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Field Release of the Knotweed Psyllid *Aphalara itadori* (Hemiptera: Psyllidae) for Classical Biological Control of Japanese, Giant, and Bohemian Knotweeds, *Fallopia japonica*, *F. sachalinensis*, and *F*. x *bohemica* (Polygonaceae), in the Contiguous United States.

Environmental Assessment, January 2020

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Contents

I. Purpose and Need for the Proposed Action

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ), Pests, Pathogens, and Biocontrol Permits (PPBP) is proposing to issue permits for release of the Kyushu and Hokkaido biotypes of the knotweed psyllid, *Aphalara itadori* (Hemiptera: Psyllidae). *Aphalara itadori* would be used for the classical biological control of Japanese, giant, and Bohemian knotweeds (*Fallopia japonica*, *F. sachalinensis*, and *F.* x *bohemica* (Polygonaceae)) in the contiguous United States.

Classical biological control of weeds is a weed control method where natural enemies from a foreign country are used to reduce exotic weed infestations that have become established in the United States. Several different kinds of organisms have been used as biological control agents of weeds: insects, mites, nematodes, and plant pathogens, although plant-feeding insects are the most commonly used. Efforts to develop a weed biological control agent consist of the following steps (TAG, 2016):

1. Foreign exploration in the weed's area of origin.
2. Host specificity studies.
3. Approval of the exotic agent by PPBP.
4. Release and establishment in areas of the United States invaded by the target weed.
5. Post-release monitoring.

This environmental assessment[1] (EA) has been prepared, consistent with USDA, APHIS' National Environmental Policy Act of 1969 (NEPA) implementing procedures (Title 7 of the Code of Federal Regulations (CFR), part 372). It examines the potential effects on the quality of the human environment that may be associated with the release of *A. itadori* to control infestations of Japanese, giant, and Bohemian knotweeds within the contiguous United States. This EA considers the potential effects of the proposed action and its alternatives, including no action. Notice of this EA was made available in the Federal Register on May 28, 2019 for a 30-day public comment period. APHIS received a total of 220 comments on the EA by the close of that comment period, and received a request to extend the comment period. APHIS extended the comment period for an additional 60 days and received an additional 80 comments. Most comments (169) were in favor of the release of *A. itadori*. There were 131

[1] Regulations implementing the National Environmental Policy Act of 1969 (42 United States Code 4321 et seq.) provide that an environmental assessment "shall include brief discussions of the need for the proposal, of alternatives as required by section 102(2)(E), of the environmental impacts of the proposed action and alternatives, and a listing of agencies and persons consulted." 40 CFR § 1508.9.

comments that were either not in favor of or raised concerns regarding the release of *A. itadori*, mainly regarding impacts to bees and pollinators. These comments are addressed in appendix 4 of this document.

APHIS has the authority to regulate biological control organisms under the Plant Protection Act of 2000 (Title IV of Pub. L. 106–224). Applicants who wish to study and release biological control organisms into the United States must receive PPQ Form 526 permits for such activities. The PPBP received a permit application requesting environmental release of two biotypes of the knotweed psyllid, *A. itadori,* from Japan, and the PPBP is proposing to issue permits for this action. Before permits are issued, the PPBP must analyze the potential impacts of the release of this agent into the contiguous United States.

The applicant's purpose for releasing *A. itadori* is to reduce the severity of infestations of invasive knotweeds in the contiguous United States. Invasive knotweeds in North America are a complex of three closely related species in the family Polygonaceae that were introduced from Japan during the late 19th century (Barney, 2006). They include *Fallopia sachalinensis* (F. Schmidt) Ronse Decraene (giant knotweed), *F. japonica* (Houtt.) Ronse Decr. (Japanese knotweed)*,* and the hybrid between the two *F.* x *bohemica* (Chrtek & Chrtková) J. P. Bailey (Bohemian or hybrid knotweed). These large herbaceous perennials have spread throughout much of North America with the greatest infestations in the Pacific Northwest (Oregon, Washington, and British Columbia), the northeast of the United States, and eastern Canada. While capable of growing in diverse habitats, the knotweeds have become especially problematic along the banks and floodplains of rivers and streams, where they crowd out native plants and potentially affect stream nutrients and food webs (Beerling and Dawah, 1993; Maerz et al., 2005; Gerber et al., 2008; Urgenson et al., 2009; McIver and Grevstad, 2010). Several states have active control programs against knotweeds. However, the large scale of the knotweed invasion in North America, the inaccessibility of some of the infestations, and the difficulty with which the plants are killed, all suggest that complete eradication of this plant is unlikely.

Existing options for management of invasive knotweeds are expensive, temporary, ineffective, and can have nontarget impacts. Biological control has the potential to provide widespread and sustained reduction in knotweed abundance at a very low cost. Without a biological control program, chemical and mechanical inputs are likely to be needed on a permanent basis with variable to limited success. For these reasons, the applicant has a need to release *A. itadori,* a host-specific, biological control organism for the control of invasive knotweeds, into the environment.

II. Alternatives

This section will explain the two alternatives available to the PPBP—no action and issuance of permits for environmental release of *A. itadori*. Although the PPBP's alternatives are limited to a decision on whether to issue permits for release of *A. itadori*, other methods available for control of invasive knotweeds are also described. These control methods are not decisions to be made by the PPBP, and their use is likely to continue whether or not permits are issued for environmental release of *A. itadori*, depending on the efficacy of *A. itadori* to control invasive knotweeds. These are methods presently being used to control invasive knotweeds by public and private concerns.

A third alternative was considered, but will not be analyzed further. Under this third alternative, the PPBP would have issued permits for the field release of *A. itadori*; however, the permits would contain special provisions or requirements concerning release procedures or mitigating measures. No issues have been raised that would indicate special provisions or requirements are necessary.

A. No Action

Under the no action alternative, the PPBP would not issue permits for the field release of *A. itadori* for the control of invasive knotweeds. The release of this biological control agent would not take place. The following methods are presently being used to control invasive knotweeds; these methods will continue under the "No Action" alternative and will likely continue even if permits are issued for release of *A. itadori*, depending on the efficacy of the organism to control invasive knotweeds.

1. Chemical Control

In the United States several states have active control programs against knotweeds where herbicide foliar application and stem injection are commonly used. Favored herbicide formulations contain the active ingredient glyphosate (Rodeo®, Roundup®, Aquamaster®) or imazapyr (Habitat®). Due to the extensive root systems of knotweed that can extend up to 3 meters (m) deep, knotweeds must be treated year after year to completely eliminate plants. In British Columbia, broad spectrum herbicide use is operationally restricted to 15 m above the the high water mark in riparian zones. Specific applications for knotweed are only possible using glyphosate hand wipes or injection within 1 m of the high water mark.

2. Mechanical Control

Small isolated plants or knotweed patches can be effectively removed by covering them for several years with sturdy tarps or by hand digging, but only if the root system is not yet well established. As an alternative to herbicides, some success in weakening knotweed stands with salt water has been reported.

B. Issue Permits for Environmental Release of *A. itadori*

Under this alternative, the PPBP would issue permits for the field release of the knotweed psyllid, *A. itadori*, for the control of invasive knotweeds. These permits would contain no special provisions or requirements concerning release procedures or mitigating measures.

Biological Control Agent Information

1. Taxonomy

Common name: knotweed psyllid
Phylum: Arthropoda
Class: Insecta
Order: Hemiptera
Family: Psyllidae
Genus: *Aphalara*
Species: *itadori*
Authority: Shinji

2. Description of *A. itadori*

Aphalara itadori (figure 1) was first described as *Psylla itadori* by Shinji (1938), but was moved to the genus *Aphalara* by Miyatake (1964). A more recent description is provided by Burckhardt and Lauterer (1997). The *Aphalara* genus includes around 40 species, many of which are difficult to distinguish from each other and are often identified from their distinct host ranges (Burckhardt and Lauterer, 1997). Damage caused by *A. itadori* is shown in figure 2.

Two populations of *A. itadori* (biotypes)--one from the northern Japan (Hokkaido) that performs better on *F. sachalinensis* and the other from southern Japan (Kyushu) that performs better on *F. japonica* were imported. A biotype is a group of organisms having the same or nearly the same genes, such as a particular strain of an insect species (AHSD, 2017). DNA sequence variation between the two biotypes was found to be about 1 percent, well within the expected range of variation within a species. The Kyushu (southern) biotype of *A. itadori* was collected in Kumamoto prefecture between the elevations of 747 meters (m) and 838 m on the Island of Kyushu in 2004 (Shaw et al., 2009). The northern or Hokkaido biotype was collected from three sites, all in the vicinity of Lake Toya on Hokkaido in July 2007.

Specimens of both biotypes (Kyushu and Hokkaido) of *A. itadori* have been preserved in alcohol and are stored at the Oregon State University Arthropod Collection and the Canadian National Collection in Ottawa. The species identity of the this psyllid was confirmed by David Hollis of the

British Natural History Museum (London) as part of the biological control program for the United Kingdom (Grevstad et al., 2012). Both biotypes were also examined by Eric Maw (AAFC Canadian National Collection) and were found to be the same species based on comparisons of both morphology and DNA (Grevstad et al., 2012).

Figure 1. *Aphalara itadori* adult (Grevstad et al., 2012).

Figure 2. Damage to *F. sachalinensis* caused by *A. itadori* nymphs (Grevstad et al., 2012).

3. Geographical Range of *A. itadori*

a. Native Range

The native range of *A. itadori* includes Japan, Korea, and the Kurile and Sakhalin Islands (Burckhardt and Lauterer, 1997). The occupied latitude ranges from 31º N latitude at the southern end of Japan to approximately 50º N on Sakhalin Island. In surveys in Japan, it was found from sea level to 2,150 m above sea level (Shaw et al., 2009). The Kyushu (or "southern") biotype was collected in southern Japan from *F. japonica* (Shaw et al., 2009). A second ("northern") biotype was collected from *F. sachalinensis* on the Island of Hokkaido in northern Japan in 2007.

b. Non-native Range

The Kyushu biotype of *A. itadori* was released in Canada and in the United Kingdom. In Canada, releases of *A. itadori* were made into field cages in Canada in the fall of 2015. In the United Kingdom, releases have been made into a limited number of sites since 2010 in England and Wales.

c. Expected Attainable Range of *A. itadori* in North America

Assuming that *Aphalara itadori* comes to occupy a similar climatic range in North America as the full range that it occupies in Asia, the new range would span from the State of Georgia to Newfoundland in the east and from central California to Alaska in the west. This fully covers the regions where knotweeds are invasive. However, localized climate adaptations of the two biotypes might limit their distribution in North America. Climate match analysis using Climex® software indicates that the Kyushu and Hokkaido biotype source locations are a good match to North American locations, especially for the eastern United States (figure 3).

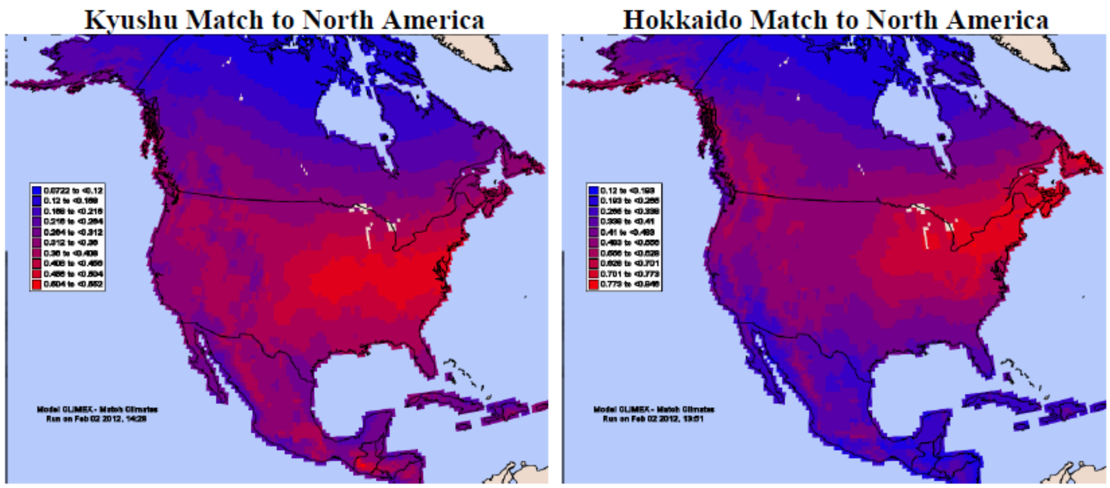


Figure 3. Output from Climex® "match climates" analysis. Regions colored red have the best climate match to the source location (Grevstad et al., 2012).

3. Life History of *A. itadori*

The biology of *A. itadori* was described by Shaw et al. (2009). All stages of the knotweed psyllid feed by inserting sucking mouthparts into the phloem cells of the leaves and stems and removing sap. Adult female psyllids lay up to 700 eggs on the plant surface during their lifetime (Shaw et al., 2009). Eggs hatch after about 12 days and the nymphs (immature insects) pass through five instars (stages of immature development). A full generation requires 33 days at 23°C. While feeding, nymphs excrete crystallized honeydew that is conspicuous as white strings or flakes on the plant surfaces. Adult *A. itadori* are winged and can fly. However, whether there is a distinct flight season and how far they can fly are unknown. The psyllids overwinter as adults. In Japan, they have been found wintering in the bark of *Pinus densiflora* Zieb. & Zucc. and *Cryptomeria japonica* D. Don (Miyatake, 1973; Baba and Miyatake, 1982; Miyatake, 2001). In the introduced range they are expected to use coniferous tree bark for winter shelter, as is the case for other *Aphalara* species (Hodkinson, 2009).

Grevstad et al. (2012) estimated the number of generations of *A. itadori* expected in North America based on temperature-dependent development studies in containment and simulation modeling. Using a conservative development threshold of 10˚C, peak adult emergence and development occurring between May 15 and October 15, and weather data from the past 10 years, two generations of *A. itadori* are expected at more than 98 percent of the current 2,205 Japanese knotweed sites in British Columbia and 6,091 sites in Oregon. For between 13–15 percent of the sites, usually at lower elevations, there would be at least a partial third generation.

III. Affected Environment

A. Taxonomy of Japanese, Giant, and Bohemian Knotweeds

Class: Magnoliopsida (Dicots)
Subclass: Caryophyllidae
Order: Caryophyllales
Family: Polygonaceae
Subfamily: Polygonoideae
Tribe: Polygoneae
Genus and species: *Fallopia japonica*, *Fallopia sachalinensis*, *Fallopia* x *bohemica*.
Common names: *Fallopia japonica*: Japanese knotweed, Japanese bamboo, Mexican bamboo, fleeceflower, itadori; *Fallopia sachalinensis:* Giant knotweed, sakhalin knotweed, sacaline; *Fallopia* x *bohemica*: Bohemian knotweed, hybrid knotweed.

The target weeds are members of the family Polygonaceae, which is a distinct and well-defined group based on molecular evidence (Chase et al., 1993; Cuénoud et al., 2002; Lamb-Frye and Kron, 2003). Although earlier classification systems placed the Polygonaceae as the sole family in the plant order Polygonales (Cronquist, 1988; Thorne, 1992; Takhtajan, 1997), the more recent molecular-based APG III system places the Polygonaceae within the plant order Caryophyllales, where it resides outside of the core Caryophyllales. Molecular phylogenies suggest that the next closest family is the Plumbaginaceae followed by the Frankeniaceae and Tamaricaceae (Cuénoud et al., 2002).

In North America north of Mexico, the Polygonaceae are represented by 35 genera and 442 species (Freeman and Reveal, 2005). The relationships among taxa within the Polygonaceae are still a subject of research. The family is divided into two subfamilies, Polygonoideae and Eriogonoideae. The genus *Fallopia* falls in the subfamily Polygonoideae and within the tribe Polygoneae. Closely allied genera in the same tribe include *Polygonum*, *Polygonella*, and *Muehlenbeckia*. Genera of interest in other tribes in the Polygonoideae include *Fagopyrum* (buckwheat), *Persicaria*, *Bistorta, Rumex*, *Rheum* (rhubarb), and *Oxyria.*

The second subfamily, Eriogonoideae, is traditionally represented in North American by 19 genera including the very large genus *Eriogonum* (224 species in North America), as well as *Chorizanthe*, *Oxytheca*, and *Acanthoscyphus*. New molecular evidence also supports the inclusion of the genera *Brunnichia*, *Antigonon,* and *Coccoloba* which were previously included in Polygonoideae (Sanchez et al., 2009). The Eriogonoids are primarily plants of dryer areas, many of them endemic to California.

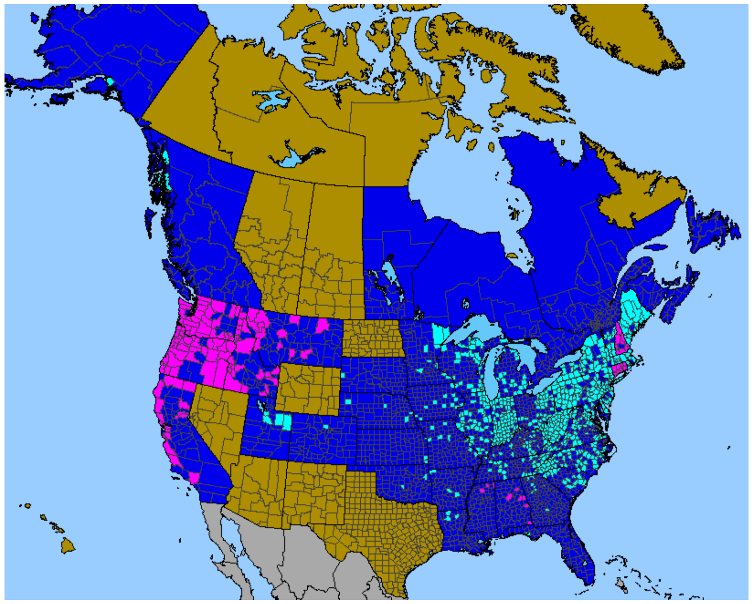
B. Areas Affected by Invasive Knotweeds

1. Native Range of Japanese, Giant, and Bohemian Knotweeds

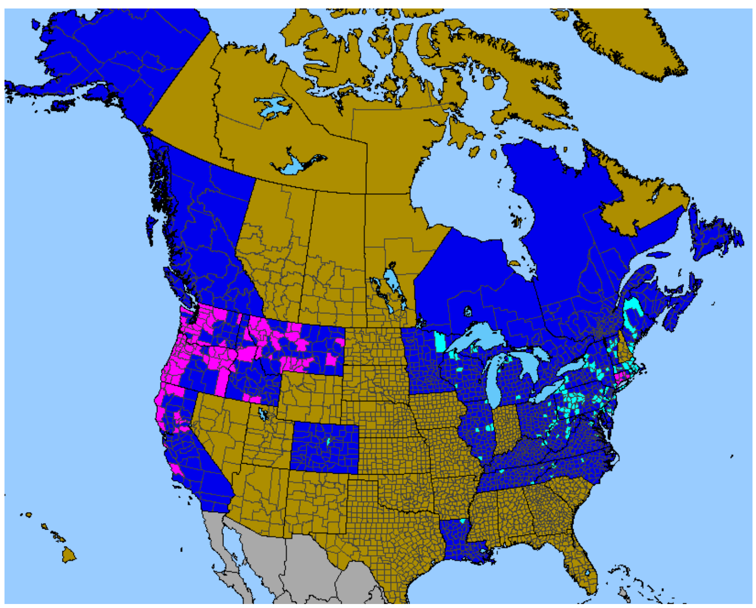
Fallopia japonica is native to East Asia including Japan, China, Korea, and Taiwan. *F. sachalinensis* is native to northern Japan and Sakhalin Island. Hybrid forms can be found in Japan at mid-latitudes.

2. Introduced Range of Japanese, Giant, and Bohemian Knotweeds

Japanese, giant, and Bohemian knotweeds have spread throughout much of North America with the greatest infestations in the Pacific Northwest (Oregon, Washington and British Columbia), the northeast of the United States, and eastern Canada. *Fallopia japonica* and *F. x bohemica* occur in at least 41 of the United States, including Alaska, and in eight Canadian provinces (Fig. 3a). *Fallopia sachalinensis* occurs in fewer states and provinces (Fig. 3b) than Japanese or hybrid knotweed but is locally just as invasive. All three species have become most abundant and problematic in the northeastern States and in the Pacific Northwest. In surveys of knotweed in the western United States, it was found that pure *F. sachalinensis* plants represented approximately 15 percent of the field plants surveyed, 15 percent were *F. japonica*, and 70 percent were hybrids (McIver and Grevstad, 2010; Gaskin et al., 2014). The northeastern United States appears to have a greater proportion of *F. japonica* (Gammon and Kesseli, 2010). In British Columbia, Japanese knotweed is the most common of the three species based on records in the Invasive Alien Plant Program (IAPP) database (IAPP, 2012) with the number of records for *F. sachalinensis* and *F. x bohemica* at approx. 10 percent of the *F. japonica* numbers. While there may be some cases of misidentification of *F. japonica* sites that are actually hybrids the relative abundance of knotweed records by species in IAAP has remain consistent between 2008 (Bourchier and VanHezewijk, 2010) and 2012.



A. ***Fallopia japonica*** **and** ***F.*** **x** ***bohemica***



B. ***Fallopia sachalinensis***

Figure 3. Distribution of knotweeds A) *Fallopia japonica* and *F.* x *bohemica,* B) *Fallopia sachalinensis* in North America. Legend: Brown = absent or no data for the state/province. Dark blue = present in state/province. Light blue = recorded in county (United States only). Pink = recorded in county and designated noxious (United States only). Maps were created with The Biota of North America Program's Plant Atlas, a synthesis of North American herbarium records (Grevstad et al., 2012).

3. Life History of Japanese, Giant, and Bohemian Knotweeds

As herbaceous perennials, knotweeds sprout anew each spring, growing rapidly to a height of 3–4 m by mid-summer. Flowering occurs in September and seeds ripen in October. Knotweeds in North America are variably reported as either dioecious (having the male and female reproductive organs in separate individuals) or gynodioecious (having female flowers on one plant and hermaphrodite flowers on another plant of the same species) (Stone, 2010). However, there is evidence for subdioecy (or "leaky dioecy") in which there are plants with female flowers (producing copious seeds if there is a pollinator available), male flowers (producing no seed), and hermaphroditic flowers (producing few seeds). Although the seeds have high germination rates in the laboratory, seedling establishment in the field occurs infrequently (Forman and Kesseli, 2003; Engler et al., 2011). Field reproduction appears to occur mainly through clonal fragmentation of stems and rhizomes. Stem fragments as small as 40 millimeters have been observed to regenerate (De Waal, 2001). *Fallopia* species spread readily along stream banks where currents and flooding events cause erosion and fragmentation of rhizomes and stems which are dispersed downstream. Once a new plant establishes, it spreads clonally by way of rhizomes.

C. Plants Related to Invasive Knotweeds and Their Distribution

The closest relatives of the target plants in North America are two native and three introduced *Fallopia* species and at least one introduced species in the closely allied genus *Muehlenbeckia* (Sanchez et al., 2009). *Fallopia cilinodis* (Michaux) Holub. (fringed bindweed) and *F. scandens* (Linnaeus) Holub (climbing buckwheat) are native, perennial, herbaceous vines (Freeman and Reveal, 2005). *Fallopia cilinodis* occurs in dry woods, thickets, and clearings throughout much of the northeastern and midwestern United States and eastern Canada. The range of *F. scandens* is similar but extends further south to the Gulf States. It occurs in low habitats including moist woods and thickets. *Fallopia baldschuanica* (Regal) Holub (Russian vine or silver lace vine) is a cultivated woody ornamental vine from Eurasia. It is widely distributed in garden plantings in the United States, occasionally escaping cultivation. *Fallopia dumetorum* (L.) Holub (copse bindweed) and *F. convolvulus* (L.) Á. Löve (black bindweed) are introduced weedy plants without ornamental value. The former is similar to the native *F. scandens* except for its annual habit (Freeman and Reveal, 2005). It occurs primarily in the eastern half of the United States and Canada. The latter, also an annual, occurs throughout temperate North America and can be an aggressive crop weed. Three species of *Muehlenbeckia* (wirevines) occur in North America as introduced ornamentals used uncommonly as ground covers (USDA hardiness zones 8–10) or as filler plants for hanging baskets. *Muehlenbeckia axillaris* (Hook.f.) Endl. (creeping wirevine), the only one of this genus that was found to be currently commercially available, is reported outside of cultivation only in Hawaii (USDA-NRCS, 2005). *Muehlenbeckia complexa* and *M. hastatula* are each reported from two counties in California (USDA-NRCS, 2005) where they are locally invasive and targeted for control (Pollak, 2008; Baldwin et al., 2012). Neither was found to be commercially available, suggesting limited use of these two plants in the nursery trade.

IV. Environmental Consequences

A. No Action

1. Impact of Invasive Knotweeds

a. Wildlife

Dense stands of invasive knotweeds have no known value for wildlife. They harbor fewer invertebrates compared to surrounding native vegetation (Beerling and Dawah, 1993; Kappes et al., 2007; Gerber et al., 2008; McIver and Grevstad, 2010). This is in part due to an absence of specialist herbivores (McIver and Grevstad, 2010) and because knotweeds are relatively resistant to generalist herbivores compared to native plants (Krebs et al., 2011). The depauperate herbivore community has consequences for the food chain. Predators of herbivores, such as spiders, are also found in reduced abundance in knotweed stands (Gerber et al., 2008). Maerz et al. (2005) found that weight gain in green frogs (*Rana clamitans*) was greatly reduced in knotweed-invaded versus non-invaded areas. This difference was attributed to a lack of prey availability. Similar food chain impacts are likely for fish and birds that rely on insects from riparian vegetation. In contrast to the autotrophic food chain, the detritus-based food chain appears to benefit from knotweed invasion where litter-dwelling detritivores (and their predators) are relatively more abundant in knotweed stands than in surrounding native vegetation (Kappes et al., 2007; Gerber et al., 2008; Topp et al., 2008).

b. Plants

Dense knotweed thickets displace native plants through a combination of shading (Siemens and Blossey, 2007), nutrient competition, and allelopathy (Murrell et al., 2011; Urgenson et al., 2012). The inability of tree seedlings to grow along invading stream banks is potentially detrimental to fish and other stream inhabitants that benefit from the shade of trees. In restoration projects, knotweeds must be fully removed before native plantings are successful.

c. Soil

Knotweed stands have been found to accumulate more top soil (Aguilera et al., 2010) and have an increased rate of nutrient cycling in the soil

(Dassonville et al., 2007; Aguilera et al., 2010) as compared to nearby non-invaded areas. Knotweeds reabsorb much of the nitrogen in their leaves before senescence, so their leaf litter supplies much less nitrogen to streams than do the leaves of native plants (Urgenson et al., 2009).

Lacking fine roots near the surface, knotweeds are less able to hold the surface soil and can cause increased erosion (Child et al., 1992). Along stream banks, knotweed stems break off and wash away in winter leaving the soil surface exposed.

d. Property and Recreation

Knotweeds can cause costly damage to road and parking lot surfaces, with forceful roots and rhizomes capable of cracking concrete and asphalt (Shaw and Seiger, 2002). In Britain, a home was reported by the British Broadcasting Corporation (2011) to have lost £250,000 in value after knotweed invaded it. Moreover, the major mortgage lenders will not finance a property in Britain if there is Japanese knotweed on it. In addition, dense knotweed thickets can be a recreational nuisance, limiting stream access for uses such as fishing and boating.

e. Beneficial Uses

Knotweeds are believed to be beneficial to honey production, providing bees with an abundance of nectar late in the summer (Andros, 2007). The new shoots of knotweed are edible by humans if harvested when young, having a flavor similar to rhubarb. Some people enjoy the aesthetic properties of knotweeds in ornamental plantings and some nurseries still stock ornamental varieties of knotweed that are deemed non-invasive such as varieties ‘variegata’, ‘compacta’, ‘crimson beauty’, ‘tricolor’, ‘freckles’, and ‘spectabile.’ Indeed these varieties do not appear to be naturalized (though they are very uncommon). Giant knotweed has been found to have fungicidal properties and is the active ingredient in a commercial organic fungicide (Regalia®) made by Marrone BioInnovations. Knotweeds also contain a high concentration of resveratrol, a compound that has been studied for its potential anti-aging and anti-cancer properties. Resveratrol applied at high concentrations has been shown to inhibit proliferation of some human cancer cells in culture and to increase longevity in yeast, fish, and mice. However, it has not yet been shown to be effective in treating or preventing cancer or extending the lifespan of humans. Nonetheless, Japanese and giant knotweeds are used as sources of resveratrol for herbal supplements sold commercially. These supplements are manufactured in China using plant material grown there.

2. Impact from Use of Other Control Methods

The continued use of chemical and mechanical controls at current levels would be a result if the "no action" alternative is chosen. These environmental consequences may occur even with the implementation of the biological control alternative, depending on the efficacy of *A. itadori* to reduce invasive knotweed populations in the contiguous United States.

a. Chemical Control

Due to the extensive root systems of knotweed which can extend up to 3 m deep, knotweeds must be treated with herbicide year after year to completely eliminate plants. Even after knotweed patches have appeared dead for several years, shoots may still re-sprout. Thus, management of knotweed through conventional means is generally considered a long term venture, if not a permanent one.

When broadcast spraying, death of adjacent or underlying non-target plants is often unavoidable. The surfactants used in some herbicide formulations are known to have detrimental effects on fish, amphibians, and aquatic invertebrates in experimental trials (Giesy et al., 2000; Relyea, 2005). In Canada broad spectrum herbicide use is operationally restricted to a range of buffer zones for riparian habitats, depending on the province, to minimize possible ecological impacts in these habitats.

b. Mechanical Control

Small isolated plants or knotweed patches can be effectively removed by covering them for several years with sturdy tarps or by hand digging, but only if the root system is not yet well established. As an alternative to herbicides, some success in weakening knotweed stands with salt water has been reported, though it is unlikely to be effective or environmentally sound on a large scale.

B. Issue Permits for Environmental Release of *A. itadori*

1. Impact of *A. itadori* on Nontarget Plants

Host specificity of *A. itadori* to Japanese, giant, and Bohemian knotweeds has been demonstrated through scientific literature and host specificity testing. If the the candidate biological control agent only attacks one or a few closely related plant species, it is considered to be very host-specific. Host specificity is an essential trait for a biological control organism proposed for environmental release.

a. Scientific Literature

Aphalara itadori is reported as being host specific to *F. japonica* and *F. sachalinensis* (Burckhardt and Lauterer, 1997). As a group worldwide, the genus *Aphalara* is restricted to plants only within the Polygonaceae including the genera *Rumex, Persicaria, Polygonum*, and *Fallopia.*

b. Host Specificity Testing

Host specificity tests are tests to determine how many plant species *A. itadori* attacks, and whether nontarget species may be at risk.

(1) Site of Quarantine Studies

Host specificity testing of *A. itadori* for the North American biocontrol program was carried out primarily at the Oregon State Quarantine Facility and at the Centre for Agriculture and Biosciences International (CABI) quarantine facility in the United Kingdom. Most of the test plants were tested in a no-choice design, where insects were caged onto individual plants. However, some of the early testing of the Kyushu biotype psyllid involved exposing insects in multiple-choice tests to two or three plant species at once. Two non-target species that had not survived several attempts at shipping for testing to either Oregon or the United Kingdom were tested in Canada at the Insect Microbial Containment Facility, Lethbridge in a multiple-choice design.

(2) Test Plant List

Test plant lists are developed by researchers for determining the host specificity of biocontrol agents of weeds in North America. Test plant lists are usually developed on the basis of phylogenetic relationships between the target weed and other plant species (Wapshere, 1974). It is generally assumed that plant species more closely related to the target weed species are at greater risk of attack than more distantly related species.

The host specificity test strategy as described by Wapshere (1974) is "a centrifugal phylogenetic testing method which involves exposing to the organism a sequence of plants from those most closely related to the weed species, progressing to successively more and more distantly related plants until the host range has been adequately circumscribed." Researchers do not pursue release of biological control agents that do not demonstrate high host specificity to the target weed.

A total of 70 plant species or varieties were tested. The organization of the test list follows the most recent molecular phylogenic analyses of the Polygonaceae by Sanchez et al. (2009), Sanchez and Kron (2008) and Sanchez et al. (2011). Nomenclature consistent with the Flora of North America North of Mexico Vol. 5 was used (Freeman and Reveal, 2005). The plants tested were selected from across North America and included three target weeds, six ornamental varieties of the target weed, 54 plants in the same family as the target plants (Polygonaceae), and seven plants in families different from that of the target plants. The test list includes all North American varieties of the target weed and plants in the same genus as the target weed. Also included was ample coverage of plants within the same tribe as the target weed (10 species) and three other tribes in the same sub-family as the target weed (28 species). All State, Provincial, and federally listed threatened and endangered species in the Polygonaceae were either tested or represented by testing a closely related surrogate species.

For more distant taxonomic groups within the family, plants were selected that were more common, which occurred in the same habitats as the target (more likely to be encountered by the biological control agents), and which were morphologically similar to the target (e.g., larger and leafier species).

Studies of the genetics of invasive knotweeds (*Fallopia* spp.) in North America are ongoing (Gammon et al., 2007; Grimsby and Kesseli, 2010; Richards et al., 2012; Gaskin et al., 2014). For the target weeds, *Fallopia japonica* tested included the single genotype from the United Kingdom (Hollingsworth and Bailey, 2000) which is also the most common in western North America Japanese knotweed populations (Gaskin et al., 2014) and additional Japanese knotweed populations from Oregon and Washington. *Fallopia sachalinensis* and *F. x bohemica* plants were collected from populations in Oregon and Washington. Additional populations of all three knotweeds from British Columbia, Washington, and Oregon were also screened for psyllid preference. There are differences between the psyllid biotypes with the Kyushu psyllid having higher survival on Japanese and Bohemian knotweeds and the Hokkaido psyllid having higher survival on giant knotweed.

(3) Discussion of Host Specificity Testing

See appendix 2 for a description of host specificity test design.

a. No-choice tests

Both psyllid biotypes exhibited a high degree of specialization to the knotweed species, with very little development occurring on non-target plant species (Appendix 1). The two biotypes differed notably in their rates of development on the different target knotweed species. They also differed slightly in their non-target use. The specific outcomes for each biotype follow.

Hokkaido biotype

Within the knotweeds, the Hokkaido biotype performed best on *Fallopia sachalinensis* with a mean of 77 F_1 adults developing per plant. This biotype also did well on certain ornamental varieties of *F. japonica* (especially var. '*variegata'*, var. '*spectabile'*, and var. '*compacta'*) (appendix 1). The researchers found it had very low nymphal survival on wild-collected *F. japonica* with a mean of just under one developing adult per plant. It performed slightly better on *F. x bohemica* with a mean of 12 adults developing per plant.

Oviposition (egg laying) by the Hokkaido biotype of *A. itadori* occurred on a number of the non-target test plants in the no-choice tests, but at much reduced rates compared to *F. sachalinensis* controls. Development occurred at very low rates on four non-target test plants: *Fallopia baldschuanica, Fallopia cilinodis*, *Muehlenbeckia axillaris*, and *Fagopyrum esculentum*. In the case of *F. baldschuanica* there was development of only a single individual. On the other three species, the number of individuals developing to adulthood was in the range of 4 to 10 percent of the number developing on *F. sachalinensis*. In addition to low survivorship, development times were also delayed on the non-target species. On both *Fallopia cilinodis* and *Fagopyrum esculentum*, it took 53 days (at approximately 23º C) for all nymphs to complete development and on *Muehlenbeckia axillaris*, it took 49 days. This compares to just 42 days on *F. sachalinensis* controls.

Kyushu biotype

In the no-choice tests, the Kyushu biotype of *A. itadori* oviposited and developed well on all three target weed species (means of 73 to 86 F_1 adults per plant, Appendix 1), but with high variability among individual plants, especially *F. sachalinensis.* The Kyushu biotype also performed well on the two ornamental cultivars that were tested (*F. japonica* var. *crimson* and *F. japonica* var. *variegata*). Patterns of oviposition among non-target plants were similar to those of the Hokkaido biotype, except that the number of eggs laid on non-target plants tended to be lower and more plants received zero eggs than for the Hokkaido biotype. Part of this disparity is likely associated with the lower overall exposure times to female psyllids for some of the plant species in the multiple choice tests versus no-choice tests. For the closest relatives of knotweed and for buckwheat (*Fagopyrum esculentum*) both biotypes were tested using the same no-choice methods (though in different quarantine facilities). On these plants, differences in oviposition rates and adult development were not significant, with one exception. With the same exposure time on buckwheat, the Kyushu biotype laid significantly fewer eggs than did the Hokkaido biotype (Mean 4.13 ± 1.77 eggs (Kyushu) versus 79.37 ± 21.91 eggs Hokkaido; two sample T-test: t15 = 5.41; $p < 0.005$).

Similar to the Hokkaido biotype, limited survivorship of the Kyushu biotype was observed on *Fallopia cilinodis* (mean of 7.50 ± 7.10 F_1 adults per plant), and *Muehlenbeckia axillaris* (mean of 3.67 ± 1.63 adults per plant). In addition, extremely low rates of development were detected on *Polygonum douglasii* Greene (total of 4 adults from 6 plants), *Polygonum achoreum* S.F. Blake (total of 1 adult on 11 plants), *Fagopyrum esculentum* (total of 1 adult on 8 plants), and *Brunnichia ovata* (Walter) Shinners (total of 2 adults on 12 plants). Development times were extended on these non-target plants with approximate mean recorded development times of 47 days for *F. esculentum*, 51 days for *Fallopia cilinodis* and *Muehlenbeckia axillaris*, 58 days for *Polygonum douglasii*, 60 days for *Brunnichia ovata*, and 70 days for *Polygonum achoreum.* These compare to a mean of approximately 42 days for development on *F. japonica*.

b. Oviposition choice tests--Laboratory

When offered a choice, both biotypes of *A. itadori* strongly preferred to oviposit on the target plant vs. non-target plants. *Aphalara itadori* females from Hokkaido laid 96 percent of their eggs on knotweed controls versus 4 percent on *Muehlenbeckia axillaris*; 98 percent on knotweed versus 2 percent on *Fallopia cilinodis*; and 92 percent on knotweed vs. 8 percent on *Fagopyrum esculentum*. Results for the Kyushu biotype were similar with 96 percent on knotweed versus 4 percent on *Muehlenbeckia axillaris*; 98 percent on knotweed versus 2 percent on *Fallopia cilinodis*; and 94 percent on knotweed vs. 6 percent on *Fagopyrum esculentum*.

c. Oviposition choice tests--Field United Kingdom

Field releases in the United Kingdom confirmed that buckwheat is a poor host for the Kyushu biotype of *Aphalara itadori*. For the first release study, the mean oviposition rate on buckwheat plants adjacent to the knotweed stand was 15.5 eggs/leaf versus 1.25 eggs per buckwheat leaf. The mean number of eggs laid on leaves from natural knotweed shoots from the stand immediately adjacent to the sentinel buckwheat patch was also significantly higher at 23.5 eggs per leaf. Adjusting for leaf area, mean oviposition on buckwheat was 0.024 eggs per square centimeter versus 0.33 and 0.26 eggs per square centimeter for sentinel knotweed and stand knotweed respectively. These oviposition values on buckwheat of between 7 percent and 9 percent of the levels on knotweed are similar to those observed in the lab choice tests. There was no survivorship of the psyllid on the buckwheat plants that were moved back to field after eggs were counted whereas there was good survivorship on knotweed controls. Of the 165 eggs found on the buckwheat plants after the 5-day exposure period, only two nymphs were alive on the buckwheat plants after three weeks. By six weeks, these nymphs had died. In comparison, for the 591 eggs found on the knotweed sentinel plants, there were 190 nymphs after three weeks. At six weeks, 106 nymphs or adults were present.

In the second buckwheat release study, buckwheat was again demonstrated to be an unsuitable host for the Kyushu biotype of *A. itadori*.

There was only one egg laid on the 20 buckwheat plants in the release stand compared to 1,131 on the knotweed sentinel leaves. No adult psyllids were observed on the buckwheat plants at any distance whereas there were psyllids found on knotweed plants at all locations and 22 eggs laid on the knotweed plants located 20 m from the release patch. Plants were not moved back to the field to assess survivorship of eggs after counting because given initial estimates of egg counts on buckwheat, the researchers conducted destructive sampling to ensure all eggs were found. There were only two eggs laid in total on all the buckwheat plants.

d. Multiple generation tests

Populations of both biotypes usually died out when forced to reside long term on the non-target hosts. Often this happened within one generation, but in some cases after one or two generations. In two trials, populations persisted into the third generation. On buckwheat, one replicate for one psyllid biotype (Kyushu) persisted to the third generation. This population remained small with just four adults in the F_3 generation from an original 30 psyllids. As with previous experiments, development on buckwheat was delayed, with generation times of approximately 52 days. The other four cases of Kyushu psyllid on buckwheat did not reproduce at all and the Hokkaido psyllid reproduced in three of five replicates on buckwheat but did not persist beyond the second generation. On *Muehlenbeckia axillaris*, one replicate of the Kyushu psyllid resulted in an expanding population. Numbers went from 41 initial eggs to three F_1 adults to 13 F_2 adults to 56 F_3 adults. At this point the plants senesced and the psyllids also died off. The Hokkaido psyllid could not persist on *Muehlenbeckia axillaris* in three replicate trials.

***e. Discussion of Risk to* Muhlenbeckia axillaris, Fallopia cilinodis, *and* Fagopyrum esculentum**

Muhlenbeckia axillaris is not native and of limited value economically. It is reported as naturalized outside of cultivation only in Hawaii (USDA-NRCS, 2005). and sold commercially in the United States as a ground cover (USDA hardiness zones 8–10) and as a filler for container plantings. The researchers found that *M. axillaris* was much more vulnerable to generalist horticultural pests such aphids, scale insects, and spider mites than it was to *A. itadori*.

Fallopia cilinodis has a widespread distribution throughout the eastern half of the United States and Canada, but is absent in the west where initial releases will be conducted. It can be found in dry woods, thickets, and clearings. It is state-listed as endangered or threatened in three states at the edge of its range (Indiana, Ohio, and Tennessee) but is relatively common in other states. Oviposition rates in choice tests were very low, suggesting that wild growing plants will not attract *A. itadori* away from knotweed patches in the field.

Although a relatively minor crop in North America, any risk to *Fagopyrum esculentum* (buckwheat) merits additional scrutiny. There is an oviposition preference for knotweed compared to buckwheat that was demonstrated in both lab and field experiments. For any eggs that were laid, survivorship was zero in 2012 United Kingdom field trials and low under optimal laboratory conditions. When it did occur, development in the laboratory was at much slower rates than on the target knotweeds. In repeated attempts to rear psyllid populations on buckwheat in the predator-free laboratory environment, 9 of 10 attempts resulted in extinction early on and one lingered into the 3rd generation without expanding. Finally, buckwheat is grown as a crop all over Japan in close proximity to knotweed populations, yet *A. itadori* is not recorded as a pest of buckwheat in Japan.

2. Impact of *A. itadori* on Japanese, Giant, and Bohemian Knotweeds

Both biotypes of *A. itadori* significantly reduced the growth of both *F. sachalinensis* and *F. x bohemica* resulting in more than a 50 percent reduction in biomass after 50 days exposure as compared to controls (Figure 4a) (Grevstad et al., 2013). Interestingly, reductions in biomass occurred even if the psyllid biotype did not reproduce well on the plant. Reduced growth of the plant and damage to the meristems appeared to occur as a result of feeding by early instar nymphs before most of the psyllid mortality occurred. A leaf twisting response was observed from the plants that was most pronounced for the Hokkaido biotype on *F. sachalinensis*. At least some of the nymphs resided inside the twisted leaves, which may provide some protection from predators in the field. Patterns of reproductive success for the two biotypes on the two hosts were opposite to each other. On *F. sachalinensis*, approximately five times more F_1 adults of the Hokkaido biotype developed than the Kyushu biotype. On *F. x bohemica*, five times more of the Kyushu biotype developed (Figure 4b).

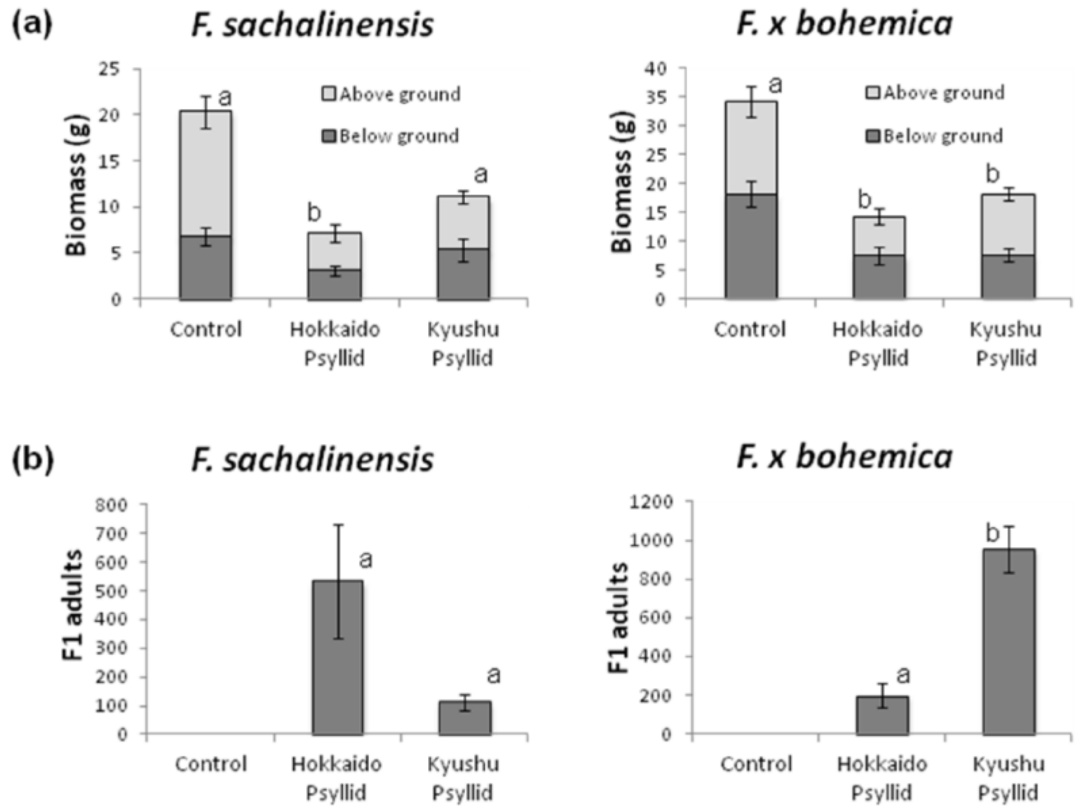


Figure 4. Final plant biomass (a) and numbers of F_1 adults (b) on *Fallopia sachalinensis* and *F.* x *bohemica* after plants were initially exposed to 20 pairs of Hokkaido or Kyushu biotypes of *Aphalara itadori* and their offspring for 50 days. N=5 for *F. sachalinensis*. N=7 for *F.* x *bohemica*. (Grevstad et al., 2012).

Aphalara itadori is expected to be able to obtain higher densities here in North America than it does in Japan because of an abundance of food material and a lack of specialist natural enemies (Grevstad et al., 2012). The insects will deplete the energy supply of the plants, leading to reduced growth and reduced root storage. Moreover, leaf deformity will lead to reduced leaf area and reduced photosynthetic rate, which will in turn lead to further reduction in growth and competitive ability of the plant. In the laboratory, psyllids can easily overcome and kill a potted knotweed plant, although it is unclear whether this could occur in the field. Both biotypes are capable of reducing both above and below ground knotweed biomass by more than 50 percent in just 50 days (Grevstad et al., 2012). The Kyushu psyllid performed best on Japanese and Bohemian knotweeds and the Hokkaido psyllid performed best on giant knotweed.

3. Uncertainties Regarding the Environmental Release of *A. itadori*

Once a biological control agent such as *A. itadori* is released into the environment and becomes established, there is a slight possibility that it could move from the target plants (invasive knotweeds) to attack nontarget plants, such as fringed black bindweed (*Fallopia cilinodis*) or buckwheat (*Fagopyrum esculentus*). Host shifts by introduced weed biological control agents to unrelated plants are rare (Pemberton, 2000). Native species that are closely related to the target species are the most likely to be attacked (Louda et al., 2003). If other plant species were to be attacked by *A. itadori*, the resulting effects could be environmental impacts that may not be easily reversed. Biological control agents such as *A. itadori* generally spread without intervention by man. In principle, therefore, release of this biological control agent at even one site must be considered equivalent to release over the entire area in which potential hosts occur, and in which the climate is suitable for reproduction and survival. However, significant non-target impacts on plant populations from previous releases of weed biological control agents are unusual (Suckling and Sforza, 2014).

In addition, this agent may not be successful in reducing invasive knotweeds populations in the contiguous United States. Worldwide, biological weed control programs have had an overall success rate of 33 percent; success rates have been considerably higher for programs in individual countries (Culliney, 2005). Actual impacts on invasive knotweeds by the two biotypes of *A. itadori* will not be known until after release occurs and post-release monitoring has been conducted (see appendix 3 for release protocol and post-release monitoring plan). However, it is expected that *A. itadori* will reduce the biomass of invasive knotweeds.

4. Soil

The gradual reduction of invasive knotweeds may be beneficial as it may allow a gradual return to pre-existing soil chemistry. In addition erosion may be reduced as native stream bank vegetation returns.

5. Wildlife

Aphalara itadori is a plant-feeding insect and poses no risk to wildlife species. Reduction of invasive knotweeds may be beneficial because invasive knotweeds have no known beneficial value to wildlife.

6. Property and Recreation

Reduction of invasive knotweeds would be beneficial for roads and parking lots as well as to homeowners. Reduction of dense stands of invasive knotweeds that block stream access would be beneficial for boating and fishing and other recreational activities.

7. Beneficial Uses

Aphalara itadori would reduce (but not eliminate) the presence of invasive knotweeds in the environment; thus, it would still be available for beneficial uses, including honey production and as a source of resveratrol. It may cause damage to ornamental or commercial plantings of invasive knotweeds.

8. Cumulative Impacts

"Cumulative impacts are defined as the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agencies or person undertakes such other actions" (40 CFR 1508.7).

Other private and public concerns work to control invasive knotweeds in invaded areas using available chemical and mechanical control methods. Release of *A. itadori* is not expected to have any negative cumulative impacts in the contiguous United States because of its host specificity to invasive knotweeds. Effective biological control of invasive knotweeds will have beneficial effects for Federal, State, local, and private weed management programs, and may result in a long-term, non-damaging method to assist in the control of Japanese, giant, and Bohemian knotweeds.

8. Endangered Species Act

Section 7 of the Endangered Species Act (ESA) and ESA's implementing regulations require Federal agencies to ensure that their actions are not likely to jeopardize the continued existence of federally listed threatened and endangered species or result in the destruction or adverse modification of critical habitat.

There are 21 plants that are federally-listed or proposed for listing in the contiguous United States in the family Polygonaceae, the same family as the target weed. These are: cushenbury buckwheat (*Eriogonum ovalifolium* var. *vineum*), Ione buckwheat (*Eriogonum apricum* (incl. var. *prostratum*)), scrub buckwheat (*Eriogonum longifolium* var. *gnaphalifolium*), steamboat buckwheat (*Eriogonum ovalifolium* var. *williamsiae*), Umtanum desert buckwheat (*Eriogonum codium*), cushenbury oxytheca (*Oxytheca parishii* var. *goodmaniana*), sandlace (*Polygonella myriophylla*), Ben Lomond spineflower (*Chorizanthe pungens* var. *hartwegiana*), Howell's spineflower (*Chorizanthe howellii*), Monterey spineflower (*Chorizanthe pungens* var. *pungens*), Orcutt's spineflower (*Chorizanthe orcuttiana*), robust spineflower (*Chorizanthe robusta* var. *robusta*), San Fernando Valley spineflower, (*Chorizanthe parryi* var. *fernandina*), Scotts Valley spineflower (*Chorizanthe robusta* var. *hartwegii*), slender-horned spineflower (*Dodecahema leptoceras*), Sonoma spineflower (*Chorizanthe valida*), clay-loving wild buckwheat (*Eriogonum pelinophilum*), gypsum wild-buckwheat (*Eriogonum gypsophilum*), southern mountain wild-buckwheat (*Eriogonum kennedyi* var. *austromontanum*), Scotts Valley polygonum (*Polygonum hickmanii*) and wireweed (*Polygonella basiramia*). Because of their relatedness to the target weed, these plants could potentially be attacked by *A. itadori.* However, based on host specificity of *A. itadori* reported in testing and in the scientific literature, APHIS has determined that environmental release of *A. itadori* may affect, but is not likely to adversely affect these plant species or their critical habitats.

Japanese knotweeds occur in the habitat of the Jesup's milkvetch (*Astragalus robbinsii* var. *jesupi*), and Virginia spiraea (*Spiraea virginiana*) and compete with them. Therefore, APHIS has determined that release of *A. itadori* may affect beneficially the Jesup's milkvetch, and Virginia spiraea.

A biological assessment was prepared and submitted to the U.S. Fish and Wildlife Service (FWS) and is part of the administrative record for this EA (prepared by T.A. Willard, October 5, 2016). APHIS requested concurrence from the FWS on these determinations, and received a concurrence letter dated April 27, 2018.

V. Other Issues

Consistent with Executive Order (EO) 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations," APHIS considered the potential for disproportionately high and adverse human health or environmental effects on any minority populations and low-income populations. There are no adverse environmental or human health effects from the field release of *A. itadori* and will not have disproportionate adverse effects to any minority or low-income populations.

Consistent with EO 13045, "Protection of Children from Environmental Health Risks and Safety Risks," APHIS considered the potential for disproportionately high and adverse environmental health and safety risks to children. No circumstances that would trigger the need for special environmental reviews are involved in implementing the preferred alternative. Therefore, it is expected that no disproportionate effects on children are anticipated as a consequence of the field release of *A. itadori*.

EO 13175, "Consultation and Coordination with Indian Tribal Governments," was issued to ensure that there would be "meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications…."

APHIS is consulting and collaborating with Indian tribal officials to ensure that they are well-informed and represented in policy and program decisions that may impact their agricultural interests in accordance with EO 13175.

VI. Agencies, Organizations, and Individuals Consulted

The Technical Advisory Group for the Biological Control Agents of Weeds (TAG) recommended the release of *A. itadori* on October 28, 2013. TAG members that reviewed the release petition (12-08) (Grevstad et al., 2012) included USDA representatives from the National Institute of Food and Agriculture, Animal and Plant Health Inspection Service, and U.S. Forest Service; U.S. Department of Interior's Bureau of Land Management; U.S. Army Corps of Engineers; and representatives from California Department of Agriculture and Agriculture and Agri-Food Canada.

This EA was prepared by personnel at APHIS, Oregon State University, Agriculture and AgriFood Canada-Lethbridge Research Centre, CABI, University of Washington, and the U.S. Forest Service. The addresses of participating APHIS units, cooperators, and consultants follow.

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Appendix 1. Numbers of eggs oviposited and F_1 adults developing following exposure of non-target plants to Hokkaido and Kyushu biotypes of the knotweed psyllid Aphalara itadori. In the tests listed as "no-choice", individual plants were exposed to 5 pairs of adults for 5 days. In the tests listed as "multi"choice, non-target plant species were exposed to 15 pairs of adults for 7 days in 9-plant arrays that also contained the target weed.

			Hokkaido psyllid					Kyushu psyllid				
Taxon Species	TAG Cat.	Nat-ivity	Eggs	F1 Adults	N	Test type	Location	Eggs	F1 Adults	N	Test type	Location
Family Polygonaceae												
Subfamily Polygonoideae												
Tribe Polygoneae												
Target species												
Fallopia x bohemica OR	1	I	247.18 ± 34.64	11.60 ± 5.27	18	no-choice	Oregon	167.64 ± 33.90	86.46 ± 15.10	7	no-choice	Oregon
Fallopia x bohemica U.K.[1]	1	I						169.42 ± 41.45	NA	12	multi	UK
Fallopia sachalinensis OR	1	I	160.31 ± 9.27	76.83 ± 5.83	107, 87[2]	no-choice	Oregon	113.04 ± 20.74	73.96 ± 31.70	6	no-choice	Oregon
Fallopia sachalinensis U.K.[1]	1	I						30.39 ± 6.96	NA	18	multi	UK
Fallopia japonica OR	1	I	124.67 ± 19.87	0.95 ± 0.57	7	no-choice	Oregon	161.85 ± 22.82	73.33 ± 18.84	12	no-choice	Oregon
Fallopia japonica U.K.[1]	1	I						207.07 ± 15.99	NA	75	no choice	UK
Varieties of target species												
Fallopia japonica var. variegata	1	I	183.00 ± 21.06	126.00 ± 28.16	9	no-choice	Oregon	125.00 ± 38.65	81.00 ± 32.48	6	no-choice	UK
Fallopia japonica var. 'compacta'	1	I	120.50 ± 16.50	20.83 ± 3.38	6	no-choice	Oregon	36.75 ± 9.92	NA	6	multi	UK
Fallopia japonica var. 'spectabile'	1	I	125.00 ± 9.61	67.17 ± 16.55	6	no-choice	Oregon					
Fallopia japonica var. 'crimson'	1	I	61.33 ± 7.56	12.00 ± 5.50	6	no-choice	Oregon	361.17 ± 113.30	143.67 ± 50.00	6	multi	UK
Fallopia japonica var. 'freckles'	1	I	121.50 ± 15.50	7.50 ± 0.50	2	no-choice	Oregon					
Fallopia japonica var. 'tricolor'	1	I	146.00 ± 28.26	1.17 ± 0.98	6	no-choice	Oregon					
Non-target species												
Fallopia cilinodis	2, 4	N	39.31 ± 14.13	6.98 ± 4.65	8	no-choice	Oregon	19.67 ± 8.95	7.50 ± 7.10	6	no-choice	UK
Fallopia baldshuanica	2	I	61.02 ± 17.81	0.14 ± 0.14	7	no-choice	Oregon	6.67 ± 1.98	0.00	15	multi[3]	UK
Fallopia scandens	2	N	61.00 ± 17.34	0.00	6	no-choice	Oregon	17.50 ± 4.68	0.00	6	no-choice	UK
Fallopia convolvulus	2	I	60.10 ± 27.03	0.00	6	no-choice	Oregon	7.09 ± 3.08	0.00	6	multi[3]	UK
Fallopia dumetorum	2	I	29.33 ± 6.90	0.00	6	no-choice	Oregon	7.75 ± 2.89	0.00	12	multi[3]	UK
Muehlenbeckia axillaris	3	I	12.00 ± 1.77	5.17 ± 1.51	6	no-choice	Oregon	34.83 ± 18.57	3.67 ± 1.73	6	no-choice	UK
Polygonum douglasii	3, 4	N	0.00	0.00	6	no-choice	Oregon	5.17 ± 2.97	0.67 ± 0.42	6	no-choice	UK
Polygonum aviculare	3, 4	N	5.14 ± 2.51	0.00	7	no-choice	Oregon	0.33 ± 0.33	0.00	6	no-choice	UK
Polygonum achoreum	3	N	1.67 ± 1.67	0.00	6	no-choice	Oregon	3.18 ± 2.17	0.09 ± 0.09	11	no-choice	UK
Polygonum ramosissimum	3, 4	N	0.00	0.00	5	no-choice	Oregon	0.00	0.00	6	multi	Canada
Polygonum paronychia	3, 4	N	7.00 ± 2.64	0.00	6	no-choice	Oregon	0.17 ± 0.17	0.00	6	no-choice	UK
Polygonum shastense	3	N	1.83 ± 1.47	0.00	6	no-choice	Oregon	6.50 ± 5.25	0.00	4	no-choice	Oregon & UK

Appendix 1 (cont.)

				Hokkaido psyllid					Kyushu psyllid				
Taxon	**Species**	**TAG Cat.**	**Nat-ivity**	**Eggs**	**F1 Adults**	**N**	**Test type**	**Location**	**Eggs**	**F1 Adults**	**N**	**Test type**	**Location**
	Polygonum maritimum	3, 4	N	2.83 ± 2.83	0.00	6	no-choice	Oregon	0.00	0.00	6	no-choice	UK
	Polygonella robusta	3	N	2.00 ± 2.00	0.00	6	no-choice	Oregon	1.38 ± 0.66	0.00	6	no-choice	Oregon
	Polygonella articulata	3, 4	N	4.00 ± 4.00	0.00	4	no-choice	Oregon	0.00	0.00	6	multi	UK
Tribe Rumiceae													
	Rheum rabarbarum	3	I	68.75 ± 13.82	0.00	6	no-choice	Oregon	15.17 ± 3.64	0.00	6	no-choice	Oregon
	Rheum palmatum	3	I	14.17 ± 5.54	0.00	6	no-choice	Oregon	17.33 ± 7.00	0.00	6	multi	UK
	Oxyria digyna	3, 4	N	29.76 ± 10.28	0.00	6	no-choice	Oregon	3.58 ± 3.05	0.00	12	multi	UK
	Rumex acetosa	3	N	11.67 ± 6.18	0.00	6	no-choice	Oregon	0.00	0.00	12	multi	UK
	Rumex acetosella	3	N	0.50 ± 0.34	0.00	6	no-choice	Oregon	0.00	0.00	6	multi	UK
	Rumex arcticus	3	N	0.00	0.00	6	no-choice	Oregon	0.17 ± 0.17	0.00	6	no-choice	UK
	Rumex britannica	3	N	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	multi	UK
	Rumex fuegenis	3	N	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	multi	UK
	Rumex occidentalis	3	N	3.74 ± 2.13	0.00	6	no-choice	Oregon	0.00	0.00	6	multi	UK
	Rumex orthoneurus	3, 4	N	1.83 ± 1.47	0.00	6	no-choice	Oregon	0.21 ± 0.21	0.00	6	no-choice	Oregon
	Rumex sanguinius	3	I	0.83 ± 0.83	0.00	6	no-choice	Oregon	0.00	0.00	6	multi	UK
	Rumex scutatus	3	I	2.00 ± 1.48	0.00	6	no-choice	Oregon	0.00	0.00	6	multi	UK
	Rumex triangulivalvis	3	N	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	multi	UK
Tribe Fagopyreae													
	Fagopyrum esculentum	3	I	79.25 ± 21.91	3.18 ± 2.17	8	no-choice	Oregon	4.13 ± 1.77	0.13 ± 0.13	8	no-choice	UK
	Fagopyrum tataricum	3	I	20.63 ± 5.29	0.00	6	no-choice	Oregon	1.22 ± 1.10	0.00	9	no-choice	UK
Tribe Persicarieae													
	Aconogonon phytolaccaefolium	3	N	0.67 ± 0.67	0.00	6	no-choice	Oregon	0.67 ± 0.67	0.00	6	no-choice	UK
	Persicaria affinis	3	I	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	multi	UK
	Persicaria amplexicaulis	3	I	3.67 ± 2.45	0.00	6	no-choice	Oregon	0.00	0.00	6	no-choice	UK
	Persicaria hydropiperoides	3, 4	N	1.33 ± 1.33	0.00	6	no-choice	Oregon	0.00	0.00	6	multi	UK
	Persicaria lapathifolia	3	N	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	multi	UK
	Persicaria microcephala	3	I	2.83 ± 1.72	0.00	6	no-choice	Oregon	0.00	0.00	6	no-choice	UK
	Persicaria orientalis	3	I	0.00	0.00	6	no-choice	Oregon	2.43 ± 2.43	0.00	7	no-choice	UK
	Persicaria pensylvanica	3	N	3.31 ± 1.86	0.00	6	no-choice	Oregon	0.00	0.00	6	multi	UK
	Persicaria sagittata	3	N	0.00	0.00	7	no-choice	Oregon	0.00	0.00	6	multi	UK
	Persicaria virginiana	3	N	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	multi	UK
	Persicaria wallichii	3	I	3.17 ± 1.94	0.00	6	no-choice	Oregon	0.83 ± 0.48	0.00	6	no-choice	Oregon

Appendix 1 (cont.)

				Hokkaido psyllid					Kyushu psyllid				
Taxon	**Species**	**TAG Cat.**	**Nat-ivity**	**Eggs**	**F1 Adults**	**N**	**Test type**	**Location**	**Eggs**	**F1 Adults**	**N**	**Test type**	**Location**
	Bistorta vivipara	3, 4	N	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	multi	UK
	Bistorta bistortoides	3	N	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	mult	UK
Subfamily Eriogonoideae													
Tribe Brunnichieae													
	Antigonon leptopus	3	N	19.13 ± 4.09	0.00	12	no-choice	Oregon	10.33 ± 3.09	0.00	6	no-choice	UK
	Brunnichia ovata OR	3	N	0.83 ± 0.83	0.00	6	no-choice	Oregon	9.33 ± 4.59	0.00	6	no-choice	OR
	Brunnichia ovata U.K.	3	N						9.33 ± 4.10	0.33 ± 0.20	6	no-choice	UK
Tribe Coccolobiae													
	Coccoloba uvifera	3	N	0.00	0.00	6	no-choice	Oregon	3.83 ± 1.94	0.00	6	no-choice	UK
Tribe Eriogoneae													
	Chorizanthe membranacea	3	N	12.00 ± 2.44	0.00	6	no-choice	Oregon	0.50 ± 0.50	0.00	6	no-choice	UK
	Eriogonum parishii	3	N	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	no-choice	Oregon
	Eriogonum cernuum	3, 4	N	0.00	0.00	6	multi	Canada	0.00	0.00	6	multi	Canada
	Eriogonum elatum	3	N	0.33 ± 0.33	0.00	6	no-choice	Oregon	0.00	0.00	6	no-choice	UK
	Eriogonum nudum	3	N	0.00	0.00	6	no-choice	Oregon	1.00 ± 1.00	0.00	6	no-choice	UK
	Eriogonum pyrolifolium	3, 4	N	0.00	0.00	6	no-choice	Oregon	2.00 ± 2.00	0.00	6	no-choice	UK
	Eriogonum umbellatum	3	N	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	multi	UK
	Oxytheca dendroidea	3	N	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	no-choice	Oregon
Family Plumbaginaceae													
	Armeria maritima	5	N	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	no-choice	UK
	Limonium carolinianum	5	N	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	no-choice	UK
Family Brassicaceae													
	Brassica oleracea	5	I	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	no-choice	UK
Family Caryophyllaceae													
	Dianthus gratianopolitanus	5	I	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	no-choice	UK
Family Ericaceae													
	Vaccinium macrocarpon	6	N	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	no-choice	UK

Appendix 1 (cont.)

				Hokkaido psyllid					Kyushu psyllid				
Taxon	Species	TAG Cat.	Nat-ivity	Eggs	F1 Adults	N	Test type	Location	Eggs	F1 Adults	N	Test type	Location
Family Poaceae													
	Zea mays	6	I	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	multi	UK
Family Pinaceae													
	Pseudotsuga mensiezii	6	N	0.00	0.00	6	no-choice	Oregon	0.00	0.00	6	no-choice	UK

1 North American knotweed plants tested in the U.K.
2 N=107 for oviposition, N=87 for development to F1 adults
3 Multi-choice tests of *F. baldshuanica, F.dumetorum, and F. convolvulus* did not include *F. japonica* in the arrays.

Appendix 2. **Host-specificity testing methods (Grevstad et al., 2012)**

Host specificity testing for the North American biocontrol program was carried out primarily at the Oregon State Quarantine Facility and at the CABI quarantine facility in the United Kingdom. Most of the test plants were tested in a no-choice design, where insects were caged onto individual plants. However, some of the early testing of the Kyushu biotype involved exposing insects in multiple-choice tests to two or three plant species at once. Two non-target species that had not survived several attempts at shipping for testing to either Oregon or in the United Kingdom were tested in Canada at the Insect Microbial Containment Facility, Lethbridge in a multiple-choice design.

No-choice tests

All of the host specificity trials for Hokkaido ("northern") biotype and over half of the tests carried out for the Kyushu ("southern") biotype were of the no-choice type, in which the insects were caged onto individual test plants. In this case, an individual plant served as the experimental unit. Each plant was grown in a greenhouse in a 1-gallon pot. The size of the test plants varied, but they were matched with knotweed control plants of similar size, except in cases where test plant species were very small at maturity. A fine mesh sleeve was designed to fit tightly around the rim of the pot and loosely over the plant. For each replicate, five pairs of *A. itadori* were placed into each cage for five days. At the end of five days, the adults were removed and the plants were searched for eggs under a magnifying lens. The plants were kept watered and fertilized for six to eight weeks sufficient time to allow any F_1 adults to emerge. Initial experiments revealed that Hokkaido biotype of *A. itadori* performed best in terms of generational survival on *F. sachalinensis*, whereas the Kyushu biotype performed best on *F. japonica*. Therefore, *F. sachalinensis* was used as the positive control for tests with the Hokkaido biotype and *F. japonica* for tests with the Kyushu biotype.

Groups of plant species were tested in blocks, each block containing one replicate of several different test-plant species plus one *F. sachalinensis* or *F. japonica* to serve as a positive control. In some cases, all six replicate blocks were tested simultaneously, but at other times the blocks were replicated through time as necessary based on the availability of test plants of the right stage. If the insects did not reproduce on the positive control plant (this happened only once), then the entire block was discarded and the experiment repeated. This design allowed the researchers to quantify and directly compare rates of oviposition and development success between the test plants and the target weed control plants. Each plant species was tested at least six times with a few exceptions.

Multiple choice tests with Kyushu biotype

For the Kyushu biotype, 30 of the test-plant species were tested using a multiple-choice test rather than a no-choice test. Three plants of each of two non-target plant species were interspersed with three target plants (nine plants total) in a cage with 30 psyllids (see Shaw et al., 2009). After seven days of exposure the adults were removed and the eggs were counted. Any non-target plants that received eggs were isolated from the target weed controls and maintained long enough to determine the number of F_1 adults that developed.

Due to differences in the number of plants, psyllids, and exposure days used in the no-choice and multiple-choice testing, the raw numbers from these two sets of tests are not directly comparable. Plants in the multi-choice tests of the Kyushu psyllid had just under half of the exposure time to female psyllids as did the plants in the no-choice tests. (Multi-Choice: (15 females per nine plants) for seven days = 11.7 female days per plant versus No-Choice: (five females per one plant) for five days = 25 female days per plant).

Oviposition choice tests-Laboratory

To further evaluate the host-range of *A. itadori*, ovipositional choice tests were carried out for three non-target plant species identified in no-choice tests as marginal hosts for one or the other of the psyllid biotypes. The plant species tested this way included *Fallopia cilinodis*, *Muehlenbeckia axillaris*, and *Fagopyrum esculentum*. In these tests, three of the non-target plant species were interspersed with three *F. sachalinensis* (for Hokkaido biotype) or *F. japonica* plants (for Kyushu biotype) of similar size in a cage measuring 61 x 91 x 61 centimeters. Twenty psyllids (10 pairs) were released from a vial that was placed in the center of the cage. After 5 days, the number of eggs on each plant was counted. The test was repeated three times for each of the three focal non-target plant species.

Oviposition choice tests- Field in United Kingdom

The recent establishment of field populations of *Aphalara itadori* in the United Kingdom, allowed the researchers to further assess *A. itadori* preference for Japanese knotweed versus buckwheat, *Fagopyrum esculentum.* Two open choice field trials were conducted in 2012 at an *A. itadori* release site in the United Kingdom. The field site selected was near to the CABI office in Surrey, United Kingdom, and is one of the Department of Environment, Food, and Rural Affairs approved release sites where *A. itadori* had successfully overwintered following releases in 2010 and 2011. In addition to the resident *A. itadori* population, psyllid numbers were supplemented for the field experiments with a releases of an estimated 20,000 psyllids (adults and nymphs) on the release stand during the each exposure of sentinel buckwheat, sentinel Japanese knotweed plants, and sampled knotweed stems in the stand.

The researcher's objective was to simulate a "worst case" scenario for buckwheat where a buckwheat plant or "patch" was located adjacent to a knotweed stand with a large population of psyllids. The first trial ran from May 22 to May 28, 2012. On May 22, psyllids were released onto the knotweed stand and allowed to settle for 24 hours. On May 23, sentinel buckwheat and knotweed plants in pots were placed in grow-bags adjacent to the release stand. Twenty-five buckwheat plants (five potted plants per grow-bag) in two groups of 10 and one group of five and one group of three potted knotweed plants (in one grow bag) were exposed. The sample unit to assess oviposition was the individual leaves. The buckwheat plants were placed immediately adjacent to the stand so that an additional 25 knotweed stems from the stand of the same height as the buckwheat could be sampled to assess oviposition. Plants were returned to the laboratory five days later. As knotweed plants had much bigger leaves than the buckwheat plant, psyllid oviposition is expressed per leaf area to compare response. All leaves were measured (length x width) to standardize the area exposed between the knotweed and buckwheat plants, and eggs were counted on the tops and bottoms of the leaves. After eggs were counted plants were returned to an open field plot adjacent to the CABI stations and held to assess development of any psyllid eggs that were found.

A second field exposure was conducted from August 15–20, 2012; psyllids were released August 15 and allowed to settle for 24 hours. On August 16 a similar set up to the May exposure was used, with 20 buckwheat plants and three knotweed plants within the field stand of knotweed. In addition, 10 buckwheat plants and 3 knotweed plants were exposed at each of 10 meters and 20 meters from the knotweed stand to assess the effects of distance on psyllid oviposition. Plants were returned to the laboratory five days later. Psyllid eggs were counted on the tops and bottoms of the leaves and psyllid oviposition is expressed per leaf area. After eggs were counted plants were returned to an open field plot adjacent to the CABI stations and held to assess development of any psyllid eggs that were found.

Multiple generation tests

The researchers tested the ability of *A. itadori* to persist for multiple generations on three non-target plant species, *Muehlenbeckia axillaris, Fallopia cilinodis,* and *Fagopyrum esculentum,* found to support marginal development in no-choice tests. Rearing cages contained two to three pots of the focal non-target plant. In some trials, the populations were initiated using plants that received eggs in the choice tests. In other cases, 20, 30, or 60 adult psyllids were placed into the cage with the plants. Fresh plants were added to the cage as needed when the original plants began to die back. The plants were searched for the presence of psyllids after a period of time equal to that required for one, two, and three generations of psyllids, based on knotweed controls.

Impact on target plants

In order to estimate the potential effectiveness of the two psyllid biotypes, impact experiments were carried put on *F. sachalinensis* and *F.* x *bohemica*. Rhizomes were collected from eight knotweed stands in western Oregon or southwest Washington. Pure *F. japonica* is uncommon in the Pacific Northwest, so it was not included in this test. The rhizomes were placed into trays of water until they sprouted. The plants were grouped into group of three plants of the same species (confirmed through DNA analysis by J. Gaskin, USDA Agricultural Research Service), collection site, and initial rhizome/shoot size. When the plants had grown to between 10 and 16 centimeters tall, they were placed into sleeve cages (similar to those used in the no-choice experiments above) and one of three treatments were applied randomly to a plant within each block. The three treatments were: 10 pairs of the Hokkaido biotype, 10 pairs of the Kyushu biotype, or no psyllids (control). Heights were measured at weekly intervals. After 50 days, F_1 adult psyllids were counted and the above and belowground biomass was harvested, dried, and weighed. The experiment included seven replicate blocks of *F.* x *bohemica* and five replicate blocks of *F. sachalinensis*.

Appendix 3. **Release Protocol and Post-Release Monitoring Plan for *Aphalara itadori* (Grevstad et al., 2012).**

Release Protocol

The current cultures are pest free and have been reared in quarantine at either CABI, Oregon State University, and the Insect Microbial Containment Facility in Lethbridge since 2006 (Kyushu) and 2007 (Hokkaido). If additional cultures of are needed, they will be obtained from original collection sites or in the case of the Kyushu biotype there are established populations of this biotype in the United Kingdom that could act as additional source of material. Any new material will be reared for at least one generation in containment before any field releases to ensure that populations are pest free and no cryptic species are present. Voucher specimens of both biotypes have been deposited in the Canadian National Collection in Ottawa and the Oregon State University Arthropod Collection.

Initial release densities will be 20,000 pysllids per location on isolated knotweed patches (based on successful release efforts in the United Kingdom). Releases will be conducted on isolated knotweed patches on separate watersheds such that the dispersal and spread can be tracked on to upstream or downstream patches. Releases will be timed as closely as possible to coincide with a predicted spring emergence time of April 15. This emergence date is based on observations in Japan (Shaw et al., 2009) and was used for releases of *A. itadori* in the United Kingdom. The researchers are planning a limited number of releases in the first year in order to carefully monitor population growth, phenology, and any occurrence of non-target feeding.

Insects will be contained and reared in the Oregon State University Quarantine Facility until permits for release are obtained and from the States of Oregon, Washington, and California. The researchers propose separate releases of each of the two biotypes of *A. itadori* at 4 sites in Oregon and Washington. Site selected will likely include the Luckiamute River (OR), which contains the dominant hybrid genotype and is conveniently located close to Oregon State University, the Cedar River (WA) which has a diverse mix of *F. japonica*, *F. sachalinensis*, and *F.* x *bohemica*, Grady Creek (WA) which has giant knotweed, and the Little Nestucca River which has the same *F. japonica* genotype as occurs in the United Kingdom. The points of release will be relatively isolated patches of knotweed to facilitate monitoring and confirmation of establishment. Knotweed populations at the release sites have been characterized using AFLP (Gaskin et al., 2014) to ensure targeting of the appropriate psyllid biotype based on laboratory screening. A single psyllid biotype, Kyushu or Hokkaido will be released per watershed depending on the dominant knotweed species. Monitoring of knotweed populations in the watersheds started with ecosystem surveys in 2004 and 2005 and included genetic sampling in 2010. Assuming no issues arise, additional releases will be added in the both the eastern and Western United States in subsequent years.

Post-Release Monitoring

Initial monitoring will focus on *A. itadori* phenology and population increase, non-target host use (if any), and dispersal.

Psyllid populations will be monitored by counting eggs on plant surfaces. The surveys will be carried out in spring for the first generation and again in mid-summer for expected second generation. The abundance of adults and their spread away from the release sites will be monitored using yellow sticky trap cards and/or vacuum sampling of knotweed plants in patches along transects radiating from the initial release point.

Though impacts to the target weed are not expected during the first year, the researchers will begin measuring plants for impacts that may occur further into the future. Transects with permanent quadrats will be set up at each release site and at nearby control sites where no releases will be made. Using repeated measurements through time, the researchers will track changes in density, height, and diameter of knotweed stems within each quadrat. Aerial photographs will also be used to monitor and quantify larger scale impacts on the knotweed populations through time. Plans are underway to develop genetic markers for the two biotypes of psyllids. This will allow the researchers to track the two biotypes and their impacts separately and to monitor the degree to which they have interbred.

Appendix 4. **Response to comments on the draft environmental assessment**

APHIS received 220 comments on the draft environmental assessment for the proposal to release *Aphalara itadori* for the biological control of Japanese knotweed during the initial 30-day comment period. There were 137 comments that were in support of the release of *Aphalara itadori*, with many commenters indicating the need for another control method for this highly invasive weed. However, 83 commenters raised issues or concerns with the proposed release of *A. itadori*, particularly related to the potential impact of loss of Japanese knotweed on honey bees, other pollinators, and on bee keepers. The comment period was extended by an additional 60 days and APHIS received 80 more comments on the proposal. Of those, 32 were in favor of the proposal and 48 commenters raised issues of concern.

Many commenters presented information about the invasive and destructive nature of knotweeds. Comments discussed the adverse impacts that invasive knotweeds have on landowners, farmers, home owners, riparian areas, and animal and plant species, and described the difficulty and cost of controlling it. These issues are not reiterated in this appendix.

Issues and concerns of commenters opposed to the release of *Aphalara itadori* are addressed below.

1. Many commenters suggested that both honey bees and native pollinators are dependent on Japanese knotweed as an important source of nutrients and nectar, and it helps maintain a diversity of pollinators. Honey bees use knotweed in the late summer when other forage is not available, and also during dry summers. It is important for building up colonies to survive through the winter. Elimination of Japanese knotweed would place additional stress on honey bees and native pollinators.

Response: National and local initiatives to protect pollinators emphasize the importance of conserving all pollinators for their role in supporting both agriculture and native plant communities. Besides honey bees, native bumble bees, solitary bees, butterflies, other insects, hummingbirds, and in even bats (in some regions) are important pollinators with up to 85 percent of flowering plants dependent on them (Ollerton et al., 2011).

Pollinator conservation initiatives emphasize the importance of conserving and restoring plant diversity and especially native plants for improving pollinator habitat (e.g., see USDA-NRCS, Xerces Society, and the Memorandum cited by the Empire State Honey Producers in the comments submitted on the draft EA). Many plants require specific pollinator species and many pollinator species require specific plants. Although Japanese and giant knotweeds are used by honeybees and some other pollinators, the dense monospecific stands that invasive knotweeds form displace plants that are important for other pollinators.

As noted by beekeepers commenting on the draft EA, pollinators require a continuous supply of flowers that bloom at different times of year. Knotweed blooms for only a short period of time in the early fall. Some locations are now so completely invaded by knotweed (or will be so in the future if not controlled) pollinators that can use knotweed do not have ready access to other critical nectar and pollen resources. Reducing the abundance of knotweeds through biological control will allow a greater diversity of plants with different flowering times to take its place, providing pollen and nectar resources for both honey bees and native pollinators throughout the growing season. APHIS emphasizes that biological control is a more pollinator-friendly alternative to traditional controls that are currently used against knotweed. Knotweeds are officially listed as noxious (or similar regulatory designation) in 26 states, and thus already considered a target for control. Many states, counties, and local land managers have active control programs in place. Herbicides commonly used to control knotweed can do harm to honey bees (1) by eliminating flowers from a site within a single season and (2) through direct effects of active and "inactive" ingredients on the bees (e.g., Goodwin and McBrydie, 2000; Motta et al., 2018). Herbicides can also contaminate the honey and render it non-organic. The use of classical biological control for both weeds and insect pests is an important way to reduce the amount of pesticides that will come in contact with pollinators and therefore should be welcomed by the honey industry.

Unlike traditional control methods, biological control acts slowly (usually over many years or even decades) and does not completely eradicate a plant from a region. Rarely does it eliminate all plants at the site level. Most likely, there will be enough knotweed remaining to provide local bees with a good supply of pollen and nectar going into the fall. A successful end point for a biological control program is a scattering of individuals of the target weed intermixed with native plants.

2. Several commenters indicated that bees and other pollinators need a diverse selection of forage, and that Japanese knotweed contributes to that diversity. Other bee forage has already been lost, such as clover, alfalfa, and buckwheat to corn production. Other forage plants including purple loosestrife, goldenrod, locust, basswood, and honeysuckle have also declined.

Response: APHIS agrees with these commenters that pollinators do need a diverse array of forage plants. However, invasive Japanese knotweed causes a decrease in plant diversity. Although Japanese and giant knotweeds are used by honeybees and some other pollinators, the dense monospecific stands that invasive knotweeds form displace plants that are important for other pollinators. Management of knotweed would not only encourage a diversity of plant communities to thrive, it would also provide nectar for honeybees and other pollinators for longer periods of time throughout the year with the varying bloom times of many native plant species. Pollinator conservation initiatives emphasize the importance of conserving and restoring plant diversity and especially native plants for improving pollinator habitat. In addition, unlike traditional control methods, biological control acts slowly and does not completely eliminate it at the site level or eradicate it from a region. Most likely, there will be plenty of knotweed remaining to provide local bees with a good supply of pollen and nectar during its several week-long flowering period. A successful end point for biological control program is a scattering of individuals of the target weed intermixed with native plants.

3. Several commenters indicated that Japanese knotweed results in a good tasting, popular fall honey, and loss of knotweed would make "bamboo honey" extinct.
Response: Biological control acts slowly (usually over many years) and does not completely

eradicate a plant from a region. Rarely does it eliminate it at the site level. Most likely, there will be enough knotweed remaining to provide local bees with a good supply of pollen and nectar going into the fall.

4. Commenters raised concerns that loss of Japanese knotweed would result in economic impacts on farmers and bee keepers because it would result in loss of hives and honey production, bees would have to be fed for survival through winter, and would result in a reduction in crop pollination. Also, harvesting knotweed stalks provides a cash “crop” for local economies in the sale of nesting material for stem dwelling native pollinators.

Response: APHIS acknowledges that honey bees provide important pollination services in agriculture; that honey production is an important industry; and that commercial and hobby beekeepers are engaged promoters of pollinator habitat conservation across the nation. Over time, a successful biological control program could eventually reduce the amount of honey produced from knotweed sources. However, APHIS does not foresee an impact to bees or the honey production as a whole. Instead, the evidence suggests that successful biological control of knotweeds could provide a net benefit to honey bees and pollinators in general by allowing a greater diversity of plant species to thrive. As stated above, biological control acts slowly and does not completely eradicate a plant. Japanese knotweed would remain in the environment for honey bees. It would also remain in the environment for collection and sale of stems for native pollinators.

5. Three commenters indicated that a non-native insect should not be released to destroy a plant that is beneficial to the honey bee. Releasing insects where they are not native is problematic.

Response: The honey bee itself is not native to North America; it was introduced in the early 17th century by Europeans for honey and wax production. The honeybee is the most widely managed crop pollinator in the United States.

6. Three commenters were concerned that the release if *A. itadori* and subsequent loss of Japanese knotweed will result in extinction of honey bees or will further endanger an already endangered pollinator.

Response: A term such as “endangered” is not appropriate to apply to honey bees. As an introduced and domesticated species, they cannot have an official federal conservation status (e.g., threatened or endangered) and they are far from being at risk of extinction. We acknowledge that bee keepers are facing increased challenges in colony maintenance from parasites, diseases, insecticides, and other unknown factors (termed “colony collapse disorder”). However, the honey bee is still very abundant and these challenges can be largely remedied by changes in how colonies are managed.

7. One commenter stated that release of *A. itadori* will be a loss to honey producers in Canada.

Response: *Aphalara itadori* has already been approved and released in Canada. Releases of *A. itadori* were made into field cages in Canada in the fall of 2015. Since 2016, the insect has been released and monitored at several sites in British Columbia. However, the insect has not yet established in Canada, although release work continues.

8. A commenter expressed concern that animal species in New York depend on bees for pollination of their food sources (nuts, berries, seeds, fruits) and so would lose health, food, and plants for their habitats.

Response: As has been repeatedly stated, the gradual reduction of Japanese knotweed monocultures and subsequent re-establishment of native plants would be beneficial to pollinators, as well as other animal species. Knotweed stands do not support the same levels of native amphibian, reptile, bird, and mammal populations as do diverse stands of native plants.

9. A commenter suggested that it would be better to spend resources on removing plants such as wild grape and Virginia creeper vines that cover trees and choke out forests.

Response: These plants are species that are native to the United States and thus would not be selected as targets for biological control.

10. Several commenters questioned why biological control is being pursued when there are often poor results. The EA states that biological weed control programs have had an overall success rate of only 33 percent. Specifically, *A. itadori* has had a poor result to date in Canada and the United Kingdom and has not established, so why pursue it? Other commenters questioned that if this species lays 700 eggs on a plant with a full generation developing in 33 days, and the adult psyllids can fly, has it not already entered the United States from releases in Canada?

Response: First, biocontrol agents can be difficult to establish, take many years to do so, and then still go on to be successful. The insects may need time to adapt to local conditions or to find their way into sites where populations can thrive, or they may simply need time to build population densities as many will be lost as they disperse away from the original release location to other knotweed patches. Succesful biological control is usually the most cost effective option to control invasive weeds. No one is claiming a failure yet in Canada or the United Kingdom. Second, part of the reason that establishment is difficult in Canada and the United Kingdom is that the climate and photoperiod regimes in those regions are not a good match to that of southern Japan where the psyllid strain used for Japanese and hybrid knotweed originated. Parts of the United States have a much better climate and photoperiod match for this insect and it is likely that it will perform better here (this is backed by a geoclimatic phenology model). Third, other factors such as plant host quality, predators, etc. are likely to be different here than in Canada and the United Kingdom and this can affect how easily the insects establish and build up to high densities. Third, it may be that the difficulty in establishing *A. itadori* in Canada and the United Kingdom has to do with the insect population being reared in a laboratory setting for more than a decade prior to its introduction. If the lab-reared populations do not thrive after introduction into the field, it would be possible to import a fresh supply of knotweed psyllid from Japan. This new import into the United States would require an additional permit from APHIS. And finally, if the insect were to establish in Canada, it is very possible that it could spread to the United States regardless of whether it was approved by APHIS for release in the United States.

11. Seven commenters stated that knotweed provides protection from Lyme disease and other human zoonoses.

Response: In a search of Google Scholar, Web of Science, and PubMed, no published peer reviewed studies were found demonstrating its effectiveness as a treatment for Lyme disease or its co-infections, either for humans or livestock. There were websites referencing its use as a home remedy and some individuals may find it helpful, but it does not appear to be widely used or scientifically demonstrated as a treatment. In any case, classical biological control never completely eliminates the target weed, it only reduces its density. Therefore, even after successful control of knotweed by *A. itadori*, plants would remain for alternative medical purposes.

12. A commenter stated that knotweeds are nutritious to grazing animals.

Response: Knotweed is just one of a very large number of plants that are nutritious to livestock. A reduction in knotweed will allow other plant species to grow in its place and quite likely those would be nutritious to livestock as well. Knotweed has extensively invaded natural riparian zones along extensive river systems where it is causing much environmental harm (as described in the Environmental Assessment). Most invasive knotweed does not occur in grazed areas. Occasionally, goats or other grazing animals have been used as biological controls for knotweed and this can work well in some situations. However, it cannot be applied in natural areas where the animals would also eat and trample native plants growing adjacent to the knotweed or in locations difficult to access. It would also be impractical and expensive to apply on a large scale.

13. Many commenters stated that Japanese knotweed is a beautiful plant and they enjoy it in their yard.

Response: Although Japanese knotweeds may be considered attractive, the negative aspects of the plant far outweigh the aesthetic qualities. Although *A. itadori* will not quickly eliminate Japanese knotweed from any location, homeowners can use insecticides to protect knotweed plants they value. Also, homeowners can replace plants with species that are native and not invasive. APHIS would caution homeowners with Japanese knotweed near their homes - it has been known to cause damage to building structures and substructures by targeting weak points, such as cracks in masonry. In the United Kingdom, a number of mortgage companies have refused to lend on properties that are contain Japanese knotweed because of the damage to property it can cause.

14. Several commenters stated that Japanese knotweed prevents erosion. It has been planted to stabilize soil in sandy seashore areas, to revegetate strip-mine spoil and to stabilize land affected by volcanoes. It has been planted to stabilize riverbanks and other steep slopes. How will erosion be prevented with elimination of knotweed?

Response: Japanese knotweed has been used as an erosion control plant. However, as described in Anderson (2012), Japanese knotweed root systems are not as dense as those of native plants, and do not hold soil as well. When Japanese knotweed establishes along stream banks, the bank can become unstable and more vulnerable to erosion and flooding. Reductions in available soil (because of erosion) and space (because of the larger root/rhizome biomass) affect the ability of the stream bank to hold water during heavy rains. Moreover, knotweed stems break off during the winter months, especially where there is flooding and moving water, and this leaves the surface soil more vulnerable to erosion.

Although knotweed may have occasionally been planted in the past with the intention of stabilizing stream banks or slopes, many accounts suggest that it likely leads to greater soil erosion compared to a native plant community. As stated previously, *A. itadori* will cause a gradual reduction in knotweeds, allowing native vegetation better suited for erosion control to reestablish.

15. A commenter noted that in the EA, survivorship was reported as a percentage on non-target hosts for the Hokkaido biotype while it is reported as the mean +/- the standard error (S.E.) for the Kyushu biotype. The latter was used for making comparisons between the two biotypes (Two-sample T-tests) but the commenter suggests reporting the mean +/- S.E. for the Hokkaido biotype as well. This would improve consistency and provide the reader with more information.

Response: For larval survival to adulthood, both Kyushu and Hokkaido biotypes are presented as the mean number developing per plant (in Appendix 1 of the EA as well as in the text). Perhaps the comment was referring to the different presentation of oviposition rates for the choice tests. These two sets of tests were very different from each other: the Hokkaido psyllid was tested in a quarantine laboratory in cages and the Kyushu psyllid was tested in the field in the United Kingdom. The tests were carried out by different investigators who chose to report the results in different ways. The information was then summarized for the EA. The data can be used to compare oviposition rates on knotweed vs. the tested non-target plants, but it is not appropriate to compare the two psyllid biotypes using these data (T-test or otherwise) given that they came from very different studies. Direct comparisons can be made between the two psyllid biotypes for certain plants on which both Hokkaido and Kyushu psyllids were both tested using the no-choice approach (see the Test Type column in Appendix 1). More details are available in the publications by Shaw et al., 2009 and Grevstad et al., 2013.

16. What parasites are being introduced with *A. itadori*? How can we be sure it will not vector plant pests?

Response: *Aphalara itadori* was screened for parasites upon importing into the U.S. quarantine facility because any parasites brought with it would only inhibit successful biological control. Known parasites of the egg and nymph stages that occur in Japan were eliminated by importing only the adult stage (which does not carry such parasites). They have also been carefully monitored for any symptoms of parasites or diseases. In addition, the researchers also had a sample of insects tested for bacteria (Liberibacter spp. and phytoplasmas) that cause plant diseases that are known from some other species of psyllids. These tests were negative.

17. A commenter states that the EA plays down potential impact on buckwheat by *A. itadori*.
Response: APHIS disagrees with the commenter. In oviposition tests in the laboratory, knotweed was strongly preferred by both biotypes of *A. itadori.* Development and survival were greatly

reduced in buckwheat compared to knotweed. In additional laboratory testing, in 10 different attempts (5 for each psyllid biotype), no *A. itadori* population expanded in size on buckwheat and ultimately none were sustained. Field studies conducted in the United Kingdom confirmed that buckwheat is a poor host for the Kyushu biotype of *A. itadori*. Few eggs were laid on buckwheat plants, and no survivorship to adult *A. itadori* were observed on buckwheat plants.

In addition, a commenter on this EA, a Cornell University professor who provides research and extension support for buckwheat growers in the northeast United States (http://www.hort.cornell.edu/bjorkman/lab/) has reviewed the host specificity data and concurs that the threat to buckwheat has been thoroughly assessed by the researchers and is insignificant. He states “the psyllid strongly prefers knotweed to buckwheat. If forced to sustain itself on buckwheat it has great trouble reproducing. Even if biocontrol were so spectacularly successful that knotweed becomes rarer than buckwheat, it seems highly unlikely that psyllids could have a detectable effect on buckwheat.”

18. Three commenters asked what will happen when *A. itadori* runs out of knotweed? Will it create problems for other plant species later on? What other non-target plant species does *A. itadori* attack? Will it attack non-target native species and become an invasive pest itself? There have been unforeseen consequences from past biocontrols and as the EA states, these impacts cannot be easily reversed. Controls of this type historically have effects on non-target species. Have the long term effects of release of *A. itadori* been studied? It should not be released until its effects are completely understood.

Response: *Aphalara itadori* has been studied for many years. *Aphalara itadori* was first described in 1938 (as *Psylla itadori*) (Shinji, 1938). *Aphalara itadori* was reported as being host specific to *Fallopia japonica* and *F. sachalinensis* in scientific literature (Burckhardt and Lauterer, 1997). Biology of *A. itadori* was described in 2009 (Shaw et al., 2009). The ability of *A. itadori* to use and damage other plant species was thoroughly tested by researchers at three institutions (Oregon State University; Lethbridge Research Center (Alberta, Canada); and the Center for Agriculture and Bioscience International-Europe (United Kingdom)). In specificity testing conducted at these facilities, the psyllid was found to be highly host specific to the targeted knotweed species. For the vast majority of non-target plants tested in *A. itadori* host specificity testing, there was either no oviposition or low oviposition without development to the adult stage (Grevstad et al., 2013). Development did occur at low rates on two close relatives of knotweed, *Muehlenbeckia axillaris* and *Fallopia cilinodis*, and at extremely low rates on *Fagopyrum esculentum* (both psyllid biotypes), *Fallopia baldschuanica* (Hokkaido only), *Polygonum douglasii* (Kyushu only), *Polygonum achoreum* (Kyushu only), and *Brunnichia ovata* (Kyushu only) (Grevstad et al., 2013). Development was always slower on these non-target plants than on the knotweeds, which would limit the viability of these populations in the field. The psyllid exhibited non-preference and an inability to persist on non-target plants (Grevstad et al., 2013). This means that when the knotweed population declines, the psyllid populations will also die back because they are incapable of reproducing and persisting on other plant species. In general, biocontrol insects do not completely eliminate the target weed, but instead lead to lower population densities of both the weed and the biocontrol insect. Most likely, a decline in knotweed will occur gradually over many years.

A recent review found that the incidences of unpredicted non-target attack by intentionally released weed biocontrol agents have decreased over time (Hinz et al., 2019). Hinz et al. (2019) found in their review that the proportion of intentionally released weed biocontrol agents causing non-target attack declined from 18.2 percent in the period for releases that occurred until the 1960s to 9.9 percent in the period from 1991–2008. This trend is expected to continue with scientific advancements in the study of host specificity (Hinz et al., 2019).

19. One commenter suggested that *A. itadori* could become a pest of bees like varroa mites and wax moths.

Response: There is no evidence that *A. itadori* would become a pest to honeybees or any other animal. It is a specialized, plant feeding insect, and is very specific to knotweeds.

20. A commenter indicated that bees make honey from knotweed that contains resveratrol. Other commenters indicated that the resveratrol in Japanese knotweed is a heart healthy antioxidant (the extract is used in some products as a source of resveratrol) and that people will not want resveratrol made from knotweed that has been sprayed to prevent insect colonization.

Response: Japanese knotweed is good source of resveratrol, although it also is found in other dietary sources such as grapes, red wine, berries, and peanuts. Resveratrol has been found to have beneficial properties for human health. However, as stated previously, classical biological control never completely eliminates the target weed, it only reduces its density. Therefore, even after successful control of knotweed by *A. itadori*, plants would remain for alternative medical purposes. There is no evidence that resveratrol is contained in honey that is produced from Japanese knotweed.

21. Commenters stated that APHIS needed to do a better job at notifying the public of this proposal. More bottom-up engagement should be sought and people's perceptions should be understood thoroughly.

Response: APHIS published the notice of availability of the draft EA in the Federal Register for a 30-day comment period, as is normally done for weed biocontrol proposals, and also issued a Stakeholder Registry notification. To ensure that APHIS heard the concerns of beekeepers, we extended the comment period an additional 60 days. It is not reasonable to expect the Federal government to personally notify every party that may be interested in its notices and rules—the regulated community has to assume some responsibility for staying on top of Federal actions that may impact it. If interested in APHIS notices and rulemakings, we suggest that you subscribe to the APHIS Stakeholder Registry. To sign up and receive email updates, visit https://public.govdelivery.com/accounts/USDAAPHIS/subscriber/new.

22. A few commenters suggested that we should learn to live with Japanese knotweed. It is here to stay and we should direct money to more important problems. Rather than fight it, find ways to make good use of it (food, crop, medicine) rather than getting rid of it. It doesn't harm anyone like hogweed does.

Response: APHIS agrees that Japanese knotweed will remain in the environment and we must learn to live with it regardless of whether *A. itadori* is released or is successful in controlling Japanese knotweed. However, it is harmful, and the harmful attributes outweigh any beneficial uses of knotweed. Knotweeds are officially listed as noxious (or similar regulatory designation) in 26 states; many states, counties, and local land managers have active control programs in place.

Anderson (2012) summarizes many of the negative aspects of Japanese knotweed on biodiversity, infrastructure, and recreation:

Biodiversity: It can severely degrade the quality of wetland and riparian habitats where it becomes established. Dense thickets of Japanese Knotweed can reduce sunlight penetration by more than 90 percent, and its thick mats of dead and decaying vegetation in fall/spring prevent other plant species from growing, by shading them out. Knotweed negatively affects the diversity of vegetation, completely eliminating native species groundcover within knotweed stands. As a result of the reduced native plant biodiversity and lowered invertebrate densities, established knotweed stands do not support the same levels of native amphibian, reptile, bird and mammal populations. Japanese knotweed may have allelopathic properties. The roots contain unique compounds which may alter soil chemistry or prohibit the growth of nearby native species.

Infrastructure: It is able to grow through concrete and asphalt up to 8 centimeters thick and building foundations. In the United Kingdom, developers must dispose of soil containing knotweed fragments at hazardous waste facilities. Japanese knotweed root systems are not as dense as those of native plants, and do not hold soil as well. When Japanese knotweed establishes along stream banks, the bank can become unstable and more vulnerable to erosion and flooding. Reductions in available soil (because of erosion) and space (because of the larger root/rhizome biomass) negatively affect the ability of the stream bank to hold water during heavy rains.

Recreation: Japanese knotweed can netagtively affect recreational activities by blocking or interfering with access to water for activities such as canoeing, boating, fishing, and swimming.

23. Two commenters were concerned about the effect of rapid eradication of knotweed by *A. itadori.* How will the potentially stark and abrupt decrease in knotweed growth affect all pollinators when native plant species have not yet had time to redistribute back into these areas? How long does it take for the native plants to fill back in? Would the native plants that are supposed to be found in these areas effectively balance out the huge loss of food source for the pollinators? Once Japanese knotweed is removed, areas may fill in with other invasive species and/or other species with no value to bees. How drastically will the already low bee population be affected?

Response: Release of *A. itadori* will not result in eradication of Japanese knotweed. Even the most successful weed biological control agents have not eradicated their host weed. Control of Japanese knotweed by *A. itadori* will not occur quickly. It takes many years for a biological control agent to establish and reduce target weed populations. Thus, release of *A. itadori* will not result in rapid eradication or a stark and abrupt decrease in knotweed. As Japanese knotweed is gradually reduced, native plants should immediately re-establish in the area, providing an additional diversity of plants for pollinators rather than a monoculture of Japanese knotweed that blooms only for a few weeks in the late summer. Therefore, reduction of Japanese knotweed would be beneficial to pollinators.

It is possible that other invasive weeds could establish in areas where Japanese knotweed has been reduced. Many invasive plants thrive in disturbed areas. Although native species seeds would still remain in the soil beneath Japanese knotweed plants, remediation of some areas with native plants may be needed in areas where knotweed has been reduced. However, any remediation would be at the discretion of the landowner/land manager. Homeowners, beekeepers, and beekeeping organizations could become involved in assisting the revegetation of areas where knotweeds are displaced with a diversity of native plants beneficial to pollinators and other native animals.

24. Commenters suggested that APHIS should consider remediation for landowners and beekeepers – provide them with local, native wetland plant species, or at least education materials should be provided to local landowners/beekeepers regarding replacing the invasive species with local cultivars. Many commenters suggested that a replacement plan for native plants should be developed, especially for those plants that bloom in the fall and provide comparable forage for honey bees and native pollinators. As part of the invasive weed control plan, native plants need to be re-introduced into the area to prohibit other opportunistic, monofloral species from taking seed. USDA-APHIS should select from regional, native plants that bloom in the fall from, for example, NASA's Bee Forage Map https://honeybeenet.gsfc.nasa.gov/Honeybees/Forage.htm.

Response: Although there may be some situations where remediation is necessary in areas where Japanese knotweed is removed, it is not in APHIS' mandate to provide plants for habitat remediation. However, with the gradual reduction of Japanese knotweed, in most cases, a variety of plant species are expected to re-establish, depending on the seed bank remaining in the soil and the other plants in the area. If necessary, local Cooperative Extension Service personnel could provide information about the best plants and cultivars to use to replace Japanese knotweed. To locate a USDA Cooperative Extension Office or other USDA offices, visit https://www.outreach.usda.gov/USDALocalOffices.htm.

25. A few commenters were concerned that once *A. itadori* is released, it cannot be controlled and will spread throughout North America.

Response: Although *A. itadori* could potentially spread throughout North America, it is unlikely all locations will be suitable for its establishment. Climate, photoperiod, and other factors can affect where *A. itadori* will establish. Establishment has been difficult in Canada and the United Kingdom where *A. itadori* has been released, possibly because the climate and photoperiod regimes in those regions are not a good match to that of southern Japan where the psyllid strain used for Japanese and hybrid knotweed originated. Parts of the United States have a much better climate and photoperiod match for this insect and it is likely that it will perform better here. However, where it will establish in the United States is difficult to predict.

Even if *A. itadori* is not approved for release in the United States, it could still eventually spread to the United States from releases made in Canada. This has occurred for other weed biological control agents approved for release in Canada. Often, weed biological control agents are approved for release in Canada years before they are approved for release in the United States because the approval process takes considerably less time in Canada compared to the approval process in the United States.

26. A few commenters indicated that it is not legal for *A. itadori* to be released on their private property. They state that if people do not like knotweed on their property, to find another way to remove it that does not affect beekeepers.

Response: In Title IV, the Plant Protection Act,, PPQ's regulatory authority, Congress finds that—(1) the detection, control, eradication, suppression, prevention, or retardation of the spread of plant pests or noxious weeds is necessary for the protection of the agriculture, environment, and economy of the United States; and (2) biological control is often a desirable, low-risk means of ridding crops and other plants of plant pests and noxious weeds, and its use should be facilitated by the Department of Agriculture, other Federal agencies, and States whenever feasible (PPA Sec. 402). In addition, Executive Order (EO) 13112 (February 3, 1999) and EO 13751 (December 5, 2016) call upon executive departments and agencies to take steps to prevent the introduction and spread of invasive species, and to support efforts to eradicate and control invasive species that are established. Invasive species are defined by these EOs to mean, with regard to a particular ecosystem, a non-native organism whose introduction causes or is likely to cause economic or environmental harm, or harm to human, animal, or plant health.

Release sites for *A. itadori* would be at locations with approval of the landowners or land managers. Should they end up on land where knotweed is being managed for honeybee forage (APHIS is not aware of purposeful management of knotweed for pollinators occurring in the United States), the owner should be able to easily control them.

27. A commenter was concerned that these chemicals have no unbiased studies showing that they are safe. The commenter stated that it is known that they cause endocrine dysfunction especially in women, immune dysfunction and cancer in humans as well as negative effects on the rest of the ecosystem.

Response: The proposed biological control agent, *Aphalara itadori*, is not a chemical but an insect. Use of *A. itadori* to reduce Japanese knotweed populations is expected to reduce the use of herbicides to control it. No adverse human health or ecosystem impacts are expected as a result of the release of *A. itadori.*

28. One commenter indicated that they advocate finding ways to change the ecological conditions that allow non-native plants to rapidly spread.

Response: Japanese knotweed thrives in disturbed areas and once established can spread rapidly, creating monoculture stands. Because of its ability to invade disturbed areas, it would be very difficult to change the ecological conditions that allow this plant to spread. Invasive species are often successful in their new ecosystems because they can reproduce and grow rapidly or because their new environment lacks any natural predators or pests. Introduction of *A. itadori* from the plant's area of origin will introduce a natural enemy that is expected to reduce Japanese knotweed above- and below-ground biomass.

29. A commenter advocates finding sustainable, creative and diverse management strategies for dealing with Japanese knotweed such as using it to produce paper, wood products, natural dyes etc. rather than releasing *A. itadori.* Also, another commenter suggests that Japanese knotweed is a rhubarb-like food source.

Response: Finding uses of invasive species can be a way to reduce the biomass of the plant in the environment. There are many examples of beneficial uses of invasive species for fiber, paper, biofuels, etc. On a small scale, artists may incorporate fibers or other plant parts into their art. However, when using these plants for such purposes it is important that they are used responsibly, and that harvesting, transport, and processing do not spread the invasive species further by releasing seeds and other vegetative propagules into new areas (Johnson, 2010). On a large scale, invasive species are planted for biofuels (e.g., *Arundo donax*) and may actually promote the spread of invasive species.

Finding alternative uses of Japanese knotweed is beyond the scope of the proposed action and this environmental assessment but because knotweed will remain in the environment even after release of *A. itadori*, the proposed action does not preclude finding beneficial uses for Japanese knotweed.

30. Many commenters suggested that there is a need to introduce a genetic marker to track the released *A. itadori*.

Response: Although many commenters indicated that there was a need to introduce a genetic marker prior to the release of *A. itadori*, no reason for this was given. A molecular marker is defined as "fragments of DNA which are associated with a particular region of the genome. Marker molecules can take the form of short DNA sequences, such as a sequence surrounding a single nucleotide polymorphism, where a single base-pair change occurs. They can also take the form of longer DNA sequences, such as microsatellites, which are 10 to 60 base pairs long" (Hutchison, 2018). Molecular techniques could solve, in part, the problem of inadequate systematics for some natural enemy groups, and molecular tools can be used to resolve taxonomic and ecological questions regarding the biotype or cryptic species status (Alvarez and Hoy, 2003). For instance, a DNA barcode has been developed to enable the identification of a reared parasitoid population (*Apanteles opuntiarum*) for biological control of *Cactoblastis cactorum* (Srivastava et al., 2019). These molecular techniques do not involve "introducing" a marker gene into the population, but rather identifying a unique gene or sequence that enables identification.

The EA indicates that "[p]lans are underway to develop genetic markers for the two biotypes of psyllids. This will allow the researchers to track the two biotypes and their impacts separately and to monitor the degree to which they have interbred." This has been completed and is published in Andersen et al., 2016. In the study, two single nucleotide polymorphism (SNP) arrays were developed and examined for their utility for identifying individuals of known pure strains (Hokkaido and Kyushu) and hybrid origins. Using an array of 141 SNPs all individuals were correctly identified to pure and hybrid classes (Andersen et al., 2016).

31. Two commenters raised concern that if it is difficult to distinguish the species of psyllid pests of knotweed, how can USDA-APHIS ensure they are releasing *A. itadori* and not another species of *Aphalara*?

Response: Both biotypes of *A. itadori* currently in quarantine were examined by Eric Maw (Agriculture and Agri-Food Canada, Canadian National Collection) and were found to be the same species based on comparisons of both morphology and DNA. If additional cultures of are needed, they will be obtained from original collection sites, or in the case of the Kyushu biotype there are established populations of this biotype in the United Kingdom that could act as additional source of material. Any new material will be reared for at least one generation in containment before any field releases to ensure that populations are pest free and no cryptic species are present. In addition, DNA testing would occur for any new material collected from the field to confirm identity.

32. A commenter indicated that goldenrod, the mainstay of provisioning hives for winter, is becoming less attractive to pollinators due to its decreasing nutritive value. High carbon dioxide causes plants to produce 30 percent less protein in the pollen, and it would not be surprising to find similar effects in other forage plants.

Response: The commenter is referring to a 2016 study (Ziska et al., 2016). The results of the study were the first to indicate that increasing atmospheric carbon dioxide can reduce protein content of Canada goldenrod (*Solidago canadensis*), a floral pollen source widely used by North American bees. The authors indicated that additional data are needed to quantify the subsequent effects of reduced protein concentration for Canada goldenrod on bee health and population stability, and also that reduced protein concentration to other floral pollen may be occurring and needs to be investigated. The study did not suggest that goldenrod is becoming less attractive to pollinators, as the commenter states. Studies cited in Ziska et al. (2016) indicate that bees do not collect high-quality pollen preferentially. Honeybee keepers may be able to counteract any nutritional deficiencies by supplying additional protein late in the fall. Regardless of the e, release of *A. itadori* will not eliminate knotweeds from the environment, and they will remain as sources for honeybees and other pollinators. It is expected that *A. itadori* will reduce the above- and below-ground biomass of knotweeds. No classical biological control agent has ever completely eliminated its host.

33. Many commenters indicated that release procedures and mitigating measures relevant to the introduction of this species should be provided. There should be more detail in the post-release monitoring plan and how to control the psyllid if it does attack native plants.

Response: The environmental assessment summarizes the release protocol and post-release monitoring plan for *Aphalara itadori* in appendix 3. A more detailed description is provided in the document "Biology and Biological Control of Knotweeds" (Grevstad et al., 2018). Specifically, details of release procedures and post-release monitoring of *A. itadori* are described in chapter 4 of the document. It is available at https://www.fs.fed.us/foresthealth/technology/pdfs/FHTET-2017-03_Biocontrol_Knotweeds.pdf.

Proposed Methods for Mitigation: *Aphalara itadori* will initially be released into isolated knotweed patches. This will allow the insects to be carefully monitored and treated with insecticides if an unexpected problem arises. In the case that the psyllid population would need to be exterminated, the permittee would use protocols developed by the University of California Davis for eradicating incipient populations of the Asian citrus psyllid (*Diaphorina citri*) that involve a combination of foliar and systemic insecticides. Products would be used that are labeled for use and would be used according to label directions.

34. Many commenters submitted the following: When we compare the range of the knotweed with the range of disease-carrying mosquitoes, the plan to remove knotweed is problematic. It is a plant found on vacant lots in urban areas and which absorbs standing water; breeding sites for mosquitoes. Vacant lots would benefit from the implementation of a native plant re-introduction plan that will absorb standing water, mitigating the risk of mosquito breeding sites, and the spread of disease. Removal of knotweed with no plan for replacement with native plants or mitigation of standing water will support mosquito habitat, thus impacting human health concerns from disease carrying mosquitoes.

Response: APHIS could find no evidence that knotweed removal (biological or otherwise) increases standing water at a site and no reason to expect that it would increase the abundance of mosquitoes. Unlike chemical or mechanical control of weeds that can temporarily leave the ground unvegetated, biological control will reduce knotweed abundance gradually over many years, with other plant species (including forbs, shrubs, and trees) filling in any extra space so the ground will not be left bare. If avoiding unvegetated ground is indeed important for keeping mosquito populations down, then biological control would be the best approach.

35. One commenter suggests that APHIS allows invasive plants into the United States on purpose for nurseries to sell.

APHIS does not purposely allow invasive plants into the United States for nurseries to sell. Invasive knotweeds were introduced into North America from Japan during the late 19th century, before the existence of APHIS (established in 1972), and possibly even the USDA, which was established in 1862. APHIS prohibits the importation and interstate movement of Federal noxious weeds, but they must meet the definition of a quarantine pest. A quarantine pest is defined as "a pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled." Invasive knotweeds do not meet this definition and are not on the Federal noxious weed list. Because they are not on the Federal noxious weed list, APHIS does not regulate the importation or interstate movement of invasive knotweeds. However, States can regulate them.

36. Many commenters indicated that the hollow stems of Japanese knotweed are often cut into lengths and bundled for use as native bee habitat. The stem diameters vary just enough to provide

suitable housing for a wide range of tunnel-nesting bees, including mason bees and leafcutters. Harvesting knotweed stalks, removing them from the ecosystem would hold two benefits: 1) provide a cash "crop" for local economies in the sale of nesting material for stem dwelling native pollinators; 2) remove the end of season "knotweed litter" from the ecosystem aiding the growth of native plants.

Response: Plants with pithy or hollow stems such as raspberries or other cane berries, Joe Pye weed, elderberry, sumac, hydrangea, and common reed, can be used naturally by cavity nesting bees. However, bee nesting tubes made of cardboard, bee nesting houses, and nesting kits are readily available from a variety of commercial sources (Stark Bros., Spring Hill Nursery, Plow and Hearth, Amazon, Kinsman Co., etc.), and patterns and plans for homemade bee nesting boxes are found online. Stems of invasive plants such as Japanese knotweed can be bundled and used by cavity nesting bees. However, sale of Japanese knotweed is prohibited in some states. For instance, in the State of New York, the Department of Environmental Conservation, has promulgated invasive species regulations (6 CRR-NY 575.3 Prohibited Invasive Species). Japanese knotweed is a prohibited species in New York. "Prohibited invasive species cannot be knowingly possessed with the intent to sell, import, purchase, transport or introduce. In addition, no person shall sell, import, purchase, transport, introduce or propagate prohibited invasive species" (Cornell University, 2014). Thus, sale of Japanese knotweed stems in New York would be illegal. Other states where Japanese knotweed is regulated include New Hampshire, Minnesota, Connecticut, Massachusetts, and Oregon although viability of the stems could make a difference in whether sale is prohibited.

Release of *A. itadori* is expected over time to reduce the above- and below-ground biomass of invasive knotweeds, reducing the need for removal of end of season knotweed litter, and with reductions occurring on a broader scale than that accomplished by the harvesting and sale by some individuals of stems as nesting material. In addition, stems of knotweeds for this purpose would still remain in the environment even with successful biocontrol by *A. itadori*.

37. Many commenters indicated that to manage invasive species of plants, physical or mechanical control, chemical control, cultural management, and/or biological controls are the methods in place now. As Japanese knotweed exhibits great tolerance to most herbicides it is critical to have a variety of tools in the toolbox, to control this non-native plant. Mechanical controls appear to have the best success, whether from weekly mowing, or digging up the plant. However, if another plant is not put in place, then knotweeds resilience to survive will lead to its return.

Response: APHIS agrees with the commenters that a variety of tools in the toolbox are needed to control Japanese knotweed because it is difficult to control. Herbicidal and mechanical controls can be successful at reducing knotweeds; however, not all locations are easily accessed with equipment. In addition, mechanical, chemical, and cultural controls need to be repeated for them to be successful. The benefit of using biological control is that once released, the insects can spread without the need for human intervention. The insects are self-reproducing and so applications would not need to be repeated if establishment is successful.

And unlike non-selective mechanical and herbicidal treatments where removal of knotweed is drastic and other non-target plants may also be removed leaving bare soil that can be reinvaded by knotweeds, biological controls selectively and gradually reduce their host leaving non-target plants untouched.

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Decision and Finding of No Significant Impact
for
Field Release of the Knotweed Psyllid *Aphalara itadori* (Hemiptera: Psyllidae) for Classical Biological Control of Japanese, Giant, and Bohemian Knotweeds, *Fallopia japonica*, *F. sachalinensis*, and *F.* x *bohemica* (Polygonaceae), in the Contiguous United States.
January 2020

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) is proposing to issue permits for environmental release of the knotweed psyllid *Aphalara itadori* (Hemiptera: Psyllidae). This agent would be used for the biological control of Japanese, giant, and Bohemian knotweeds, *Fallopia japonica*, *F. sachalinensis*, and *F.* x *bohemica* (Polygonaceae) in the contiguous United States. Before permits are issued for release of *A. itadori*, APHIS must analyze the potential impacts of its release into the contiguous United States in accordance with USDA, APHIS National Environmental Policy Act implementing regulations (7 Code of Federal Regulations Part 372). APHIS has prepared an environmental assessment (EA) that analyzes the potential environmental consequences of this action. The EA is available from:

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine
Pests, Pathogens, and Biocontrol Permits
4700 River Road, Unit 133
Riverdale, MD 20737
http://www.aphis.usda.gov/plant_health/ea/index.shtml

The EA analyzed the following two alternatives in response to a request for permits authorizing environmental release of *A. itadori*: (1) no action, and (2) issue permits for the release of *A. itadori* for biological control of invasive knotweeds (preferred alternative). A third alternative, to issue permits with special provisions or requirements concerning release procedures or mitigating measures, was considered. However, this alternative was dismissed because no issues were raised that indicated that special provisions or requirements were necessary. The No Action alternative, as described in the EA, would likely result in the continued use at the current level of chemical and mechanical controls for the management of invasive knotweeds. These control methods described are not alternatives for decisions to be made by APHIS, but are presently being used to control invasive knotweeds in the United States and may continue regardless of permit issuance for field release of *A. itadori.* Notice of this EA was made available in the Federal Register on May 28, 2019 for a 30-day public comment period. APHIS received a total of 221 comments on the EA by the close of that comment period, and received a request to extend the comment period. APHIS extended the comment period for 60 more days and received an additional 80 comments. Most comments (170) were in favor of the release of *A. itadori*. There were 131 comments that were either not in favor of or raised concerns regarding the release of *A. itadori*, mainly regarding potential impacts to honey bees and other pollinators. These comments are addressed in appendix 4 of the EA.

I have decided to authorize APHIS to issue permits for the environmental release of *A. itadori*. The reasons for my decision are:

- *Aphalara itadori* is sufficiently host specific and poses little, if any, threat to the biological resources, including non-target plant species and pollinators, of the contiguous United States.

- *Aphalara itadori* is not likely to adversely affect federally listed threatened and endangered species or their critical habitats in the contiguous United States.

- *Aphalara itadori* poses no threat to human or wildlife health.

- *Aphalara itadori* is expected to result in benefits to soil, wildlife, property, and recreational opportunities.

- No negative cumulative impacts are expected from release of *Aphalara itadori.*

- There are no disproportionate adverse effects to minorities, low-income populations, or children in accordance with Executive Order 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations" and Executive Order 13045, "Protection of Children from Environmental Health Risks and Safety Risks."

- While there is not total assurance that the release of *A. itadori* into the environment will be reversible, there is no evidence that this organism will cause any adverse environmental effects.

I have determined that there would be no significant impact to the human environment from the implementation of the preferred alternative and, therefore, no Environmental Impact Statement needs to be prepared.

Steven Crook, Director
Permitting and Coordination Compliance
U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine

01/09/2020
Date