National Water Vole Database and Mapping Project

PART 1: PROJECT REPORT 2006-2015

Catherine McGuire and Deborah Whitfield

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Cyfoeth Naturiol Cymru Natural Resources Wales

people's trust for endangered species

The Wildlife Trusts

EXECUTIVE SUMMARY

The National Water Vole Database and Mapping Project was established in January 2008 with the aim of collating and mapping available water vole data to:

- Assess population and distribution trends;
- Create a geographic information system (GIS) for water voles to support conservation measures and enable more strategic working at local, regional and national levels.
- Report against national BAP targets.

The project has collected water vole and mink data every year from volunteers, Local Environmental Records Centres (LERCs), the People's Trust for Endangered Species (PTES), The Wildlife Trusts (TWT) and other suppliers in England, Wales and Scotland.

Data is 'cleaned' and analysed using a methodology devised by Berkshire, Buckinghamshire and Oxfordshire Wildlife Trust (BBOWT) to produce three tiers of mapping: alert, local key areas, and regional key areas. The aim of the alert and key areas maps is to identify the areas known to support water vole populations.

A project report has been produced each year since 2009, using records from the previous five years (from 1st January of the first year to 31st December of the fourth year e.g. 1st January 2007 to 31st December 2011). This report presents an analysis of all water vole data from the last 10 years.

Key Findings

The most recent five-year reporting period (2011 to 2015) shows a slight increase in distribution on the previous five-year reporting period (2010 to 2014) and some successful conservation activity.

Nevertheless, analysis of the full data set over the last 10 years has revealed that water vole distribution has declined.

The overall decline is estimated at 30% between 2006 and 2015 across England and Wales.

This finding is of great concern and highlights the importance of this project in monitoring change and identifying issues of conservation concern. When the 30% figure is compared with the previously calculated estimate of a 94% decline in the number of sites where it was once prevalent in the last century, there is confidence that overall, despite conservation efforts to boost local populations locally, the range of water voles in England and Wales is continuing to contract.

When the 30% figure is compared with previously calculated estimates of a 70% decline between the 1980s and 1990s (GWCT, 2017) and a 90% decline since the 1970s (PTES, 2017) there is confidence that overall, despite conservation efforts to boost water vole populations locally, the range of the species in England and Wales is continuing to contract.

This finding is of great concern and highlights the importance of this project in monitoring change and identifying issues of conservation concern.

Conservation efforts have been put in place to conserve this charismatic species in many areas and sites. At a local level, these projects appear to have been highly successful in conserving and/or reintroducing water voles to sites - but the data from this project suggest these successes have not yet been expanded at a sufficient scale to reverse the national distribution trends.

The project was managed by Hampshire & Isle of Wight Wildlife Trust.

RECOMMENDATIONS

Everyone can help improve the fate of water voles. The following recommendations are aimed at the different groups of people who can directly help: Government, landowners, conservation charities and individuals.

Government

1. **Revise the UK strategy for water vole conservation,** as the UK Biodiversity Action Plan has failed to achieve its national targets.

2. **Support landscape-scale water vole conservation programmes** (see Recommendation 5), including through ensuring that future land management policy and public payments for farmers and land managers help to restore restoration and manage habitat for water voles.

Landowners

3. **Manage riverbank habitat positively** for water voles, e.g. providing generous buffer strips to provide shelter and feeding, opening up sections of the bank to the sun to prevent overshading, and creating soft edges to river banks for water voles to create burrows in.

Conservation charities

4. **Enlarge and expand conservation projects** to protect and enhance water vole populations at a landscape-scale, to help water vole populations recover and re-occupy their former range and distribution (see also Recommendation 3).

5. **Continue to monitor water vole populations** using the methods developed by this project. The data becomes more important over time, as the body of comparable information grows. Monitoring and mapping should continue to assess population and distribution trends to inform future conservation efforts.

6. **Invest further in volunteers** to maintain, develop and expand coverage of survey effort to improve the data set, as the network of expert volunteer recorders is critical to water vole conservation. Catchment Partnerships play a key role as they hold the key to reaching all riparian owners at a catchment scale to maintain conservation efforts at a meaningful level.

7. **Use alert maps** to inform the design and implementation of conservation programmes, and all other work/management (including habitat enhancements, river rehabilitation and restoration projects as well as routine works) undertaken in or adjacent to important water vole sites. It is important to follow the mitigation hierarchy and minimise the risk of harm to water vole. This approach is likely to boost population recovery by both increasing numbers through reduced mortality and increasing carrying capacity and scope for expansion by increasing suitable habitat. These maps must be integrated with local plans and ecological network maps.

8. **Further document and disseminate** the work of water vole reintroduction projects and make this information available to conservation practitioners, in order to share experiences, successes and best practice. This could involve developing new ways to make the study data openly accessible (subject to funding). For example, it would be desirable to create a project website with an online searchable map. This could provide a "linking up" facility to encourage cross-border collaboration on landscape-scale conservation projects, and by direct sharing with Catchment Partnerships.

Individuals

9. Find out about **volunteering** opportunities as a water vole surveyor with your local Wildlife Trust. **Donate** to charities helping to protect and restore water voles.

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INTRODUCTION

Background to the Project

The water vole is the largest of Britain's vole species. It lives along rivers, streams and ditches, around ponds and lakes and in marshes, reedbeds and areas of wet moorland. Water voles have disappeared from many parts of the country where they were once common. They are one of Britain's fastest declining mammal species. Intensification of farming practices, urbanisation, development and predation by American mink are all factors that have contributed to the decline of water voles. As a result, conservation efforts are underway across the country to protect remaining populations of water voles and to restore them to places where they have been lost.

Previous research and surveying has identified that the distribution and abundance of water voles has declined significantly in the UK over the last few decades. This has been widely attributed to loss of habitat and predation by American mink.

The National Water Vole Database and Mapping Project was established in 2008 by the UK Water Vole Steering Group to collate water vole survey records, map the distribution of this species and identify important areas for water vole conservation. The project outputs also provide information needed to support conservation measures and enable more strategic working at local, regional and national levels. The project data is also essential for assessing the national status of the species' distribution and for reporting against national biodiversity targets.

The revised UK Biodiversity Action Plan (BAP) targets for water vole, published in 2006 were as follows:

- **Target 1:** Maintain the current range (730 occupied 10km squares) of water vole in UK.

- **Target 2:** Achieve an increase in range by 50 new occupied 10km squares in the UK by 2010. Achieve a further increase in range by 55 new occupied 10km squares by 2015.

Conservation efforts have been put in place to conserve this charismatic species in many areas and sites. At a local level, these projects appear to have been highly successful in conserving and/or reintroducing water voles to sites - but the data from this project suggest these successes have not yet been expanded at a sufficient scale to reverse the national distribution trends.

The project is managed and delivered by Hampshire & Isle of Wight Wildlife Trust, with funding provided by members of the UK Water Vole Steering Group.

Aims of the Project

The aims of the project are to:

- Develop standardised methods for storing and managing water vole (Arvicola amphibius) and American mink (Neovison vison) data.

- Collate existing water vole and American mink data.

- Develop a GIS to enable mapping of data and to maximise the use of the datasets.

- Establish procedures for enabling annual updates to the dataset.

- Disseminate key outputs from the project to the steering group and data suppliers.

- Ensure sustained and effective use of datasets and methodologies developed during the life of the project.

METHODOLOGY

Data Collation and Formatting

Each year, data requests for water vole and mink data are made to Local Environmental Records Centres (LERCs), PTES, Wildlife Trusts and other suppliers in England, Wales and Scotland. The data received is usually for the previous year, as it can take a year for survey data to reach the LERCs. Once received, the data is quality checked, cleaned, and formatted in Excel, ready for import and analysis in GIS.

Key Area Data Analysis and Mapping

Using water vole data from the last 10 years, the aim of the alert and key areas maps is to identify the areas known to support water vole populations and areas where some of the more robust populations may be found. Previous reports have covered a five-year period, however this year the UK Water Vole Steering Group requested a 10-year period of analysis in order to look at trends over a longer time period.

The methodology for producing the alert and key areas mapping is based on work undertaken originally by the Berkshire, Buckinghamshire and Oxfordshire Wildlife Trust, which is summarised in the second edition of the Water Vole Conservation Handbook (Strachan and Moorhouse, 2006). Mapping is produced by buffering water vole records to capture some of the potential surrounding habitat and areas within average water vole dispersal distance. A figure of 0.5km (measured from occupied watercourses) has been used to capture some of the surrounding habitat and a figure of 2km, as measured from water vole records, has been used to capture dispersal distance. It is suggested that this 2km buffer should capture dispersal areas on most occasions, though water voles have been recorded as dispersing over longer distances. Telfer et al. (2003) recorded the average dispersal distance in an upland area to be 2.18 +/- 0.27 (Standard Error, SE) km for females and 1.65 +/- 0.27 SE km for males. This study found dispersal distance of animals in lowland areas to be 1.04 +/- 0.19 SE km for females and 1.50 +/- 0.25 SE km for males. In a study in the Peak District, Johnson (2008) recorded the maximum distance from an occupied transect to a core colony as 1.3km, with single latrines recorded at 1.9km.

Three tiers of mapping have been produced (alert, local and regional key area maps) for the 11 English River Basin Districts, for Wales, and for Scotland (12 maps in total). A further map has been produced to display the Regional Key Areas across the UK. The maps are available in Part 2 of the report.

The methodology used to derive the alert maps can be summarised as follows:

- All positive records from the last 10 years of the project dataset are selected and entered onto a single formatted spreadsheet in Excel.
- The records are filtered to remove all records of 1km resolution, giving a data set comprising records at or greater than 100m resolution.
- The water vole alert area is made up of a collection of 0.5km buffer zones, generated from the water vole data by using the MapInfo GIS.
- Many of these buffer zones are around river sections which have been identified as lying within 1.5km of a water vole record.
- The remaining buffer zones are generated around water vole records which lie outside the river sections identified above.
- The river section buffer zones include an additional 0.5km length at either end, thereby buffering a total of 2km from the nearest water vole record.
- All records and selected river sections lying within 2km of each other are grouped. These groups are applied to the buffer zones and used to identify the key areas.

Using the alert layer, Local Key Areas are identified by selecting areas of 6km2. This is an estimate based on water vole ecology, believed to be important for maintaining the sustainability of the local water vole population (expert opinion provided by the late UK water vole specialist Rob Strachan pers. comm.). These Local Key Areas are likely to support one of the following:

- Several colonies of water voles occupying an area of a river system or waterway.
- Robust populations at large but isolated non-linear sites.
- A series of sub-populations that form a metapopulation covering an extensive upland area.

Using the alert layer, Regional Key Areas are identified by selecting areas of 35km2 and over. Rob Strachan suggested areas of 35km2 and over could help identify those areas where water vole populations are more likely to survive the impacts of stochastic events and more likely to persist for more than 40 years.

Limitations

Data accuracy

Data received for this project has been through a process of verification resulting in a good quality dataset. It is further cleaned and formatted and only those records with a minimum 6 figure reference are included in the analysis. However, there may still be errors in the original data such as transposed numbers placing records in a different, incorrect location. Spot checks are carried out but due to the volume of records in the database it is not possible to check each one for accuracy.

Recorder effort

Recorder effort is an important factor to consider when comparing distribution over time; and budgets for conducting water vole surveys have reduced over recent years. However, by comparing averages between four-year periods, variations in effort over time are reduced. Variations in spatial recorder effort are further reduced by analysing distribution by 10km grid squares.

Population versus distribution

The decision to extend the period of alert area coverage to ten years from five will mean that some apparently new or additional alert areas are shown on the maps. It is important to understand these are not a reflection of water vole populations; this is not what this project intends or can show. The outputs do not show population sizes, but rather the distribution of the species. It is also important to note that one record in a square turns it positive, i.e. one small positive record on a 1ha site implies a range expansion across 10 sq km (or 10,000ha).

Areas of known water vole absence

In some parts of the UK it is known that water voles are functionally extinct. Due to the extended period of alert area coverage in this report, some of these areas will feature apparently new alert areas despite absences being recorded within these areas in the last year. This means that very recent localised distribution changes will not be shown. However, the fact that these areas have, within the last 10 years, supported water vole populations to a greater or lesser extent, suggests there is potential for re-establishment of water vole populations, given appropriate management. It is hoped that the alert areas will continue to inform these conservation efforts such that robust water vole populations may be restored in the future.

Project funding

Funding to update the distribution and alert maps has been received for England and Wales only. A limited update to data for Scotland has been produced this year and includes historic records originally supplied by Scottish Local Environmental Records Centres, supplemented by data arising from the PTES National Water Vole Monitoring Programme. The distribution and alert maps for Scotland should therefore be treated with caution as they cannot represent a complete picture with the data available.

RESULTS

Extent of Dataset

Table 1 shows the cumulative number of presence and absence records for water vole and mink held in the database. The figures in each column represent the total number of records held in the database up to the end of the year stated in that column. The total number of positive water vole records held to date is 75,063.

Table 1: Total cumulative number of records held in the national database by year

	2009	2010	2011	2012	2013	2014	2015
Water vole presence	36,898	42,006	50,717	62,080	67,161	71,922	75,063
Water vole absence	10,288	10,463	11,734	12,512	12,661	12,913	13,541
American mink presence	7,883	8,582	9,146	12,730	15,460	16,109	16,377
American mink absence	4,213	4,213	5,136	5,282	5,451	5,645	5,790
Otter presence	-	1,874	-	-	-	-	-

Some of the datasets initially collated by the Project were extensive and included water vole records dating back to the late 19th Century. The majority of data however were from the mid-1990s to the present day. The earliest water vole record is dated 1861 and the earliest American mink record is dated 1952. As refinements are made to databases held by LERCs and additional past records are validated and digitised or removed due to ambiguity, revised datasets are occasionally supplied to replace some existing records in the project database.

It is important to note that the figures above represent the cumulative data held in the database for both presence and absence records used to analyse the spatial distribution of water voles and do not suggest an increase in population size of either species.

Records by data supplier

Data for the current update was received from 43 different data suppliers across England and Wales with historic records included from 26 further data suppliers in England and Wales, as well as historic records from 19 data suppliers in Scotland. The full list of current and historic data suppliers is included in Appendix 1.

The number of records submitted per year per data supplier is given in Table A (water vole) and Table B (American mink), in Appendix 2. The figures include both presence and absence records and are for single years only, i.e. they do not include the cumulative data from previous years.

DISTRIBUTION

The project outputs also provide information needed to support conservation measures and enable more strategic working at local, regional and national levels. The project data is also essential for assessing the national status of the species' distribution and for reporting against national biodiversity targets.

The revised UK Biodiversity Action Plan (BAP) targets for water vole, published in 2006 were as follows:

- Target 1 Maintain the current range (730 occupied 10km squares) of water vole in UK.

- Target 2 Achieve an increase in range by 50 new occupied 10km squares in the UK by 2010. Achieve a further increase in range by 55 new occupied 10km squares by 2015.

Data for England and Wales was analysed against these targets to assess progress and identify any potential issues. A summary of the results from each previous five-year reporting period is shown in Fig. 1.

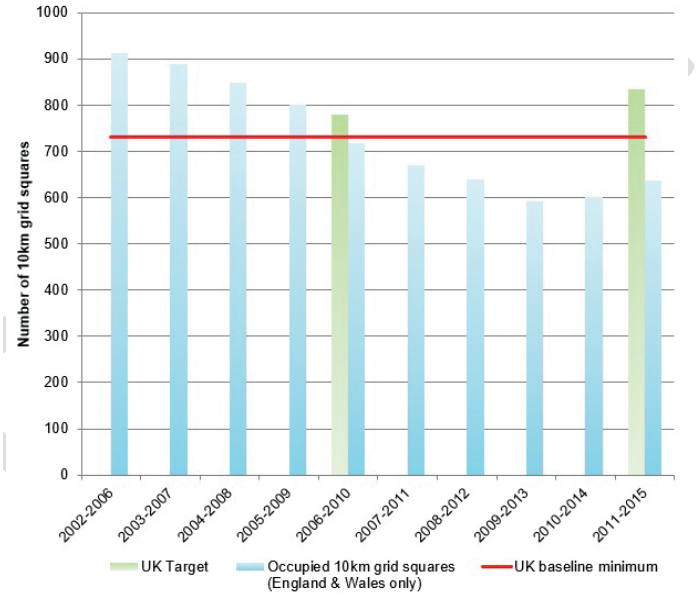


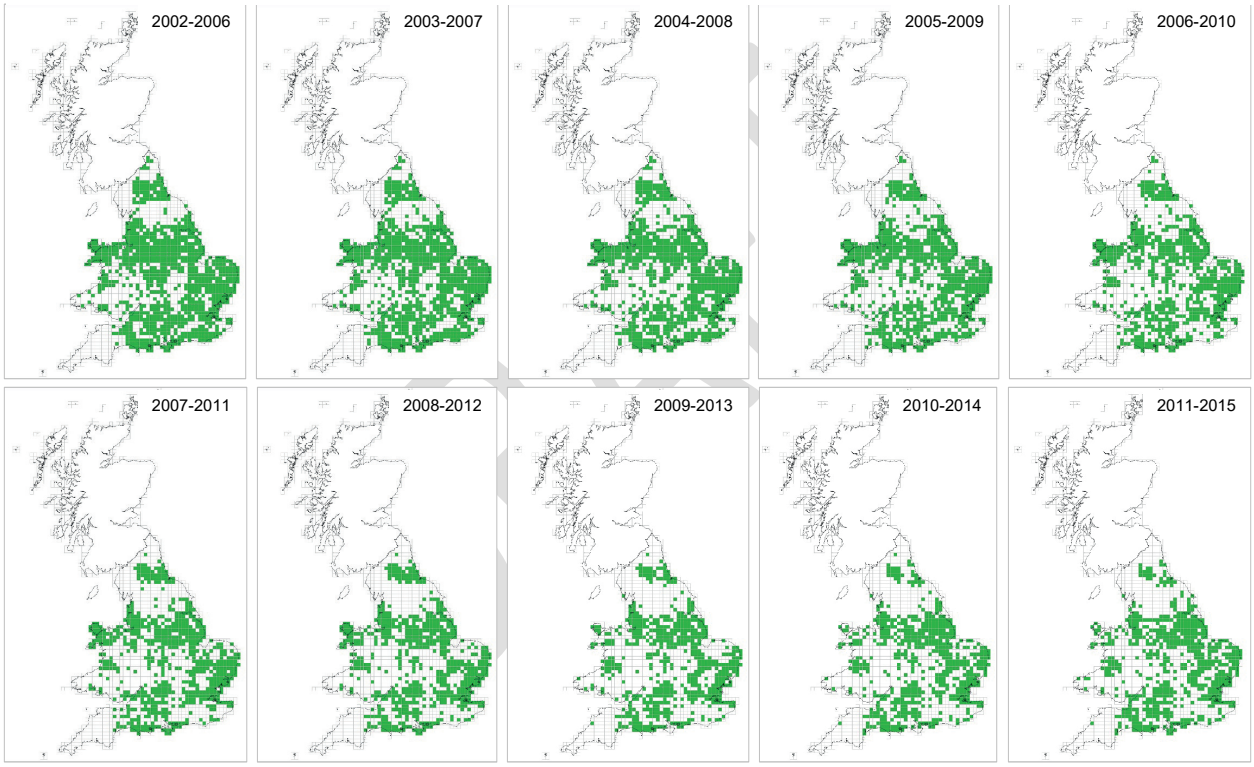
Fig. 1: Occupancy of 10km grid squares by five- year reporting period in England & Wales against UK BAP targets

The combined England and Wales figures fall below the target set for the whole of the UK in 2006 to maintain the current range of water voles in the UK (see 'UK baseline minimum'), as well as falling well below both the 2010 and 2015 targets to increase the range of water voles. Overall the results reveal a 30% decline in distribution of water voles across England and Wales in the last 10 years.

Whilst the most recent five-year reporting period, 2011-2015, shows a slight increase in distribution since the previous reporting period (2010-2014), this is still well below the UK baseline minimum (as defined by the UK Water Vole Steering Group pers. comm. 2008). Nonetheless, this slight increase is welcome news and there is good evidence to show that coordinated conservation activity is successful locally.

The overall picture of water vole distribution is of great concern and highlights the importance of this project in monitoring water vole at a national level. The trend is more tangibly illustrated in the following series of distribution maps from each of the previous reporting periods (Fig. 2). The maps show the changing distribution and declining number of occupied 10km squares over time. The change in distribution pattern appears to show a contraction in range across all regions rather than complete losses in individual regions.

Fig. 2: Change in distribution of water vole over time (occupied 10km squares are shown in green).



To investigate the change in distribution further, a comparison of the total size of the key alert areas for England and Wales was carried out for all available datasets for each reporting period. The results are shown below in Figure 4.

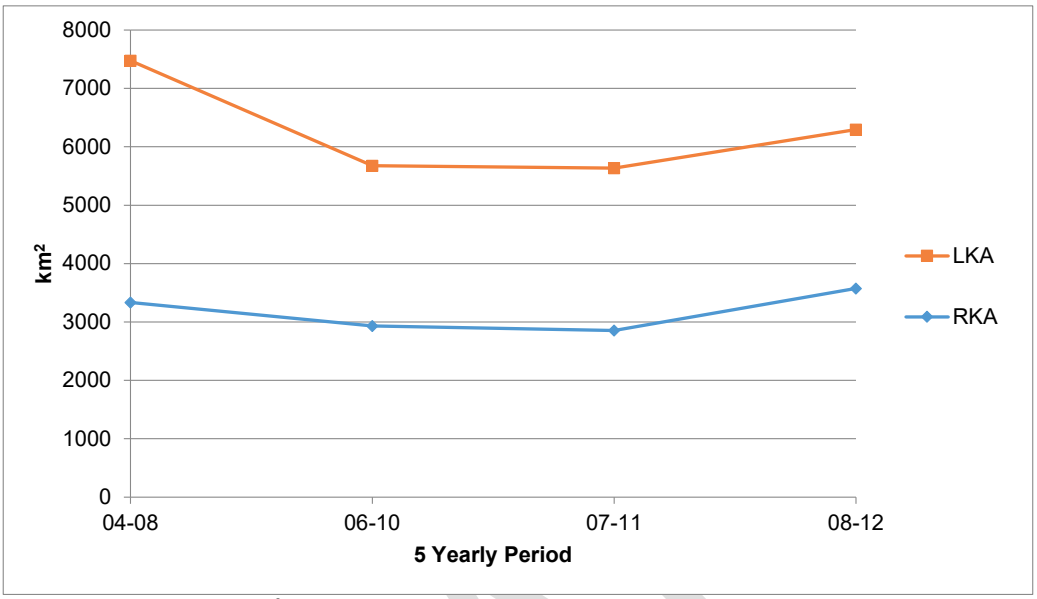


Fig. 4: Trend in total areas (km^2) for Regional (RKA) and Local Key Areas (LKA) in England and Wales from 2004-08 to 2008-12.

Fig. 4: Trend in total areas (km2) for Regional (RKA) and Local Key Areas (LKA) in England and Wales from 2004-08 to 2008-12.

This analysis shows that the change over time in total Regional Key Area size shows a very similar trend to the change in the total number of occupied squares over time: a decline and then slight upward turn in recent years, and an overall increase of 7% during the analysis period. The Local Key Areas pattern shows an initial steeper decline, and overall decline of 15%. This suggests that efforts to conserve water vole in their strongholds are being successful, however water voles are continuing to be lost from peripheral areas (possibly suboptimal habitat) at the extremes of their current range.

CASE STUDIES: THE ALERT MAPS IN ACTION

Feedback from Data Suppliers and End Users

A key aim of the project was to: Ensure sustained and effective use of datasets and methodologies developed during the life of the project.

In 2015, a questionnaire was sent to all data suppliers requesting feedback on how the alert maps are used to further water vole conservation in their area. Feedback was encouraging and supportive of the project, with a number of data suppliers offering examples of where the alert maps have played a key role in their own projects. Examples of the alert maps being used around the UK are described below.

To guide habitat restoration

Cheshire Wildlife Trust and the Wildlife Trust for Bedfordshire, Cambridgeshire and Northamptonshire have successfully used the alert maps to target areas for habitat restoration, increasing the connectivity between water vole populations.

In Cheshire, the Canal Connections project used the Local Key Areas GIS layer in combination with data gathered on land management, habitat assessments, and additional water vole records outside of the key areas to illustrate the fragmented nature of water vole habitat across the Meres and Mosses Nature Improvement Area. This information contributed to a successful funding bid and, following comprehensive land owner liaison work, habitat improvement works were carried out at four connecting sites along the Llangollen canal around Whitchurch.

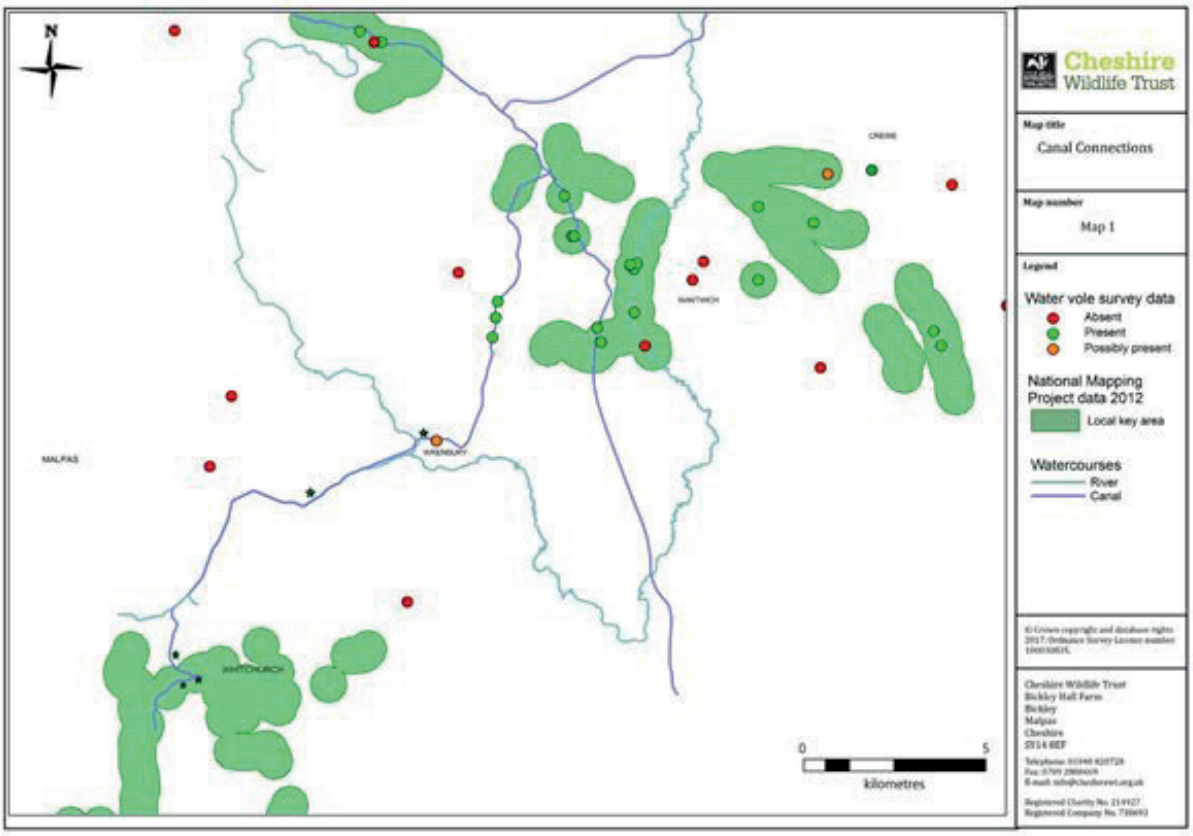


Fig. 3: Cheshire Wildlife Trust Canal Connections initial evidence base (reproduced with permission of CWT, 2017)

To carry out landscape-scale conservation

The Environmental Records Information Centre for the North East of England (ERIC) and Berkshire, Buckinghamshire and Oxfordshire Wildlife Trust (BBOWT) used the alert maps GIS layer to connect with neighbouring organisations and deliver landscape-scale water vole conservation work:

"Your data is especially useful when looking at sites beyond our county boundaries as I don't have access to these records. For example, seeing that our Regional Key Area on the Upper Thames and River Cole extends over the county boundary into Gloucestershire and incorporates some of Gloucestershire Wildlife Trust's known water vole sites; I therefore know to talk to John Fields at GWT when working in this area so that we can try to link our schemes up."

Julia Lofthouse, Mammal Project Officer, Beds, Bucks & Oxon Wildlife Trust

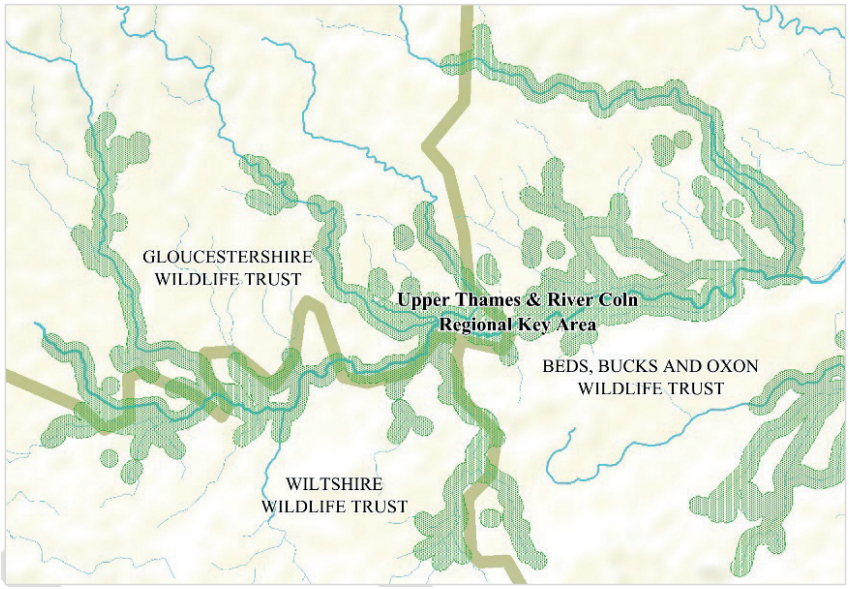


Fig. 4: Extract from Regional Key Areas map illustrating the Upper Thames & River Coln RKA (HIWWT, 2017).

To inform water vole conservation and reintroduction

The combination of national mink records and water vole alert areas allows users to focus conservation efforts and to identify potential release sites for water vole reintroduction.

Bespoke maps were created by Hampshire & Isle of Wight Wildlife Trust for the South Downs National Park Authority (SDNPA) to help inform conservation efforts in the Park:

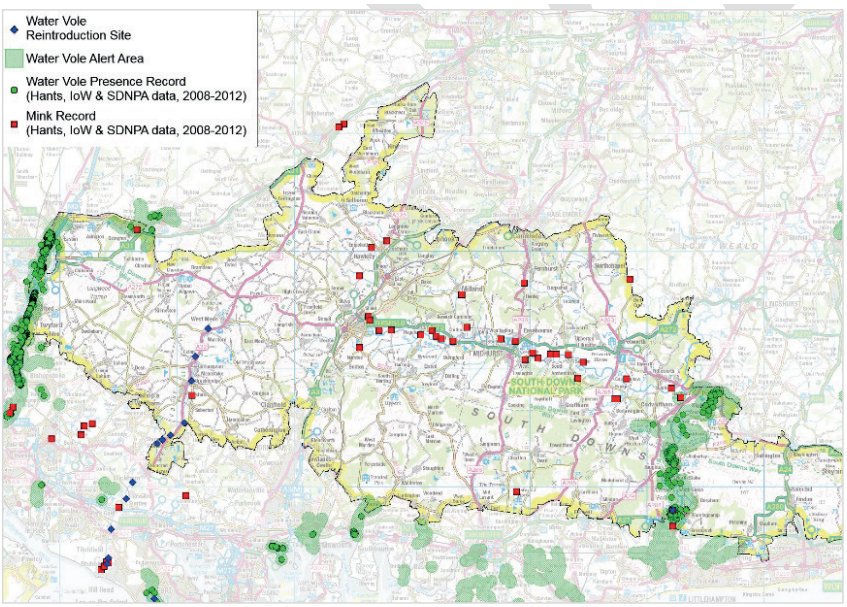


Fig. 5: Extract from bespoke map produced for the SDNPA (Hampshire & Isle of Wight Wildlife Trust, 2016).

"We are planning a Rivers for Life project (including water vole reintroduction and surveys) within the SDNPA and the alert maps have been useful in prioritising areas within the National Park area, where there are mink and/or water voles. Having access to these maps and the ability to request variations on them will assist us in contributing to the conservation of water voles within the National Park. Baseline data, especially shown in maps, is important when planning any future projects and reference for those ones that have been completed."
Elaina Whittaker-Slark, Lead Ranger (Western Downs), South Downs National Park Authority

Northumberland Wildlife Trust used the alert maps as part of the Kielder Water Vole Heritage Project. Phase 2 of their project: Restoring Ratty will use reintroduction to re-establish water voles into the Kielder and North Tyne catchment:

"This work forms an integral part of the north-east water vole strategy to expand existing water vole strongholds into previously occupied areas that have been cleared of mink and where habitat management is not enough. The maps indicate effectively their stronghold and help target conservation effort."
Kevin O'Hara, Conservation Officer (Living Landscapes), Northumberland Wildlife Trust

RESTORING Ratty
Bringing the **water vole** back to **Kielder**

Fig. 6: Restoring Ratty project logo (with permission, NWT, 2017)

To increase understanding and awareness

Environmental Records Information Centre, North East, has used the maps along with their own data to show Sunderland Council areas where water voles have previously been recorded but now appear to have been lost.

As supporting evidence

BBOWT also used the alert maps as supporting evidence for a successful funding bid as part of their Water Vole Recovery Project, the longest-standing local water vole conservation project in the UK.

WATER VOLES MONITORING

National Water Vole Monitoring Programme

The last co-ordinated national surveys of water vole were carried out by the Vincent Wildlife Trust in the 1990s, and these studies documented dramatic declines of water voles across Britain. In 2012, the UK Water Vole Steering Group agreed to explore the potential for developing a national water vole monitoring scheme, with the aim of resurveying the Vincent Wildlife Trust sites and supporting the National Water Vole Database and Mapping project by recruiting volunteer water vole surveyors to increase recording efforts. The data gathered from the surveys could then supplement the National Water Vole Data and Mapping Project.

In 2015, PTES, in collaboration with the other members of the UK Water Vole Steering Group (the Environment Agency, Natural England, Natural Resources Wales, Sottish National Heritage, The Wildlife Trusts and the RSPB), launched the first year of the National Water Vole Monitoring Programme (NWVMP). PTES asked volunteers to choose one or more of 900 pre-selected sites across England, Wales and Scotland and to survey them once a year in May, recording all sightings and signs of water voles along a 500m length of riverbank. If volunteers already monitored water voles, they could register their site online and submit their data to be included in the yearly analysis.

In the first year of the NWVMP 188 sites across the UK were surveyed by volunteers. Almost 150 sites were ones surveyed in the previous national surveys and 44 were new sites registered with the programme by volunteers. Of the 188 sites, 68 had water vole signs present on one or more transect. In 2016, PTES had data submitted from 406 sites. Data from 164 sites were submitted online and PTES also received records from an additional 242 sites surveyed as part of two University of Aberdeen projects in Scotland.

Of the 406 sites, 187 had water vole field signs present (46%). The distribution of positive sites was skewed towards Scotland, partly due to the large number of sites surveyed there but encouragingly there were occupied sites across the UK from Cornwall up to the Highlands. Once enough data is collected it will be used to analyse population trends of water voles, especially any further declines, and in conjunction with the National Water Vole Database and Mapping Project, which analyses distribution trends to help inform future conservation efforts.

A map summarising the results of the first two years of monitoring data is shown in Figure 7.

Fig. 7: Summary map of water vole records for 2015-16 PTES Monitoring Programme

Water Vole Reintroduction Mapping

In 2012, Hampshire & Isle of Wight Wildlife Trust began collating records of water vole reintroduction work across the UK and the first national map of water vole reintroductions was published in the 2008-2012 report. Although initially only created as a snapshot of this aspect of conservation work at the time, it was subsequently found that there was no other national record of where water voles were being released. Consequently, updates to the database of reintroductions have been sought in the following years.

Data is primarily sourced from Derek Gow Consultancy, as the leading specialist in captive breeding and release of water voles in the UK. This is supplemented by records of other schemes submitted by data providers to the project.

The database currently holds information on the location of releases, number of individuals and date of release, and an indication of whether the release is to be monitored. A newly updated map is included with this report (see Figure 8).

Fig. 8: UK map of water vole reintroductions up to December 2015

DISCUSSION

The critical finding of the project report is that there has been an estimated 30% decline in water vole distribution across England and Wales between 2006 and 2015. Although the most recent five-year reporting period, 2011-2015, shows a slight increase in distribution from the previous reporting period (2010-2014). The report analysis shows that water vole populations are struggling to maintain densities and expand their ranges. This is linked to habitat change and loss and predation.

This finding is of significant conservation concern and highlights the importance of this project in monitoring change and identifying issues of conservation concern. This study indicates that the revised UK Biodiversity Action Plan (BAP) targets for water vole, published in 2006 have not been achieved - and by some margin. The target to maintain the current range of 730 occupied 10km squares was missed (actual number of squares occupied was fewer than 640 in the 2011-2015 reporting period) along with the ambition to achieve an increase in range by 50 new occupied 10km squares in the UK by 2010 (or another 55 new occupied 10km squares by 2015).

Some of the apparent decline may be attributed to recorder effort, although as the effects of this have largely been eliminated by comparing 10km squares and averages over a 10-year period, it is unlikely that recorder effort alone can explain this finding.

When the 30% figure is compared with previously calculated estimates of a 70% decline between the 1980's and 1990's (GWCT, 2017) and a 90% decline since the 1970's (PTES, 2017) there is confidence that overall, despite conservation efforts to boost local populations locally, the range of water voles in England and Wales is continuing to contract.

This is supported by the area analysis of the Regional and Local Key Area. The data suggests that water vole conservation efforts are being successful in defending strongholds for the species, but they continue to decline in peripheral areas away from core populations. Conservation measures include better habitat management, habitat restoration, water vole reintroduction to restored habitat and reducing the impact of mink predation and control.

This trend is consistent with the findings of the State of Nature Report (2016) for many rare species in the UK.

Excellent water vole conservation work continues and there are many success stories, as demonstrated by the case studies and reintroduction evidence in this report. Local upward trends in water vole numbers have been observed where predation levels have reduced and catchment level habitat management has been applied, for example in East Anglia (D.Tansley, pers. comm).

Strategic reintroductions to isolated sites of suitable habitat have also been successful in increasing water vole densities and ranges (see the South Downs Case Study).

RECOMMENDATIONS

Everyone can help improve the fate of water voles. The following recommendations are aimed at the different groups of people who can directly help: Government, landowners, conservation charities and individuals.

Government

1. **Revise the UK strategy for water vole conservation,** as the Biodiversity Action Plan has failed to achieve its national targets.
2. **Support landscape-scale water vole conservation programmes** (see Recommendation 5), including through integrating future land management policy and public payments for land managers with funding the restoration and management of habitat for water voles.

Landowners

3. **Manage river bank habitat positively** for water voles, e.g. providing generous buffer strips to provide shelter and feeding, opening up sections of the bank to the sun to prevent overshading, and creating soft edges to river banks for water voles to create burrows in.

Conservation charities

4. **Enlarge and expand conservation projects** to protect and enhance water vole populations at a landscape-scale, to help water vole populations recover and re-occupy their former range and distribution (see also Recommendation 3).
5. **Continue to monitor water vole populations** using the methods developed by this project. The data become more important over time, as the body of comparable information grows. Monitoring and mapping should continue to assess population and distribution trends to inform future conservation efforts.
6. **Invest further in volunteers** to maintain, develop and expand coverage of survey effort to improve the data set as the network of expert volunteer recorders is critical to water vole conservation. Catchment Partnerships play a key role as they hold the key to reaching all riparian owners at a catchment scale to maintain conservation efforts at a meaningful level.
7. **Use alert maps** to inform the design and implementation of conservation programmes and all other work / management (including habitat enhancements, river rehabilitation and restoration projects as well as routine works) undertaken in or adjacent to important water vole sites. It is important to follow the mitigation hierarchy and minimise the risk of harm to water vole. This approach is likely to boost population recovery by both increasing numbers through reduced mortality and increasing carrying capacity and scope for expansion by increasing suitable habitat. These maps must be integrated with local plans and ecological network maps.
8. **Further document and disseminate** the water vole reintroduction projects and make this information available to conservation practitioners, in order to share experiences, successes and best practice. This could involve developing new ways to make the study data openly accessible (subject to funding). For example, it would be desirable to create a project website with an online searchable map. This could provide a “linking up” facility to encourage cross-border collaboration on landscape-scale conservation projects, and by direct sharing with Catchment Partnerships.

Individuals

9. Find out about **volunteering** opportunities as a water vole surveyor with your local Wildlife Trust. **Donate** to charities helping to protect and restore water voles.

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APPENDICES

Appendix 1:

List of Project Data Suppliers

Appendix 1: Suppliers of water vole and / or mink data for England, Scotland and Wales 2008 onwards

Suppliers of water vole and American mink data from 2008 onwards	
ENGLAND	
Bedfordshire & Luton Biodiversity Recording and Monitoring Centre	London Borough of Havering
Berkshire, Buckinghamshire & Oxfordshire Wildlife Trust	Merseyside BioBank
Bristol Regional Environmental Records Centre	Natural England
British Energy	Norfolk Biodiversity Information Service
Cheshire Mammal Group	Norfolk Wildlife Trust
Cheshire Wildlife Trust	North Pennines AONB
Cheshire RECORD	Northamptonshire Biodiversity Records Centre
Cornwall Wildlife Trust	Northumberland Wildlife Trust
Cotswold Water Park Trust	Northwest Lowlands Water Vole Project
Cumbria Biodiversity Data Centre	Nottinghamshire Mammal Group
Cumbria Wildlife Trust	Nottinghamshire Wildlife Trust
Derbyshire Wildlife Trust	Paul Gambling
Devon Biodiversity Records Centre	People's Trust for Endangered Species
Dorset Environmental Records Centre	River Axe Water Vole Recovery Project
Dorset Wildlife Trust	Royal Holloway University of London
Durham Wildlife Trust	Royal Society for the Protection of Birds
East Devon District Council: Devon Water Vole Recovery Project	Sheffield Biological Records Centre
EcoRecord: Birmingham & The Black Country	Sheffield City Council: City Ecology Unit
Environment Agency	Shropshire Mammal Group
Environmental Records Centre for Cornwall and the Isles of Scilly	Shropshire Wildlife Trust
Environmental Records Information Centre North East	Somerset Environmental Records Centre
Essex Wildlife Trust	Staffordshire Mammal Group
Gloucestershire Centre for Environmental Records	Staffordshire Wildlife Trust
Greater Manchester Ecology Unit	Suffolk Biological Records Centre
Greenspace Information for Greater London	Suffolk Wildlife Trust
H.M.P. Full Sutton	Surrey Biological Records Centre
Hampshire & Isle of Wight Wildlife Trust	Surrey Wildlife Trust
Hampshire Mammal Group	Sussex Biodiversity Record Centre
Herefordshire Biological Records Centre	Sussex Wildlife Trust
Hertfordshire & Middlesex Wildlife Trust	Tees Valley Wildlife Trust
Kent & Medway Biological Records Centre	Warwickshire Wildlife Trust
Lancashire Environment Record Network	Wildfowl & Wetlands Trust
Lancashire Wildlife Trust	Wildlife Trust for Bedfordshire, Cambridgeshire & Northamptonshire
Leicestershire & Rutland Wildlife Trust	Wiltshire and Swindon Biological Record Centre
Leicestershire and Rutland Environmental Records Centre	Wiltshire Wildlife Trust
Lincolnshire Environmental Records Centre	Worcestershire Biological Records Centre
Lincolnshire Wildlife Trust	Yorkshire Wildlife Trust

SCOTLAND	WALES
Alan Ross	Biodiversity Information Service for Powys and Brecon Beacons National Park
Cairngorms Water Vole Conservation Project	Brecon Beacons National Park Authority
Caithness Biodiversity Information Group	Cofnod (North Wales BRC)
Dumfries & Galloway Environmental Record Centre	Gwent Wildlife Trust
Forestry Commission Scotland	Natural Resources Wales
Glasgow Museums Biological Records Centre	Radnorshire Wildlife Trust
Highland Biological Recording Group	South East Wales Biodiversity Records Centre
International Otter Survival Fund	The Wildlife Trust of South and West Wales
John Muir Trust	West Wales Biodiversity Information Centre
Lothian Wildlife Information Centre	Wildlife Trusts Wales/ Ymddiriedolaethau Natur Cymru
North East Scotland Biological Records Centre	
Perth Museum & Art Gallery	**NATIONAL**
Scottish Borders Biological Record Centre	People's Trust for Endangered Species
Scottish Mink Initiative	
Scottish Natural Heritage	
The McManus: Dundee's Art Gallery and Museum	
The National Trust for Scotland	
University of Aberdeen: Institute of Biological and Environmental Sciences	

Appendix 2:

Presence and Absence Records per Data Supplier per Year

Appendix 2 Table A: Records submitted per year per data supplier – Water Vole (Sheet 1 of 3)

Data Supplier - Water Vole	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Alan Ross		4									4
Bedfordshire & Luton Biodiversity Recording and Monitoring Centre	18	100	31			1	6	7		85	248
Berkshire, Buckinghamshire & Oxfordshire Wildlife Trust	681	49	491	498	428	438	278	318	339	329	3849
Biodiversity Information Service for Powys & Brecon Beacons National Park			28	25	35	10	29	10	6	6	149
Bristol Regional Environmental Records Centre	20	192	274	117	15	30	6	5	87	1	747
Cairngorms Water Vole Conservation Project	73	406	128	153							760
Caithness Biodiversity Group								5			5
Cheshire Mammal Group c/o Cheshire Wildlife Trust	3	3		142	19	5					172
Cheshire RECOrd						1		5	2	8	16
Cheshire Wildlife Trust - Cheshire Water Vole Project							52	40			92
City Ecology Unit, Sheffield City Council	7	2	3	1			126	542	13	11	705
Cofnod - North Wales Environmental Information Service	134	230	394	15	37	23	13	6	16	38	906
Cotswold Water Park Trust (via Gloucestershire Centre for Environmental Records)				2	6		2				10
Cumbria Biodiversity Data Centre				81		1	4	4			90
Derbyshire Wildlife Trust	220	397	103	28	41	34	36	174			1033
Devon Biodiversity Records Centre				16				15	2		33
Devon Water Vole Recovery Project, East Devon District Council	18	9	19	7	48	209					310
Dorset Environmental Records Centre	33	88	1	62	31	13	53	18	44	243	586
Dorset Wildlife Trust		1	61				35				97
Dumfries & Galloway Environmental Resources Centre	2			1							3
Durham Wildlife Trust	64	22	431	55							572
EcoRecord (Birmingham)	2	4	2					6	1	2	17
Environment Agency	138	80	93								311
Environmental Records Centre for Cornwall and the Isles of Scilly								1	10	9	20
Environmental Records Information Centre North East	225	116	774	268	156	44	18	24	25	21	1671
Essex Wildlife Trust	90	83	63	12	9	69	38	22	213	54	653
FLD		3	18								21
Forestry Commission Scotland			12								12
Glasgow Museums Biological Records Centre	8	1	18	7	3	10	5	15			67
Gloucestershire Centre for Environmental Records	16	19	29	2	5	24	2	1	15	23	136
Greater Manchester Ecology Unit	5	10	75	74	69		7	2	9	5	256
Greenspace Information for Greater London	64	344	226	314	43	62	6	10	11	10	1090
Hampshire & Isle of Wight Wildlife Trust	303	89	2100	934	1095	1318	130	177	523	498	7167

Appendix 2 Table A: Records submitted per year per data supplier – Water Vole cont. (Sheet 2 of 3)

Data Supplier - Water Vole	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Hampshire Mammal Group						3					3
Herefordshire Biological Records Centre	4					2	1		1		8
Hertfordshire & Middlesex Wildlife Trust	31	59				16	53	64	58	77	358
Highland Biological Recording Group	77	79	104	19	2	6	6				293
Institute of Biological and Environmental Sciences, University of Aberdeen	113	85									198
John Muir Trust	24	49	16								89
Kent & Medway Biological Records Centre	222	34	10			127	135		832		1360
Lancashire Environment Record Network	25	15	2	7	3	70	3			2	127
Lancashire Wildlife Trust	56	58		98							212
Leicestershire & Rutland Wildlife Trust									2		2
Leicestershire Environmental Resources Centre, Leicestershire County Council	13	2	1								16
Lincolnshire Environmental Records Centre	803	1305	1112	764	1848	1457	1689	1172	1384	22	11556
Lothian Wildlife Information Centre	1		1								2
Merseyside BioBank	11	2	6	38	7	85	24	3	1	13	190
Norfolk Biodiversity Information Service	8					14	16	31	30	56	155
Norfolk Wildlife Trust	625	235	36								896
North East Scotland Biological Records Centre	52	119	58	137	10	1					377
Northamptonshire Biodiversity Records Centre				3	1		2	2	4	2	14
Northumberland Wildlife Trust								4			4
Nottinghamshire Wildlife Trust	12	9	9	17	5	132	17	22	171	14	408
People's Trust for Endangered Species	29	29	30	30	5	18	24	23	8	199	395
Data Supplier - Water Vole	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Perth Museum & Art Gallery	1										1
Royal Holloway University of London		38	38								76
Scottish Borders Biological Record Centre	4	2	1								7
Scottish Natural Heritage	5	1	1								7
Sheffield Biological Records Centre						2					2
Shropshire Mammal Group							15	36	54	27	132
Shropshire Wildlife Trust	81	28	25			20					154
Somerset Environmental Records Centre	12	11			1	14	60	9	37	5	149
South East Wales Biodiversity Records Centre	6	5	3	5	1	1	40	16	198	168	443
Staffordshire Ecological Record	7		12	7	7	2	3	5	8		51
Suffolk Biological Records Centre	168	193	90	77	64	19	28	16	11	97	763
Suffolk Wildlife Trust	162	184	49	80	62	1					538
Surrey Biological Records Centre c/o Surrey Wildlife Trust	1	7	5								13
Sussex Biodiversity Record Centre c/o Sussex Wildlife Trust	134	55	276	90	121	80	370	138	96	260	1620
Sussex Wildlife Trust						12					12
Tees Valley Wildlife Trust	13	38	5	13	10	23					102
The National Trust for Scotland		4									4
The Wildlife Trust of South and West Wales	13	3								117	133
University of Aberdeen	5	5	5								15
Vincent Wildlife Trust										199	199
Warwickshire Wildlife Trust	32	84			10	18	32	12	14	6	208
West Wales Biodiversity Information Centre	6	12	2	8	5	4	8	13	34	7	99

Appendix 2 Table A: Records submitted per year per data supplier – Water Vole cont. (Sheet 3 of 3)

Data Supplier - Water Vole	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Wildlife Trust for Bedfordshire, Cambridgeshire & Northamptonshire	110	6	29	3	103	361	423	142	390	1031	2598
Wiltshire and Swindon Biological Record Centre	4	1	15	517	54	26	48	56	139	93	953
Worcestershire Biological Records Centre	2	1		1	5	2	2				13
Yorkshire Wildlife Trust	349	288	84	34	28	165	354		225	31	1558
Total	**5345**	**5298**	**7399**	**4762**	**4392**	**4973**	**4199**	**3171**	**5013**	**3769**	**48321**

Appendix 2 Table B: Records submitted per year per data supplier – American Mink (Sheet 1 of 2)

Data Supplier	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Bedfordshire & Luton Biodiversity Recording and Monitoring Centre	44	110	47	10	6	5	4	2		2	230
Berkshire, Buckinghamshire & Oxfordshire Wildlife Trust	75	148	170				15	170	200	161	939
Biodiversity Information Service for Powys & Brecon Beacons National Park	5	12	10	38	35	8	9	13	10	6	146
Bristol Regional Environmental Records Centre	2	4	15	14	9	2	6	6	13	3	74
Cheshire Mammal Group	5	3				1					9
Cheshire RECOrd				1	1			2	2	5	11
Cheshire Wildlife Trust - Cheshire water vole project							1	11			12
City Ecology Unit, Sheffield City Council							10	3	1	7	21
Cofnod - North Wales Environmental Information Service	33	45	36	108	36	34	10	24	11	18	355
Cornwall Wildlife Trust	73	23									96
Cumbria Biodiversity Data Centre				4	2		5	3		3	17
Cumbria Wildlife Trust		7									7
Derbyshire Wildlife Trust	139	55	15				17	36			262
Devon Biodiversity Records Centre	168	54	3			3	6	18	46		298
Devon Water Vole Recovery Project			18	2	26	2					48
Dorset Environmental Record Centre	20	13	7	11	7	2	2			1	63
Dorset Wildlife Trust							2				2
Durham Wildlife Trust			7		1		1	4	16		29
EA Otter Survey of England 2009-10				503	7						510
EcoRecord	2	3	1								6
Environment Agency	16	2	3	1	1						23
Environmental Records Centre for Cornwall and the Isles of Scilly	76	14	1	4	6	8	3	4	2		118
Environmental Records Information Centre North East	20	3	12	20	20	18	11	5	22	22	153
Essex Wildlife Trust			43	16	3						62
Forestry Commission Scotland		1									1
Glasgow Museums Biological Records Centre	1		19	7	4	1		1			33
Gloucestershire Centre for Environmental Records	2	12	12		5	7	1		1	2	42
Greater Manchester Ecology Unit		2	6	6		4	3	3	5	11	40
Greenspace Information for Greater London	9	36	132	296	47	58	2		4	1	585
Hampshire & Isle of Wight Wildlife Trust	4	19	56	32	6	1	1	8	1	3	131
Herefordshire Biological Records Centre		2							1		3
Hertfordshire & Middlesex Wildlife Trust	33	35				10	22	39	26		165

Appendix 2 Table B: Records submitted per year per data supplier – American Mink (Sheet 2 of 2)

Data Supplier	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Highland Biological Recording Group	9	4	1								14
International Otter Survival Fund	3										3
Kent & Medway Biological Records Centre	17	7	2	4	7	6	5		8		56
Lancashire Natural Environment Record Network			1			25					26
Lancashire Wildlife Trust	9	12									21
Lincolnshire Environmental Records Centre	30	32	23	47	40	37	31	23	21	13	297
Lincolnshire Wildlife Trust	17	21	4	17	5						64
Lothian Wildlife Information Centre			3								3
Merseyside Biobank				1	2		6	3	2	1	15
Norfolk Biodiversity Information Service	9					1	3	10	107	51	181
Norfolk Wildlife Trust	32	17	1	1							51
North East Scotland Biological Records Centre	3	5	6	7	8	3		2			34
North Pennines AONB							5				5
Northamptonshire Biodiversity Records Centre						1			3	1	5
Northumberland Wildlife Trust		1									1
Northwest Lowlands Water Vole Project				51	2						53
Nottinghamshire Mammal Group	5	1									6
Nottinghamshire Records Centre								3			3
Nottinghamshire Wildlife Trust			3			5	10	5	12	24	59
Operation Otter						173					173
Paul Gambling	218	99									317
People's Trust for Endangered Species								1	1	4	6
Perth Museum & Art Gallery		1									1
River Axe Water Vole Recovery Project	34	67									101
Scottish Borders Biological Record Centre	1	3									4
Scottish Mink Initiative	21	78	146	158	166	328	418	34	205	1	1555
Sheffield Biological Records Centre			4								4
Shropshire Wildlife Trust	3	4				8					15
Somerset Environmental Records Centre						26	26	26	29	20	127
South East Wales Biodiversity Records Centre	11	15	12	16	13	4	11	12	52	22	168
Suffolk Biological Records Centre	210	346	1	4							561
Suffolk Wildlife Trust			78								78
Sussex Biodiversity Record Centre c/o Sussex Wildlife Trust	13	11	5		4	4	33	20	13	17	120
Sussex Wildlife Trust	5	5	4			27					41
Tees Valley Wildlife Trust				2	3	4					9
Warwickshire Wildlife Trust	32	16	3	19	10	20	32				132
West Wales Biodiversity Information Centre		1	1	18	6		1	1	2		30
Wildlife Trust for Bedfordshire, Cambridgeshire & Northamptonshire	2	2									4
Wiltshire & Swindon Biological Records Centre						3	15	26	8	14	66
Wiltshire Wildlife Trust			7	3							10
Worcestershire Biological Records Centre	3	1				4	3				11
Yorkshire Wildlife Trust	8	1	1					7	11		28
Grand Total	**1422**	**1353**	**919**	**1421**	**488**	**843**	**730**	**525**	**835**	**413**	**8949**