

**DRAFT WRITTEN FINDINGS OF THE
WASHINGTON STATE NOXIOUS WEED CONTROL BOARD
Proposed Class A Noxious Weed Listing**

Scientific Name: *Impatiens parviflora* DC.

Common Name: small-flowered jewelweed, small-flowered touch-me-not, small balsam

Synonyms: *Impatiens nevskii* Pobed.

Family: Balsaminaceae

Legal Status: Proposed Class A noxious weed



Images: left, infestation of *Impatiens parviflora* in King County, Washington; image by Alexander J. Wright; right, upper stem leaves, with few flowers in bloom, image by Udo Schmidt, licensed under the Creative Commons Attribution-Share Alike 2.0 Generic license.

Description and Variation:

A widespread invasive annual in Europe, there are two recently discovered population of *Impatiens parviflora* in Washington.

Overall habit:

Impatiens parviflora is an annual that is glabrous or with sparse stalked glands on the upper parts (Chen et al. 2007, Coombe 1956). Plants can have high morphological variation in height of fruiting individuals depending on the environment (Chmura 2008 in Quinet et al. 2015). Flowers are small, pale yellow and have a short, straight spur.

Roots:

Impatiens parviflora has a fibrous root system typical of annual *Impatiens* species (Chen et al. 2007, Reczyńska et al. 2015). The laterals commonly develop more than the primary root (Coombe 1956) and may have adventitious roots from its lower node (Chmura 2014). Stems that lay lie on the ground in wet soils can form adventitious roots on the lower side (Coombe 1956).

Recently *Impatiens parviflora* plants in Europe were found to have arbuscular mycorrhiza, with arbuscule structures found in its roots (Štajerová et al. 2009), but the frequency in where they are found varies (Chmura 2014). More research is needed on the role mycorrhiza may play in the production and growth of *I. parviflora* (Chmura 2014).

Stems:

Stems are erect, succulent, growing 10-100 cm (-150 cm) tall (Coombe 1956, Moore 1968). Stems simple or branched and having swollen nodes (Coombe 1956).



Images: left, pulled plant with small root system, image by Alexander J. Wright, 2016; right, image of *I. parviflora* leaf shape and margins with teeth pointed toward leaf tips, image by AnRo0002, Creative Commons CC0 1.0 Universal Public Domain Dedication.

Leaves:

Leaves are alternately arranged and have petioles 0.6 to 0.8 inches rarely to 1.6 inches (1.2 to 2 cm, rarely to 4 cm) long (Chen et al. 2007). Leaf blades elliptic to ovate-elliptic, 1.6 to 7.9 inches (4 to 20 cm) long by 0.8 to 3.5 inches (2 to 9 cm) wide, the uppermost leaves typically the largest (Moore 1968). Leaf base cuneate, tapering down the petiole (decurrent) and leaf apex acuminate (gradually tapering to a sharp point) or shortly acute (Coombe 1956, Chen et al. 2007). Leaf margins serrate or crenate-serrate, teeth directed forward, often with stalked glands near the base (Moore 1968). Petioles may also have stalked glands that may serve as extrafloral nectaries (Chmura 2014).

Flowers:

Impatiens parviflora inflorescences grow in the upper leaf axils and are comprised of (1-) 3 to 12 (-15) flowers (Moore 1968, Chmura 2014). The peduncles (inflorescence stalks) are about as long or slightly longer than the subtending leaf or shorter than leaves in shaded situations (Coombe 1956, Chen et al. 2007). Plants can produce two types of flowers: cleistogamous flowers (do not open, self-fertilizing) and chasmogamous flowers (open for cross pollination), which are showy and used for identification. The early flowers are often cleistogamous (Moore 1968). Chasmogamous flowers are 0.24 to 0.71 inches (0.6 to 1.8 cm) long, including the spur (Moore 1968), and measure 1 to 5 mm from the pedicel to spur base

(not tip) (Zika 2009). Flowers are pale yellow, often having reddish spots in the throat. Flowers have three sepals—2 small lateral sepals and the lowest sepal gradually tapered into a +/- straight spur up to 7 mm long (Chen et al. 2007). Flowers with 5 petals, upper petal orbicular with notch at the tip. The other four petals are fused into two pairs, each pair resembling a single bilobed petal, with reddish spots, 0.39 to 0.47 inches (1 to 1.2 cm) (Chen et al. 2007). Flowers have 5 united stamens that initially cover the stigma when the flower opens. Flower spurs have a very small amount of nectar, much less than *Impatiens glandulifera*, another invasive *Impatiens* species. A study of nectar quantities of plants in Belgium measured *I. parviflora* having 0.13 to 0.34 microliters compared to *Impatiens glandulifera* having 0.84 to 7.31 microliters, with the amounts varying due to flower stage (Vervoort et al. 2011).

Two flower forms have been described in Europe: var. *albiflora* has white flowers with yellow spots and forma *albescens* has white flowers with orange spots in the flower's throat (Jorgensen 1927 in Chmura 2014).



Images: side view of *Impatiens parviflora* flower showing spur and front view of flower, images by André Karwath, Aka, Creative Commons Attribution-Share Alike 2.5 Generic license.

Fruit:

Impatiens parviflora produces capsules that are glabrous, linear-oblong, club-shaped (clavate) or cylindrical, 0.4 to 1 inches (1 to 2.5 cm) long, and are pale green at maturity (Moore 1968, Chen et al. 2007). Capsules produce 1 to 5 seeds that are oblong, 3 to 5 mm long with longitudinal striations (Coombe 1956, Chen et al. 2007). Both types of flowers produce capsules with seeds. Capsules have 5 outer valves that coil rapidly during dehiscence, causing seeds in the capsule to be ejected when ripe (Schmitt et al. 1985, Caris et al. 2006 both in Hayashi et al. 2009).



Image, developing and mature capsules along with flowers of *Impatiens parviflora*, image by wikicommons, file is licensed under the [Creative Commons Attribution 3.0 Unported](https://creativecommons.org/licenses/by/3.0/) license; right, image of capsules, image by Sebastian Wallroth, public domain.

Similar Species:

Impatiens parviflora can look most like other *Impatiens* species, both native and non-native, occurring in Washington. Its small yellow flower, with a straight spur, differentiates it from other *Impatiens* species.

Name	Location, other	Flower	Image
<i>Impatiens parviflora</i> ; non-native to WA	Western Washington, only known in King County	Small pale yellow flowers, short straight spur	 <p>Image by Alexander J. Wright</p>
<i>Impatiens capensis</i> ; non-native to WA	West side of Cascade Mountains	Flowers with spots (though there is a rare spotless form); abrupt and convex taper to spur, spots primarily ventral, coarse and dense	 <p>Image by, Karan A. Rawlins, University of Georgia, Bugwood.org</p>

<p><i>Impatiens ecornuta</i> (syn. <i>I. ecalcarata</i>); native to WA</p>	<p>Both sides of Cascade Mountains</p>	<p>Flowers without a spur or spots</p>	 <p>Image © 2005, Ben Legler</p>
<p><i>Impatiens x pacifica</i>; hybrid between native and non-native species</p>	<p>West of the Cascade mountains</p>	<p>Some plants with spurred flowers and no spots; some spurless with spots</p>	
<p><i>Impatiens noli-tangere</i>; native; critically Imperiled species in WA</p>	<p>West side of Cascade mountains</p>	<p>yellow flowers with gradual concave taper to recurved spur; flowers spotted, primarily dorsal, small and sparse</p>	 <p>Image: Frank Vincentz, https://commons.wikimedia.org/wiki/File:Impatiens_noli-tangere_05_ies.jpg</p>
<p><i>Impatiens glandulifera</i>; non-native to WA; Class B noxious weed</p>	<p>West of the Cascade mountains</p>	<p>Flowers range in color, purple, pink or white; short spur, hooked or curved.</p>	 <p>Angelica Velazquez, Cowlitz County Noxious Weed Control Board</p>

<i>Impatiens aurella</i> ; native to WA	Eastern Washington	Flowers yellow to orange, with or without spots, spur strongly curved	
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Image © Richard Old

(Zika 2009, WTU Herbarium 2017)

Habitat:

Impatiens parviflora grows in shaded places with dry to moist soils (Stace 1997). Plants can grow on a range of mineral soils, from nutrient rich to poor, which retain moisture but are not waterlogged, having a pH range of 4.5 to 7.6 (Coombe 1956, Chmura 2014). Plants prefer shade to part shade, though can survive in open sites, with a range of 5 to 40% relative daylight (Tanner 2008 in Chmura 2014). They can reproduce at low light levels and are more shade tolerant than *Impatiens glandulifera* and *Impatiens capensis*, two other invasive *Impatiens* species the Pacific Northwest (Hughes 1965, Jouret, 1977, Lee 1984, Perrins et al. 1993 in Tabak and von Wettberg 2008).

Impatiens parviflora can establish and grow in a wide range of habitats including: forests, forest clearings, forest edges or paths, riparian forests, riverbanks, lake shores, hedges, disturbed and cultivated sites and lesser so in open sites including railway embankments, open roadsides and rock outcrops (Moore 1968, Stace 1997, Tabak and von Wettberg 2008, Reczyńska et al. 2015, Cordes et al. 2006 in Diekmann et al. 2016). In Europe, it is noted to also invade undisturbed deciduous forests (Kornas 1990 in Tabak and von Wettberg 2008) and grow in herb-rich deciduous and mixed woodlands. Where it's native, plants are noted to grow on stream and riverbanks, ravines, stony mountain sides, moist shady places at elevations of 1200-1700 meters (Pobedimova 1949 in Coombe 1956, Chen et al. 2007). In Britain, it grows primarily in lowlands, while elsewhere in Europe plants have naturalized in low areas up to 1860 meters (in Switzerland) and up to 8200 feet (2500 meters) in eastern Turkestan (Coombe 1956, Seifriz 1932 in Coombe 1956).

In Britain, *Impatiens parviflora* can be found growing with *Impatiens glandulifera* and *Impatiens capensis* on shaded lake shores, riverbanks and swampy woodlands (Coombe 1956). Where it grows with *I. glandulifera*, *I. parviflora* grows higher up, usually at the limit of winter floods while *I. glandulifera* forms a lower fringe on the riverbank.

Geographical Distribution:

Impatiens parviflora is native to parts of Asia. The USDA GRIN database (USDA ARS 2017) specifically lists *I. parviflora* native in:

- China, Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, Mongolia, Russian Federation, and Afghanistan.

USDA GRIN database (USDA ARS 2017) lists *Impatiens parviflora* naturalized or adventive in:

- Russian Federation (Khabarovsk)

- Austria, Belgium, Czech Republic, Germany, Hungary, Poland, Slovakia, Switzerland, Denmark, Finland, Sweden, United Kingdom, Italy, Romania, Serbia, Slovenia, France
- Canada (Quebec, Nova Scotia, Prince Edward Island, British Columbia)
- United States (Washington, Oregon (Consortium of Pacific Northwest Herbaria 2017))



Images: left, map of countries in Europe that have documented *Impatiens parviflora* populations (DAISIE 2017); right, *Impatiens parviflora* growing in the Czech Republic, image by Tim Miller.

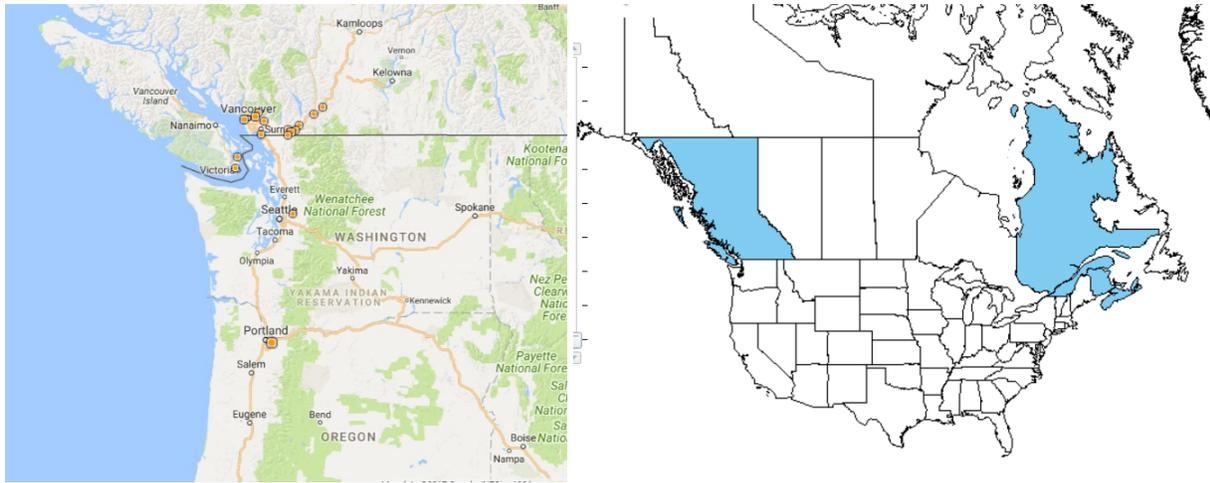
History:

Impatiens parviflora is thought to have been introduced to Europe around 1830 into several botanic gardens and was first recorded in the wild in 1848 (Vervoort et al. 2011, Trepl 1984 in Reczyńska et al. 2015, Stace and Crawley 2015). Plants may have been introduced along with imported timber from Russia or, another theory, introduced with imported buckwheat from Asia (Stace and Crawley 2015). Coombe (1956), who wrote a treatment on *Impatiens parviflora*, thought that plants were not brought in with softwood from Russia, but rather its presence at local timber yards was due to transported timber from local parks where the plants were already growing (Druce 1897 in Stace and Crawley 2015). *Impatiens parviflora* has also been dispersed with plants from nurseries (Stace and Crawley 2015). Records and observations in Europe indicate the species, after first establishing in disturbed areas, underwent the process of a lag-phase, which then resulted in its faster spread and entering into natural communities during the second half of the 20th century (Trepl 1984, Obidziński and Symonides 2000 all in Chmura 2014). It is now considered to be one of the most widespread annual invasive species in Europe and the most commonly observed alien plant in central European deciduous forests (Quinet et al. 2015, Trepl 1984, Kuhn et al. 2004, and Sadlo et al. 2007 in Reczyńska et al. 2015).

It is not known how *Impatiens parviflora* was originally introduced to North America. It is thought that it may have been introduced as an ornamental species, though it does not have large, showy flowers and was not found for sale in catalogs in collection at the U.S. National Agricultural library before 1970 (E. von Wettberg, unpublished data in Tabak and von Wettberg 2008).

The earliest herbarium records in Canadian provinces document *Impatiens parviflora* at Prince Edward Island 1970 (UPEI 00990), New Brunswick 1980 (CAN 584812), Quebec 1961 (MT00068254), and British Columbia 1949 (V43581) (Canadian Museum of Nature 2017, Consortium of Northeastern Herbaria 2017). Other than populations found in Washington and Oregon, the only other documented location of

I. parviflora in the United States is in Wisconsin. On the campus of the University of Wisconsin-Eau Claire, a specimen (Rohrer 10892) of *I. parviflora* was collected in 2016, noting that plant are carpeting a forest floor (Peter Zika, pers. comm. 2017).



Maps: left, herbarium records (orange dots) of *Impatiens parviflora* in Washington, parts of Oregon, Idaho, and British Columbia, map by Consortium of Pacific Northwest Herbaria 2017; right, map showing Canadian provinces with *I. parviflora* (USDA NRCS 2017).

Nearby to Washington:

Impatiens parviflora is documented at one location in Portland, Oregon. Herbarium specimens collected July 19, 2013 were of flowering and fruiting plants. Hundreds of plants were growing in a ravine on a wooded, mesic slope with big leaf maple (*Acer macrophyllum*) and Douglas fir (*Pseudotsuga menziesii*) in the overstory (WTU 394885) (Consortium of Pacific Northwest Herbaria 2017, USDA APHIS 2013). Four specimens were collected near to each other, two in a natural area near Clatsop Butte and two nearby to Powell Butte at 100 meters elevation (HPSU 15598, OSC241051, and OSC241857) (Consortium of Pacific Northwest Herbaria 2017).

In British Columbia, there are a few sites documented in southern British Columbia and a couple on the south end of Vancouver Island (Consortium of Pacific Northwest Herbaria 2017). The two earliest specimens document *I. parviflora* from 1949 in Vancouver (V43581 and V237014). Specimens then range from 1972 through 2014, many of them from near and around Vancouver and the Fraser Valley. Specimens were collected from habitats including shaded roadsides, mixed shade steep slopes, along wooded trails, and in wooded areas (Consortium of Pacific Northwest Herbaria 2017).

Washington:

There are only two known locations of *Impatiens parviflora* growing in Washington.

The first record of *Impatiens parviflora* in Washington is from King County, in Seattle, near the Woodland Park Zoo on September 4, 2013 (Record ID 3060424, EDDMaps West 2017). The population, discovered by the King County Noxious Weed Control Board, covered approximately 1000 square feet and was in seed (EDDMapS West 2017). The plants were on a service road in the northeast corner of Woodland Park Zoo, on both sides of the fence west of Aurora Ave (Shaw 2017). Zoo staff have been hand-pulling the plants they can reach, but some are growing outside of a fence where there is no control taking place (Shaw 2017). As of summer of 2016, there were still plants growing, but the patch is getting smaller (Shaw 2017).

In 2016, the second population of *Impatiens parviflora* was found in northeast King County Washington. Plants were flowering and fruiting when the herbarium specimen was collected on June 26 (Consortium of Pacific Northwest Herbaria 2017). Plants were growing along a moist, shady roadside and into the adjacent property (Shaw 2017). The population was very dense and consisted of well over 1,000 plants (Shaw 2017, Alexander J. Wright 2016-9, WTU 409155). *Impatiens parviflora* was mixed with spotted jewelweed, *Impatiens capensis*, and was overtopping most associated species (Alexander J. Wright 2016-9, WTU 409155). Surrounding plants included big leaf maple, *Acer macrophyllum*, in the overstory and other associate plants *Lapsana communis*, *Phalaris arundinacea*, and *Galium aparine* (Alexander J. Wright 2016-9, WTU 409155). As of April 26, 2017, the infestation covered about 2,000 square feet, 20% cover (Shaw 2017).

Impatiens parviflora populations in Washington and Oregon are the only known populations of this species in the United States (EDDMapS 2017, USDA ARS 2017, USDA NRCS 2017).

Listings:

Impatiens parviflora is not quarantined or listed as a noxious weed anywhere in the United States (National Plant Board 2017).



Image: *Impatiens parviflora* seedling, image by Kenraiz Krzysztof Ziarnik, licensed under the Creative Commons Attribution-Share Alike 3.0 Unported license.

Growth and Development:

Note, the following growth and development information is based on *Impatiens parviflora* plants studied in Europe. Timing of growth, flowering and fruiting could vary for plants growing in Washington State.

Seed germination typically occurs in the second half of March to April after undergoing a period of cold stratification (Coombe 1956). Seeds have been found to need a minimum period of dormancy after ripening of 90 days in wet conditions and 41 degrees Fahrenheit (5 degrees Celsius), but may also germinate sooner if they experience colder temperatures. (Chmura 2014). Seedlings of *Impatiens parviflora* are vulnerable to being killed by frost. From an experiment in Britain, seeds that were planted in beginning February germinated in later March and the first half of April, were hit by a hard frost (~-5C)

as the seedling emerged and 67% of the seedlings died (Perrins et al. 1993). Seedlings of *Impatiens glandulifera* from the same experiment were not as severely affected by the frost, with only 3% being killed (Perrins et al. 1993). The height of the plants tends to increase with light intensity on moist soils, while the shortest plants tend to grow either in deep shade (on moist or dry soils) or in light shade on dry soil. Plants grow taller when they are an individual or in growing in small groups on moist soil and with fairly high light intensity (Coombe 1956).

Typically, wild plants take 8 to 9 weeks from germination to flower production (Coombe 1956). Flowering begins toward the end of May in full daylight or in the beginning of June in shade (Coombe 1956). The earliest flowers are typically cleistogamous (self-fertilizing) flowers (Moore 1968) but overall chasmogamous flowers are more common (Chmura 2014). Chasmogamous flowers are protandrous, meaning that the stamens come to maturity before the pistil so that these flowers should not be able to self-pollinate. The joined filaments of stamens cover the stigma until they fall off as they are pushed off by the elongating ovary (Coombe 1956). After the stamens are finished, the stigmas are then receptive to being fertilized. Vervoort et al. (2011) observed partial protandry in their research of *I. parviflora*. They observed the stigma being already receptive at bud stage and not fully covered by stamens, thus allowing an extended period of when the stigma is receptive at the same time the flower's pollen is mature, allowing self-fertilization.

Opening flowers last on average for two days, with the male phase lasting two to four hours and the female phase of one to two days (Coombe 1956, Tanner 2008 in Chmura 2014). *Impatiens parviflora* flowers are predominately pollinated by small to medium-sized hoverflies (family Syrphidae) (Coombe 1956). Vervoort et al. (2011) observed 87% of *I. parviflora* flower visitors in Belgium to be small-sized Syrphidae, with *Episyrphus balteatus* and *Melanostoma mellinum* being the most common hoverfly visitors. Syrphidae serve as pollinators, visiting the flowers for pollen and nectar (Csizsár and Bartha 2008). Flowering and fruiting continues to late September or early October in moist, partially shaded sites (Coombe 1956).

In Britain, *Impatiens parviflora* can form extensive infestations of dense growth in woodland or fringing riverbanks (Coombe 1956). A population at Pusey Common Wood (Berks.) in August of 1954, had on average 160 plants per square meter (most flowering), with the entire wood containing about 10 million plants (Coombe 1956). The highest rate of spread of *I. parviflora*, since its introduction to Britain, was calculated to be 24 km/year in 1915 (Perrins et al. 1993).

Reproduction:

Impatiens parviflora is an annual that reproduces by seed. Plants produce capsules that are formed by both flower types. The capsules explosively dehisce to ballistically disperse seeds (Hayashi et al. 2009). When the pod dehisces, there is a rapid coiling of the pod's valves that shorten the pod longitudinally, and ejects the seeds 1 to 2 meters (Coombe 1956, Hayashi et al. 2009) or potentially as far as 3.4 meters (Trepl 1984).

Overall seed production can range based on habitat conditions and can be a challenge to estimate as seeds can be dispersed over 3 months (Coombe 1956). Estimated in ideal conditions, production per plant can be up to 10,000 seeds, but 1,000-2,000 is more common (Coombe 1956). Perrins et al. (1993) found an average of 675 seeds produced per plant in their study. Another estimate by Salisbury (1961) was that plants produced about 220 seeds per plant, but with large plants in gardens producing up to 1,800 seeds (USDA APHIS 2013). Even if growing in shade, plants are able to achieve reasonable seed production (Perrins et al. 1993).

After seeds are expelled from their capsules, they may undergo secondary dispersal. Seeds are able to float and can be dispersed by water (Coombe 1956). Seeds are also dispersed with timber, soils (including from nurseries), on people's shoes and clothing and possibly originally by buckwheat for pheasants (Druce 1889 in Coombe 1956, Coombe 1956). Soil on wheels and equipment may also spread seeds. And seeds may also be carried to new locations as a hitchhiker on the fur of wild animals (Trepl 1984 in Tanner 2008).

Impatiens parviflora is thought to have a transient seedbank, such that seeds have no, or a very short period of dormancy (Coombe 1956, Quinet et al. 2015). Seeds that have been collected and germinated appear to all germinate after a period of cold stratification (Coombe 1956). A small amount of seed might remain in the seedbank for short period of time, potentially a year, enough to aid the population in surviving if control work prevented seed production, but further research is needed (Csontos 1986 in USDA APHIS 2013). Even though it does not appear to have seeds that can be dormant in the seedbank very long if at all, *I. parviflora* maintains a high reproductive output that allows it to persist and spread (Quinet et al. 2015).

Economic Importance:

Detrimental:

Impatiens parviflora is an invasive species that can invade a variety of habitats, and it is able to adapt to different growing conditions and minimize the negative effects of decreases in resources (Elemans 2004, Godefroid and Koedam 2010). It has a number of growth traits that allow it to invade variety of habitats including: short lifecycle, cleistogamous and chasmogamous flowers, high seed production, long flowering period, fast growth of seedlings, and high tolerance to light conditions (Coombe 1956, Perrins et al. 1993, Eliáš 1999 in Florianová and Münzbergová 2017). Plants can grow well under low light conditions as well as tolerate lower moisture conditions (Quinet et al. 2015).

Impatiens parviflora is able to dominate the herb layer of invaded forests, forming large, dense monospecific stands (Quinet et al. 2015). It may be displacing native species as well its congener *Impatiens noli-tangere* (Godefroid and Koedam 2010, Vervoort 2011, Dostál et al. 2012), though more research is needed to determine how it is impacting community diversity (Quinet et al. 2015). Florianová, and Münzbergová (2017) conducted a removal experiment in the Czech Republic to see what happened in plots that became free of *I. parviflora* for four years. They found that both the number and cover of species increased after *I. parviflora* removal and that *I. parviflora* seemed to be the driver of this change. Also, the impact of *I. parviflora* was due mostly to above-ground competition for light, as its roots are small and insubstantial. *Impatiens parviflora*, due to its early germination, is more likely to impact spring vegetation than the native dominant species. They also saw the greatest change in species composition after year two in their study, indicating that species in invaded areas may recover in a few years after *I. parviflora* removal.

In Europe, *Impatiens parviflora* grows in similar habitats, and has many similar biological attributes, to the native *Impatiens noli-tangere*, even forming mixed stands (Vervoort et al. 2011). The two species are not known to have, or be able, to hybridize, but they may be competing with each other for similar resources (Vervoort et al. 2011) though the results on studies of the two species are ambiguous (Chmura 2014). The native appears more at risk when it is growing in suboptimal conditions (such as drier conditions), where it can be overgrown by *I. parviflora* (Trepl 1984 in Chmura 2014). *Impatiens noli-tangere* is also a native plant with limited distribution in Washington—listed threatened at the state level and critically imperiled (Arnett 2017).

In some other studies, *Impatiens parviflora* did not appear to cause major negative impacts. For example, Diekmann et al. (2017) found that *Impatiens parviflora* did not cause as great an impact on species richness as found in some other studies. *Impatiens parviflora* does not form as high or dense a canopy as *Impatiens glandulifera* and thus may not attain a high competitive dominance, even though its populations does not show strong fluctuations between years (Hejda 2012). This may also be the result of *I. parviflora* often invading species-poor, disturbed sites with a sparse herbaceous layer (Obidziński and Symonides 2000). It is not known if *I. parviflora* causes degradation of forest communities or if it is an indicator of them.

Impatiens parviflora may have some allelopathic effects. Chmura (2014) summarized research that has looked at this aspect of the plant (Csiszár and Bartha 2008, Vrchatová et al. 2009, Csiszár et al. 2012). These studies demonstrated that under laboratory conditions, *I. parviflora* had intermediate inhibitory effects. Leaf extracts had an inhibitory effect on the seeds of study plants (*Sinapis alba* and *Brassica napus*), reducing the percentage of germination and lengths of the radicle and hypocotyl (portion of embryonic stem below the cotyledons). In another laboratory study, *I. parviflora* had an inhibitory effect on the germination rate, shoot length and root length of white mustard (*Sinapis alba*). It is not known how these results relate to natural conditions.

The USDA's Plant Protection and Quarantine Weed Risk Assessment result for *Impatiens parviflora* is high risk (USDA APHIS 2013). The WRA results indicate *I. parviflora* shares many of the same traits and impacts as other major-invaders and high-scoring minor-invaders; however, for species with similar establishment and spread risk scores, it had a relatively low impact score (USDA APHIS 2013). While there was a high amount of certainty in looking at the establishment and risk of *I. parviflora* spreading, there was an above average amount of uncertainty for its impact potential. More research is needed in this area. Despite this uncertainty for impacts, the model concluded an overall high risk conclusion for *I. parviflora*.

Impatiens parviflora can be a host for cucumber mosaic virus, which can attack many crop plants besides cucumbers (Polák 1967, Brcak 1979 in Chmura 2014). Cucumber mosaic virus does have a wide host range, and it is not known how common it is for *I. parviflora* to serve as a host or what the economic impacts may be (Tanner 2008). *Impatiens parviflora* also is noted as an alternative host for the black bean aphid (*Aphis fabae*), a pest of sugar beets, beans, and celery, causing the stunting of plants (Schmitz 1998 in Chmura 2014).

Burrows and Tyrl (2013) provide general information for the genus of *Impatiens* in North America noting that although crushed leaves and stems of several *Impatiens* species are reputed to help prevent a reaction to poison ivy and to promote healing of minor burns, they, and the flowers, contain naphthoquinone lawsone (naphthalenic acid). Naphthoquinone may cause mild to moderate irritation of the digestive track (Thomson 1971 in Burrows and Tyrl 2013).

Beneficial:

The USDA APHIS (2013) could not find any record of *Impatiens parviflora* being sold in the United States as an ornamental species though it is thought that may be how it was first introduced here. It is theorized that apart from it being included in some botanical gardens collections, *Impatiens parviflora* is no longer used as an ornamental plant (Tanner 2008).

Impatiens parviflora has many uses medicinally, and it can in some cases be consumed. As noted above, species in the genus *Impatiens* may help reduce the reaction to poison ivy and promote healing of minor burns and other skin ailments (Burrows and Tyril 2013). If cooked, the leaves are edible and the seeds are okay to eat raw or cooked (Elemans 2004). However, the shoots should not be eaten raw or they can cause nausea (Chmura 2014). Also, plants contain a high level of oxalates and are not recommended for consumption by people who are prone to certain conditions such as kidney stones or arthritis (Luczaj 2002 in Chmura 2014). Hydro-alcoholic extracts of the fruit and herbs made from the fruits are very useful medicinally, having such uses as an anti-inflammatory, a diuretic, an antispasmodic and an antipsoriasis treatment (Chmura 2014).

Control methods:

There is limited information available on control methods for *Impatiens parviflora*. Control methods used for *Impatiens glandulifera*, a Class B noxious weed in Washington, can be adapted for *I. parviflora*. *Impatiens parviflora* may have some seeds that remain in the seedbank after the first year so it is important to manage and monitor sites and provide additional control when necessary.

Removing invasive species can open up a habitat to reinvasion if follow up management does not occur. By planting a variety of desirable species, a community will be present to help provide competition and shade weed seedlings and to also provide a food source for pollinators. As found in Florianová and Münzbergová (2017), after controlling *I. parviflora* populations, the native community may be able to recover, but it is important to keep monitoring and conduct further control where needed. When possible, carry out control methods when pollinators are not active on plants. Also, make sure to clean shoes, clothing, and equipment when leaving infested areas to prevent spreading seed to new locations.

Mechanical methods:

Impatiens parviflora has a shallow root system and can easily be hand-pulled when growing in damp soils. Make sure to remove the roots, especially in drier soils where plants may break off. If the plants do not have seed capsules, they can be crushed and left on site in a dry place to compost (King County Noxious Weed Control Program 2016). If plants have seed capsules, make sure to bag and put them in the trash (King County Noxious Weed Control Program 2016). It is important to properly identify *I. parviflora* plants before removal to avoid accidentally removing native *Impatiens* species. Plants will need to be identified while in bloom, and care needs to be taken as native *Impatiens* may grow among *I. parviflora* plants.

Peter Zika's 2009 article in the Botanical Electronic News "Jewelweeds and touch-me-nots (*Impatiens*, Balsaminaceae) in the Pacific Northwest of North America" provides a key along with a set of color images that can be used to identify *Impatiens* species <http://www.ou.edu/cas/botany-micro/ben/ben408.html>.

Cultural Methods:

Provide competition to *Impatiens parviflora* plants by planting, seeding and promoting native plants in areas after control has taken place. High species diversity and cover are effective barriers to reduce the invasion success of *I. parviflora* (Chmura 2014).

Biological Control:

There is currently no biological control agent used to control *Impatiens parviflora*. In Europe, mammals rarely graze on plants, though 13 insects and 5 fungi have been found on plants, with *Puccinia komarovii*, a rust fungus that is able to kill it (Chmura 2014). *Puccinia komarovii* is not found in the

United States but is being tested as a possible biocontrol agent for *Impatiens glandulifera* in Europe (Tanner 2008, Tanner et al. 2015).

Response to Herbicides:

Large populations of *Impatiens parviflora* may need chemical control for management. Make sure to survey populations of *I. parviflora* before herbicide use to avoid treating native *Impatiens* species. *Impatiens parviflora* is not currently included in The Pacific Northwest Weed Management Handbook, but check back as this resource is continually updated: <https://pnwhandbooks.org/>. For questions about specific herbicide use, please contact your county noxious weed control board.

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

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