

Background

History and identification

Himalayan or Indian Balsam, the scientific name for which is *Impatiens glandulifera*, was introduced into Britain in 1839 as an ornamental garden plant. It escaped from cultivation and has spread rapidly throughout the UK and Ireland, favouring moist and semi-shaded damp places, predominantly banksides by slow-moving watercourses and waste land. It is an herbaceous annual plant with characteristic pink-purple flowers, matt darkish green finely serrated leaves, stout succulent hollow reddish translucent stems (up to 2.5 m in height) and very shallow roots. While the species is reasonably easy to identify when mature (especially when flowering), the seedlings and last year's dead stems are more difficult to spot.

Aids to Himalayans Balsam identification can be found at:
<http://www.nonnativespecies.org/index.cfm?sectionid=47>

Legislation

In the UK, legislation concerning Himalayan Balsam is provided by a number of instruments (Table 1). The primary aim of these instruments is to prevent the spread of Himalayan Balsam. In short, it is an offence to cause Himalayan Balsam to spread into the wild and, if transported offsite, there is a duty of care for any part of the plant that can facilitate growth (propagules) and any soils etc. containing propagules, i.e. such material must be treated as controlled waste. For further information see 'PCA Guidance Note on Legislation and policy for Invasive Non-native Plant Species including Japanese Knotweed'.

Control action should be carried out in conformity with any relevant legislation in a given geographic region. Legislation is continuously changing; it is the responsibility of individual members to remain up to date.

Table 1: Summary of key legislative instruments relating to the management of Himalayan Balsam

Instrument	Relevant section	Summary of key aspects	Countries of UK covered
Wildlife and Countryside Act 1981 (as amended)	Section 9, Schedule 14	It is illegal to plant or otherwise cause Himalayan Balsam to grow in the wild in the UK	England and Wales
Wildlife and Environment (Scotland) Act 2011		It is illegal to plant or otherwise cause Himalayan Balsam to grow in the wild in Scotland	Scotland

PCA Guidance Note – Management of Himalayan Balsam

Instrument	Relevant section	Summary of key aspects	Countries of UK covered
Wildlife (Northern Ireland) Order 1985	Section 9	It is illegal to plant or otherwise cause Himalayan Balsam to grow in the wild in Northern Ireland	Northern Ireland
Anti-social Behaviour, Crime and Policing Act 2014 and Community Protection Notices		Local councils and the police have the power to issue Community Protection Notices against “individuals who are acting unreasonably and who persistently or continually act in a way that has a detrimental effect on the quality of life of those in the locality” including for invasive non-native species like Himalayan Balsam. A notice could require an individual or organisation to make reasonable efforts to make good the problems arising as a result of Himalayan within a specified period of time and/or a requirement to take reasonable steps to prevent future occurrence of the problem. Breach of any requirement of a Community Protection Notice, without reasonable excuse, would be a criminal offence	
Environmental Protection Act 1990	Sections 33 and 34	If taken away from the site of origin, Himalayan Balsam and associated material, e.g. soil, becomes Controlled Waste and must be disposed of at a landfill site that is authorised to accept it. Himalayan Balsam waste that is disposed of at a landfill site must be accompanied by appropriate waste transfer documentation	UK
Town and Country Planning Act 1990 and Town and Country Planning Act (Scotland) 1992	Section 215 of the England and Wales Act and Section 63 of the Scottish Act	Although these Acts do not make specific reference to specific weeds, they provide local authorities with power to serve notices on owners or occupiers of land to control weeds that may be harming the amenity of the surrounding area and if the owners and occupiers fail to remedy the situation, they may be liable to a fine or have to repay the costs of action taken by the local authority to control the weeds	UK
Common Law		There is provision within Common Law to take civil action against neighbouring landowners where the spread of Himalayan Balsam is considered to be a private or public nuisance	UK

Life cycle and reproduction

Being an annual plant, Himalayan Balsam completes its entire life cycle in one growth season, reproducing from year to year solely by small spherical seeds, 2-4 mm in diameter. The highly viable seeds germinate early in the growth season (usually from March to June) with vigorous growth following. Plants will reach their full height by July/August, flower and set seed.

While the species does not spread by vegetative means, e.g. from fragments of root or stem, uprooted plants left in moist conditions can re-root from nodes on the stem. Additionally, plants that have been cut will re-sprout unless the primary stem is cut below the first node. When the stem is cut above the first node, the species will regrow extremely vigorously and potentially produce more flowers and seeds than it would have otherwise.

While Himalayan Balsam generally produces seeds once it has reached its full height, plants can seed at heights under 15 cm in certain conditions (particularly after disturbance).

A single plant germinating from a single seed could start a significant invasion.

Seed bank and dispersal

Himalayan Balsam seeds generally persist in the soil for approximately 18 to 24 months; however, seed persistence up to three years has been reported. Individual plants can produce over 800 seeds per year, with the seeds being contained in exploding seed pods, usually about 6 seeds per pod, which can propel/disperse seeds up to 6 metres from plants. Seeds can be spread over greater distances by various means including water flow (the seeds float) and through human activity (e.g. attached to vehicles, clothing and footwear). In order to germinate, the seeds require a period of cold stratification.

The seed bank characteristics of Himalayan Balsam are not well understood; however, Defra guidance (2013) states that: ‘to clear ground contaminated with Himalayan Balsam, you **may** need to remove soil up to 6 metres from the parent plant and to a depth of 0.5 metres’. It has been found that for most species seed movement in soil is slow and that deeper seeds are older, except in severely disturbed soils. There is also a strong correlation between species where seeds are found at depth in the soil and species with extended seed longevity. The fact that Himalayan Balsam seeds are not long lived makes it very unlikely that they will be present at depths down to 0.5 metres in all but highly disturbed or cracked soils. As such, the depth potential for seeds should be considered on a site by site basis.

Impacts

Himalayan Balsam can form dense colonies which shade out and suppress the growth of native plants reducing biodiversity. Potentially negative impacts of Himalayan Balsam include:

- outcompeting native plants with similar habitat preferences;
- leaving riverbanks exposed to erosion following winter dieback;
- increased risk of flooding in summer due to constricted water flow, siltation of water courses and increasing bank instability; and
- attracting pollinators away from native species.

It should be noted that clearing certain habitats, e.g. riverbanks, of Himalayan Balsam can increase the risk of erosion and potentially open up the area to invasion by even less desirable invasive species, such as Japanese Knotweed or Giant Hogweed. As such, cleared soils should be re-vegetated with suitable native species as part of any Management Plan.

Himalayan Balsam Management Plan

Small local infestations can be controlled reasonably easily.

Where the probability of re-infestation is high, e.g. the species is also present upstream from a site, a catchment level approach may be required to achieve long term control. Additionally, if the species is present on a neighbouring property within approximately 6 metres of the property boundary, seeds may be propelled back onto the site following local removal. An assessment of the re-infestation potential from the wider environment is critical. A single seed arriving on a site following control action could return the site to its original state rapidly. In the space of two years, one plant can become hundreds and then hundreds of plants can become thousands.

Due to the species preference for growth on riverbanks and in wet woodland, access can frequently be problematic. In such scenarios, control options may be limited (i.e. plants may not be accessible for hand pulling or herbicide treatment) and **all appropriate health and safety precautions must be taken.**

The aims of a Himalayan Balsam Management Plan should be clearly stated and will usually include killing the existing plants and eradicating the remaining seed bank. A number of methods are available to achieve both ends (see Table 2 and Control

Methods section). The method(s) chosen depend on a number of factors including the resources available, e.g. staff and money, and the target date for completion of control.

In order to control Himalayan Balsam *in situ* it must be prevented from producing seeds until the seed bank is exhausted (i.e. no viable seeds remain in the soil). The existing plants can be killed relatively quickly by hand pulling, cutting the stem below the first node or by applying herbicide (see below for further details). As the seed bank is short lived (usually 18 months), two years of control action (taking place before plants set seed) should eradicate the species. Monitoring with follow up treatment, when necessary, should be maintained until at least one year has passed with no Himalayan Balsam growth.

Control carried out after the plants have set seed is unlikely to have long-term benefits; in fact, spread will likely be facilitated by carrying out control action when seed pods are present and mature. If plants containing seeds must be removed, great care should be taken not to facilitate seed dispersal by triggering off the expulsion of seeds from the seed pods, e.g. the seed heads must be bagged.

Removal, or herbicide treatment, of plants that have already shed their seeds is pointless, as the plants will die at the end of the growing season regardless.

It is likely, particularly in the first year of control, that new plants will sprout following the initial removal/treatment, either because shade suppression will be reduced or due to soil disturbance. As such, several additional visits will likely be required. Three visits, May/June, July/August and September/October should be sufficient to catch all regrowth. Plants that germinate after September/October are very unlikely to have sufficient time to complete their life cycle and produce seeds. However, this will depend on the control method chosen (see below) and weather conditions, so a cautionary approach is advisable.

If there is insufficient time to allow the seed bank to become exhausted, contaminated soil can be removed quickly by excavation. Arisings should be retained onsite (e.g. banded or buried) whenever possible and only disposed of offsite as a last resort. **Disposal offsite is environmentally unsound** and expensive.

Using a cheaper approach can be highly effective but would take several years.

Where dealing with an existing infestation, where the aims cannot be confidently met, serious consideration should be given to stopping or delaying implementation.

This is because the plant will recover and often within a short period of time return to the initial state.

Alternative aims of a Management Plan could be to prevent an area currently free from Himalayan Balsam becoming infested or to limit the spread of plants from a known infestation.

Aims should be:

- closely linked to the associated costs and/or the budget available for implementing the Management Plan;
- realistic with regards to time scale;
- measurable to determine the degree or progress and/or success;

The project area within which control is proposed or from which it is planned to exclude the plant should carefully selected or defined and documented in plan/map.

The three stages for a control programme are:

- killing the growing plants to prevent any further seed production using one of the methods described below
- follow up monitoring in the same growing season to deal with any regrowth (e.g. post-cutting) or plants missed in the initial treatment
- physically remove the seed bank or undertake annual treatment of seedlings growing from the seed bank until it is completely destroyed.

Once control has commenced, serious consideration should be given to stopping or delaying implementation. This is because plants will recover and often within a short period of time return to the initial state, negating all work up to that time.

In order of preference, Himalayan Balsam should be controlled by:

- hand pulling
- cutting
- herbicide application
- onsite burial (or other methods relating to excavation and retention on-site)
- excavation and off-site disposal

Grazing (cattle and sheep) or mowing can also be effective, but are more suitable for containment rather than eradication.

PCA Guidance Note – Management of Himalayan Balsam

Table 2. Summary of the main features of the different methods available for Himalayan Balsam control

Control method	Use	Positives	Negatives	Eradication timescale	Cost relative to effort
Hand-pulling	Small stands, particularly in sensitive areas	Prevents damage to other species and/or habitats. Avoids herbicide use.	Labour intensive.	Kills adults immediately. Follow-up treatment for seed bank of 2-3 years	Moderate
Cutting/strimming	Medium sized stands	Avoids herbicide use.	Collateral damage to other species is difficult to avoid.	Kills adults immediately. Follow-up treatment for seed bank of 2-3 years	Moderate
Mowing	Large stands where herbicide applications are inappropriate	Avoids herbicide use	Collateral damage to other species. Can stimulate bushy growth and enhance seed production	Better suited to containment	Low
Grazing	Farm land and others where livestock can gain long term access	Avoids herbicide use	Livestock need managing.	Better suited to containment	Low
Herbicide treatment	Individual plants to large stands	Easier and quicker than physical removal and can be used on difficult to reach stands	Herbicides can damage the environment. Use restricted in some areas.	Kills adults immediately. Follow-up treatment for seed bank over 2-3 years	Low
Excavation and onsite bunding	Small to medium sized stands on non-sensitive area(s)	Immediate removal of seed bank. Offsite disposal not required	High level of disturbance. Expensive.	Immediate in infestation area. Follow-up treatment for bund of 2-3 years	High
Excavation and onsite burial	Small to medium sized stands on non-sensitive area(s)	Immediate removal of seed bank. Offsite disposal not required	High level of disturbance. Expensive.	Immediate	High
Excavation and disposal to landfill	Small to medium sized stands on non-sensitive area(s)	Immediate kill of adults and removal of seed bank	High level of disturbance. Environmentally unsound. Very expensive.	Immediate	Very High

Control Methods

Hand pulling

Himalayan Balsam can be easily hand pulled as the species has very shallow roots growing to a depth of 10-15 cm. This method is particularly useful for smaller infestations and in high ecological value areas where the use of herbicides, or indiscriminate cutting, should be avoided. While hand pulling is time consuming, as other species can be easily avoided, the re-establishment of native vegetation should be facilitated by using this approach.

A gentle tug is usually enough to remove the entire root system. Multiple plants can be pulled simultaneously. Gloves should be worn to avoid injury, including stings from nettles which are often found growing beside Himalayan Balsam.

Hand pulling should ideally commence in May/June when plants can be easily found/identified and they will not have set seed. However, it can be carried out sooner (although identification can be tricky) and there will typically be more plants, as numbers reduce with time due to competition. .

Repeat treatments will likely be required, see above.

Pulled plants should not be placed on soil or in damp areas as they can readily re-root. The plants can be allowed to dry out or composted. Once dried, the remains can be left on site as they reduce to small amounts, if fully desiccated and seedless, disposed of as inert waste, or burnt,

Cutting/trimming

As with hand pulling, if the species is cut back prior to setting seed for two consecutive years control should be achieved. In order to prevent vigorous regrowth, plant stems should be cut below the first node, which is often very close to ground level. Cutting below the first node will be much easier once the plants have reached approximately 50cm in height in about May.

Compared to hand pulling, cutting/trimming will likely cause more collateral damage to other, potentially desirable, plant species.

Repeat treatments will likely be required, see above.

Plant remains should be dealt with as above.

Mowing

As with cutting/strimming, if the species is mown for two consecutive years preventing seed production and seed setting, control can be achieved.

However, mowing is less likely to cut the stem below the first node than strimming and, as such, the potential for vigorous regrowth is increased. Consequently, mowing will likely require more treatments per year than strimming and/or hand pulling. Additionally, mowing will likely cause significant bushy regrowth and stimulate the growth of short seeding plants (due to cutting above the first node), increasing the potential of seeds persisting from year to year.

As with cutting/strimming, mowing will likely cause collateral damage to other, potentially desirable, plant species.

Grazing

Cattle and sheep have been observed to eat young Himalayan Balsam. Grazing is unlikely to result in total control, but will likely reduce the density of the infestation and reduce the potential for range expansion.

Grazing could be of particular relevance in rural situations where there is no urgency to remove the Himalayan Balsam straightaway and the area concerned is relatively large.

Herbicidal control

Where *in situ* physical removal is not feasible, potentially due to stand density/size or location/inaccessibility, the species can be successfully treated with herbicide.

Several herbicides have been shown to be effective at killing Himalayan Balsam and often just one application is sufficient. Nevertheless re-application in the same season should be planned for, as new growth from seed is likely (see above).

Herbicide application should be carried out during periods of active growth, before flowering but late enough to ensure that germinating seedlings have grown up sufficiently to be adequately covered by the herbicide (50+ cm would be suitable).

The initial application should ideally be carried out in May/June with subsequent treatments/monitoring likely being required in July/August and September/October, as above.

Herbicide application could be used as a follow up to hand pulling, e.g. later in the year to deal with any missed plants or regrowth from seed bank.

Due to Himalayan Balsam's preference for habitats near water, this limits herbicide selection to products approved for use near water, e.g. glyphosate based herbicides and certain formulations of 2,4-D Amine.

The herbicide can be applied as a spot treatment to individual plants, using hand-held equipment, or as an overall spray using machine-mounted spray booms. In the latter instance, total weed control of all vegetation will occur, increasing the requirement for revegetation (see the Revegetation section below).

Where accessibility is problematic, e.g. river banks, a long lance sprayer is useful. Weedwiping reduces the risk of damaging surrounding vegetation but is only feasible for relatively small infestations.

Herbicide application will not kill seeds in the seed bank and monitoring with follow-up control must be repeated annually over 2-3 years to eradicate new plants growing in subsequent years, though the numbers decrease significantly from one year to the next (see Seed bank and dispersal section above).

For additional information on the use of herbicide to control invasive species see 'PCA Guidance Note on Japanese Knotweed Control: Guidance Notes for Herbicide Treatment'.

Excavation

Where immediate eradication is required, for example in a location that is shortly to be developed, the most appropriate solution is likely to be excavation.

Following excavation, if possible, contaminated soil should be retained onsite, e.g. stockpiled elsewhere on the site and regrowth treated as above. This stockpile area should be cordoned off from the rest of the site with appropriate signage put in place. Once control is achieved, the soil will be suitable for use as backfill or in landscaping.

If material is stockpiled, it is very important to monitor and carry out control prior to plants setting seed, or new areas of the site can be infested. Stockpiles should be at least 10 metres from the property boundary.

Arising can also be buried. As per Defra (2013) guidance, soil containing Himalayan Balsam seeds should be buried at a depth of at least one metre. Burial at this depth is sufficient to prevent regrowth. Prior to the burial of invasive plant waste the appropriate authority (e.g. the Environment Agency in England) must be contacted and approval granted. Himalayan Balsam seeds do not contain sufficient energy reserves to allow them to germinate and grow up through hard substrates; as such, burial immediately beneath hardstanding (e.g. poured concrete) is appropriate.

Where offsite disposal is unavoidable, you should: 'Try to minimise the amount of waste you generate that contains invasive plants, or their seeds and rhizomes' (Defra, 2013). The Environment Agency will accept the removal of soil as controlled waste from Himalayan Balsam infested areas less than the stated limits (6 metres from visible plants and down to 500 mm) if the methodology can be adequately justified. Any contaminated waste that is taken offsite must be taken by a licensed waste carrier and must go to a suitably authorised landfill site (as per the Environmental Protection Act; see Table 1).

An experienced clerk of works should supervise excavation and disposal ensuring that the work is undertaken under controlled conditions and that appropriate health and safety measures are implemented.

Monitoring

Monitoring (with control action when necessary) should be carried out for four full growth seasons subsequent to the last time the plants could have produced seeds.

Where reintroduction is likely, i.e. the species is present upstream, an annual monitoring/control programme should be implemented, ideally along with a catchment level management programme.

Revegetation

Bare ground is often left following Himalayan Balsam control. This exposes the soil to erosion, e.g. overwinter and/or along a watercourse, and to re-invasion by Himalayan Balsam and/or other undesirable plant species. The revegetation of such bare areas provides an opportunity to re-establish biodiverse habitat. A dense grass sward tends to discourage Himalayan Balsam seed germination.

The nature of the revegetation will depend on the short, medium and long term objectives, e.g. rapid soil stabilisation along a river bank or reinstating an area of playfield field. The use of residual herbicides could inhibit revegetation (e.g. of broadleaved species); as such, the use of non-persistent herbicides will likely be more appropriate.

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