

**AUDIT OF PRIORITY SPECIES
OF RIVERS AND WETLANDS**
*Water Vole *Arvicola terrestris* in
South Hampshire*

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Water Vole *Arvicola terrestris* in Hampshire

1. Introduction

The following report has been commissioned by the Environment Agency (Southern Region). It has been prepared on behalf of the Hampshire and Isle of Wight Wildlife Trust and is one of seven audits covering species of rivers and wetlands that are considered to be a priority for conservation action by the Environment Agency and its partners.

The species covered by the audits are:

- Wetland and river molluscs:
 - Anisus vorticulus*
 - Pisidium tenuilineatum*
 - Pseudanodonta complanata*
 - Segmentina nitida*
 - Vertigo moulinsiana*
- Fresh water Cray-fish
- Southern Damselfly
- Marsh Fritillary
- Black Bog Ant
- Birds of rivers and reedbeds
 - Kingfisher
 - Bittern
- Water Vole

1.1 Confidentiality

There are complex issues concerning the confidentiality of Water Vole sites surveyed by the Vernon Wildlife Trust. Many of the records for the species in both counties come from this source and for this reason records are given at the 10 km square level of resolution.

2. Species Description.

2.1 Taxonomy.

The Water Vole, *Arvicola terrestris* (Linnaeus 1758), is a Murid Rodent of the subfamily Arvicolinae, along with all other voles, lemmings and Muskrats. The genus *Arvicola* contains two species (Wilson and Reeder 1993), both of which are European in distribution; *A. terrestris*, known internationally as the **Northern Water Vole** (2n chromosome no. =36) and *A. sapidus*, the **Southern Water Vole** (2n chromosome no. =40). The genus *Arvicola* has been the subject of several taxonomic revisions and has previously been considered as comprising of as many as 7 species, with different distributions and lifestyles (Miller 1912). The current taxonomic status may well be an over simplification of a complex of species ranging right across Europe and a taxonomic revision of the genus is needed (Wilson and Reeder 1993), and any change in the number of species may well place increased significance on the British population. The British population was previously considered to be specifically distinct, *A. amphibius* (Linnaeus 1758) and for much of this century has been cited as such. A third species *Microtus richardsoni* from the United States of America is often included within the genus *Arvicola* although is now more correctly assigned to the genus *Microtus*. Many subspecies are recognised across the range of *A. terrestris*, reflecting morphological and ecological differences. The British population is generally attributed to *Arvicola terrestris amphibius* a taxon with a predominantly semi-aquatic lifestyle.

Arvicola terrestris has a number of local common names. In Britain it is generally referred to as just the 'Water Vole' due to the absence of *A. sapidus*, but it is also frequently called the Water Rat and occasionally known as the Earth Hound, Water Dog or Water Mole.

2.2 Morphology.

2.2.1 General Characteristics

The Water Vole is typically vole-like in its morphology, although its generally much larger size easily distinguishes it from all other British Vole species. It has a rounded body with a blunt muzzle and short rounded ears, usually hidden by the thick fur of the head and nape. It has very few obvious adaptations for an aquatic lifestyle and the feet are not webbed, nor is the tail flattened. Adults weigh from 200-350g with males normally slightly larger than females.

2.2.2 Pelage Variation

The pelage is variable, although most southern England populations are typically rich to chocolate brown dorsally which grades into an ochreous grey-brown on the ventral surface. Some individuals are considerably darker. In Northern England, Scotland and parts of East Anglia, melanism can be frequent. Near Aberdeen only 3.2% of the population was brown (Stoddart 1968), whilst a population in Wester Ross consisted

of 70% melanic, 20% brown and 10% 'black and tan'. Several other bizarre colour mutations have been recorded infrequently. Partial albinism is fairly common particularly a white tail-tip.

2.2.3 Determination from similar species.

Water Voles are most frequently mistaken for Brown Rats (*Rattus norvegicus*) which frequently inhabit waterside habitats and are also excellent swimmers. However, Brown Rats are generally larger, weighing up to 500g (Corbet & Harris 1991), although there is considerable overlap between the weights of the two species and the thick fur of Water Voles often makes them appear larger than they actually are. Water Voles have a much more rounded muzzle and less conspicuous ears than Brown Rats and the tail is considerably shorter, only around 60% of the head and body length in Water Voles compared to 90% in Brown Rat.

Confusion can also exist between newly weaned Water Voles and adult Field Voles (*Microtus agrestis*), the former leave the nest weighing as little as 30g. which overlaps with the upper end of the Field Vole weight range. However juvenile Water Voles are generally darker with larger heads and much larger hind feet, being around 30mm as opposed to only approximately 17.5mm in adult Field Voles.

3. Habitat Requirements.

3.1 Water course characteristics

In Britain Water Voles typically inhabit water side habitats. They occur most frequently along the fringe of densely vegetated water courses such as rivers, streams, canals, ditches and dykes. They are also frequently found on ponds, lakes and gravel pits, although the degree of isolation of such habitats may well be important as a barrier to colonisation. They occur in both upland and lowland regions although in upland areas populations generally occur on the slower flowing reaches of streams. They do not normally occur in areas where water is only available seasonally and dries out for the remainder of the year. They are intolerant of brackish water.

3.2 Feeding Requirements

Water Voles are herbivores and rely upon macrophyte growth for most of their diet. They are most frequent along water courses with a dense marginal macrophyte fringe. From feeding remains, a nationwide survey identified 227 species of plants being eaten (Strachan & Jefferies 1993). Seasonal dietary requirements or changes are not fully understood. Water Voles frequently exhibit a habitat preference for areas with extensive tall monocot growth such as *Phragmites*, *Phalaris*, *Carex*, *Glyceria* and *Sparganium*. Close cropped vegetation, either along one bank of a water course or occurring in small patches, is often utilised for grazing although more dense vegetation is required for providing cover for runs and burrows.

Locally some animal matter may be consumed and Signal Crayfish, freshwater snails and Common Frog have all been found consumed within Hampshire.

3.3 Nesting Requirements

Water Voles normally inhabit burrow systems dug into the banks, which are frequently complex with several entrances both above and below the water level. Consequently, steep banks above the highest normal water level are generally important for good populations. Occasionally in the absence of sufficient suitable bank they are known to construct large domed nests in water-side vegetation. These are most frequent amongst areas of dense *Phragmites* or occasionally in Tussock Sedge (*Carex paniculata*), however such nesting habits may leave Water Voles particularly vulnerable to predation.

3.3.1 Subterranean Populations

Exceptionally populations in Britain have been known to occur away from water living totally subterranean (Corbet & Harris 1991). This is much more frequent amongst populations from continental Europe and the normal mode of life for the subspecies *A. terrestris scherman*.

4. Species Distribution.

4.1 Worldwide Distribution

The type locality for the species is Uppsala, Sweden.

The current distribution extends from Europe (except Central and South Spain, Western France and South West Italy), from mountains of the Mediterranean region to the Arctic Sea, east through Siberia almost to the Pacific coast, south to Israel, Iran, Lake Baikal and the North Tien Shan mountains of North-west China (Corbet 1978, Bobrinskii et al 1965, Wilson & Reeder 1993).

4.2 European Distribution

The Water Vole is very widespread across Europe. It occurs from Great Britain (absent in Ireland), to the North and East of a line that runs from the Belgian coast due south to central France and then South-west to the top of the Italian peninsula. To the north its range extends right through the Scandinavian countries to the Arctic sea and south as far as the Mediterranean and east right across to the former USSR and beyond (see 4.1) (Niethammer & Krapp 1982, Macdonald & Barrett 1993). An isolated population occurs in North Spain and Portugal. The species is replaced in western France and most of the Iberian peninsula by *A. sapidus* with which it has a generally mutually exclusive range.

4.3 British Distribution

The species has been revealed as widespread in the British Isles. Arnold (1993) cites a total of 3007 records for Water Vole covering 1139 10km grid squares ranging from the extreme North-east of Scotland to the westerly tip of Cornwall. The systematic survey during 1989/90 of Strachan & Jefferies (1993) found Water Voles at 1418 sites (representing 47.7% of sites surveyed) again spread right across the British Isles. A further 1724 were collated from information obtained from the general public. For each Water Authority region the percentage of sites positive for Water Voles and the number of sites surveyed (in parentheses) were: Southern 74.11% (224), Thames 73.50% (200), Anglian 72.44% (479), Northumbrian 54.11% (146), Severn-Trent 47.29% (277), Wessex 44.97% (169), Yorkshire 40.82% (196), North-West 40.20% (199), Scottish 32.74% (730), Welsh 23.08% (247) and South-West 15.53% (103) (Strachan & Jefferies 1993).

4.3.1 Population Trends

Despite widespread distribution of the Water Vole, the population trends are very disturbing. The Water Vole is undergoing the most dramatic decline of any British Mammal this century. Strachan & Jefferies (1993) showed that there had been a steady decline during this century with Water Voles already lost from 67.7% of sites, and a continuation of this rate of decline calculates a loss of voles from 94% of sites by the end of this century. Also the number of Water Voles at each site is believed to decline

with the percentage of occupied sites (Harris et al 1995), making the decline in Water Vole numbers even more severe than that of occupied sites. Recent survey work in the Thames region suggests that since the 1989/90 survey there has been a further loss from around 70% of sites found to be positive for Water Voles when surveyed formerly (Macdonald et al 1996). The total British spring pre-breeding population has been estimated as 1,169,000 with a confidence level of only 50% (ie. 584,500 - 1,753,500) (Harris et al 1995), however given the Water Voles alarming rate of decline this may well be an over estimate.

5. Historic Status in Hampshire.

Even since the days of Gilbert White (1789) the Water Vole has been recorded in Hampshire. It has been widespread and considered a common sight in the county wherever suitable habitat existed. Along the River Test and Itchen catchments, it has sometimes even been considered a nuisance and treated as a pest due to its extensive burrowing activities in riverside banks. It has suffered in the past as a result of control measures in an effort to alleviate this damage and in a few areas still continues to be persecuted.

6. Population Trends in Hampshire.

Despite still having buoyant populations in some areas, there is evidence of a decline in Hampshire and the Isle of Wight. Strachan & Jefferies (1993) in their appraisal of the rate of loss from historic sites for each Water Authority region cited for the Southern Region that 50% of sites occupied pre-1939 no longer supported Water Voles in 1990. However, this represented the lowest rate of loss nationally.

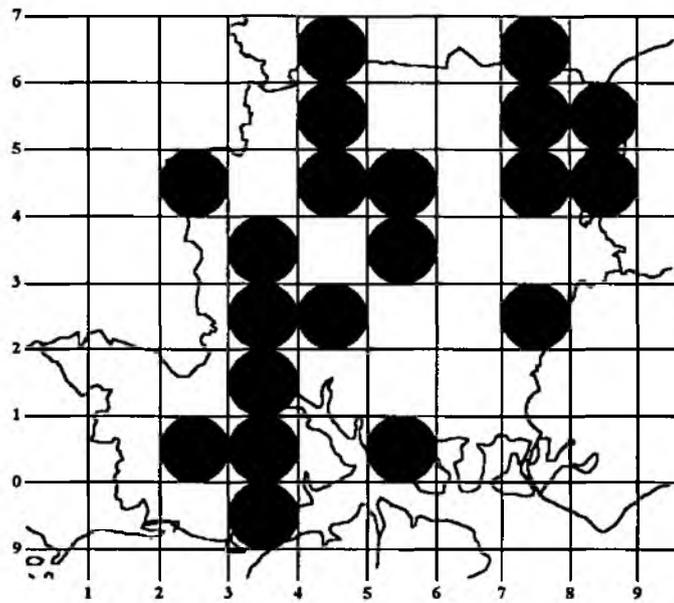
This decline appears to be continuing, unsubstantiated qualitative reports from several observers comment that Water Voles 'are declining' or 'have disappeared' from localised sites. Additionally one relatively isolated site at Crampmoor, near Romsey in the River Test catchment which was surveyed in winter 1994/95 and had Water Voles present in sufficient numbers to cause localised bank damage had totally lost its Water Vole population by summer 1996 when intensive surveying and trapping revealed Water Voles to be totally absent.

7. Current Status in Hampshire.

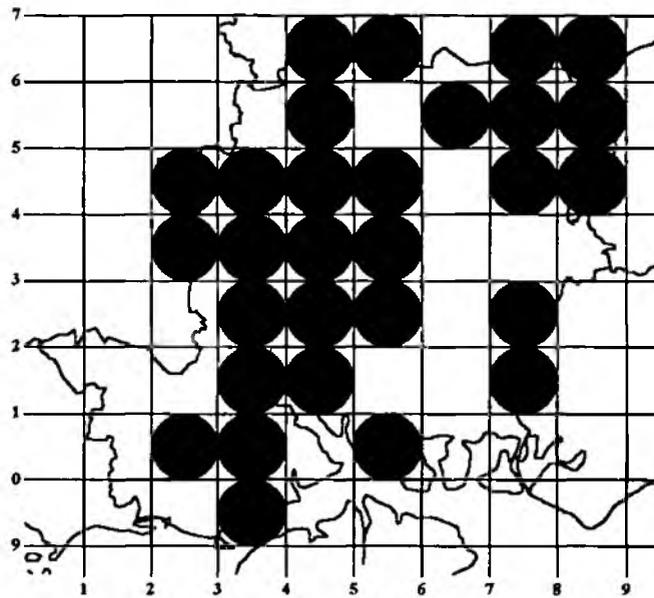
Current distribution records for most of Hampshire are in the main patchy and a reflection of the previously sporadic nature of recording (only since 1996 has Hampshire had an official Mammal Recorder), rather than a reflection of Water Vole distribution. In April 1989 they were recorded from 48 sites in 20 10km grid squares, representing an occupancy of 76.2% of sites examined (Strachan & Jefferies 1993). Since 1990 Water Voles have been recorded on the following river catchments in Hampshire: Itchen, Test, Avon, Loddon, Blackwater, Meon, Lymington, Wey and the Whitewater, mostly as a result of accidental sightings.

The only Hampshire river catchment which has been systematically surveyed is the River Itchen (Jordan 1997). Preliminary results are encouraging and have revealed a widespread distribution. Despite the generally clumped nature of Water Vole populations, they are still present from the upper reaches at Cheriton and Alresford right down to Woodmill in Southampton. The process of fragmentation usually associated with the eventual extirpation of Water Voles appears currently to be hardly impacting on populations along the River Itchen.

Water Vole distribution from sites surveyed April 1989 (Strachan & Jefferies 1993)



Total Water Vole distribution from sites surveyed April 1989 and additional records from members of the public (Strachan & Jefferies 1993)



8. Information on Hampshire Populations.

Water Vole populations on the River Itchen have been extensively studied since 1995 (Jordan 1996) and all the information on demography specific to Hampshire is derived from these studies. At some sites, comprising of prime habitat, Water Voles occur at very high densities. At Kingsworthy (SU 4932) during the autumn peak of 1995 densities reached 1 Water Vole every 24m of river, whilst at a site experiencing extreme damage lower down the Itchen at Bishopstoke (SU 4817) a mid-summer population of 1 Water Vole every 16m of river was present. However at high density at Kingsworthy 12.8% of Water Voles were in very poor body condition, in some instances close to death. The spring 1996 pre-breeding population was only 34% of the previous autumn peak (an overwinter mortality/dispersal of 66%).

Despite apparent high densities, movements appear to be very limited. At Kingsworthy two parallel channels, separated by only approximately 10m of marshy ground are monitored. The maximum linear distance travelled along a channel by a Water Vole during 1995 was 120m yet no lateral dispersal between channels occurred.

There is evidence that some Water Vole populations in Hampshire are still subject to control measures to alleviate damage (Jordan 1996). The burrowing activity undermines banks which can lead to subsidence or make certain bank side activities such as mowing of paths difficult. In some cases this breakdown of bank integrity can be serious, particularly to some specialist activities such as ornamental fish farming. The control of Water Voles normally takes the form of shooting all individuals seen.

9. Predicted additional distribution in Hampshire.

It is likely that despite the previously sporadic nature of most Water Vole records in Hampshire (excluding the River Itchen) they may well still be distributed along many of the main river catchments where suitable habitat exists. Hampshire is one of the counties experiencing the lowest rate of loss, nevertheless a decline has been demonstrated (see section 5.) and this predicted distribution should be confirmed as soon as possible in order to provide a baseline from which to monitor any further decline.

10. Current conservation work in Hampshire.

10.1 Extensive surveys

The national Water Vole and Mink survey (Strachan & Jefferies 1993), conducted during April 1989 (100km grid squares SZ & SU) provided the first extensive survey of Hampshire and still provides a baseline upon which to discuss distribution in Hampshire and compare future work. This was however conducted eight years ago and a resurvey has again been commissioned by the Vincent Wildlife Trust which will survey the 100km grid squares SZ and SU during March 1997 (R. Strachan pers comm.). This will provide a quantitative estimate of the rate of decline in Hampshire over the previous eight years. However, this national survey represents a systematic sampling survey examining a predetermined pattern of 90 sites each consisting of 600m of river bank in each 100km grid square and is specifically designed to give a national overview rather than detailed local information. As such it inevitably misses important aspects of distribution amongst a species with clumped and partially fragmented populations.

On a local scale a catchment based approach utilising similar techniques to an abbreviated river corridor survey are preferable (Strachan 1996), in which every metre of waterway is surveyed and all field signs plotted on to a base map. This yields very detailed information and is useful not only in ascertaining distribution but also in correlating populations to habitat variables. To date only one such detailed survey has been carried out in Hampshire, the River Itchen survey during July - November 1996 coordinated and conducted by Sparsholt College Hampshire in conjunction with WildCRU and the Environment Agency (Jordan 1997). Surveys of this design should also take the opportunity to record all other potentially interacting species at the same time (American Mink, Brown Rat and Otter).

10.2 Ecological Research

A substantial amount of ecological research into Water Vole populations is currently taking place in Hampshire (Jordan 1996). The high populations still present in some areas provide an ideal situation in which to investigate many aspects of Water Vole ecology which are still only poorly known. A standard protocol for trapping, handling and marking has arisen from this work (Jordan 1996) and demographic research continues via regular population monitoring. During the summer of 1996 this intensive research ran simultaneously with the extensive surveying (see section 10.1) and the correlation of field sign indices to an area of known population will prove extremely useful in ascertaining Water Vole population information from other extensive surveys in Hampshire.

10.3 Relocation from problem areas

During 1995 and 1996 Water Voles were removed from four sites in Hampshire at which they were causing extensive damage to banks (see section 7) (Jordan 1996). This was performed by Sparsholt College Hampshire in conjunction with New Forest

Nature Quest, as an alternative to control via shooting. In addition Water Voles were also trapped at one Hampshire site on the route of the Newbury bypass prior to construction work. All Water Voles were relocated to a series of pens funded by the Environment Agency to form the nucleus of a captive breeding group.

10.4 Captive Breeding

A successful captive breeding programme has been established at New Forest Nature Quest (Gow 1996) utilising Water Voles relocated from problem sites. The species has only been sporadically bred in captivity in the past, however during 1995 over 40 individuals were bred at New Forest Nature Quest, clearly illustrating the potential that captive breeding could play in the conservation of this species. Currently no clear protocol exists for the release of Water Voles, however in order to formalise this, scientific trials will be required incorporating both wild translocated and captive bred Water Voles.

A captive facility also serves an important research function. Already interesting information on reproduction has been revealed and DNA samples from animals of known relatedness are contributing to the verification of field work researching dispersal.

11. Potential future opportunities in Hampshire.

Hampshire already has a role of national importance in the conservation of Water Voles. It still possesses flourishing populations, in some cases so high that significant damage to banks is still occurring (see section 7). This is of obvious importance with regard to the national significance of these Water Vole populations. Additional to this obvious role is the very important resource that Hampshire provides for future research activities. With many aspects of Water Vole biology still poorly understood, the most suitable areas to research these aspects are those where Water Voles still occur in high numbers and particularly where an existing programme of research is already in place (see section 9.2).

Currently the only large scale captive facility for Water Voles is in Hampshire. This represents a potential opportunity by making Hampshire key in any future captive breeding programmes or reintroduction trials. Initially trials will be required to formulate a scientific release protocol based upon the standard IUCN guidelines for reintroductions and this will only be possible with the cooperation of a captive breeding facility. Research is already underway by Aberdeen University to investigate genetic variability within Water Voles in Great Britain and such considerations should be borne in mind before releases occur, although should not delay the process of establishing separate captive stocks from a number of geographic locales. Additionally this facility provides a unique opportunity for further research into many aspects of Water Vole biology under strictly controlled environments and the potential to heighten awareness to the general public of the plight of this species.

The current conservation effort and close cooperation already in existence in Hampshire presents a great potential opportunity for this species within the county. The National Water Vole Technical Support Group which inputs priorities directly to the Water Vole Steering Group, comprises of seven members, two from establishments within Hampshire (Sparsholt College Hampshire and New Forest Nature Quest), whilst two other members are already involved in collaborative research taking place within Hampshire with the aforementioned establishments. This technical expertise within the county, combined with the high level of commitment and support already demonstrated by the Environment Agency and Hampshire Wildlife Trust, ensures that Hampshire has a key role to play in the future conservation of this species.

12. Conservation Issues.

The Water Vole is a species which for many years has been widespread and abundant and has escaped the attention of most scientific research. Therefore the very highest priority afforded in the proposed action for conservation in the Species Action Plan (Strachan & Macdonald 1996) is that of 'Future Research and Monitoring'. The following key conservation issues all require further detailed scientific investigation in order to determine the effects and importance of each on the decline of Water Vole populations.

12.1 Legislation

Imminent moves are in place to add the Water Vole to Schedule 5 of the Wildlife and Countryside act (1981). This legislative protection may take one of two forms: full protection under section 9, affording the same level of protection as that granted to other fully protected mammals such as the Otter; or protection in respect of section 9(4) only, which will make it an offence for any person to intentionally 'damage or destroy, or obstruct access to, any structure or place which any wild animal included in schedule 5 uses for shelter or protection; or disturbs any such animal while it is occupying a structure or place which it uses for that purpose'. The latter may potentially cause problems with riparian land owners, for whilst the Water Vole itself will not be protected, its burrows will be, restricting bank modification works and ultimately encouraging the removal of Water Voles in order to continue bank modifications unimpeded. Careful appraisal of each individual bank modification would therefore need to be carried out to assess the impact on Water Voles prior to the commencement of any alterations.

12.2 Habitat degradation

12.2.1 Bank side grazing

A negative correlation has been shown between the intensity of grazing on river banks and the presence of Water Voles (Macdonald et al 1996). Heavy grazing removes tall plant growth, reducing food and cover whilst at the same time poaching and eroding banks required for burrowing activities.

12.2.2 Engineering and maintenance works

The removal of bank side vegetation and canalisation can have an obvious immediate negative effect on Water Voles. The effects of dredging may well only be short term (Singleton 1984): in Lancashire dredging and re-sloping of a drainage dyke displaced Water Voles for 6 months and it took a total of 18 months for populations and vegetation to return to former levels. However any recolonisation following such works will be heavily dependent upon the adjacent proximity of a population from which to disperse.

In the longer term such activities may influence water flow and fluctuations in water level (see section 12.4)

12.3 Habitat Fragmentation

Increasing isolation of blocks of suitable habitat may potentially be very serious for the long term viability of Water Voles within a river catchment. The dynamics of such a meta-population situation will be affected by the loss of each sub-population which will also increase the level of isolation between sub-populations. Ultimately this pattern of site loss in a poorly dispersing species can lead to extinction.

12.4 Fluctuating Water levels

Exclusion of Water Voles from burrows and food by periods of flooding may well negatively affect survival of Water Voles, by increasing predation and leaving voles susceptible to starvation and chilling. Also populations are usually absent from areas which are subject to periodic drying out. Therefore a reduction in seasonal fluctuations at a suitable level very likely benefit long term survival of Water Vole populations.

12.5 Predation

Over-winter mortality is high amongst Water Voles and their rate of productivity is also large. However, there now appears to be little doubt that predation by the introduced American Mink (*Mustela vison*) can have a severe impact upon Water Voles. This semi-aquatic predator hunts linearly along riparian features, with females being small enough to enter some Water Vole burrows. The control of American Mink may well be an important feature in safeguarding small or fragmented Water Vole populations which are restricted to predominantly linear features. Predation may play a less important role in more expansive wetland areas (Barreto 1996, Macdonald et al 1996).

The likely effects of the spread of Otters (*Lutra lutra*) and Polecats (*Mustela putorius*) on American Mink are unknown but could potentially influence the severity of their impact Water Voles.

Predation by Brown Rat (*Rattus norvegicus*) is an area requiring much further research. There is conflicting evidence concerning the potential effect on populations, however, Brown Rats have been known to kill and eat both juvenile and adult Water Voles. This may be an area of particular concern to populations in urbanised or canalised habitats.

12.6 Competition

In addition to potential predation by Brown Rats it has been suggested that competition with them for food and space may be important in the decline of the Water Vole, particularly in sub-optimal canalised or urban habitats. Effects are presently unknown.

12.7 Pollution

There have been suggestions that contamination of water bodies may be relevant to the decline of the Water Vole (Morris 1993), although currently there is no evidence to support this.

12.8 Disease

At present there is no evidence to support the hypothesis that an epizootic disease has contributed to the decline in Water Voles.

13. Discussion and Conclusion.

There is no doubt that the Water Vole is under going a catastrophic decline across much of it's range in Britain and in Hampshire too there is evidence that it has been lost from sites at which it formerly occurred. However current distribution data does still show that the Water Vole occurs on many river catchments, with the only one of those extensively surveyed, the River Itchen, still showing widespread and in some places large populations.

The decline of Water Voles is probably attributable to a number of factors which may act cumulatively. Predation by the American Mink is often blamed for the current situation, although there is evidence that Water Voles were already in decline prior to the widespread release and establishment of American Mink in this country (Strachan & Jefferies 1993). A 'tightrope hypothesis' has been suggested (Macdonald et al 1996) whereby Water Voles already constrained by habitat orientated factors are then left susceptible to extirpation by other causes such as Mink predation. This may well be important in explaining why multi-braided rivers such as the Itchen, bounded in places by extensive wetland habitats, still contain good Water Vole populations.

The current lack of information concerning many basic aspects of Water Vole biology means that research is vital before the exact causes of population decline can be ascertained and steps taken to try and arrest the current situation. This research will inevitably focus on areas where reasonable populations of Water Voles still occur and monitoring populations closely during periods of decline may well furnish an insight into factors affecting populations. Similarly the use of captive facilities for research and breeding rely at least initially upon founder stocks preferably from areas experiencing damage problems (almost invariably high populations), or animals from habitats destined for destruction (such as development or road building schemes).

It is evident that Hampshire is an important county with regard to Water Vole conservation and the populations still present are of national significance. These populations are already acting as a focus for research into the species and the only large scale captive facility for Water Voles is also situated within the county.

14. Recommendations for future work.

Action	Cost	Priority
Facilitate and encourage the local survey of Water Vole populations. Ideally River Corridor Survey based full catchment surveys should be conducted, similar to the River Itchen survey, of the other main river catchments within Hampshire.	£24,000 (<i>Full RCS based survey of Rivers Test, Meon, Lymington and Avon</i>)	Very High
Regular monitoring of a series of sample sites on each major river catchment, both occupied and unoccupied by Water Voles. Given the dramatic rate of decline this monitoring should be conducted at a maximum of three yearly intervals.	£600 per 10km (<i>20 x 500m sites</i>)	Medium
Ensure that all distribution and population data is passed to the county mammal recorder in order that data from all sources can be collated and accessed from one source.		Medium
In accordance with the Species Action Plan identify large, viable breeding populations of Water Voles in Hampshire to act as Water Vole sanctuaries and seek to retain these with appropriate management and monitoring	<i>Costs not currently quantifiable.</i>	Very High
Protect and enhance existing habitats through appropriate management by, reducing bank side grazing to acceptable levels, encouraging fringes of emergent vegetation, where mowing is necessary leaving strips of 50m uncut at regular intervals, where river channel management is necessary dredge from one bank only, where bank erosion requires reinforcement sympathetic small scale repairs should ideally be carried out avoiding concreting or metal piling.	<i>Costs totally dependent upon the extent of habitat and the management required.</i>	High.
Undertake research on demography of populations in a variety of typical Hampshire habitats in order to more fully understand the roles of over-winter mortality and dispersal in population regulation.	£12000 per annum for full demographic study of 4 sites.	High.
Undertake research to establish a scientific protocol for the translocation/reintroduction of Water Voles and evaluate the use of such programmes in restoring populations where they have been lost.	£16000.	Medium.

Undertake research to evaluate the effects of predation or competition with Brown Rats on Water Voles. £9500. Low.

Provide a central focus point disseminating information on habitat management and advice for people experiencing damage problems so that a coordinated approach to bank stabilisation or translocation can be carried out Medium.

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