Risk Assessment of *Impatiens glandulifera*

for

The Northwest Invasive Plant Council Operating Area

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Executive summary

Impatiens glandulifera is currently a category one extremely invasive plant in NWIPC 2009 Plan and Profile. It is a tall (60-200 cm) annual herb with a pink to purple orchid-like flower and a bamboo-like main stem with a reddish tinge. Its seeds can spread, ejecting up to 2500 seeds per plant from exploding seed pods. Historical records from Europe indicate it spreads fast along riparian corridors to become vast in distribution. It went from initial introduction to common weed status in less than 60 years in the United Kingdom (UK). The NWIPC operating area was analyzed and areas at risk were highlighted. Due to the large area to research, only a few sites were given specific recommendations and the rest of the area was analyzed and given a general level of risk depending on heat-sums greater or equal to 1275. It has a high tolerance to many different climactic, latitudinal, and elevation extremes. Its detrimental impacts to the environment decrease native plant diversity, increase soil erosion, and increase potential area for other invasive species to invade. Four different species at risk are located around known *Impatiens glandulifera* sites and share similar types of habitats. Infestations on the banks of streams and channels are high priority sites likely to be staging grounds for further infestations downstream. Taking in all the information, the areas it is found, the ecological impacts, and the potential areas at risk to infestation; *Impatiens glandulifera* should continue to be a category one extremely invasive plant until the NWIPC decides otherwise. Education and awareness work needs to continue and be expanded as do inventories and treatments to prevent *Impatiens glandulifera* from further expanding and damaging the natural environment.

Introduction

Impatiens glandulifera; common names policeman's helmet, touch-me-not, and Himalayan balsam; is listed as an Alien Invasive Plant in British Columbia (IAPP). The Northwest Invasive Plant Council (NWIPC) initially placed it as a category one invasive plant (hereafter IP). *Impatiens glandulifera* has been found in the operating area of the NWIPC. Since the formation of the NWIPC in 1992, this IP has been brought to the attention of the NWIPC and a risk assessment has been requested. *Impatiens glandulifera* is not listed in the weed act or any other provincial or federal legislation within Canada. Washington State categorizes it as a noxious weed as of 2002 within their Administrative Code. BC's earliest recorded specimen was found in Burnaby in around Still Creek (Burnaby Lake) in 1937. Ship ballast water is likely the pathway it took to get to BC's shores (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008).

The area considered in this risk assessment was the entire operating area of the NWIPC; the Northwest quarter of British Columbia, west of the Rockies and north of the Cariboo regional district, south of the Yukon and Alaska borders. This is a large area to be encompassed within a risk assessment, so this assessment did not cover all the associated site specific factors and pathways. The variability within climate, topography, site moisture/nutrient regimes, elevation, and ecosystems was too great to predict all the specific areas at risk. The areas adjacent to known IP sites were assessed for risk, and all other areas were given an estimated level of risk or susceptibility to invasion of the IP. Topic covered are: biology of *Impatiens glandulifera,* impacts to environment, distribution and range, potential distribution within NWIPC area, specific areas at risk and their resulting pathway hazards, red and blue listed species that could be affected by *Impatiens glandulifera*, treatment options, and education and public perception.

Excerpt from the NWIPC's 2009 Plan and Profile

Policeman's helmet or Himalayan balsam – *Impatiens glandulifera* (IM)– preliminary placement in category 1 – risk assessment required – containment.

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- The exact distribution of Policeman's helmet has not been determined and inventory work only began in 2006. As of 2008 22 sites have been inventoried It is possible the plant has a wide distribution as it is a commonly grown garden plant. Inventory information is mostly from the Vanderhoof – Prince George area but the plant is in gardens in the Hazelton's and has spread up into the Kispiox Valley. A mid sized infestation was reported at the end of the 2008 field season from the Copper River area near Terrace and spread from this site into the lower Skeena systems is a serious threat.

    - Control information on policeman's helmet needs to be researched and added.

        - Inventory will continue on policeman's helmet. Extension and awareness with nurseries and gardeners is necessary and will be conducted. All sites found outside of garden areas that are threatening habitat will be treated.

Biology of *Impatiens gladulifera*:

The biological characteristics of *Impatiens glandulifera* tend to make it stand out from most native plants in British Columbia. This annual, succulent herb displays a pink or purple coloured flower shaped like an orchid or snap -dragon flower by mid-summer. The 6 -15 cm elliptic leaves, sharply and closely saw-toothed, have 18 – 50 pointed teeth on each side, a reddish midrib and grow opposite in whorls. The 60 – 200 cm tall erect main stem is coloured with a reddish tinge and has nodes much like bamboo from where the branches and leaves grow out.

Flowers bloom in June through to October or until the first heavy frost. Flowers are so attractive to pollinators that the seed set of each flower is consistently 100% (Titze, A. 2008.). The flower's shape can entirely enclose a visiting bee, thus leading to efficient pollination of the ovule. The nectar is very high in sugar content, average 0.47mg h^{-1} per flower (milligrams of nectar at constant rate) compared to

European flowers average 0.1mg h^{-1} (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008). Though many studies differ in how this affects pollinator visits to native flowers throughout the spring and summer, they do agree that *Impatiens glandulifera* has more visits than native flowers (Bartomeus, I., M. Vilà, and I. Steffan-Dewenter 2010).

Seed pods are established on the tips of the main stem and lateral stems. Seed pods are elastically dehiscent meaning they rupture when touched ejecting the seeds. The amount of seeds per plant will vary with elevation, plant densities (plants per m^2), and growing conditions. The maximum seed output is 2500 seeds per plant (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008). Seed maturity from unripe to mature can be gauged by their change in colour from green to brown to black. (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008). Due to the prolific seed production and dispersal, even 99% control is ineffective (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008).

It should not be confused with the native *Impatiens noli-tangere* (also called policeman's helmet or common touch-me-not). The yellow flowers of *I. noli-tangere* , its elliptic alternate leaves coarsely saw-toothed , and its height of 20 – 60 cm are key characteristics (Klinkenberg, Brian. 2010).

I. glandulifera is classified as a summer annual (Pysek , P. and Prach, K. 1994). It grows in sites varying in rain fall from 500mm to 1200mm per year. Precipitation is not a limiting factor as much as soil moisture is because *Impatiens glandulifera* will grow in wet riparian or moisture receiving areas where there is little precipitation. The naturalized population in Winnipeg's Assiniboine forest shows that even low precipitation 514mm per year can provide wet niches for *Impatiens glandulifera* to grow. Light is not a limiting factor but flowering is delayed about two to three weeks (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008). *Impatiens glandulifera* can tolerate shade as long as the soil has significant nitrogen deposits (Andrews, M., H. G. Maule, J. A. Raven, and A. Mistry. 2005). NO_3 gathered within the stem allows *Impatiens glandulifera* to grow tall even under tree cover, thus allowing it to enter forested areas. The species is considered nitrophilous (nitrogen loving) because it can grow taller in nitrogen rich soils (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008). It can tolerate a wide variety of soil factors: Fine to coarse texture, 15% - 53% soil moisture, 7.5 – 3.4 pH, low to very high nitrogen levels, clay to gravel to shale.

Impacts to Environment:

The invasive nature of *Impatiens glandulifera* is evident in how it dominates sites. It stands a couple meters above other native annuals, shading them and choking them out with dense patches of growth. A 25% reduction in diversity of native species was observed in the UK (Hulme, P. E., E. T. Bremner. 2006). In the Czech Republic, changes in diversity were negligible, but there were changes in dominance hierarchy of native nitrophilous annuals (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008). Spread is associated with riparian areas because of ideal soil moisture and nutrient conditions for the species (Pysek , P. and Prach, K. 1994). Seeds eject out of elastically dehiscent seed pods (Hayashi, M., K. L. Feilich, and D. J. Ellerby, 2009). Seeds landing in water pathways readily float down stream and are deposited upon banks where they can germinate in water-logged soils (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008). Stream management issues are observed in dense monotypic stands of *Impatiens glandulifera* when the roots rot in the fall leaving the soil exposed, unanchored, and prone to erosion (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008). The deposits of rotting plant matter can also create a very slippery and slimy surface that is dangerous to walk on (correspondence with Claire Watkins, City of Prince George Parks Dept.).

A chemical with allelopathic properties (chemicals detrimental to other organisms) was found in the stem and leaves of *Impatiens glandulifera* (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008).

Distribution and Range:

Currently the majority of known *Impatiens glandulifera* sites are localized around urban/rural populated areas, but data shows that it is tolerant to many site factors and will expand its distribution. Thriving in riparian habitats it is likely to use those as seed transport corridors (Pysek , P. and Prach, K. 1994). Data gathered on the geographical occurrences of *Impatiens glandulifera* show that it has a high tolerance to many different climactic, latitudinal, and elevation extremes. Searching www.eddmaps.org, a database much like the Invasive Alien Plant Application(IAPP), *Impatiens glandulifera* is listed as far north as Anchorage Alaska at 61*N Latitude. It has naturalized within ten US states and is found in eight

Canadian Provinces. In NWIPC operating area, one or more sites can be found in all four regional district areas within IAPP IP species data extracts. Known sites in IAPP are as high as 800m above sea level, but it can be found in its native range 4000m above sea level in the alpine of the Himalayan Mountains. Elevation does not directly affect *Impatiens glandulifera* as much as having long enough growing periods measured by heat sum units above five degrees Celsius (Willis S. G. and Hulme P. E. 2002.). Data from the UK states a lower post-emergence heat-sum limit of 1200 is considered a minimum for flowering and 1350 for seed pod production. Alpine tundra (AT) and Engelmann Spruce Subalpine Fir (ESSF) Biogeoclimactic zones and lower north facing slopes are expected considerably below this heat-sum. Areas with heat-sums above do occur in the NWIPC area (examples – see below).

Potential distribution within NWIPC area:

Impatiens glandulifera potential distribution is as reliant on topography/climate as it is on the pathways of transport for seeds. We cannot predict where the pathways will take the seeds; we can only predict what areas would support self sustaining populations after the initial deposit of seeds. The approximate post emergence heat-sum limit of *Impatiens glandulifera* is 1200 to form flowers and 1350 to form seed pods (Willis S. G. and Hulme P. E. 2002). Given the variability within sampled areas, heat-sums should be at least 1275 or more each year to allow the species to sustain itself on the site. It is understood that figures in heat sum units are similar to growing degree days above five degrees Celsius within various literature. Biogeoclassification (BEC) of British Columbia and Agriculture Canada have data on Growing Degree days above five degrees Celsius. From this data a general description of areas at risk to naturalization by *Impatiens glandulifera* were estimated. Aquatic pathways within these areas are also outlined. These are general descriptions that do not take into account errors in data and all micro-climates within large areas. Note that the two Northern Interior Forest Districts mentioned below have now been amalgamated into one administrative area. The two separate districts were retained here because the BEC guide data from the former Prince George Region was more descriptive by using sub-zones, were the Prince Rupert Region BEC guide used zones.

Areas at risk within the NWIPC operating area: Northern Interior Forest Districts Prince George Region BWBS dk1, SBS wk3, SBS dw1, SBS dw2, SBS mw, SBS mh subzones; Northern Interior Forest Districts

Prince Rupert Region CWH and ICH zones of the southern portion; Haida Gwaii Islands CWH wh1, CWH vh2 zones (BECWEB guidebooks).

Agriculture and Food Canada growing degree day Base 5 Map shows heat-sum ranges of agricultural areas. Prince George, Terrace and Alliford bay (Haida Gwaii) have ideal heat-sums of 1330 – 1521. Agricultural areas near Vanderhoof, Hazelton, Smithers and Tlell river valley (Haida Gwaii) have moderate heat-sums of 1140 – 1330; Burns Lake and Houston agricultural areas having too low heat-sums of 949 – 1140 for *Impatiens glandulifera*.

A measurement of the total area at risk is possible by mapping and overlapping areas of polygons that exist within Invasive Alien Plant Program, and Agriculture and Food Canada databases. The task of assembling this map should be done by a GIS specialist with the appropriate experience and access to GIS software. In comparing BEC maps and Agriculture and Food Canada maps a general estimate of the susceptible areas could be derived.

The speed at which the areas at risk will be infested is an exponential equation dependant on site factors and pathway. Given its history in Europe, it is known to spread fast. It took less than 60 years to become a common weed in the UK (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008). Similarly, it took only 62 years to spread from seven known sites to infest 56% of the total river length in the Czech Republic, with an estimated 100% coverage by 2025 (Pysek , P. and Prach, K. 1994). Though it has been 73 years since BC's earliest recorded specimen found in Burnaby's Still Creek in 1937, it hasn't spread as quickly. It is possible that it requires key staging areas further upstream to quickly spread across the landscape. Data is needed to create an experimental model that can predict its spread. An extensive inventory would need to be done over many years to create such a model.

Specific areas at Risk and their resulting pathway hazards:

Reported infestations of *I. glandulifera* in IAPP database were assessed and interpreted for potential spread to adjacent areas. Certain sites posed greater risk because they were near aquatic pathways. Because seeds are buoyant in water, aquatic pathways could be the greatest channel to seed transportation and riparian infestation. Timely inventory and treatment of infestations along aquatic pathways are key to protecting these riparian areas. Historical records of infestations in Europe point to riparian corridors as the primary factor in its introduction into other areas (Pysek , P. and Prach, K. 1994).

The following is a discussion on the specific areas at risk due to their susceptible site factors.

Known sites within the municipal area of Prince George are located in the SBSmh. SBSmh has an ideal heat-sum range of 1342 – 1510 with a mean of 1428. This BEC subzone flows along the Fraser River south into the Cariboo Regional district. An *Impatiens glandulifera* infestation alongside the river is likely to transport floating seeds and grow naturalized populations downstream. A NWIPC hotline caller reported an infestation of *Impatiens glandulifera*, “Report - Location of Site around 400 block of North Nicolson St. - close to Nechako River. Go across green-belt to river bank. *Impatiens glandulifera* is growing all down river bank." This infestation is a staging ground for seeds to be transported into the Nechako and Fraser rivers. It is critical that this site be treated and landowners in the adjacent area are notified and/or educated.

There is currently a containment line surrounding the *Tanacetum vulgare L.* infestation in Terrance. Due to the abundance of *Tanacetum vulgare L* (Common Tansy) in Terrace, manually treated *Impatiens glandulifera* sites are likely to be invaded by it. Studies showed that removal of *Impatiens glandulifera* resulted in the introduction of other invasive species in its place (Hulme, P. E., E. T. Bremner 2006). Twenty-five percent of species sprouting from manually treated plots were non-native. Though *Tanacetum vulgare L.* was not found in the study plots, *T. parthenium* was found indicating that *Tanacetum* species could invade manually treated areas. The study suggests that manually treating *Impatiens glandulifera* should be done in conjunction with treatment of adjacent invasive weeds also. Further discussion on how to deal with this dynamic should be addressed by the NWIPC. *Impatiens glandulifera* infestations near the Skeena River and its tributaries should be considered high priority and

treated regardless of a resulting *Tanacetum vulgare L.* infestation because seeds can spread downstream.

Kitimat is host to the largest infestation known in the NWIPC area. A seven hectare infestation is growing on the banks of the Kitimat River (correspondence with Andrea Eastham). The present waterway flows into the mouth of the Douglas Channel were it flows out into the various fiords, estuaries, and islands beyond. This staging area could spread seeds into areas that are remote and difficult to access. Treatment/inventory of the resulting infestations would be costly and only accessible by boat of float plane. Treatment of *Impatiens glandulifera* infestations near waterways is paramount, focusing more funds on upstream infestations because of the movement of seed downstream. Some Kitimat sites do not occur near riparian areas, these sites could be kept under containment until the key riparian sites are dealt with. Containment would cut costs allowing crews to focus on more important sites. There were garden refuse dumping sites found next to infestations in the area (correspondence with Andrea Eastham). Education of the community should be used in conjunction with bylaw enforcement by the municipality to stop dumping.

The Arctic Divide is just north of Prince George and is the location of the southern tributaries of river systems flowing into the Arctic. If *Impatiens glandulifera* gets established into riparian areas north of the Arctic Divide, it will be perfectly situated to spread seeds north along streams, rivers, and lakes flowing into the Arctic Ocean. It is unknown what this species is likely to do once it enters the boreal forests. Cold winters are not known to adversely affect seed banks. The further north, the lower the elevation, and the wetter the soils are. The soil moisture and nitrogen levels would be ideal. Currently the heat-sum units are around 1000 units, so it is unlikely to sustain a naturalized population. If such a staging area existed, then steady sources of seeds flowing north would be needed to maintain populations.

A possible staging area for *Impatiens glandulifera* to spread north is Summit Lake. The current urban problem areas occur in the city of Prince George in the SBSmh subzone. Summit Lake is only 15 km north of the northern tip of this subzone. The waterways of Summit Lake flow north to the Arctic Ocean. The residents living along the shores of the lake should be educated/notified of the significance of this lake and the possibility that it could become a staging area. A survey or inventory would provide data on whether *I. glandulifera* is already present on people's property along the lake.

The BWBSdk1 Subzone – Variant has a heat-sum range of 595 – 1897 units (Reynolds, G. 1989) and its wetter south facing lower elevation micro-sites could provide a staging area. This subzone's geographical distribution is described in the BEC guide (DeLong, C. 2004). "BWBSdk1 occurs in the valley bottoms of the Omineca Mountains and Rocky Mountain Trench as far south as the Germansen River, as far north as the Turnagain River, as far east as the Rocky Mountain divide, and as far west as the divide east of Takla Lake". Considering that Mackenzie Township is near the southern reaches of this BEC subzone, it is advised that information be given to locals about *Impatiens glandulifera*. An Invasive Plant inventory should be taken of the areas in and around the Germansen River as its waters flow into Williston Lake.

Anthropogenic pathways such as garden escapees, garden/yard refuse piles, plant gifting, local plant sales, container ships expelling ballast water, and recreational vehicles (ATVs/Boats) are likely to spread the seeds into areas beyond its range. Seeds deposited outside the range might sprout depending on the temperature and moisture. If the seeds find an appropriate niche, then another naturalized population would be established from which the plant could spread.

Red and blue listed species near *Impatiens glandulifera:*

Endangered species and ecosystems surveys were cross-referenced with *Impatiens glandulifera* IAPP sites using IMapBC application. The following are a list of plants that could be affected by the spread and dominance of *Impatiens glandulifera* into their associated habitats. *Impatiens glandulifera* exists within the vicinity of where the endangered plant was surveyed. Bog Adder's-mouth Orchid *Malaxis paludosa* and Bog Rush *Juncus stygius* were found in the area surrounding Kitimat infestations. Bog Adder's-mouth Orchid *Malaxis paludosa* was found near Prince Rupert infestations. American Sweet-flag *Acorus americanus was* found in shallow water habitats near Smithers infestations. Kamchatka Spike-rush *Eleocharis kamtschatica* was found in gravelly tidal flats near the infestation west of the Town of Stewart were dirt roads enter the Alaskan border. Sharing similar habitat types means that *Impatiens glandulifera* will likely take over these moist habitats, thus impacting and possibly displacing the resident endangered species.

Treatment:

Manual treatment of *Impatiens glandulifera* is a community event in the UK (WATSON, MAGGIE. July 2009). Two-three years of well timed mechanical treatments is all it takes for seed banks to become depleted. Community groups “Balsam Bash” before the flowers turn to seed pods . It is very important to remove the plants before the seed pods are ripe because the pods are sensitive to touch and will explode dispersing seed all over the immediate area. Care is taken to revisit the site the following year because other invasive plants could colonize the treated area (Hulme, P. E., E. T. Bremner 2006). Treated areas should be seeded with other native species or plant trees in order to reclaim the area (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008). According to the Langley Environmental Group, mowing is the most efficient method. Mowing an area twice, early and late in the season would be best. A study in Langley B.C. showed that plants cut in August were able to re-sprout and produce seed in the fall. The re-sprouting is highly dependent on site. Pulling the plant’s shallow roots up could hinder re-sprouting. Pulling *Impatiens glandulifera*’s predominantly shallow root system doesn’t require hand tools to up root, and pulling shallow roots has less impact on the soil than pulling deep roots. Provided that there are no seed pods attached, plants can be piled on site to compost. Though more costly and time consuming, the study does recommend mechanical treatment as a practical option in BC context. Given the wet sites that it grows on in BC, chemical treatments might not be an option. (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008).

Chemical controls are glyphosate (2.5 – 3.5L/ha) or 24-D (6-9L/ha) applied twice early in the season before flowering. Spraying after flowering will likely not kill the plant before seed production (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008). Flaming the plants using a propane torch has been explored as a treatment in the Fraser Valley, with some limited success.

Biological controls are at this point unavailable. Numerous insects were collected from Pakistan for further study as biocontrol agents in Europe. The thrips *Taeniothrips major* Bagnall is being tested further (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008).

Collecting *Impatiens glandulifera* and composting it can provide nitrogen for gardens but it can also be beneficial healthwise. Natural remedies are: a reliever of itchiness from minor skin irritations and stronger concentrations are used to prevent allergic reactions to poison ivy. It is also known to have

anti-fungal properties. Liquid from stems can be used to treat athlete's foot (Martin, Corinne. 1992). An essence from the flowers is an ingredient in a widely used stress reliever called Bach's Rescue Remedy.

Education and Public perception:

Being a beautiful garden plant is a problem because people like to grow the plant, but do not realize that it can spread rapidly. The flowers attract bees and other pollinators to a garden due to their very sweet nectar. It is aesthetically pleasing and is not perceived as a nuisance. In one instance it was found at a community plant sale in Prince George, but it was luckily removed before it was sold (correspondence with Claire Watkins, City of Prince George Parks Dept.). In the UK, it took only 16 years to spread from gardens and become established (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008).

It is an annual with seeds stay viable in the soil for up to 18 months (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008). This means that if treatments can stop seeds being produced on site, the population will eventually die off. This task doesn't seem daunting until one sees the difficulty of treating within riparian areas. The riparian sites can be steep and slippery and mechanical treatment is likely the only option. In the Czech Republic, there were more than twice as many riparian infestations as there were in settlement areas (Pysek , P. and Prach, K. 1994). Seed production of up to 2500 seeds per plant from exploding seed pods can be a problem if the seeds travel downstream (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008). A canoe or kayak would be one way to inventory a riparian corridor, but highly depending on stream flow and topography. Given its history in Europe, it is known to spread fast. It went from initial introduction to common weed status in less than 60 years in the UK (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008). Due to the prolific seed production and dispersal, even 99% control was found to be ineffective (Clements, D. R., K. R. Feenstra, K. Jones, and R. Staniforth. 2008). One Hundred percent control would require treatment everywhere including the plants growing in people's gardens. A gardener unaware of the impacts and where the seeds go could prompt another naturalized population. Education efforts should be used in conjunction with bylaw enforcement to get the point across to land owners that *Impatiens glandulifera* is not safe to grow and garden refuse should not be dumped in green spaces.

Motivating the public to report sightings of this plant is the key. *Impatiens glandulifera* is a very recognizable plant species because of its biological characteristics. The pink purple orchid-like flowers, bamboo-like stalk, exploding seed pods and dense tall populations are all traits that are easily identifiable. *Impatiens glandulifera* stands out of natural landscape as something alien, so there is little difficulty in identifying it. Community groups could be encouraged to remove patches. Unlike many other invasive plants that persist despite years of treatment, *Impatiens glandulifera* can be eradicated with relatively fewer treatment visits. Community groups that treat *Impatiens glandulifera* will be able to see a visible improvement within a short time span and feel like they are making a positive change in the environment around them. This is likely why groups from the UK are so active and outspoken about the infestations here in BC (correspondence with Andrea Eastham).

The "Himalayan Balsam/Knotweeds" brochure insert should be updated, printed and combined with the "Guide to Invasive Plants" (black brochures). The completed brochure should be distributed at boating supply stores, garden centres, community events, and door to door (near infestations). Posters or signs should be made and posted near green spaces to deter people from dumping garden refuse. Radio and television ads should be produced and aired late June, just prior to *Impatiens glandulifera's* flowering period when it is most recognizable. A call to neighbourhood and community groups to help clean up their green spaces would be made part of a public advisory.

It is suggested that maps and site lists be made to further assist in planning the management, containment and treatment of key areas and sites at risk. A map could be created with layers of susceptible BEC zones, IAPP sites, water bodies, endangered plant locations, and directional arrows on rivers. The combined information will help to predict were seeds might travel and germinate. This map could also be used to educate and inform the public about the NWIPC's commitment to treatment in their community.

Conclusion:

Impatiens glandulifera is currently a category one extremely invasive plant in NWIPC 2009 Plan and Profile. Historical records from Europe indicate it spreads fast along riparian corridors to become vast in distribution. It went from initial introduction to common weed status in less than 60 years in the UK. The

NWIPC operating area was analyzed and areas at risk were highlighted. Many zones, subzones, agricultural lands, and riparian corridors were found to be at risk. It has a high tolerance to many different climactic, latitudinal, and elevation extremes. Human assisted movement of seed and plant matter could expand its range beyond climactic limits. Its detrimental impacts to the environment decrease native plant diversity, increase soil erosion, and increase potential area for other invasive species to invade. Four different species at risk were located around known *Impatiens glandulifera* sites and share similar types of habitats. Infestations on the banks of streams and channels are high priority sites likely to be staging grounds for further infestations downstream. Taking in all the information, the areas it is found, the ecological impacts, and the potential areas at risk to infestation; *Impatiens glandulifera* should continue to be a category one extremely invasive plant until the NWIPC decides otherwise. Education and awareness work along with bylaw enforcement needs to continue and be expanded as do inventories and treatments to prevent *Impatiens glandulifera* from further expanding and damaging the environment.

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