**EPPO data sheet on Invasive Plants**

*Impatiens glandulifera*

**IDENTITY**
**Preferred Scientific Name :** *Impatiens glandulifera* Royle
**Other Scientific Names:** *Impatiens glanduligera* Lindley, *Impatiens roylei* Walpers
**Taxonomic position:** Balsaminaceae.
**Common Names:** Himalayan balsam, Indian balsam, policeman's helmet, ornamental jewelweed (English), balsamine d'Inde, balsamine géante (French), impaciencia (Spanish), Drüsiges Springkraut, Indisches Springkraut (German), kjempespringfrø (Danish), jättipalsami (Finnish), kæmpe balsamin (Norwegean), niecierpek himalajski (Polish), jättebalsamin (Swedish).
**EPPO computer code**: IPAGL
**Notes on taxonomy and nomenclature:**

## MORPHOLOGY

*I. glandulifera* is a glabrous annual 50 to 250 cm tall, with stems 0.5 to 5 cm in diameter sometimes branched in the upper part. Roots are up to 15 cm deep, often forming numerous adventitious roots from the lower nodes. The leaves are opposite, the upper ones sometimes in whorls of three, up to 25 cm long and 7 cm wide, lanceolate to obovate, petiolate and sharply serrated at the edges. The inflorescences are racemes 25-40 mm long, containing 2-14 flowers, each strongly zygomorphic, their posterior sepal forming a sac that ends in a straight spur, and varying in colour from white to pink and purple. The capsule is 3-5 cm long and up to 1.5 cm wide, containing up to 6 (Grime *et al.*, 1988) or 4-16 seeds (Beerling and Perrins, 1993), 4-7 mm long and 2-4 mm wide with a mean weight of 7.32 mg.

## SIMILARITIES TO OTHER SPECIES

Other *Impatiens* species are similar, but differ in conspicuous features. The Asian *I. parviflora* is much smaller and has small pale-yellow flowers. The yellow flowered European *I. noli-tangere* and the orange flowered American *I. capensis* are also both smaller. The garden ornamental *I. balsamina* that occasionally escapes onto waste ground in North America and Europe has pubescent stems and capsules and usually single flowers.

## PLANT TYPE

*I. glandulifera* is an herbaceous annual, seed propagated shrub.

## BIOLOGY AND ECOLOGY

The self-compatible flowers of *I. glandulifera* attract numerous insect pollinators, especially bees (*Apis mellifera*), bumble-bees (*Bombus* spp.) and syrphids. The species is exclusively propagated by seeds. The number of seeds produced is 700-800 seeds per plant and 5.7 seeds per pod (Beerling and Perrins, 1993), or up to 4000 seeds per plant and 6.4 seeds per pod (Sebald *et al.*, 1998), and a maximum of 32,000 seeds were produced per square metre in a pure stand in Germany (Koenies and Glavac, 1979). Explosive capsules expel seeds up to 7 m from the plant, and dissemination is also aided by flowing water as dry seeds are buoyant, or transported with sediment. Although the species is reported as not having a persistent seed bank (Grime *et al.*, 1988) there are indications that at least some seed can persist for 18 months (Beerling and Perrins, 1993). Seeds require chilling to germinate, which they do in early spring with a high germination rate of approximately 80% (Sebald *et al.*, 1998). The cotyledon phase lasts until April in the UK when rapid shoot growth begins and the root system is augmented by adventitious roots from the lower nodes (Beerling and Perrins, 1993). The time from germination to the onset of flowering is 13 weeks in Germany, with flowering continuing for a further 12 weeks (Sebald *et al.*, 1998). The chromosome number is 2n=18 or 2n=20 (Grime *et al.*, 1988; Beerling and Perrins, 1993).

### Associations

In its principal habitat where introduced and invasive, along riverbanks, *I. glandulifera* is mostly found in the phytosociological unit Convolvuletalia. In southern Germany, it is most often accompanied by *Urtica dioica*, *Aegopodium podagraria*, *Lamium maculatum* and *Galium aparine* (Oberdorfer, 1983). Dense riverbank vegetation with *I. glandulifera* was described as Impatienti-Calystegietum, e.g., along the Odra in Poland (Dajdok *et al.*, 1998). In the UK, associated vesicular-arbuscular mycorrhiza was sparse though fungal epiphytes were numerous (Beerling and Perrins, 1993).

### Environmental requirements

*I. glandulifera* has a preference for temperate climates with high relative humidity, being drought-intolerant and quickly wilting in dry periods (Beerling and Perrins, 1993). In Europe, plants of all ages are frost intolerant with adults killed by the first frost in autumn and seedlings by late frosts in spring (Sebald *et al.*, 1998). Mortality of seedlings and young plants can also be high due to physical damage from rainfall (Prowse, 1998). It grows in half-shade but also in full sunlight. In the native range the plant occurs at high altitudes between 1600 and 4300 m, but in Europe it is found at lower elevations, up to 1200 m in the eastern Alps in Austria and not found above 210 m in the UK (Drescher and Prots, 2000). As an annual, the species is dependent on open sites for germination each spring, it so is consequently favoured by disturbance. It occurs on a wide spectrum of soils from nutrient-poor to nutrient-rich and grows on mineral soils as well as on peat (Kowarik, 2003).

### Climatic and vegetational categorization

*I. glandulifera* is associated with areas with a warm to hot wet summer and a cool to cold winter (wet or dry). It is hardy to zone 7 (-18 to –12°C). It is associated with the vegetation zones: temperate deciduous forests and mixed conifer forests.

## HABITAT

*I. glandulifera* grows in moist coniferous forests and forest gaps, light floodplain forests, in road ditches, along field boundaries, in wet meadows, and on riverbanks. Riverbanks are noted as the main habitat type in the invaded range in Europe (e.g. Kowarik, 2003), although Beerling and Perrins (1993) state that it is rarely found in riparian vegetation along streams, and Drescher and Prots (2000) note that it was not recorded along larger rivers.

## CROPS / OTHER PLANTS AFFECTED

Native herbaceous plants and tree regeneration can be out-competed by the dense growth of *I. glandulifera* (Larson and Martinson, 1998; Maule *et al.*, 2000). It is a weed in managed forests, natural forests, rail and roadsides, wastelands and urban areas, but not in agricultural fields.

## PATHWAYS FOR MOVEMENT AND DISPERSAL

### Natural dispersal

Seeds are expelled from the plant by explosive dehiscence of the capsule which can lead to dispersal distances of 7 m. Long-distance dispersal of seeds is aided by flowing water, with fresh seeds transported in sediment on the beds of rivers, and dry seeds being buoyant can float over large distances.

### Vector Transmission

Isolated observations of seeds dispersed up to 10 m from the mother plant may indicate the possibility of seed transport by small rodents (Beerling and Perrins, 1993).

### Agricultural Practices

Bee-keepers have been known to disperse seeds in order to enhance forage for honey bees (Hegi, 1912; Hartmann *et al.*, 1995).

### Movement in trade

*I. glandulifera* was imported as an ornamental species for its showy and scented flowers, is still being used as a garden plant in many European countries and continues to be sold by seed companies (Beerling and Perrins, 1993). Transport with topsoil is probable (Beerling and Perrins, 1993), or as a seed contaminant, but it is not clear, however, to what extent this has occurred in the introduction or spread to new areas. The transport of seed with river gravel in trains was reported in Germany (Hartmann *et al.*, 1995), as well as contamination of building rubbish transported to waste disposal sites.

## USES AND BENEFITS

*I. glandulifera* is used as a garden ornamental and as a honey plant. Cattle are known to feed on the whole plant (Beerling and Perrins, 1993) but the browse value is not known.

## GEOGRAPHICAL DISTRIBUTION

**EPPO region:** Austria, Belgium, Croatia, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Netherlands, Norway, Poland, Romania, Russia (Central Russia, Eastern Siberia, Russian Far East), Slovakia, Spain, Sweden, Switzerland, Ukraine, United Kingdom.
**Asia:** India (Himachal Pradesh, Jammu and Kashmir, Mizoram, Uttar Pradesh), Japan (Honshu), Nepal, Pakistan, Russia (Eastern Siberia, Russian Far East).
**North America:** Canada (British Columbia, Manitoba, Ontario, Saskatchewan), USA (California, Idaho, Maine, Massachusetts, Michigan, Montana, New York, Oregon, Rhode Island, Vermont, Washington).
**Oceania:** New Zealand.

## HISTORY OF INTRODUCTION / SPREAD

The native range is the western Himalayas, restricted to parts of northern Pakistan, northern India and Nepal. The species is known as invasive in temperate European and Asian countries, North America and New Zealand. *I. glandulifera* was first introduced to the UK in 1839 as a garden ornamental, from where it was taken to gardens in many European countries where it is still popular. The spread was enhanced by beekeepers who released the plant into the wild on many occasions, which was noticed as early as 1855 in the UK, and escaped plants were found in Switzerland in 1904, from where the species migrated along the Rhine to Germany. Spread is rapid, with seeds transported over large distances along rivers and aided by humans. In the UK, the rate of spread was estimated as up to 38 km per year, compared to up to 24 km per year for *I. parviflora* (Perrins *et al.*, 1993). The history and dynamics of invasion in Europe are well studied (e.g. Pysek and Prach, 1995). Further spread of *I. glandulifera* is likely, and as a result of seed transport with flowing water, it will predominantly lead to an increase in abundance within countries or regions. International transport may be motivated by the ongoing use and promotion of the species internationally as a garden plant, as seeds or whole plants. Transport of seeds as a contaminant of soil, building material, etc. is less likely to cause new introductions. The spread is likely to continue with global warming to more northerly or montane areas (Beerling, 1993).

## IMPACT

### Economic impact

Nature conservation may involve costly control measures but these costs have not been quantified. *I. glandulifera* has been noted as leading to increased riverbank erosion in places as it leaves soils bare when it dies back in winter, although in general, it is often integrated in perennial vegetation.

### Impact on biodiversity

Associated flora is often reduced in vigour and numbers due to the superior competitive strength of *I. glandulifera*, though not excluded, as being an annual, is not present in the vegetation for the whole growing season. It germinates in spring and reaches dominance in the summer, and plants completing their life cycle in spring or early summer are little affected. In addition, the dominance of *I. glandulifera* may vary from year to year according to the weather conditions in the germination phase. Another effect on other plants results from competition for pollinators, as *I. glandulifera* with its nectar-rich and scented flowers attracts many more pollinators than native plants, and thus has a negative effect on the fitness of the natives (Chittka and Schürkens, 2001). The impact on wild fauna is both positive and negative and the net effect is not easily assessed. The rich nectar production supports many insects and aphid infestations support a food-chain of aphidophagous arthropods, although, the displacement of food plants may reduce mono- or oligophagous insects.

## RISK AND IMPACT FACTORS

*I. glandulifera* has a negative impact on biodiversity and native flora, but is also noted as having a positive impact on native fauna, and animal and plant products.

**SUMMARY OF INVASIVENESS**

*I. glandulifera* has spread rapidly in many parts of Europe and North America after its introduction as an ornamental and spread is likely to continue. Due to its ability to form dense stands and its conspicuous appearance it has been blamed for negative biodiversity effects. Even though these effects are less severe than often thought, further spread is undesirable and should not be facilitated by further use, particularly in natural areas. Control is advisable in certain situations, e.g. nature reserves, but eradication from larger parts of its invasive range is not considered feasible.

| | **CHARACTERISTIC** | **(Y)es, (N)o** |
|---|---|---|
| | **Invasiveness** | |
| 1 | Is the species invasive in its native range? | N |
| 2 | Has it proved invasive outside its native range? (i.e. is it an invasive alien species)? | Y |
| 3 | Is it highly adaptable to different environments? | N |
| 4 | Does it have high reproductive potential? (e.g. for weeds; prolific seed production, high germination rate, reproduction by rhizomes, tubers, stolons or root/stem fragments). | Y |
| 5 | Is it highly mobile locally? (i.e. for weeds, propagules capable of moving long distances by wind, water, attachment to machinery, animals or humans). | Y |
| 6 | Can its propagules remain viable for more than one year? | Y |
| 7 | Does it tolerate, or benefit from, cultivation, browsing pressure, mutilation, fire etc? | Y |
| | **Impacts** | |
| 8 | Is it competitive to agricultural and plantation crops or pasture plants? | N |
| 9 | Does it cause impacts on ecosystem processes? (e.g. hydrology, sedimentation, fire risk, nutrient cycling etc.). | Y |
| 10 | Does it adversely affect natural communities? (biodiversity, native populations, endangered or threatened species) by competition or hybridization (underline one or both). | Y |
| 11 | Does it adversely affect community structure? (e.g. effects on the food chain, elimination or creation of a canopy). | Y |
| 12 | Does it adversely affect human health? (e.g. allergies, effects on water or air quality). | N |
| 13 | Does it have sociological impacts on recreational patterns, aesthetics, property values? | N |
| 14 | Is it harmful to animals? (e.g. poisonous plant parts or vector of animal diseases). | N |
| 15 | Does it produce spines, thorns or burrs (or other discomfort)? | N |
| 16 | Is it a host or vector to recognised pests and pathogens of agriculture or forestry etc? | N |
| | **Likelihood of entry/control** | |
| 17 | Is it highly likely to be transported internationally (a) accidentally? (e.g. as a contaminant). | N |
| 18 | Is it highly likely to be transported internationally (b) deliberately? (e.g. as an ornamental) | Y |
| 19 | Is it difficult to identify / detect as a commodity contaminant? (e.g. due to small seed size) | Y |
| 20 | Is it difficult to identify / detect in the field? (e.g. similarities to other species, inconspicuousness) | N |
| 21 | Is it difficult / costly to control? (e.g. resistance to pesticides) | N |

## CONTROL

### Cultural Control

*I. glandulifera* is not resistant to grazing or cutting. Maintaining traditional forms of land-use in grassland will prevent invasion, and mowing and grazing can also be successful in eliminating infestations.

### Mechanical control

As an annual, *I. glandulifera* can be more easily controlled than perennial invasive plants, and any control must aim at preventing seed production. Best results are achieved by mechanical control late in the season, i.e. when the plants are in flower or beginning to flower, whereas early cutting of the plants leads to re-sprouting. Mowing with or without removal of the plant material, mulching or soil cultivation have all proved successful in Germany (Hartmann *et al.*, 1995). Agricultural machinery may be used, but where the soil is wet and soft, heavy machinery will damage the soil and provide open spaces ideal for the re-establishment of the species. In smaller stands, hand-held brush cutters can be used. Hand-pulling of the plants may also be feasible, but care must be taken that pulled plants find no chance to re-grow where they are deposited. For lasting success, the area should be monitored for re-growth a few weeks after measures are applied.

### Chemical Control

Both selective herbicides such as 2,4-D and triclopyr, and non-selective herbicides such as glyphosate were found suitable in controlling *I. glandulifera*.

### Biological Control

No biological control agents have been identified. A specialized herbivore of *I. parviflora* in its native range, the aphid *Impatientinum asiaticum*, was first recorded in Europe in Moscow, Russia in 1967 and is now widespread in central and northern Europe where it also infests *I. glandulifera*, though does not appear to cause significant damage to the plant. Slugs also cause considerable damage to young plants (Prowse, 1998).

### Integrated Control

Integrated control must aim at maximizing the control effect while minimizing environmental side effects. Due to the downstream transportation of seeds, control measures in the catchment area of a river must start at the upper reaches and move on downstream. Complete control in a given area necessitates monitoring and ongoing management for several years.

## REGULATORY STATUS

*I. glandulifera* is rarely listed as a noxious or quarantine weed. However, it is regarded as an important invader in several European countries. It is among those invasives in Germany against which specific control measures are directed (Kowarik, 2003), is on the Swiss 'black list' of harmful invasives (Anon., 2002) and is listed as invasive in Austria (Essl and Rabitsch, 2002). In Washington, USA, it is designated for control in regions where not yet widespread (USDA-ARS, 2004).

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