Invasive Non-native Species (INNS) and Plant Diseases

There are at least 3,224 non-native species in Great Britain, 2,010 of which are classified as established (self-sustaining in the wild).[1] At least 275 established non-native species have been designated as having a negative ecological or human impact and are therefore termed invasive non-native species (INNS).[2] Once established, INNS can be extremely difficult and costly to contain or eradicate; only nine are known to have been eradicated from Britain.[2]

The number of species arriving in Britain is increasing, as is the number of INNS.[2] The area over which they are established is also increasing.[1] Most non-native species established in Britain originate from Europe, but in recent decades the rates of new arrivals originating from North America and temperate Asia are increasing.[2] Most arrive as ornamental species, but aquaculture is also an important pathway in freshwater environments. In marine environments, the arrival pathway for many species is unknown, but stowaways and aquaculture are both significant pathways.[2]

Impacts associated with INNS include reduced yields and productivity of crops, reduction in amenity and recreational value, increased erosion and siltation, decreased water retention and flooding. Impacts on native biodiversity include preying on or outcompeting native species, habitat disruption (such as shading), introducing and spreading disease, and interfering with genetic integrity. The cost of INNS to the Welsh economy, including both managing and controlling INNS and mitigating their impacts, is estimated over £125 million annually.[3] The cost of controlling INNS increases exponentially as invasion progresses.[3]

At the UK level, INNS actions are directed by the Great Britain Invasive Non-native Species Strategy,[4] which aims to increase awareness, improve co-ordination on INNS issues and provide a framework for action. The GB Non-native Species Secretariat (NNSS) provides a portal for species information, best practice and alerts and risk assessments for species that pose significant threats. The NNSS also co-ordinates campaigns such as 'Check, Clean, Dry' and 'Be Plant-Wise'.

There is a specific Welsh INNS portal hosted by NBN Atlas Wales, which includes over 300 non-native species of interest to Wales. The Wales Biodiversity Partnership (WBP) INNS Group has produced a list of Priority INNS for Action,[5] which classifies INNS as priorities for prevention, management (where eradication is feasible) or long-term management (where control, containment or mitigation is feasible). There are currently 45 species on the Welsh list of Priority INNS. An INNS strategy for Wales is under development through the Wales Resilient Ecological Networks (WaREN) project.

Plant pests and diseases, although clearly linked with INNS, are covered by a separate strategy – the Plant Biosecurity Strategy for Great Britain[6] – which forms part of wider work on plant health, one of DEFRA's top priorities. The strategy has a similar focus to INNS priorities, including on raising awareness and early identification of risks. There is a UK Plant Health Information Portal[7] that lists more than 1,200 plant pests and pathogens on the Plant Health Risk Register. Pests and pathogens are given a risk rating based on likelihood of occurrence, level of impact and the value of the host plant(s). Certain plant pests and diseases are notifiable, meaning that the appropriate plant health authority must be informed if they are found.

This section includes the 'big three' plant INNS: Giant Hogweed, Japanese Knotweed, Himalayan Balsam and the American Signal Crayfish. It also includes a significant plant pathogen: Ash Dieback.

Ash Dieback *Hymenoscyphus fraxineus* (T. Kowalski, Baral, Queloz & Hosoya)

Andy Karran

Relevant legislation: The Plant Health (Forestry) Order (Amendment, 2012)

Data availability: Poor (8 records)

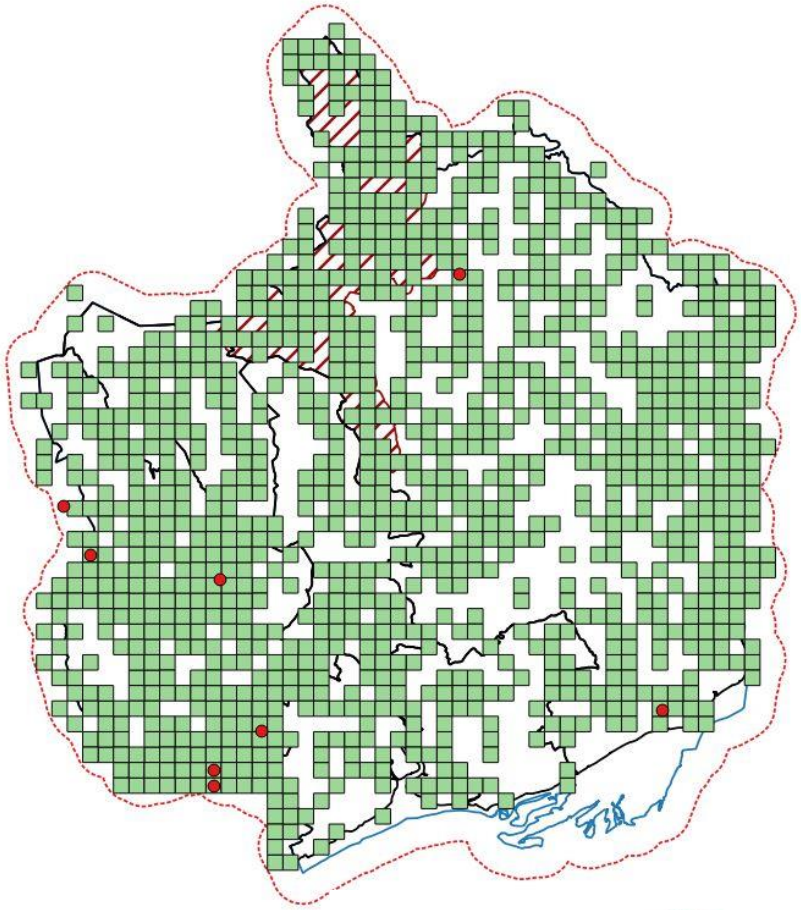
Context: Ash Dieback is a fungal disease affecting ash trees (*Fraxinus excelsior*), previously known as *Chalara fraxinea.* It was first confirmed in the UK in nursery trees in 2012, although there is now evidence that it first entered Great Britain as early as 2006.[8] It is now widespread across England, Wales and parts of Scotland.[9] Symptoms of Ash Dieback include blackened leaves, leaf loss, crown dieback and bark lesions. Most infected trees will eventually die, although this depends on many factors such as tree age and location.[10]

Outlook: Ash trees account for almost 7% of Welsh woodland cover, estimated at around 16.5 million trees.[11] JNCC research has identified 44 lichen, fungi and invertebrate species that only occur on living or dead ash. A further 62 are highly associated with ash, and over a thousand are associated with ash; the list includes mammals, birds, plants, bryophytes, fungi and over 500 invertebrates.[12] It is not feasible to stop the spread of Ash Dieback, and the Welsh Strategy is focussed on research, monitoring and reactive management.[10] Nationally, research is focussed on identifying and breeding tolerant trees.[8] Recent research from France suggests that the disease is less severe when ash density is low and in isolated trees.[13]

Greater Gwent range: There are very few records for Ash Dieback: just five records within Greater Gwent, with the earliest in 2016. By contrast, mapping provided by Fera, Natural Resources Wales and Forestry Commission at hectad scale shows Ash Dieback to be widespread, dating back to 2014.[9] Ash trees are widespread across the area in both woods and linear features.[10]

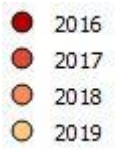
This discrepancy could be due to several factors: time lags in reporting cases of Ash Dieback to Local Records Centres; the use of other recording pathways, such as internal organisational reporting, Observatree or Treealert; or lack of confidence among recorders in identifying Ash Dieback, especially as other diseases affecting ash can appear similar.

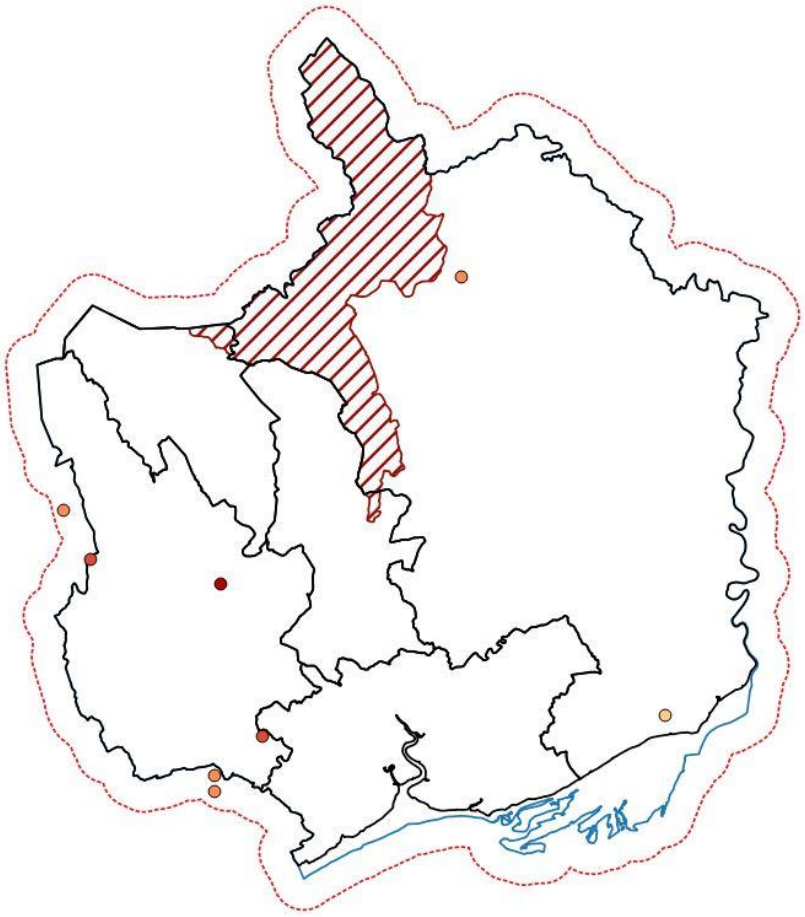
This is of particular concern as 'engaging citizen science to help build tree health capacity and assist with the monitoring of *Chalara* dieback of ash' is a Key Priority in Wales's response to Ash Dieback.[10]



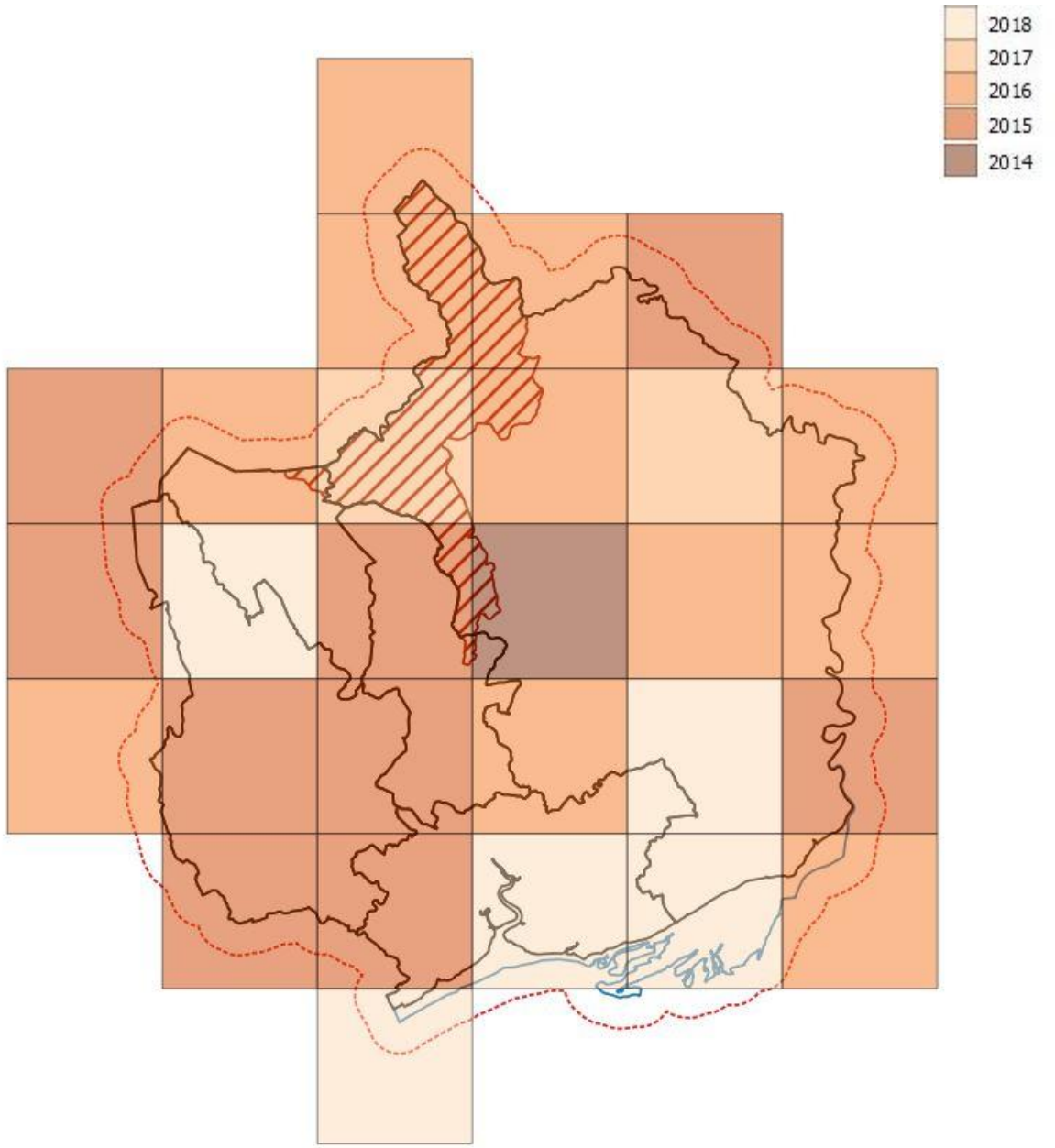
Distribution of Ash Dieback records across Greater Gwent (red), with monads with records of Ash 1970–2019 (green)

Records of Ash Dieback by date





Confirmed Ash Dieback infections[9]



Population trends: There is not enough data to determine how Ash Dieback is spreading across Greater Gwent. It is apparent that it has moved across the area in less than a decade, but the route taken is not clear. The spatial pattern of cases – whether there are isolated cases, clusters or systemic infection – is unknown.

Protected sites: Of the five individual records in Greater Gwent, one is within a SSSI (Ruperra) and one within a SINC (Pentwyn Isaf Woodlands). Large areas of broadleaved woodland are protected across Greater Gwent, from the Wye Valley Woodlands SAC to local woodland SINCs. It is likely that ash is a component of many of these woodlands.

Giant Hogweed *Heracleum mantegazzium* (Sommier & Levier)

Andy Karran

Legislation: Wildlife & Countryside Act (1981, as amended) Schedule 9, Environmental Protection Act 1990.

Priority status: Long-term Management Priority (Wales)[5]

Data availability: Moderate (206 records)

Context: Giant Hogweed was introduced to Britain as an ornamental plant in the nineteenth century, but now occurs alongside lowland watercourses and on rough ground. It resembles Common Hogweed (*Heracleum sphondylium*) but can grow up to 5m tall, with basal leaves reaching over 1m. Its large size means that it can outcompete native species, and contact with its sap can cause skin to become photosensitive, leading to serious burns.

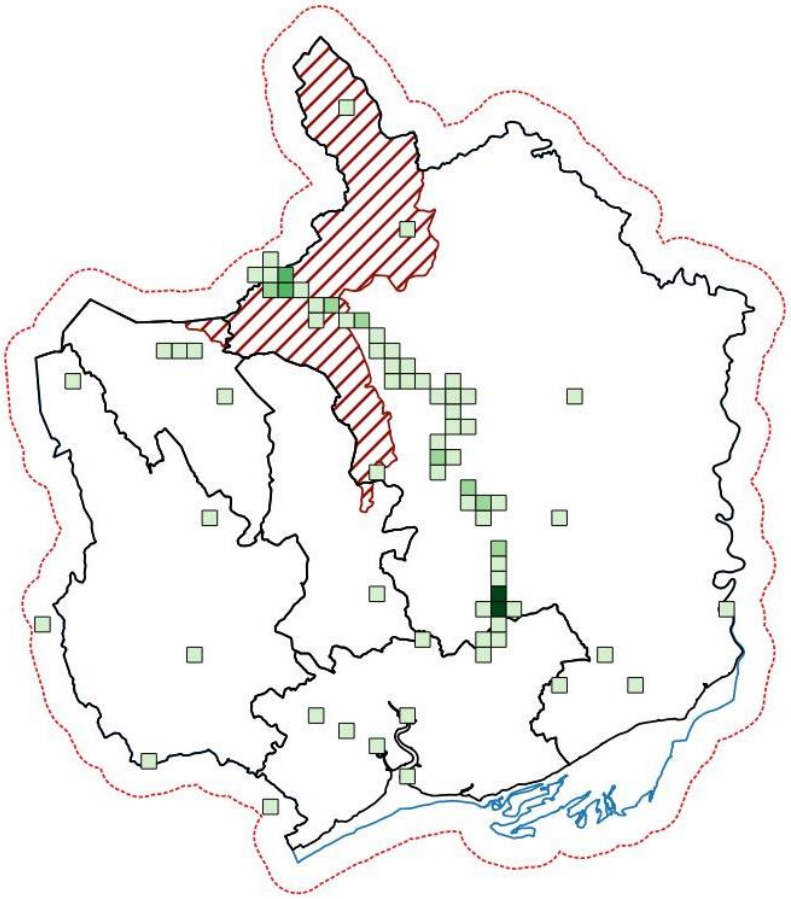
Outlook: Giant Hogweed has spread across most of the UK, with the exception of upland areas, and has been spreading rapidly, despite control measures.[14] Both flooding and warm weather can increase growth and seed distribution, making it seem likely that climate change will exacerbate Giant Hogweed spread.

In Wales, the Wales Resilient Ecological Network (WaREN) project aims to develop a 'pan-Wales INNS Framework for Collaboration' to promote tackling invasive species, including Giant Hogweed, in a coordinated way.

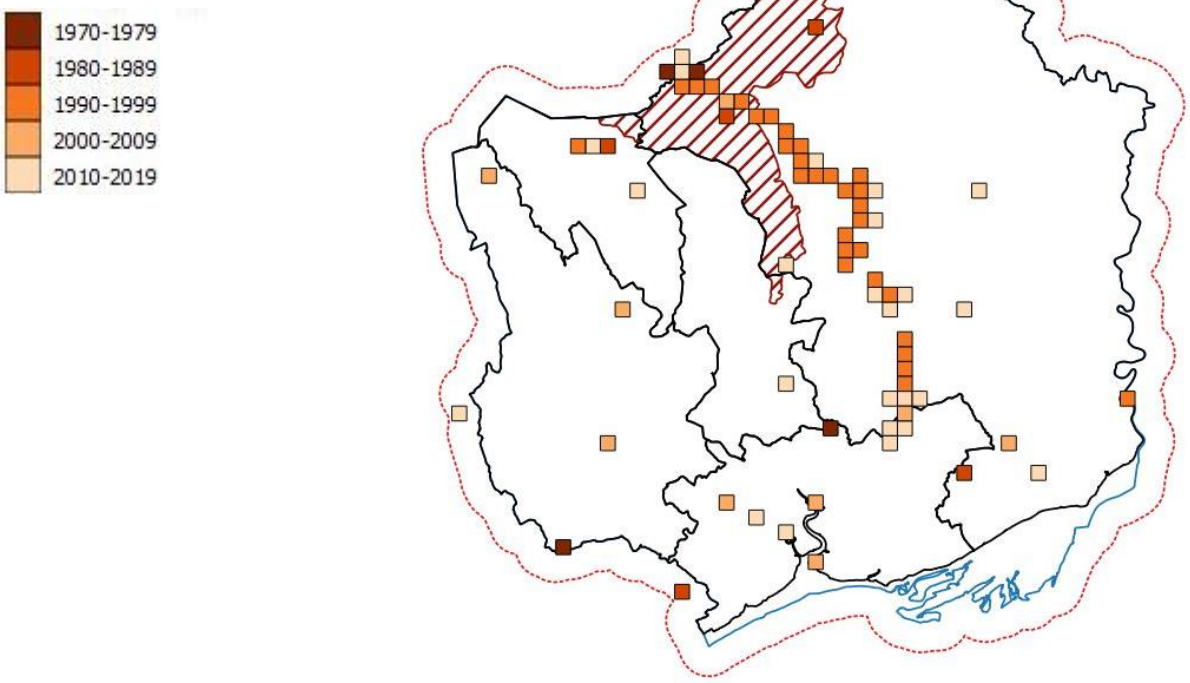
Greater Gwent range: Giant Hogweed has been found along almost the entire length of the Usk within Greater Gwent, with scattered records on other watercourses, such as the Ebbw. Note that the Usk has been the focus of intensive recording effort, particularly in the 1990s and there are 27 Usk records that may be duplicates. It is possible that Giant Hogweed is under-recorded on other watercourses, or that isolated records may be cases of misidentification.

Spread of Giant Hogweed along the Usk appears to have moved southwards, as would be expected, although recording effort has also increased during the timescale of this study.

Distribution of Giant Hogweed records across Greater Gwent (max 18/km^2)



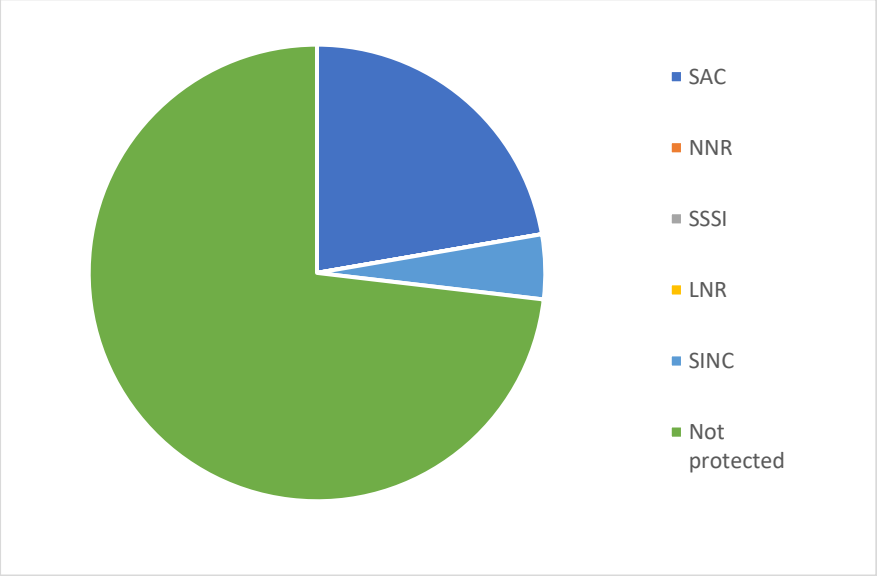
Earliest records of Giant Hogweed by decade (spread)



Control measures: The Usk has been the focus of control effort by Natural Resources Wales (formerly Environment Agency Wales) and the Wye and Usk Foundation. Giant Hogweed was one of the target species in the Wye & Usk Foundation 'Giving up the Weed' project – a three-year project running from 2007 to 2010. As a part of the project, 125km of double bank was treated (around 4,000 plants); subsequently, over 455km (3,336 stands) have been treated, and the Foundation reports that it has almost been eliminated.[15] Note that this project extends beyond the study area.

Protection: 27% of records come from protected sites, with high numbers of records from the Usk SAC. However, this is unlikely to be an accurate measure of the impact of Giant Hogweed on protected sites, as the majority of records are in close proximity to watercourses, and most main watercourses within the study area are protected to some level. This underestimate is due to protected site boundaries often only extending to the high-water mark, or a few metres to either bank. Equally, using the centre point of a grid reference can move a record away from its true location. For example, whilst 39 records fall within the Usk SAC, a further 47 records fall within 25m of it.

Giant Hogweed records from protected sites



Himalayan Balsam *Impatiens glandulifera* (Royle)

Andy Karran

Legislation: Wildlife & Countryside Act (1981, as amended) Schedule 9

Priority status: Long-term Management Priority (Wales)[5]

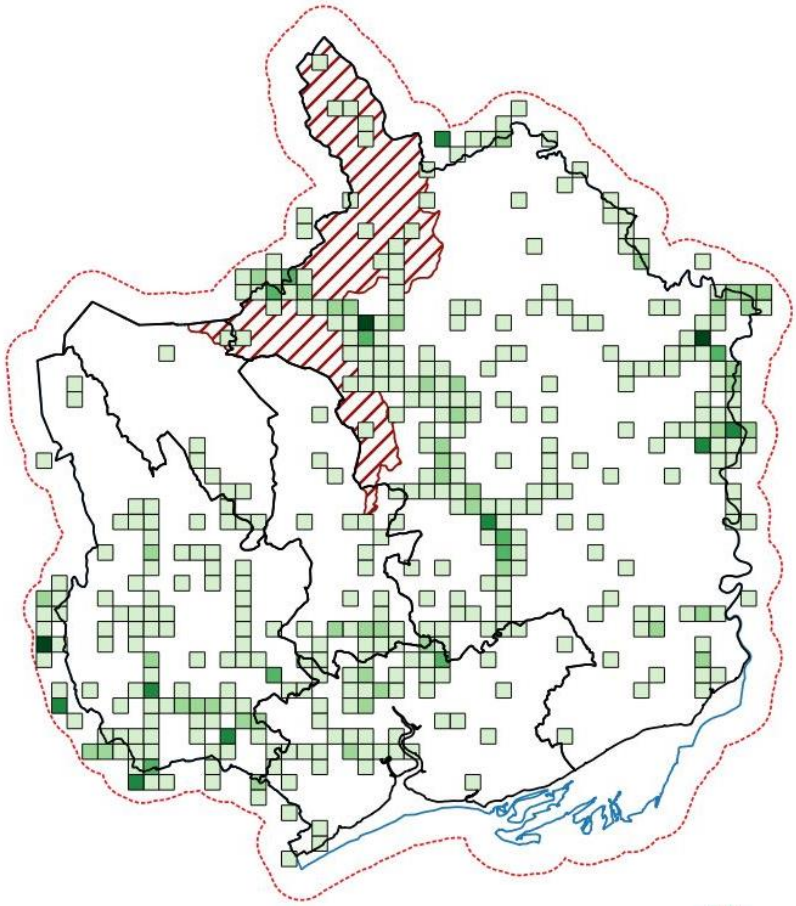
Data availability: Moderate (1034 records)

Context: Himalayan Balsam (also called Indian Balsam or Policeman's Helmet) was introduced to Britain in 1930 and spread rapidly, especially along riverbanks. An annual plant with pink flowers, it grows up to 3m tall and produces seed pods that explode when touched, firing seeds up to 7m away.[16] It forms dense stands which outcompete native species, and when it dies back in winter, riverbanks are left vulnerable to erosion. It also produces more nectar than native species, attracting pollinators away from them and reducing their fitness.[17] The cost of eradicating Himalayan Balsam from the UK was estimated at £150–300 million.[16]

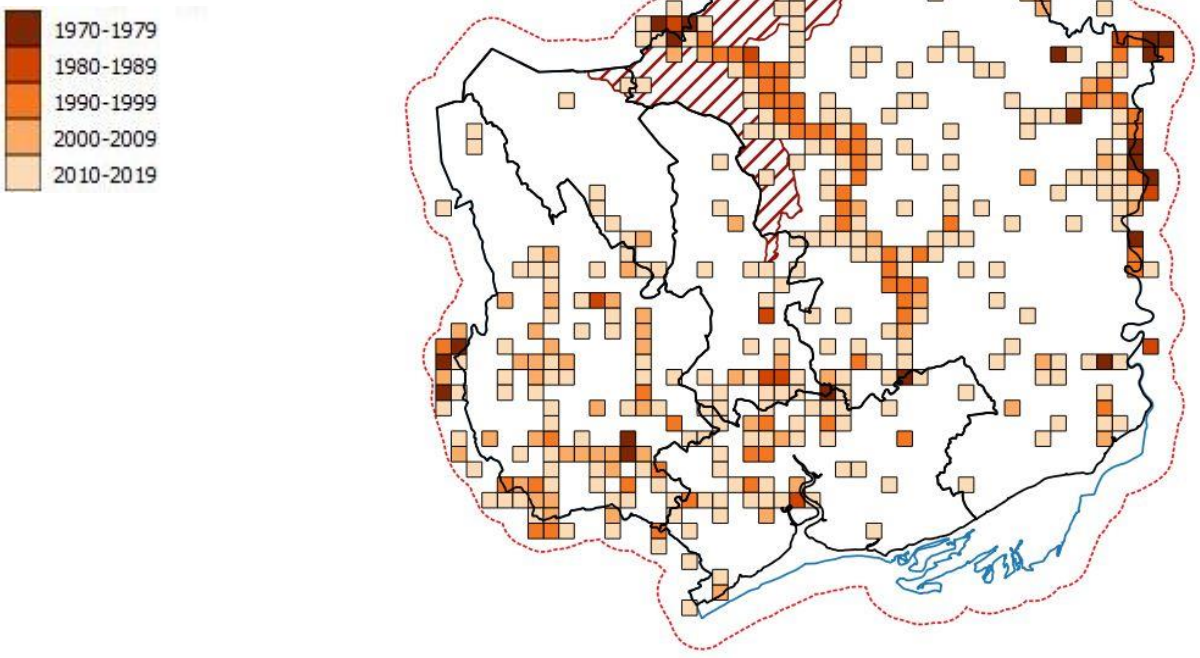
Outlook: Eradication of Himalayan Balsam seems unlikely given the cost of control methods. Many sites control balsam by manual pulling or herbicides, but without a coordinated approach at the catchment scale, recolonisation is inevitable. The Centre for Agriculture and Bioscience International (CABI) are currently researching the potential use of a rust fungus as a biological control.[18] In Wales, the Wales Resilient Ecological Network (WaREN) project aims to develop a 'pan-Wales INNS Framework for Collaboration' to promote tackling invasive species, including Himalayan Balsam, in a coordinated way.

Greater Gwent range: Himalayan Balsam is found across Greater Gwent and is particularly well recorded along the Wye and Usk rivers. More recent records are found away from the larger watercourses, although this could be attributed to increased recording rather than colonisation. It is very likely that Himalayan Balsam is under-recorded, and that it occurs throughout the study area.

Distribution of Himalayan Balsam records across Greater Gwent (max 8/km^2)



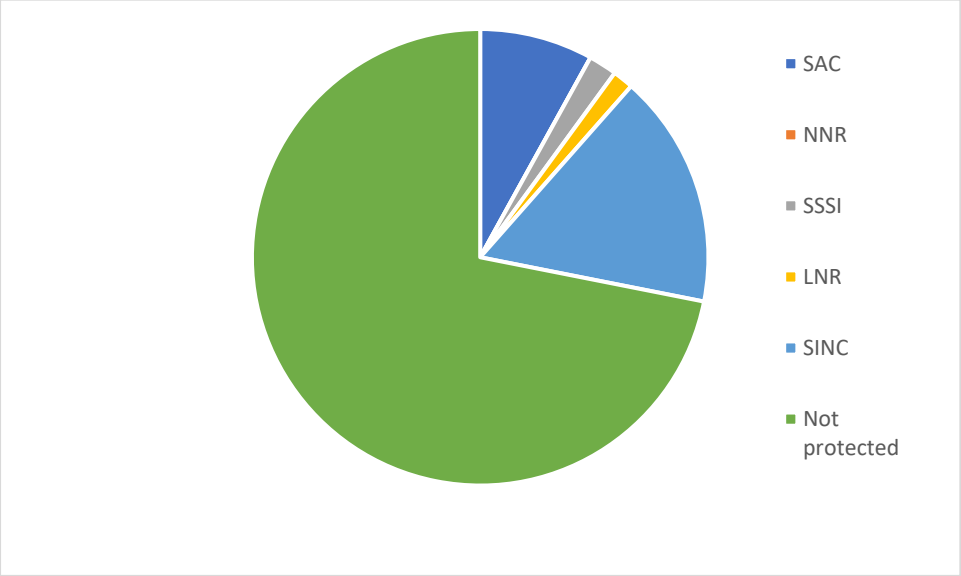
Earliest records of Himalayan Balsam by decade (spread)



Control Measures: Most control measures in Greater Gwent have taken place at the individual site level, although the Wye and Usk have been systematically removing it from the Monnow catchment for several years. Release of the biological control rust fungus at two trial sites on the River Wye was approved in 2019 as a part of the Restoring Our Amazing River project.[19]

Protection: 28% of records come from protected sites, with high numbers of records from the Wye and Usk SACs, and other watercourse SINCs. It is likely that more records are associated with protected watercourses, as records close to the watercourse may not fall within the designated area.

Himalayan Balsam records from protected sites



Japanese Knotweed *Fallopia japonica* (Houtt.) Ronse Decr.

Andy Karran

Legislation: Wildlife & Countryside Act (1981, as amended) Schedule 9, Environmental Protection Act (1990)

Priority Status: Long-term Management Priority (Wales)[5]

Greater Gwent data availability: Good (2617 records)

Context: Japanese Knotweed was introduced in the mid-nineteenth century and spread rapidly across Britain. It has a rhizome structure and extraordinary regenerative ability: tiny fragments of stem and rhizome can quickly regrow into a new plant,[20] and the entire population is believed to be the clones of a single plant.[21] Because it spreads so easily, Japanese Knotweed quickly colonises rivers, railways and other waste ground. Concerns that Japanese Knotweed could damage building structures have had negative impacts on the property market, although recent research suggests that it is no worse than other plant species.[22]

In terms of biodiversity impact, Japanese Knotweed forms monoculture stands, outcompeting native species. It can impact aquatic ecosystems through shading, and production of leaf litter, as well as leaving banks vulnerable to erosion in the winter. It can block sluices and drains, as well as paths, leading to a negative impact on recreation. Growth next to roads and railway lines can cause safety issues by obscuring signs and signals. Japanese Knotweed costs Great Britain an estimated £165 million every year.[3]

Outlook: CABI trials with the sap-sucking psyllid *Aphalara itadori* have had limited success so far. Although the psyllid has been shown not to affect native plants, there have been difficulties in establishing self-sustaining populations.[23] Japanese Knotweed control is further complicated by an unwillingness from landowners to publish records, for fear of legal action, as experienced by Network Rail.[24] This also means that control efforts may prioritise protection of property over biodiversity issues.

Also of concern, Japanese Knotweed can hybridise with Russian Vine and Giant Knotweed, and the resulting hybrids can back-cross with the parent plants. There are indications that *Fallopia x bohemica* is more vigorous and persistent than either parent and can produce viable seed in certain climatic conditions. *F. x bohemica* is already present in Newport.[25]

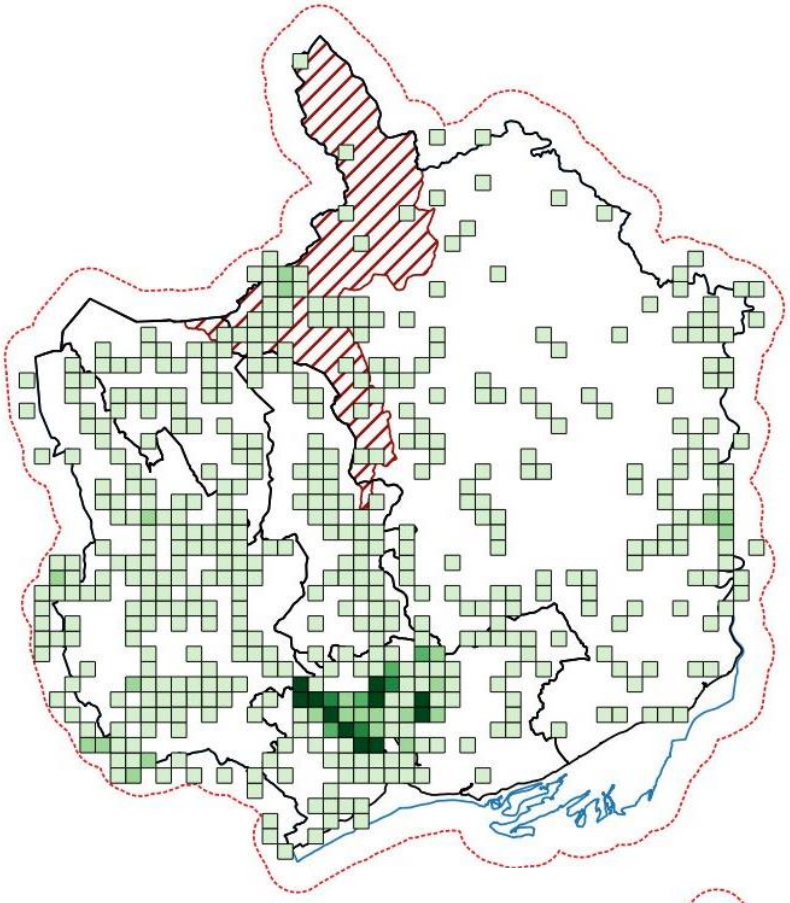
In Wales, the Wales Resilient Ecological Network (WaREN) project aims to develop a 'pan-Wales INNS Framework for Collaboration' to promote tackling invasive species, including Japanese Knotweed, in a coordinated way.

Greater Gwent range: Japanese Knotweed is found across Greater Gwent, with greater concentrations in the south and west – corresponding to the more urban areas (although this may also be a factor of recorder effort). Newport has a higher concentration of records due to recent county-wide dedicated surveys. When viewed in detail, the Newport records showed linear distribution of Knotweed along the Monmouth and Brecon Canal and River Ebbw, and along the

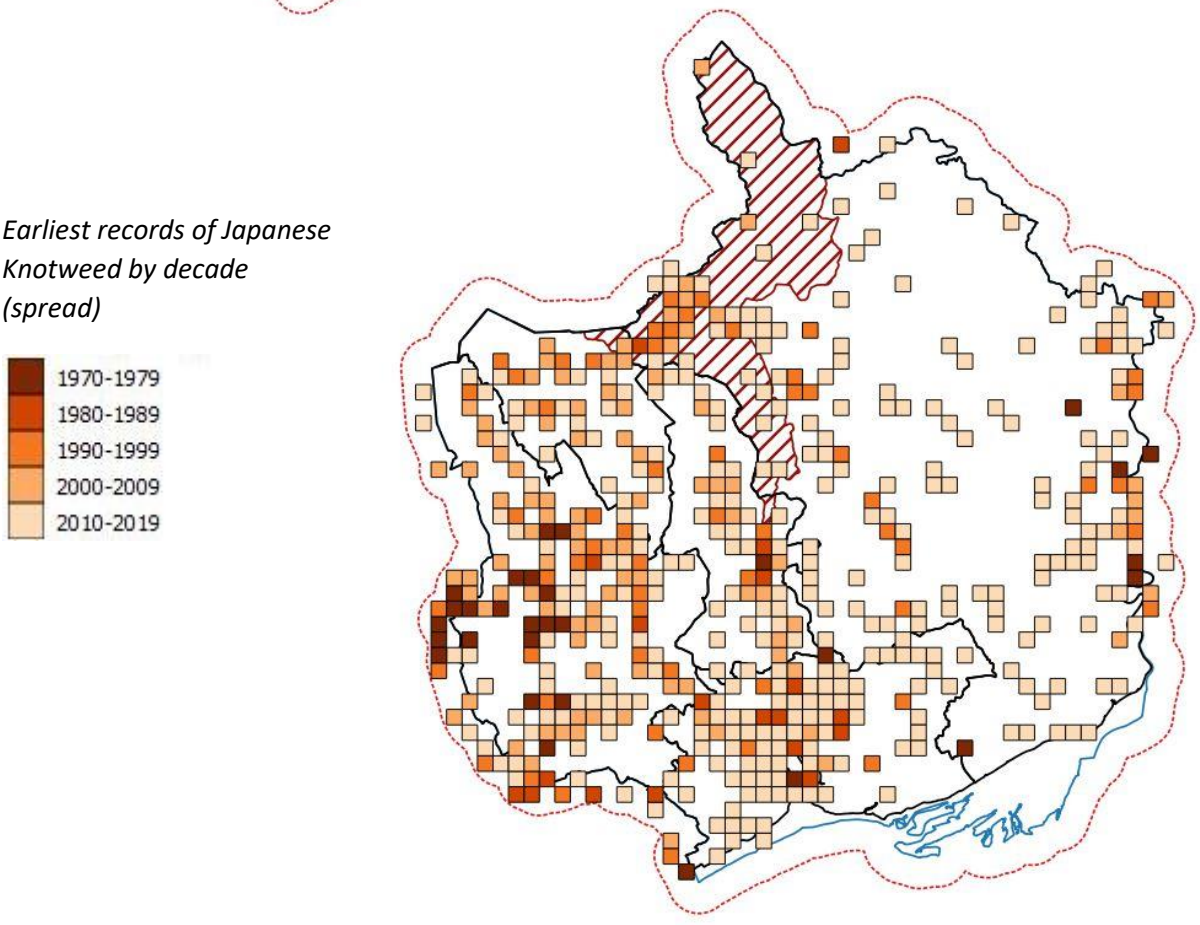
railway lines, as well as isolated sites varying from single plants to large, dense stands. It is likely that this pattern is similar in other urban areas.

Historically, Knotweed has been present in urban areas and the Wye Valley since the 1970s. Spread seems to have been outwards from these urban centres, although recording and awareness of Japanese Knotweed have also both increased over the same time period.

Distribution of Japanese Knotweed records across Greater Gwent (max ≥50/km²)



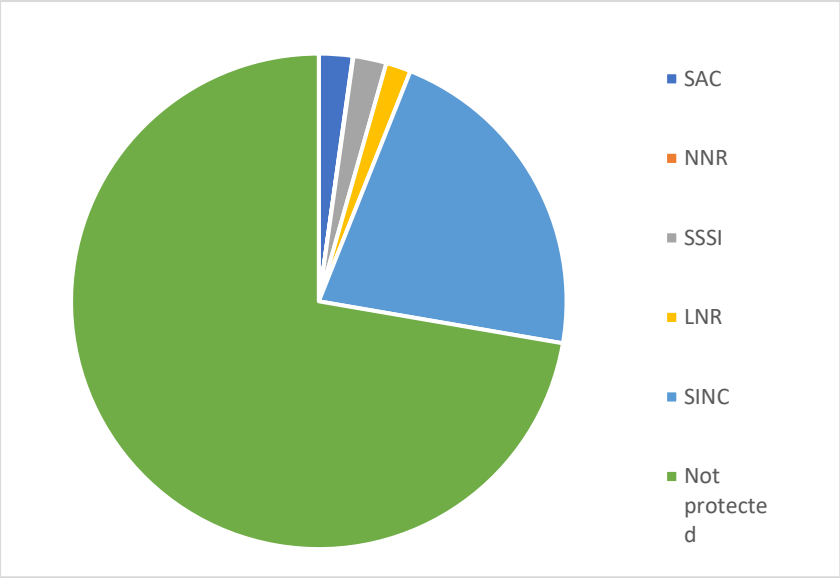
Earliest records of Japanese Knotweed by decade (spread)



Control measures: Each local authority in Greater Gwent has a programme of Knotweed control although the extent covered varies considerably. Stakeholders such as Network Rail and South Wales Trunk Road Agent (SWTRA) also have control programmes. However, coordinated approaches at the catchment level may be prohibitively expensive.

Protection: 24% of records come from protected sites, with high numbers of records from SINCs, particularly the River Ebbw, River Sirhowy, River Rhymney and the Monmouth & Brecon canal. There are smaller numbers of records from the River Usk SAC at Newport, and scattered records from the Gwent Levels SSSIs. SINCs may be particularly vulnerable as they are less likely to be in public ownership, and have fewer resources available for their management.

Japanese Knotweed records from protected sites



Signal Crayfish *Pacifastacus leniusculus* (Dana, 1852)

Legislation: Wildlife & Countryside Act (1981, as amended) Schedule 9, The Prohibition of Keeping Live Fish (Crayfish) Order (1996).

Priority status: Long-term Management Priority (Wales)[5]

Greater Gwent data availability: Poor (12 records)

Context: Signal Crayfish were introduced to Britain in the 1970s as a commercial farmed species but escaped and spread rapidly across England and Wales.[3] Signal Crayfish are larger than the native White-Clawed Crayfish (*Austropotamobius pallipes*), which has declined by 50–80% across Europe[26] and is classified as Endangered at the global level.[27] Competition and transmission of fatal crayfish plague from Signal Crayfish is a significant cause of this decline.

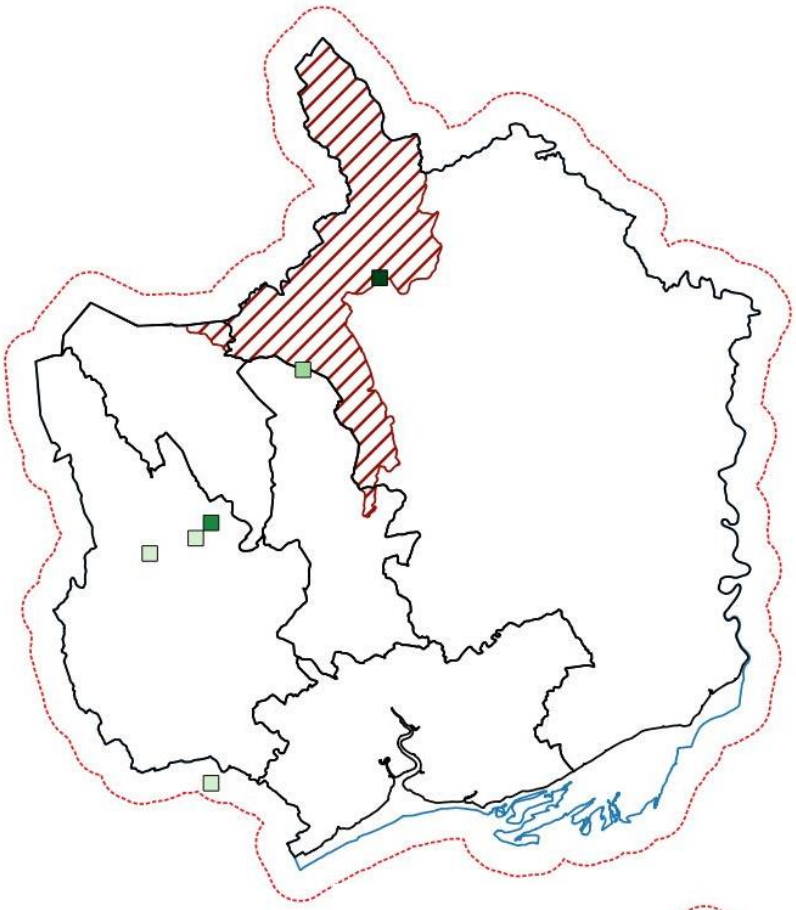
Signal Crayfish also damage riverbanks by burrowing and predate fish eggs, affecting wild and commercial fish stocks.[3] There is also evidence that the presence of Signal Crayfish has a negative impact on aquatic invertebrates, lowering invertebrate density and species richness.[28] The annual cost of managing and mitigating Signal Crayfish is estimated at £2.7 million in the UK, and just over £500,000 in Wales.

Outlook: Options for Signal Crayfish control include trapping, biocides and barriers to limit colonisation of new areas. However, all have implications for other species, and most are only effective at suppressing, rather than completely eradicating, the population.[31] Current campaigns include promoting biosecurity (for example, the 'Check, Clean, Dry' campaign) and the selection of isolated 'Ark' sites for White-Clawed crayfish.[32] It is not known whether any targeted attempts at Signal Crayfish control have taken place in Greater Gwent, although some projects have taken place elsewhere in Wales.

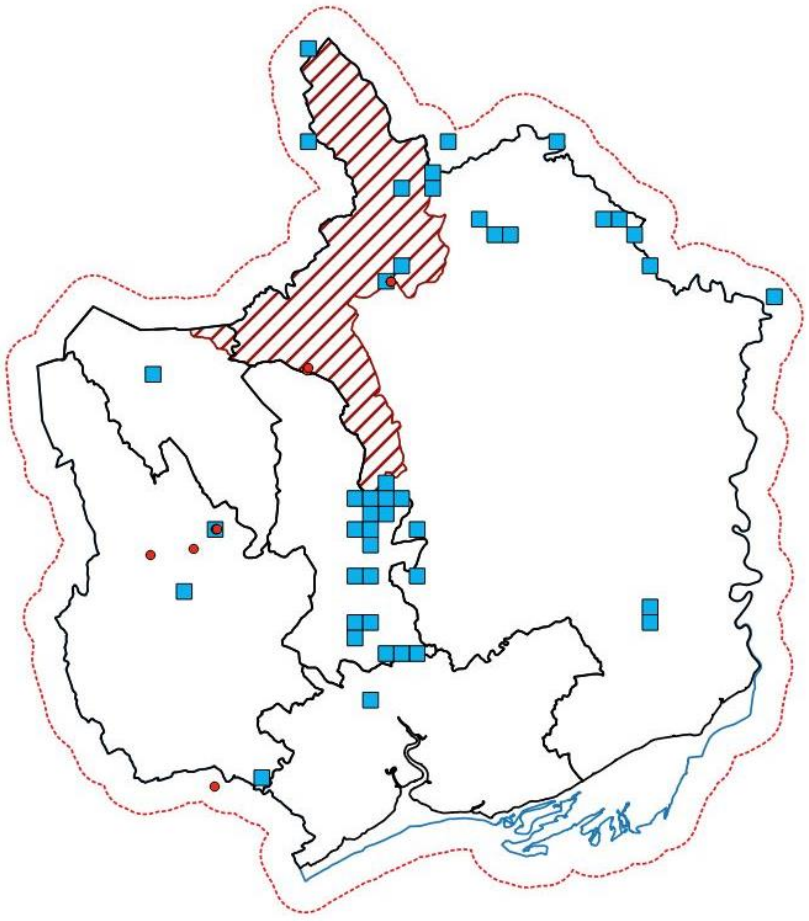
Greater Gwent range: Signal Crayfish have been found in six locations within the study area (five within Greater Gwent), but each site has very few records, and some records appear to be duplicates. The records date from 2000 and refer to both ponds and watercourses. Records of the native White-Clawed Crayfish are much more widespread, especially in central Greater Gwent. However, this should be treated with caution, as older records may not reflect recent losses:[29] only 6 of the 111 Greater Gwent records are within the last decade. There are two sites (Pen y Fan pond and Mardy) where both species have been recorded.

It is very likely that this is not an accurate picture of distribution for either species. Crayfish are unlikely to be recorded casually, and dedicated survey requires specialist trapping equipment and a licence. Additionally, chances of recording crayfish vary, depending on the population density and the time of year.[30]

Distribution of Signal Crayfish records across Greater Gwent (max ≥50/km^2)

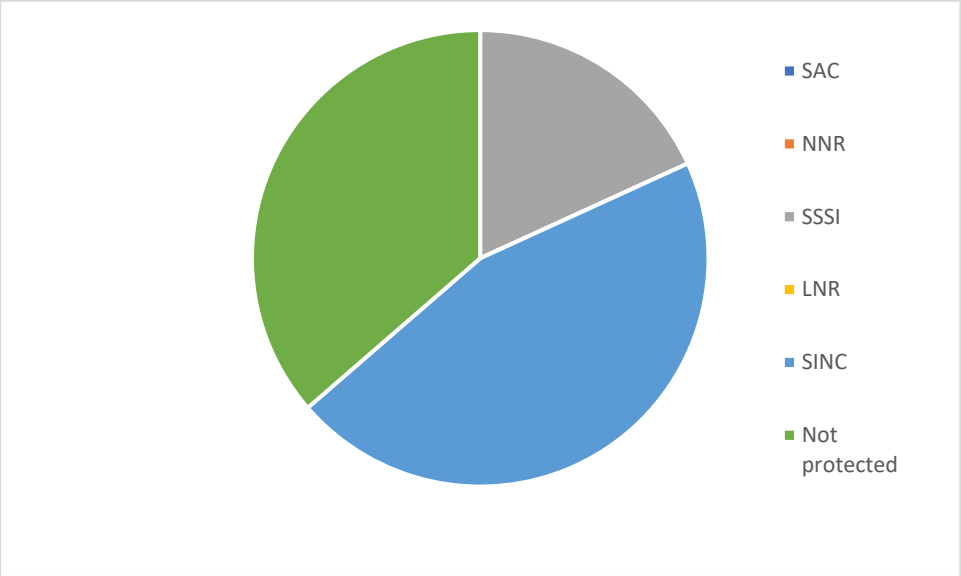


Records of Signal Crayfish (red) against monads with White-Clawed Crayfish records (blue)



Protection: 64% of records come from protected sites, with records from Keepers Pond within the Blorenge SSSI, and SINCs at Pen y Fan Pond, Blackwood Riverside Woods and the river Rhymney. It is important to note that a large portion of the river network within Greater Gwent is protected to some level.

Signal Crayfish records from protected sites



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