Contract No: 1516/42/1

Pond Assessment

Tunbridge Wells and Rusthall Commons

Pond Assessment for:
Tunbridge Wells Freehold Tenants

L. D. Brady
10th May 2016

CALUMMA
Ecological Services

Contents

1. Aim and Objectives

1.1 Aim

To provide advice that will help the Freehold tenants update the Management Plan used for maintaining and preserving the Commons.

1.2. Objectives

The objectives of the management plan are to recommend the following:

1.2.1 Visit and Review Ponds

- to assess invasive plant species
- to comment on native plants
- to consider fish management
- to comment on tree cover
- to review amphibians
- to comment on marginal vegetation

1.2.2 Review Proposed Locations for New Ponds

2. Site Information

2.1 Location

Site Name:	Tunbridge Wells and Rusthall Commons
Grid Reference:	Tunbridge Wells Common: TQ 578 389
	Rusthall Common: TQ 563 393
County:	Kent (VC16: West Kent)
Natural Area:	High Weald

The site location is illustrated in Fig. 2.1.

2.2 Ownership

The Commons are owned by the Manor Rusthall with the title held by Targetfollow (Pantiles).

Further information is available from:

Commons Conservators, Town Hall, Tunbridge Wells, Kent TN1 1RS

(info@twcommons.org).

2.3 Authority

Management decisions are made by Tunbridge Wells Commons Conservators in accordance with the County of Kent Act 1981. Management work is funded by Tunbridge Wells Borough Council.

2.4 Soils/Geology and Natural Area Characteristics

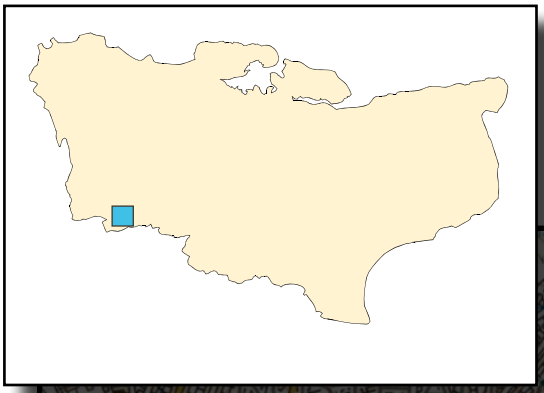
The Commons are located within the High Weald Natural Area with a geology defined by the Wealden Group (Fig. 2.2). Natural England has described the key characteristics of the High Weald Natural Area:

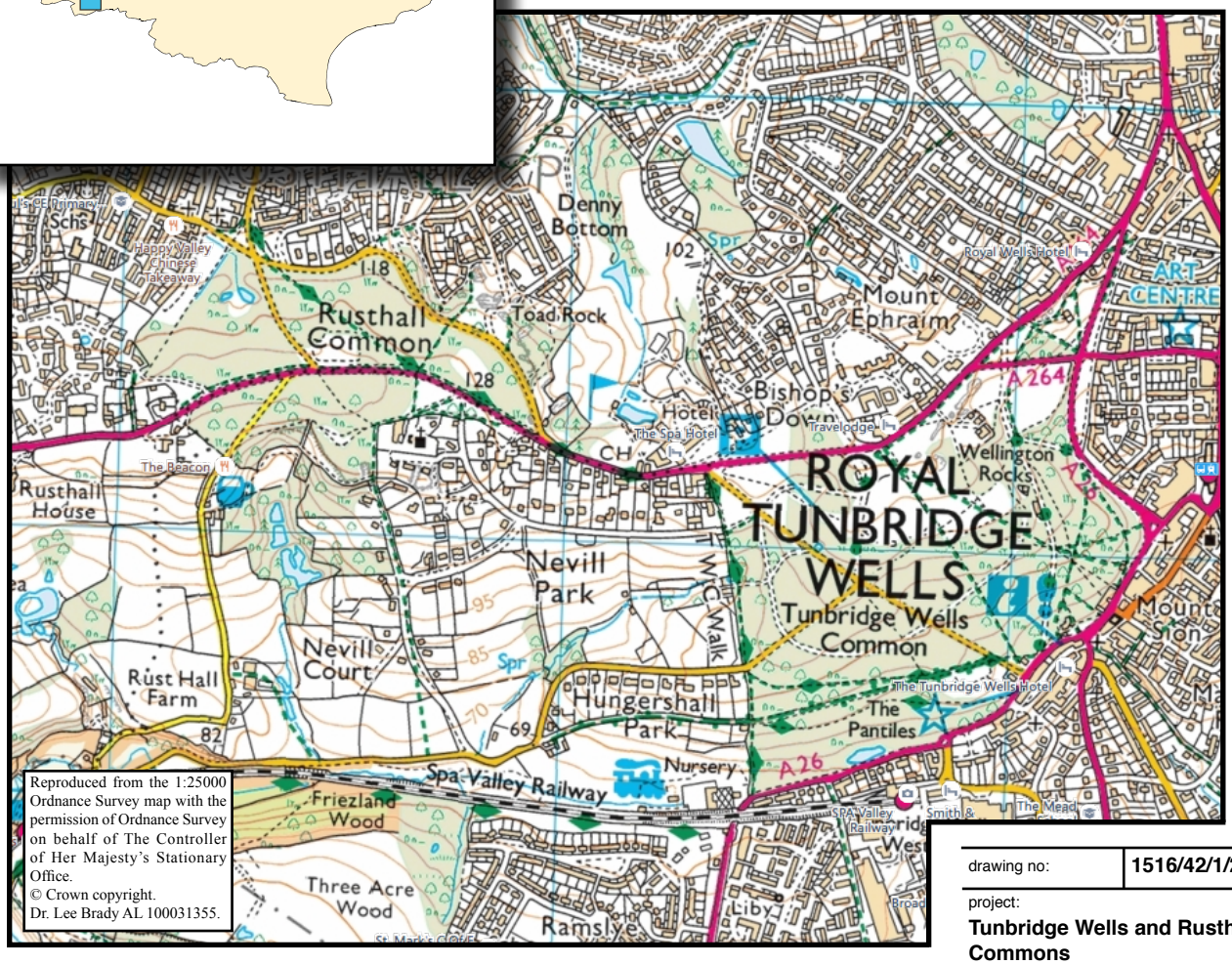
- Gill woodlands and associated streams.
- Hedgerows and shaws.
- Heathland.
- Hay Meadows and neutral pastures.

- Parklands.
- Ponds.
- Sand-rock bryophyte assemblages.
- Geological features: Purbeck Group and Hastings Beds of the Wealden Series.

Fig. 2.1 Tunbridge Wells and Rusthall Commons

Site locations.





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drawing no:	**1516/42/1/2.1**

project:
Tunbridge Wells and Rusthall Commons

title:
Site Locations

scale: **N.T.S.**	date: **May 2016**

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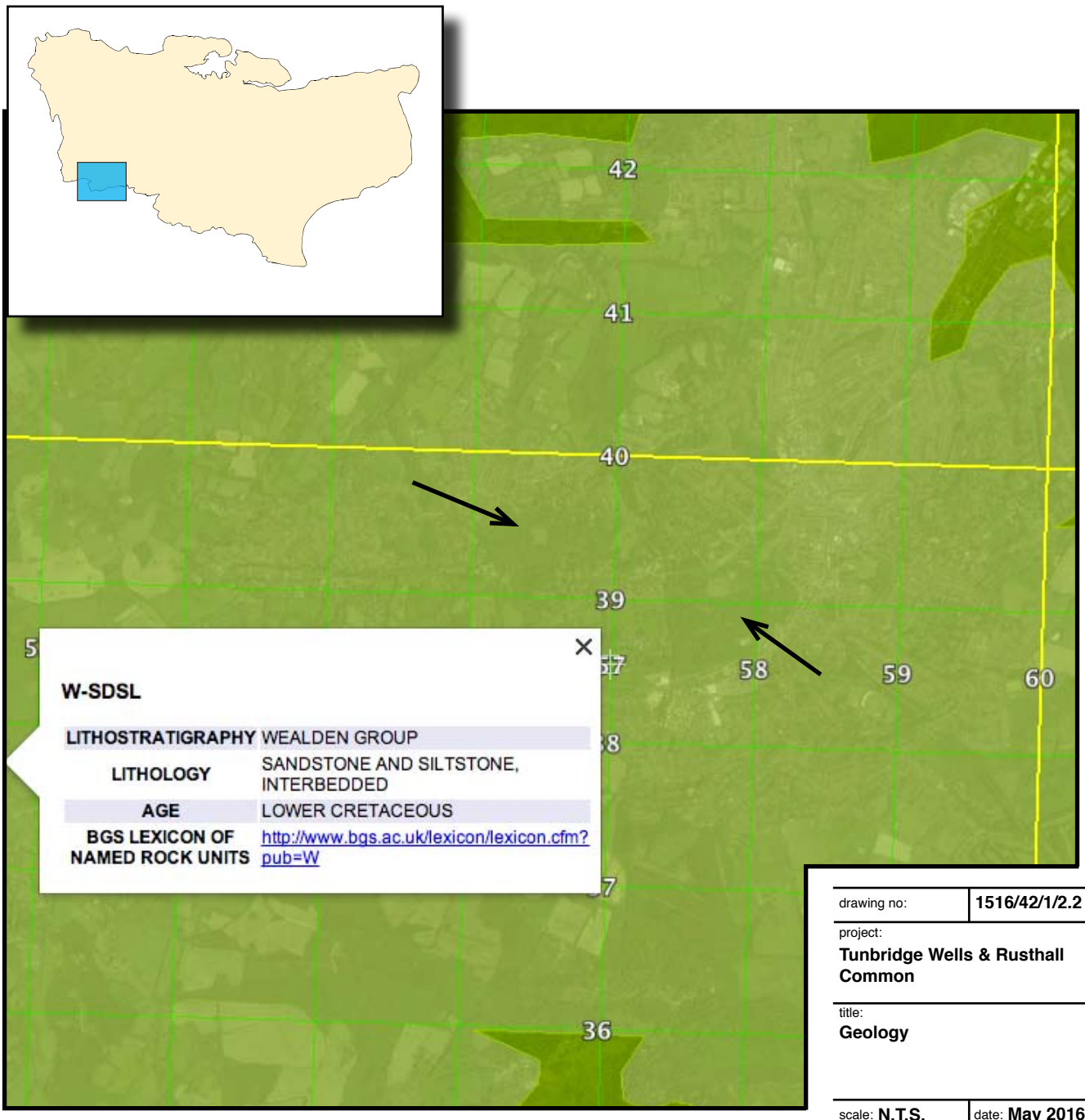
Fig. 2.2 Local Geology

Location of Tunbridge Wells and Rusthall Commons indicated by arrows.

Data based on British Geological Society, Onshore Geology Survey and plotted within Google Earth.



drawing no:	**1516/42/1/2.2**
project:	**Tunbridge Wells & Rusthall Common**
title:	**Geology**
scale: **N.T.S.**	date: **May 2016**

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3. Historical Records

Information supplied by Kent Reptile and Amphibian Group (KRAG) indicates that common frog, common toad, smooth newt, palmate newt and great crested newt have all previously been recorded from the local area (Appendices I & II). The recorded local distribution of great crested newt is illustrated in Fig. 3.1. The recorded county distributions of amphibian species is illustrated in Appendix III

Available data indicates that viviparous lizard, slow-worm and grass snake have been recorded from the local area. The closest confirmed adder observation is from Broadwater Forest. The recorded distributions of reptile species in Kent is illustrated in Appendix IV.

KRAG has prepared a summary risk assessment that describes the likely presence of herpetofauna at each of the two Commons (Tables 3.1 - 3.2). The risk assessment is based on statistical analysis of available distribution data but does not take into consideration the quality of available habitat.

Note that the availability of records and accuracy of the risk assessment is directly related to survey effort. A lack of records does not necessarily indicate the absence of protected species.

Species	Likelihood of Presence
Amphibians	
common frog	**HIGH**
common toad	**HIGH**
natterjack	*n/a*
smooth newt	**HIGH**
palmate newt	**HIGH**
great crested newt	Likely
Reptiles	
viviparous lizard	Likely
slow-worm	Likely
sand lizard	*n/a*
grass snake	**HIGH**
adder	Possible
smooth snake	*n/a*

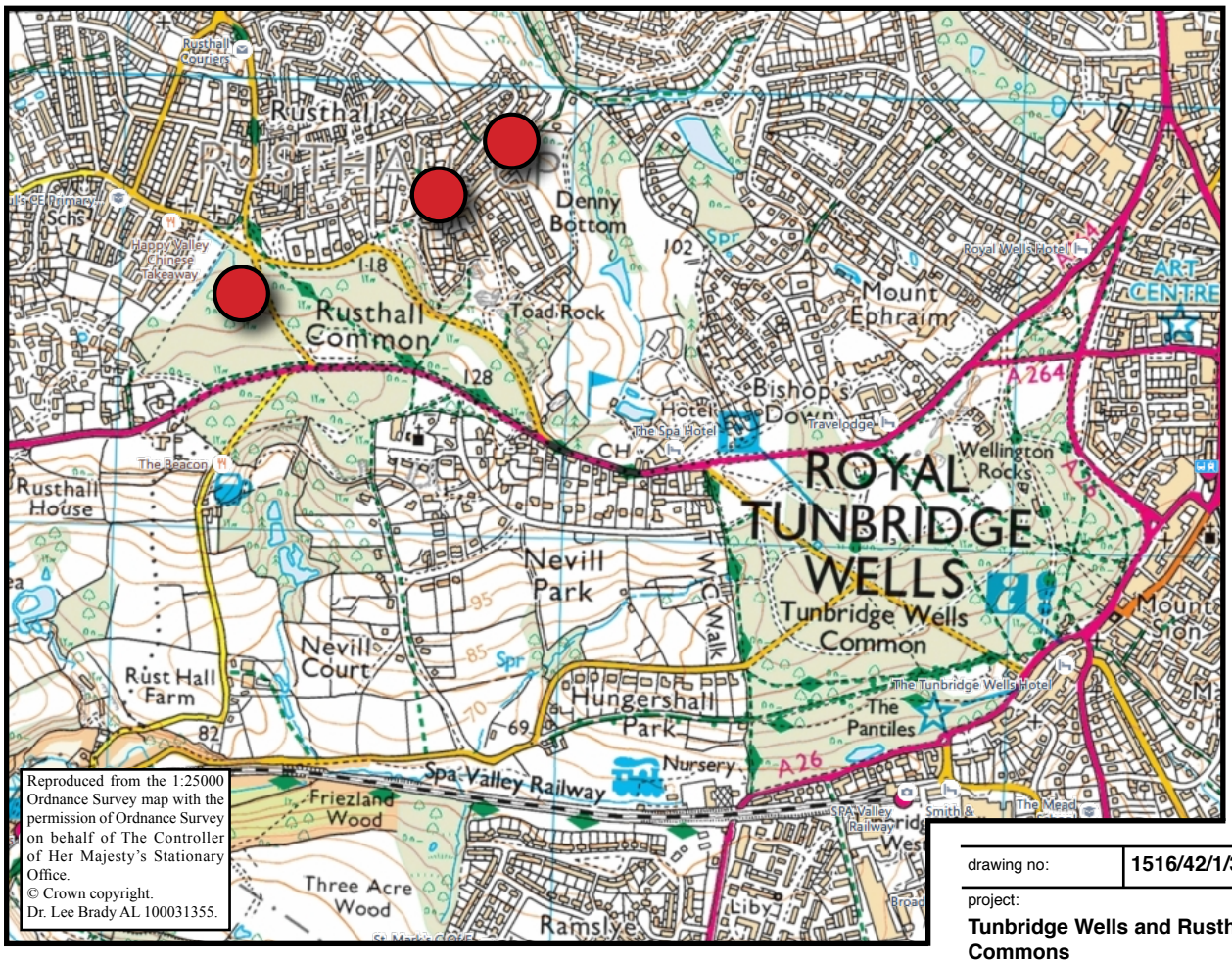
Table 3.1. Herpetofauna risk assessment for Tunbridge Wells Common prepared by Kent Reptile and Amphibian Group.

Species	Likelihood of Presence
Amphibians	
common frog	**HIGH**
common toad	**HIGH**
natterjack	*n/a*
smooth newt	**HIGH**
palmate newt	**HIGH**
great crested newt	**HIGH**
Reptiles	
viviparous lizard	Likely
slow-worm	Likely
sand lizard	*n/a*
grass snake	**HIGH**
adder	Possible
smooth snake	*n/a*

Table 3.2. Herpetofauna risk assessment for Rusthall Common prepared by Kent Reptile and Amphibian Group.

Fig. 3.1 Great Crested Newt

Recorded distribution of great crested newt in local area.



drawing no: **1516/42/1/3.1**

project:
Tunbridge Wells and Rusthall Commons

title:
Great Crested Newt

scale: **N.T.S.** date: **May 2016**

Key to Symbols

great crested newt

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4. Pond Assessments

Ponds within the two Commons were visited on 14th April 2016 and habitat data recorded. A Habitat Suitability Index (HSI) was calculated for each waterbody based on methodology developed by Oldham et. al. (2001). The HSI is represented by a number from 0 to 1, the higher the number the more likely the pond is to support breeding great crested newt (Table 4.1). Data collected by Calumma Ecological Services has revealed that HSI results provide a useful means to determining the suitability of ponds for great crested newt (Appendix V). Information on amphibian occupancy of the ponds has been summarised from existing historical data and observations made during the site visit (Tables 4.2 - 4.3).

Pond descriptions updated from Young and Brady (2004).

4.1 Tunbridge Wells Common

The locations of ponds on Tunbridge Wells Common are illustrated in Fig. 4.1.

4.1.1 Brighton Lake (WB1)

A large pond (area: 2225 m^2) adjacent to Eridge Road, steep sided with stonework banks. There are two islands, one supporting a duck house. The pond is relatively open, with less than 10% of the shoreline shaded by trees. Emergent marginal plants (including reedmace, *Typha latifolia*) are found along the shoreline but are mainly restricted to the eastern end of the pond, where they cover much of the pond surface area (probably due to shallow water in this area). Aquatic vegetation, both floating and submerged, is extensive, covering more than 70% of the pond during the April 2016 assessment. Aquatic vegetation appears to be dominated by *Potamogeton* sp. and Canadian pondweed (*Elodea canadensis*). The latter is a non-native species that frequently displays vigorous growth. Whilst it may not be possible to eliminate Canadian Pondweed from Brighton Lake, it should be removed from any other ponds that it is encountered in on the Commons (for more information see Appendix VI). Canadian pondweed can spread from small fragments so mechanical clearance should be avoided.

This pond supports numerous waterfowl including moorhen, mallard and Canada goose.

Brighton Lake was reportedly desilted in 2012.

The area between the pond and the road is managed as amenity grassland and characterised by mown grass with a short sward. A stone wall runs just above the northern side of the pond and beyond that, sloping upwards, is grass and bramble scrub leading into woodland. This vegetation is more structurally complex. For both reptiles and amphibians, south facing banks covered with dense vegetation represent good foraging and sheltering habitat and are good hibernation sites if there are sun-warmed patches of open ground and/or lighter vegetation cover allowing the sun to reach the ground but affording some protection from predators. In 2004, the south facing wall, overgrown with vegetation in places was considered to provide excellent hibernation sites for overwintering amphibians and reptiles. Whilst this continues to be the case, additional sheltering places could be provided (in the form of log piles) along the inside edge of the woodland.

Frogs and toads both spawn in this pond (common toad tadpoles were observed during the 2016 assessment). Smooth newt was recorded in the pond in 1993. The pond supports a large

population of fish and may also support native crayfish. More survey work is required to establish the full amphibian assemblage and to confirm occupancy by crayfish. Great crested newts are unlikely to form a breeding population in this pond due to the presence of a major fish population.

4.1.2 Cabbage Stalk Pond (WB2)

A relatively small pond (area 220m^2) set in a woodland clearing. In 2004, less than 5% of the pond margin was shaded by trees and this was found to be still the case in 2016. Much of the bank was fringed with marginal vegetation. The extensive growth of reedmace (*Typha latifolia*) observed in 2004 was not present. In 2016, floating and submerged vegetation covered much of the pond area. There was no invasive alien vegetation observed. No waterfowl were observed. When this pond was visited in October 2003, it held very little water and was reported to have dried the previous year. During the April 2016 assessment, water within the pond was found to be at its maximum extent.

Along one side of the pond is a steep wooded south facing bank; a narrow strip of rough grassland separates the pond from the woodland on the remaining sides. On the north eastern side of the pond is a shallow scrape that is managed as an area of marshy ground.

Terrestrial habitat surrounding this pond continues to offer good potential for amphibians. There is an ample supply of logs and fallen wood available, providing shelter for amphibians as well as foraging opportunities. Some disturbance to the logs was noted. Disturbance could be reduced by burying logs into the ground and/or tying the bottom row of logs together using wire. Although this pond offers suitable breeding habitat for great crested newt, it may be too distant from a source population to be colonised.

Smooth newt was confirmed present in this pond in April 2016. The eggs of either smooth or palmate newt were also observed. Fish are unlikely to establish due to the ephemeral nature of the pond.

4.1.3 Bracken Cottage Pond (WB3)

A medium sized pond (area 400 m^2) set in a hollow on the edge of the common. Bank-side trees shade around 30 - 40% of the shoreline. This level of shading is not detrimental to the pond. Emergent marginal plants encompass the remainder of the shoreline, including stands of iris (*Iris pseudarorus*) and reedmace (*Typha latifolia)*. These plants are managed on a rotational basis. There was no invasive alien vegetation observed in 2016, although water lilies have been introduced. Introduction of plants into ponds on the Commons should be avoided wherever possible since such introductions are frequently the source of invasive species.

The pond is at the bottom of a south westerly facing slope covered with a structurally complex grassland sward (bracken was also noted in 2004). A drainage ditch leads down to the pond; around this, the ground is boggy and supports reeds. Ditches are valuable habitat features for amphibians since they provide a sheltered migration route to and from the pond and add to habitat variety.

A tarmac path crosses the foot of the slope, and below this is rough grass, to the pond edge. At the top of the slope, and also to the south of the pond is woodland, on the east is a house and beyond that, fields. The terrestrial habitat around the pond was considered to offer good habitat for amphibians in 2004. This remains the case in 2016, with rough grassland and woodland providing opportunities for sheltering and foraging.

In 2004 a small common frog population was believed to breed in this pond. No frog tadpoles were observed in 2016. There is reported to be a good population of small newts and the eggs of smooth/palmate newts were observed during the 2016 assessment. In 2004, goldfish were believed to have been introduced but since water levels within the pond drop significantly during years with below average precipitation, significant populations of fish are unlikely to become established. This pond offers suitable breeding habitat for great crested newt but may be located too far away from a source population to be colonised.

4.1.4 Fir Tree Road Pond (WB4)

A medium sized pond (320 m^2) in a woodland clearing beside Major York's Road, containing a small island. The pond remains very open, with no overhanging trees. The island and approximately 50% of the pond margin are vegetated with a mixture of rushes, reedmace and iris. Floating vegetation such as flote grass (*Glyceria* sp.) covers a significant proportion of the pond surface. In 2004, the invasive exotic Parrots Feather was found to cover a significant proportion of the pond area. There was no evidence of Parrots Feather during the 2016 assessment, but this may have been due to the early assessment period. A follow-up site visit is recommended during the summer to confirm whether Parrots Feather remains present. More information on Parrots Feather is available in Appendix VI. Vegetation within the pond is reportedly managed on a rotational basis with approximately 33% removed in any one year.

The pond is set in a small clearing within the woods, surrounded by a narrow belt of damp and rough grassland, broadening at one end into a boggy area with mixed rushes and grass. This damp habitat continues to offer good habitat for foraging amphibians, and the woodland beyond provides many structures suitable for foraging, sheltering and hibernation.

The pond supports a large breeding population of common frogs. Smooth and palmate newts have been recorded and grass snakes observed. Although the eggs of smooth/palmate newts were observed in April 2016, the last observation of an adult amphibian was in 2006. The pond is currently not occupied by fish. Relatively shallow water and somewhat ephemeral conditions will constrain establishment of significant fish populations. This pond offers suitable breeding habitat for great crested newt but once again, the distance between this pond and the closest source population may constrain colonisation.

4.1.5 Shaded Bomb Site Pond (WB10)

A small water-filled hollow amongst trees situated off a path leading to Brighton Lake. This small pond is highly shaded and devoid of aquatic vegetation. Shaded woodland ponds such as this typically support few amphibian species (although they can be favoured by palmate newts). Low oxygen levels and high rates of desiccation during the summer mean that establishment by fish is unlikely. Some uncommon aquatic invertebrates can be found in this type of aquatic habitat (e.g. the aquatic beetle, *Achileus canaliculatus*).

4.2 Rusthall Common

The locations of ponds are illustrated in Fig. 4.2.

4.2.1 Tarry Path Pond (WB5; previously known as 'New Pond')

This pond is of a medium size (360 m^2) set in a hollow within woodland. Approximately 60% of the shoreline is shaded by trees. In 2004, there was little aquatic vegetation with 20% of the

pond surface covered with a mixture of *Glyceria* and *Lemna*. Similar quantities of vegetation were observed in 2016. The water was found to be turbid in 2004 and 2016. Marginal plants have now established with some rushes evident. There was no evidence of invasive aquatic species.

The woodland slopes steeply down to the pond on two sides, these banks display a deep layer of leaf litter. On the other side of the pond is wet grassland, and a scrub covered hillock beside a drainage ditch.

Common frog tadpoles and adult smooth newts were observed in 2016. Palmate newts are also likely to be present. The pond could support great crested newt and is located ~ 590 m from the occupied large marl pit (WB6). Whilst this is within expected dispersal distance, barriers such as Coach Road may hinder colonisation. Establishment of a 'stepping stone" pond between the two may therefore be beneficial. Additional survey work of Tarry Path Pond is recommended.

4.2.2 Large Marl Pit (WB6)

This is a medium sized pond on the edge of a clearing on the common. The pond has a relatively open aspect and only 15% of the shoreline is shaded by trees. The shoreline is heavily vegetated with rushes and reedmace. In 2016, submerged and floating vegetation were found to cover more than 70% of the pond area. Bog bean was also observed in 2016. In 2004 there was considerable growth of Parrot's Feather. Whilst only small quantities were observed in 2016, this may have been due to the early assessment period. Australian Swamp Stonecrop (*Crassula helmsii*) was observed during the 2016 assessment. A follow-up site visit is recommended during the summer to confirm the extent of Australian Swamp Stonecrop and Parrots Feather. More information on Australian Swamp Stonecrop is available in Appendix VI.

This pond is known to support a large population of smooth newt and a low population of great crested newt. Adult smooth newts and great crested newt eggs were observed in April 2016. This is the only pond on the Commons that is known to support a breeding population of great crested newt.

Grass snakes reportedly forage around this pond and the local area is likely to support a good population.

The pond was deepened ~1993, and is reported as holding water most years. There is a high risk that fish will be introduced into this pond and a small population was reported as present in 2002. Establishment of a major fish population will have a significant negative impact on breeding great crested newts. If a fish population does become established the only way to eliminate it may be to drain the pond. Ideally such work should be undertaken when newts are unlikely to be present (i.e. during the winter). If the work must be undertaken during the summer months (e.g. for logistical reasons due to low water levels), a licence may be required from Natural England due to possible impacts on newt larvae.

There is an extensive area of rough grassland and scrub close to the pond, offering excellent potential for foraging and sheltering amphibians and reptiles.

4.2.3 Small Marl Pit (WB7)

Located within the same clearing as the large marl pit pond (WB6), this is a very small and highly ephemeral pond (area 72 m^2) close to the woodland edge and shaded along most of its shoreline. The pond is shallow and fully desiccates most years. No water was present at the

time of the 2016 assessment. In 2004, vegetation present in the pond included a mixture of flooded terrestrial vegetation and *Glyceria*, covering around 80% of the pond surface area. There was no marginal vegetation. Smooth newts were last recorded in this pond in 2003.

4.2.4 Rusthall Common View Large Pond (WB8)

A newly constructed pond (~2014) that is situated within woodland. The pond is relatively small with an area of ~100 m^2 and has been created along a small stream. Water in the pond was turbid in April 2016. Some *Lemna* was present on the pond surface. *Glyceria* is also present. An overflow is supposed to allow water to drain into WB9, but water was instead observed draining away across the footpath.

Surrounding woodland habitat offers good opportunities for foraging and sheltering amphibians.

Common frog tadpoles were observed in the pond in 2016 and the pond is also considered suitable for smooth, palmate and great crested newts. The close proximity to WB6 means that the pond (~65 m) may already be colonised by these three newt species. Additional survey work is recommended.

Fish were not observed but small species could colonise if they are present in the stream.

4.2.5 Rusthall Common View Small Pond (WB9)

A newly constructed pond (~2014) situated within woodland on the opposite side of the footpath from WB8. A small pond (~80m^2) with clear water in April 2016. *Glyceria* and starwort are present with some *Potomageton* sp. and *Lemna* sp.

Surrounding woodland habitat offers good opportunities for foraging and sheltering amphibians.

Common frog tadpoles were observed in the pond in 2016 and the pond is also considered suitable for smooth, palmate and great crested newts. Like WB9, the close proximity to WB6 means that the pond (~65 m) may already be colonised by these three newt species. Additional survey work is recommended.

Fish were not observed but could colonise if they become established in the adjacent WB8.

4.2.6 Rusthall Road Bus Stop Pond (WB11)

A small highly shaded pond located alongside Rusthall Road. Like WB10 on Tunbridge Wells Common, this pond is unlikely to support amphibians other than palmate newts and perhaps a small number of common frogs. No aquatic vegetation was observed and the pond is likely to be highly ephemeral.

4.2.7 Woodland Pond (WB12)

A small shaded pond located amongst woodland. This pond is also unlikely to support many amphibian species but is likely to be occupied by palmate newts. The pond was covered by duckweed (*Lemna*) in April 2016.

WB#	Pond	Grid Reference	GCN HSI	GCN Suitability
Tunbridge Wells Common				
1	Brighton Lake	TQ 57697 38553	0.50	Below Average
2	Cabbage Stalk Lane Pond	TQ 57493 38663	0.86	Excellent
3	Bracken Cottage Pond	TQ 57383 38939	0.89	Excellent
4	Fir Tree Pond	TQ 57575 39012	0.92	Excellent
10	Shaded Bomb Site Pond	TQ 57731 38624	0.40	Poor
Rusthall Common				
5	Tarry Path Pond	TQ 56596 39499	0.84	Excellent
6	Large Marl Pit Pond	TQ 56282 39533	0.86	Excellent
7	Small Marl Pit Pond	TQ 56237 39531	0.54	Below Average
8	Rusthall Common View Large Pond	TQ 56219 39505	0.74	Good
9	Rusthall Common View Small Pond	TQ 56219 39512	0.77	Good
11	Rusthall Road Bus Stop Pond	TQ 56878 39406	0.41	Poor
12	Woodland Pond	TQ 56245 39459	0.50	Below Average

Table 4.1. Calculated Habitat Suitability Index values for ponds (after Oldham et. al., 2001).

Waterbody	Year				
	Common Frog	**Common Toad**	**Smooth Newt**	**Palmate Newt**	**GCN**
1	1993	2016	1993	-	-
2	-	-	2016	-	-
3	-	-	-	-	-
4	2006	2006	2006	2006	-
10	-	-	-	-	-
Species Count Score	**1 (4 species)**				

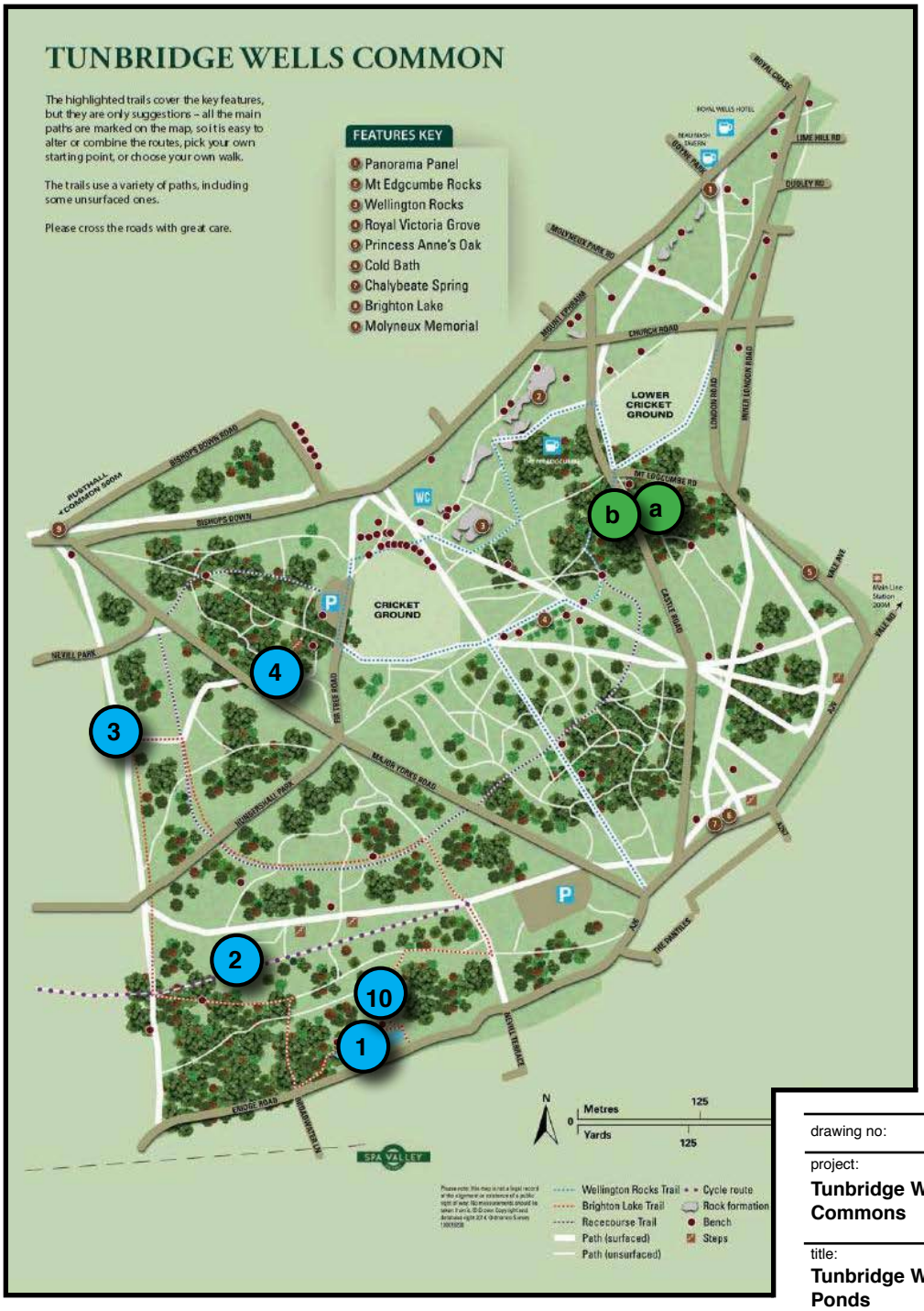
Table 4.2. Amphibian survey results for Tunbridge Wells Common using all available data. Figures represent the last year that occupancy was confirmed.

Waterbody	Year				
	Common Frog	**Common Toad**	**Smooth Newt**	**Palmate Newt**	**GCN**
5	2016	-	2016	-	-
6	1993	2003	2016	-	2016
7	-	-	2003	-	-
8	2016	-	-	-	-
9	2016	-	-	-	-
11	-	-	-	-	-
12	-	-	-	-	-
Species Count Score	**1 (4 species)**				

Table 4.3. Amphibian survey results for Rusthall Common using all available data. Figures represent the last year that occupancy was confirmed. WB7 was fully desiccated at the time of the 2016 assessment.

Fig. 4.1 Tunbridge Wells Common

Figure illustrates locations of known ponds.



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project: **Tunbridge Wells and Rusthall Commons**	
title: **Tunbridge Wells Common Ponds**	
scale: **N.T.S.**	date: **May 2016**

Key to Symbols

pond

proposed pond

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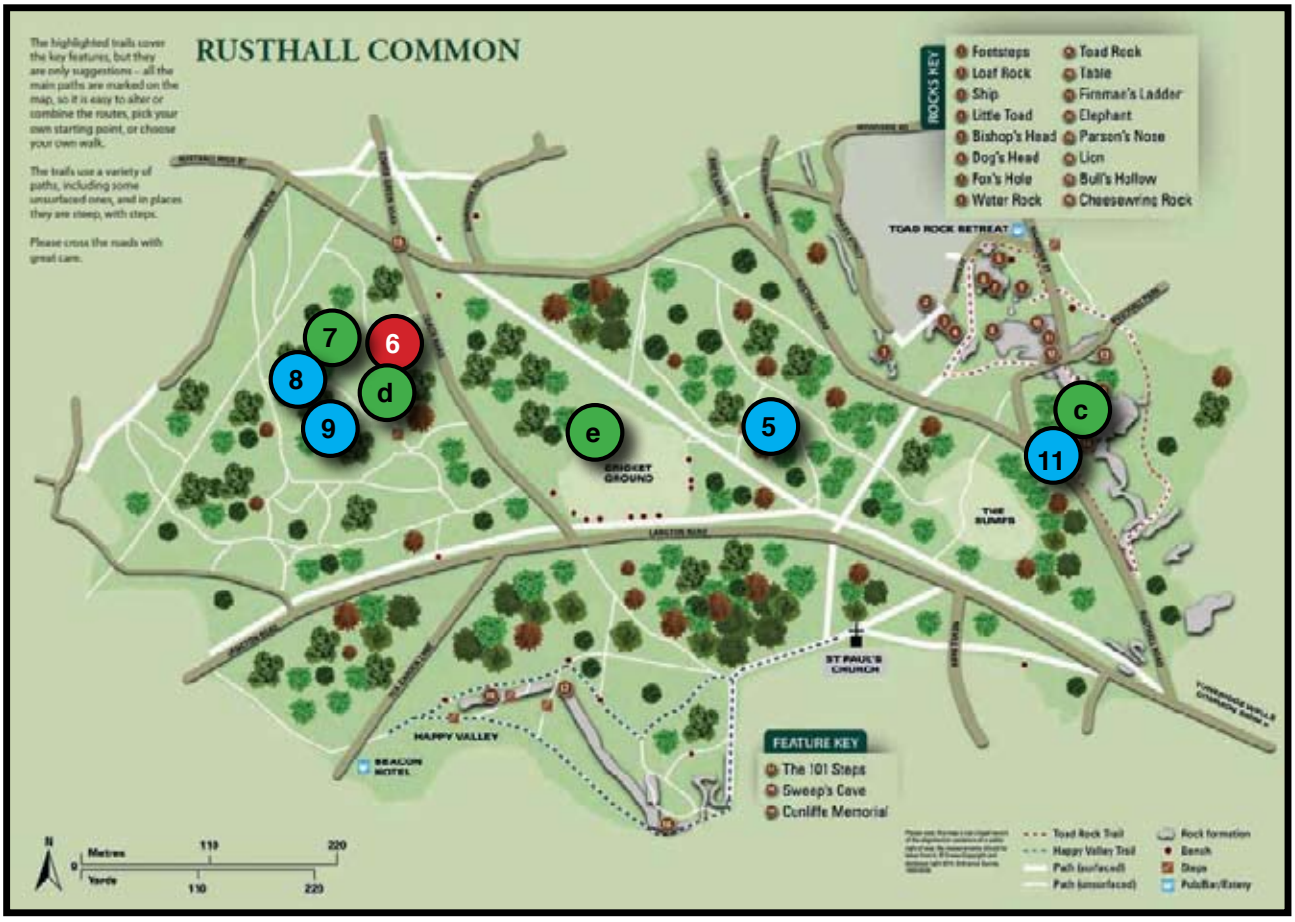
Fig. 4.2 Rusthall Common

Figure illustrates locations of known ponds.



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Key to Symbols

pond

gcn occupied pond

proposed pond

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5. New Pond Creation

New ponds have been proposed for both Commons (Figs. 4.1 & 4.2). Ponds will be created to satisfy a number of criteria:

- create new habitats
- increase biodiversity
- provide possible amenity/educational resource
- reinstate historical landscape feature
- help to provide drainage
- provide habitat specifically for great crested newt

5.1 Tunbridge Wells Common

5.1.1 Lower Section near Castle Road

Two locations have been proposed (on either side of Castle Road). Location *a* is situated in an area of short sward grassland that is regularly managed. Location *b* is situated amongst trees.

The available working area in Location *a* is larger meaning a pond with a greater surface area can be created. Logs covered by spoil from the pond construction can be used to help create sheltering places for overwintering amphibians. Current management of the grassland has created a short sward that constrains biodiversity interest. Creation of a pond at this location will enable a different management strategy to be employed around the pond that will help to increase biodiversity interest in terrestrial as well as aquatic habitats.

More resources will be required to create a pond in Location *b*; trees will need to be cut and stumps removed. Removal of trees at location *b* will have a greater impact on existing biodiversity interest than disturbance of the short sward grassland in location *a*. If a pond is created at location *b* it will be shaded and may require more ongoing management work (to remove leaf litter etc).

Recommendation: create new pond at location *a* with a surface area of 150 - 200 m^2.

5.2 Rusthall Common

Two locations have been proposed by the Freehold Tenants at Rusthall Common: Bulls Hollow (location *c*) and reinstatement of the smaller marl pit (WB7). Calumma Ecological Services recommends that two other locations also be considered (*d* and *e*). See Fig. 4.2.

5.2.1 Bulls Hollow

This location forms part of a geological Site of Special Scientific Interest. The primary objective would be to facilitate drainage away from the protected geological formation. A pond created at Bulls Hollow would be somewhat shaded and also likely rather ephemeral. Such waterbodies can offer good habitat for a wide variety of aquatic organisms. Creating a waterbody in this location would not have a significant negative impact on existing biodiversity interest and would potentially be within dispersal distance of great crested newts that are believed to occupy garden ponds in Rusthall (Fig. 3.1).

5.2.2 Smaller Marl Pit Pond

Reinstating the smaller marl pit (WB7) has been proposed by the Freehold Tenants in order to achieve two objectives: (1) reinstate an existing landscape feature & (2) provide habitat for great crested newt. A proposal has been made to open up a path from the lower of the two newer ponds (WB9) to the smaller marl pit and cut a drainage channel to feed the marl pit with water. Such an action could help to provide water but the reasons for water loss from the smaller marl pit must first be identified.

Marl pits were originally created by extracting marl (clay with concentrations of calcium carbonate) from the ground to spread over sandy soils and thus enrich the soil and improve its water holding capacity. Such practices were probably undertaken in Kent from at least the Iron Age and were certainly widely practiced in the Middle-Ages.

Marl pits typically hold water due to their clay substratum. A marl pit that no longer holds water may be experiencing rapid evaporation (particularly if it has a relatively high surface area to volume ration; i.e. it is shallow) and/or the clay base of the marl pit may have become compromised. Such damage could occur if the clay is relatively shallow and becomes cracked over time or if the marl pit is located amongst trees and the clay is perforated by roots. Probing tree roots may also result in increased water loss through transpiration.

In order to reinstate the smaller marl pit at Rusthall Common, it will probably be necessary to remove surrounding trees and repair the pond base (e.g. by excavating and repuddling with clay). If the pond is relined and found to hold water, it will be filled by normal winter precipitation. Although the creation of a drainage ditch from WB9 would help to increase water inflow, it also presents an increased risk of colonisation by fish.

Whilst work on WB7 will reinstate a historical feature and not have a significant negative impact on existing biodiversity interest, the resulting pond will remain small with a surface area of probably less than $100m^2$.

Ideally, ponds created as great crested newt breeding habitat should have a minimum surface area of at least 100 m^2 (if possible they should be 400 - $800m^2$).

5.2.3 Location *d*

An area of managed grassland located within 50 m of the larger marlpit (WB6). Creating a new pond at this location would have the following benefits: (1) a pond with an area greater than 100 m^2 could be created, (2) the pond would be rapidly colonised by newts from WB6. Unfortunately, creating a pond at location *d* may negatively impact on existing biodiversity interest (including great crested newt sheltering habitat). Also, since the location is so close to WB6 there is a high risk that invasive aquatic plants that already grow in the larger marl pit would also quickly spread to the new pond.

5.2.4 Location *e*

An area of short sward grassland that is associated with a local cricket club and managed for its amenity value. Creating a pond at this location would not significantly impact on existing biodiversity interests but would provide the following benefits: (1) a pond with an area greater than 100 m^2 could be created, (2) the pond is within colonisation distance of newts from WB6, (3) the pond would provide a 'stepping stone' between WBs 6 & 5.

Recommendation: Creating a new waterbody at Bulls Hollow (location *c*) and reinstating the smaller marl pit (WB7) can be undertaken without significantly compromising existing biodiversity interest. However, creating a new breeding pond for great crested newts on Rusthall Common should be considered a priority. The only existing breeding pond (WB6) is subject to public disturbance (with introductions of invasive plants and fish). If available resources are constrained and only one pond can be created in the near future, Location *e* is the preferred option.

Ponds created to benefit breeding great crested newt should have the following characteristics:

1. Minimum surface area 100 m^2.
2. Variable depth (maximum depth 1.5 m), with shallow margins.
3. Water to be fed by precipitation.
4. Natural colonisation of native aquatic vegetation
5. Minimum shading around boundary (<40%).
6. No fish introductions.
7. No encouragement of waterfowl through artificial feeding.
8. Surrounding terrestrial vegetation to be managed to encourage a structurally complex sward.
9. Installation of semi-buried log-piles and hibernacula at strategic locations within 50 m of shoreline.

6. References and Further Reading

Beebee, T. and Grayson, R. (1998) Site Assessment and Protection. In: *Herpetofauna Workers' Manual*. Gent, A. H. & Gibson, S. D. (eds.), Joint Nature Conservation Committee, Peterborough, p. 97.

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Griffiths, R. A. and Inns, H. (1998) Surveying. In: Herpetofauna Workers' Manual. Gent, A. H. & Gibson, S. D. (eds.), Joint Nature Conservation Committee, Peterborough, pp. 1 - 6.

Langton, T., Beckett, C. and Foster, J. (2001) Great Crested Newt Conservation Handbook. Froglife.

Young, S. and Brady, L. D. (2004) Rusthall and Tunbridge Wells Commons Management Advice. Calumma Ecological Services.

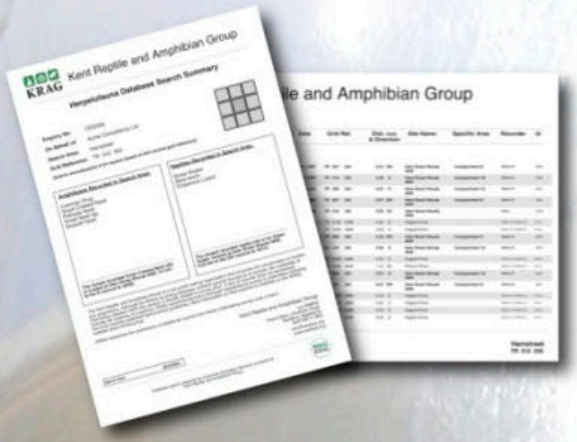
Appendix I: KRAG database search results: Tunbridge Wells Common

Source:

Kent Reptile and Amphibian Group (Ref: CES/16/186)

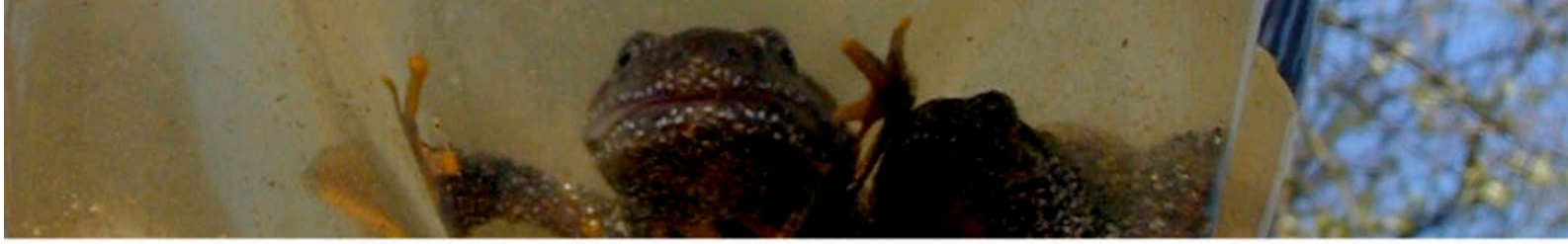
working with KRAG to promote best practice

KRAG



DATABASE SEARCH RESULTS

KENT REPTILE AND AMPHIBIAN GROUP



HERPETOFAUNA SEARCH RESULTS

The herpetofauna search results include only non-confidential records held on the Kent Reptile and Amphibian Group records database. The report consists of the following items:

1. Summary

A summary of all species recently reported from the search area (including distance to closest great crested newt record and distance to closest reptile record).

2. Risk Assessment

A risk assessment that summarises likely presence of species based on statistical analysis of nearest neighbour data and landscape level habitat suitability. The risk assessment also includes an appraisal of relative survey effort for the search area. The risk assessment only takes into consideration records collected within the last 20 years. Historical records are still listed within the report, but they are not included within the risk assessment calculation.

3. Record List

A list of validated observations reported from the search area. All stated distances are to the supplied grid reference.

4. Google Earth Record File

A kml file containing a summary of the listed records for displaying in Google Earth (or other compatible GIS system). The kml file includes species icons designed by *Aye-Aye Design*. Less precise grid references are represented by smaller icons, while older records appear more transparent. Metadata associated with each record can be viewed by clicking individual icons. Ordnance Survey maps can be reviewed by clicking the OS Map icon within the metadata (opens either directly within Google Earth or in a separate window within the user's web browser as preferred).

5. Google Earth Pond File

A kml file containing a summary of the pond records for displaying in Google Earth. The kml file includes details of all known ponds located within 1 km of the specified grid reference. Metadata associated with each pond can be viewed by clicking individual icons. If species records are available for the pond (or immediate vicinity), these will be listed. Ordnance Survey maps can be reviewed by clicking the OS Map icon within the metadata.

Please note that the pond data kml file is likely to change over time. We would request that users report any errors directly to KRAG so the dataset can be improved (e.g. incorrect pond locations, missing ponds etc). When reporting ponds to KRAG please quote the ARG ID (*WB123* etc). The pond database does not generally include small garden ponds.

Google Earth can be downloaded from:

http://earth.google.com

Remember that database searches are completely free to Conservation Partners and Corporate Members that contribute records to our system!

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Kent Reptile and Amphibian Group

Herpetofauna Database Search Summary

Enquiry No: CES/16/186

On Behalf of: Calumma Ecological Services

Search Area: Tunbridge Wells Common

Grid Reference: TQ 578 389

Search Radius (km): 1

Amphibians Recorded in Search Area:

Common Frog
Common Toad
Smooth Newt
Palmate Newt

list excludes historical observations

The closest recorded Great Crested Newt observation is located at [Private Residence], 1.35 km to the NW (record id: 27408).

Reptiles Recorded in Search Area:

Slow-worm
Grass Snake

list excludes historical observations

The closest recorded reptile observation is for Grass Snake, located at Tunbridge Wells Common, 0.42 km to the SW (record id: 26620).

The Kent Reptile and Amphibian Group is a non-profit making organisation that promotes the conservation of reptiles and amphibians. Although the KRAG recording database contains several thousands of records, the availability of information detailed within this search is directly related to survey effort. A lack of records does not necessarily indicate the absence of a species. KRAG recommends that a thorough herpetofauna survey is undertaken following the most recently published best practice guidelines.

KRAG welcomes the submission of additional records from those undertaking survey work in Kent.

Kent Reptile and Amphibian Group

c/o CES,
13 Woodside, Dunkirk,
Faversham, Kent

info@kentarg.org
www.kentarg.org

Search Date: 27/4/2016

Database search prepared by Calumma Ecological Services on behalf of Kent Reptile and Amphibian Group.

Kent Reptile and Amphibian Group

Species Risk Assessment

Enquiry No: CES/16/186

On Behalf of: Calumma Ecological Services

Search Area: Tunbridge Wells Common

Grid Reference: TQ 578 389

Amphibians

	Likelihood of Presence	
	Score	Dist (km)
Common Frog:	**HIGH**	**0.32**
Common Toad:	**HIGH**	**0.14**
Natterjack:	n/a	79.64
Smooth Newt:	**HIGH**	**0.32**
Palmate Newt:	**HIGH**	**0.32**
Great Crested Newt:	Likely	1.35
Marsh Frog:	*unlikely*	*11.34*
Alpine Newt:	n/a	35.24

Amphibian survey effort in local area is considered to be relatively high.

Reptiles

	Likelihood of Presence	
	Score	Dist (km)
Viviparous Lizard:	Likely	1.17
Slow-worm:	Likely	0.82
Sand Lizard:	*unlikely*	*80.59*
Grass Snake:	**HIGH**	**0.42**
Adder:	Possible	1.17
Smooth Snake:	n/a	n/a

Reptile survey effort in local area is considered to be relatively high.

 # ponds within 1 km: 16

distance to nearest pond (km): 0.29

This risk assessment is based on a nearest neighbour analysis of records available at the time of this search request. The assessment considers habitat characteristics for each species at the landscape level, but does not control for the suitability of available habitat at the specified grid reference. The risk assessment does not include historical records and may underestimate likely presence of a species in areas with limited survey effort. The risk assessment is provided for guidance only and should not be used in place of a full herpetofauna survey.

For sites with no waterbodies where the analysis suggests that amphibians are likely to be present, individual animals may use suitable terrestrial habitat for sheltering, foraging and/or dispersal.

Kent Reptile and Amphibian Group

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Search Date: 27/4/2016

Database search prepared by Calumma Ecological Services on behalf of Kent Reptile and Amphibian Group.

Appendix II: KRAG database search results: Rusthall Common

Source:

Kent Reptile and Amphibian Group (Ref: CES/16/187)

Kent Reptile and Amphibian Group

Herpetofauna Database Search Summary

Enquiry No: CES/16/187

On Behalf of: Calumma Ecological Services

Search Area: Rusthall Common

Grid Reference: TQ 563 393

Search Radius (km): 1

Amphibians Recorded in Search Area:

Common Frog
Common Toad
Smooth Newt
Great Crested Newt

list excludes historical observations

The closest recorded Great Crested Newt observation is located at Rusthall Common, 0.22 km to the NW (record id: 67919).

Reptiles Recorded in Search Area:

Viviparous Lizard
Slow-worm
Grass Snake

list excludes historical observations

The closest recorded reptile observation is for Grass Snake, located at Rusthall Common, 0.22 km to the NW (record id: 42334).

The Kent Reptile and Amphibian Group is a non-profit making organisation that promotes the conservation of reptiles and amphibians. Although the KRAG recording database contains several thousands of records, the availability of information detailed within this search is directly related to survey effort. A lack of records does not necessarily indicate the absence of a species. KRAG recommends that a thorough herpetofauna survey is undertaken following the most recently published best practice guidelines.

KRAG welcomes the submission of additional records from those undertaking survey work in Kent.

Kent Reptile and Amphibian Group

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www.kentarg.org

Search Date: 27/4/2016

Database search prepared by Calumma Ecological Services on behalf of Kent Reptile and Amphibian Group.

Kent Reptile and Amphibian Group

Species Risk Assessment

Enquiry No: CES/16/187

On Behalf of: Calumma Ecological Services

Search Area: Rusthall Common

Grid Reference: TQ 563 393

Amphibians

	Likelihood of Presence	
	Score	Dist (km)
Common Frog:	**HIGH**	**0.50**
Common Toad:	**HIGH**	**0.22**
Natterjack:	n/a	80.96
Smooth Newt:	**HIGH**	**0.22**
Palmate Newt:	**HIGH**	**1.24**
Great Crested Newt:	**HIGH**	**0.22**
Marsh Frog:	*unlikely*	*12.48*
Alpine Newt:	n/a	34.67

Amphibian survey effort in local area is considered to be relatively high.

Reptiles

	Likelihood of Presence	
	Score	Dist (km)
Viviparous Lizard:	Likely	0.71
Slow-worm:	Likely	0.50
Sand Lizard:	*unlikely*	*81.92*
Grass Snake:	**HIGH**	**0.22**
Adder:	Possible	1.12
Smooth Snake:	n/a	n/a

Reptile survey effort in local area is considered to be relatively high.

 # ponds within 1 km: 28

distance to nearest pond (km): 0.15

This risk assessment is based on a nearest neighbour analysis of records available at the time of this search request. The assessment considers habitat characteristics for each species at the landscape level, but does not control for the suitability of available habitat at the specified grid reference. The risk assessment does not include historical records and may underestimate likely presence of a species in areas with limited survey effort. The risk assessment is provided for guidance only and should not be used in place of a full herpetofauna survey.

For sites with no waterbodies where the analysis suggests that amphibians are likely to be present, individual animals may use suitable terrestrial habitat for sheltering, foraging and/or dispersal.

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c/o CES,
13 Woodside, Dunkirk,
Faversham, Kent

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www.kentarg.org

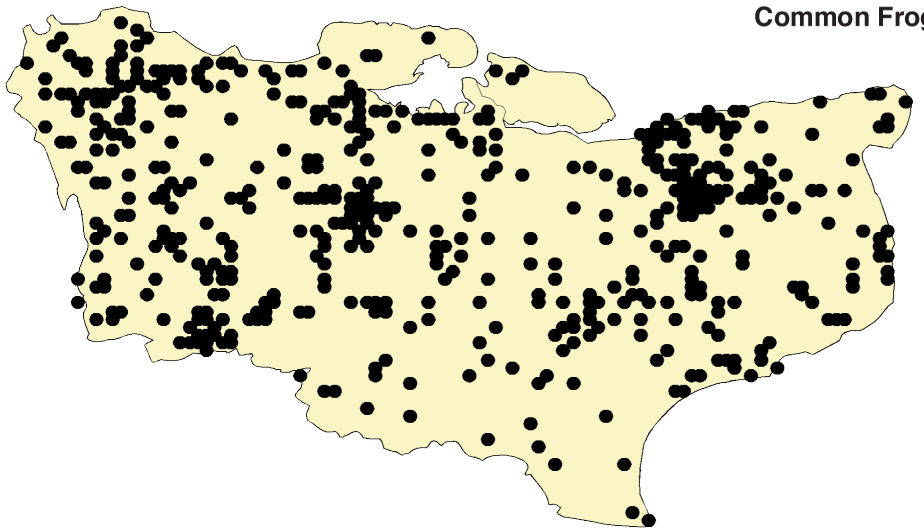
Search Date: 27/4/2016

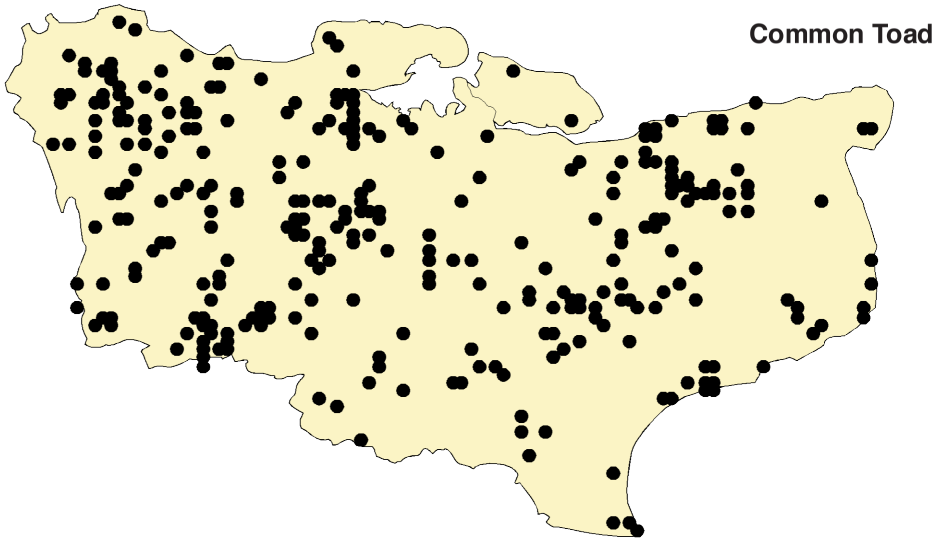
Database search prepared by Calumma Ecological Services on behalf of Kent Reptile and Amphibian Group.

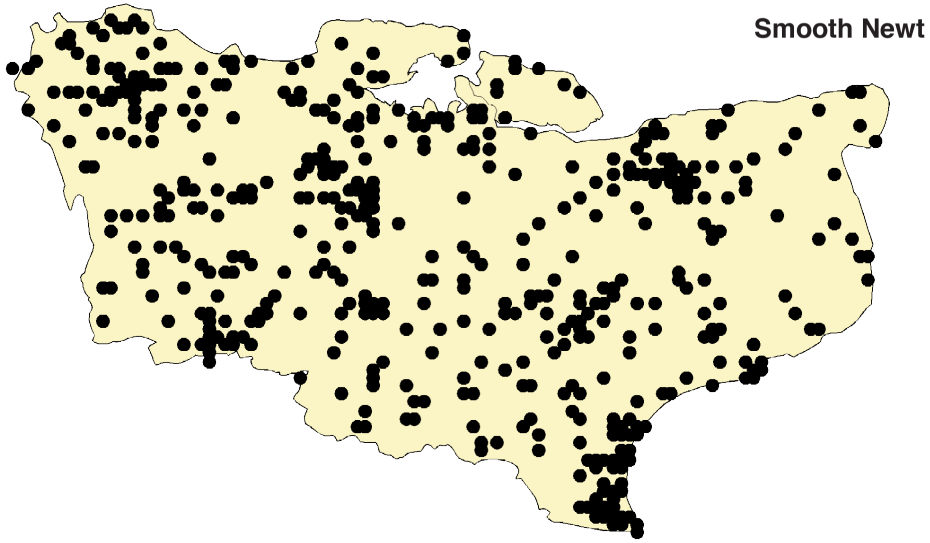
Appendix III: Recorded distribution of amphibians in Kent

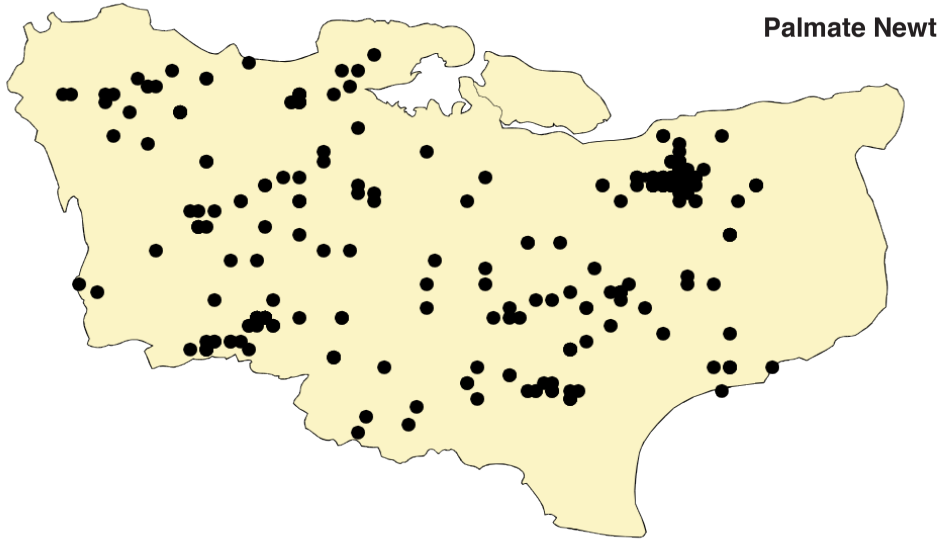
Source:

Kent Reptile and Amphibian Group









Amphibians

Recorded distribution of amphibians in vIce counties East Kent (15) and West Kent (16). The availability of records is directly related to survey effort. A lack of records does not necessarily indicate the absence of a species.

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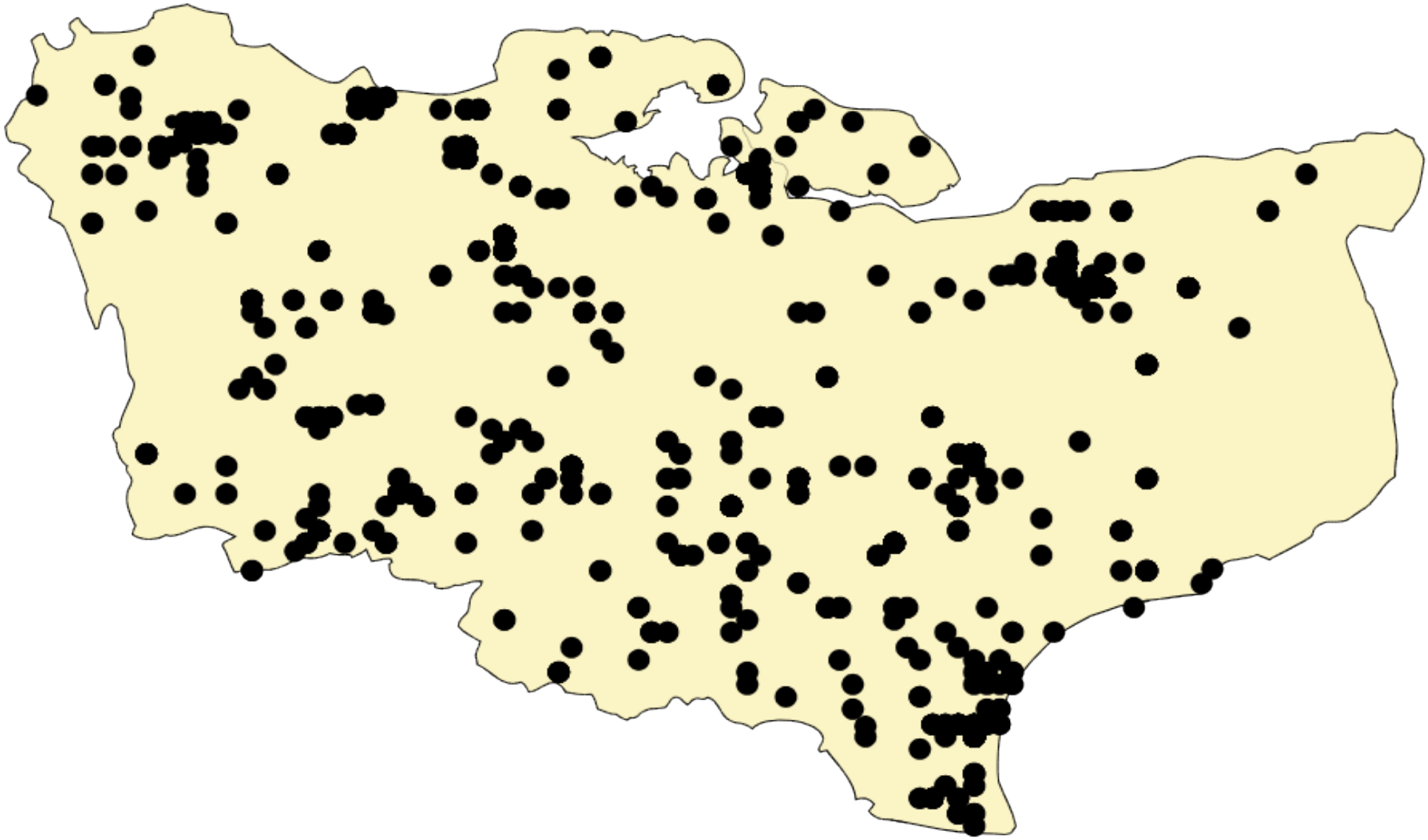

Great Crested Newt

Recorded distribution of great crested newt in vIce counties East Kent (15) and West Kent (16). The availability of records is directly related to survey effort. A lack of records does not necessarily indicate the absence of a species.

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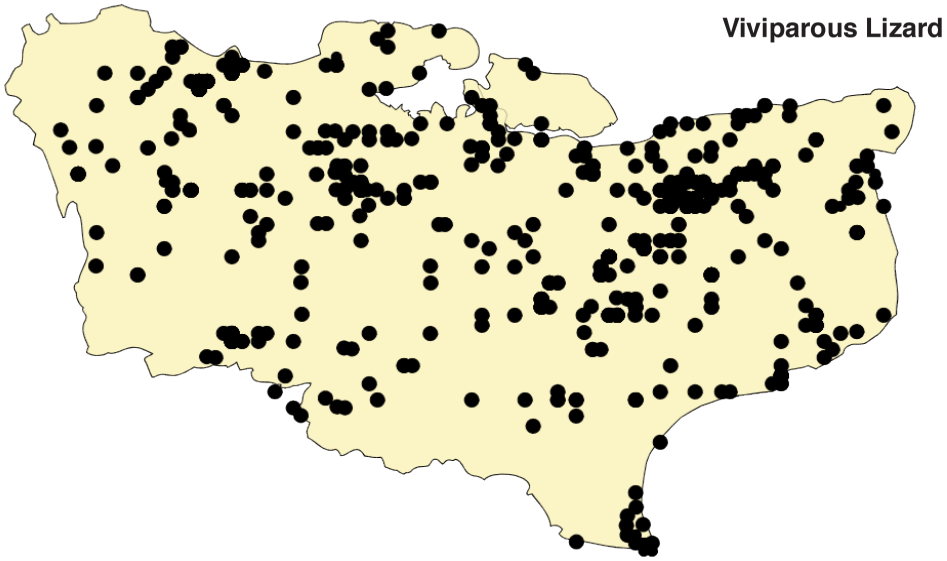
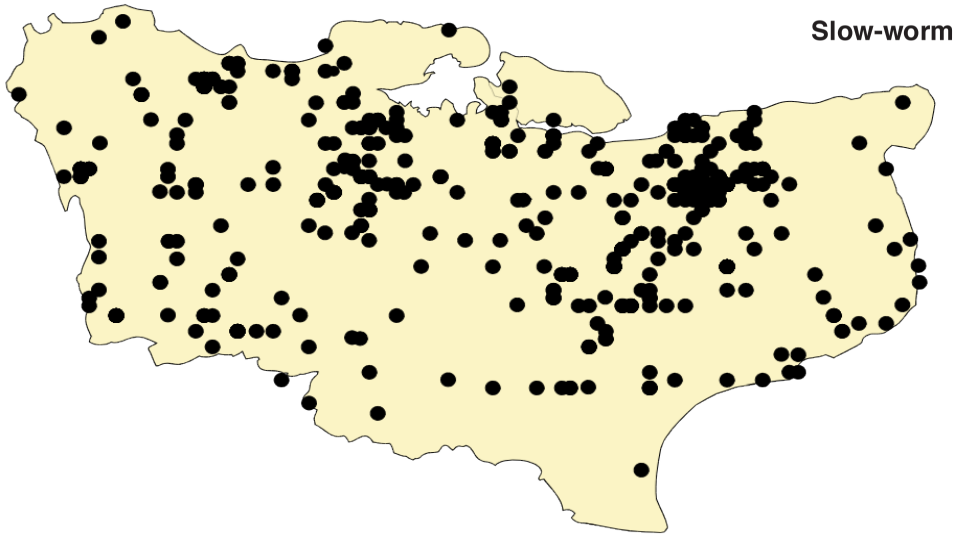
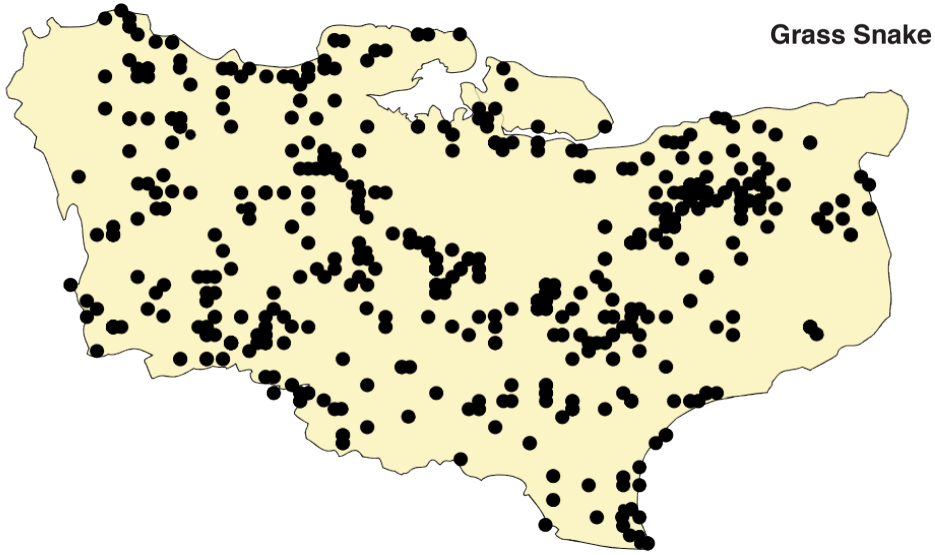
Appendix IV: Recorded distribution of reptiles in Kent

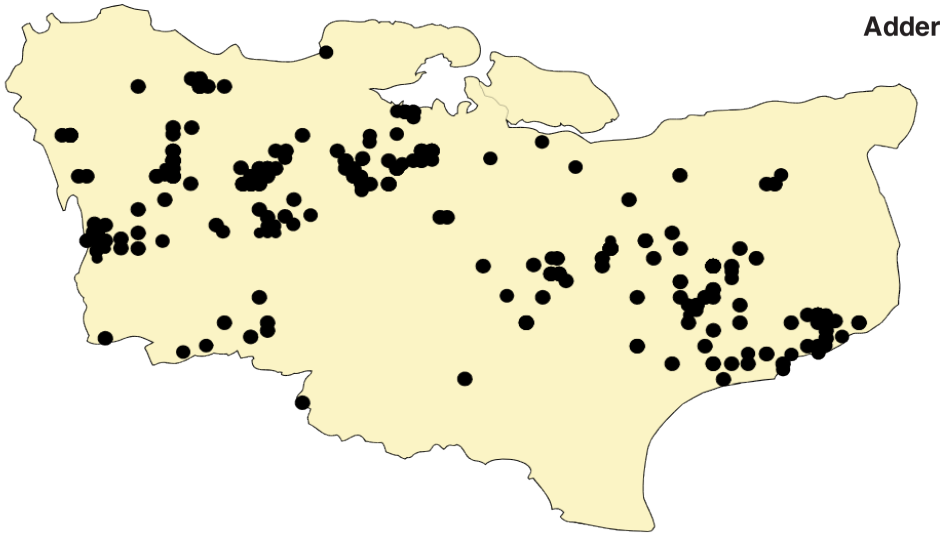
Source:

Kent Reptile and Amphibian Group









Reptiles

Recorded distribution of reptiles in vIce counties East Kent (15) and West Kent (16). The availability of records is directly related to survey effort. A lack of records does not necessarily indicate the absence of a species.

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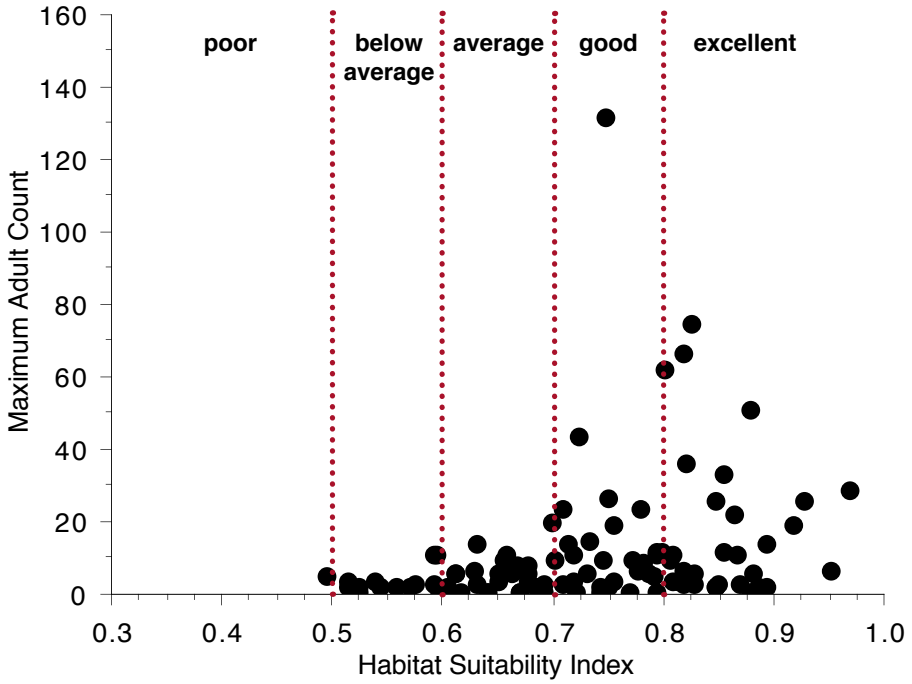
Appendix V: Habitat Suitability Indices

Source:

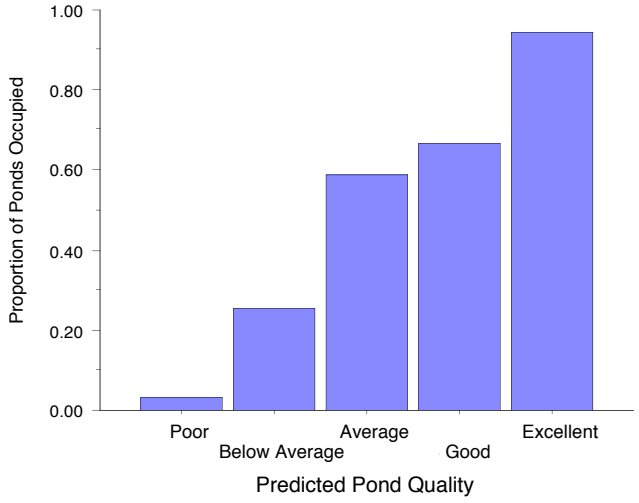
Calumma Ecological Services

Appendix. 1. Predicted Presence of Great Crested Newt.

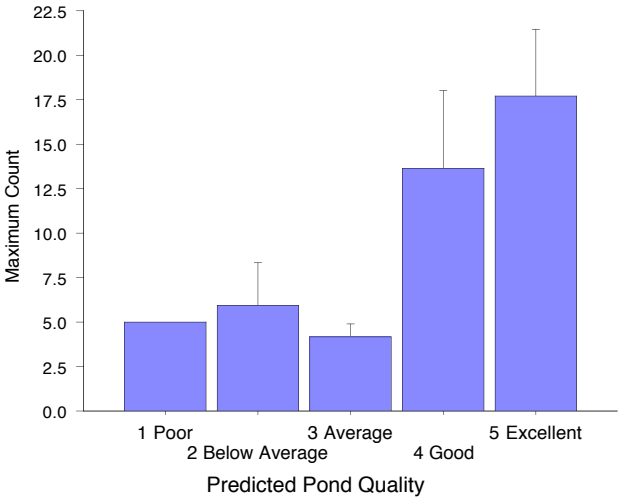
Figures illustrates relationship between predicted presence of great crested newt and field based observations. Predictions based on Habitat Suitability Indices (HSI) developed by Oldham *et. al*. 2000.



Qualitative description of pond suitability for great crested newt based on HSI score



Proportion of ponds occupied by great crested newt



Mean maximum adult great crested newt count (excluding ponds with zero count)

Appendix VI: Invasive Plants

Source:

Environment Agency

Would you like to find out more about us, or about your environment?

Then call us on
03708 506 506* (Mon-Fri 8-6)

email
enquiries@environment-agency.gov.uk

or visit our website
www.environment-agency.gov.uk

incident hotline 0800 80 70 60 (24hrs)
floodline 0845 988 1188

* Calls to 03 numbers cost the same as calls to standard geographic numbers (i.e. numbers beginning with 01 or 02).

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GEHO0410BSBR-E-E

2010 International Year of Biodiversity

Environment Agency

managing invasive non-native plants

Managing invasive non-native plants in or near fresh water

Revised version April 2010

We are the Environment Agency. It's our job to look after your environment and make it a better place – for you, and for future generations.

Your environment is the air you breathe, the water you drink and the ground you walk on. Working with business, Government and society as a whole, we are making your environment cleaner and healthier.

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April 2010

Foreword

People living in and visiting England and Wales are able to enjoy and benefit from a wide range of native plant-life. But sometimes the natural diversity is threatened by the introduction and spread of invasive non-native species.

While only a small percentage of non-native plants introduced in England and Wales represent a problem, when they do become established in the wild, certain types can have a dramatic effect. Careless disposal of garden waste, by dumping it over fences, hedges and into lay-bys, ditches, streams and ponds, increases the chances of these plants spreading into the countryside. This can lead to long-term consequences for native biodiversity.

Invasive non-native species can harm the environment in different ways. Whilst Himalayan balsam and water primrose are colourful and attractive, they often become so prolific that they displace native plants. Dense mats of floating pennywort or parrot's feather can choke watercourses leading to increased flood risk, reduced angling opportunities and problems for navigation.

Several non-native species are already well-established and are likely to spread further as a result of climate change. Others that are currently not a problem could become invasive as temperature rises create better growing conditions for them. The Invasive Non-Native Species Framework Strategy for Great Britain launched in May 2008, by Defra and the devolved administrations, has spurred public and private sector organisations, charities, local groups and individuals into action and much good work has been done to tackle local problems. The purpose of this guidance is to increase awareness of some of the invasive non-native plants that are a priority for us and to provide advice on how the problems they cause can be reduced.

We are publishing this revised guidance, in the International Year of Biodiversity, as part of our contribution to the conservation of wildlife along the waterways and fresh waters in England and Wales.

Paul Leinster
Chief Executive, Environment Agency

Contents

What are invasive weeds?

Several types of plant can become invasive weeds. They are either native species that grow well in disturbed or nutrient-enriched conditions, to the detriment of other plant and animal species, or non-native plants that have been introduced to this country by accident or as a consequence of trade or deliberate collection. The latter tend to grow in situations where native plants of similar form do not. Not all non-native species become weeds, but if they do, they become very difficult to control. Native weed species, although troublesome, do not cause as much ecological or physical damage as the non-native variety. This booklet deals with those non-native invasive species that have caused serious problems in the aquatic and riparian environments of Britain.

Invasive non-native species tend to share characteristics that make them successful. These are related to the method of reproduction, growth rate, growth form and persistence, but in particular the absence of pests and diseases and their consequent resistance to control. Species in aquatic plant families are more likely to be both weedy and invaders of natural environments than those of any other plant families. In addition, the frequently disturbed nature of man-made aquatic habitats and artificial nutrient enrichment of aquatic systems makes them more prone to invasion. Successful management of alien invasive species requires an understanding of how they grow and also the ecology of the aquatic systems in which they occur.

The introduction of plant species into new environments carries risks. The danger of species becoming serious weeds in agricultural areas is well controlled, but other potential weeds are not currently recognised and subject to risk assessment and management. The effects of climate change will alter the distribution of weed species in future; already, several aquatic weeds found in Europe originated in sub-tropical areas of the world. The predicted consequences of global warming, including increased temperatures, increased carbon dioxide and stormier weather, make it more likely that additional invasive species will cause problems in future. The huge increase in the distribution of Himalayan balsam since 1962 indicates that conditions are ideally suited for this species. Other species may respond similarly in future if climate change favours their colonisation and rapid growth. Plants that grow in water and on riverbanks can cause flooding if not managed correctly. All the species described in this booklet create serious flood risks.

The consequences and costs of invasive non-native species are huge. The annual cost of invasive non-native species in Europe is estimated as at least 19.1 billion Euros a year. This booklet tells you how to identify seven problem species and how to reduce their threat to aquatic ecosystems.

Existing legislation

When non-native species become invasive they can transform ecosystems, causing a variety of problems including seriously threatening native and endangered species. These problems are acknowledged in several international treaties, European Union Directives and also in domestic legislation. The problems caused by some invasive non-native species occur worldwide, and international obligations to address them are placed on the United Kingdom through regional and global agreements. These include the Convention on Biological Diversity (CBD), International Plant Protection Convention (IPPC), the Bern Convention on the Conservation of European Wildlife and Natural Habitats, and the EC Habitats and Species Directive. The sixth CBD conference adopted a series of Guiding Principles for States to follow as part of their invasive non-native species policies.

The Wildlife and Countryside Act 1981 provides the primary controls on the release of non-native species into the wild in Great Britain. It is an offence under section 14(2) of the Act to 'plant or otherwise cause to grow in the wild' any plant listed in Schedule 9, Part II. The seven plants described within this booklet will all be included in Schedule 9 from April 2010.

Stricter enforcement provisions for wildlife offences were introduced under the Countryside and Rights of Way Act 2000. These include increased penalties available to the courts for offences committed under the Wildlife and Countryside Act 1981.

The Weeds Act 1959 provides for the control of five specified weeds. These are non aquatic species, though ragwort, (Senecio jacobaea), can grow in riparian areas. This legislation is directed at clearing weeds that threaten agricultural production.

The Government has acknowledged the problems that can be caused by non-native invasive species. In 2008 the Government launched 'The Invasive Non-Native Species Framework Strategy for Great Britain'. The strategy provides a framework for a more co-ordinated approach to invasive species management. It seeks to create a stronger sense of shared responsibility across government, key organisations, land managers and the public.

Other legislation relevant to non-native species control includes:

- Environmental Protection Act 1990
- Environmental Protection (Duty of Care) Regulations 1991
- Town and Country Planning Act 1990
- Highways Act 1980
- Water Resources Act 1991
- The Environmental Permitting (England and Wales) Regulations 2007
- The Landfill (England and Wales) Regulations 2002

The Non-Native Species Secretariat has been established to oversee the implementation of the strategy. Details of the secretariat are available at www.nonnativespecies.org. This site also provides valuable reference material, such as identification sheets, species risk assessments and action plans, and details of local action groups that may be active in your area.

Responsibility for invasive weed control

Responsibility for dealing with invasive weeds rests with individual landowners. Strategic, widespread control is currently not the sole responsibility of any statutory organisation. The Environment Agency may seek to control specific invasive weeds on land that it owns or flood defence structures that it maintains.

Control efforts by individuals can help reduce the spread of invasive non-native species and are most successful if carried out as a catchment wide co-ordinated strategy with collaboration of all relevant parties. Control often needs to be repeated year after year.

General methods of control

There are four basic methods of controlling weeds: mechanical, chemical, natural and environmental. Mechanical control includes cultivation, hoeing, pulling, cutting, raking, dredging or other methods to uproot or cut weeds. Chemical control uses specific herbicides. Natural control uses pests and diseases of the target weed to weaken it and prevent it from becoming a nuisance. Environmental control works by altering the environment to make it less suitable for weed growth, for example by increasing or decreasing water velocity.

In England and Wales the use of herbicides in or near rivers, canals, lakes and drainage channels requires prior agreement from the Environment Agency. Users must follow the instructions on the label.

Health and safety

Take care when using machinery or herbicides. Environment Agency staff, contractors and others should undertake Control of Substances Hazardous to Health (COSHH) assessments for the activity, and others should be aware of the risks of working near water. There is often a high risk of slipping on banks and other muddy surfaces when carrying equipment or chemicals.

All mixing and application of herbicides must be carried out in accordance with the manufacturer's instructions, which will be found on the product label. All precautions recommended by the manufacturer must be followed.

Although most species in this booklet are not toxic to humans, great care should be taken to avoid contact with the sap of giant hogweed, as this can cause serious skin blistering.

Disposal of non-native weeds

Plant material is considered a 'controlled waste' and must be disposed of in accordance with, and environmental permit issued under, the Environmental Permitting (England and Wales) Regulations 2007, unless one of the exemptions set out in Schedule 3 of these regulations applies, although exemptions also require registration with the Environment Agency.

The correct disposal of plant material as part of mechanical control is vital. It is best to contact the Environment Agency for advice on disposal because there are Regulations which cover the composting, burning and burial of plant materials on-site and transfer and disposal of material to permitted landfill sites. Any burning must not produce excess smoke or create a nuisance and must take place on a hot fire consisting of wood or clean timber. Plastic and other rubbish must not be burnt. Tyres and petrol must NEVER be used to start a fire. The Environment Agency can give advice on suitable disposal sites and disposal methods.

Japanese knotweed will survive composting and therefore this method of disposal is NOT advisable. Japanese knotweed must only be buried or burnt in accordance with Environment Agency advice. Failure to ensure safe legal disposal or obtain an appropriate licence or exemption could result in prosecution. Burial on-site may require a licence under the Landfill Regulations 2002, whilst removal of plant material will need to be carried out by a licensed waste carrier and buried at a licensed landfill site. Further advice is available from 'The knotweed code of practice – managing Japanese knotweed on development sites', published by the Environment Agency.

Monitoring

New records of the plants described in this booklet will be helpful in assessing how fast they are spreading and determining local control options. If you see any of these species, please tell Dr Jonathan Newman, Centre for Ecology and Hydrology – jone@ceh.ac.uk, or telephone 01491 692556. Information required is the exact location, with a map grid reference if possible, the extent of the infestation and the kind of water body it is affecting.

What to do and what not to do

Do:

- take immediate action;
- contact the Centre for Ecology and Hydrology to confirm identification and the location of the plant;
- seek advice on correct management for your specific location;
- obtain approval from the Environment Agency if planning to use herbicides;
- remove all plant debris from the water after cutting operations;
- seek advice from the Environment Agency on the disposal of plant material;
- alert your neighbours to the problem.

Don't:

- delay in doing something;
- allow the plant to spread to nearby water bodies;
- dispose of cut material in the nearest water body;
- use invasive non-native species in habitat restoration projects.

Fact file

Japanese knotweed

Source: NBN Gateway. Check website for current distribution

Japanese knotweed was first brought to Britain in the mid-nineteenth century as an ornamental garden plant. Since then it has caused serious problems in a range of habitats – particularly roadsides, riverbanks and derelict land – by displacing native flora and even causing structural damage. There are three species of invasive knotweed in the UK: Japanese knotweed (Fallopia japonica); giant knotweed (Fallopia sachalinensis); and hybrid knotweed (Fallopia x bohemica), which is a cross between Japanese and giant knotweed. Japanese knotweed is the most widespread and troublesome bankside species, followed closely by hybrid knotweed, which has a similarly high regeneration capacity.

Only female plants are present in the UK. Japanese knotweed forms dense clumps with fleshy, red/green shoots, 2-3m tall, which have hollow green stems with red/purple flecks. Leaves are green, heart or shield-shaped with a flat base, up to 120mm long. Creamy clusters of flowers are borne on the tips of most stems in late summer. The root system consists of rhizomes which are orange/yellow when cut.

The underground rhizome system can extend at least 7m from the parent plant, and reach a depth of 3m or more. A piece of rhizome the size of a little finger nail can grow into a new plant. The crown, located at the base of the stem, will produce new plants. The stems die back in winter and take up to three years to decompose. Japanese knotweed should not be removed from site without a waste licence.

Control

Knotweed should be cut with a single clean cut near the base of the stem. Cutting methods that produce fragments, such as flailing, should be avoided. Stems can regenerate from nodes, or fragments of nodes. If cut stem is dried until it is crisp and brown it can be burnt or disposed of as an inert waste. If stems have been pulled up, they will have fragments of knotweed crown still attached at their base. This is highly regenerative and will regrow, even after the stem has dried. Avoid pulling stems. Refer to the code of practice for their disposal.

Chemical control using a biactive formulation of glyphosate approved for use in or near water is the most effective treatment near water. Spraying both top and underside of leaves improves control. Chemical treatment is most effective when it is applied in Aug-Sept, particularly when applied to mature uncut growth. This provides the greatest surface area for herbicide to be translocated down to the rhizome. A stem injection method can be used to avoid damage to surrounding sensitive areas.

The knotweed code of practice is available on the Environment Agency website. Copies can also be requested by calling the Environment Agency National Customer Call Centre on 08708 506 506. The code was written to provide advice on the management of Japanese knotweed on development sites, but much of the advice regarding control and disposal may be useful for riparian control.

Contact the Environment Agency for disposal advice on 08708 506 506

Non-chemical control

Cutting

Use a simple scythe method of cutting to prevent stem fragmentation. Flail mowing, or similar methods, should not be undertaken.

Cutting will have to be performed every 2-4 weeks during the growing season if it is the sole method of management. Alternatively, treat regrowth with herbicide.

Burn cut stems on site or remove to landfill (licence required).

Digging

This is rarely an option that is appropriate to riparian situations. If digging is undertaken, refer to the code of practice and ensure that no knotweed material is allowed to enter the watercourse.

Biological

Grazing of shoots by horses, donkeys, sheep and goats may keep the plant in check, provided previous dead growth is removed.

The psyllid bug Aphalara itadori will be released in 2010 and should reduce the vigour of Japanese knotweed in the UK.

Chemical control

Glyphosate

Glyphosate is more effective when applied to mature canes in Aug-Sept. If access or the risk of drift is a problem, either cut or spray the stems earlier in the season to restrict regrowth. For formulations approved for stump treatment, a 1 in 10 dilution can be used for stem injection.

2,4-D amine

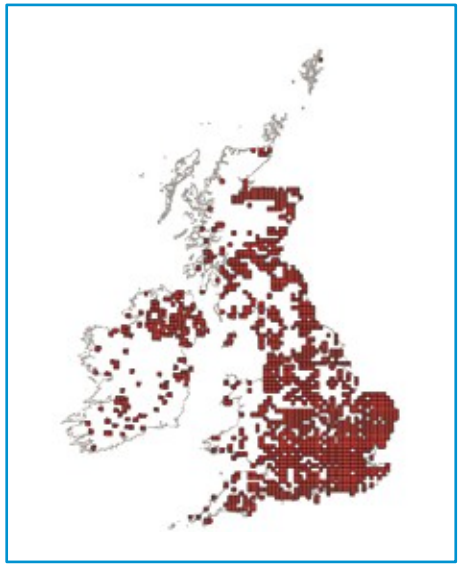
2,4-D Amine is also effective against knotweed and is best applied in May.

In general

Herbicides can be applied using tractor-mounted, knapsack long-lance or CDA applicators. Control is easier if dead winter stems are removed before growth commences. Be careful to avoid spreading knotweed crowns when clearing dead canes. Application in sensitive areas is best achieved by stem injection or weed wiper.

Fact file

Giant hogweed



Source: NBN Gateway. Check website for current distribution

Giant hogweed (Heracleum mantegazzianum), is a native of the Caucasus mountains and was introduced to Britain in 1893 as an ornamental plant. It escaped from gardens and now colonises many areas of wasteland and riverbanks. Each flowerhead produces several thousand seeds that are easily dispersed by water, so the plant spreads rapidly along watercourses.

It is a perennial plant, taking up to four years to mature and flower, after which it dies. It forms dense colonies that suppress the growth of native plants and grasses, leaving the banks bare of vegetation in winter and increasing the risk of erosion and recolonisation from seeds washed downstream.

Growth starts in March and the plants reach 5m in height. The leaves are dark green, and form a rosette. The lobes are deeply cut and spiked at the ends. The stems are green with dark red or purple spots or blotches. Stems are ribbed, with sparse spiky hairs on the ridges. The stems are hollow and up to 100mm across. The flowers are white, forming a large umbel. Each plant produces up to 50,000 seeds,

approximately 10mm long by 7mm wide. Seeds may remain viable for up to 15 years.

Control

The aim should be to kill the plant or prevent flowering. Repeated treatment may be necessary during the growing season to prevent flowering.

Chemical control using glyphosate at 6 litres/ha is the most effective method. Spraying can start as soon as the plant is about 1m high, usually in March and continue throughout the summer. More than one application is often necessary and follow-up spraying will be required to kill seedlings in subsequent years.

Cutting down the stems with a sharp scythe or sickle before flowering will help to control this plant. Flail mowing may be carried out, but extreme caution is required to avoid the risk of being sprayed with sap. Strimming is not recommended, unless full protective clothing is worn.

Digging out the crown just below ground prevents regrowth and will provide good control. Alternatively, make a spade cut at 45 degrees to sever the tap root at approximately 15cm below soil level.

Health hazard

Children have been known to use the hollow stems as 'pea shooters' and 'telescopes'. However, the stems, edges and undersides of the leaves bear small hairs containing poisonous sap, and the slightest touch causes painful blistering and severe skin irritation. Unshaded habitats with high soil nitrate levels (for example, riverbanks, roadsides and waste ground) tend to produce greater quantities of toxins in the plant. Contact with the cut material in sunlight produces a skin reaction in almost all cases. Blistering symptoms occur 24-48 hours after exposure, and dense pigmentation is visible after three to five days. This may persist for six years or more. Cut material remains active for several hours after cutting. Protective clothing must be worn when treating this plant because the hairs can penetrate light fabrics.

Contact the Environment Agency for disposal advice on 08708 506 506

Non-chemical control

Cutting

Cut root approximately 15cm below ground using a spade. Wear full protective clothing, especially if strimming. Cut regularly early in the season to prevent flowering. Cutting should be repeated regularly for between 5 and 10 years to eradicate the plant.

Digging

Shallow excavation to about 20cm will remove the growing crown. Spoil should be disposed of at landfill or by piling on site and composting. Any regrowth should be treated chemically.

Biological

Grazing by cattle, sheep, pigs or goats throughout the growing season will suppress growth, but does not eradicate it. There is further research into potential biological controls.

Chemical control

Glyphosate

In mixed stands, use a weed wipe when plants are about 1m tall between March and May. When plants are more than 1.5m tall, proceed with extreme caution. Repeat chemical treatment may be required for up to 10 years.

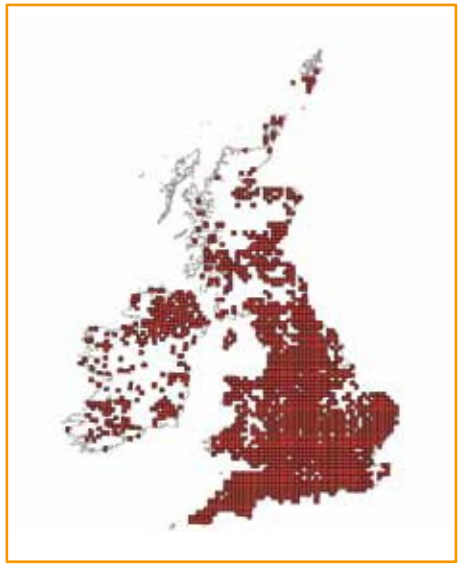
Cutting the stem above ground, followed by injection of 1 in 10 dilution of glyphosate in water below the first node, will give good control. This technique can be used for established plants later in the season.

In general

It is essential to establish vegetation quickly after control measures have been applied. Dense grass sward tends to discourage seed germination. Control should be undertaken on a catchment basis, working from the upstream end to prevent seed recolonisation.

Fact file

Himalayan balsam



Source: NBN Gateway. Check website for current distribution

Himalayan or Indian balsam (Impatiens glandulifera) is a native of the western Himalayas. Introduced to Britain in 1839, it escaped from gardens and rapidly colonised river banks and areas of damp ground. It is the tallest annual plant in Britain, growing up to 3m high. The characteristic purplish-pink slipper-shaped flowers appear in June. When the seed pods mature, they explode when touched, scattering the seed up to 7m away. Seeds are also spread by water and they may remain viable for up to two years.

Himalayan balsam plants grow in dense stands that suppress the growth of native grasses and other flora. In autumn the plants die back, leaving the banks bare of vegetation, and therefore liable to erosion.

The stems are pinkish-red, hollow and jointed, often with some branching. Leaves and side branches originate from stem joints. The stem is sappy and brittle. The shiny dark green leaves are lance-shaped, have serrated edges, a dark red midrib and can be up to 150mm long. They grow on the stem in whorls of three. Purplish-pink flowers, held on long stalks, appear from June to October.

The white, brown or black seeds are produced from July to October and are 4-7mm in diameter. There are between 4 and 16 seeds per pod.

Control

Control measures should aim to prevent flowering, and are best carried out before June for maximum effectiveness.

Chemical control near water can be carried out with herbicides containing glyphosate or 2,4-D amine. Glyphosate will also kill grasses, but 2,4-D amine will kill only broad-leaved weeds; for best effect, use when the plant is small and actively growing, particularly in springtime.

Cutting, strimming or pulling on a regular basis for about three years will be effective and may even eradicate the plant from isolated sites. Plants must be cut below the lowest node to avoid reflowering.

Contact the Environment Agency for disposal advice on 08708 506 506

Non-chemical control

Cutting

Cut at ground level using a scythe, machete, flail or strimmer before the flowering stage in June. Cutting earlier than this will promote greater seed production from plants that regrow. Cutting should be repeated annually until no more growth occurs.

Pulling

Shallow-rooted plants can be pulled up very easily and disposed of by burning, or composting unless seeds are present.

Biological

Grazing by cattle and sheep is effective from April throughout the growing season. It should be continued until no new growth occurs. There is encouraging evidence for the potential for biological control.

Chemical control

Glyphosate

Treatment with a weed wipe in mixed stands, or by foliar spray in dense stands, before flowering. If all plants are controlled, then spraying programmes should only be required for two to three years.

2,4-D amine

Treat during early spring at the rosette stage for effective control.

In general

It is essential to establish vegetation quickly after control measures have been applied. Dense grass sward tends to discourage seed germination. Control should be undertaken on a catchment basis, working from the upstream end to prevent seed recolonisation.

Fact file

Australian swamp stonecrop

Source: NBN Gateway. Check website for current distribution

Australian swamp stonecrop (Crassula helmsii) was introduced from Tasmania to Britain in 1911. It was first sold as an 'oxygenating plant' in 1927.

The first occurrence in the wild was reported in Essex in 1956. In recent years, it has spread much more rapidly due to the increased availability of the plant at garden centres and aquatic nurseries. It is now widespread across the UK. It is sometimes referred to as Tillaea recurva, Tillaea helmsii, or New Zealand pigmy weed.

The plant is easily dispersed and, although not always sold by suppliers, it is often found as a 'contaminant' with other water plants. Introductions to new sites are associated with a wide range of human, water-based activities, and awareness and education programmes can dramatically reduce transport of the plant between sites. Local dispersal is aided by the high viability of small fragments, which can be carried on mud to new sites.

The success of Crassula lies mainly in its ability to colonise virtually any

suitable static to very-slow-flowing freshwater habitat across a wide range of water chemistry. It has vigorous, year-round growth, and can grow equally well either on damp ground or in water up to 3m deep.

Where Crassula invades, it quickly out-competes native vegetation, and maintains its dominance by very rapid growth and uptake of almost all the available nutrients.

There are three typical growth forms: (i) a terrestrial form with creeping stems and aerial, succulent leaves; (ii) an emergent form with densely packed stems, found in water less than 0.6m deep; (iii) and a submerged form that grows from a basal rosette with long, sparsely-leaved stems reaching the surface. The three forms change according to prevailing conditions. The rigid stems have pairs of fleshy leaves that vary in shape from long and narrow in deeper water to slightly elliptical, with sharp or bluntish tips in air. The leaf tip is never notched, which distinguishes it from the native water starwort (Callitriche spp.). The leaf bases are joined, forming a distinctive 1mm collar around the stem. In summer, white flowers grow in the axils of the leaves on emergent and terrestrial forms.

Control

This plant is best treated at the early stages of infestation. Delay will make the problem several orders of magnitude worse in each successive year.

Emergent growth can be controlled using a highly dilute, high volume solution of glyphosate (5ml/l), applied at a walking rate of 6 seconds per metre. This provides a treatment of 6l/ha.

Cutting is not recommended, but dredging out marginal and emergent material can be effective, as the plant is shallow-rooted. The area around any infestation should be fenced to prevent movement of fragments by livestock. Dredged material should be piled in heaps and covered with thick black polythene sheeting or at least 20cm of soil.

Shading of terrestrial or emergent forms with opaque material such as black polythene for about three months may be effective, but is difficult to install and manage, and vandalism can be a problem.

Contact the Environment Agency for disposal advice on 08708 506 506

Non-chemical control

Cutting

Not recommended.

Dredging

Dredging of marginal and emergent material throughout the year can be effective, although it is necessary to ensure that plant fragments cannot be transported elsewhere.

Shading

Covering with black polythene or similar for up to 3 months during the growing season.

Chemical control

Glyphosate

Application of glyphosate at 6 litres/ha to emergent stands from March to October. Regular treatment is required, and at least two applications may be necessary each year.

Submerged

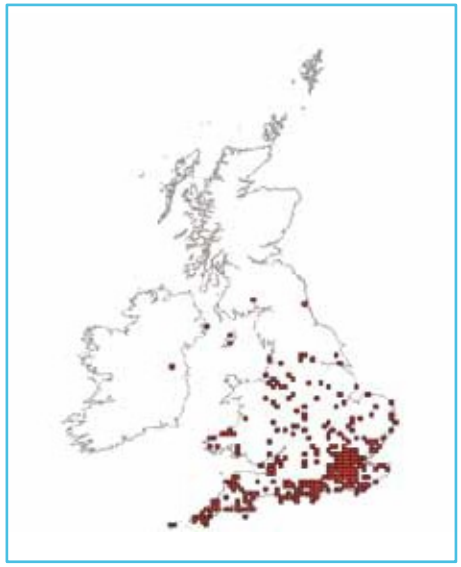
There is no effective herbicide treatment for submerged Crassula. Draw down or drain the waterbody, if possible, and treat as emergent growth.

In general

Regular treatment is necessary. Weed wiping may be appropriate in mixed marginal vegetation. Spot treatment of small patches will prevent complete dominance. Treat early and regularly.

Fact file

Parrot's feather



Source: NBN Gateway. Check website for current distribution

Parrot's feather (Myriophyllum aquaticum) is a native of lowland central South America. It was first found in Britain in 1960 and has now spread extensively, particularly in southern England. It grows in ponds, reservoirs, gravel pits, streams, canals and ditches, particularly where eutrophic water occurs. It can grow as a terrestrial plant when a pond dries out, and has even been found growing on the dry bank of a rubbish tip in Cornwall. It produces emergent shoots in addition to submerged ones, which give it the characteristic feathery appearance, hence its name.

Only female plants are established in the UK and it therefore spreads by vegetative means only. The stems are brittle and the plant propagates by growth from small stem fragments. The species is attractive to look at and is widely grown in garden ponds. Introductions to the wild are usually not deliberate, but fragments can be concealed in the soil of other pot plants sold at aquatic garden centres and nurseries.

Contact the Environment Agency for disposal advice on 08708 506 506

Control

Chemical control can be achieved by applying glyphosate with the adjuvant Topfilm to emergent growth. Hand-pulling can be a very effective method of control.

Volunteer groups can tackle large infestations with the use of rakes and forks. Care is needed to ensure fragments do not drift and establish growth elsewhere.

Non-chemical control

Pulling

Material must be removed from the water as soon as possible. Fragmentation must be avoided. Material should be removed as often as necessary and at least every six to nine weeks from March to October to weaken the plant.

Dredging

Dredging shallow areas will remove this plant very effectively. Carefully pulling out stems by hand after mechanical removal will help to eradicate it.

Biological

The plant is not palatable to herbivores; cattle and horses will avoid it. There is virtually no insect damage to plants in the UK, but research into biological control agents is under way.

Chemical control

Emergent

Apply glyphosate at 6 litres/ha to emergent stands from March to October. Regular annual treatment is required, and at least two applications will be necessary each year. The adjuvant Topfilm improves efficacy.

In general

Regular treatment is necessary. Weed wiping with glyphosate may be appropriate in mixed marginal vegetation. Spot treatment of small patches will prevent complete dominance. Treat early and regularly.

Fact file

Floating pennywort

Source: NBN Gateway. Check website for current distribution

Floating pennywort (Hydrocotyle ranunculoides) is a native of North and South America. It was first brought to Britain in the 1980s as a plant for tropical aquaria and garden ponds, and was first noted in the wild in Essex in 1991.

Floating pennywort grows in the shallow margins of slow-flowing eutrophic water bodies (particularly ditches, slow flowing dykes and lakes), and forms dense interwoven mats of vegetation. These quickly cover the water surface interfering with both the ecology and amenity uses of the water body. These mats grow up to 15m from the bank in a single season, with stem growth rates of up to 20cm per day.

Floating pennywort roots freely from nodes at approximately 40-150mm intervals. The roots are profuse and hair-like. The leaves are emergent, rising on stalks from horizontally growing stems. Both the stem and the petioles are fleshy. The leaf form ranges from circular to kidney-shaped; they are deeply lobed, and up to 180mm across. Leaves are held above the water surface whilst the interwoven mat of roots and stems sink up to 1.2m into the water.

Reproduction in Britain is thought to be principally vegetative, and the plant is capable of forming extensive mats from the smallest shoot fragment. Introduction by seed from growth in indoor aquaria, however, may also have occurred. Floating pennywort can double its wet weight in as little as three days. The plant exhibits seasonally variable growth in Britain. Maximum growth occurs in the late summer when it typically forms the extensive floating mats of vegetation, whilst it over-winters in the margins and on banks as a much flatter and smaller plant.

The plant is relatively restricted in its distribution, largely in southern England and south Wales. Its appearance is likely to have been as a result of escapes from aquaria and garden ponds. Floating pennywort has already proved to be difficult to control because of its rapid growth rates, its ability to re-grow from a single node, and its resistance to chemical control.

Control

Chemical control can be achieved with herbicides containing glyphosate. Use of the adjuvants Top Film and Codacide Oil improve the efficacy of glyphosate.

Cutting and removal is a very good method of management, but it will not control or reduce the vigour of the plant. The cut or dredged material should be left on site at the top of the bank, well away from water. Manual removal by volunteer groups has proved a successful method of management, particularly for smaller sites.

Contact the Environment Agency for disposal advice on 08708 506 506

Non-chemical control

Cutting

Regular cutting from May to October will prevent complete dominance of this species. Cut material should be removed from the water immediately. Cutting should be followed by hand pulling or by spot treatment with chemicals to reduce the risk of regrowth.

Pulling or dredging

Hand pulling works very well in small infestations and as a follow-up after major mechanical removal. Eradication is possible using this technique.

Biological

Cattle grazing has been seen to damage the emergent stems, but it has no long-term effect on the dominance of the plant. There are no known biological control agents in the UK, but research is underway.

Chemical control

Glyphosate

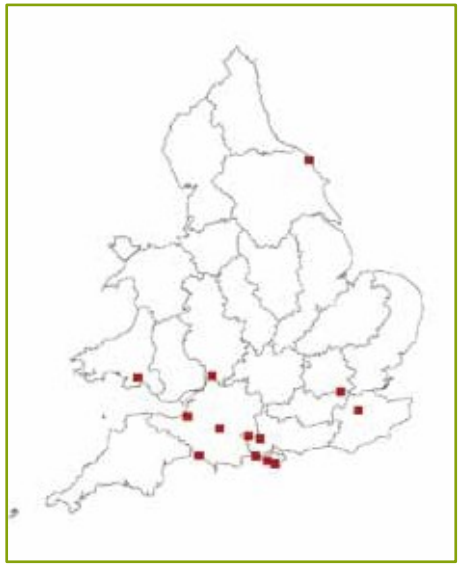
Applying glyphosate at 6 litres product/ha in 400 litres of water is the most effective treatment with this chemical particularly when used with Codacide Oil. Repeat treatments will be necessary throughout the growing season as soon as regrowth occurs.

In general

The plant does not rot down very quickly after chemical treatment, and treated vegetation in flood-risk areas should be removed after two to three weeks if possible. Follow-up spot treatment after mechanical removal is recommended. Regular treatment is necessary.

Fact file

Creeping water primrose



Source: NBN Gateway. Check website for current distribution

Image: Alain Dutartre

Creeping water primrose has recently been sold in the UK as a pond and aquarium plant. It is traded under a variety of names, including primrose willow and Jussiaea. Its correct taxonomic attribution is equally confused and Ludwigia grandiflora, L. hexapetala and L. peploides are among the names that have been applied to it.

Creeping water primrose produces a distinctive yellow flower, approximately 3cm across, in July – September. The stems extend across the water surface, producing round or oval leaves that can be mistaken for native brooklime. The stems also extend across mud, intermittently rooting at nodes. As they mature, the fleshy stems grow upright and the leaves lengthen and become lanceolate, approximately 9cm long. The flowering stems can become quite tall and resemble willow-herb.

Creeping water primrose thrives in ponds, lakes, watercourses, wetlands and wet meadows. It has currently been recorded from thirteen sites in the wild. All of

these infestations are either being managed, or are believed to have been eradicated. Whilst it has only caused minimal damage to our habitats so far, we know from the situation in France, Holland and Belgium that this plant has the potential to cause serious damage to our aquatic environment. An economic study estimated that Ludwigia could cost the UK over £150 million per annum if it were allowed to establish.

Whilst it is unlikely that you will find creeping water primrose in the wild, it is very important that any sites at which it is found are reported promptly so that control can be undertaken. This plant is known to be widespread in ornamental gardens, and therefore likely to occasionally appear in the wild if it escapes from ponds or is disposed of inappropriately.

Control

Chemical control can be achieved with formulations of glyphosate approved for use in or near water. Efficacy is greatly increased if it is mixed with an appropriate adjuvant, such as Topfilm at 1 L/ha.

Careful manual removal can be a highly effective method of management. This is the preferred method of management in France where herbicide treatment is not allowed. If Ludwigia is well established, mechanical removal may be initially used to reduce the biomass. Dredged or pulled material should be composted at sites away from waterbodies or wetland areas.

Manual, mechanical or herbicide treatment is likely to require at least two years of control. The site will need to be surveyed for any residual growth for at least a year after the last growth has been treated. Care should be taken not to spread the plant by fragmentation using these methods.

Contact the Environment Agency for disposal advice on 08708 506 506

Non-chemical control

Pulling

Hand-pulling works well, particularly with small infestations and as a follow-up to chemical or mechanical control. Material must be composted away from waterbodies.

Dredging

Mechanical removal is effective. Fragments must be contained and removed to avoid further spread. Material must be composted away from waterbodies.

Chemical control

Glyphosate

Apply glyphosate at 6 litres product/ha. Addition of the adjuvant Topfilm at 1 l/ha greatly increases the sticking and uptake of glyphosate through the waxy leaves

Repeat treatments are necessary, and regular monitoring of the site is required for between two and three years.

Glossary

2,4-D amine – a selective translocated herbicide.

Adjuvant – a herbicide additive used to increase absorption of the herbicide through the waxy leaves of aquatic plants.

Axil – the angle where the leaf joins the stem.

Biomass – the amount of plant material produced during growth.

Contact – a herbicide that kills the parts of plants to which it is applied, for example leaves.

COSHH – Control of Substances Hazardous to Health.

Eutrophic – water that has an excess of plant nutrients.

Glyphosate – a non-selective, translocated herbicide.

Hybrid – offspring of closely related species that are often more vigorous than either of the parents.

Node – region of attachment of leaves to the stem and of swelling on rhizomes from which roots and shoots arise.

Petiole – the stalk of a leaf.

Riparian – the area at the edge of watercourses.

Selective – term used for a herbicide that kills only one type of plant, for example only grasses or only broad-leaved weeds.

Succulent – fleshy or swollen.

Translocated – absorbed and distributed throughout the plant to the roots and shoots.

Whorl – a circular set of leaves arising at the same level on a stem.

Further information

There are many sources of information about invasive plants and methods of controlling them. The Centre for Ecology and Hydrology (CEH) provides advice on the control of aquatic and riparian invasive species.

This publication gives invaluable information on managing Japanese knotweed:

Environment Agency (2006)The knotweed code of practice – Managing Japanese knotweed on development sites.

The following websites are very useful sources of information for non-native invasive species in general:

GB non-native species secretariat: www.nonnativespecies.org

Centre for Ecology and Hydrology: www.ceh.ac.uk/sci_programmes/AquaticPlantManagement.html

CABI: www.cabi.org

National Biodiversity Network (NBN): www.nbn.org.uk

The World Conservation Union: www.iucn.org

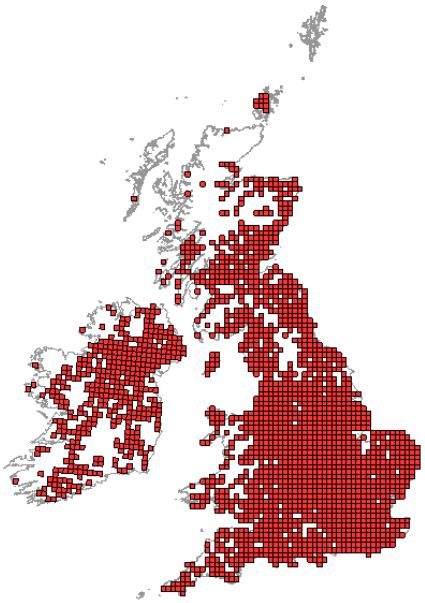
Plantlife: www.plantlife.org.uk

Chemicals Regulation Directorate: www.pesticides.gov.uk

The ‘Be Plant Wise’ campaign provides advice to gardeners on invasive pond plant recognition, guidance on how to dispose of pond plants and information on the impacts they may have in the environment. Posters and a leaflet are available from http://beplantwise.direct.gov.uk/index.html

Newman, J.R. and Duenas, M.A. (2010)

Information Sheet 7: *Elodea canadensis* (Canadian Waterweed)



Canadian Pondweed or Waterweed (*Elodea canadensis*) is native to North and South America where it occurs in lakes ponds, canals and slow flowing water. It was introduced to Ireland in 1836 as a fragment on an imported log from Canada, and rapidly spread to Europe soon after, occurring in similar habitats. In many regions of the world it is considered a pest. It grows from stolons (creeping stems) and has vertical, narrow, sparsely branched stems with leaves in whorls of three. The leaves are flat (not recurved like *Lagarosiphon major* and pointed like *E. nuttallii*). It can form dense mono-specific stands. It does not reproduce by seed in the UK and relies entirely on vegetative reproduction for its spread. Although it is now regarded as a naturalised aquatic plant, it causes problems by competing for nutrients and outgrowing many native species. However, it is now considered preferable to both *major* and *nuttallii* and where there is a danger of invasion from these species after control, care should be exercised not to eradicate all of the plant.

Mechanical control

This plant is easily cut and controlled for short periods (1-2 months in summer) by mechanical control methods. The cut weed should be removed from the water to avoid deoxygenation. The cut weed can be left to decompose in small heaps away from the side of the water, taking care to avoid seepage of the liquor back into the water. However, if large amounts are to be disposed of then it should be taken away for composting or alternative disposal.

Cutting early in spring may delay the onset of the peak biomass period. Dragging trailing knives across the bottom in March is the best time for this. If the weed can be kept at a low level by regularly doing this then peak biomass should not be reached. Continued cutting will weaken the

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plant and may lead to its disappearance from the system

There are several appropriate methods of mechanical control, removal by hand, raking, chains, weed bucket weed boat or dredging. All are suitable.

Chemical control

There are no methods for chemical control of *Elodea* species in Europe. Outside Europe, some herbicides are approved, and readers should consult their local government Environment Agency or equivalent.

Biological control

The use of herbivorous Grass Carp is appropriate as a control method for this plant. Common Carp, and other bottom feeding fish, which create turbid water, can also be effective in preventing regrowth of the plant after mechanical removal or control by a herbicide. There have been reports of sudden population crashes of this species and it may be that some form of self-regulation occurs in some situations. It is not known if this is due to a pathogen, or a stem mining fly which is yet to be investigated.

Environmental control

Shade will control most submerged aquatic plants. This can be achieved by planting trees on the south side of waterbodies or by using a floating sheet of opaque material. Care must be taken when using the latter to prevent sudden deoxygenation.

The use of dyes has been successful in static waters. Early application of the dye is critical to the success of this technique, preferably before the plant has started to grow in spring, or when water temperatures are still less than 8 to 10ºC. A further application may be required after 6 – 8 weeks, depending on dilution from rainfall, or degradation by UV light. Blue dyes are generally cheaper than other colours, but all colours will reduce or completely control *E. canadensis*.

Best option

In mixed stands: Remove as much of the plant as possible by mechanical means. If mechanical removal is not possible then treat early with a pond dye in static waters only. Repeat application of dye throughout the season as necessary.

If you prefer a biological control option then use Grass Carp. Be sure to obtain all the necessary agreements from DEFRA, Environment Agency, SEPA, and Natural England or Countryside Council for Wales, or Scottish Natural Heritage.

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