Ampelopsis brevipedunculata

INTRODUCTORY

Photo by Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

AUTHORSHIP AND CITATION:
Waggy, Melissa A. 2009. Ampelopsis brevipedunculata. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2010, January 29].

FEIS ABBREVIATION:
AMPBRE

NRCS PLANT CODE [65]:
AMBR7

COMMON NAMES:
porcelainberry
amur peppervine
porcelain berry
porcelain-berry

TAXONOMY:
The scientific name of porcelainberry is *Ampelopsis brevipedunculata* (Maxim.) Trautv (Vitaceae) [31]. The variety *A. brevipedunculata* var. *brevipedunculata* occurs in Japan [39,68].

SYNONYMS:
None

LIFE FORM:
Vine-liana

DISTRIBUTION AND OCCURRENCE

SPECIES: Ampelopsis brevipedunculata

GENERAL DISTRIBUTION:
Porcelainberry is a nonnative species in North America, and at the time of this writing (2009) it occurs throughout most of the eastern United States and the Great Lakes region from New Hampshire [31,65], south to Alabama [1], west to Iowa [31,65] and north to Ontario [22,31,65]. Porcelainberry is most common along the northeastern Atlantic coast (reviews by [2,13,69]) and may be less common to the west, particularly in Wisconsin where it had been recorded in only 1 natural area by 2005 (reviews by [13]). Plants Database provides a map of porcelainberry's distribution in the United States.

Porcelainberry is native to Asia [7,37,49], particularly the northeastern portion ([22], reviews by [13,56]). Porcelainberry was introduced to the northeastern United States in 1870 as a bedding and landscape plant (reviews by [2,11,16,56]) and escaped cultivation [22].

HABITAT TYPES AND PLANT COMMUNITIES:
Information pertaining to common plant associates of porcelainberry comes primarily from the northeastern United States. Porcelainberry is most commonly found in deciduous forests [6,17,18,24,43,48,58,76] and may occur in coniferous or mixed forests (review by [14]). Porcelainberry also occurs in shrublands, thickets [48,58], and wetland plant communities [34,53]. It is often associated with plant communities that contain a high percentage of nonnative species [6,53,58,76]. In the eastern United States, porcelainberry is a dominant species in a few plant communities [43,58] and has become so abundant in Rock Creek National Park in Washington, DC that an Allegheny blackberry/porcelainberry (*Rubus allegheniensis*/*Ampelopsis brevipedunculata*) shrubland vegetation type has been described [58].

Available literature [6,17,18,24,43,48,58,76] indicates that in deciduous forests, porcelainberry is most commonly associated with northern red oak (*Quercus rubra*), yellow-poplar (*Liriodendron tulipifera*), red maple (*Acer rubrum*), American beech (*Fagus grandifolia*), white oak (*Q. alba*), and to a lesser degree, ash (*Fraxinus* spp.), sugar maple (*A. saccharum*), bitternut hickory (*Carya cordiformis*), and various other oaks (*Quercus* spp.). In Rock Creek National Park, porcelainberry is a dominant shrub in a yellow-poplar forest type that is primarily a yellow-poplar canopy with a boxelder (*A. negundo*) subcanopy. This community tends to be weedy and contains other nonative species, such as fig buttercup (*Ranunculus ficaria*) and multiflora rose (*Rosa multiflora*) [58]. In Appomattox Court House National Historical Park in Virginia, porcelainberry makes up part of the dense shrub layer in a Northern Piedmont/Lower New England Basic Seepage Swamp open forest. Canopy trees in this association include green ash (*Fraxinus pennsylvanica*) and some red maple [43].

Porcelainberry's occurrence on open sites is typically associated with disturbance and/or degraded native plant communities. In Rock Creek National Park, the Allegheny blackberry/porcelainberry shrubland vegetation type occurs on forest edges or in forest gaps. In this community, porcelainberry forms dense thickets with other native and nonnative vines including multiflora rose, Oriental bittersweet (*Celastrus orbiculatus*), English ivy (*Hedera helix*), Japanese honeysuckle (*Lonicera japonica*), greenbrier (*Smilax* spp.), poison-ivy (*Toxicodendron radicans*), and grapes (*Vitis* spp.). On some sites, combined vine cover is so dense that tree seedlings and herbaceous species are rare. Canopy gaps on mesic sites, rather than dry sites, may contain fewer nonnative species and support more tree seedlings and shrubs—especially beech, oak, yellow-poplar, mountain-laurel (*Kalmia latifolia*), and northern spicebush (*Lindera benzoin*) [58]. In New York, porcelainberry occurred in a marshy inlet of the Atlantic Ocean that had been substantially altered by dredging and filling and contained nearly 50% nonnative species [53]. On this site, porcelainberry was common in shrublands and thickets characterized by northern bayberry (*Myrica pensylvanica*), black cherry (*Prunus serotina*), flameleaf sumac (*Rhus copallinum*), multiflora rose, and numerous other shrubs [54]. In New Jersey, porcelainberry established in a constructed wetland along with other opportunistic nonnatives. On this site, porcelainberry occurred with other woody species including river birch (*Betula nigra*), sycamore (*Platanus occidentalis*), blackberry (*Rubus* spp.), willow (*Salix* spp.), and various grapes [34], but it was unclear whether these trees and shrubs had established naturally or if they had been planted. Porcelainberry was common in an abandoned agriculture field in Pennsylvania where it occurred with milkweeds (*Asclepias* spp.), Indianhemp (*Apocynum cannabinum*), blackberry, little bluestem (*Schizachyrium scoparium*), goldenrods (*Solidago* spp.), and poison-ivy [48]. A review by Dibble and others [14] indicated that porcelainberry seems problematic in northeastern grasslands but did not describe plant associates for this community.

BOTANICAL AND ECOLOGICAL CHARACTERISTICS

SPECIES: Ampelopsis brevipedunculata

Photo by Nancy Loewenstein, Auburn University, Bugwood.org

GENERAL BOTANICAL CHARACTERISTICS:

Botanical description: This description covers characteristics that may be relevant to fire ecology and is not meant for identification. Keys for identification are available (e.g., [7,22,37,45,49]).

Aboveground: Porcelainberry is a deciduous, woody vine that typically grows to lengths of 10 to 25 feet (3-7.6 m) but occasionally longer (reviews by [16,20,56,70]). Tendrils develop opposite the stem leaves and enable porcelainberry to climb suitable structures ([44,50], reviews by [13,16,56,70]). Gerrath [21] described the leaf-opposed structures on porcelainberry as elongated inflorescences, rather than tendrils, that have dual functions of support and reproduction. Porcelainberry's leaves are about 4 inches wide and 5 inches long (9 × 12 cm) [45], sometimes smaller (reviews by [16,70]), and are typically dark green but may also be variegated (reviews by [2,13,16]). Flowers are small and inconspicuous, 1 to 2 mm in diameter (review by [70]), and borne on a cyme ([21,45], reviews by [16,70]). Porcelainberry fruits are about 0.2 inch (review by [70]) to 0.33 inch (reviews by [13,16,56]) (5-8 mm) in diameter and come in several colors including bright blue, yellow, and purple (reviews by [11,13,16,56]).

Belowground: As of 2009, information pertaining to porcelainberry's belowground structures was found only in species fact sheets and reviews and was highly generalized. Reviews describe porcelainberry's root system as "extensive" [2] with a "large and vigorous" taproot [63,77]. Stalter and others [53] indicated that porcelainberry produces "sucker shoots" but no details were provided. Porcelainberry roots often merge with the roots of associated shrubs or other vegetation [67].

Stand structure: Porcelainberry vines can dominate the vegetation by forming a uniform "blanket" over shrubs, trees, and the ground, especially on forest edges ([3,76], reviews by [14,47]). In New York, porcelainberry maintained well over 100% combined cover with Amur honeysuckle (*Lonicera maackii*) on some sites [76]. In another New York location, porcelainberry had an average cover of 13% but its cover was 28% when only open canopy sites were considered [3]. In a Washington DC park, porcelainberry climbed trees with diameters of up to 4 inches (10 cm) and was able to climb larger diameter trees and ascend into their crowns by attaching to other vine species adapted to climb larger trees [44].

Raunkiaer [46] life form:
Chamaephyte
Geophyte

SEASONAL DEVELOPMENT:
Reviews from North America indicate that porcelainberry flowers during midsummer [13] but may begin as early as June in some locations [16]. It continues to flower throughout the growing season [21]. Its fruit begins to develop in late summer (review by [52]) and matures in the fall (reviews by [16,52]). Because porcelainberry is slow to leaf out, most vegetative growth may occur in late summer [3].

In Canada, porcelainberry cultivated in a greenhouse flowered throughout the growing season from May to August; inflorescences developed a few weeks prior to anthesis. Shoots began forming and elongating in July. Growth continued until the first hard frost. Within a week after the first frost, all but the first-order and possibly a few of the oldest second-order shoots had abscised. A few fruits overwintered on the vine. Overwintering buds, not externally visible, developed at the base of the vine at the end of the growing season [21].

In a grassland community in Japan, porcelainberry seedlings typically emerged by mid-May, but some did not emerge until mid-July [39].

REGENERATION PROCESSES:

Porcelainberry reproduces vegetatively (3,54, reviews by [2,13,16,63,77]) and from seed (reviews by [2,13,53]).

Pollination and breeding system: Porcelainberry flowers are perfect ([21], review by [16]) and protandrous, suggesting the flowers may be cross pollinated (review by [78]). The flowers secrete nectar [21], which may attract insects for pollination.

Seed production: Each porcelainberry fruit contains 1 to 4 ([21], reviews by [56,70]) smooth, triangular ovoid seeds about 3.5 mm in length (review by [70]). In Japan, seed rain was surveyed every 1 or 2 weeks for approximately 8 months in 1987 on 6 plots containing 4 seed traps each. During that time, seed traps on one plot averaged 133 porcelainberry seeds per m², while seed traps on the remaining 5 plots had no porcelainberry seed. No details, however, were provided regarding porcelainberry's fruit production or abundance in the aboveground vegetation [39].

Seed dispersal: Porcelainberry seed is dispersed by birds ([53], reviews by [13,56]) and other small animals (review by [56]). White-tailed deer eat its fruit and may also disperse porcelainberry seed [73]. Porcelainberry fruits float (review by [40]), and it has been speculated that its seed may be dispersed by water [48], which may provide another mechanism for long-range dispersal (review by [40]).

Seed banking: No information is available on this topic at the time of this publication (2009).

Germination: Available evidence indicates that porcelainberry seed has a high germination rate ([2,3], review by [40]) and readily germinates following soil disturbance (review by [56]). Germination of porcelainberry seed may be enhanced by removing the fruit pulp [2,16] or by scarifying seed through digestion (review by [53]). Moist chilling may also stimulate germination of porcelainberry seed [2,16,68]. In Japan, freshly collected porcelainberry seed failed to germinate in a controlled environment. Seeds were placed in a paper bag for less than 1 month to facilitate after-ripening and then were exposed to a variety of moisture and temperature regimes. Porcelainberry germination rates were low (5% to 19%) with one exception: 53% of porcelainberry seeds germinated when placed in moist, cool conditions for 1 month and then exposed to increasing temperatures. Researchers speculated that moist chilling of porcelainberry seed had a dormancy breaking effect [68].

Seedling establishment and plant growth: As of this writing (2009), little had been reported on seedling establishment in procelainberry. In one study [3], researchers counted 700 porcelainberry seedlings in a 1-m² plot underneath a cluster of porcelainberry. During a 2-year grassland study in Japan, porcelainberry seedlings emerged infrequently, averaging only 1.5 seedlings/m² during the 1st year and 0.1 seedlings/m² in the 2nd year. The maximum number of seedlings produced in any one plot was 4 [39].

Reviews generally describe porcelainberry as a rapid grower [16,40,54,70], but details about its growth are lacking. One review indicated that in North America, porcelainberry may grow 15 to 20 feet (4.6-6.1 m) in a single growing season; however, this is considered an exception [16].

Vegetative regeneration: Although reviews indicate that porcelainberry regenerates vegetatively [2,13,16], it is

unclear by what means this occurs or how important this characteristic is to wild populations. Antenen and others [3] described porcelainberry as spreading by "extensive underground growth". One report indicated that porcelainberry may increase rapidly during a growing season by producing "copious sucker shoots" [53]. Recommendations for porcelainberry control and management indicate that porcelainberry sprouts after its aboveground stem is cut (reviews by [63,77]), suggesting it may sprout from its root crown; however, no details were provided as to the origin of the sprouts. Under cultivation, porcelainberry easily roots from leafy cuttings of "firm growth" taken in summer [16]. Reviews indicate that porcelainberry regenerates from root segments [2,13].

SITE CHARACTERISTICS:

Climate: Information pertaining to porcelainberry's overall climate range is unavailable; however, a few publications provide localized examples. Two accounts from the northeastern United States indicate that porcelainberry occurs in temperate climates that are moist and have winter temperatures that do not typically fall below freezing. In the District of Columbia, porcelainberry occurred in an area with an average annual minimum temperature of 43.5 °F (6.4 °C) in January and an average annual high temperature of 88.2 °F (31.2 °C) in July. Average annual precipitation for the area was 38.9 inches (987.8 mm) and was distributed evenly throughout the year [18]. In New York, porcelainberry occurred in an area with an average annual low temperature of 32 °F (0 °C) in January and an average annual high temperature of 77 °F (25 °C) in July. The area received an average of 44.1 inches (1,120 mm) of rainfall per year (Ruffner and Bair 1987 cited by [76]). Porcelainberry has been described as winter-hardy [3], and one publication indicated that porcelainberry may be grown in hardiness zones with average winter temperatures below freezing [16].

Elevation: A Forest Service fact sheet [63] stated that in North America, porcelainberry occurs at altitudes from approximately 500 to 2,000 feet (150-600 m). In New York, porcelainberry occurred at altitudes of approximately 82 feet (25 m) on one site [6] and from 250 to 705 feet (75-215 m) on another site [19] .

General habitat: Available evidence indicates that porcelainberry is common in urban areas ([4], review by [56]) and on anthropogenically influenced sites such as rights-of-way (railway, road, utility) ([2,7], reviews by [40,52]), vacant lots (review by [40]), and cultivated or abandoned agricultural fields ([47], reviews by [14,40,52]). It establishes in artificially created wetlands [34] or those that have been extensively altered [53]. Porcelainberry also invades wildlands including forests [6,17,18,24,43,48,58,76], wetlands [34], grasslands (reviews by [13,14]), shrublands [58], sand dunes (review by [52]), and riparian areas ([2], reviews by [14,40,52,56,70]). Because porcelainberry is likely intolerant of deep shade (see Successional status), its occurrence in forests and other shaded habitats is likely associated with edge habitat ([2,76], reviews by [38,40,52,70]) or disturbances that create canopy gaps ([2], reviews by [52,69]). One review [14] indicated that in the Northeast, porcelainberry can dominate forest edge vegetation. In New York, porcelainberry was abundant in a natural area that had undergone repeated anthropogenic disturbance, including extensive clearing and landscaping [76].

Moisture and Substrate: Information pertaining to moisture and substrate preference of porcelainberry is limited to anecdotal information derived from a few publications specific to the northeastern United States; porcelainberry may not be limited to the moisture regimes or substrates described here.

In the District of Columbia, porcelainberry occurred on well-drained to excessively well-drained sites (J. Short personal communication cited in [18]). It grows well in moist soils (reviews by [40,56,66]); however, it is not likely to thrive in permanently flooded soils (reviews by [16,56]).

A review of available literature [6,18,34,48] indicates that porcelainberry occurs in soils of variable texture; its preference for any specific type is unclear. In the District of Columbia porcelainberry occurred in fine loams or somewhat coarser soils [18], and in New York, it occurred in a mixed deciduous hardwood forest in loamy soil [6]. In Pennsylvania, porcelainberry occurred on a mesic site in deep silty soils derived from weathering of ancient granitic and hornblende gneisses [48]. In a constructed wetland in New Jersey, porcelainberry established in coarse sediments derived from river cobblestones, sand, and gravel [34].

Reports from the northeastern United States indicate that porcelainberry tolerates soil pH ranging from 3.6 to 5.5 ([6], J. Short personal communication cited in [18]) and may occur in soils low in nutrients (J. Short personal communication cited in [18]).

SUCCESSIONAL STATUS:
Shade Tolerance: Various sources including original research [3,25,47,76] and reviews [16,38,40,66] agree that porcelainberry prefers full sun but tolerates partial shade. Plants that primarily occur on forest edges and openings—like porcelainberry— typically require high light intensities to thrive (review by [48]). Based on field observations, Yost [76] speculated that porcelainberry is shade intolerant. A review from the Virginia Department of Conservation indicated that porcelainberry grows in shade [66], but the source of this statement was not given.

Porcelainberry has been studied from a successional perspective in Japan [30] and Pennsylvania [48], and based on these studies, porcelainberry likely occurs in early-successional habitats. In New England, porcelainberry is considered an early-successional species in forests (review by [40]). In Japan, porcelainberry occurred on sites undergoing primary succession following volcanic eruptions. It was more frequent on 37-year-old lava fields (41-60% frequency) than on 125-year-old lava fields (21-40% frequency) [30]. A study in southeastern Pennsylvania reported porcelainberry's abundance in various successional stages and found it was common in woodland ("uniform stands of mixed deciduous trees") and was least common in mature forest (with "extremely" dense shade). Porcelainberry's abundance was greatest in riparian forests that had experienced repeated disturbance:

Frequency and mean stem density of porcelainberry by vegetation type or seral stage [48]					
	Mature Forest	Woodland	Thicket	Old Field	Riparian
Frequency (%)	4	37	6	12	45
Density (stems/20 m²)	2a*	5.5b	3.0b	2.5b,c	33.3c

*Values followed by same letter are not significantly different (P<0.05)

Researchers speculated that porcelainberry's abundance in riparian areas may have been more a function of seed dispersal than a preference for a particular seral stage. They speculated that given enough time, porcelainberry may spread to the mature forests [48].

There is evidence that porcelainberry may persist in forest communities with well developed canopies ([6,18], review by [69]). In the District of Columbia, porcelainberry occurred in a "mature" oak forest with several trees over 275 years old [18] and also in a mixed deciduous forest containing large trees with diameters in excess of 24 inches (60 cm) (review by [69]). In New York, porcelainberry occurred in a 100-year-old mixed deciduous forest with a well developed canopy [6]. In New York, porcelainberry seedlings planted in a hardwood forest persisted under an intact canopy but grew better under canopy gaps [25], suggesting that while porcelainberry may grow in mature forests, it may be more abundant on forest edges or under canopy gaps rather then in deep shade.

Heavy infestations of porcelainberry may influence succession by killing supportive vegetation (i.e., trees and shrubs) and preventing seedling emergence (review by [47]).

FIRE EFFECTS AND MANAGEMENT

SPECIES: Ampelopsis brevipedunculata

FIRE EFFECTS:
Immediate fire effect on plant: As of this writing (2009), porcelainberry's ability to survive fire had not been described in available literature. Its belowground structures may be protected from fire if they are located deep enough

in the soil. Plants with perennating buds well below the soil surface are typically least affected by fire ([10], reviews by [41,72]).

Postfire regeneration strategy [55]:
Tall shrub, adventitious buds and/or a sprouting root crown
Initial off-site colonizer (off site, initial community)
Secondary colonizer (on- or off-site seed sources)

Fire adaptations and plant response to fire:
Fire adaptations: As of this writing (2009), information pertaining to porcelainberry's fire adaptations was limited to inferences based on its known biological attributes. Porcelainberry's underground structures may provide a source for postfire sprouting if they are not damaged by fire. Porcelainberry sprouts when cut (reviews by [63,77]), and may sprout—possibly from its roots or root crown—if it is top-killed by fire (see Vegetative regeneration).

Porcelainberry spreads by seed and may establish on burned sites from off-site seed sources. Information is needed on porcelainberry's seed banking potential before speculating on its ability to establish from residual seed sources on burned sites.

Plant response to fire: Based on porcelainberry's ability to regenerate vegetatively, produce abundant seed, and establish on open sites, it has been suggested that fire may favor porcelainberry's spread (review by [14]).

FUELS AND FIRE REGIMES:
Fuels: No information was available on porcelainberry's fuels characteristics at the time of this publication (2009). Porcelainberry may increase fuel loads on sites where it climbs over and kills supporting trees (see Impacts and Control and Succession Status).

Fire regimes: At the time of this publication (2009), no information was found on fire regimes in plant communities where porcelainberry is native. In its nonnative North American range, porcelainberry occurs in plant communities with a wide range of historical fire regimes. It is especially invasive in deciduous forests in the northeastern United States where high severity fires have historically been infrequent; stand-replacement fires have return intervals estimated to be greater than 1,000 years [33]. Porcelainberry is also invasive in northeastern grasslands that have historically been maintained by frequent fire—primarily anthropogenic in origin; however, research on porcelainberry's relationship to fire in grasslands is lacking (review by [14]). It is unclear how historical fire regimes might influence porcelainberry or how porcelainberry populations may influence fuel characteristics and fire regimes in native plant communities.

See the Fire Regime Table for further information on fire regimes in plant communities in which porcelainberry may occur.

FIRE MANAGEMENT CONSIDERATIONS:
Preventing postfire establishment and spread: There is potential for porcelainberry to establish from seed on burned sites or to persist and possibly spread via vegetative regeneration after fire (see Fire adaptations); however, postfire control measures specific to porcelainberry have not been described in the literature. In general, preventing invasive plants from establishing in weed-free burned areas is the most effective and least costly management method. Prevention of postfire establishment and spread of porcelainberry on burned sites may be accomplished by limiting dispersal of its seed to burned sites, early detection and eradication of seedlings and sprouts, and careful monitoring and follow-up.

General recommendations for preventing postfire establishment and spread of invasive plants include:

- Incorporate cost of weed prevention and management into fire rehabilitation plans
- Acquire restoration funding
- Include weed prevention education in fire training

- Minimize soil disturbance and vegetation removal during fire suppression and rehabilitation activities
- Minimize the use of retardants containing nitrogen and phosphorus
- Avoid areas dominated by high priority invasive plants when locating firelines, monitoring camps, staging areas, and helibases
- Clean equipment and vehicles prior to entering burned areas
- Regulate or prevent human and livestock entry into burned areas until desirable site vegetation has recovered sufficiently to resist invasion by undesirable vegetation
- Monitor burned areas and areas of significant disturbance or traffic from management activity
- Detect weeds early and eradicate before vegetative spread and/or seed dispersal
- Eradicate small patches and contain or control large infestations within or adjacent to the burned area
- Reestablish vegetation on bare ground as soon as possible
- Avoid use of fertilizers in postfire rehabilitation and restoration
- Use only certified weed-free seed mixes when revegetation is necessary

For more detailed information on these topics see the following publications: [5,8,23,64].

Use of prescribed fire as a control agent: No information is available regarding the use of prescribed fire to control porcelainberry at the time of this publication (2009).

MANAGEMENT CONSIDERATIONS

SPECIES: Ampelopsis brevipedunculata

FEDERAL LEGAL STATUS:
None

OTHER STATUS:
Information on state-level noxious weed status of plants in the United States is available at Plants Database.

IMPORTANCE TO WILDLIFE AND LIVESTOCK:
Birds ([53], reviews by [13,56]) and white-tailed deer [73] eat porcelainberry fruit, but it is unknown if it is an important food for any particular species. In Europe, porcelainberry serves as a host for the European grapevine moth [59].

Palatability and/or nutritional value: No information is available on this topic at the time of this publication (2009).

Cover value: No information is available on this topic at the time of this publication (2009).

OTHER USES:
In Asia, porcelainberry has been used in traditional folk medicine as an anti-inflammatory, diuretic, anti-hepatotoxic agent [74], and to treat liver disease [75]. Porcelainberry extracts are being investigated for their antioxidant activity [74] and their potential to be used to treat liver disease [75].

IMPACTS AND CONTROL:
Although porcelainberry is considered invasive in 12 states (reviews by [63,77]), its impacts are likely greatest along coastal areas of the Northeast where it is most common (see General Distribution). In the US Forest Service's Eastern Region, porcelainberry is classified as a Category 1 invasive species. Plants in this catagory are "nonnative, highly invasive plants which invade natural habitats and replace native species" [62]. Porcelainberry has been described in various parts of the Northeast as a "pernicious invader" (review by [47]), "extremely destructive" [53], "aggressive" ([18,76], review by [71]) and "highly invasive" [66]. However, based on a literature review, Luken [35] did not consider porcelainberry invasive in eastern forests, suggesting that it may not be invasive throughout its entire northeastern United States range. Although porcelainberry may not currently (2009) be problematic throughout its range, numerous states including Massachusetts [38], Connecticut [12], Tennessee [57], Georgia [20], and the upper Great Lakes states [13], have placed it on their invasive species lists due to its potential to become invasive.

Porcelainberry invades wildlands and can climb over and shade out native vegetation ([53], reviews by [40,42,56,70,71]). The extra weight of this vine may make supporting vegetation more susceptible to wind and ice damage (reviews by [2,40,53,71]). Heavy infestations of porcelainberry may kill native vegetation (reviews by [47,53]), suppress the establishment of tree seedlings ([76], review by [47]), and alter successional courses in invaded plant communities (see Successional Status). NatureServe [42] considers porcelainberry to have medium to low ecological impacts; its tendencies to shade out native vegetation and exploit other resources (i.e., water, nutrients) are of most concern.

Control: Once porcelainberry is established it is extremely difficult to control (reviews by [2,69]), and eradication is doubtful (reviews by [2,13,69]). Recommended control methods for porcelainberry (reviews by [2,13,47,56,69,70]) tend to be labor intensive and/or may be slow to show effects. Porcelainberry's potential for long-range seed dispersal [42] and ongoing intentional planting of it ([27], reviews by [11,42,71]) make control more difficult.

Fire: No information is available on the use of prescribed fire for porcelainberry control at the time of this publication (2009).

Prevention: Preventing the establishment and spread of porcelainberry has not been discussed in the literature; however, concern in the literature over porcelainberry's ongoing use for landscaping ([27] reviews by [11,42,71]) suggests that restricting the sale of porcelainberry may reduce future establishment and spread.

It is commonly argued that the most cost-efficient and effective method of managing invasive species is to prevent their establishment and spread by maintaining "healthy" natural communities [36,51] (e.g., avoid road building in wildlands [61]) and by monitoring several times each year [29]. Managing to maintain the integrity of the native plant community and mitigate the factors enhancing ecosystem invasibility is likely to be more effective than managing solely to control the invader [28].

Cultural control: Shading has been recommended as a means for controlling porcelainberry. Planting fast growing trees such as tulip-poplar and red maple, or allowing existing trees to mature, may shade out porcelainberry, provided trees are kept free of its vines (reviews by [2,47]). Shading may control porcelainberry best when used as a part of an integrated management plan [47].

Physical or mechanical control: Porcelainberry vines can be pulled down from trees (reviews by [13,69]). Cutting or mowing may control porcelainberry [53]—particularly after its vines have been pulled down from trees (reviews by [69])—but repeated treatments are necessary to prevent sprouting (reviews by [2,69]). Because it prevents flowering, cutting may be most effective in the fall or spring (reviews by [13,56,70]). Repeated mowing may reduce porcelainberry's "vigor" (review by [70]). One review indicated that porcelainberry's root system cannot be dug out [2].

Biological control: Based on a literature review, Ding and others [15] identified porcelainberry as one of a group of invasive species from Asia most in need of a biological control. Four natural enemies were identified as potential biological controls for porcelainberry [15], but as of this writing (2009) nothing more has been published.

Chemical control: Porcelainberry may be controlled with herbicides ([53], review by [56]) such as triclopyr or glyphosate (review by [70]). One review recommended a foliar application of glyphosate in early autumn to be the most effective control for porcelainberry. Basal bark applications of triclopyr formulated for use with penetrating oil control porcelainberry, but precaution must be taken not to harm other woody species (review by [13]). Experimental treatments to control porcelainberry indicated that herbicides controlled porcelainberry when used in conjunction with mowing [47]. It has been suggested that large porcelainberry vines be targeted for broad applications of herbicide and smaller vines be spot-sprayed ([47], review by [70]).

Herbicides are effective in gaining initial control of a new invasion or a severe infestation, but they are rarely a complete or long-term solution to weed management [9]. See the Weed control methods handbook [60] for considerations on the use of herbicides in natural areas and detailed information on specific chemicals.

Integrated management: Based on preliminary field testing, Robertson [47] recommended cutting porcelainberry to the ground and treating stumps with herbicide to gain initial control of porcelainberry, followed up with a dense planting of fast growing trees that may eventually shade out porcelainberry. He recommended that hand-pulling or herbicide spot-spraying be used to control subsequent sprouting.

APPENDIX: FIRE REGIME TABLE

SPECIES: Ampelopsis brevipedunculata

The following table provides fire regime information that may be relevant to porcelainberry's habitats. Follow the links in the table to documents that provide more detailed information on these fire regimes.

Fire regime information on vegetation communities in which porcelainberry may occur. This information is taken from the LANDFIRE Rapid Assessment Vegetation Models [33], which were developed by local experts using available literature, local data, and/or expert opinion. This table summarizes fire regime characteristics for each plant community listed. The PDF file linked from each plant community name describes the model and synthesizes the knowledge available on vegetation composition, structure, and dynamics in that community. Cells are blank where information is not available in the Rapid Assessment Vegetation Model.

Northeast Southern Appalachians

Northeast

- Northeast Grassland
- Northeast Woodland
- Northeast Forested

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Northeast Grassland					
Northern coastal marsh	Replacement	97%	7	2	50
	Mixed	3%	265	20	
Northeast Woodland					

Eastern woodland mosaic	Replacement	2%	200	100	300
	Mixed	9%	40	20	60
	Surface or low	89%	4	1	7
Northeast Forested					
Northern hardwoods (Northeast)	Replacement	39%	≥1,000		
	Mixed	61%	650		
Northern hardwoods-eastern hemlock	Replacement	50%	≥1,000		
	Surface or low	50%	≥1,000		
Northern hardwoods-spruce	Replacement	100%	≥1,000	400	>1,000
Appalachian oak forest (dry-mesic)	Replacement	2%	625	500	≥1,000
	Mixed	6%	250	200	500
	Surface or low	92%	15	7	26
Beech-maple	Replacement	100%	>1,000		
Southern Appalachians • Southern Appalachians Grassland • Southern Appalachians Woodland • Southern Appalachians Forested					
Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Southern Appalachians Grassland					
Eastern prairie-woodland mosaic	Replacement	50%	10		
	Mixed	1%	900		
	Surface or low	50%	10		
Southern Appalachians Woodland					
Oak-ash woodland	Replacement	23%	119		
	Mixed	28%	95		
	Surface or low	49%	55		
Southern Appalachians Forested					

Bottomland hardwood forest	Replacement	25%	435	200	≥1,000
	Mixed	24%	455	150	500
	Surface or low	51%	210	50	250
Mixed mesophytic hardwood	Replacement	11%	665		
	Mixed	10%	715		
	Surface or low	79%	90		
Appalachian oak-hickory-pine	Replacement	3%	180	30	500
	Mixed	8%	65	15	150
	Surface or low	89%	6	3	10
Oak (eastern dry-xeric)	Replacement	6%	128	50	100
	Mixed	16%	50	20	30
	Surface or low	78%	10	1	10
Appalachian oak forest (dry-mesic)	Replacement	6%	220		
	Mixed	15%	90		
	Surface or low	79%	17		

*Fire Severities—
Replacement: Any fire that causes greater than 75% top removal of a vegetation-fuel type, resulting in general replacement of existing vegetation; may or may not cause a lethal effect on the plants.
Mixed: Any fire burning more than 5% of an area that does not qualify as a replacement, surface, or low-severity fire; includes mosaic and other fires that are intermediate in effects.
Surface or low: Any fire that causes less than 25% upper layer replacement and/or removal in a vegetation-fuel class but burns 5% or more of the area [26,32].

Ampelopsis brevipedunculata: REFERENCES

1. Alabama Invasive Plant Council. 2007. List of Alabama's invasive plants by land-use and water-use sectors. Alabama Invasive Plant Council (Producer). Available: http://www.se-eppc.org/alabama/2007plantlist.pdf [2009, January 5]. [72714]

2. Antenen, Susan. 1996. Ampelopsis brevipedunculata--procelain berry. In: Randall, John M.; Marinelli, Janet, eds. Invasive plants: Weeds of the global garden. Handbook #149. Brooklyn, NY: Brooklyn Botanic Garden: 91. [73461]

3. Antenen, Susan; Yost, Susan; Hartvigsen, Gregg. 1989. Porcelainberry vine control methods explored (New York). Restoration and Management Notes. 7(1): 44. [8059]

4. Aronson, Myla F. J.; Handel, Steven N.; Clemants, Steven E. 2007. Fruit type, life form and origin determine the success of woody plant invaders in an urban landscape. Biological Invasions. 9: 465-475. [68816]

5. Asher, Jerry; Dewey, Steven; Olivarez, Jim; Johnson, Curt. 1998. Minimizing weed spread following wildland fires. Proceedings, Western Society of Weed Science. 51: 49. Abstract. [40409]

6. Ashton, Isabel W.; Hyatt, Laura A.; Howe, Katherine M.; Gurevitch, Jessica; Lerdau, Manuel T. 2005. Invasive species accelerate decomposition and litter nitrogen loss in a mixed deciduous forest. Ecological Applications. 15(4): 1263-1272. [54520]

7. Braun, E. Lucy. 1989. The woody plants of Ohio. Columbus, OH: Ohio State University Press. 362 p. [12914]

8. Brooks, Matthew L. 2008. Effects of fire suppression and postfire management activities on plant invasions. In: Zouhar, Kristin; Smith, Jane Kapler; Sutherland, Steve; Brooks, Matthew L., eds. Wildland fire in ecosystems: Fire and nonnative invasive plants. Gen. Tech. Rep. RMRS-GTR-42-vol. 6. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 269-280. [70909]

9. Bussan, Alvin J.; Dyer, William E. 1999. Herbicides and rangeland. In: Sheley, Roger L.; Petroff, Janet K., eds. Biology and management of noxious rangeland weeds. Corvallis, OR: Oregon State University Press: 116-132. [35716]

10. Chapman, Rachel Ross; Crow, Garrett E. 1981. Raunkiaer's life form classification in relation to fire. Bartonia. Philadelphia, PA: Philadelphia Botanical Club. 48: 19-33. [53612]

11. Clark, Frances H.; Mittrick, Chris; Shonbrun, Sarah. 1998. Rogues gallery: New England's notable invasives. Conservation Notes of the New England Wild Flower Society. 2(3): 19-26. [74009]

12. Connecticut Invasive Plant Working Group. 2009. Connecticut invasive plant list, July 2009, [Online]. In: Connecticut invasive plant list. Storrs, CT: University of Connecticut, Connecticut Invasive Plant Working Group (Producer). Available: http://www.hort.uconn.edu/CIPWG/invplantsCT09commonname.pdf [2010, January 25]. [78290]

13. Czarapata, Elizabeth J. 2005. Invasive plants of the Upper Midwest: An illustrated guide to their identification and control. Madison, WI: The University of Wisconsin Press. 215 p. [71442]

14. Dibble, Alison C.; Zouhar, Kristin; Smith, Jane Kapler. 2008. Fire and nonnative invasive plants in the Northeast bioregion. In: Zouhar, Kristin; Smith, Jane Kapler; Sutherland, Steve; Brooks, Matthew L., eds. Wildland fire in ecosystems: fire and nonnative invasive plants. Gen. Tech. Rep. RMRS-GTR-42-vol. 6. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 61-90. [70902]

15. Ding, Jianqing; Reardon, Richard; Wu, Yun; Zheng, Hao; Fu, Weidong. 2006. Biological control of invasive plants through collaboration between China and the United States of America: a perspective. Biological Invasions. 8(7): 1439-1450. [71691]

16. Dirr, Michael A. 1998. Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses. 5th ed. Champaign, IL: Stipes Publishing. 1187 p. [74836]

17. Fitzgerald, Judith M.; Loeb, Robert E. 2008. Historical ecology of Inwood Hill Park, Manhattan, New York. The Journal of the Torrey Botanical Society. 135(2): 281-293. [72480]

18. Fleming, Peggy; Kanal, Raclare. 1995. Annotated list of vascular plants of Rock Creek Park, National Park Service, Washington, DC. Castanea. 60(4): 283-316. [71991]

19. Frankel, Edward. 1978. A floristic survey of the vascular plants of the Bronx River Park in Westchester County, New York. Bulletin of the Torrey Botanical Club. 105(2): 147-155. [73732]

20. Georgia Exotic Pest Plant Council. 2006. List of non-native invasive plants in Georgia, [Online]. Southeast Exotic Pest Plant Council (Producer). Available: http://www.gaeppc.org/list.cfm [2009, January 5]. [72787]

21. Gerrath, Jean M.; Posluszny, Usher. 1989. Morphological and anatomical development in the Vitaceae. V. Vegetative and floral development in Ampelopsis brevipedunculata. Canadian Journal of Botany. 67(8): 2371-2386. [76766]

22. Gleason, H. A.; Cronquist, A. 1963. Manual of vascular plants of northeastern United States and adjacent Canada. Princeton, NJ: D. Van Nostrand Company, Inc. 810 p. [7065]

23. Goodwin, Kim; Sheley, Roger; Clark, Janet. 2002. Integrated noxious weed management after wildfires. EB-160. Bozeman, MT: Montana State University, Extension Service. 46 p. Available online: http://www.montana.edu/wwwpb/pubs/eb160.html [2003, October 1]. [45303]

24. Greller, Andrew M. 1977. A vascular flora of the forested portion of Cunningham Park, Queens County, New York. Bulletin of the Torrey Botanical Club. 104(2): 170-176. [73024]

25. Gurevitch, Jessica; Howard, Timothy G.; Ashton, Isabel W.; Leger, Elizabeth A.; Howe, Katherine M.; Woo, Eliza; Lerdau, Manuel. 2008. Effects of experimental manipulation of light and nutrients on establishment of seedlings of native and invasive woody species in Long Island, NY forests. Biological Invasions. 10: 821-831. [73303]

26. Hann, Wendel; Havlina, Doug; Shlisky, Ayn; [and others]. 2008. Interagency fire regime condition class guidebook. Version 1.3, [Online]. In: Interagency fire regime condition class website. U.S. Department of Agriculture, Forest Service; U.S. Department of the Interior; The Nature Conservancy; Systems for Environmental Management (Producer). 119 p. Available: http://frames.nbii.gov/frcc/documents/FRCC_Guidebook_2008.07.10.pdf [2008, September 03]. [70966]

27. Harrington, Robin A.; Kujawski, Ronald; Ryan, H. Dennis P. 2003. Invasive plants and the green industry. Journal of Arboriculture. 29(1): 42-48. [49826]

28. Hobbs, Richard J.; Humphries, Stella E. 1995. An integrated approach to the ecology and management of plant invasions. Conservation Biology. 9(4): 761-770. [44463]

29. Johnson, Douglas E. 1999. Surveying, mapping, and monitoring noxious weeds on rangelands. In: Sheley, Roger L.; Petroff, Janet K., eds. Biology and management of noxious rangeland weeds. Corvallis, OR: Oregon State University Press: 19-36. [35707]

30. Kamijo, Takashi; Kitayama, Kanehiro; Sugawara, Aya; Urushimichi, Shinya; Sasai, Kanako. 2002. Primary succession of the warm-temperate broad-leaved forest on a volcanic island, Miyake-Jima, Japan. Folia Geobotanica. 37(1): 71-89, 91. [75832]

31. Kartesz, John T. 1999. A synonymized checklist and atlas with biological attributes for the vascular flora of the United States, Canada, and Greenland. 1st ed. In: Kartesz, John T.; Meacham, Christopher A. Synthesis of the North American flora (Windows Version 1.0), [CD-ROM]. Chapel Hill, NC: North Carolina Botanical Garden (Producer). In cooperation with: The Nature Conservancy; U.S. Department of Agriculture, Natural Resources Conservation Service; U.S. Department of the Interior, Fish and Wildlife Service. [36715]

32. LANDFIRE Rapid Assessment. 2005. Reference condition modeling manual (Version 2.1), [Online]. In: LANDFIRE. Cooperative Agreement 04-CA-11132543-189. Boulder, CO: The Nature Conservancy; U.S. Department of Agriculture, Forest Service; U.S. Department of the Interior (Producers). 72 p. Available: http://www.landfire.gov/downloadfile.php?file=RA_Modeling_Manual_v2_1.pdf [2007, May 24]. [66741]

33. LANDFIRE Rapid Assessment. 2007. Rapid assessment reference condition models, [Online]. In: LANDFIRE. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Lab; U.S. Geological Survey; The Nature Conservancy (Producers). Available: http://www.landfire.gov/models_EW.php [2008, April 18] [66533]

34. Leck, Mary Allessio; Leck, Charles F. 2005. Vascular plants of a Delaware River tidal freshwater wetland and adjacent terrestrial areas: seed bank and vegetation comparisons of reference and constructed marshes and annotated species list. Journal of the Torrey Botanical Society. 132(2): 323-354. [60627]

35. Luken, James O. 2003. Invasions of forests in the eastern United States. In: Gilliam, Frank S.; Roberts, Mark R., eds. The herbaceous layer in forests of eastern North America. New York: Oxford University Press, Inc: 283-400. [71484]

36. Mack, Richard N.; Simberloff, Daniel; Lonsdale, W. Mark; Evans, Harry; Clout, Michael; Bazzaz, Fakhri A. 2000. Biotic invasions: causes, epidemiology, global consequences, and control. Ecological Applications. 10(3): 689-710. [48324]

37. Magee, Dennis W.; Ahles, Harry E. 2007. Flora of the Northeast: A manual of the vascular flora of New England and adjacent New York. 2nd ed. Amherst, MA: University of Massachusetts Press. 1214 p. [74293]

38. Massachusetts Invasive Plant Advisory Group (MIPAG). 2005. Strategic recommendations for managing invasive plants in Massachusetts. Final report: February 28, 2005, [Online]. Massachusetts Invasive Plant Advisory Group (Producer). Available: http://www.massnrc.org/mipag/docs/STRATEGIC_PLAN_FINAL_042005.pdf [2009, July 2]. [71599]

39. Masuda, M.; Washitani, I. 1990. A comparative ecology of the seasonal schedules for 'reproduction by seeds' in a moist tall grassland community. Functional Ecology. 4(2): 169-182. [75827]

40. Mehrhoff, L. J.; Silander, J. A., Jr.; Leicht, S. A.; Mosher, E. S.; Tabak, N. M. 2003. IPANE: Invasive Plant Atlas of New England, [Online]. Storrs, CT: University of Connecticut, Department of Ecology and Evolutionary Biology (Producer). Available: http://nbii-nin.ciesin.columbia.edu/ipane/ [2008, May 28]. [70356]

41. Miller, Melanie. 2000. Fire autecology. In: Brown, James K.; Smith, Jane Kapler, eds. Wildland fire in ecosystems: Effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 9-34. [36981]

42. NatureServe. 2010. NatureServe Explorer: An online encyclopedia of life, [Online]. Version 7.1. Arlington, VA: NatureServe (Producer). Available http://www.natureserve.org/explorer. [69873]

43. Patterson, Karen D. 2008. Vegetation classification and mapping at Appomattox Court House National Historical Park, Virginia. Technical Report NPS/NER/NRTR—2008/125. Philadelphia, PA: U.S. Department of the Interior, National Park Service, Northeast Region. 261 p. [78026]

44. Putz, Francis E. 1995. Relay ascension of big trees by vines in Rock Creek Park, District of Columbia. Castanea. 60(2): 167-169. [40214]

45. Radford, Albert E.; Ahles, Harry E.; Bell, C. Ritchie. 1968. Manual of the vascular flora of the Carolinas. Chapel Hill, NC: The University of North Carolina Press. 1183 p. [7606]

46. Raunkiaer, C. 1934. The life forms of plants and statistical plant geography. Oxford: Clarendon Press. 632 p. [2843]

47. Robertson, David J.; Antenen, Susan. 1990. Alien vine control in Piedmont forest restorations.

Restoration & Management Notes. 8(1): 52. [13550]

48. Robertson, David J.; Robertson, Mary C.; Tague, Thomas. 1994. Colonization dynamics of four exotic plants in a northern piedmont natural area. Bulletin of the Torrey Botanical Club. 121(2): 107-118. [24418]

49. Seymour, Frank Conkling. 1982. The flora of New England. 2nd ed. Phytologia Memoirs 5. Plainfield, NJ: Harold N. Moldenke and Alma L. Moldenke. 611 p. [7604]

50. Shah, J. J.; Dave, Y. S. 1970. Morpho-histogenic studies on tendrils of Vitaceae. American Journal of Botany. 57(4): 363-373. [76749]

51. Sheley, Roger; Manoukian, Mark; Marks, Gerald. 1999. Preventing noxious weed invasion. In: Sheley, Roger L.; Petroff, Janet K., eds. Biology and management of noxious rangeland weeds. Corvallis, OR: Oregon State University Press: 69-72. [35711]

52. Snyder, David; Kaufman, Sylvan R. 2004. An overview of nonindigenous plant species in New Jersey. Trenton, NJ: New Jersey Department of Environmental Protection, Division of Parks and Forestry, Office of Natural Lands Management, Natural Heritage Program. 107 p. [71446]

53. Stalter Richard; Kincaid, Dwight; Byer, Michael. 2009. Control of nonnative invasive woody plant species at Jamaica Bay Wildlife Refuge, New York City. Arboriculture and Urban Forestry. 35(3): 152-156. [76768]

54. Stalter, Richard; Lamont Eric E. 2002. Vascular flora of Jamaica Bay Wildlife Refuge, Long Island, New York. Journal of the Torrey Botanical Society. 129(4): 346-358. [75389]

55. Stickney, Peter F. 1989. Seral origin of species comprising secondary plant succession in Northern Rocky Mountain forests. FEIS workshop: Postfire regeneration. Unpublished draft on file at: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, MT. 10 p. [20090]

56. Swearingen, J.; Reshetiloff, K.; Slattery, B.; Zwicker, S. 2002. Plant invaders of mid-Atlantic natural areas. [Washington, DC]: U.S. Department of the Interior, National Park Service; Fish and Wildlife Service. 82 p. Available online: http://www.invasive.org/eastern/midatlantic/index.html [2009, November 19]. [54192]

57. Tennessee Exotic Pest Plant Council. 2001. Tennessee invasive exotic plant list, [Online]. In: Invasive exotic plants in Tennessee. Fairview, TN: Tennessee Exotic Pest Plant Council (Producer) Available: http://www.tneppc.org/Invasive_Exotic_Plant_List/The_List.htm [2009, June 12]. [74677]

58. The Nature Conservancy. 1998. Vegetation classification of Rock Creek Park. NBS/NPS Vegetation Mapping Program. Arlington, VA: The Nature Conservancy. 50 p. Available online: http://biology.usgs.gov/npsveg/rocr/rocrrpt.pdf [2010, January 25]. [78028]

59. Thiery, Denis; Moreau, Jerome. 2005. Relative performance of European grapevine moth (Lobesia botrana) on grapes and other hosts. Oecologia. 143(4): 548-557. [76746]

60. Tu, Mandy; Hurd, Callie; Randall, John M., eds. 2001. Weed control methods handbook: tools and techniques for use in natural areas. Davis, CA: The Nature Conservancy. 194 p. [37787]

61. Tyser, Robin W.; Worley, Christopher A. 1992. Alien flora in grasslands adjacent to road and trail corridors in Glacier National Park, Montana (U.S.A.). Conservation Biology. 6(2): 253-262. [19435]

62. U.S. Department of Agriculture, Forest Service, Eastern Region. 2004. Eastern Region invasive plants

ranked by degree of invasiveness, [Online]. In: Noxious weeds and non-native invasive plants. Section 3: Invasive plants. Milwaukee, WI: Eastern Region (Producer). Available: http://www.fs.fed.us/r9/wildlife/range/weed/Sec3B.htm [2004, February 16]. [46748]

63. U.S. Department of Agriculture, Forest Service, Northeastern Area, Forest Health Staff. 2006. Weed of the week: Porcelain-berry--Ampelopsis brevipedunculata (Mazim.) Trautv., [Online]. In: Invasive plant fact sheets. WOW 07-13-06. In: Forest health protection--invasive plants. Newtown Square, PA: Forest Health Protection, Northeastern Area (Producer). Available: http://na.fs.fed.us/fhp/invasive_plants/weeds/porcelain-berry.pdf [2009, December 18]. [78037]

64. U.S. Department of Agriculture, Forest Service. 2001. Guide to noxious weed prevention practices. Washington, DC: U.S. Department of Agriculture, Forest Service. 25 p. Available online: http://www.fs.fed.us/invasivespecies/documents/FS_WeedBMP_2001.pdf [2009, November 19]. [37889]

65. U.S. Department of Agriculture, Natural Resources Conservation Service. 2010. PLANTS Database, [Online]. Available: http://plants.usda.gov/. [34262]

66. Virginia Department of Conservation and Recreation, Division of Natural Heritage. 2003. Invasive alien plant species of Virginia, [Online]. In: Natural Heritage Program--Invasive plants list. Richmond, VA: Virginia Department of Conservation and Recreation, Division of Natural Heritage; Virginia Native Plant Society (Producers). Available: http://www.dcr.virginia.gov/natural_heritage/documents/invlist.pdf [2009, March 23]. [44942]

67. Virginia Department of Conservation and Recreation, Natural Heritage Program. 2006. Species factsheets: Porcelain-berry (Ampelopsis brevipedunculata (Maxim.) Trautv.), [Online]. In: Invasive alien plant species of Virginia. Richmond, VA: Virginia Natural Heritage Program (Producer). Available: http://www.dcr.virginia.gov/natural_heritage/documents/fsambr.pdf [2009, December 8]. [78038]

68. Washitani, I.; Masuda, M. 1990. A comparative study of the germination characteristics of seeds from a moist tall grassland community. Functional Ecology. 4(4): 543-557. [75825]

69. Weatherbee, Pamela B.; Somers, Paul; Simmons, Tim. 1998. A guide to invasive plants in Massachusetts. Westborough, MA: Massachusetts Division of Fisheries and Wildlife. 23 p. [71448]

70. Weber, Ewald. 2003. Invasive plant species of the world: a reference guide to environmental weeds. Cambridge, MA: CABI Publishing. 548 p. [71904]

71. Westbrooks, Randy G. 1998. Invasive plants: changing the landscape of America. Fact Book. Washington, DC: Federal Interagency Committee for the Management of Noxious and Exotic Weeds. 109 p. [33874]

72. Whelan, Robert J. 1995. Survival of individual organisms. In: Whelan, Robert J., ed. The ecology of fire. Cambridge, UK: Cambridge University Press: 57-134. [52505]

73. Williams, Scott C.; Ward, Jeffrey S.; Ramakrishnan, Uma. 2008. Endozoochory by white-tailed deer (Odocoileus virginianus) across a suburban/woodland interface. Forest Ecology and Management. 255(3-4): 940-947. [70535]

74. Wu, Ming-Jiuan; Yen, Jui-Hung; Wang, Lisu; Weng, Ching-Yi. 2004. Antioxidant activity of porcelainberry (Ampelopsis brevipedunculata (Maxim.) Trautv.). American Journal of Chinese Medicine. 32(5): 681-693. [76780]

75. Yabe, Noritsugu; Matsui, Hisao. 1997. Ampelopsis brevipedunculata (Vitaceae) extract stimulates collagen synthesis through superoxide generation in the serum-free cultures of rat dermal fibroblasts and Ito cells. Journal of ethnopharmacology. 56(1): 67-76. [76764]

76. Yost, Susan E.; Antenen, Susan; Harvigsen, Gregg. 1991. The vegetation of the Wave Hill Natural Area, Bronx, New York. Torreya. 118(3): 312-325. [16546]

77. Young, Jamie. 2005. Fact sheet: Porcelain-berry--Ampelopsis brevipedunculata (Maxim.) Trautv., [Online]. In: Weeds gone wild: Alien plant invaders of natural areas. Washington, DC: National Park Service; The Plant Conservation Alliance's Alien Plant Working Group (Producer). Available: http://www.nps.gov/plants/alien/fact/pdf/ambr1.pdf [2009, December 8]. [78015]

78. Zomlefer, Wendy B. 1994. Guide to flowering plant families. Chapel Hill, NC: The University of Carolina Press. 430 p. [72836]

FEIS Home Page