WRITTEN FINDINGS OF THE
WASHINGTON STATE NOXIOUS WEED CONTROL BOARD
Updated 2015

Scientific Name: *Amorpha fruticosa* L.

Synonyms: *Amorpha elata* Hayne, *Amorpha fragrans* Sweet, *Amorpha fruticosa* var. *angustifolia* Pursh, *Amorpha fruticosa* f. *crispa* (G. Kirchn.) C. K. Schneid., *Amorpha fruticosa* var. *tennesseensis* (Shuttlew. ex Kunze) E. J. Palmer, *Amorpha tennessensis* Shuttlew. ex Kunze, *Amorpha virgata* Small

Common Name: indigobush, false indigo, lead plant,

Family: Fabaceae

Legal Status: Class B noxious weed in 1988

Images: left, habit of a planted *Amorpha fruticosa*, image John Ruter, University of Georgia, Bugwood.org; center, *A. fruticosa* infestation along a river in southeast Washington; blooming inflorescences, center and left images by WSNWCB.

Description and Variation:
The genus *Amorpha* is Greek and means 'without form' or 'deformed' in reference to the flowers which only have one petal, not the typically pea-like flower of the Fabaceae family (Gledhill 2008 in Wikipedia 2015). *Amorpha fruticosa* contains indigo pigment, but it is in too small amounts for commercial use, hence one of the common names "false indigo" (Missouri Botanical Gardens n.d.).

Overall habit:
Amorpha fruticosa is a deciduous shrub with multiple stems that can grow to over 12 feet tall and can form thickets. Plants have alternate, pinnately compound deciduous leaves that are dotted with glands. Flowers are in dense, upright clusters of violet to purple flowers and occur in the upper branches.

Roots:
Plants have an extensive root system and grow from its proliferating lateral root sprouts (McGregor et al. 1986). *Amorpha fruticosa*'s root system was studied in China and found to have its roots dominated by roots of vertical growth, with the coarse roots of A. fruticosa being distributed in the 0 to 100 cm soil layer (Wang et al. 2011).

The roots of *A. fruticosa* have a symbiotic relationship with soil bacteria, forming nodules on the roots and having the ability to fix atmospheric nitrogen (Huxley 1992 in Brigić et al. 2014). The bacterium species has been identified to be *Mesorhizobium amorphae* (Wang et al. 1999 in DeHaan et al. 2006).

Stems:

Shrubs have multiple, erect stems that grow 3.3 to 13 feet (1 to 4 meters) tall, though sometimes to 20 feet, and are commonly branched near the tips (McGregor et al. 1986, Barneby 1990). Shrubs can have an open crown of many stems. Stems are unarmed (no thorns, spines), and the new growth is densely hairy (McGregor et al. 1986).

Leaves:

Leaves are deciduous, compound, and alternately arranged on stems. Leaves primarily occur on the upper third of the stems. Leaf petioles are 0.8 to 2 inches (2 to 5 cm) long (McGregor et al. 1986). Leaves are gland-dotted, finely hairy or almost hairless (subglabrous) (Barneby 1990). Leaves are 2.8 to 7.9 inches (7 to 20 cm) long, odd-pinnately compound with 9 to 31 leaflets that are 0.6 to 1.6 inches (1.5 to 4 cm) long by 0.3 to 0.8 inches (0.7 to 2 cm) wide (Barneby 1990). The leaflets are oblong to elliptic, apiculate and are green to gray-green above and pallid on their undersides (Barneby 1990). The midrib of each leaflet typically ends in a thin hair-like projection that is 0.5 to 1.5 mm long (Boyd and Isely 2013).

Images: left, center, right, compound leaves alternately arranged on stem, image by John Ruter, University of Georgia, Bugwood.org.

Flowers:

Flowers are in terminal, dense racemes, solitary or in clusters (McGregor et al. 1986). The calyx (sepals collectively) is conspicuously gland-dotted and 2.5 to 4 mm long (Kozloff 2005, Barneby 1990). Flowers only have a one petal (banner), lacking wings and a keel which are common of other flowers in the Fabaceae family (Kozloff 2005). The petal curves around a single pistil and 10 stamens, is violet-blue to purple, and 0.2 to 0.24 inches (5 to 6 mm) long (DeHaan et al. 2006, Barneby, 1990). Stamen filaments are 0.2 to 0.3 inches (6 to 8 mm) long, extend beyond the petal and at their tips have yellow-orange anthers (McGregor et al. 1986).

Images: left, blooming inflorescences of *Amorpha fruticosa* at stem tips; center, blooming raceme, left and center image by WSNWCB; right, close-up of *A. fruticosa* flowers showing one petal and exserted stamens with yellow-orange anthers, image by Jim Conrad, public domain, 2008.

Fruit:

Fruits are an indehiscent legume (pod) that is conspicuously gland-dotted, glabrous or short pubescent (DeHaan et al. 2006, McGregor et al. 1986). Pods are incurved distally, 0.2 to 0.4 inches (5 to 9 mm) long by 0.06 to 0.16 inches (1.5 to 4 mm) wide, and contain 1 to 2 seeds (Barneby 1990).

Images: left, immature seed pods, image by Leslie J. Mehrhoff, University of Connecticut, Bugwood.org; center, a mix of mature and immature seed pods, image by Leslie J. Mehrhoff, University of Connecticut, Bugwood.org; right, seed pods in late winter, image by WSNWCB.

Habitat:

Amorpha fruticosa is most commonly found growing in riparian areas in full sun or part shade. It can grow in thickets, woods, canyons and disturbed wetlands (Jepson 2013, Barneby 1990). In Washington, *A. fruticosa* is found in the upper fluctuation zone of run-of-the-river reservoirs along the Columbia and Snake Rivers and upper drawdown zones of storage reservoirs (Glad and Halse 1993). In Washington, it is commonly found growing in rocks (including riprap) and sand along waterways (Glad and Halse 1993).

Geographic Distribution:

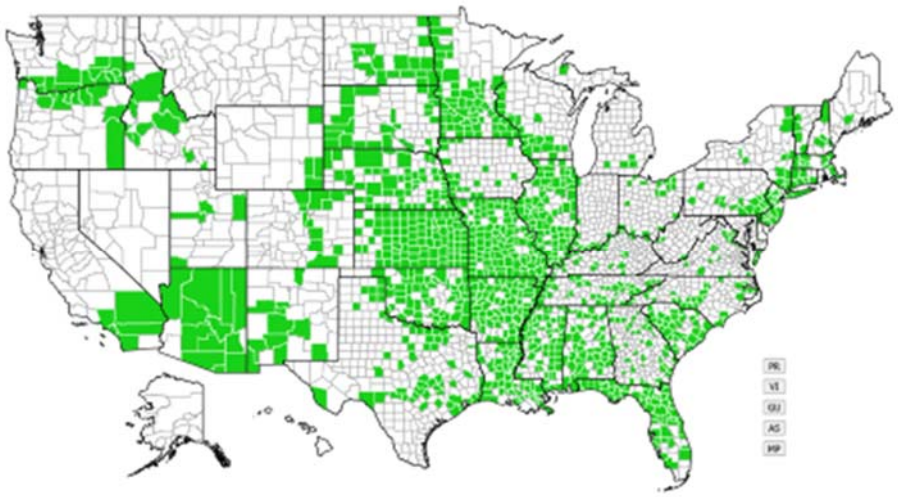
Amorpha fruticosa is not native to Washington but it is native to other parts of North America, from southern Canada by the Dakotas south to Texas and northern Chihuaha, east from New England and Florida and west to southern California and northern Baja California (including eastern Wyoming, central Colorado, New Mexico, and Arizona) (Barney 1990). USDA ARS (2015) specifically lists where A. fruticosa is native as:

- Canada: Manitoba
- Mexico: Baja Norte, Chihuahua, Sonora

- United States: Connecticut, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New York, Ohio, Pennsylvania, Vermont, West Virginia, Illinois, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, Wisconsin, Colorado, Wyoming, Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, New Mexico, Texas, Arizona, California (southwest)

USDA GRIN database (USDA ARS 2015) lists *Amorpha fruticosa* naturalized in:

- Western Indian Ocean: Mauritius
- Asia: Iraq, Azerbaijan, Russian Federation (Kurgan, Primorye, European part), Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, China, Korea, India, Pakistan,
- Europe, where is it widespread in the southeast and most of central Europe (Brigić et al. 2014)
- South America: Argentina
- North America: Northwestern U.S.A: Idaho (southwest), Washington (though not listed in GRIN).



Map: County level presence/absence distribution map of *Amorpha fruticosa* showing both native and nonnative collections, map by EDDMapS 2015.

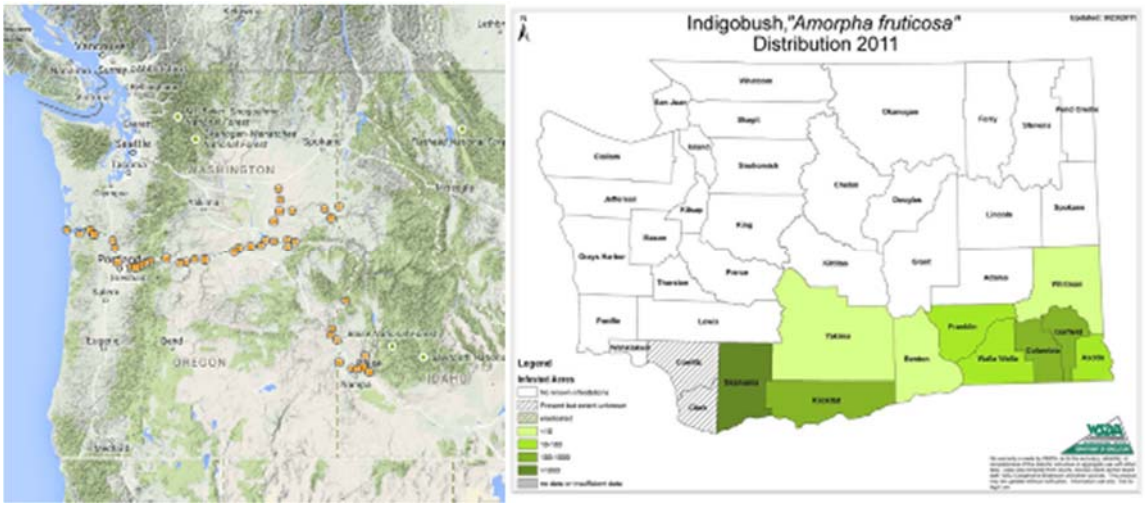
Listings:

Amorpha fruticosa is listed as a Class B noxious weed in Washington and is also listed on Washington's Quarantine List, WAC 16-752, which prohibits transporting, buying, selling, offering for sale or distribution of regulated plants or plant parts within the state. Besides Washington, *A. fruticosa* is also listed as a noxious weed in Connecticut.

Washington:

Though *Amorpha fruticosa* is native to North America, including parts of the United States, it is not native to Washington State. The earliest herbarium record of *A. fruticosa* in Washington is a garden collection by William N. Suksdorf in 1893 from Klickitat County (WS145274). After that collection, there were no online herbarium collections of *A. fruticosa* in Washington until 1973 when there is a herbarium collection from Walla Walla County from the edge of Mill Creek, where there were numerous scattered plants growing below a dam (WS331986). After 1973, there are a number of collections in southeastern Washington as well as in southwest Washington. Glad and Halse (1993) report it being found along the Columbia River, from the Handford Reach in Benton and Franklin counties, west to Multnomah County (Oregon) and Wahkiakum County (WA). Other waterways where it has also been found include Deadman Creek (Garfield County), Tucannon River (above Starbuck in Columbia County) and Mill Creek (near Walla Walla in Walla Walla County) (Glad and Halse 1993). In western Washington, *A. fruticosa* was first found at Home Valley (Skamania County) in 1988, but it was

originally thought to be *A. occidentalis* (Glad and Halse 1993). Since then, additional locations of *A. fruticosa* have been found along or near the Columbia River. The Washington State Department of Agriculture produced a map displaying the county level distribution of *A. fruticosa* based on information from land managers in 2011 (WSDA 2011).



Maps: left, herbarium collections of *Amorpha fruticosa* in Washington, Oregon and Idaho, all states are outside of its native range, map by Consortium of Pacific Northwest Herbaria, 2015; right, Washington State Department of Agriculture county distribution map of *A. fruticosa* in Washington (WSDA 2011).

Amorpha fruticosa winter dormant stems with seed pods.

<u>Growth and Development</u>:
Amorpha fruticosa is a perennial, deciduous shrub. Its leaves emerge in the spring and flowers typically bloom May to July depending on environmental conditions (Boyd and Isley 2013). Seed pods develop during the summer to fall and are mature by fall. Pods can remain on dormant stems throughout the winter.

<u>Reproduction:</u>
Plants spread primarily by seed but can also spread vegetatively by suckers and cuttings. *Amorpha fruticosa* shows strong coppicing ability (Takagi and Hioki 2013). Seed viability is high. Seeds collected from samples growing in sun and shade averaged 94% to 98% respectively. In favorable conditions, seeds can be viable for 3 to 5 years (Skamania County Noxious Weed Control Program 2014). Seeds can move downstream on water and can also stick to people, animals or equipment and move to new sites (Simon 2004).

Economic Importance:

Detrimental:

In Washington, *Amorpha fruticosa* forms dense, impenetrable stands in riparian areas, including rivers, streams and reservoirs (Simon 2004). These thick stands can crowd out native plant communities that grow in these riparian habitats (Department of Ecology n.d.). In the Pierce Wildlife Refuge in Skamania County, *A. fruticosa* has been degrading the habitat for Columbia yellow cress (*Rorippa columbiae*), a threatened, endemic species (Skamania County Noxious Weed Control Program 2015). *Amorpha fruticosa* impacts have been studied in Europe where it was introduced for a variety of purposes, including as an ornamental plant, as a windbreak plant and for stabilizing slopes, and it subsequently escaped and spread (Brigic et al. 2014). In invaded European habitats, such as wetlands, it has caused changes in the vegetation community, microclimate, nutrient cycling and productivity (Houlahan and Findlay 2004, Schirmel et al. 2010 in Brigić et al. 2014). A study in Croatia found that sites invaded and dominated by *A. fruticosa*, compared to uninvaded sites, had lower plant species richness and diversity (Brigić et al. 2014). A study by Fried et al. (2014) researched a number of invasive species, including *A. fruticosa*, and looked at their community effects in the French continental region. *Amorpha fruticosa* was studied in sand dune habitats and found to have low community level effects (on diversity, richness and impacts) but they did find it favored a different species association than that occurring in uninvaded habitats. Besides Europe, *A. fruticosa* has been introduced into Japan to revegetate artificial slopes and has escaped into riverbeds (Takagi and Hioki 2013). In these areas, species diversity was found to be lower in and around areas where *A. fruticosa* was growing (Takagi and Hioki 2013).

The change in the native plant community can cause changes for other species including invertebrates. Brigić et al. (2014) study found the carabid beetle assemblages and other soil invertebrates altered after *A. fruticosa* invasion. Although some carabid beetle species benefited from the change to *A. fruticosa* dominated community, there can be a reduction or even a removal of open habitat carabid beetle species.

Amorpha fruticosa forms dense thickets that block access to waterways for recreational activities such as boating and fishing (Skamania County Noxious Weed Control Program 2015). This leads to the inappropriate use, and unintentional damage, of sensitive habitat areas to gain access to the water (Skamania County Noxious Weed Control Program 2014).

Extracts of the leaves and pods of *Amorpha fruticosa* have been found to be toxic to various insects (DeHaan et al. 2006, Herman et al. n.d.).

Beneficial:

Where *Amorpha fruticosa* is native, it provides a number of benefits such as wildlife cover and forage. It has also been planted and introduced to new areas for forage, soil stabilization, erosion control, as a windbreak, wildlife food, green manure, and seed usage as an oil source in the manufacture of glycerol (Wang et al. 1999 in Brigić et al. 2014). *Amorpha fruticosa* has been found to provide good grazable material, and plants are tolerant of defoliation and able to resprout (DeHaan et al. 2006). Goats that grazed *A. fruticosa* in September gained weight at a rate similar to that of being fed alfalfa (*Medicago sativa* L.) (Papachristou et. al. 1999 in DeHaan et al. 2006).

Amorpha fruticosa has also been used as a landscape ornamental plant. Though it can have beneficial uses, DeHaan et al. (2006) note that in regions where the species could be invasive, it either should not be planted for agricultural use or needs to be strictly controlled.

Control:

Though it is illegal to transport, buy, or sell *Amorpha fruticosa*, make sure to avoid planting *A. fruticosa* in Washington State. Monitor areas where control has taken place to prevent resprouts and control seedlings. Since seeds can be transported by water, monitor downstream from infestations and control new infestations.

Mechanical Control:
Seedlings and small plants may be pulled or dug out of the ground. Large plants can have extensive root systems and may not be feasible for digging. Cutting, carried out by The Nature Conservancy, twice per year for three years, reduced growth and seed production and slowed the vegetative spread (Simon 2004).

Cultural Control:
Healthy native plant communities will help prevent *Amorpha fruticosa* invasion and limit seed germination by providing cover and competition.

Biocontrol Control:
There are no approved biological control agents for *Amorpha fruticosa*.

Though *Amorpha fruticosa* can be grazed by animals, it is unknown what impact any grazing has had on plants in Washington.

Herbicide Control:
Though *Amorpha fruticosa* is not currently included in the Pacific Northwest Weed Management Handbook, check this resource for information on herbicide use as it is continually updated:
http://pnwhandbooks.org/weed/control-problem-weeds

Klickitat County Noxious Weed Control Board has had success treating terrestrial *A. fruticosa* plants with Milestone at 5 oz/acre. Treatment is conducted on plants just prior to bloom and also in late summer with good success. The earlier treatment is the preferable treatment time so as to prevent seed production (Marty Hudson pers.comm.).

The Skamania County Noxious Weed Control Board has also been working to control *Amorpha fruticosa* with land managers and volunteers, trying a number of different control treatments. In 2006, cut stem treatments (cutting back plant stems and then treating the freshly cut surface with herbicide) using glyphosate at 50% solution and triclopyr at a 50% solution were tested. Treatments were carried out in late July as the waters of the Columbia River permitted. No significant difference was found between treatments with both resulting in over 70% control of *A. fruticosa*. It is important to treat the cut surfaces as soon as possible after cutting, as too much time between cutting and treating can result in lower control. Tests using a foliar treatment of glyphosate (2% solution) resulted in over 80% control. Another successful treatment in use, with a 95% control rate, has been to cut the plants back in the spring and apply a foliar treatment of glyphosate (2% solution) to the regrowth later that season. Challenges faced when using these treatments included varying water levels and inundation from the Columbia River, limiting treatment time, and working around cut plant material. Control work is also followed by planting stakes of native willow (*Salix* spp.) and dogwood (*Cornus sericea*), to help prevent reinvasion of *A. fruticosa* and provide erosion control in treated areas. (All from Cyndi Soliz and Emily Stevenson pers. comm. Skamania County Noxious Weed Control Board).

Simon (2004) reported on research conducted in 2002 by Tim Miller, WSU Extension Weed Scientist, looking at the effectiveness of using Roundup, Transline, and Crossbow applied as a foliar treatment (at 2%) and as a cut stem treatment (at 33%). After 10 months, Transline provided 98% control of both foliar and cut stem treatments while the other successful treatments were cut stem treatments of both Crossbow (93% control) and Roundup (78% control) (Simon 2004).

In general, use herbicide control in combination with other control methods to reduce usage when possible. If using a foliar spray, treat plants when pollinators are not present or are the least active.

While treatments of *Amorpha fruticosa* may be terrestrial, plants may also be growing in water. Please note: the use of pesticides in water is regulated in Washington. All applicators must have an aquatic endorsement on their pesticide applicators' license, which is issued by the Washington State Department of Agriculture. In addition, coverage under an NPDES permit issued by the Department of Ecology may also be required. Please contact your county noxious weed board or the Washington State Department of Ecology for more information.

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