20-31.	[Produces spines, thorns or burrs? Yes] "Callery pear often produces thorny thickets as it escapes into marginal and disturbed areas, and appears to be reproducing readily in the wild." ... "It often forms dense thickets, and these are often thorny, since thornless cultivars appear to retain genes for thorniness that may be expressed as genes recombine in their progeny."
401	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Produces spines, thorns or burrs? Yes] "The susceptibility of wild trees to deer damage remains unknown, although herbivory may be deterred in some wild plants by the production of thorns along stems and branches, a condition often seen within <i>P. calleryana</i> 's native range in Asia. The thorns are not typically lost in mature shoots of wild <i>P. calleryana</i> , as they are in several other <i>Pyrus</i> species that also possess this phenotype. In the case of wild <i>P. calleryana</i> , protective thorns may enhance individual fitness by reducing herbivory."

402	2011. Phillips, N.C. /Jones, L.M./Stefanski, J.. Allelopathic Potential of Fruits and Seeds of Five Common Woody Landscape Plants Assessed by Lettuce Germination Bioassays. HortScience. 46(9): S311-S312 (Abstr.).	[Allelopathic? Possibly Yes] "The effects of fruit and seed extracts of five species (Pyrus calleryana, Cornus florida, Crataegus phaenopyrum 'Vaughn', Malus 'Donald Wyman', Ilex x attenuata 'Fosteri #2') were investigated for their allelopathic potential on lettuce seed germination. Collected fruits and seeds were dried, and five grams were triturated prior to a 24 hour soak in dH ₂ O, 15% EtOH, or 30% EtOH. The supernatants were filtered, resulting in one aqueous, and two ethanolic solutions for each species. The solutions were mixed with Captan fungicide at 0.9g/L and added to 47mm petri dishes with filter pads containing 30 'Black Seeded Simpson' lettuce seeds. Each of the 15 treatments was replicated 5 times, and germination was recorded daily over 16 days. Lettuce seeds in both the aqueous and ethanolic extracts of Malus 'Donald Wyman' and Pyrus calleryana demonstrated significantly lower overall germination percentages compared to the other species. Furthermore, T50 and T10-90 values were significantly greater in these two species germinated in the aqueous and 15% ethanol solutions. All species germinated at lower rates in the 30% EtOH solutions, with C. florida failing to germinate a single seed. Due to the apparent inhibitory effects of the Malus 'Donald Wyman' and Pyrus calleryana extracts, another experiment was conducted subjecting lettuce seeds to decreasing concentrations of the extracts. Germination inhibition was again observed in these experiments, most clearly with the Malus extracts exhibiting increasing germination rates with decreasing concentrations of the solution. Our results suggest possible allelopathic properties inherent in the fruits and/or seeds of Malus 'Donald Wyman' and Pyrus calleryana. Further studies of this allelopathic potential could be beneficial in considering proximal plantings of these species in the landscape, or the use of plant material from these species in composting, and the possible future development of bio herbicides."
403	2003. Wu, Z.Y./Raven,P.H./Hong, D.Y. (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	[Parasitic? No] "Trees 5-8 m tall. Branchlets reddish brown when young, grayish brown when old, terete, initially tomentose, soon glabrescent, glabrous when old" [Rosaceae]
404	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. BioScience. 57(11): 956-964.	[Unpalatable to grazing animals? No] "The Callery pear is susceptible to several herbivores. Damage from white-tailed deer has been observed in cultivated varieties of P. calleryana (e.g., 'Bradford', 'Chanticleer', and 'Aristocrat') and in other ornamental Pyrus cultivars (Kays et al. 2003)."
405	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. BioScience. 57(11): 956-964.	[Toxic to animals? No evidence] "The Callery pear is susceptible to several herbivores. Damage from white-tailed deer has been observed in cultivated varieties of P. calleryana (e.g., 'Bradford', 'Chanticleer', and 'Aristocrat') and in other ornamental Pyrus cultivars (Kays et al. 2003)."
405	2010. LeBoeuf-Little, N.J.. Bradford Pear Trees and Cyanide. gardenguides.com, http://www.gardenguides.com/108208-bradford-pear-trees-cyanide.html	[Toxic to animals? Seeds potentially toxic to pets] "The Bradford pear or Callery Pear (Pyrus calleryana) is a common landscaping tree that many home owners consider a nuisance. Its flowers smell fishy, its branches tend to break, and its tiny fruits fall messily everywhere. Even worse, that unsightly pulp littering your yard and sidewalk can be downright dangerous. The Bradford pear contains seeds, each of which contain a small amount of cyanide." ... "The real danger of the Bradford pear is to pets and small children. Their smaller body mass makes them more susceptible to toxins than an adult human. They also tend to consider edible any object that will fit in their mouths, they won't necessarily stop at just one, and they'll find hundreds of them while wandering around the yard under your Bradford pear tree. If you're in this situation, be vigilant when your tree is fruiting. Clean up every pear you can find. Watch your children and pets when they're out in the yard to prevent them snacking on any fruit you missed. Better still, consider replacing your tree with another ornamental, one that doesn't fruit."
406	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. BioScience. 57(11): 956-964.	[Host for recognized pests and pathogens? No] "One reason the Callery pear is so popular is that it is more resistant to disease and pests than many other ornamental trees. Although all P. calleryana cultivars have some degree of resistance to fire blight, 'Bradford' has consistently higher resistance (Gilman and Watson 1994), whereas 'Whitehouse' is more susceptible to the disease (Gerhold 2000), especially in warm and humid southern states where fire blight is more common. 'Bradford' is highly resistant to the Japanese beetle (Popillia japonica; Keathley et al. 1999) but is susceptible to the pearleaf blister mite (Eriophyes pyri)—a species that also feeds on leaves of 'Chanticleer', 'Redspire', and 'Whitehouse', causing significant foliar injury (Gill 1997). P. calleryana resists wood-boring beetles (Anoplophora glabripennis), apparently by producing chemical compounds that interfere with normal beetle growth and development (Morewood et al. 2004)."

407	2010. LeBoeuf-Little, N.J.. Bradford Pear Trees and Cyanide. gardenguides.com, http://www.gardenguides.com/108208-bradford-pear-trees-cyanide.html	[Causes allergies or is otherwise toxic to humans? Potentially from the seeds] "The Bradford pear or Callery Pear (<i>Pyrus calleryana</i>) is a common landscaping tree that many home owners consider a nuisance. Its flowers smell fishy, its branches tend to break, and its tiny fruits fall messily everywhere. Even worse, that unsightly pulp littering your yard and sidewalk can be downright dangerous. The Bradford pear contains seeds, each of which contain a small amount of cyanide." ... "The real danger of the Bradford pear is to pets and small children. Their smaller body mass makes them more susceptible to toxins than an adult human. They also tend to consider edible any object that will fit in their mouths, they won't necessarily stop at just one, and they'll find hundreds of them while wandering around the yard under your Bradford pear tree. If you're in this situation, be vigilant when your tree is fruiting. Clean up every pear you can find. Watch your children and pets when they're out in the yard to prevent them snacking on any fruit you missed. Better still, consider replacing your tree with another ornamental, one that doesn't fruit."
408	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Creates a fire hazard in natural ecosystems? No evidence] Not listed among detrimental impacts of this species
408	2007. Skelly, J./Smith, E.. Choosing the Right Plants for Northern Nevada's High Fire Hazard Areas. University of Nevada Cooperative Extension, Reno, NV	[Creates a fire hazard in natural ecosystems? No evidence] Recommended as a suitable tree for high fire risk areas
409	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Is a shade tolerant plant at some stage of its life cycle? No] "Second, <i>P. calleryana</i> and its cultivars do not tolerate shade well, preferring instead high light environments. Wild <i>P. calleryana</i> are rarely found in the understory of larger trees; they prefer open or disturbed habitats where they may form dense, monocultural stands."
410	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Tolerates a wide range of soil conditions? Yes] "The ability of <i>P. calleryana</i> to persist in variable and adverse soil conditions is also a reason for its success as rootstock for <i>Pyrus</i> species that are cultivated for fruit consumption (e.g., <i>P. communis</i>) or ornamental use. In China, young <i>P. calleryana</i> saplings are commonly used for rootstock if they are found naturally growing in a suitable location, where they could be grafted in situ. Callery pears in general adapt well to different soils (including clay) of variable pH and also tolerate restricted root zones, pollution, drought, and heat."
411	2003. Wu, Z.Y./Raven, P.H./Hong, D.Y. (eds.). <i>Flora of China</i> . Vol. 9 (Pittosporaceae through Connaraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	[Climbing or smothering growth habit? No] "Trees 5-8 m tall."
412	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Forms dense thickets? Yes] "Wild <i>P. calleryana</i> are rarely found in the understory of larger trees; they prefer open or disturbed habitats where they may form dense, monocultural stands." ... " <i>P. calleryana</i> can also form dense, thorny thickets, especially from the root sprouts of abandoned trees. These thickets, which are impenetrable to humans, may provide cover for birds and small mammals."
412	2010. Swearingen, J./Slattery, B./Reshetiloff, K./Zwicker, S.. <i>Plant Invaders of Mid-Atlantic Natural Areas</i> , 4th ed.. National Park Service and U.S. Fish and Wildlife Service, Washington, DC.	[Forms dense thickets? Yes] "Once established Callery pear forms dense thickets that push out other plants including native species that can't tolerate the deep shade or compete with pear for water, soil and space."
501	2003. Wu, Z.Y./Raven, P.H./Hong, D.Y. (eds.). <i>Flora of China</i> . Vol. 9 (Pittosporaceae through Connaraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	[Aquatic? No] "Trees 5-8 m tall." [Terrestrial]
502	2003. Wu, Z.Y./Raven, P.H./Hong, D.Y. (eds.). <i>Flora of China</i> . Vol. 9 (Pittosporaceae through Connaraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	[Grass? No] Rosaceae
503	2003. Wu, Z.Y./Raven, P.H./Hong, D.Y. (eds.). <i>Flora of China</i> . Vol. 9 (Pittosporaceae through Connaraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	[Nitrogen fixing woody plant? No] Genus <i>Pyrus</i> not documented to be nitrogen-fixing

504	2003. Wu, Z.Y./Raven,P.H./Hong, D.Y. (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	[Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)? No] "Trees 5-8 m tall. Branchlets reddish brown when young, grayish brown when old, terete, initially tomentose, soon glabrescent, glabrous when old; buds triangular ovoid, sparsely tomentose, apex shortly acuminate. Stipules caducous, linear-lanceolate, 4-7 cm, herbaceous, glabrous, margin entire, apex acuminate; petiole 2-4 cm, glabrous; leaf blade broadly ovate or ovate, rarely narrowly elliptic, 4-8 × 3.5-6 cm, glabrous, base rounded or broadly cuneate, margin obtusely serrate, apex acuminate, rarely acute."
601	2003. Wu, Z.Y./Raven,P.H./Hong, D.Y. (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	[Evidence of substantial reproductive failure in native habitat? No] No evidence
602	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. BioScience. 57(11): 956-964.	[Produces viable seed? Yes] "In recent years, Callery pear seedlings have begun to appear in many natural areas in the eastern United States (Stewart 1999, Swearingen et al. 2002, Haldeman 2003, Vincent 2005)."
603	2005. Vincent, M.A.. On the Spread and Current Distribution of <i>Pyrus calleryana</i> in the United States. Castanea. 70(1): 20-31.	[Hybridizes naturally? Yes] "Many pear species interbreed fairly readily, and interspecific hybrids are known (Bell 1990, Kimura et al. 2002). <i>Pyrus calleryana</i> has been shown to cross-pollinate with several other pear species and produce fertile progeny (Ackerman and Creech 1966, Westwood and Bjornstad 1971). In fact, some "callery pear" cultivars are of hybrid origin (e.g., 'Edgewood', derived from <i>P. calleryana</i> x <i>betulifolia</i> [Wandell 1997])."
603	2009. Culley, T.M./Hardiman, N.A.. The role of intraspecific hybridization in the evolution of invasiveness: a case study of the ornamental pear tree <i>Pyrus calleryana</i> . Biol Invasions. 11: 1107-1119.	[Hybridizes naturally? Yes. Among cultivars that increase invasiveness] "Hybridization between genetically distinct populations of a single species can serve as an important stimulus for the evolution of invasiveness. Such intraspecific hybridization was examined in <i>Pyrus calleryana</i> , a Chinese tree species commonly planted as an ornamental in residential and commercial areas throughout the United States. This self-incompatible species is now escaping cultivation and appearing in disturbed habitats, where it has the potential to form dense thickets. Using genetic techniques incorporating nine microsatellite markers, we show that abundant fruit set on cultivated trees as well as the subsequent appearance of wild individuals result from crossing between genetically distinct horticultural cultivars of the same species that originated from different areas of China. We conclude that intraspecific hybridization can be a potent but little recognized process impacting the evolution of invasiveness in certain species."
604	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. BioScience. 57(11): 956-964.	[Self-compatible or apomictic? No] "The species cannot self-pollinate because of a self incompatibility system, but recent fruit set is due to crossing between different cultivars or between the scion and rootstock of cultivated individuals. Consequently, individual cultivars themselves are not invasive, but the combination of cultivars within an area creates a situation in which invasive plants can be produced."
604	2009. Culley, T.M./Hardiman, N.A.. The role of intraspecific hybridization in the evolution of invasiveness: a case study of the ornamental pear tree <i>Pyrus calleryana</i> . Biol Invasions. 11: 1107-1119.	[Self-compatible or apomictic? No] "This self-incompatible species is now escaping cultivation and appearing in disturbed habitats, where it has the potential to form dense thickets." ... " <i>Pyrus calleryana</i> exhibits gametophytic self incompatibility (Zielinski 1965) in which compatible crosses are only possible between haploid pollen and diploid pistil tissue that do not share a self-incompatibility allele. In this system, crosses can result in full compatibility, partial compatibility, or complete incompatibility, depending on the genotypes of the two individuals being crossed. In invasive populations, the self-incompatibility (SI) system acts to maximize outcrossing and hence hybridization events (Culley and Hardiman 2007) but its effectiveness depends on the number of SI alleles present within populations."
604	2011. Culley, T.M./Hardiman, N.A./Hawks, J.. The role of horticulture in plant invasions: how grafting in cultivars of Callery pear (<i>Pyrus calleryana</i>) can facilitate spread into natural areas. Biological Invasions. 13: 739-746.	[Self-compatible or apomictic? No] " <i>Pyrus calleryana</i> exhibits gametophytic SI, and genetically identical individuals are unable to self-pollinate or cross with one another to produce fruit, with few exceptions (N. Hardiman, unpubl. data)."
605	2003. Wu, Z.Y./Raven,P.H./Hong, D.Y. (eds.). Flora of China. Vol. 9 (Pittosporaceae through Connaraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	[Requires specialist pollinators? No] "Raceme umbel-like, 6-12-flowered; peduncle glabrous; bracts caducous, linear lanceolate, 0.8-1.3 cm, membranous, adaxially tomentose, margin initially glandular serrate, apex acuminate. Pedicel 1.5-3 cm, glabrous. Flowers 2-2.5 cm in diam. Hypanthium cupular, glabrous. Sepals lanceolate, ca. 5 mm, abaxially glabrous, adaxially tomentose, margin entire, apex acuminate. Petals white, ovate, ca. 1.3 × 1 cm, base shortly clawed, apex rounded. Stamens 20, slightly shorter than petals. Ovary 2(or 3)-loculed, with 2 ovules per locule; styles 2(or 3), nearly as long as stamens, glabrous basally."

605	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Requires specialist pollinators? No] "The flowers are strongly malodiferous and are highly attractive to insect pollinators, including generalist honeybees (<i>Apis mellifera</i> L.), bumblebees (<i>Bombus terrestris</i> L.), other introduced bees, and hoverflies (<i>Syrphidae</i>) (Farkas et al. 2002)."
605	2009. Culley, T.M./Hardiman, N.A.. The role of intraspecific hybridization in the evolution of invasiveness: a case study of the ornamental pear tree <i>Pyrus calleryana</i> . <i>Biol Invasions</i> . 11: 1107-1119.	[Requires specialist pollinators? No] "Pollen is dispersed by several generalist pollinators, including honeybees (<i>Apis mellifera</i> L.), bumble bees (<i>Bombus terrestris</i> L.) and hover flies (Farkas et al. 2002)."
606	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Reproduction by vegetative fragmentation? Potentially Yes] "Sucker growth at the base of the tree trunk should also be removed promptly to prevent possible growth, flowering, and cross-pollination with the scion. Additional research is needed on the effectiveness of different herbicides and control treatments."
606	2010. Swearingen, J./Slattery, B./Reshetiloff, K./Zwicker, S.. Plant Invaders of Mid-Atlantic Natural Areas, 4th ed.. National Park Service and U.S. Fish and Wildlife Service, Washington, DC.	[Reproduction by vegetative fragmentation? Yes] "A single tree can spread rapidly by seed and vegetative means forming a sizeable patch within several years."
607	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Minimum generative time (years)? 3] "Reproduction. <i>Pyrus calleryana</i> is a perennial tree that begins flowering at approximately three years of age. It is one of the first trees to leaf out in the early spring and one of the last to retain its leaves in late autumn. Flower buds of this species are produced in early spring before leaf formation, and typically appear grouped together in approximately 6 to 12 flowers per inflorescence (Cuizhi and Spongberg 2003)."
701	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)? No evidence] "Wild populations of <i>P. calleryana</i> can now be found throughout the United States (figure 1; Vincent 2005) in disturbed sites with high light, including transportation corridors, park boundaries, and restored wetland prairies." [Although occurring in heavily trafficked areas, this distribution is likely the result of the disturbance occurring along these corridors, and not due to the inadvertent transport of seeds which lack means of external attachment]
702	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Propagules dispersed intentionally by people? Yes] "Because of the popularity of Callery pear cultivars, the species has been planted at high densities in many urban areas across the United States, where the trees are cultivated to maximize growth."
702	2009. Culley, T.M./Hardiman, N.A.. The role of intraspecific hybridization in the evolution of invasiveness: a case study of the ornamental pear tree <i>Pyrus calleryana</i> . <i>Biol Invasions</i> . 11: 1107-1119.	[Propagules dispersed intentionally by people? Yes] "The species, commonly known as the Callery Pear, is a popular cultivated tree often planted in commercial and residential areas, where it is prized for its early spring flowers, rapid growth, and fall color."
703	2010. Swearingen, J./Slattery, B./Reshetiloff, K./Zwicker, S.. Plant Invaders of Mid-Atlantic Natural Areas, 4th ed.. National Park Service and U.S. Fish and Wildlife Service, Washington, DC.	[Propagules likely to disperse as a produce contaminant? No evidence] "Spreads: by seeds that are dispersed to new locations by starlings and other birds that eat the fruits."
704	2003. Wu, Z.Y./Raven, P.H./Hong, D.Y. (eds.). <i>Flora of China</i> . Vol. 9 (Pittosporaceae through Connaraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	[Propagules adapted to wind dispersal? No] "Pome blackish brown with pale dots, globose, ca. 1 cm in diam., 2(or 3)-loculed; sepals caducous; fruiting pedicel 1.5-3 cm, glabrous." [Fleshy-fruited]
705	2010. Swearingen, J./Slattery, B./Reshetiloff, K./Zwicker, S.. Plant Invaders of Mid-Atlantic Natural Areas, 4th ed.. National Park Service and U.S. Fish and Wildlife Service, Washington, DC.	[Propagules water dispersed? No evidence] "Its success as an invader results from its capacity to produce copious amounts of seed that is dispersed by birds and possibly small mammals, seedlings that germinate and grow rapidly in disturbed areas and a general lack of natural controls like insects and diseases, with the exception of fire blight." [Primarily adapted for bird and mammal dispersal]
706	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Propagules bird dispersed? Yes] "Seed dispersal into natural areas is promoted by indiscriminant and abundant birds, and a seed bank enables the species to persist in areas after adults have been removed." ... " <i>Pyrus calleryana</i> fruit is also consumed by birds, albeit mostly by introduced European starlings."
706	2009. Culley, T.M./Hardiman, N.A.. The role of intraspecific hybridization in the evolution of invasiveness: a case study of the ornamental pear tree <i>Pyrus calleryana</i> . <i>Biol Invasions</i> . 11: 1107-1119.	[Propagules bird dispersed? Yes] "Fruits mature in autumn and are dispersed by animals such as European starlings, American Robins, and squirrels (Gilman and Watson 1994)."

707	2009. Culley, T.M./Hardiman, N.A.. The role of intraspecific hybridization in the evolution of invasiveness: a case study of the ornamental pear tree <i>Pyrus calleryana</i> . <i>Biol Invasions</i> . 11: 1107–1119.	[Propagules dispersed by other animals (externally)? Primarily adapted for internal dispersal] "Fruits mature in autumn and are dispersed by animals such as European starlings, American Robins, and squirrels (Gilman and Watson 1994)."
708	2009. Culley, T.M./Hardiman, N.A.. The role of intraspecific hybridization in the evolution of invasiveness: a case study of the ornamental pear tree <i>Pyrus calleryana</i> . <i>Biol Invasions</i> . 11: 1107–1119.	[Propagules survive passage through the gut? Presumably Yes] "Fruits mature in autumn and are dispersed by animals such as European starlings, American Robins, and squirrels (Gilman and Watson 1994)."
801	2010. Swearingen, J./Slattery, B./Reshetiloff, K./Zwicker, S.. <i>Plant Invaders of Mid-Atlantic Natural Areas</i> , 4th ed.. National Park Service and U.S. Fish and Wildlife Service, Washington, DC.	[Prolific seed production (>1000/m ²)? Unknown. Probably not at such high densities] "Its success as an invader results from its capacity to produce copious amounts of seed that is dispersed by birds and possibly small mammals..."
802	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Evidence that a persistent propagule bank is formed (>1 yr)? Presumably Yes] "A prominent seed bank is likely for <i>P. calleryana</i> because its seeds possess secondary dormancy if exposed to warm temperatures in late winter (Huxley 1999)."
803	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Well controlled by herbicides? Yes] "There are few documented management strategies for the Callery pear. The most effective control practice for wild trees is complete removal (Swearingen et al. 2002). For large trees that have been cut down, an appropriate systemic herbicide, such as concentrated glyphosate or triclopyr, must be applied immediately to all parts of the freshly cut trunk to prevent regrowth (Swearingen et al. 2002). Trees can also be girdled about 15 cm above the ground during spring and summer, if complete removal is not possible. Mowing of saplings and small trees is ineffective, because the species readily sprouts from any existing trunk or root system. Seedlings and shallow-rooted plants can be pulled up with care if the soil is moist (Swearingen et al.2002)."
804	2007. Culley, T.M./Hardiman, N.A.. The Beginning of a New Invasive Plant: A History of the Ornamental Callery Pear in the United States. <i>BioScience</i> . 57(11): 956-964.	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes] "There are cases of Callery pear infestations at abandoned nurseries (e.g., Taylor et al. 1996) where the rootstock has sprouted and flowered, potentially allowing it to cross with the genetically distinct scion. Thus a single cultivated tree can produce fruit under the proper conditions. Rootstock sprouting may occur at random or when roots near the soil surface are nicked by lawn machinery."
804	2008. Mahala, M.. <i>Kentucky Terrestrial Nuisance Species Management Plan</i> . Kentucky Department of Fish and Wildlife Resources, Frankfort, KY	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes] "tolerant of fire (good resprouter);"
804	2011. Culley, T.M./Hardiman, N.A./Hawks, J.. The role of horticulture in plant invasions: how grafting in cultivars of Callery pear (<i>Pyrus calleryana</i>) can facilitate spread into natural areas. <i>Biological Invasions</i> . 13: 739–746.	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes] "Rootstock of cultivated individuals often forms suckers in poorly maintained conditions and frequently after a damaged tree is cut off at the base."
805	2005. Vincent, M.A.. On the Spread and Current Distribution of <i>Pyrus calleryana</i> in the United States. <i>Castanea</i> . 70(1): 20-31.	[Effective natural enemies present locally (e.g. introduced biocontrol agents)? Unknown, but unlikely in the Hawaiian Islands or other tropical Pacific Islands] "It seems to have few, if any, natural controls. Indeed, callery pear seems almost ideally suited to become an invasive species: it is tolerant of a wide range of growing conditions (Gilman and Watson 1994a, 1994b, 1994c), is attacked by few pests (Bell 1990), grows rapidly, reaches sexual maturity at a young age (Bell and Zimmerman 1990), and has bird dispersed seeds that are produced in frequent large fruit set (Fare et al. 1987b; Gilman and Watson 1994a, 1994b, 1994c)."

Summary of Risk Traits

High Risk / Undesirable Traits

- Broad climate suitability
- Naturalized across North America
- Can grow in subtropical climates
- Invades disturbed areas
- Thorny
- Potentially allelopathic
- Seeds contain a small amount of cyanide – risk of accidental poisoning
- Tolerates many soil conditions (and potentially able to exploit many different habitat types)
- Can form dense, thorny thickets
- Hybridizes with other cultivars and species and increases invasiveness
- Can spread vegetatively by root suckering
- Fleshy-fruited; Seeds dispersed by birds and mammals
- Seeds persist in the soil; forms a seed bank
- Tolerates cutting and fires

Low Risk / Desirable Traits

- Foliage palatable to deer and other browsing animals
- Relatively shade intolerant
- Self-incompatible
- Landscaping and ornamental value
- Herbicides may provide effective control