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Report on the distribution of INNS in the River Dee Catchment

June 2019

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Summary

Report on the distribution of INNS in the River Dee Catchment

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Keywords

Japanese knotweed; Himalayan balsam; American skunk cabbage; Signal crayfish; River Dee; Electrofishing; Galloway

Background

Invasive Non-Native Species (INNS) are plants or animals which have been introduced to an area by human activity to which they are not naturally found. The invasive nature of these species is ecologically, environmentally and economically damaging. Their ability to spread and dominate riparian areas is altering ecosystems and has led to the ongoing destruction and loss of natural habitats.

This report focuses on six key species which are present within the Kirkcudbrightshire Dee catchment. These include North American signal crayfish, American mink, American skunk cabbage, Japanese knotweed, Himalayan balsam and most recently Giant hogweed.

Main findings

- The presence of Signal crayfish were checked at 280 Galloway Fisheries Trust electrofishing sites completed within the River Dee catchment.
- Signal crayfish were recorded at 23 of the electrofishing sites.
- Numerous reports of Signal crayfish, invasive plants and Mink were provided by the public following a social media request and targeted emails.
- The 27 un-confirmed reports of crayfish suggest crayfish presence over a wider area than confirmed records show. The un-confirmed reports were spread across the River Dee from Loch Ken down to Arkland, upper Water of Ken at Smittons Bridge, Mossdale Loch and Woodhall Loch.
- Most of the reports from the public on the distribution of invasive plants in the catchment matched those Galloway Fisheries Trust were aware of from previous surveys and historical reports.
- The first report of Giant hogweed has been made to Galloway Fisheries Trust within the Dee catchment however it is a coastal population and the risk of it traveling upstream is low.
- Reports of Mink in the catchment indicates that the species is well established and is widely distributed.

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1. INTRODUCTION

Invasive Non-Native Species (INNS) are plants or animals which have been introduced to an area by human activity to which they are not naturally found. The invasive nature of these species is ecologically, environmentally and economically damaging. Their ability to spread and dominate riparian areas is altering ecosystems and has led to the ongoing destruction and loss of natural habitats.

This report focuses on six key species which are present within the Kirkcudbrightshire Dee catchment. These include North American signal crayfish, American mink, American skunk cabbage, Japanese knotweed, Himalayan balsam and most recently Giant hogweed.

North American signal crayfish (*Pacifastacus leniusculus*) is an Invasive Non-Native (INN) invertebrate species which has become established in some Scottish waters. It is recognised that they can impact on native species, in particular due to their burrowing activity, competing with fish species for habitat, grazing pressure on aquatic plants and predation on invertebrates, fish and fish eggs. They appear to be able to successfully colonise a wide variety of freshwater habitats.

The first record of American mink (*Neovison vison)* in the Kirkcudbrightshire Dee catchment was in 1963[1]. They were introduced into the wild through releases from Mink farms throughout the UK and the first recorded breeding activity in Scotland was in 1962 in Aberdeenshire. In the Kirkcudbrightshire Dee catchment there is little in the way of consistent trapping and monitoring so it is not possibly to quantify current densities, only spatial distribution.

Japanese knotweed (*Fallopia japonica),* Himalayan balsam *(Impatiens glandulifera),* American skunk cabbage *(Lysichiton americanus)* and Giant hogweed *(Heracleum mantegazzianum)* are all invasive species of plants which are found in the Dee catchment.

Japanese knotweed and Himalayan balsam are both negatively impacting riparian areas due to their ability to dominate large areas of ground and outcompete native plants. When allowed to grow unchecked they spread throughout river systems and negatively affect local biodiversity. As these species are annual plants they die back in winter, exposing large areas of bare river bank which leads to increased rates of bankside erosion resulting in habitat loss.

The presence of Giant hogweed is currently unconfirmed on the River Dee however there has been a sighting in the coastal reaches of the catchment. If this sighting is accurate it is concerning that a new species has been introduced, most likely through seed dispersal by the sea. Giant hogweed is highly invasive with each plant producing an average of 20,000 seeds which can lie dormant in the ground for over 10 years. The primary concern with this species is the risk to public health due to its notoriously dangerous sap.

In the present study Galloway Fisheries Trust (GFT) will provide updated distribution information of INNS within the Kirkcudbrightshire Dee catchment. The study will utilise electrofishing and habitat surveying data already held by GFT and will collect un-confirmed reports from the public to direct future survey and treatment programmes.

[1] Lever, C., 1977. The naturalised animals of the British Isles. Granada Publishing

2. METHODOLOGY

2.1 Electrofishing data for surveying Signal crayfish

The GFT undertakes electrofishing at up to 200 sites annually across the Galloway river catchments. While the primary aim of these surveys are to investigate the resident fish populations, if certain survey protocols are covered then they would also be expected to capture any Signal crayfish present in the survey site.

The Scottish Signal crayfish distribution survey in 2009 developed a standard crayfish survey methodology, using combinations of kick sampling, electrofishing and baited trap setting, to assess the presence or absence of Signal crayfish. As part of a Glasgow University PhD[2], further investigations through a comparative field study on the River Clyde was used to test the efficacy of the different sampling methods for detecting Signal crayfish in shallow, flowing waters. This report recommended a combination of kick-sampling and electrofishing as a Signal crayfish detection protocol. The kick sampling was considered effective at capturing the very young age classes of crayfish while electrofishing caught samples of the older larger crayfish. Thus electrofishing would be expected to catch Signal crayfish if an established population was present.

The electrofishing data held by GFT had all been collected to a recognised standard; Scottish Fishery Co-ordination Centre (SFCC) protocol. In Galloway, it is confirmed that Signal crayfish are present in parts of the Kirkcudbrightshire Dee.

For this study GFT reviewed electrofishing data from Kirkcudbrightshire Dee collected between 2010 and 2018. Data was only included in the study if it was area based electrofishing, a banner net was used and environmental conditions (water temperature, water flow) were suitable for effective use of electrofishing. The presence or absence of crayfish was noted for each site.

2.2 Confirmed sightings

GFT have been treating INNS within the Dee catchment since 2011 and have a basic understanding on the current distribution. Surveys were carried out in 2019 to provide additional reports. Along with this, confirmed reports from other various sources have contributed to a map which presents currently known populations and their range within the river system.

2.3 Un-confirmed reports

Information was collated from un-confirmed reports of INNS within the Dee catchment from a variety of sources as described below. All other historical reports of INNS have been either confirmed or denied.

2.3.1 Historical reports made to GFT

Possible sightings of INNS are reported to GFT from time to time by members of the public and anglers. These reports are often vague with little information on their exact location. GFT will often investigate these reports if they appear plausible. Un-confirmed reports of crayfish made to GFT since 2009, which do not cover already confirmed crayfish locations, are presented in this report.

[2] Gladman, Z. F. 2012. Crayfish in Scotland. PhD thesis, University of Glasgow.

2.3.2 Social media search and requests

A search was undertaken of angling and wildlife on-line forums, discussion groups and websites to look for reports of INNS in Galloway where particular species have not yet been confirmed. This method was primarily used for monitoring Signal crayfish distribution.

Requests for INNS sightings were made by email to key GFT contacts and through the news section of the GFT website, GFT twitter account and GFT Facebook page.

3. RESULTS

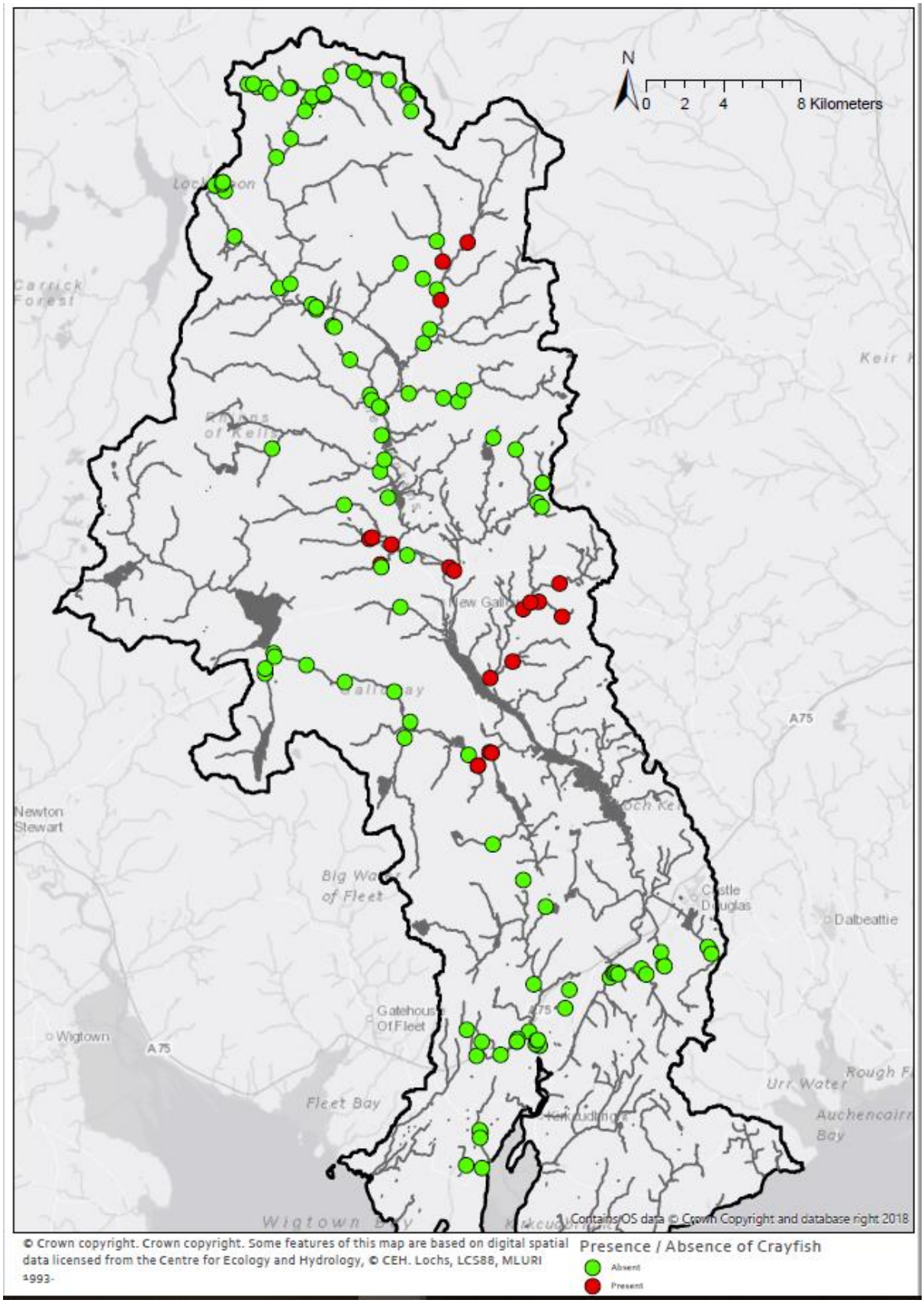
3.1 Electrofishing data

Electrofishing data analysis was a method utilised to attain information on the distribution of American signal crayfish. A total of 280 electrofishing sites were found to be suitable to provide reliable presence or absence data. Many of the sites are surveyed over more than one year. Twenty three sites were found to contain Signal crayfish.

The electrofishing data is summarised in Table 1 below and presented on Map 1.

Table 1: Electrofishing data summary

River catchment	Survey years	Total number of electrofishing sites	Number of sites with Signal crayfish recorded
Dee	2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018	280	23



Map 1: Presence/absence of Signal crayfish within the Dee catchment. Data drawn from historical electrofishing results.

3.2 Historical reports made to GFT

Many reports have been made to GFT over the years regarding INNS within the Dee catchment. All of these which have been confirmed are listed in Tables 2 and 3.

Table 2: Historical American signal crayfish reports since 2009 (un-confirmed)

Species	Year(s) of record	Location	Grid ref	Information
Signal crayfish	2018	Bridge of Dee	273400 559500	Numerous crayfish remains from otter kills on banks of the river

Table 3: Historical reports of INNS of plants made to GFT

Species	Year(s) of record	Location	Grid ref	Information
Japanese knotweed	2017	Shirmers Burn	266750 575450	Private farmland
Japanese knotweed	2016	Glenlee Farm	261150 580050	Private land
Japanese knotweed	2016	Sheil Farm	261850 579780	Private farm
American skunk cabbage	2017	Balmaclellan	264800 578800	Private property
American skunk cabbage	2017	Balmaclellan	264200 578200	Found within and downstream of Aquavitae Burn
Japanese knotweed	2016	Glenlochar	273150 564550	Reported by Scottish power
Japanese knotweed	2016	Shirmers	265950 573650	Reported by Scottish power
Japanese knotweed	2016	Earlston wood	261450 582150	Reported by Scottish power
Japanese knotweed	2016	Pumphouse	273850 563500	Reported by Scottish power
Japanese knotweed	2016	Tongland	269700 553700	Reported by Scottish power
Himalayan balsam	2017	Glenlochar barrage	273150 564450	Anonymous source

3.3 Reports found by internet search and made to GFT via social media

3.3.1 American signal crayfish

A total of 23 different reports of Signal crayfish were submitted to GFT by email or through social media. These reports suggest a wider distribution of Signal crayfish than detailed in 2009 or identified earlier in this report from the electrofishing data.

The Facebook post requesting crayfish reports reached 7,967 people. GFT estimated the grid reference of each report based on the information provided.

The reports made to GFT are summarised in Table 4 below and are presented on Map 3 alongside the historical crayfish reports data.

Table 4: Reported Signal crayfish sightings from social media (un-confirmed)

Year(s) of record	Location	Grid Ref	Information
Since 2010	Glenlee Burn	259500 580700	Seen regularly in the burn over the last 9 years
2015, 2016, 2017, 2018	Water of Ken by Smittons Farm	263300 591700	Seen in the river behind the farm
2015	Water of Ken at Smittons Bridge	263300 591800	Seen while fishing
2016	Water of Ken at Smittons Bridge	263300 591800	Several seen while looking over bridge and when fishing upstream
2015	Dee by Kenbridge Hotel	264000 578400	10 crayfish were seen when looking over the bridge outside the hotel
2017	Black Water of Dee at Stroan Bridge	264500 570500	Seen while fishing
2017	Black Water of Dee at Stroan Bridge	264500 570500	Three seen on the bank below the bridge
2015	Mossdale Loch (outflow into Black Water of Dee	265600 571000	Several carcasses on an angling jetty
2018	Nether Crae Burn (flows into Woodhall Loch)	266000 567500	Berried female crayfish were found in November
2018	Top of Woodhall Loch	266400 568500	Claws spotted at edge of water in November
2017, 2018	Woodhall Loch	266700 567700	Seen while fishing
2007, 2018	Loch Ken	271500 568500	Several reports of crayfish seen and caught while fishing
2018	Loch Ken	271500 568500	110 crayfish caught while fishing over a period of two days, berried females seen
Not stated	Dee at Arkland Beat	271800 557700	Second hand report of crayfish seen in river
2014, 2015, 2016, 2017, 2018	Loch Ken by Crossmichael	272900 566700	Crayfish are caught every May and September while fishing
Not stated	Dee at Culvennan	273300 564100	Seen while fishing
2014, 2015, 2016, 2017, 2018	Dee by Threave Castle	273800 562400	Seen while fishing; numbers have increased each year
2016	Dee by Threave Castle	273800 562400	Shown crayfish in the river next to the castle
Not stated	Arvie Burn	268500 572700	Caught while fishing
Not stated	Coom Burn	260700 580700	Seen
2018	Water of Deugh at Knockengorroch	255500 597100	Claw possibly from a crayfish found on river bank during

Not stated	Water of Deugh by Kendoon	Approx 259000 592200	Knockengorroch Festival Heard second hand of a crayfish being seen. Vague location provided

3.3.2 Invasive plants

A total of eight reports of INNS of plants were submitted to GFT by email or through social media. A few of these reports were duplicated or were already known to GFT so were not noted in Table 5 but all known locations are presented on Map 2.

The Facebook post requesting INNS reports (excluding Signal crayfish) reached 704 people. GFT estimated the grid reference of each report based on the information provided.

Table 5: Reports of INNS plants made to GFT via social media (Grid references are approximate)

Species	Year(s) of record	Location	Grid Ref	Information
Japanese Knotweed	2019	St Marys Isle	267500 549100	Anonymous source
Giant Hogweed	2019	St Marys Isle	267434 548968	Anonymous source
Himalayan balsam	2017	Glenlochar barrage	273150 564450	Anonymous source

3.3.3 American mink

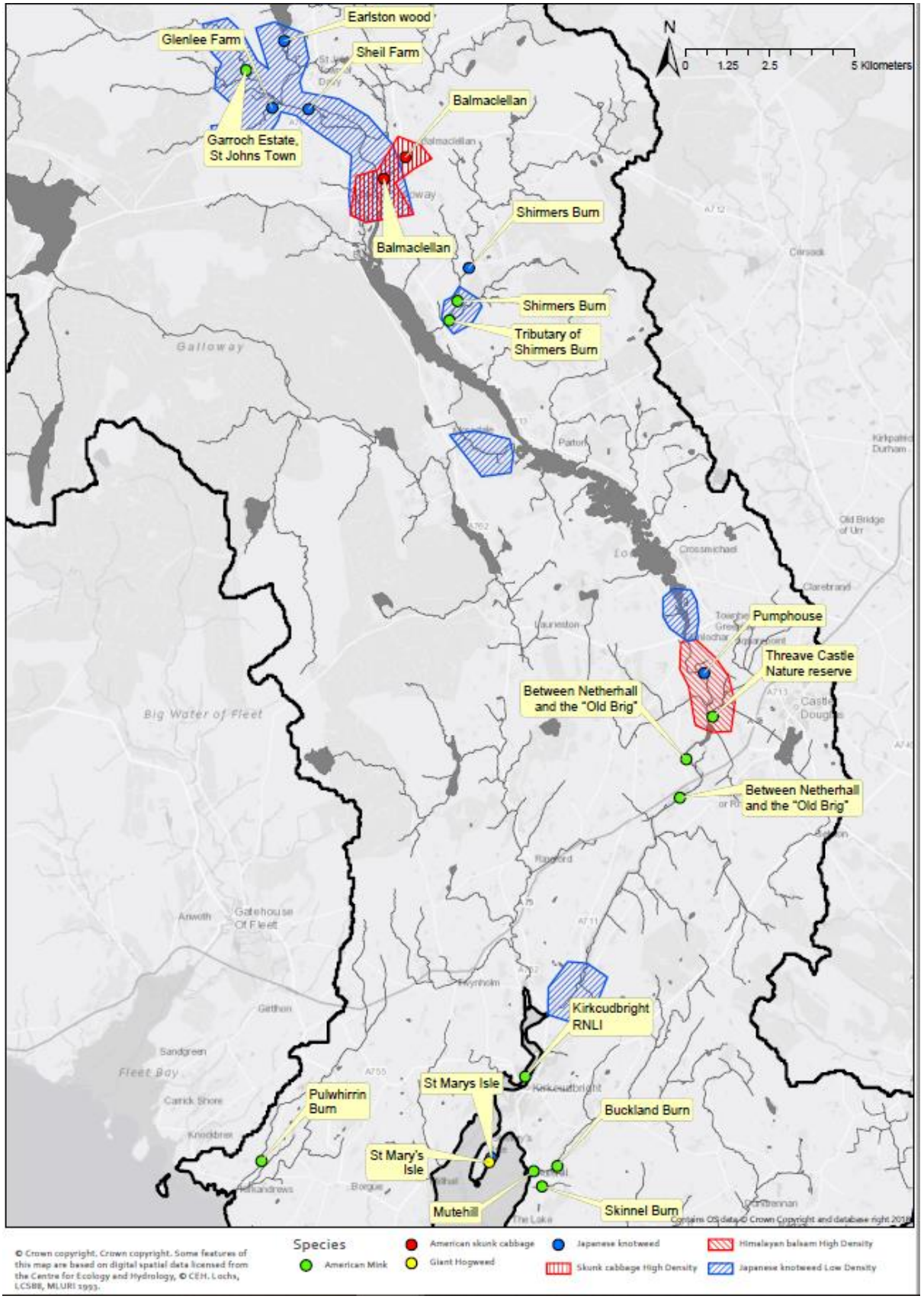
A total of 10 reports of American mink were submitted to GFT by email or through social media. These reports are listed in Table 6 and presented in Map 2. There are records of Mink as far up the system as Garroch Estate near St Johns Town of Dalry and as low down as the Skinnel Burn. There are further populations recorded within Bridge of Dee which highlights that this species is wide spread within the catchment and any areas which do not inhabit Mink are most certainly at risk. Only a few of these reports are confirmed through trappings however all reports are considered a sighting and provide an insight into the spatial distribution of the species however does not indicate specific densities. This information can be used to direct future tracking and trapping programs in the region.

The Facebook post requesting American mink reports reached 934 people. GFT estimated the grid reference of each report based on the information provided.

Table 6: Reports of American mink made to GFT via social media and other external sources

Year(s) of record	Location	Grid ref	Information
2019	Pulwhirrin Burn	260700 549000	Reported mink within private property and along the stretch of burn towards Kirkandrews
2019	Mutehill	268750 548700	Local report
2019	Skinnel Burn	269000 548250	Local report
2019	Buckland Burn	269450 548850	Local report

2019	Kirkcudbright RNLI	268500 551500	Local report
2019	Between Netherhall and the "Old Brig"	273000 559850 273350 560900	Local report
2019	Garroch Estate, St Johns Town	260200 581200	Local report
2018	Shirmers Burn	266500 574450	Remains of a mink seen on the roadside
2015	Tributary of Shirmers Burn	266250 573900	Mink have been trapped alongside the Dee hatchery for a number of years
2018	Auchlane (Water of Ken)	N/A	Local report
2019	Threave Castle Nature Reserve	274074 562141	Local report



Map 2: Map of reported sightings of INNS (excluding Signal crayfish) within the Dee catchment. Hatched areas are locations which are known to GFT through surveying, dots are new reports in 2019, some of which overlap previously known areas.

3.4 Known locations of INNS plants through GFT surveys undertaken since 2011

3.4.1 Japanese knotweed

Known populations of Japanese knotweed within the Dee catchment range from sporadic patches to dense stretches along the River Dee and surrounding burns and tributaries. GFT have previously treated an area approximately 5 km in length which has notable populations of Japanese knotweed. Surveys in 2019 confirmed reports and added additional sightings which are presented in Map 2. Along with treating river banks, GFT have been called into specific locations where Japanese knotweed has been allowed to grow extensively and treatment is ongoing. Since 2016 Scottish Power (now Drax) have contracted GFT to treat various sites within their land and this is an ongoing program.

3.4.2 American skunk cabbage

There is one population of American skunk cabbage within the Dee catchment that has spread from a known source on the Aquavitae Burn. A marsh area at the bottom of this burn near the confluence with River Dee is now host to a dense population of Skunk cabbage covering at least 0.1 Ha. Some treatment began in 2017 however there will be a significant seed bank built up over time as the plant has been prevalent at source for a couple of decades according to local knowledge.

3.4.3 Himalayan balsam

Himalayan balsam has been spotted in one particular stretch of the River Dee, covering at least 1 km in a relatively low density. This report was made in 2017 so densities are likely to have increased. This record is presented in Map 2.

3.4.4 Giant hogweed

A confirmed sighting of Giant hogweed has been reported on the River Dee, in its lower reaches on St Marys Isle. As there are no further reports further up the catchment, it is likely this infestation has resulted from seeds being washed in from the sea.

4. DISCUSSION

4.1 American signal crayfish

In 2007, the Scottish Government listed Signal crayfish under the Species Action Framework (SAF), a five-year strategy for species management in Scotland. The objectives included determining the distribution of invasive crayfish so that control or containment efforts could be targeted. In 2009 Scottish Natural Heritage (SNH) contracted the River and Fishery Trusts of Scotland (RAFTS) and its members to investigate and detail the distribution of Signal crayfish in Scotland. The 2009 study[3] considered existing records of crayfish distribution to direct extensive field surveys. A standard crayfish detection protocol involving kick sampling, electrofishing and baited traps was applied at all sites. The report stated that Signal crayfish were known to occupy at least 58 km of river length in Scotland. The Kirkcudbrightshire Dee catchment was found to support the most abundant and widely distributed Signal crayfish population in Scotland. Over the following 10 years no further Scottish wide crayfish distribution surveys have been undertaken.

The Scottish Government's 'Code of Practice on NNS and INNS, a framework of responsibilities' was developed for the relevant Government organisations in 2012. The Scottish Environment Protection Agency (SEPA) was given the habitat responsibility for freshwater (still and flowing waters).

In 2009 SNH contracted RAFTS and its members to investigate and detail the distribution of Signal crayfish in Scotland using a standard crayfish detection protocol involving kick sampling, electrofishing and baited traps. Signal crayfish were found to occupy at least 58 km of river length in Scotland with the Kirkcudbrightshire Dee catchment supporting the most abundant and widely distributed Signal crayfish population. No further Scottish wide crayfish distribution surveys have been undertaken since.

4.1.1 Control of Signal crayfish

Control of crayfish is done primarily through trapping. However, it is illegal to trap crayfish without the appropriate licence. This law was put in place to reduce the chance of spreading crayfish any further. Biocides have also been used in the past however most events have proven unsuccessful.

Due to the size of the crayfish population in the Dee catchment, eradication is no longer possible. The focus now is primarily on stopping the spread through improved biosecurity.

4.1.2 Confirmed and un-confirmed Signal crayfish reports

280 sites were electrofished across the Dee catchment between 2009 – 2018. Signal crayfish were reported at 23 sites covering 11 different watercourses; Shirmers Burn, Garple Burn, Glenlee Burn, Black Water of Dee, Barlay Burn, Water of Ken, Cassenvey Burn, Craigshinnie Burn, Polifferie Burn, Coom Burn and Dullarg Burn. The previous distribution report in 2009 did not identify crayfish in the Glenlee Burn, Barclay Burn, Cassenvey Burn, Craigshinnie Burn, Polifferie Burn, Dullarg Burn and Water of Ken (upstream of Kendoon).

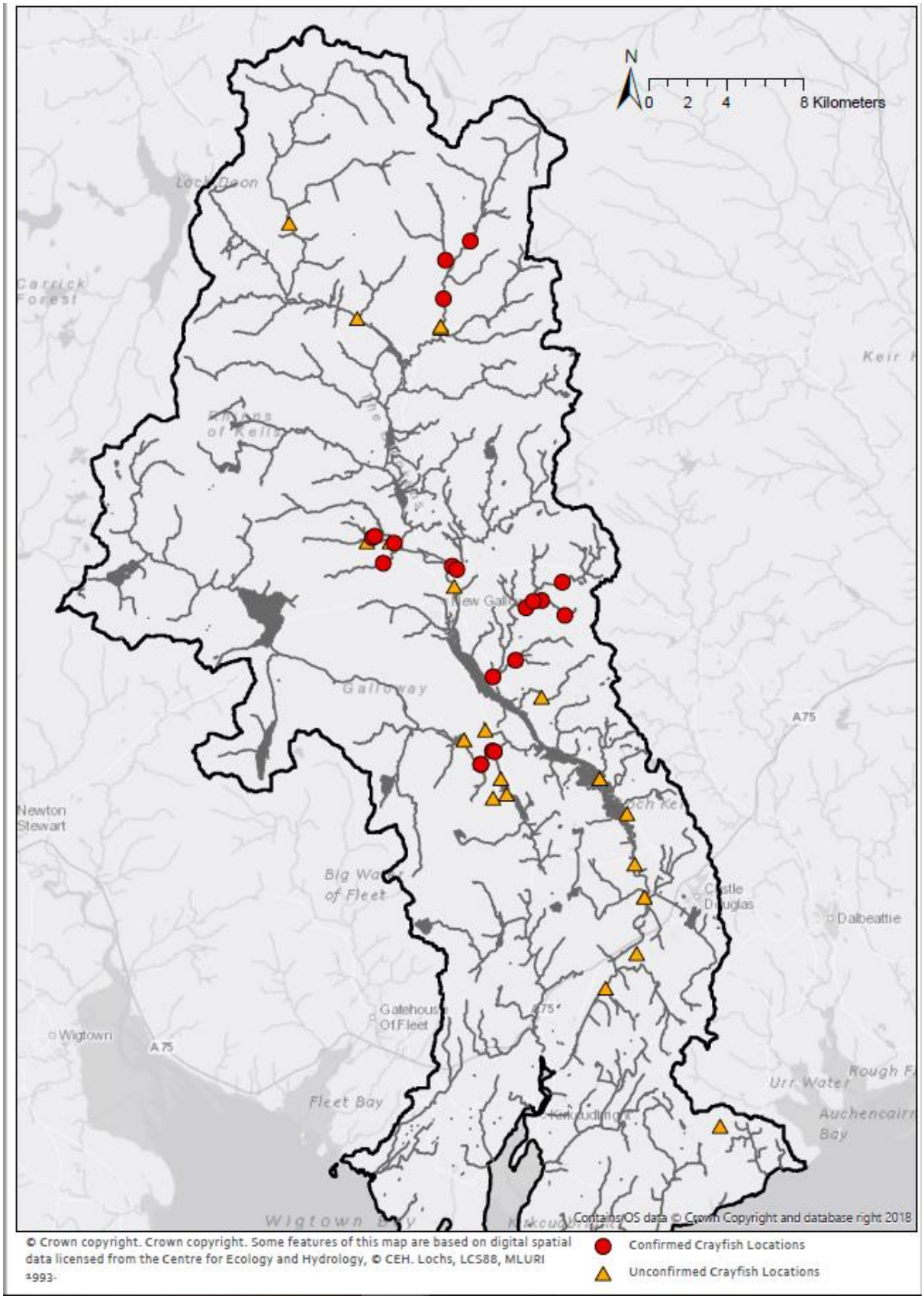
Numerous un-confirmed reports of crayfish were made to GFT via social media in the present study. These reports suggested crayfish presence over a wider area than the confirmed records show. New areas of particular interest include; River Dee (down to

[3] Sinclair, C.A. 2009. Fine scale mapping of Signal crayfish distribution in Scotland. Scottish Natural Heritage Commissioned Report, Project 26686.

Arkland), upper Water of Ken (down to Smitton Bridge), Mossdale Loch, Woodhall Loch (and inflowing tributary Nether Crae) and Water of Deugh.

Two reports (one historical and one via social media) suggest an established population in a coastal burn catchment near Auchencairn. The exact location is unknown and the grid reference provided in this report has been estimated by GFT based on the reports. It has been reported that crayfish at this location have been harvested for private consumption.

The locations of the confirmed and un-confirmed Signal crayfish records for the Dee catchment are presented on Map



Map 3: Dee catchment showing confirmed and un-confirmed crayfish reports

4.1.3 High risk areas for potential crayfish introductions

In Table 7 below, watercourses have been identified where there is a potential high risk of the Dee crayfish population accessing other 'crayfish free' neighbouring river catchment(s). If a watercourse was found to contain crayfish then for this exercise it was assumed crayfish were present throughout the whole of that water.

This was a desk top exercise and it will be necessary to ground truth these areas of concern to clarify how accessible it would be crayfish to move between the watercourse catchments and to check if there are any barriers to crayfish movement that would stop their natural spread.

Table 7: Potential high risk areas of crayfish transfer between catchments

Water at risk	Grid reference	Notes
Loch Doon (Doon catchment)	251000 599250	The Galloway Hydro Scheme periodically pumps water from both the Water of Deugh (GR:254600 598400) and the Bow Burn (GR:255900 598050) to Loch Doon. In this study there were two possible reports of Signal crayfish in the Water of Deugh.
Polskeoch Burn (Nith)	268400 602200	Crayfish are confirmed in the Water of Ken at GR:263448 593168 although their upper limit is unknown. The very upper reaches of the Water of Ken stretches very close to the Polskeoch Burn (Nith catchment). These watercourses appear on maps to possibly be linked.
Auchrae Burn-Benbrack Burn (Dee-Nith)	267000 596400	Auchrae Burn is a tributary of the Water of Ken close to where crayfish are now confirmed. It is unknown if Signal crayfish are present in the burn. The Auchrae Burn is very close to the upper reaches of the Benbrack Burn (Nith catchment).

4.1.4 Priority areas for future crayfish surveys

In Table 8 below, locations have been identified which are considered as priority areas for further survey work. These areas have been prioritised as there is a need to identify the limits of some confirmed crayfish populations and to check the validity of some un-confirmed crayfish reports that are considered plausible.

Table 8: Recommended priority areas for further crayfish surveys

Watercourse (catchment)	Grid ref.	Justification / purpose
Coastal burn catchment near Auchencairn	Approx. 277700 550600	Two reliable sources have reported crayfish present in ponds but exact location was not provided. Need to identify possible ponds, liaise with land owners and undertake crayfish surveys. It has been suggested this population is being harvested for private

		consumption.
Water of Ken (upstream of Kendoon)	Upstream of 261800 590100	Crayfish surveys required to identify upper and lower point of the confirmed crayfish population. It is important to understand if crayfish have reached Kendoon Reservoir where there is a fish farm located.
Kendoon Loch	261400 590000	Trapping should take place in Kendoon Loch to check whether crayfish are present. If present then could have implications for the operations of a fish farm and increase the risk of them entering the Water of Deugh.
Water of Deugh and Carsphairn Lane	Upstream of 258600 592300	Two vague reports of crayfish were made. Due to the high risk of possible transfer of crayfish from the Deugh catchment to the Doon through the workings of the Galloway Hydro Scheme it is essential to know if they are present in this sub-catchment.
Lower River Dee	272300 558500 – 270700 556000	The lowest confirmed record for crayfish in the Dee system is immediately below Loch Ken but numerous angler reports now suggest they are far further down the system including Arkland. It should now be assumed that crayfish are now present in the River Dee down to the estuary. Trapping should be undertaken in the lower river around Arkland / Tongland to confirm their presence throughout the lower river.
Mossdale Loch / Woodhall Loch	265600 571000 and 266400 568500	Trapping should be undertaken to confirm these lochs support crayfish so appropriate biosecurity measures are put into place. Numerous reports made by anglers that they are present.
Auchrae Burn, Barlay Burn, Cassenvey Burn	Upstream of; 266300 595750, 269574 578572, 268505 577629	These three burns have been identified as containing or possibly containing crayfish and that their headwaters may be linked through drainage / wet ground to other river catchments without crayfish. It is recommended that the potential cross catchment risk through watercourse linkages is assessed in detail and if there is a true risk then the location of crayfish in the burns is identified.

4.2 Invasive Non-Native species of plants

GFT have been treating INNS within the Kirkcudbrightshire Dee catchment since 2011. Limited funding has directed control to focus on priority areas and therefore there are large areas of the Dee catchment which have not been surveyed and the distribution of INNS is unknown. There are four SSSIs' in close proximity to known INNS populations within the Dee catchment (SNH 764; 1597; 833 and 1535) and a further three SSSIs' which are within areas considered at risk from the existing INNS upstream.

Japanese knotweed and Himalayan balsam are both negatively impacting riparian areas due to their ability to dominate large areas of ground and outcompete native plants. When allowed to grow unchecked they spread throughout river systems and negatively affect local biodiversity. As these species are annual plants they die back in winter, exposing large areas of bare river bank which leads to increased rates of bankside erosion resulting in habitat loss.

Himalayan balsam is very popular with bees, which in turn results in a reduction of the pollination of native plants. Control of this species is also very challenging. The most effective control method of invasive plants is herbicide control, however depending on the density in which Himalayan balsam can be found, there could be too many non-target areas impacted which could outweigh the benefit of control. Mechanical removal of this species is preferred however this is often an impossible task due to the sheer extent of the species distribution within a catchment. The species also has a very prolific method of seed dispersal and with up to 800 seeds per plant re-population of an area is usually very quick. In some cases treatment is no longer a viable option. Biological control methods have been introduced in England however are still being trialled and are hopefully going to be introduced into Scotland in 2019. This may be the only way to reduce the impact of Himalayan balsam in the region if future surveys suggest that the population is beyond mechanical or chemical control.

American skunk cabbage is usually found around ponds, swamps and marshes. Currently this species is still available to purchase in local garden centres and is very popular in ornamental gardens. The primary concern surrounding this invasive species is its impact on biodiversity in the areas which it dominates. The plant can grow very large and its leathery leaves can block out sunlight to any remaining ground and reduces the ability for native plants to grow. The nature of the plant also means that if left unchecked, it can choke off small watercourses as it can become very dense.

Giant hogweed is a species of plant which along with being invasive, is also a public health risk. The plant produces a hazardous, photo-reactive sap which burns the skin in a way that mimics a chemical burn. The sap reacts to the UV in sunlight and can re-blister when exposed. This species has never before been reported in the Dee catchment and given its current location presented in Map 2, it is coastal and potentially introduced through sea dispersal. GFT confirmed this sighting and it is understood that this population is being managed by the land owner. These plants are bordering a public footpath and pose a significant risk to the general public. Care must be taken and efforts need to be made to raise awareness in the community.

4.2.1 Risk of spread

Each plant species has its own level of risk depending on its current distribution and its method of dispersal. As it stands, Japanese knotweed is the most prevalent species and is widespread throughout the catchment. The area at risk below the lowest known location of Japanese knotweed is approximately 5 km in length however there are many stretches of river bank between the current sites which are at risk of infestation if control is not

undertaken. As this species is infertile and spreads only via vegetation, further spreading should only occur if the plant is interfered with or if there are areas of ground disturbance above dormant rhizomes. Currently established populations will increase in size every year if left untouched. A primary concern associated with Japanese knotweed is its ability to re-activate even if it appears to have been killed and is no longer actively growing. This means that treated ground should remain untouched and can be a problem if found in built up and residential areas.

Himalayan balsam has been confirmed to be present within the catchment downstream of Glenlochar barrage. The exact area of coverage is unknown however it is assumed that the area at risk of infestation below the currently known population is approximately 15 km. As this plant spreads by seed and is predominantly found along river banks, the risk of spread is considerable if left unchecked.

American skunk cabbage is only known to be present in one area on the River Dee catchment and appears to have remained relatively contained considering it is presumed to have been present in this location for over a decade according to local reports. This plant spreads by seed however as the lowest population is contained within a marsh as opposed to fast flowing water, the spread downstream appears to be slow. Regardless of the speed of spread, the river length downstream of this population which is at risk is significant (approximately 30 km) and includes Loch Ken.

As a result of requesting reports of INNS within the Dee Catchment as part of this report, GFT have received a report of a confirmed sighting of Giant hogweed. Currently there are no other known population of this species within the catchment, and as this sighting is in Kirkcudbright Bay it may be an isolated population from seeds washed ashore. There is a risk of this spreading upstream however it is a very low risk. Early response and effective treatment before the plants seeds later in the season could eliminate the problem.

4.2.2 Control of Invasive Non-Native Species of plants

Each species reacts differently to treatment. Giant hogweed and Japanese knotweed both respond well to herbicide applications, however treatment should be carried out at different times of year. Giant hogweed should be treated before it produces a flower head to reduce the risk of seed production, usually around May and June. Japanese knotweed reacts better to treatment when it is carried out in late summer, around August or early September. This is in response to the winter drawback of the plant, where it pulls in all its reserves into the roots, drawing in more chemical as a result. Japanese knotweed is a perennial and requires up to four years of treatment in order to eradicate the plant. The species rhizomes are capable of lying dormant however and reappearing if disturbed years after it was actively growing.

American skunk cabbage responds well to herbicide application but not well to foliar spray. Due to the waxy nature of the plants leaves, they are less permeable to chemical and therefor it is suggested that the plants are injected or their stems should be cut to allow chemical to access their root system.

Himalayan balsam does respond well to herbicide application however due to the densities that this species is regularly found in, usually dispersed between many different native plant species, there would be an unacceptably high non-target impact of foliar spraying. Hand pulling is the preferred method of treatment, which should be carried out in June or July before seed pods are formed.

4.2.3 Future surveys

As each species growing season differs, it is advisable to survey each one at the most effective time of year.

American skunk cabbage is the first species to appear early spring. It is distinguishable even as a young sapling so surveying for this species can be carried out earlier than the other plant species.

Giant hogweed appears mid-April however new saplings can emerge at various times within spring so it would be most effective to survey for this species in June-October. Using drone footage to survey for Giant hogweed would be most effective later in the growing season as the white flower head is a very distinguishable feature which could highlight areas where access is limited on foot.

Surveying for Himalayan balsam is most effective when the plant is in flower as younger saplings can be missed under thicker foliage. Again, this plant can emerge and grow at various rates so delaying surveys until later is beneficial.

Japanese knotweed surveys are best conducted late summer when the plant is at its largest, to ensue small saplings are not missed. Surveys of these plants can be conducted at the same time as treatment.

The top most known location affected by invasive plants known to GFT on the Dee catchment is Grid reference: 261500 582050. Future surveys should be conducted to confirm this is the upmost point and completed to provide an accurate representation of the spread of INNS within the catchment. Once this level of information is available, effective treatment programs can be implemented and future management plans can be produced.

4.3 American mink

American mink are a carnivorous mammal which inhabit watersides such as burns, rivers, lochs, marshes, swamps and coastlines. Their presence is linked to the decline in numbers of water voles and they can have a damaging effect on nesting birds on offshore islands, game birds and fish stocks. The presence of American mink in the Dee catchment appears to be considerable. Their distribution is widespread and although the number of reports is limited, the top and bottom limits of the reports signify there is a large area of the catchment at risk of infestation. Considering the scale of the impact this species can have and the area at risk within the Dee catchment, it is imperative that there is future monitoring and trapping programs put in place to provide an ongoing management procedure to ensure this species does not further dominate or impact the local watercourses.

4.3.1 Control of American mink

Control of American mink is carried out across the region however not as often as required to control the species. Mink are tracked using mink rafts which are placed in areas which show signs of activity. The rafts have a clay pot which records paw prints and can show whether mink are present within the area. If there is evidence of mink using the raft, a trap is then placed in the vicinity with bait inside. Once a mink is caught it is then dispatched.

4.4 Legislation

It is illegal to allow the spread of invasive species in Scotland. As amended by the Nature Conservation (Scotland) Act (2004) and the Wildlife and Natural Environment (Scotland) Act 2011 the Wildlife and Countryside Act (1981) (Sections 14 to 14P) is the principal legislation dealing with non-native species in Scotland. Section 14(1) of the Act makes it illegal to

release, allow to escape, or cause an animal to be at a place out with its native range. Section 14(2) makes it illegal to plant or otherwise cause a plant to grow in the wild at a place out with its native range. Offences under section 14 carry a maximum penalty of a £40,000 fine and/or 12 months imprisonment on summary conviction and an unlimited fine (i.e. whatever the court feels to be commensurate with the offence) and/or 2 years imprisonment on indictment.

Due to the location of INNS in the Dee catchment, in particular the Giant hogweed which is situated on St Marys Isle on a public footpath, it is important that the local community is aware of the risks associated with the species and follows the Check, Clean, Dry protocol to ensure further spread does not occur.