

Axe Invasives Report

October 2015



Himalayan Balsam on spoil heap from pond construction 3/6/15

Mervyn Newman
Natural England



Contents

Summary.....	4
Introduction.....	5
Himalayan Balsam.....	6
Biological Control.....	11
Volunteers.....	12
Himalayan Balsam - Key Points.....	19
Balsam Hotspots in the Axe Catchment.....	20
Giant Hogweed.....	21
Japanese Knotweed.....	24
Axe Invasive Project Costs	30
Project Costs Differences.....	31
Conclusion.....	32
Acknowledgements.....	33
Funding.....	33
Bibliography and References.....	34

Summary

This report covers the fourth year of the project to control Himalayan balsam, Japanese knotweed and giant hogweed in the River Axe catchment.

One stand of giant hogweed had to be dealt with in a meadow by the Umborne Brook and A35 and a single plant was noted at Forde Abbey where the gardeners dealt with it. One other report was followed up, finding a thick-stemmed angelica plant.

Five new stands of Japanese knotweed were tackled as well as the previous 50 stands being treated on 40 separate sites. Most of the original stands have now been reduced to a handful of single stems, several of them from hundreds or even thousands of stems. However it would be prudent to ensure that these sites are re-visited for some years to ensure complete eradication.

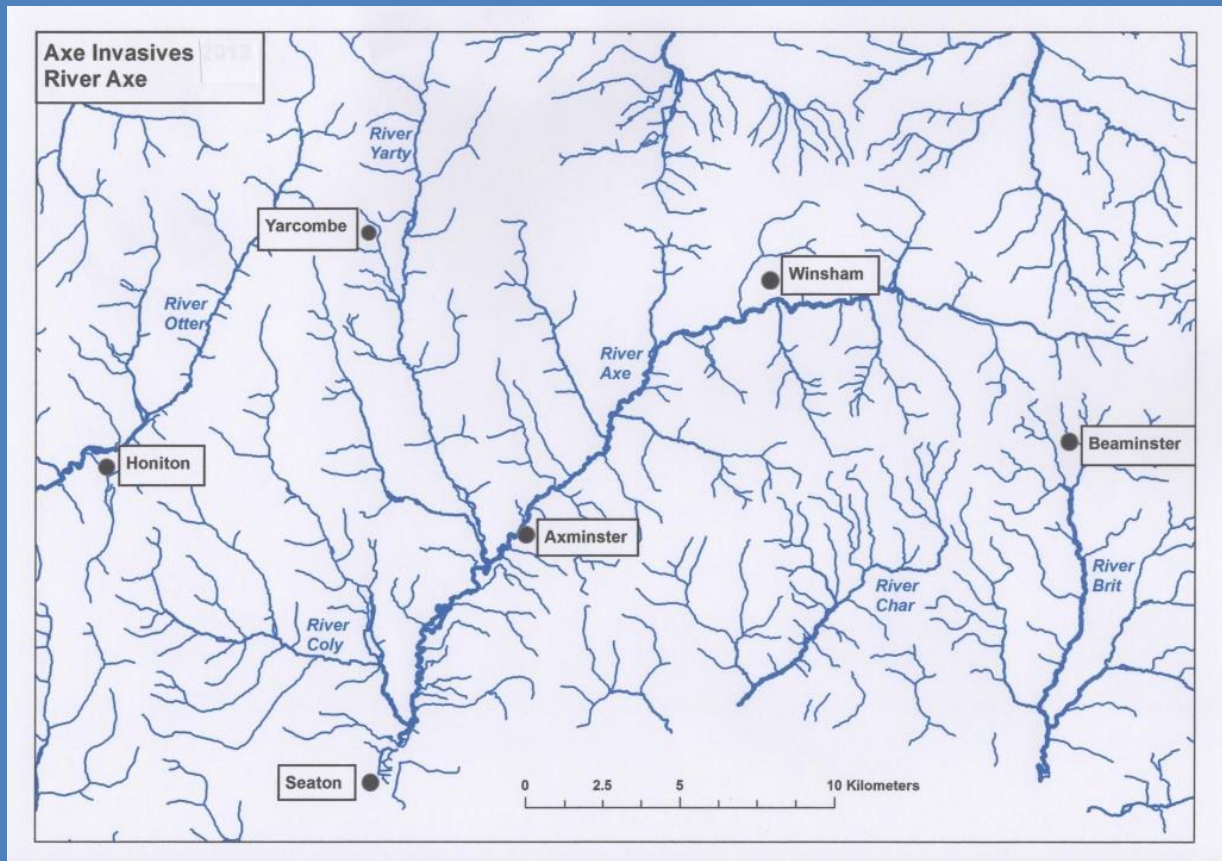
Himalayan balsam was again tackled with a mix of volunteers and contractors. Areas that have been tackled consistently and with several visits each year have shown great improvement but overall this year the resources of both funding and people were inadequate to tackle the scale of the problem on the main River Axe. It has to be said that it was a particularly good growing year from the balsam's standpoint which made it that much more difficult to control. However it was disappointing to be finding it frequently in new areas such as hedgerows, woodland and meadows that have not been managed.

The withdrawal of the agri-environment scheme cross compliance requirements for balsam control could not have come at a worse time and such slight impetus as had been gained was lost overnight.

Introduction

2015 was a fourth year added on to the original three year project trying to eradicate three invasive non-native plant species from the River Axe catchment (Fig. 1). The three species are Himalayan balsam *Impatiens glandulifera*, Japanese knotweed *Fallopia japonica* and giant hogweed *Heracleum mantegazzianum*.

Fig. 1 River Axe Catchment with local towns

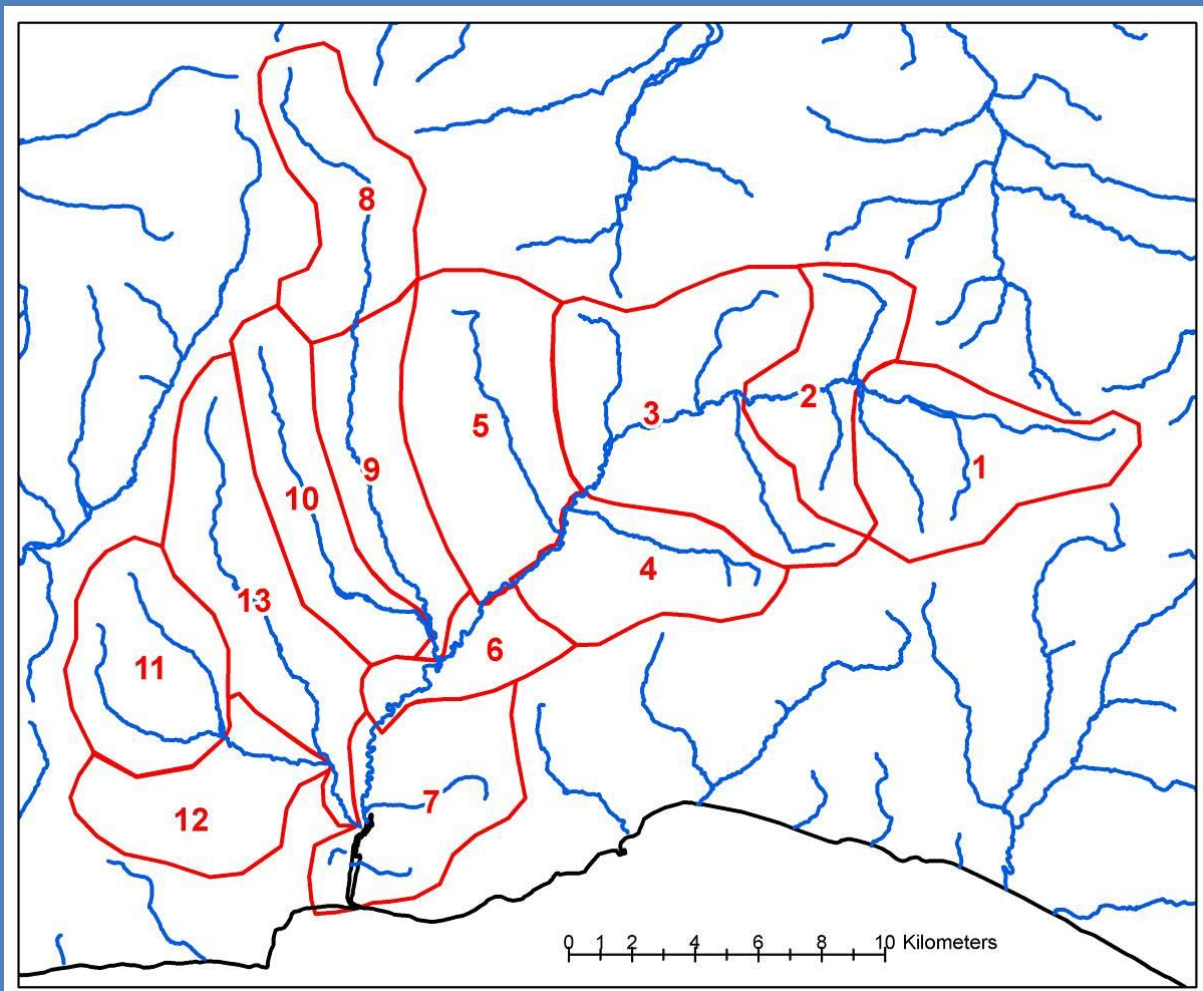


The giant hogweed was dealt with by contractors removing the flower and seed heads offsite in heavy-duty plastic sacks for disposal by incineration. The Japanese knotweed was also tackled by contractors using one application of a Glyphosate-based herbicide in September. Himalayan balsam was removed by pulling, cutting, strimming, brushcutting with both volunteers and contractors involved.

Himalayan Balsam

For the Axe Invasives Project, the whole catchment was sub-divided into sections of approximately 40 km of waterway in each one. (Fig. 2). The part of the river that is designated as a SSSI and SAC is the main river channel within sections 4,5,6 and 7. Many of the riverside fields in these sections can be kept reasonably clear of balsam but the problem is that upstream on most tributaries the balsam is long established and unless these areas are also tackled, the balsam will always return to the downstream sites.

Fig. 2 River Axe catchment Himalayan balsam control sections



Axe Invasives was set up as a project in 2012 with a view to repeating on a river and catchment scale the success of the work on the River Tale, a tributary of the River Otter north of Ottery St Mary. In practice the Axe project has found many areas of woodland, abandoned pasture and wet meadow and even hedgerows where balsam has established itself over decades where the model of half a dozen volunteers coming out once a month in the summer is not going to be able to progress things.

The scale of the balsam problem is such that on two of the farms right at the head of the river, a total of 440 person days of clearance have been contributed over the last four years, of which 140 days were contractors using brushcutters and still neither farm is clear of balsam. These are just two of the sites recorded as 'hotspots' on the catchment map on page 20.

2015 has proved a particularly good growing year for Himalayan balsam as it had an early start with no frosts to contend with after early March (Musbury Weather) and some very consistent temperatures through May, June and July and most of August until a relatively cold snap at the end of August.

**Fig. 3 Balsam plants of differing sizes (photo 3/6/15) around newly constructed ponds at Woonton, Holy City.
The blue penknife on the fifth stem is 57mm in length**



The balsam at Woonton has been present in wet woodland for a considerable time and so the creation of new ponds there cleared any competing grasses and other plants but left balsam seeded right across the open area. Its growth rate then varied presumably with soil and moisture availability (fig. 3)

Like the nettle, *Urtica dioica*, Himalayan balsam is found very much in man's 'footprint' and like nettle it responds strongly to nutrient availability. Early on in this year's balsam control work, a good example was found of how Himalayan balsam reacts to nutrient input. Balsam seedlings were growing to an even height over an large area of field except where bonfires had been lit to dispose of brash from a newly-layed hedge. No seedlings survived in the fire sites but those plants immediately around the open ash areas were already much bigger plants than those further away, particularly those downslope (to the left of picture)(Fig. 4) This effect was repeated at other fire sites in this location.

Fig. 4 Balsam growing preferentially larger near a fire site (16/6/15) near Cuckolds Pit Lane, Chardstock



Presumably it is a combination of nutrient and water availability is responsible for the size of balsam plants found along some of the waterways such as on the River Yarty (Fig. 5). If this is the case, then these balsam stands can be taken as a visual indicator of eutrophication of the river system. On the same site but in a more arid position on stony and sandy soil, the balsam plants had much restricted growth (Fig. 6), reaching a height of only 15-25 cms before flowering.

Fig. 5 River Yarty, Luggs Farm - a break in cutting (photo 21/7/15)



Fig. 6 River Yarty, Luggs Farm - balsam on drier, less fertile soil (21/7/15)



Whilst there was low rainfall in April, the ground was still holding water and most balsam plants were not short of water at any stage in their development right through the spring and summer. The effect of this was that many more plants both grew and survived than in previous years. Plants growing at the water's edge were able to extend their root systems so far that in places the river's edge took on a red hue from the mat of interlinked balsam roots.

Fig. 7 River Yarty, Luggs Farm - Extensive balsam root system (photo 22/7/15)



Balsam was still growing strongly in September with no sign of any frost by the end of the first week in October (Musbury Weather).

The lower sections of the main river are much better than they were and there has been good progress on particular sections such as the Stafford Brook, the Kit Brook, the Synderford, the Cricket stream, the upper Yarty (down to the A30) and the very top of the main River Axe but it is very much a work in progress and will require many more years to achieve a better control of the balsam on the River Axe.

It was good to see a number of landowners taking the initiative and large areas of balsam were cut at Blackdown House, Lugg's Farm, Gilletts Farm and Bere Farm by concerned owners and helped by family and friends.

One of the Organisers noted several piles of pulled balsam in different places where people were taking their own initiative. Also they felt that more of the farmers had been helping this year which was good. They commented that the late notification of funding each year is not helping with the recruitment of volunteers. A number of organisations such as the Devon Wildlife Trust and the Axe Vale and District Conservation Society might have been able to include balsam control days but their calendar is planned months ahead and so just a few weeks' notice is never going to be enough. Once in the calendar of course it would be much easier to get people used to the idea of when different places get visited.

Some groups like the Stockland Turbary volunteers would already be planning balsam days at Shore Bottom but groups like the Neroche Volunteers could perhaps have been involved with more notice. Also from the individual's viewpoint, they would be better able to schedule days in to their own calendars given a bit more warning.

Biological Control

CABI Bioscience have been trialling a fungal rust brought from the Himalayas as a targeted biological control of Himalayan balsam and the rust successfully overwintered (2014-2015) at the three trial sites (including one in Cornwall) and re-infected this year's new plants as they grew through the leaf litter from last year's plants. The trial was extended this year to 25 further sites from Cornwall across to London and the south-east as well as up to the Midlands, South Wales, Yorkshire and Northumberland (CABI, 2015)(Sonal Varia, 2015).

Volunteers

Two groups that contributed more than most to the balsam clearance efforts on the Axe were EuCAN DMV - Dorchester Midweek Volunteers who were ably lead and encouraged by Dave Searle and who this year contributed 75 days of their time over 7 visits. Their group, which has been running for many years, exemplifies how an improbable mix of people with a range of abilities can, through application and camaraderie, get great enjoyment and satisfaction out of a range of weekly conservation tasks. We were very lucky to have their services.

Fig. 8 EuCAN Dorchester Midweek Volunteers at Broadleaze Farm 2/9/15



Several in the group were able to operate brushcutters, which when fitted with the scrub clearance blade, are particularly useful in clearing extensive stands of balsam. The sideways movement of the blade felling the taller plants and then the 90° downturned ends of the blades could cut up the stems where they lay.

Similarly, Nigel Spring with EuCAN CIC - the Community Interest Company also brought many volunteers who were willing and able to tackle balsam that even the brushcutters couldn't reach. They saved the machine operators much time in getting to awkward or difficult areas that couldn't be worked with a brushcutter and generally operated very efficiently on cake.

Fig.9 EuCAN CIC Contractors and Volunteers at North Buckham Farm 4/8/15



But thanks should go to many others who contributed their time on different stretches of the river throughout the project. They are very important as they represent the chance of continuity as they will be the ones who know the different areas and the lie of the land and can continue to make sure that even the most awkward and hidden areas are checked in future years.

Other groups were encountered that had set up operations independently having, for example, a beer and balsam session on the Umborne and even a balsam and Beaujolais evening at Wayford Woods but these days have not been included in Table 1 detailing the Axe Invasives work this year.

Table 1 Himalayan balsam control days 2015

Section	Organiser Days	Contractor Days	Volunteer Days	Total
1	4	34	80*	118
2	2		26	28
3	42	30	79	151
4				-
5	2	25		27
6	3	13		16
7	10	30		40
8	1	1		2
9	6	6	57	69
10	10	6	22	38
11				-
12	7		18	25
13	2	1		3
			*10 with brushcutters	
Total	89	146	282	517

Occasionally, individuals were using trimmers or brushcutters to good effect on their own land which will help the main river in turn. Gilletts Farm was a good example where considerable effort had been put in by the Axe Invasives team in 2013 and 2014 clearing balsam in two fairly awkward wet woodlands and a new woodland planting. This year new owners purchase a suitable brushcutter after abandoning trimmers and in a fantastic effort (more than 55 days), managed to clear the entire area over the summer. Seed heads from later plants were bagged and by the end of September there wasn't a balsam plant standing. Hopefully this momentum can be maintained over time and several hectares of woodland will be cleared of balsam.

Fig.11 Gilletts Farm

9/9/13



Fig.12 Gilletts Farm

24/9/15



Fig.13 Gilletts Farm - wet woodland 11/9/13



Fig.14 Gilletts Farm - wet woodland 24/9/15



Fig. 15 Gilletts Farm - new woodland planting 3/9/14



Fig. 16 Gilletts Farm - new woodland planting 22/9/15



Fig. 17 River Axe, Clapton - Budmouth College, Weymouth students



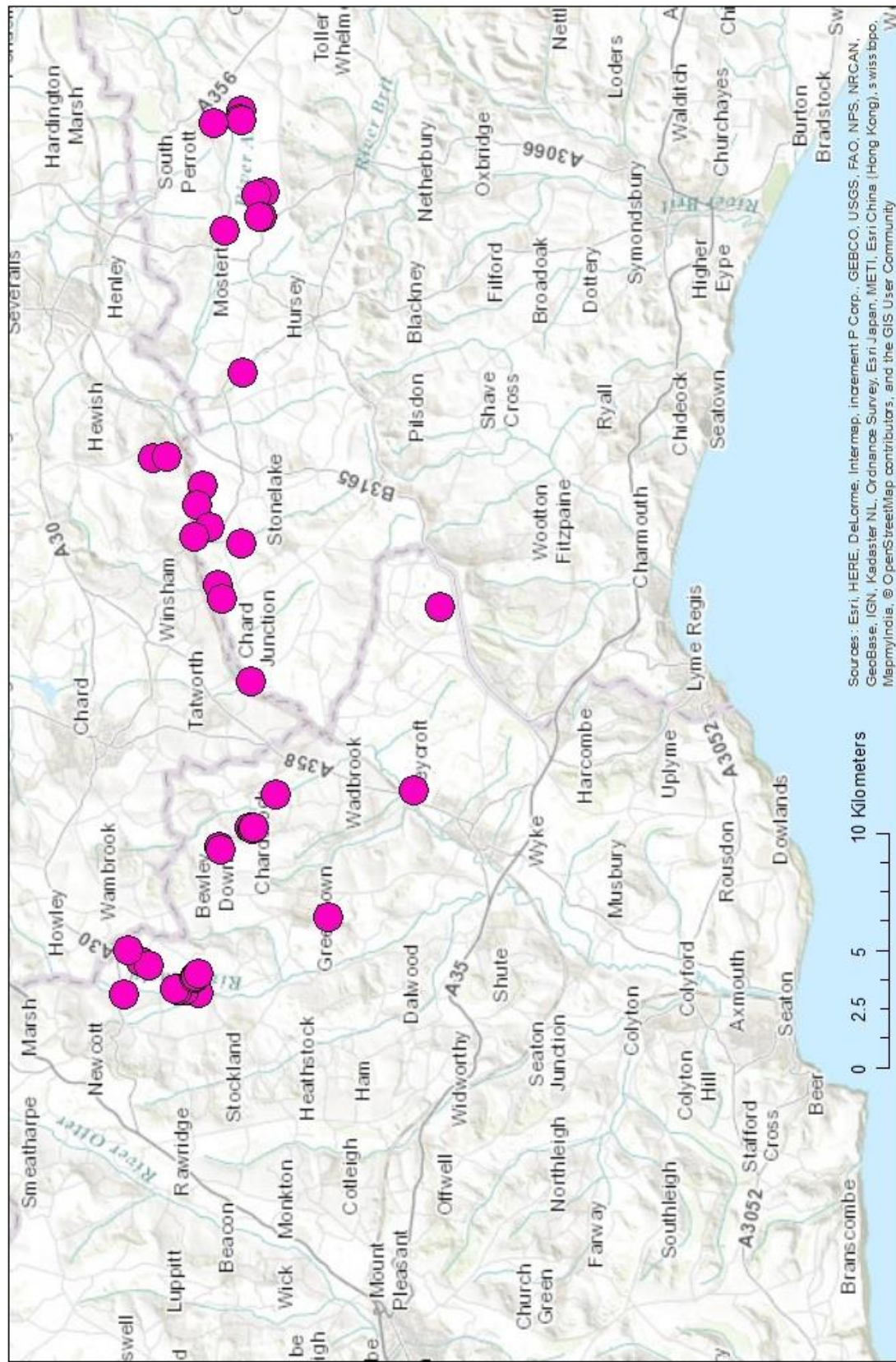
Fig. 18 River Axe, Clapton - Budmouth College staff and students



Key points from the Himalayan Balsam Work

- To be effective, balsam control needs to be carried out three times on the same site each season with the first visit preferably in June but no later than mid-July and the last sweep during September to catch any recent seedlings or regrowth from cut or damaged plants.
- If plants are being cut, whether by hand or by strimmer, brushcutter or mower, they will need to be re-cut with 8 weeks if the re-growth is to be prevented from flowering and setting seed.
- Himalayan balsam is doing well where there are plentiful nutrients and a lack of competition. This can be a gravel or silt bar along the river or it can be a newly dug pond system, civil engineering works such as mobile phone masts, newly planted or harvested forestry blocks.
- A particular effort will be needed to keep balsam out of hedgerows as otherwise it will become more and more difficult to deal with as well as risking the spread of the plant onto field edge or road side.
- Whilst not the most favoured conservation task, 'balsam-bashing' can still be rewarding and give people a day by stretches of the river that they might never normally see. Plant, wildlife and geological points of interest also provide part of the motivation for many of the volunteers.
- Those who are returning year after year to the same site can get great satisfaction out of seeing the changes over time.
- Consider brushcutter training for suitable volunteers to help in areas with large stands of balsam. Large balsam monocultures are very time-consuming to clear by hand-pulling and volunteers might be better used where balsam is interspersed with native species which might be lost with indiscriminate cutting.
- Cattle are a useful biological control of balsam but are not so good for the river or its banks.
- If grant-funding fences to keep stock out of the river, agree at the time how the area between the fence and the river will be managed.

River Axe - Himalayan Balsam hotspots off the main river 2015



Giant Hogweed

Two areas were found to have giant hogweed this year. The first was at Forde Abbey where a single plant was noted and the flower head was removed by the gardeners before seeding. The second was a group of thirty flowering stems in an overgrown wet meadow immediately to the east of the Umborne Brook and adjacent to the main A35 road near Wilmington.

In dealing with the latter it became clear that at least two plants had flowered there last year (2014) and consequently this meadow and areas downstream of it will need close monitoring in the next few years to ensure that the plant does not take hold. The flower heads were removed, bagged (4 heavy duty plastic sacks full) and taken off site for disposal by burning.

There has been no management of the area for a while, perhaps due to illness and bereavement in the family that own it, but it is quite likely that there will be further giant hogweed plants on or near this site in future years. Also it is not at all obvious from where the original plants have emanated so there may be others upstream as well. Ideally the meadow needs to be cut as there is much Himalayan balsam there and the tall growth may have obscured the growth of giant hogweed plants in the past.

Fig. 19 Giant Hogweed leaf



Fig. 20 Giant Hogweed by Umborne Brook and A35 at Wilmington (14/7/15)

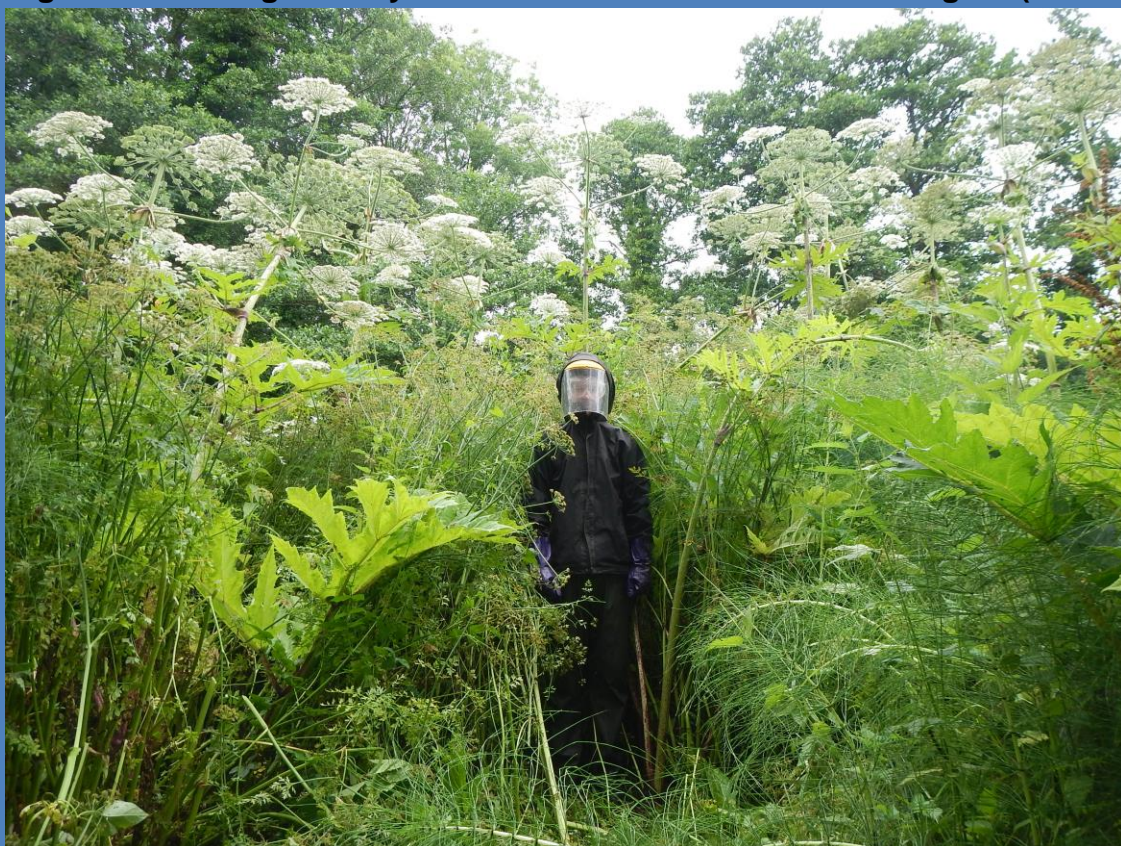
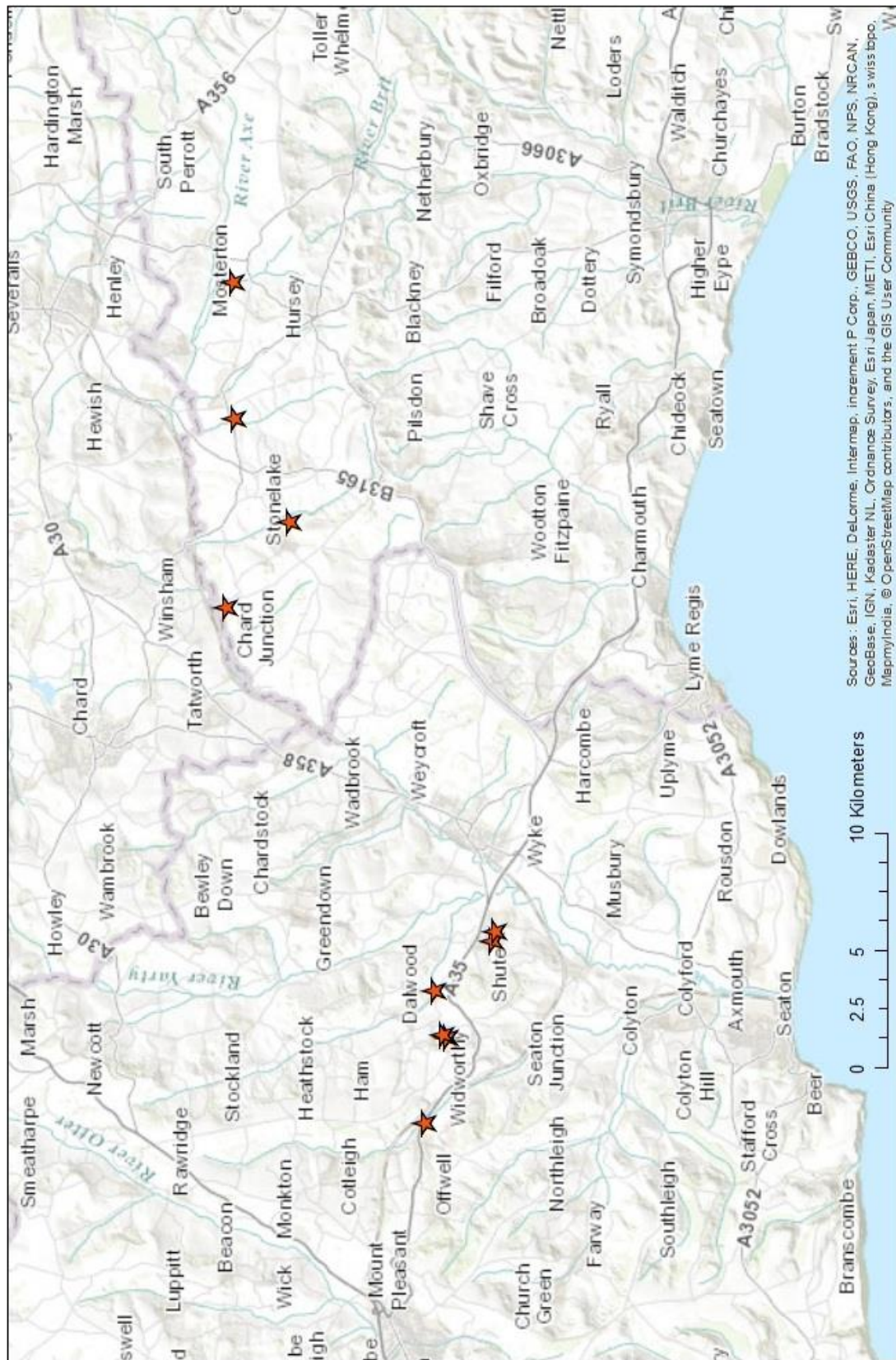


Fig. 21 Giant Hogweed at Wilmington after flower head removal (14/7/15)



River Axe - Giant Hogweed records to 2015



Japanese Knotweed

Seven more stands of Japanese knotweed were added to the list this year. This brought the number of known stands up to 64 of which some 58 have been treated or visited at 45 separate sites. The stands treated were dealt with using one application of a 'Glyphosate' based herbicide during September. The same two separate contractors re-visited the sites to undertake this work and note how the previous years' control efforts had fared.

There have been some notable results with several of the sites that started with hundreds or even thousands of stems now reported to be down to tens or even single figures of stems. The knotweed appears to have been eradicated at several sites although an annual check for one or two years afterwards would seem to be a necessity.

Not all the stands shown on the map on page 28 have been treated although the majority have been. One owner has not given permission and the sites on the River Coly need a plan worked through with the organic farm tenant before permission is sought from the Environment Agency. This also applies to one site on the Blackwater near Hawkchurch.

Fig. 22 Japanese Knotweed at Old Park Farm, Axminster 16/9/2015



Fig. 23 Japanese Knotweed (100s) at Castlewell, Millhayes 12/9/12



Fig. 24 Japanese Knotweed (1s) at Castlewell, Millhayes 21/5/15



Fig. 25 Japanese Knotweed (100s) at Whitford, Pump Farm 28/8/13



Fig. 26 Japanese Knotweed (1s) at Whitford, Pump Farm 29/7/15



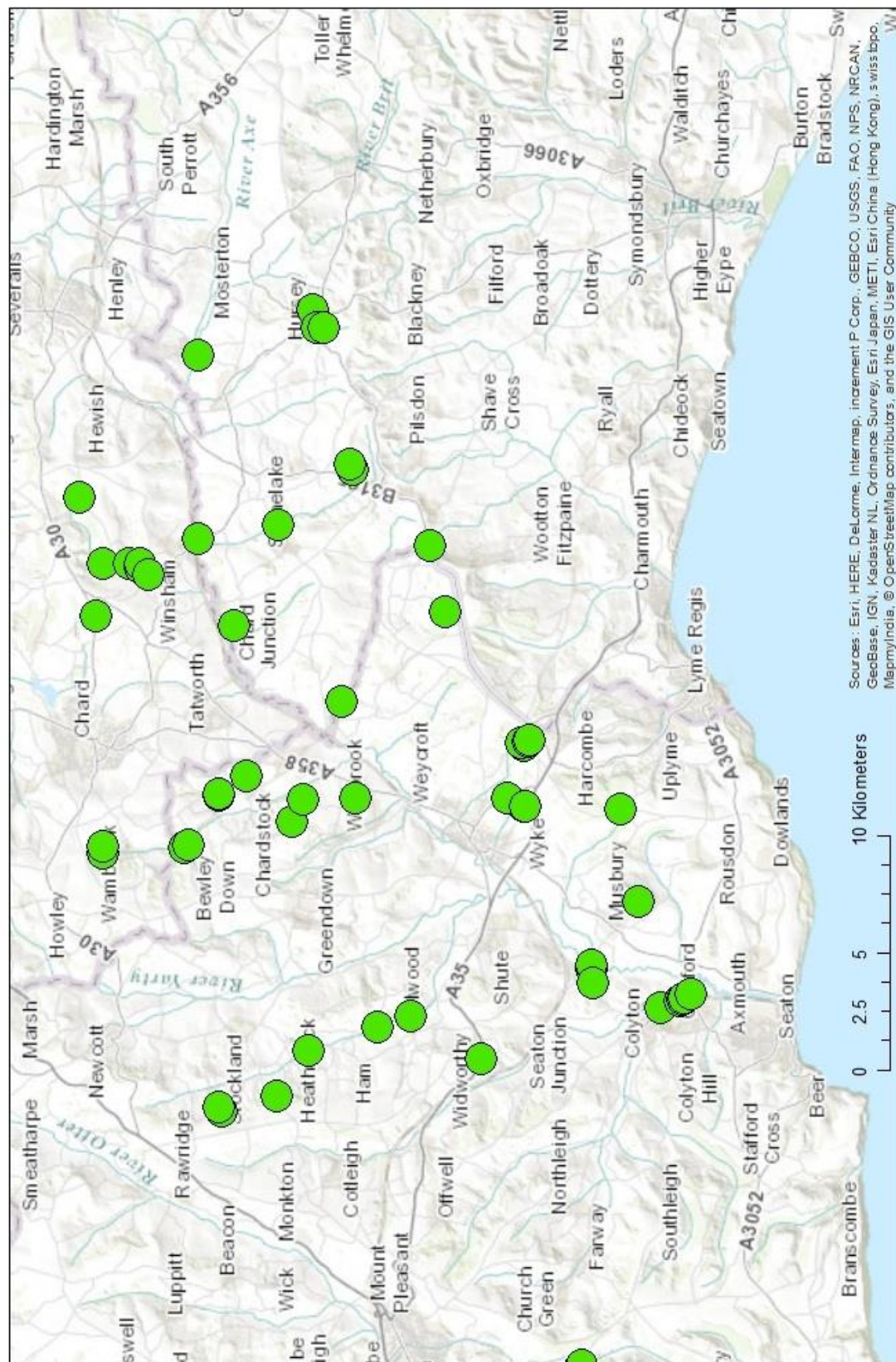
Fig. 27 Japanese Knotweed (100s) at Whitford, Pump Farm 28/8/13



Fig. 28 Japanese Knotweed (1s) at Whitford, Pump Farm 29/7/15



River Axe - Japanese Knotweed sites by 2015



A sum of £2,500 annually should be enough to keep this work on the knotweed going and ensure that stands identified but not yet treated (proximity to watercourses / on organic farmland) such as on the Coly at Colyton and on the Blackwater at Buddlehayes Farm, Hawkchurch could also be brought in to the control programme.

Also, it became clear this year that pressure on budgets means that some highways departments are no longer treating roadside weeds such as Japanese knotweed so it would be important to keep an eye on any such infestations to make sure they are not spread inadvertently into the watercourses of the catchment.

A number of farms seem to have acquired Japanese knotweed by allowing soil to be dumped and which turns out to be harbouring it. These are usually evident when a full range of invasive plants has established in a localised area of the farm! Several more have received it from roadside dumping in the past and once a stand is established in a hedge it is difficult to control, particularly if the hedge is managed by flail cutting. Even some of the sites we have been controlling have had the knotweed flailed along with the four foot red topped posts at each end of the stand! Eradication will take longer at such sites as a smaller amount of the herbicide is transferred to the root system.

One site on common land at Hursey near Broadwindsor is being controlled by cutting and responsible removal of the cut material in agreement with the local Parish Council. It will be interesting to see how quickly this is effective.

Table 2 Axe Invasives Project Costs

Items	Year 1 Plan	Year 1 Actual 2012	Year 2 Plan	Year 2 Actual 2013	Year 3 Plan	Year 3 Actual 2014	Year 4 Plan	Year 4 Actual 2015
Giant hogweed & Japanese knotweed control	8,000	3,538	6,000	2,832	3,000	2,370	2,500	2,010
Himalayan balsam Section Organisers	50,000	27,435	38,400	28,655	27,800	42,072	15,300	15,825
Contractors	22,500	51,820	30,000	50,611	48,500	21,843	9,500	9,732
Volunteer Groups		3,800	6,000	3,600	4,000	1320	1,320	1,320
Probation Groups		540		-		-		-
Axe Invasives Project Manager	15,000	8,500	12,000	12,060	12,060	11,500	8,844	9,332
Travel	4,000	1,899	3,850	1,393	3,000	2,434	2,000	1,987
Info. sheets / Banner flags		350		220	490	430 / 414	200	-
Business Cards				118				-
First Aid Courses			1600	234	500	1296		-
Tools and First Aid kits		280	2,000	127	400	414		-
Maps / Expenses		204			100	0 / 227	200	103
Mobile Phone		100	150	150	150	150	150	150
Total	99,500	98,966	100,000	100,000	100,000	84,470	40,000	40,459

Cost Differences

The cost of controlling the **Japanese knotweed and giant hogweed** was less than expected despite a further 5 new sites being treated.

There were still enough **Information sheets available** (Himalayan balsam, Japanese knotweed and giant hogweed) to avoid requiring a reprint.

No further **maps** were required as the existing ones were adequate.

Overall, the **total** for the fourth year of the Project was slightly more than expected with the late inclusion of employer pension contributions (£1,292 estimated) for the **Project Manager**.

Conclusion

This fourth year was a difficult one for the balsam work as there were not enough people days on the main river to begin to tackle the scale of the problem. However, there were good improvements seen on some of the tributaries such as the Stafford Brook, Kit Brook, upper Yarty, Cricket stream, Synderford and on the main headwaters of the Axe. But these would need to be revisited three times every year to defend the improvements gained so far.

Successful liaison with Network Rail will be needed if their embanked riverside sections of the line through the Axe valley are ever to be cleared of balsam. They may be a better candidate for the balsam rust being trialled (CABI) at the moment than some riverbank sites.

There was good assistance again from several volunteer groups such as EuCAN DMV, EuCAN CIC and the Stockland Turbary Volunteers and several individuals put in many full days of balsam control work on their own and others' land.

Funding even on a small scale (£2,500 per year) for a further three years would help to eradicate most if not all of the Japanese knotweed encountered. Even where reduced to no stems showing, these existing sites need to be checked for a couple more seasons to ensure that no plants come through from dormant rhizomes.

Thirty flowering plants of Giant Hogweed were found at Wilmington (Umborne Brook and A35 meadow) and the flowers and seeds removed. This area and the three garden sites known of in the Axe catchment (Forde Abbey at WInsham, Burrow Farm Gardens at Dalwood and Upperfold House at Thorncombe) and their surroundings should be checked each year to help keep this species out of the Axe catchment.

Acknowledgements

Many thanks to:

All the Farmers and Landowners who allowed us to work on their land and riverbanks,

All the volunteers that helped with their time and effort,

The many contractors who helped in all weathers and also:

Dave Searle

EuCAN DMV

Nigel Spring

EuCAN CIC

Jeremy Bunting

}

John Bell

}

Section Organisers

Louise Woolley

}

Jadie Baker

}

Joanne Jasper

Natural England

Eamon Crowe

Natural England

Simon McHugh

Environment Agency

Roland Stonex

FWAG SW

Linda Bennett

Blackdown Hills AONB

Claire Dennys

Glendale

Daniel Williams

DRM Trees

Gerard Wood

Musbury Weather

Hazel Kendall

West Country Rivers Trust

(All photos by Mervyn Newman unless stated)

Thanks also to the Axe Vale Festival for supporting us again this year by having our stand at the showground.

Funding

This project has been funded by Defra through Water Framework Directive 2015/16 funding

Bibliography and References

ABC (2014) Anti-social Behaviour, Crime and Policing Act 2014: Reform of anti-social behaviour powers Statutory guidance for frontline professionals July 2014
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/332839/StatutoryGuidanceFrontline.pdf

ADAS (2008) *Alien species and the Water Framework Directive: using alien species forums to address problems in Scottish catchments* Scottish Natural Heritage Commissioned Report No.299 (ROAME No. R07AC614)

Bailey J (2008) *Opening Pandora's seed packet: unpredictable outcomes in indestructible plants?* in NEOBIOTA: Towards a Synthesis 5th European Conference on Biological Invasions Prague (Czech Republic) 23-26 Sept 2008

BBR (2004) *Catchment Fluvial Geomorphological Audit of the Axe Catchment* Babbie, Brown and Root for Environment Agency South West Region

BCNP (2011) *Review of the work on the non-native invasive species Himalayan Balsam Impatiens glandulifera along the River Flit during 2011* The Wildlife Trusts Bedfordshire Cambridgeshire Northamptonshire Peterborough

Beerling DJ & Perrins JM (1993) Impatiens glandulifera Royle (Impatiens roylei Walp.) Journal of Ecology 81, 367-382

Bond W, Davies G & Turner R (2007) *The Biology and non-chemical control of Himalayan Balsam (Impatiens glandulifera)*
www.gardenorganic.org.uk/organicweeds

CABI (2015) *Himalayan Balsam* himalayanbalsam.cabi.org

Camel Valley Invasives Group (2007) *Himalayan Balsam - Guidance and Control* Cornwall County Council

CEH (2004) *Information Sheet 3: Himalayan Balsam* Centre for Ecology and Hydrology www.ceh.ac.uk

Craxford S (2009) *River Usk Giant Hogweed Project* Environment Agency Wales
<http://www.biodiversitywales.org.uk/content/uploads/documents/Conference/Conf09/Presentations/Pres%205%20Usk%20Giant%20Hogweed%20Stuart%20Craxford.pdf>

DARDNI (2012) *Giant Hogweed* *Heracleum mantegazzianum*
Department of Agriculture and Rural Development Northern Ireland
http://www.dardni.gov.uk/ruralni/giant_hogweed.pdf

Devon Knotweed Forum (2012) www.devon.gov.uk/knotweed

EA (2010) *Removing Himalayan Balsam from London Rivers* Environment Agency
<http://publications.environment-agency.gov.uk>

EA (2012) *Japanese Knotweed* Environment Agency
<http://www.environment-agency.gov.uk/homeandleisure/wildlife/130079.aspx>

FERA (2009) *A report on Himalayan balsam control in the Wye Valley Area of Outstanding Natural Beauty (AONB)*
<https://secure.fera.defra.gov.uk/.../downloadDocument.cfm?id=62>

FERA (2012) *Giant Hogweed* *Heracleum mantegazzianum*
<https://secure.fera.defra.gov.uk/nonnativespecies/factsheet/downloadFactsheet.cfm?speciesId=1705>

Grieve N, Clarke S (2003) *Macrophyte surveys of the River Axe SAC* Centre for Aquatic Plant Management Rothamsted Research report for English Nature

Gucker CL (2009) *Heracleum mantegazzianum*. In: *Fire Effects Information System*, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available:
<http://www.fs.fed.us/database/feis/> [2012, February 23].

Hejda M (2006) *Impatiens glandulifera* Delivering Alien Invasive Species Inventories for Europe (DAISIE) www.europe-aliens.org/pdf/Impatiens_glandulifera

Hejda M, Pysek P (2006) *What is the impact of Impatiens glandulifera on species diversity of invaded riparian vegetation?* Biological Conservation 132 143-152

Helmisaari H (2010) *NOBANIS – Invasive Alien Species Fact Sheet*
www.nobanic.org/files/factsheets/Impatiens_glandulifera

Lancashire Invasive Species Project www.lancashireinvasives.org

Moser I (2013) A Study of the distribution of alien invasive, Himalayan balsam (Impatiens glandulifera) on roads and the attitude of landowners and farmers to this non-native plant species BSc dissertation University of the West of England Bristol

Mumford PM (1988) Alleviation and introduction of dormancy by temperature in Impatiens glandulifera Royle New Phytologist 109 pp 107-110

Musbury Weather (2013) <http://www.musburyweather.co.nr>

Newman M (2012) Axe Invasives Devon/Dorset/Somerset River Axe Catchment

Invasive Alien Plant Species Control Proposal Natural England Exeter (unpublished)

NISWG (2012) *Giant Hogweed - National Factsheet*

National Invasive Species Working Group (Canada)
http://www.mun.ca/botgarden/Giant_Hogweed_NISWG_Factsheet.pdf

NRA (2008) *Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads* National Roads Authority Dublin

Page NA, Wall RE, Darbyshire SJ & Mulligan GA (2006) The Biology of Invasive Alien Plants in Canada 4. *Heracleum mantegazzianum* Sommer & Levier Can. J. Plant Sci. 86: 569–589

Perglova I, Pergl J, Skalova H, Moravcova L, Jarosik J & Pysek P (2009) Differences in germination and seedling establishment of alien and native *Impatiens* species Preslia 81 pp 357-275

Prout M (undated) A Management Plan for Invasive Weeds on the River Camel SAC as part of the WATERWAYSNET Project Westcountry Rivers Trust

Prowse A (2001) *Ecological Effects of the Invasion of Native Plant Communities by the Alien Himalayan Balsam (Impatiens Glandulifera Royle)* PhD Thesis Univeristy of Manchester

RHS (2011) *Himalayan Balsam* Royal Horticultural Society
<http://apps.rhs.org.uk/advicesearch/Profile.aspx?pid=480> (09/11/2011)

Shabbir A & Nasim G (2011) *Distribution, ethnobotanical uses and natural enemies of Himalayan Balsam from northern Pakistan* 3rd International Symposium on Weeds and Invasive Plants October 2-7, 2011 Ascona Switzerland

Tanner RA (2011) *An Ecological Assessment of Impatiens glandulifera in its Introduced and Native Range and the Potential for its Classical Biological Control*

PhD Thesis School of Biological Sciences Royal Holloway University of London
October 2011

Tanner RA (2006) *The Potential for the Biological Control of Himalayan Balsam (Impatiens glandulifera)* www.cabi.org

Tweed (2006) *The Tweed Invasives Project The Long-term Control of Giant Hogweed and Japanese Knotweed* Tweed Forum www.tweedforum.org

UKTAG (2008) Revised classification of aquatic alien species according to their level of impact UK Technical Advisory Group on the Water Framework Directive (Rev 3 16/04/08)

Varia Sonal (2015) Personal Communication

www.weed-killer.net/giant-hogweed.html

Zybartaitė L, Zukauskienė J, Jodinskienė M, Jansens SB, Paulauskas A &

Kupcinskiene E (2011) *RAPD analysis of genetic diversity among Lithuanian populations of Impatiens glandulifera* Žemdirbystė Agriculture, vol. 98, No. 4 (2011), p. 391–398 [http://zemdirbyste-agriculture.lzi.lt/98\(4\)tomas/98_4_tomas_str7.pdf](http://zemdirbyste-agriculture.lzi.lt/98(4)tomas/98_4_tomas_str7.pdf)

Fig. 29 Axe Vale Festival - balsam drawing competition 20/6/2015

