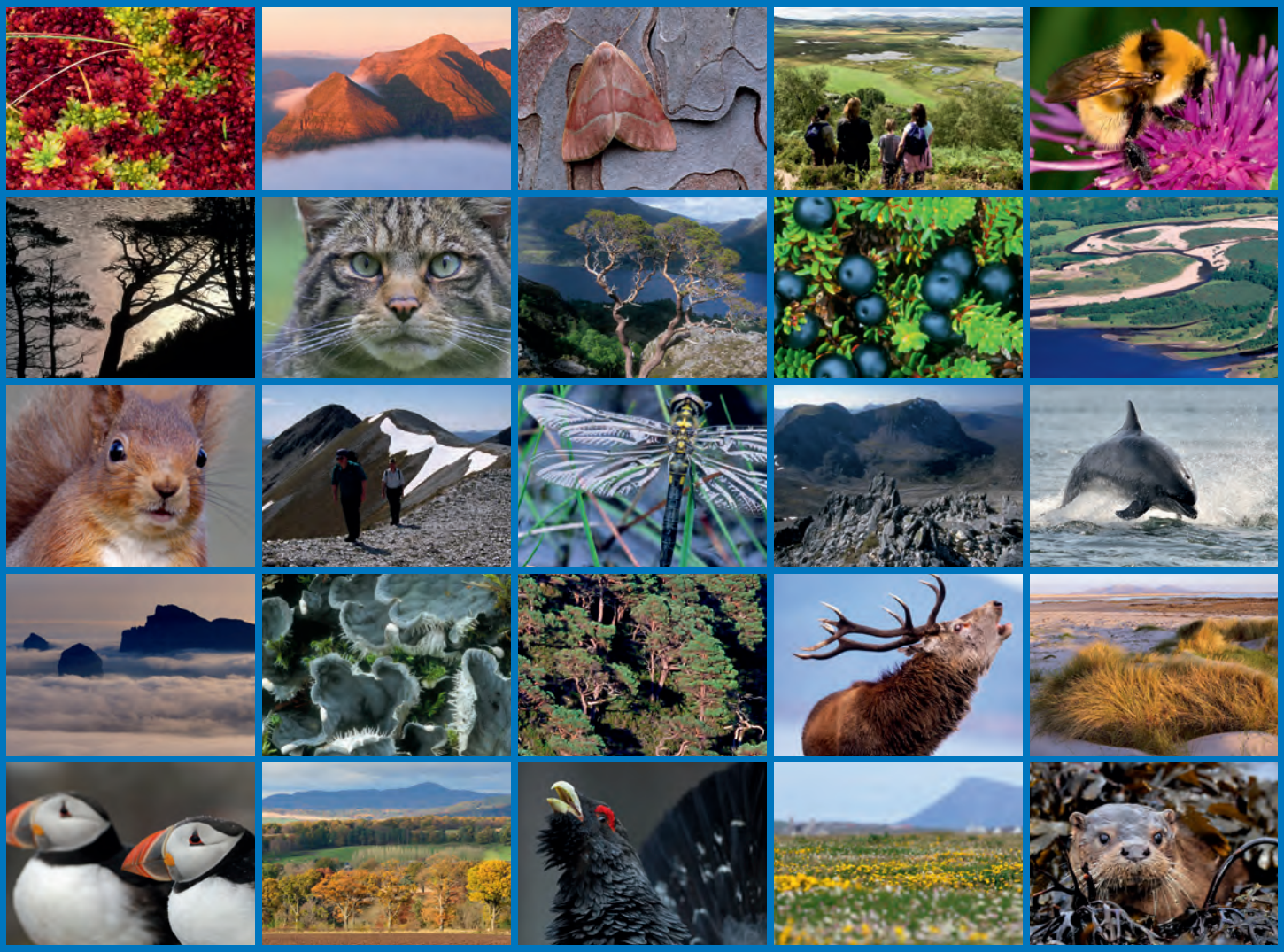
Scottish Natural Heritage
Commissioned Report No. 541

Water vole survey of Beinn Eighe National Nature Reserve



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COMMISSIONED REPORT

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COMMISSIONED REPORT

Summary

Water vole survey of Beinn Eighe National Nature Reserve

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Water vole; *Arvicola amphibious*; American mink; *Neovison vison*; Beinn Eighe Reserve Plan 2009-2015.

Background

Within the last fifty years the water vole *Arvicola amphibius* has suffered one of the most rapid and serious declines of any mammal in the UK. The water vole received legal protection in 1998 through its inclusion on Schedule 5 of the Wildlife & Countryside Act 1981 (as amended), Section 9(4). It is listed as a 'Priority Species' in the UK Biodiversity Action Plan, requiring the implementation of a Species Action Plan dedicated to its survival (Biodiversity Steering Group 1995). As such, it is also listed as a priority species in the Wester Ross Biodiversity Action Plan.

The distribution of water vole colonies and suitable habitat within the Beinn Eighe National Nature Reserve (NNR) were largely unknown until the present survey. The survey was undertaken in October 2011 to identify water vole populations, map their distribution and identify those water vole colonies potentially at greatest risk of extinction. The findings were incorporated into a long-term management strategy for water vole conservation within the NNR.

Main findings

- A total of 19 separate locations were found to have current, recent or old signs of water vole activity.
- Of these 19 locations, 8 were considered to have currently active water vole colonies.
- Smaller colonies are generally considered at greater risk of natural bouts of extinction. Geographically isolated colonies are more likely to take longer to re-colonise after an extinction incident.
- No colony was considered to be at risk of extinction as a result of any current Reserve management strategy.
- The report provides recommendations for water vole conservation with regard to the Beinn Eighe Reserve Plan 2009-2015, focusing mainly on footpath development and woodland regeneration.

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1. BACKGROUND

1.1 National and local status

Within the Scottish Natural Heritage (SNH) Beinn Eighe National Nature Reserve (NNR) property the distribution of water voles *Arvicola amphibius* is poorly known. SNH commissioned the present survey to detect water vole populations, map their distribution and identify those water vole colonies thought to be at greatest risk of extinction.

The water vole is one of Britain's most threatened mammal species. Over the last fifty years its population is estimated to have declined by 94% (Strachan & Jefferies, 1993; Strachan *et al*., 2000), one of the most rapid and serious declines of any UK mammal. Habitat loss and degradation, fluctuations in water levels and pollution have all contributed to this decline but it has been exacerbated by the spread of the American mink *Neovison vison*, an introduced and very efficient generalist predator (Strachan, 1998). Mink remain largely absent from the north west of Scotland (Harrington *et al*., 2009), which is therefore a potentially important refuge for water voles.

Although the Atlas of Mammals in Britain (Arnold, 1993) showed water voles to be largely absent from most of the Scottish highlands recent studies have shown them to be far more widespread than previously thought (Woodroffe, 2000), occurring throughout north and west mainland Scotland (Woodroffe *et al*., 2008). Gaps in known distribution partly reflect the fact that water voles are still under-recorded in upland areas. Upland populations tend to be localised and small reflecting the naturally patchy distribution of suitable habitat.

A search of the NBN Gateway found no records of water vole within the SNH Beinn Eighe property, however water vole colonies have been recorded on the NNR within the National Trust for Scotland (NTS) Torridon property and on the neighbouring Grudie Estate (Brown *et al*., 2010; Waterside Ecology, 2011). The Statement of Requirement provided by SNH suggests that water voles have been recorded within the SNH property but that the records are not site specific.

1.2 Legislation and conservation

The water vole received legal protection in 1998 through its inclusion on Schedule 5 of the Wildlife & Countryside Act 1981 (as amended), Section 9(4). This provided protection for the water voles' places of shelter, making it an offence to intentionally or recklessly damage, destroy or obstruct access to any such structure or place, or to disturb water voles while they are using such a place. Water voles themselves were not protected until April 2008 when the legislation was changed to give the water vole full protection under the Wildlife and Countryside Act. It is now illegal to intentionally or recklessly kill, injure or take a water vole from the wild.

The water vole is listed as a 'Priority Species' in the UK Biodiversity Action Plan requiring the implementation of a Species Action Plan dedicated to its survival (Biodiversity Steering Group, 1995). As such, it is also listed as a priority species in the Wester Ross Biodiversity Action Plan.

1.3 General ecology

The water vole is found living along waterway edges in a variety of habitats from upland streams to wide rivers and agricultural ditches (Aars *et al.,* 2001; Lambin *et al.*, 2004; Strachan, 1998). Water voles are almost wholly vegetarian, feeding on a wide range of plants. They favour riparian habitats affording luxurious bank-side vegetation, particularly grasses and sedges, to provide food and cover from predators. They may tolerate brackish

water and feed on halophytic plants, but do not generally inhabit areas that dry out twice daily, and so are largely absent from estuaries and salt marshes.

Water voles create extensive systems of burrows with interconnecting tunnels and entrances both above and below the water surface. Steep banks with a slope of 35 degrees or more allow burrowing and, importantly, provide refuge during flood events. However, vertical or overhanging banks may be difficult for water voles to access for burrowing, unless there are access ledges at water level. Rocky banks are avoided due to the difficulty of excavation. Within the Scottish highlands stretches of suitable habitat can typically be anything between 200 m and 1500 m apart, separated by unsuitable habitat with fast flowing water and rocky, heather clad banks (Lambin *et al*., 2011). This highly localised distribution of habitat leads to a population structure where a large regional population comprises many smaller sub-populations. In these upland populations it is common for each small colony to consist of only one female and her progeny and it is rare for adults to survive to breed in two successive years (Lambin *et al.,* 2011). As the juveniles do not reproduce within the year of their birth such small sub-populations are vulnerable to extinction. However they can be sustained through dispersal from other sub-populations. As a result the overall population, likened by Macdonald and Strachan (1999) to "a constellation of twinkling stars blinking on and off", may remain relatively stable while individual sub-populations come and go. This phenomenon of many small sub-populations within an overall patchy distribution functioning independently but interacting via movements of individuals is known as a *metapopulation*.

Water voles are effective dispersers and in upland areas travel an average distance of 3.5 km (and up to 23.9 km) to find a mate and appropriate habitat (Lambin *et al*., 2011). Radio tracking has shown that they disperse both along waterways and overland and can create temporary refuges as they move through less suitable habitat. It has also shown that they are capable of travelling hundreds of metres in one day (Fisher *et al*., 2009). This movement of individuals between areas of suitable habitat can not only boost existing population numbers but can result in (re)colonisation of new or previously occupied patches of suitable habitat. Recent work by Sutherland *et al.* (2012) has shown that well connected patches of suitable habitat close to colonies containing higher numbers of juveniles are more likely to be (re)colonised than more isolated patches.

Thus a key principle of metapopulation dynamics is that loss of unoccupied habitat may be as important as loss of occupied habitat, since it may become occupied over time, maintaining the overall stability of the population. It also means that small and sub-optimal patches of habitat in otherwise unsuitable areas can be important in providing stepping stones of foraging and shelter during dispersal to areas with more suitable habitat. Loss of even small habitat patches may affect the wider water vole population by increasing isolation and therefore raising extinction risks. This has clear management implications, in particular that conservation efforts within the wider geographic range of water voles should seek to protect and preserve suitable water vole habitat even if currently unoccupied.

Water voles leave a number of distinctive field signs, useful for their study. They make runways in the vegetation, leave piles of feeding remains, which are short lengths (5-10 cm) of chopped up vegetation, and most significantly mark their home ranges with faecal latrines. Well-grazed 'lawns' are frequently visible at the entrances to burrows. The presence of latrines and burrows are the most reliable field signs of water vole presence, as feeding signs may be indistinguishable from those left by field voles *Microtus agrestis* or bank voles *Myodes glareolus* (Ryland & Kemp, 2009).

1.4 Factors affecting Scottish water vole populations

1.4.1 Mink predation

American mink were introduced to the UK in the 1920s and 1930s for fur-farming. Following escapes and intentional releases they began to establish themselves in the wild in the late 1950's, with the first record of breeding occurring in Devon in 1956. Mink are now widespread throughout Britain with the exception of the far north west of Scotland (Green & Green, 1997; Harrington *et al.*, 2009).

Once a mink has colonised a waterway its impact on water voles is usually catastrophic leading to localised water vole extinction. Mink tend to be scarce in open moorland and mountainous terrain, preferring the greater cover and abundance of prey that is found in the lower lying parts of river systems (Raynor, 2005). Predation on water voles in the upper reaches of rivers is likely to occur only intermittently unless alternative prey sources such as rabbits are available and the mink become more persistent within that area. Until recently mink sightings within Wester Ross were limited and sporadic, however in 2009 nine mink were trapped on Isle Ewe. Within the last year a group consisting of local conservation organisations and volunteers initiated a mink trapping programme within the Wester Ross area. Due to difficulties in maintaining monitoring rafts short periods of intensive trapping were planned. During the first trapping period in August 2011 one mink was captured at the mouth of the Little Gruinard River. No mink were captured in traps set on the Beinn Eighe NNR, Coulin Estate or the NTS Torridon property (N. Tallach, *pers. comm*.).

1.4.2 Development and dredging

The canalisation and culverting of waterways using 'hard' engineering has had a long term impact on UK water vole habitat, especially in lowland urban and agricultural areas. Under the latest legislation developers should avoid water vole habitat and ideally leave a riparian corridor to allow movement between subpopulations. In some cases where this has not been possible mitigation has included translocation and creation of habitat outside the development area.

Current best practice guidelines for dredging and ditch management suggest that dredging should be partial with a maximum of two thirds of the width of the ditch dredged at any one time. The opposite bank should remain untouched or dredging short alternating sections on each bank, although this may not always be possible on small watercourses (WWF Scotland, 2000). Telfer (2000) found that individual voles did not traverse a dredged area of 260 m, effectively splitting the studied colony into two smaller subpopulations. The outcome of this study was to suggest recommendations that:

- Sections to be dredge should be no longer than 150 m;
- Sections of untouched habitat between dredging zones should be 250 m in length;
- The approach should be similar within suitable habitat where no water vole activity has been recorded, as this may still play an important role in the long-term viability of the local metapopulation (Telfer, 2000).

Details of best dredging practice are included in Appendix 8.5.

1.4.3 Habitat degradation by grazing

Overgrazing can lead to reduced availability of food and cover for water voles. This is particularly true where sheep grazing occurs and the sward is cropped close to the ground. Where grazing is severe riverbanks can become poached and erosion may occur, leading to loss of burrows. SNH guidelines suggest that a fenced buffer strip of 6 m be created on

either side of a watercourse and vegetation cut back on one bank in alternating years (http://www.snh.org.uk/publications/on-line/wildlife/voles/management.asp).

1.4.4 Woodland regeneration

Although planting and regeneration of riparian woodland can stabilise river banks where over grazing has caused bank erosion, increasing tree densities along riparian zones can also cause problems for water vole colonies. Over-shading by developing canopies can reduce the number of grass species available for vole foraging and in extreme cases can lead to reduction in ground cover. Where grazing is prevented an increasing scrub layer can make the banks unsuitable for burrowing. Selective coppicing of trees and shrubs along ditches and channels may increase their suitability by increasing light levels, encouraging growth of marginal and in channel vegetation and reducing leaf fall into the channel.

Current guidelines suggest leaving a narrow riparian corridor of approximately 6 m and leaving some sections of up to 250 m open during planting. Long-term maintenance of fenced banks should include either periodic grazing or mechanical flail mowing to stimulate grass cover.

1.4.5 Muirburn

Uncontrolled muirburn can have a serious localised effect on individual vole subpopulations. Current SNH guidelines suggest that an unburned buffer strip of at least 10 m is required on either side of a watercourse used by water voles, in order to protect the vole habitat.

2. SURVEY AIMS AND METHODS

The aims of the water vole survey were to:

- Establish presence/absence of water voles along watercourses in the SNH Beinn Eighe NNR property;
- Assess the habitat quality for water voles along the same watercourses;
- Identify those water vole colonies which are considered to be at greatest risk of extinction.

All sections of watercourse with level ground or a gentle slope (of less than three percent gradient) within the NNR were included in the survey, as water voles do not occur on steeper gradient ground (Strachan and Jefferies, 1993). Apart for a small side tributary of the Allt Coire an Laoigh that enters the Torridon River, all watercourses surveyed were within the River Ewe catchment.

2.1 Water vole signs

The banks of each watercourse were surveyed and signs of water vole activity were noted. Where access and water depth allowed, the search was conducted from the channel itself. During surveying, copies of 1:10,000 maps were used in conjunction with a GPS to accurately establish the upstream and downstream limits of each water vole colony. Water vole signs separated by less than 200 m within one watercourse were considered to be within one colony, as adult males are known to have a home range of up to 200 m (Capreolus 2005; Sah 1998). Within each colony the following data were recorded:

- Number of latrines
- Number of active burrows
- Number of old inactive burrows
- Number of burrows with lawns

- Number of sightings
- Presence of runs
- Presence of tracks
- Presence of feeding remains.

A number of the streams where water vole activity was observed had long sections where the stream ran underground. Within this habitat the water voles had created many 'drop holes', which led directly to the stream bed. On these occasions the surveyor attempted to determine the number of true burrows and the number of stream access holes separately (see Appendix 8.7, Photograph 6).

2.2 Water vole habitat

Water vole habitat was assessed longitudinally as a series of contiguous survey sections. For the purposes of recording, habitat section breaks were inserted where the habitat type changed significantly. If habitat remained uniform section breaks were created approximately every 200 m. Each survey section was ranked in one of three categories: optimal, sub-optimal or unsuitable water vole habitat. The attributes of each habitat category are taken from Lawton and Woodroffe (1991) and the UK Water Vole Steering Group Action Plan (1997) as follows:

Optimal habitat
A slow-flowing watercourse, less than 5m wide and about 1m deep, without extreme fluctuations in water level. Shore type should be predominantly earth or peat with a stepped or steep incline (35 degrees or more), into which the voles can burrow and create nest chambers above the water table. There should be an abundance of bankside vegetation, with 70% or more of grasses and high foliage height diversity. Water voles can also occur on low banks, such as along ditches and drains where there is no fluctuation in water levels. Sections were only regarded as optimal where 60 m or more of the above habitat type was present.

Sub-optimal habitat
Slow flowing watercourse with adequate covering of vegetation and the potential for burrowing in banks. Within the mountainous terrain of the NNR an entire section was considered sub-optimal where patches of habitat suitable for burrowing was interspersed with less suitable habitat.

Unsuitable habitat
Unsuitable sites have low potential for cover or food, such as banks that are heavily grazed or trampled by livestock. The channel may be flat-sided, providing no refuge against fluctuating water levels or may be dry. Sites that are excessively shaded, rocky or engineered are also less favoured, because this has a limiting effect on growth of suitable bankside vegetation. Rocky or engineered banks may also prevent burrowing. An entire section of habitat was deemed unsuitable if no areas of burrowable, grassy habitat were present.

For each habitat section the following data were recorded:

- Habitat type (e.g. running, loch, ditch, marsh)
- Bank substrate type
- Bank profile
- Bank height
- Soil softness
- Bed substrate
- Abundance of vegetation types

- Vegetation height
- Water width
- Water depth
- Current water speed
- Disturbance
- Land use
- Presence/absence of water vole signs

The recommended survey period is between March and October when water voles are active above ground.

2.3 Other mammal species

Any field signs of other mammal species, such as European otters *Lutra lutra*, observed during the survey were recorded and a grid reference noted.

3. RESULTS

3.1 Water vole signs throughout the Reserve

Surveys were carried out from the 2nd to the 5th of October 2011. Fresh faeces were found in many latrines and water voles were considered to be active above ground. Although there were heavy rainfalls in early September the weather was relatively dry in the weeks preceding the survey.

All data collected on water vole signs are presented in Appendices 8.1 and 8.2. This consists of all survey sections, including areas with old (inactive) burrows. The data are ordered from downstream to upstream, with all sections in the mainstem of each system recorded prior to the tributaries. So for example, the River Grudie is the most downstream sub-catchment of the Ewe. On the River Grudie itself, the Allt Toll a' Ghiubhais is the most downstream tributary therefore all sections on the Allt Toll a' Ghiubhais are recorded before those of its first tributary, i.e. the Allt Coire Ruadh-staca.

Thirty five survey sections out of a total of 149 held past and/or present water vole activity (see also Figure 1a and b). These can be considered as 19 individual areas of activity, each separated by over 200 m of habitat where no water vole signs were recorded. One further sub-population was also recorded on the on the left bank of the Allt Coire Ruadh-staca, but this was beyond the NNR boundary.

Active water vole colonies tend to be considered as those with active latrines. Using latrines as a sign of occupancy, six of the 19 areas held currently active colonies (Table 1). In the present study some of the water vole colonies occurred along streams that partly or predominantly ran through underground tunnels. In these locations latrines were occasionally found on stones or underground embankments where the stream was observable through holes from above. It was considered that there could potentially be more such latrines below ground. If so, using latrines as an index of activity would bias results and lead to an underestimate of the actual number of active colonies. Including additional colonies where no latrines were found but where burrows had smoothed large entrances and could therefore be considered active (i.e. colonies 8 and 19) increased the total number of active colonies to eight (Table 1).

Solitary burrows found at three isolated locations were considered to have been created by individuals for temporary shelter during dispersal.

As stated in the methods, an attempt was made to determine the number of drop holes used to access streams. At one location, in section GAC1, between NG 9620 6146 and NG 9627 6138, 37 holes were considered to be burrows while approximately 44 were considered to be drop holes providing direct access to the underground stream.

3.2 Water vole signs by sub-catchment

3.2.1 Grudie

Six colonies were found in the River Grudie system, four of which were classified as active. Active colonies were present on the Allt Toll A' Ghiubhais and Allt Coire Ruadh-staca, with further inactive colonies on both streams (Table 1, Appendix 8.1)

The Allt Coire Ruadh-staca held two active colonies with well-used latrines, and signs continued as far upstream as NG 9616 6072. Two of the colonies on the plateau Toll A' Ghiubhais had many fresh faeces in the latrines. Indeed the colony centred at approximately NG 977 624 (colony 5) held the highest number of latrines, burrows and drop holes of any colony found on the Reserve (Appendix 8.6, Photo 1). This colony ran along small tributaries to both the north and south of the main stem and extended up the northern hillside to a small wet flush at NG 6784 6261. Colony 4 had well-used burrows but only field vole faeces were present and it was difficult to determine if water voles were resident. Six old burrows and two drop holes were found on the Allt Toll A' Ghiubhais at NG 9698 6035 (colony 6).

3.2.2 Loch Bhanamhoir

Four small colonies were found in streams around Loch Bhanamhoir in the north of the Reserve (Appendix 8.1). Although latrines were not found, much of the small west inflow to Loch Bhanamhoir ran underground making latrines difficult to locate. Burrow entrances within this area were worn and there were large water vole sized runs so this colony was considered to be active (colony 8). The upstream end of the Allt Bhanamhoir tributary at Meall na h-Airigh also had a 10 m underground section with burrows (colony 7), however in this instance it was less clear whether the burrows were active as they were not as worn around the edges and runs were less well defined.

3.2.3 Allt na Doire-daraich

To the east of the Allt Toll A' Ghiubhais signs were found at three widely spaced locations on Allt na Doire-daraich tributaries (locations 11, 12, and 13). No fresh faeces were found and although burrow entrances looked smooth, field vole signs were observed at all three locations. Two locations had a number of burrows and were classified as inactive colonies. However one site at NH 0014 6282, on the Alltan Leacach was approximately 750 m from any other known water vole location. Only one burrow was recorded in this area and it was therefore likely to have been created by a transient individual as a temporary resting site during dispersal.

3.2.4 Glen Torridon

In the south of the Reserve three areas of current water vole activity were found. Two small unnamed tributaries of the A' Ghairbhe held active colonies, one with six latrines and a number of individual droppings (colony 18) and the other with at least 13 latrines (colony 17). Although no latrines were observed on the Allt Coire an Laoigh (colony 19) there were clear signs that water voles had plugged burrows recently (Appendix 8.6, Photo 7).

Many active latrines were found during a spot-check downstream of the road bridge beyond the NNR boundary and it is clear that colony 19 is the upper limit of a larger colony

extending down into the Feithe Ghlas tributary of the Torridon River. It is also possible that a solitary burrow on the Caochan Ban by Kinlochewe at approximately NH 0264 6159 (location 14) was the upstream extent of a colony extending downstream beyond the Reserve boundary. This was not confirmed. Two other solitary burrows identified on the Alltan na Caise (locations 15 and 16) were geographically isolated from any other burrows or habitat and it is likely that transient individuals created them as temporary resting sites.

3.3 Habitat availability and distribution

Habitat rankings and target notes on each section are recorded in Appendix 8.3. Sections where the gradient was less than 3 percent but the habitat was unsuitable due e.g. to fast water flow or rocky banks were recorded as unsuitable on the data sheet. Of the 147 survey sections, 75 (51.0%) were judged to be wholly unsuitable. Although marked in red on the original maps, this colour has been omitted from Figures 1a and b to allow the available optimal and sub-optimal vole habitat to be more clearly presented. Only 2 survey sections were classified as wholly optimal (1.4%) with a further 4 (2.7%) having small patches of optimal present. The remaining 66 sections (44.9%) were classified as suboptimal. Many of the suitable (optimal or suboptimal) sections were adjacent to one another and, in total, only 29 discrete patches of suitable habitat, over 200 m apart, were identified.

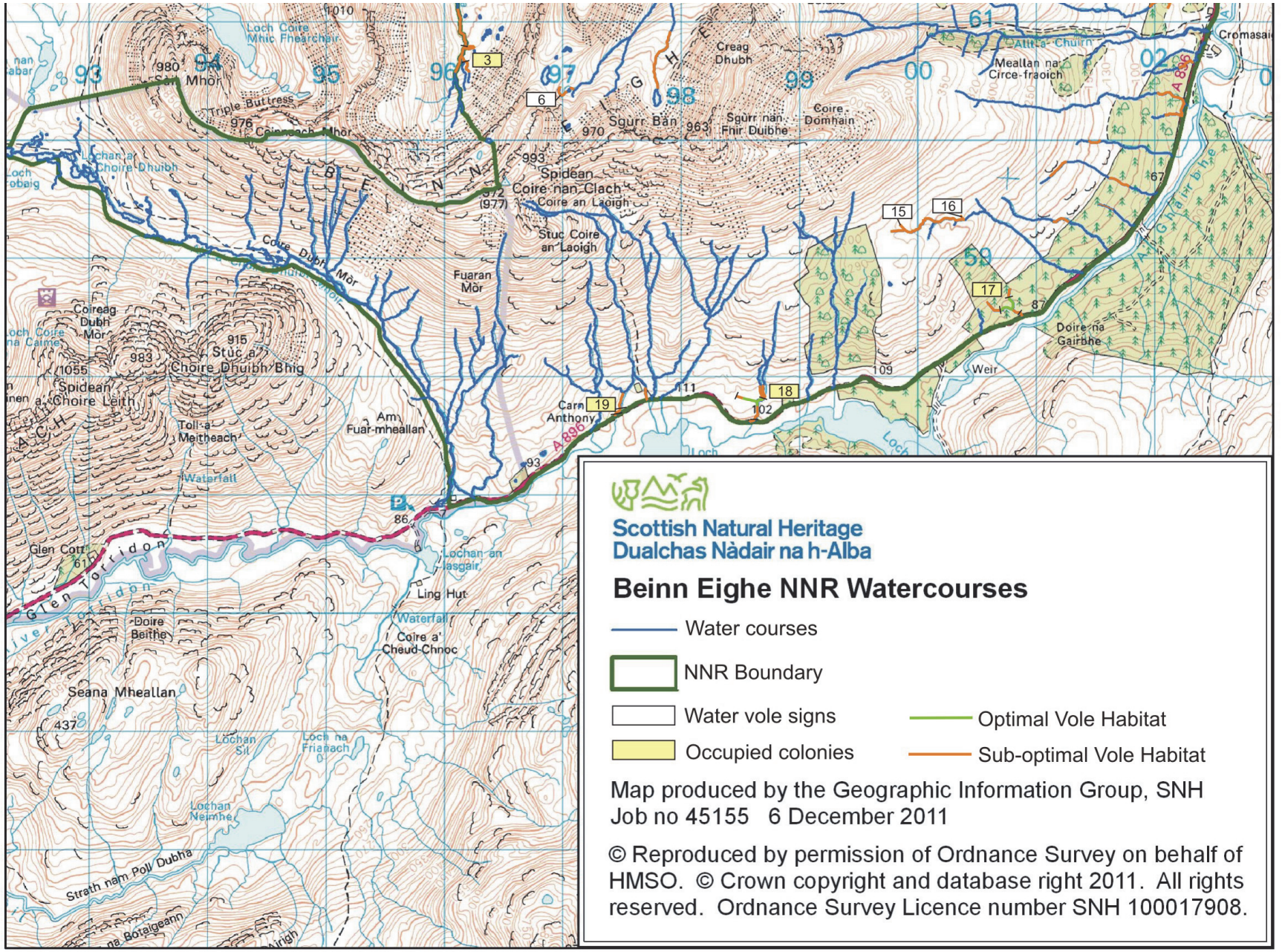

Figure 1a. Distribution of water vole signs and habitat, NNR south.

Figure 1b. Distribution of water vole signs and habitat, NNR north.

Table 1. Water vole colonies found with latrines and/or active burrows present.

Section code	Colony	Sub catchment	Tributary	Main or side tributary	Grid ref start signs	Grid ref end signs	Latrines (n)	Active burrows (n)
G6	1	Grudie	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9710 6224	NG 9708 6224	0	0
GC1	1	Grudie	Allt Toll a' Ghiubhais	Unnamed tributary	NG 9710 6217	NG 9720 6226	0	0
GD1	1	Grudie	Allt Toll a' Ghiubhais	Unnamed tributary	NG 9710 6223	NG 9713 6219	7	11
GA6	2	Grudie	Allt Coire Ruadh - staca	Allt Coire Ruadh - staca	NG 9620 6148	NG 9620 6148	0	1
GAB1	2	Grudie	Allt Coire Ruadh - staca	Unmapped lochan outflow	NG 9623 6164	NG 9623 6164	0	8
GAC1	2	Grudie	Allt Coire Ruadh - staca	Unmapped lochan outflow	NG 9620 6146	NG 9627 6138	5	37
GAD1	2	Grudie	Allt Coire Ruadh - staca	Unmapped lochan outflow	NG 9616 6139	NG 9616 6139	1	0
GA8	3	Grudie	Allt Coire Ruadh - staca	Allt Coire Ruadh - staca	NG 9620 6081	NG 9620 6081	0	0
GA9	3	Grudie	Allt Coire Ruadh - staca	Allt Coire Ruadh - staca	NG 9616 6072	NG 9616 6072	1	2
GAG1	3	Grudie	Allt Coire Ruadh - staca	Unnamed tributary	NG 9616 6068	NG 9616 6068	1	1
GH1	5	Grudie	Allt Toll a' Ghiubhais	Unmapped lochan outflow	NG 9766 6242	NG 9767 6246	0	13
GI1	5	Grudie	Allt Toll a' Ghiubhais	Unnamed tributary	NG 9774 6244	NG 9792 6246	7	91
GI1	5	Grudie	Allt Toll a' Ghiubhais	Side channel	NG 9774 6244	NG 9787 6255	1	13
GI1	5	Grudie	Allt Toll a' Ghiubhais	Wet flush	NG 6782 6260	NG 6784 6261	1	30
GK1/GKA1	5	Grudie	Allt Toll a' Ghiubhais	Unnamed tributary	NG 9776 6238	NG 9777 6213	10	31
GK2	5	Grudie	Allt Toll a' Ghiubhais	Unnamed tributary	NG 9777 6220	NG 9781 6214	0	0
B5	8	Bhanamhoir	Loch Bhanamhoir	Inflow	NG 9729 6456	NG 9731 6457	0	8
AK1/2	17	A' Ghairbhe	Unnamed tributary	Unnamed tributary	NH 0084 5853	NH 0082 5861	13	12
AN1	18	A' Ghairbhe	Unnamed tributary	Unnamed tributary	NG 9859 5761	NG 9865 5774	1	18
AN2	18	A' Ghairbhe	Unnamed tributary	Unnamed tributary	NG 9865 5774	NG 9853 5781	5	22
AN3	18	A' Ghairbhe	Unnamed tributary	Unnamed tributary	NG 9853 5781	NG 9848 5785	0	9
T1	19	Torridon	Allt Coire an Laoigh	Allt Coire an Laoigh	NG 9750 5772	NG 9745 5766	0	15

Measuring habitat types along watercourse lengths, a total of 420 m of optimal habitat was found, 270 m of which occurred on tributaries of the A 'Ghairbhe. A total of 10.75 km of suboptimal habitat was recorded. Of this 7.51 km (69.9%) was of poor quality and only likely to hold low densities of water voles or single burrows created during dispersal. Adding the optimal sections to the sections with better quality suboptimal, at total of 3.66 km of watercourse with good potential support water vole was recorded. This is clearly a tiny proportion of total watercourse length in the Reserve, reflecting the steep and rocky nature of most stream habitats.

Both of the sections of optimal habitat (AK2 and AN2) contained active burrows and latrines, as did the four sections containing some optimal habitat. The other suboptimal habitat sections varied from good quality habitat with lengths of bank suitable for burrowing, to very poor suboptimal sections dominated by unsuitable habitat but a few patches suited to the creation of temporary resting burrows by transient individuals. Twelve of 29 discrete patches of habitat had no signs of water voles. Most of this habitat was considered to be at this lower quality end of the suboptimal habitat and therefore unlikely to hold more than an occasional temporary resting burrow. One small side tributary of the Allt na Creige Baine tributary of Allt Toll a' Ghiubhais did however have suitable banks for both burrowing and foraging for about 20 m. This small section was surrounded by poor suboptimal or unsuitable habitat and the nearest colonies were over a kilometre to the north or south.

3.4 Other mammal species

Few otter signs were recorded during the survey (Appendix 8.4). Many boulders appeared to have the potential to be traditional spraint sites with slight greening from nutrient enrichment but no bones could be found as evidence that otters, rather than bird species, were responsible for the greening. It may be that otters only frequent these upland areas in the spring when frogs are spawning and the lack of recent otter spraints may be a consequence of heavy rains in late summer.

No signs of mink were found. However, it must be borne in mind that since the main focus of the present study was the water vole, surveyors passed rapidly through sections where habitat was deemed entirely unsuitable for this species and are likely to have overlooked some mammalian signs.

4. CURRENT WATER VOLE STATUS

4.1 Interpretation of status within the Benn Eighe NNR

The steep nature of the landscape Beinn Eighe NNR prohibits water vole colonisation of many of the watercourses. Even where the gradient is of a more gentle nature approximately half of the sections surveyed were considered unsuitable with hard, heather clad banks. This is evident in the limited distribution of sub-optimal and optimal habitats in Figures 1a and b. Indeed, to some degree these maps over-emphasise the availability of vole habitat as much of the sub-optimal habitat is of poor quality. Overall, most of the NNR presents a harsh environment for water voles within which there are scattered, mainly rather small, patches of suitable habitat.

However, the presence of water vole signs, either old or current, in many of the patches more suitable habitat is reassuring regarding the status of water voles in the area and suggests that mink have not yet had a major, if any, impact on the local population. Five main centres of activity were recorded: Loch Bhanamhoir, the Allt Toll a' Ghiubhais flats, the upper Allt Coire Ruadha-staca, and two unnamed tributaries on the A' Ghairbhe, one above and one below Loch Clair. By including NTS Torridon estate survey data (Appendix 8.7 and 8.8) to complete the picture of the status within the NNR, a further three centres of activity

are added - the lower Allt Slugach, the Allt an Fhuarain Mhoir and the Lochan a Choire Dhuibh tributaries.

A number of previous water vole studies have used mark and recapture techniques to attempt to calibrate the relationship between the number of water voles present and latrine counts. The relationship has been found to vary greatly from site to site and is thought to be influenced by several factors including season, population density, population structure, availability of suitable latrine sites and the variation in latrine detection rates in different habitat types. The SNH upland water vole study (Capreolus, 2005) used six different regression relationships (taken from five different studies) to calculate water vole population density for a hypothetical site. They found that this produced estimates of anywhere between 3 and 20 voles per 100 m of river. It did not follow that all upland studies produced similar densities and all lowland studies produced similar densities, indeed the SNH upland study had a more similar estimate to two lowland studies than to the other upland study. They concluded that the use of latrines to estimate population was imprecise and may be insensitive in detecting statistically significant changes in population size over time.

It is also difficult to compare the present survey to many previous studies as the latter have often selected random sections of river rather than the entire rivers and the outcome is given as the percentage of sections found to contain water voles. In an attempt to try and put the present study in some context, with the knowledge that latrine counts give at best an indication of population size, a comparison of studies is shown below (Table 2). Each survey listed in Table 2 was examined to find the colony with the highest number of latrines and the colony with the highest density of latrines per km of stream bank. The highest density of latrines per km found in the SNH owned portion of the NNR was 31.7, (colony 5 Allt Toll a' Ghiubhais), which makes it one of the studies with the highest density per km. The NTS Torridon survey had both the highest number of latrines within one colony, and the highest density per km. These signs were in a colony covering the Feithe Glas and the lower Allt Slugach. The lower Allt Slugach alone had a very high density of 28 latrines in 270 m i.e. 104 per km and is within the Beinn Eighe NNR (Appendix 8.7).

Whilst acknowledging the uncertainty of latrine counts as a measure of vole numbers, WildCRU (2002) consider that such counts do at least provide a useful index of water vole activity, with the larger and more robust populations showing a larger number of closely packed latrines. This being the case, the data indicate that the upper reaches of the Torridon catchment and colonies 1 and 5 on the Allt Toll a' Ghiubhais flats are important core areas for water voles within the NNR.

WildCRU identified water vole signs at between 8% and 68% (mean 42%) of survey sections on five catchments from the Cairngorms area in 2004. Of the 29 discrete suitable (optimal and/or suboptimal) habitat patches on the SNH property, 8 (29%) showed signs of current occupancy. Seventeen habitat patches (59%) showed signs of either current or past occupancy. However it must be remembered that at least 4 areas of previous occupancy were single burrows rather than colonies. Removing single burrows from the calculation gives a figure of 44.8%. Overall, the data would seem to suggest that water vole site occupancy at Beinn Eighe is within expected levels.

Table 2. Comparison of water vole latrine numbers and densities between studies.

Survey	Maximum latrines in one colony (n)	Highest density of latrines (no/km)	Study (Author & year)
SNH Beinn Eighe	19	19/0.6 = 31.7	This study
NTS Torridon	67	67/1.3 = 51.5	Brown *et al.*, 2010

Cairngorm	66 (signs found over 8 km)	16/1.6 = 10	WildCRU, 2004
Tyne	23	23/0.5 = 46	Reynolds & Telfer, 2000
Forth and Clyde canal	14	14/2 = 7	WildCRU, 2002
Fife	8	8/0.6 = 13.3	WildCRU, 2004

4.2 Individual colony status in relation to known or potential habitat availability

Extinction of water vole colonies is influenced by both colony size and extinction rates within neighbouring colonies, i.e. a colony is more likely to become extinct if there are few individuals present and neighbouring colonies are also suffering extinction events (Sutherland *et al.* 2012). Predation and disease are thought to be the most likely causes of these localised extinction events. This is perhaps unsurprising as predators such as otters, grey herons *Ardea cinerea*, stoats *Mustela erminea*, and buzzards *Buteo buteo* may have home ranges that include many vole colonies, while disease will be passed between neighbouring colonies by transient individuals. Colonisation is influenced by both distance and juvenile numbers, i.e. habitat patches in close vicinity of colonies with high numbers of juveniles are most likely to be colonised. However there is also some degree of 'rescue' effect for more distant patches of habitat; Lambin *et al.* (2011) found that radio tracked juveniles would stop their dispersal phase and remain in suitable habitat if as little as one individual of the opposite sex was present.

For Beinn Eighe, this suggests that the colonies close proximity to one another within large areas of suitable habitat are more likely to continue to be re-colonised than smaller geographically isolated populations. Re-colonisation of the latter may occur from time to time if two individuals meet during their dispersal phase. Overall, however, existing data suggest that colonies that are most vulnerable to extinction are those which are geographically isolated by long reaches of unsuitable habitat, contain few individuals, or both. Using this information we have attempted to determine which colonies are most vulnerable to extinction if the present habitat remains available.

Colonies 18 and 19 in the Reserve are linked with the NTS owned area by a long stretch of water vole habitat along the Feithe Glas and Loch Bharranch streams, which fall within Coulin Estate. The large number of burrows and latrines suggests that none of these colonies is likely to suffer from a localised, stochastic extinction event and is also more likely to be re-colonised if extinction did occur. However these colonies are at a relatively low-altitude and may be most vulnerable if mink were to colonised the area (section 5.2).

Similarly colonies 1, 4 and 5 on the Allt Toll a' Ghiubhais are closely linked to one another and, based on counts of latrines and active burrows, appeared to hold good populations suggesting they too should be less prone to extinction.

Colonies 2 and 3 on the Allt Coire Ruadh-staca are close to one another but are geographically isolated from other colonies, the next closest being colony 4, which is 3 km from colony 2 (assuming dispersal along watercourses). Although these colonies are less than a kilometre apart and water voles are known to occasionally disperse across land, the terrain is broken and boulder strewn and it is unclear whether they would disperse across this habitat.

Colony 17 is over 2 km downstream of the nearest known colony on the Reserve, however its susceptibility to extinction is unknown as it is unclear if there are other 'stepping stone' colonies within Coulin Estate on the low lying tributaries of the A 'Ghairbhe.

Colonies 7 to 10, around Loch Bhanamhoir, held a total of 62 burrows and when water voles are locally numerous there will be good dispersal potential within these groups of colonies. However these colonies occur on a plateau on the north face of Meall a 'Ghiubhais and are surrounded on all sides by steep terrain. It is therefore likely that migration from outwith this area is infrequent, and that it would take some time for re-colonisation to occur after a localised extinction.

Similarly the few burrows found in short stretches of habitat in the Allt na Doire-daraich catchment (Colonies 11, 12 and 13) and the upper Allt Toll a 'Ghiubhais by Lochan Uaine (Colony 6) are accessible only across mountainous terrain. Being small and geographically isolated they are extinction-prone, and are only likely to be re-colonised in the event of two individuals meeting during dispersal. Colony 6 at NG 9698 6035 was discovered in a very small and isolated patch of habitat at an elevation of 680 m, and is a testament to the dispersal abilities of this species (Appendix 8.6, Photos 7 and 8).

While accepting a high degree of uncertainty, we would suggest that in the absence of major perturbations such as mink invasion, the colonies most likely to persist are 1, 5, 18 and 19. Those likely to be at most risk due to small size and/or isolation are 12 and 13.

Extinction rates may also be exacerbated by human activity and the following section provides management recommendations to ensure that human-influenced extinction rates are minimised.

5. MANAGEMENT

5.1 General management strategy

From the present study it appears that current estate management strategies are broadly favourable for water voles. In no location was current practice thought to be inhibiting water vole use of habitat or movement between colonies. Although signs of deer activity and a low level of bankside poaching were observed on a very small number of streams, general levels of deer activity appeared low and overgrazing was not considered to be currently limiting the abundance or suitability of water vole habitat. The current plan to keep deer numbers at an appropriate level (Reserve Plan, 2009-2015) should maintain this balance.

A number of specific issues, which may have deleterious effects on the water vole population in the future, are examined in sections 5.2 to 5.6 below and the Management Overview in Section 6. To ensure that the favourable status of water voles is maintained, a long term monitoring programme is proposed in section 5.7.

5.2 Monitoring of mink activity

The possibility of mink colonisation is considered to be the greatest threat to the long-term survival of the local water vole population and the recent spate of mink activity within the Loch Ewe area is a worrying development. Mink tend to colonise areas by arriving firstly along the coastline then spreading inland along low lying watercourses and reaching upper tributaries later, if at all. It is therefore likely that the low-altitude colonies in the vicinity of the NTS/SNH boundary will be more vulnerable to attack than those of the Allt Toll a' Ghiubhais.

With regard to water vole conservation, mink trapping has been found to be most successful where it is concentrated at the mouths of upland sub-catchments. Targeting these areas with traps during late January to April is thought to facilitate the removal of pre-breeding females from water vole habitat. The use of traps in September and October is also used as a way of removing mink during their main dispersal period, when kits move away from their natal range to establish new territories (Harrington *et al*., 2008). Generally traps are

deployed only when there is evidence of mink presence from mink rafts, as traps must be checked daily. However the local mink control group found that the number of volunteers needed to maintain mink monitoring rafts was prohibitive and sheltered locations for rafts hard to come by. Instead they plan to focus on two short periods of intensive trapping during the aforementioned time periods.

The first such trapping period took place in the autumn of 201. After receiving advice from Gunnar Scholtz of the Scottish Mink Initiative (www.scottishmink.org.uk) twelve traps were placed in tributaries of the lower Ewe system from Slattadale to Incheril, including the lower River Grudie. Three traps were also placed in the upper Ewe system on Coulin Estate. NTS set traps in the lower Torridon River. No mink were captured within this area although one was observed on the shoreline of Loch Ewe (P. Cunningham, *pers. comm*.). The continued use of this extensive layout of traps during the appropriate time periods should help to prevent mink reaching the NNR water vole colonies by migration through the Torridon or Ewe systems.

Mink are highly mobile generalists, know to re-colonise areas where they have been successfully removed, so long term monitoring should remain a high priority even when trapping schemes have proven to be successful (Dunstone, 1993). Furthermore, Harrington *et al*. (2008) make it clear that mink monitoring and trapping must be adaptive, so that the timing and frequency of either should be responsive to (i) local findings and (ii) new research.

Mink are most likely to become established as residents where a permanent food source, such as rabbit, is available. Indeed the high level of mink activity on the Isle of Ewe may be linked to the presence of rabbits on the island. Therefore it may be possible to discourage the establishment of resident mink by controlling rabbit numbers. This is not thought to be an issue in any of the low-lying agricultural areas in the vicinity of the NNR (E. Maclean, *pers. comm*.).

5.3 Footpaths

Only one public footpath on the SNH property is in close proximity to a water vole colony. This is the pony path that leads from NH 021 622 to NH NG 980 625. This path currently ends 100 m to the west of colony 5 and has no detrimental effect on the colony.

If a path/cycle route from Kinlochewe to Torridon is developed in the future (Reserve Plan, 2009-2015) the route would have to be considered carefully to ensure it did not encroach on colonies 17, 18 or 19 (Table 3). Ideally it would also not damage the small patches of sub-optimal habitat on the northern tributaries of the lower A ‘Ghairbhe (Table 4). As can be seen in the table, much of this habitat is verging on unsuitable, unlikely to support large numbers of water voles, instead providing cover and foraging ‘stepping stones’ for migratory individuals. Only sections AK3 and AKA1, in the upper reaches above colony 17, have good quality habitat. Any potential impact could be ameliorated by careful micro-siting.

Table 3. Locations of water vole signs to the north of the A896.

Section Code	Start of signs	End of signs	Notes
AK2	NH 0084 5853	NH 0082 5861	Active colony 17
AN1 to 3	NG 9859 5761	NG 9848 5785	Active colony 18
T1	NG 9750 5772	NG 9745 5766	Colony 19, no latrines but active burrows

Within the NTS property water vole activity in the Abhainn Coire Mhic Nobuil catchment occurred along small tributary streams on the north bank of the river (Brown *et. al.,* 2011). These small subpopulations provide important stepping-stone links between the subpopulations in the Allt a' Bealaich and the River Torridon catchments. The main footpath from the car park in Glen Torridon crosses the Allt a 'Choire Dhuibh Mhoir and runs along the north bank of the lochans at the head of the Abhainn Coire Mhic Nobuil, within the NNR boundary. Burrows were present in or adjacent to the path at two locations (Table 5). At present, human activity along the path does not appear to be having a detrimental effect on the vole population, but any future path maintenance work will have to take into consideration the presence of these colonies in order to avoid damage.

Table 4. Locations of sub-optimal habitat within Glen Torridon with no current water vole signs.

Section Code	Downstream	Upstream	Notes
AC2	NH 0213 6058	NH 0237 6066	Medium flow, rocky bed, peat banks, choked in places with old rotten branch material from felled plantation. Lots of birch and heather but some patches of *Molinia*.
AD1	NH 0226 6029	NH 0207 6037	Fairly fast-flowing, rocky bed, peat banks and some patches of sub optimal habitat, all within old felled plantation.
AD2	NH 0226 6029	NH 0224 6018	Slow-flowing ditch, peat banks with *Molinia*. Through old felled plantation so probably US in past.
AF1	NH 0179 5960	NH 0163 5965	Grassy banks but many old tree roots in bank.
AG1	NH 0168 5936	NH 0152 5944	Mostly low lying with few high banks, mix of bog myrtle and *Molinia.*
AK3	NH 0083 5855	NH 0061 5855	Lower good optimal, upper shallow gully then more open and braided with floodable banks.
AKA1	NH 0081 5863	NH 0078 5872	Mostly heather dominated, soft rush in upper section.
AQ1	NG 9772 5779	NG 9770 5789	Verging on unsuitable. Fast flowing and steep, often undercut peat/stony banks

Table 5. Locations of water vole signs on tributaries crossed by Coire Mhic Nobuil footpath.

Code	Start of signs	End of signs	Notes
MAG1	NG 9309 5994	NG 9309 5970	Burrows in footpath and to sides
MAF1	NG 9288 5990	NG 9293 5990	Approximately 30m upstream of path

5.4 Woodland regeneration

Within Glen Torridon an area of clear-felled forestry was replanted with local original Scots Pine *Pinus sylvestris* and native broadleaves in 2010 (Enclosure 2, Map A, Page 7 in the Reserve Plan, 2009-2015). Colony 17 lies within this area (Table 3). At the present time the water voles within this area are thriving, with many burrows, latrines and runs observed. However, over time the regeneration of broadleaves and consequent self-seedling may lead to an increasingly dense canopy cover. This could in turn shade out many of the grasses decreasing foraging opportunities. Increasing density of seedlings may eventually make the

banks difficult to burrow. At the present time there is no conflict between management for regeneration or water vole conservation. The regeneration should be carefully monitored and a buffer strip of 6 m kept clear along the banks where there are active burrows. If necessary in the future, removal of young trees should be carried out with caution to ensure that the banks are not destabilised. Ideally removal should occur from November to February when the water voles are less active above the ground.

The stretches of suboptimal habitat discussed in section 5.3 in relation to track development, also lie within Enclosure 2 (Table 4). As mentioned above, these areas are a lower priority for water vole conservation, having no vole signs and being of a poorer habitat quality. Nonetheless, maintaining stretches of open grassy habitat with banks suitable for burrows should aid water vole dispersal.

The location for woodland expansion to the west of Enclosure 2 (Map B, Page 10 in the Reserve Plan, 2009-2015) extends to the left bank of the lower reaches of colony 18 (NG 9859 5761) and again this should be designed carefully to ensure water vole habitat remains unaffected in a 6 m buffer strip along the riparian zone.

5.5 Legal obligations

No water vole activity was observed within the vicinity of any buildings and there are no plans for future building creation within the Reserve.

A number of streams in Glen Torridon have water vole burrows close to the roadside (Table 3) and if they are to be dredged then the best practice guidelines for dredging in known water vole habitat should be followed (Appendix 8.5). One section on the Allt Coire an Laoigh had poor suboptimal habitat with no vole signs. This should be re-checked for signs before dredging occurs (NG 9772 5779 to NG 9770 5789).

5.6 Livestock access

At the present time there is no livestock access on the Beinn Eighe NNR.

5.7 Future water vole monitoring

The present study has provided a map of water vole habitat and an assessment of the status of the water vole population within the NNR. As stated in the introduction, water vole metapopulations are comprised of many small sub-populations, which go extinct and are re-colonised over time, providing that no overriding factor impacts on the whole metapopulation. The long-term study at Assynt has shown that although water vole activity may change over time, the availability of habitat in upland catchments remains fairly constant (Lambin *et al.*, 2011). We consider it likely that the availability and distribution of suitable water vole habitat in the NNR will also remain stable over time, as no widespread impacts on these habitats were identified. However, patterns of use of the habitat may vary over time and it is worth noting that less than half of the areas showing some field signs of water vole had clear signs of current activity.

The 2011 survey provides a snapshot of water vole activity and distribution, but it is not clear if 2011 was a good, bad or indifferent year for the species. Some time series data would be worth collecting and, should mink colonise the NNR, would be essential for assessing their impact. As such, monitoring for water vole presence in suitable habitats every two to three years would be worthwhile. The cost would be relatively low as the areas of suitable habitat have already been identified. As much of the current understanding of upland water vole population dynamics and annual fluctuations comes from the ongoing Assynt studies, where habitats differ from those of Beinn Eighe NNR, such data would be of wider conservation value and interest.

Given the uncertainty over the interpretation of latrine counts, Capreolus (2005) suggests that monitoring may best be achieved by undertaking latrine counts in conjunction with an assessment of percentage site occupancy (e.g. the percentage of occupied streams within a catchment). Given the difficulty of counting latrines in some parts of the NNR, where streams often flow below ground, we concur that the current survey provides two data sets that may be suitable as a monitoring baseline, namely (i) the proportion of occupied habitat patches, (ii) the number of sites showing signs of current activity.

6. MANAGEMENT OVERVIEW

Issue	Actions	Benefits	Responsibility (Lead/other)	Priority	Notes
Mink control	Continue to use protocol for trapping initiated in 2011	Co-ordinated trapping should ensure success	**SNH staff**, volunteers, neighbouring estates	High	1.1
Rabbit control	Be aware of any information on increasing rabbit numbers within the area	Reduce chance of resident mink population	Property staff, local crofters	Low	
Footpath or cycle track development	Survey specific stream crossings in optimal and suboptimal habitat at scoping stage	Protect present water vole colonies and potential vole habitat	**SNH staff** or **NTstaff**, ecological contractors	High if planned	1.2 and see also Tables 3-5
Woodland regeneration	Monitor woodland regeneration. Remove scrub and open out areas of the stream bank when necessary	Prevent over-shading and loss of habitat	**SNH staff**	Low at present time	Colony 17 (table 3) and table 4
Dredging	Contact Highland Council if necessary	Prevent dredging in water vole colonies	**SNH staff, Highland Council**	Low at present time	Appendix 8.5
Water vole monitoring	Plan for future monitoring	Detect changes in population	SNH NNR Manager, NTS Nature Conservation Advisor	Moderate	1.3
Water vole survey	Widen survey to cover potential, linked core areas out with NNR and NTS ground, particularly Coulin Estate.	Fuller understanding of likely population dynamics allowing targeted monitoring and control of mink or other threats	Neighbouring estates, volunteers	Moderate	1.3

1.1 See www.scottishmink.org.uk. Guidance on trapping and use of mink rafts from Game & Wildlife Conservation Trust http://www.gwct.org.uk/media/198255/gwct_mink_raft_guidelineshr2009.pdf and in Harrinton *et al*. (2008).
1.2 See http://www.snh.org.uk/publications/on-line/wildlife/voles/law.asp for information on the legal guidelines
1.3 Potential as student or volunteer projects, assuming appropriate supervision and training.

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8. APPENDICES

Appendix 8.1 All water vole signs including old/inactive burrows.

Code	Colony	Catchment	Sub-catchment	Tributary	Grid ref start signs	Grid ref end signs	Latrines	Active burrows	Old burrows
G6	1	Grudie	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9710 6224	NG 9708 6224			6
GC1	1	Grudie	Allt Toll a' Ghiubhais	Unnamed tributary	NG 9710 6217	NG 9720 6226			15
GD1	1	Grudie	Allt Toll a' Ghiubhais	Unnamed tributary	NG 9710 6223	NG 9713 6219	7	11	7
GA6	2	Grudie	Allt Coire Ruadh - staca	Allt Coire Ruadh - staca	NG 9620 6148	NG 9620 6148		1	
GAB1	2	Grudie	Allt Coire Ruadh - staca	Unmapped lochan outflow	NG 9623 6164	NG 9623 6164		8	
GAC1	2	Grudie	Allt Coire Ruadh - staca	Unmapped lochan outflow	NG 9620 6146	NG 9627 6138	5	37	
GAD1	2	Grudie	Allt Coire Ruadh - staca	Unmapped lochan outflow	NG 9616 6139	NG 9616 6139	1		1
GA8	3	Grudie	Allt Coire Ruadh - staca	Allt Coire Ruadh - staca	NG 9620 6081	NG 9620 6081			10
GA9	3	Grudie	Allt Coire Ruadh - staca	Allt Coire Ruadh - staca	NG 9616 6072	NG 9616 6072	1	2	
GAG1	3	Grudie	Allt Coire Ruadh - staca	Unnamed tributary	NG 9616 6068	NG 9616 6068	1	1	
GF1	4	Grudie	Allt Toll a' Ghiubhais	Allt na Creige Baine	NG 9722 6241	NG 9722 6242		3	4
GH1	5	Grudie	Allt Toll a' Ghiubhais	Unmapped lochan outflow	NG 9766 6242	NG 9767 6246		13	
GI1	5	Grudie	Allt Toll a' Ghiubhais	Unnamed tributary	NG 9774 6244	NG 9792 6246	7	91	
GI1	5	Grudie	Allt Toll a' Ghiubhais	Side channel	NG 9774 6244	NG 9787 6255	1	13	
GI1	5	Grudie	Allt Toll a' Ghiubhais	Wet flush	NG 6782 6260	NG 6784 6261	1	30	
GK1 GKA1	5	Grudie	Allt Toll a' Ghiubhais	Unnamed tributary	NG 9776 6238	NG 9777 6213	10	31	6
GK2	5	Grudie	Allt Toll a' Ghiubhais	Unnamed tributary	NG 9777 6220	NG 9781 6214			4

Appendix 8.1 Contd.

Code	Colony	Catchment	Sub-catchment	Tributary	Grid ref start signs	Grid ref end signs	Latrines	Active burrows	Old burrows
GL3	6	Grudie	Allt Toll a' Ghiubhais	Lochan Uaine tributary	NG 9704 6039	NG 9698 6035			6
B3	7	Allt Bhanamhoir	Allt Bhanamhoir	Allt Bhanamhoir	NG 9751 6477	NG 9749 6483			23
B5	8	Allt Bhanamhoir	Loch Bhanamhoir	Inflow	NG 9729 6456	NG 9731 6457		8	12
BB1	9	Allt Bhanamhoir	East tributary	Small tributary	NG 9805 6485	NG 9805 6484			3
BD1	10	Allt Bhanamhoir	Loch Bhanamhoir	Inflow	NG 9764 6448	NG 9765 6450			16
RB2	11	Allt na Doire daraich	Allt na Doire daraich	Allt na Doire daraich	NH 0014 6282	NH 0014 6282			1
RD1	12	Allt na Doire daraich	Allt na Doire daraich	Unmapped tributary	NG 9962 6309	NG 9962 6309			5
RE2	13	Allt na Doire daraich	Allt Dearg	Allt Dearg	NG 9870 6159	NG 9870 6156			3
AA1	14	A' Ghairbhe	Caochan Ban	Caochan Ban	NH 0264 6159	NH 0264 6159			1
AI4	15	A' Ghairbhe	Alltan na Caise	Alltan na Caise	NG 9984 5925	NG 9984 5925			1
AIA1	16	A' Ghairbhe	Alltan na Caise	Unmapped tributary	NH 0036 5932	NH 0036 5932			1
AK2	17	A' Ghairbhe	Unnamed tributary	Unnamed tributary	NH 0084 5853	NH 0082 5861	13	12	
AN1	18	A' Ghairbhe	Unnamed tributary	Unnamed tributary	NG 9859 5761	NG 9865 5774	1	18	
AN2	18	A' Ghairbhe	Unnamed tributary	Unnamed tributary	NG 9865 5774	NG 9853 5781	5	22	
AN3	18	A' Ghairbhe	Unnamed tributary	Unnamed tributary	NG 9853 5781	NG 9848 5785		9	
T1	19	Torridon	Allt Coire an Laoigh	Allt Coire an Laoigh	NG 9750 5772	NG 9745 5766		15	

Appendix 8.2 All water vole signs, notes

Code	Notes
G6	Field vole signs.
GC1	Field vole signs.
GD1	Also a small number of drop holes.
GA6	Part of larger colony.
GAB1	Small area on right bank.
GAC1	44 further holes may be drop holes. Most in lower 50m, another 7 at 9627 6139.
GAD1	Very old hole.
GA8	Field vole signs, holes set back from stream bank but very water vole sized.
GAG1	Tiny patch of suboptimal on bend of stream.
GF1	Currently occupied by field vole, more open mossy area within heather, 1m above water and back from banks.
GH1	A small proportion of burrows may be drop hole but stream does not go underground.
GI1	Less than 200m to next tributary.
GI1	Part of colony above.
GI1	Part of colony above.
GK1/GKA1	Possibly one water vole heard splashing in stream underground, 17 drop holes to stream.
GK2	Habitat less suitable at this top end of the colony.
GL3	Two drop holes to stream.
B3	Holes where stream broadens to series deep pools. Look worn but no other signs. Holes in moss/sparse heather.
B5	Many look like access holes to underground water. Worn and well used but only field vole signs seen.
BB1	10m underground section, worn holes but no other signs.
BD1	Holes look worn but only field vole signs found.
RB2	Field vole signs.
RD1	Field vole signs. Unmarked steam through soft rush.
RE2	Field vole signs. Old holes at steeper bank on bend with heather cover,
AA1	Just one hole in *Molinia* in slightly less flood-prone section to E of road
AI4	Many field voles signs upstream of burrow
AIA1	One possible very old hole lower end of tributary
AK2	Well used area. Latrines may be missed in broad area (20m wide) dense soft rush tussocks. Burrows on steep banks.
AN1	Also scattered individual droppings. Also field vole signs in area. Runways betweeen *Molinia* tussocks.
AN2	Many runs and access holes to underground burn. 5 burrows plugged. Field vole signs also present.
AN3	Looks active but no signs. Field vole signs.
T1	Some holes plugged with signs of recent workings. Downstream of this area to NG 9742 5751, outside survey area, habitat becomes optimal dominated by *Molinia* tussocks (31+ holes with 2 fresh latrines, plugged holes, 2 older latrines).

Appendix 8.3. Habitat classifications and notes

Code	Sub-Catchment	Tributary	Upstream grid ref	Downstream grid ref	Habitat rank	Notes
G1	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9600 6297	NG 9634 6280	US	Steep stream with fast flow, boulder and heather banks, many waterfalls
G2	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9634 6280	NG 9647 6259	US	Steep stream with fast flow, boulder and heather banks, many waterfalls
G3	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9647 6259	NG 9663 6247	US	Steep stream with fast flow, boulder and heather banks, many waterfalls
G4	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9663 6247	NG 9683 6231	US	Steep stream with fast flow, boulder and heather banks, many waterfalls
G5	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9683 6231	NG9700 6224	SO	Poor suboptimal, slow meanders but heather covers bank to water's edge
G6	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9700 6224	NG 9709 6230	SO	Slow bends and meanders have suboptimal habitat on outside of bends with some sloping, grass or moss covered banks
G7	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9709 6230	NG 9723 6241	US	Slightly lower gradient than upstream but still unsuitable banks
G8	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9723 6241	NG 97476245	US	As upstream
G9	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9747 6245	NG 9774 6245	US	Banks are either vertical with much boulder in bank face and heather on bank top, or low lying with gravel bars and short grass
G10	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9774 6245	NG 9794 6236	US	Low gradient but quite fast flowing run or riffle, often bare edges to banks or heather undercuts
G11	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9794 6236	NG 9811 6217	US	Low gradient but much bare or heather clad banks with little grass, water often shallow run or riffle
G12	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9811 6217	NG 9820 6198	US	Instream substrate larger than downstream, much bare bank or heather
G13	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9820 6198	NG 9814 6173	US	At lower end of gorge. Fast flowing with unsuitable heather and boulder clad banks
G14	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9810 6162	NG 9796 6138	US	Low gradient stretch in the middle of a steep gully with many small falls and torrents. Banks are bare boulder or heather clad. Flow is fast with many instream boulders
G15	Allt Toll a' Ghiubhais	Allt Loch an Tuill Bhain	NG 9794 6102	NG 9780 6041	SO	Largely unsuitable, fast flowing and banks generally stony especially on steeper sections. Middle section has gentler gradient with some peat.
G16	Loch an Tuill Bhain	Loch an Tuill Bhain	NG 978 604	NG 978 604	US	Rocky shore
GA1	Allt Coire Ruadh - staca	Allt Coire Ruadh - staca	NG 9600 6297	NG 9611 6264	US	Steep stream with fast flow and boulder embedded in banks
GA2	Allt Coire Ruadh - staca	Allt Coire Ruadh - staca	NG 9611 6264	NG 9601 6240	US	Steep stream with fast flow and boulder embedded in banks
GA3	Allt Coire Ruadh - staca	Allt Coire Ruadh - staca	NG 9601 6240	NG 9609 6217	US	Steep stream with fast flow and boulder embedded in banks
GA4	Allt Coire Ruadh - staca	Allt Coire Ruadh - staca	NG 9609 6217	NG 9610 6191	US	Steep stream with fast flow and boulder embedded in banks
GA5	Allt Coire Ruadh - staca	Allt Coire Ruadh - staca	NG 9610 6191	NG 9619 6168	US	Steep stream with fast flow and boulder embedded in banks

Key

US = Unsuitable

SO = Suboptimal

O = Optimal

Appendix 8.3 contd. Habitat classifications and notes

Code	Sub-Catchment	Tributary	Upstream grid ref	Downstream grid ref	Habitat rank	Notes
GA6	Allt Coire Ruadh - staca	Allt Coire Ruadh - staca	NG 9619 6168	NG 9616 6139	SO	Poor suboptimal, slow flowing with meanders but banks generally heathery and stony
GA7	Allt Coire Ruadh - staca	Allt Coire Ruadh - staca	NG 9616 6139	NG 9613 6113	US	Steep stream with fast flow, boulder embedded in banks, bank tops grass, heather and moss
GA8	Allt Coire Ruadh - staca	Allt Coire Ruadh - staca	NG 9613 6113	NG9620 6081	SO	Similar to upstream section of stream with occasional areas where banks are grassy, burrows not in bank but set back from bank
GA9	Allt Coire Ruadh - staca	Allt Coire Ruadh - staca	NG 9620 6081	NG 9610 6053	SO	Banks have much boulder but occasional areas where dry grassy bank extends down to stream side
GAA1	Allt Coire Ruadh - staca	Unmapped lochan outflow	NG 9608 6192	NG 9603 6192	SO	Tiny tributary with small area of underground flow where burrows, much *Molinia*
GAB1	Allt Coire Ruadh - staca	Unmapped lochan outflow	NG 9623 6164	NG 9624 6154	SO	Meandering slow tributary, banks mostly low and heathery clad, voles in high dry bank at downstream end
GAC1	Allt Coire Ruadh - staca	Unmapped lochan outflow	NG 9620 6146	NG 9627 6138	SO	Downstream 15 m is underground with some grass, remains low gradient with some food plants upstream
GAD1	Allt Coire Ruadh - staca	Unmapped lochan outflow	NG 9616 6139	NG 9622 6129	SO	Has some good sloping banks for burrowing but very little food plants
GAF1	Allt Coire Ruadh - staca	Unmapped lochan outflow	NG 9618 6077	NG 9624 6079	SO/US	Very poor suboptimal pools and ditches, much of which has low banks
GAG1	Allt Coire Ruadh - staca	Unnamed tributary	NG 9614 6071	NG 9679 6053	SO	Poor, mostly very low banks and heather, two patches of high dry grassy suboptimal on lower bends
GB1	Allt Toll a' Ghiubhais	Unnamed tributary	NG 9705 6224	NG 9699 6244	SO	Very poor suboptimal pools with low heather clad banks, some boulder and a little grass
GC1	Allt Toll a' Ghiubhais	Unnamed tributary	NG 9710 6217	NG 9720 6226	SO	Tiny stream curves round base of slope with some underground channel and good feeding, may dry up in summer
GD1	Allt Toll a' Ghiubhais	Unnamed tributary	NG 9710 6223	NG 9713 6219	SO/O	Downstream end has burrows in habitat with high dry banks but poor feeding, upstream end is good underground stream with mixed grasses
GE1	Allt Toll a' Ghiubhais	Unnamed tributary	NG 9710 6231	NG 9710 6242	SO	Long pool with low floodable banks, becomes small ditch upstream with one bank low and floodable and the other high with some heather
GF1	Allt Toll a' Ghiubhais	Allt na Creige Baine	NG 9721 6239	NG 9723 6244	SO	Straight stretches have low, soft, damp banks for grazing but not suitable for burrows, bends steeper, more peaty banks where burrows present.
GF2	Allt Toll a' Ghiubhais	Allt na Creige Baine	NG 9723 6244	NG 9709 6268	US	Burn flows underground beneath rocky/boulder burn bed.
GF3	Allt Toll a' Ghiubhais	Allt na Creige Baine	NG 9687 6318	NG 9683 6238	US	Bedrock slabs and fast flowing burn
GF4	Allt Toll a' Ghiubhais	Allt na Creige Baine	NG 9685 6322	NG 9686 6325	SO	Side limb with reasonable banks 20 m long with sedges and heather, alongside main rocky burn
GF5	Allt Toll a' Ghiubhais	Allt na Creige Baine	NG 9684 6328	NG 9687 6351	SO	Widens to small pool, still rocky in places otherwise steeper banks tending to be heathery and lower banks damp and mossy. Mainly sparse cover but could provide some temporary refuge.
GF6	Allt Toll a' Ghiubhais	Allt na Creige Baine	NG 9687 6351	NG 9699 6360	SO	Banks soft with sedge in many places with low cover. Steeper heather banks may provide temporary refuge, not great grazing potential
GF7	Allt Toll a' Ghiubhais	Lochan	NG 9683 6372	NG 9683 6372	US	Very marginal habitat. Mostly exposed peat banks, verging on unsuitable, some firmer heather/sedge banks
GH1	Allt Toll a' Ghiubhais	Unmapped lochan outflow	NG 9766 6242	NG 9767 6247	SO	Sloping mossy banks with some *Juncus* and some *Molinia*

Appendix 8.3 contd. Habitat classifications and notes

Code	Sub-Catchment	Tributary	Upstream grid ref	Downstream grid ref	Habitat rank	Notes
GI1	Allt Toll a' Ghiubhais	Unnamed tributary	NG 9774 6244	NG 9792 6246	SO/O	Mid section very good with *Molinia* and good banks, top of section very low banks but good grass mix for foraging
GK1	Allt Toll a' Ghiubhais	Unnamed tributary	NG 9776 6239	NG 9777 6220	SO	Occasional grassy corners on bends are very low and flood prone. Burrows on the higher dry heather clad banks
GK2	Allt Toll a' Ghiubhais	Unnamed tributary	NG 9777 6220	NG 9787 6209	SO	Small and narrow, heather with occasional grass covered bends in lower section. Short grass with flood prone banks but feeding potential in upper
GKA1	Allt Toll a' Ghiubhais	Small side channel	NG 9777 6220	NG 9777 6213	SO/O	Underground with occasional patches where stream shows above ground. Good mix of grasses and sedges
GL1	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9724 6047	NG 9706 6042	US	Generally unsuitable, stony banks and fast flowing but short patches on bends or slower flowing with peat banks and better cover though generally poor grazing
GL2	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9706 6042	NG 9704 6040	US	Lochan with stony, low banks, poor for burrows and coarse grazing, mostly sedges
GL3	Allt Toll a' Ghiubhais	Allt Toll a' Ghiubhais	NG 9704 6040	NG 9698 6035	SO	Some good grass cover and boulders with peat between for burrowing
GL4	Allt Toll a' Ghiubhais	Lochan Uaine	NG 9689 6048	NG 9689 6048	US	Rocky shores
S1	Allt Slocach	Allt Slocach	NH 9780 6751	NG 9772 6743	SO	Low gradient section of burn with *Molinia*, patches of burrowable banks but clearly floods at high water
S2	Allt Slocach	Allt Slocach	NG 9772 6743	NG 9750 6713	SO	Lower part of section is in shallow gully, upper part is more open, can become braided and banks are floodable.
B1	Allt Bhanamhoir	Allt Bhanamhoir	NG 9743 6517	NG 9741 0494	US	Fast flowing and stony banked.
B2	Allt Bhanamhoir	Allt Bhanamhoir	NG 9747 6487	NG 9749 6484	US	Becomes stony banked and fast flowing
B3	Allt Bhanamhoir	Allt Bhanamhoir	NG 9749 6484	NG 9755 6471	SO	Peaty banks with heather and grass cover
B4	Loch Bhanamhoir	Loch	NG 973 645	NG 973 645	US	Rocky shore
B5	Loch Bhanamhoir	Inflow	NG 9732 6458	NG 9719 6445	SO	Small, unmarked burn from lochan. Old water vole holes on underground stretch
B6	Loch Bhanamhoir	Inflow	NG 9719 6445	NG 9719 6445	US	Lochan as LB1
B7	Loch Bhanamhoir	Lochan	NG 9710 6434	NG 9710 6434	US	Vegetation too sparse. Stony on north shore. Not enough cover
BA1	Allt Bhanamhoir	Unnamed tributary	NH 9836 6610	NH 9824 6610	US	Fast-flowing, boggy, low flood prone banks.
BB1	Allt Bhanamhoir	Small tributary	NG 9799 6496	NG 9806 6483	SO	Underground in places with grass and heather cover
BB2	Allt Bhanamhoir	Small tributary	NG 9806 6483	NG 9811 6473	US	Stony shore
BB3	Allt Bhanamhoir	Small tributary	NG 9811 6473	NG 9811 6468	US	Exposed peat banks and sparse cover
BB4	Allt Bhanamhoir	Lochan	NG 9808 6463	NG 9808 6463	US	Mostly stony shore or small sections with low/mossy/soft banks, very small section with heather and better banks but very unlikely
BBA1	Allt Bhanamhoir	East tributary	NG 9796 6483	NG 9783 6480	SO	Very low flow, soft poorly defined banks at upper end, may be too low flow to be suitable
BBA2	Allt Bhanamhoir	Lochan	NG 9780 6473	NG 9780 6473	SO	Lochan with stony shore and some moss/heather/grass cover on more peaty banks
BC1	Allt Bhanamhoir	Lochan	NG 9759 6483	NG 9759 6483	SO	Lochan with short heather/moss banks, verging on unsuitable with very sparse cover
BD1	Loch Bhanamhoir	Inflow	NG 9766 6451	NG 9764 6448	SO	Underground in stretches. Good habitat though short
N1	Allt na h-Airighe	Allt na h-Airighe	NH 0010 6504	NH 0016 6485	US	Fast-flowing burn through woodland. Shaded, no grass. Boulder banks.
N2	Loch Bhanabhaig	Allt na h- Airighes	NG 9873 6385	NG 9842 6401	US	Stony banks
N3	Loch Bhanabhaig	Loch	NG 984 640	NG 984 640	US	Stony or soft mossy banks
NA1	East tributary	Tributary	NG 9898 6379	NG 9874 6371		Stony, heather clad banks

Appendix 8.3 contd. Habitat classifications and notes

Code	Sub-Catchment	Tributary	Upstream grid ref	Downstream grid ref	Habitat rank	Notes
NA2	East tributary	Lochan	NG 9876 6375	NG 9876 6375	US	Stony shore
E1	Alltan Mhic Eogheinn	Alltan Mhic Eogheinn	NH 0051 6466	NH 0050 6447	US	Fast-flowing burn through woodland. Shaded, no grass. Boulder banks.
R1	Allt na Doire-daraich	Allt na Doire-daraich	NH 0185 6319	NH 0171 6301	US	Fast-flowing river, some woodland, banks not burrowable, many boulders
R2	Allt na Doire daraich	Stone shelter tributary	NG 9977 6243	NG 9938 6255	US	Fast flowing and rocky, steep sided.
R3	Allt na Doire daraich	Loch Allt an Daraich	NG 9895 6339	NG 9895 6339	US	Soft or stony banks, lochan
R4	Allt na Doire daraich	Loch Allt an Daraich	NG 9896 6339	NG 9896 6351	US	Stony, fast flowing
R5	Allt na Doire daraich	Lochan	NG 9896 0351	NG 9896 0351	US	Lochan with soft banks and sparse cover, undercut peat in places.
RA1	Allt na Doire daraich	Unnamed tributary	NH 0051 6285	NH 0046 6297	US	Low flow, peat hags at top, sphagnum and heather, underground in places, very short section
RB1	Allt na Doire daraich	Alltan Leacach	NH 0020 6273	NH 0015 6278	US	Fast flowing, stony and undercut, much heather on banks
RB2	Allt na Doire daraich	Alltan Leacach	NH 0015 6278	NH 0011 6298	SO	*Molinia* with heather, meanders to slow flow, quite shrubby but better potential. Photo 1551 hrs.
RB3	Allt na Doire daraich	Alltan Leacach	NH 0009 6306	NH 0000 6312	SO(US)	Some good *Molinia* and soft rush cover with peat banks but tending to be fast flowing so undercut and stony may make it unsuitable
RBA1	Allt na Doire daraich	Lochan	NH 0027 6287	NH 0027 6287	US	Lochan with soft sphagnum, low heather or stony, no good banks or grazing
RC1	Allt na Doire daraich	Unnamed tributary	NH 0027 6245	NH 0012 6262	US	Fast flowing, stony in general, mostly heather though some better grass cover in places, overall unsuitable
RD1	Allt na Doire daraich	Not mapped	NG 9962 6309	NG 9962 6309	SO	Wet flush
RE1	Allt Dearg	Allt Dearg	NG 9905 6173	NG 9891 6162	US	Stony shallow burn with sparse cover, bog asphodel dominant with short sedges and grass, nothing to burrow into.
RE2	Allt Dearg	Allt Dearg	NG 9870 6159	NG 9870 0156	SO	Unmarked burn, sparse cover
RF1	Allt na Doire daraich	Lochan	NG 9880 6220	NG 9880 6220	US	Soft sphagnum and heather covered banks, little potential for burrowing or grazing
RF2	Allt na Doire daraich	Unnamed outflow	NH 9896 6233	NH 9886 6224	SO	Flood prone with no good high banks.
RG1	Allt na Doire daraich	Unnamed outflow	NG 9896 6240	NG 9896 6233	US	Heather dominated, rocky and fast flowing
RG2	Allt na Doire daraich	Lochan	NG 9896 6240	NG 9896 6240	US	Lochan, soft banked, moss and heather dominant, good *Molinia* cover at inflow and small areas of banks but soft and flood prone and largely unsuitable
RG3	Allt na Doire-daraich	Unnamed tributary	NG 9831 6272	NG 9870 6255	US	Heather dominant and rocky banks.
RG4	Allt na Doire-daraich	Unnamed tributary	NG 9880 6255	NG 9895 6259	US	Lochans with heather dominant and stony banked
RH1	Allt Sguabaidh	Allt Sguabaidh	NH 0202 6290	NH 0200 6278	US	Burn through *Molinia*. Floodable banks
RH2	Allt Sguabaidh	Allt Sguabaidh	NH 0200 6278	NH 0171 6244	US	Fast-flowing with boulders, no grass
RH3	Allt Sguabaidh	Tributary	NH 0046 6189	NH 0037 6173	US	Dry bed along much of its length or rocky and fast flowing, heather dominant on banks with some grass and sedge
RJ1	Trib nr A. Sguabaidh	Unnamed tributary	NH 0216 6275	NH 0215 6255	US	Canalised burn through open pine plantation with *Molinia* and bog myrtle. Banks low and can become waterlogged.
K1	Kinlochewe	Alltan Aramaidh	NH 0253 6189	NH 0249 6157	SO	*Molinia* tussocks, flood prone, good cover and grazing but very wet between tussocks may make it unsuitable.
K2	Kinlochewe	Alltan Aramaidh	NH 0259 6207	NH 0253 6189	US	Fast flowing with stony banks and largely shaded by trees.
K3	Kinlochewe	Alltan Aramaidh	NH 0249 6157	NH 0239 6143	SO	Ditch alongside path. Low flow.

Appendix 8.3 contd. Habitat classifications and notes

Code	Sub-Catchment	Tributary	Upstream grid ref	Downstream grid ref	Habitat rank	Notes
K4	Kinlochewe	Alltan Aramaidh	NH 0239 6143	NH 0229 6135	US/SO	Stream very braided and partly underground, fast flowing. Ground floodable, no proper banks (very low)
KA1	Kinlochewe	Unmapped tributary	NH 0249 6157	NH 0247 6153	SO	Unmapped burn to E of footpath (just out of Kinlochewe to south). Low gradient, burrowable banks
AA1	A' Ghairbhe	Caochan Ban	NH 0264 6159	NH 0248 6142	SO	As upstream, but ground very boggy and waterlogged and banks mainly low. Clearly floods frequently.
AA2	A' Ghairbhe	Caochan Ban	NH 0248 6142	NH 0235 6127	SO	Low gradient, quite fast flow, burrowable banks with grass and heather
AA3	A' Ghairbhe	Caochan Ban	NH 0235 6127	NH 0221 6128	SO(US)	Some parts slow, low gradient, alternating with steep fast flow. Banks mixed grass/shrub.
AA4	A' Ghairbhe	Caochan Ban	NH 0235 6127	NH 0216 6118	US	Steep, rocky and fast-flowing
AA5	A' Ghairbhe	Caochan Ban	NH 0216 6118	NH 0212 6114	SO	Unmapped burn. Very narrow, almost underground. Alternating fast/slow sections, burrowable banks, *Molinia* and bog myrtle
AA6	A' Ghairbhe	Caochan Ban	NH 0216 6118	NH 0201 6115	SO	Quite fast-flowing and rocky but burrowable banks, grassy under young pines
AB1	A' Ghairbhe	Allt a'Chuirn	NH 0245 6090	NH 0225 6092	US	Fast flowing, rocky, banks un-burrowable. River unstable, through deciduous woodland.
AB2	A' Ghairbhe	Allt a'Chuirn	NH 0186 6089	NH 0163 6089	US	Gorge, stream is fast-flowing and rocky. Banks unsuitable for burrowing.
AC1	A' Ghairbhe	Cromasaig	NH 0243 6080	NH 0237 6066	US	Fairly fast-flowing, rocky bed, through dense deciduous woodland, very shaded.
AC2	A' Ghairbhe	Cromasaig	NH 0213 6058	NH 0237 6066	SO	Medium flow, rocky bed, peat banks, choked in places with old rotten branch material from felled plantation. Lots of birch and heather but some patches of *Molinia*
AD1	A' Ghairbhe	500m S of Cromasaig	NH 0226 6029	NH 0207 6037	SO	Fairly fast-flowing, rocky bed, peat banks and some patches of sub optimal habitat, all within old felled plantation.
AD2	A' Ghairbhe	600m S of Cromasaig	NH 0226 6029	NH 0224 6018	SO	Slow-flowing ditch, peat banks with *Molinia*. Through old felled plantation so probably US in past
AE1	A' Ghairbhe	Unnamed tributary	NH 0215 5985	NH 0204 5988	US	High vertical banks, dense heather cladding, tree stumps and boulders in bank sides
AE2	A' Ghairbhe	Unnamed tributary	NH 0157 5998	NH 0146 5998	SO/US	Many banks low and floodable with bog myrtle and heather, occasional bends have poor suboptimal mossy patches with field vole signs
AF1	A' Ghairbhe	Unnamed tributary	NH 0179 5960	NH 0163 5965	SO/US	Grassy banks but many old tree roots in bank
AF2	A' Ghairbhe	Unnamed tributary	NH 0129 5980	NH 0102 5962	US/SO	Banks floodable with bog myrtle and heather, occasional bends have poor suboptimal mossy patches with field vole signs
AG1	A' Ghairbhe	Unnamed tributary	NH 0168 5936	NH 0152 5944	SO/US	Mostly low lying with few high banks, mix of bog myrtle and *Molinia*
AH1	A' Ghairbhe	Alltan Fearna	NH 0147 5918	NH 0087 5933	US/SO	Steep and fast flowing with low lying banks, small suboptimal patches
AI1	A' Ghairbhe	Alltan na Caise	NH 0140 5885	NH 0117 5893	US	Fast flowing, stony, shaded by deciduous trees along much of its length.
AI2	A' Ghairbhe	Alltan na Caise	NH 0049 5937	NH 0025 5933	SO	Very poor suboptimal with left bank low and floodable and right bank very steep with thick heather
AI3	A' Ghairbhe	Alltan na Caise	NH 0025 5933	NH 0002 5926	SO	Left bank low and floodable and right bank very steep with thick heather
AI4	A' Ghairbhe	Alltan na Caise	NH 0002 5926	NG 9980 5921	SO	Some slow bends with many small vole signs, much is still low lying
AI5	A' Ghairbhe	Alltan na Caise	NG 9989 5921	NG 9980 5926	SO	Short section runs underground at upstream end
AIA1	A' Ghairbhe	Unmapped tributary	NH 0036 5932	NH 0029 5937	SO	Some undercut and broken bank gives burrowing potential, but very little food availability
AJ1	A' Ghairbhe	Unnamed tributary	NH 0133 5879	NH 0112 5885	US	Undercut peat banks with brash often in channel, good cover on top of high banks. Access difficult.

Appendix 8.3 contd. Habitat classifications and notes

Code	Sub-Catchment	Tributary	Upstream grid ref	Downstream grid ref	Habitat rank	Notes
AK1	A' Ghairbhe	Unnamed tributary	NH 0089 5850	NH 0083 5855	SO	Steep or undercut peat banks, stony lower down. Mossy banks with *Molinia* and soft rush provide good grazing, steep banks for burrows with slumping providing access further up
AK2	A' Ghairbhe	Unnamed tributary	NH 0083 5855	NH 0081 5863	O	Soft rush and *Molinia* dominant, soft ground, tussocks provide refuge
AK3	A' Ghairbhe	Unnamed tributary	NH 0083 5855	NH 0061 5855	O/SO	Lower good optimal, upper shallow gully then more open and braided with floodable banks.
AKA1	A' Ghairbhe	Unnamed tributary	NH 0081 5863	NH 0078 5872	SO	Mostly heather dominated, soft rush in upper section.
AL1	A' Ghairbhe	Unnamed tributary	NG 0054 5836	NG 0050 5848	US	Undercut peat or stony banks, fast flowing. Cleared forestry, replanted with native species. Access to banks difficult though good *Molinia* cover especially downstream
AM1	A' Ghairbhe	Allt a' Ghille	NG 9928 5789	NG 9929 5796	US	Fast flowing, stony banks
AN1	A' Ghairbhe	Unnamed tributary	NG 9858 5761	NG 9865 5778	SO	Heathery banks, stony in places but reasonable *Molinia* cover, holes at top of high banks and peaty ledge.
AN2	A' Ghairbhe	Unnamed tributary	NG 9865 5778	NG 9853 5781	O	*Molinia* dominated small burn, underground for long stretches, sheltered channels and runways between tussocks.
AN3	A' Ghairbhe	Unnamed tributary	NG 9853 5781	NG 9848 5785	SO	Less *Molinia* and more wet heather species
ANA1	A' Ghairbhe	Unnamed tributary	NG 9865 5778	9867 5789	SO	Generally too fast flowing, heather and *Molinia* banks provide some shelter and grazing. Improves downstream
ANB1	A' Ghairbhe	Unnamed tributary	NG 9870 5782	NG 9870 5788	SO	Narrow burn with good *Molinia* cover but fast flowing and prone to flooding.
AO1	Loch Bharranch	Unnamed tributary	NG 9783 5780	NG 9797 5793	US	Fast flowing, rocky banks.
AP1	Loch Bharranch	Am Fiann-alltan	NG 9776 5780	NG 9777 5799	US	Rocky and fast flowing
AP2	Loch Bharranch	Am Fiann-alltan	NG 9778 5797	NG 9799 5815	US	Rocky and fast flowing
AQ1	Loch Bharranch	Allt Coire an Laoigh	NG9772 5779	NG 9770 5789	SO(US)	Verging on totally unsuitable. Fast flowing and steep, often undercut, peat/stony banks
AQ2	Loch Bharranch	Allt Coire an Laoigh	NG 9770 5789	NG 9766 5795	US	Fast flowing and stony. Undercut banks
T1	Torridon	Allt Coire an Laoigh	NG 9745 5766	NG 9752 5785	SO	Becomes better downstream towards the road with M*olinia* tussocks, heather and muddy runs between tussocks.
T2	Torridon	Allt Coire an Laoigh	NG 9752 5785	NG 9759 5793	US	Fast flowing and stony
T3	Torridon	Allt nan Sac	NG 9725 5753	NG 9732 5769	US	Undercut peat or stony/gravel banks, downstream short stretches of lower peat banks are accessible but generally too fast flowing

Appendix 8.4 Other species data.

NGR	Species	Location	Notes
NG 9706 6042	Pine marten	Bank side	Fresh scat with berry, beetle and frog bones.
NG 9776 6239	Otter	Boulder in water	Large greened boulder – no bones but looks like spraint site
Allt na Creige Bainn	Otter	Various	Number of boulders look enriched but no definite spraints
NH 0245 6090	Otter	Under road bridge	Recent spraint

Appendix 8.5. Best Practice for Dredging

The Water Vole Conservation Handbook recommends that disturbance should be minimised by phasing engineering works. The length affected at any one time should be minimised with at least one year elapsing between actions on adjacent lengths to allow re-colonisation. Dredging and bank protection through good water vole areas should only be carried out where essential and if possible small sections or nearby waterways or lateral channels should be left untouched to allow a refuge. Further advice is given as follows:

- Use suitable machinery for the size of the waterway.
- Leave a minimum percentage of river channel untouched in marginal strips or patches centred on the core of the water vole population.
- Leave gaps of 10-20 m as untouched refuge areas.
- One third of the existing habitat around the determined water vole centre must be retained.
- Existing marginals can be lifted and restored to site immediately after completion of works.
- New profiles should provide a gradual transition at the bank. A stepped profile may allow for more rapid re-colonisation. Re-grading will provide a variety of habitats suitable for water voles in both long and cross sections.
- Working in an upstream direction enables re-colonisation downstream.
- Work from one bank only for short stretches upstream. Telfer (2000) suggests up to 250 m where possible.
- Sensitively dispose of any spoil and channel vegetation material.
- No de-silting from March to September. Aim to carry out work between November and January.
- Note that ditches and channels that dry out in the summer can be enhanced by erection of sluices.

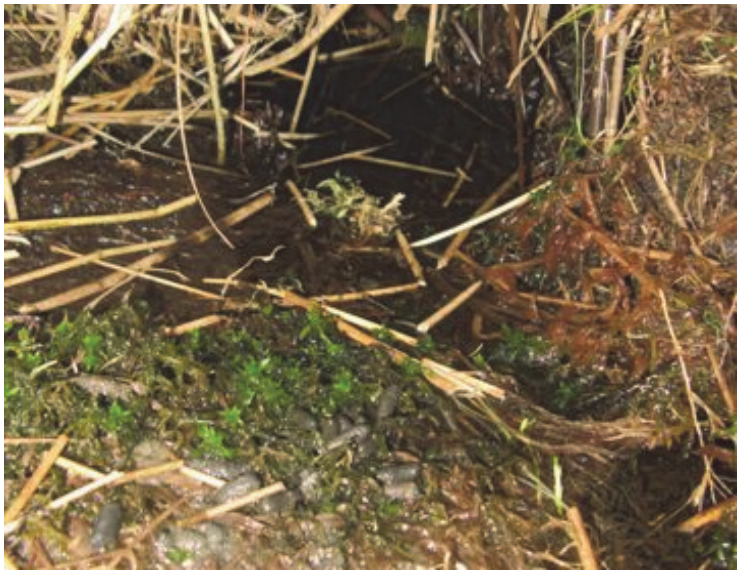
Appendix 8.6 Selected photographs

1. Looking downhill at area of water vole habitat. Some of this is optimal with slow flow and penetrable banks covered in grasses, sedges and rushes (Allt Toll a' Ghiubhais tributary, code GI1, colony 5)

2. Suboptimal water vole habitat with moderate flow, some areas of penetrable bank and a mix of plant species (lower end of section GI1).

3. Unsuitable water vole habitat, with fast flow and rocky, impenetrable banks (section G7 on the main Allt Toll a' Ghuibhais).

Appendix 8.6 Selected photographs contd.



4. Typical water vole latrine below an overhanging bank.

5. Active water vole burrows in suitable habitat.

6. Typical underground stream with numerous burrows and drop holes to streambed (Allt Coire Ruadha-staca; colony 2).

Appendix 8.6 Selected photographs contd.

7. A burrow recently plugged by water voles.

8. The inhospitable landscape that water voles disperse across to reach colony 6 in the upper catchment of Allt Toll a 'Ghiubhais. The arrow shows the location of the tributary where burrows were observed.

9. One of the disused burrows found in section GL3, colony 6 in the upper catchment of Allt Toll a 'Ghiubhais.

Appendix 8.7 Data from the National Trust Survey, collected June 2010.

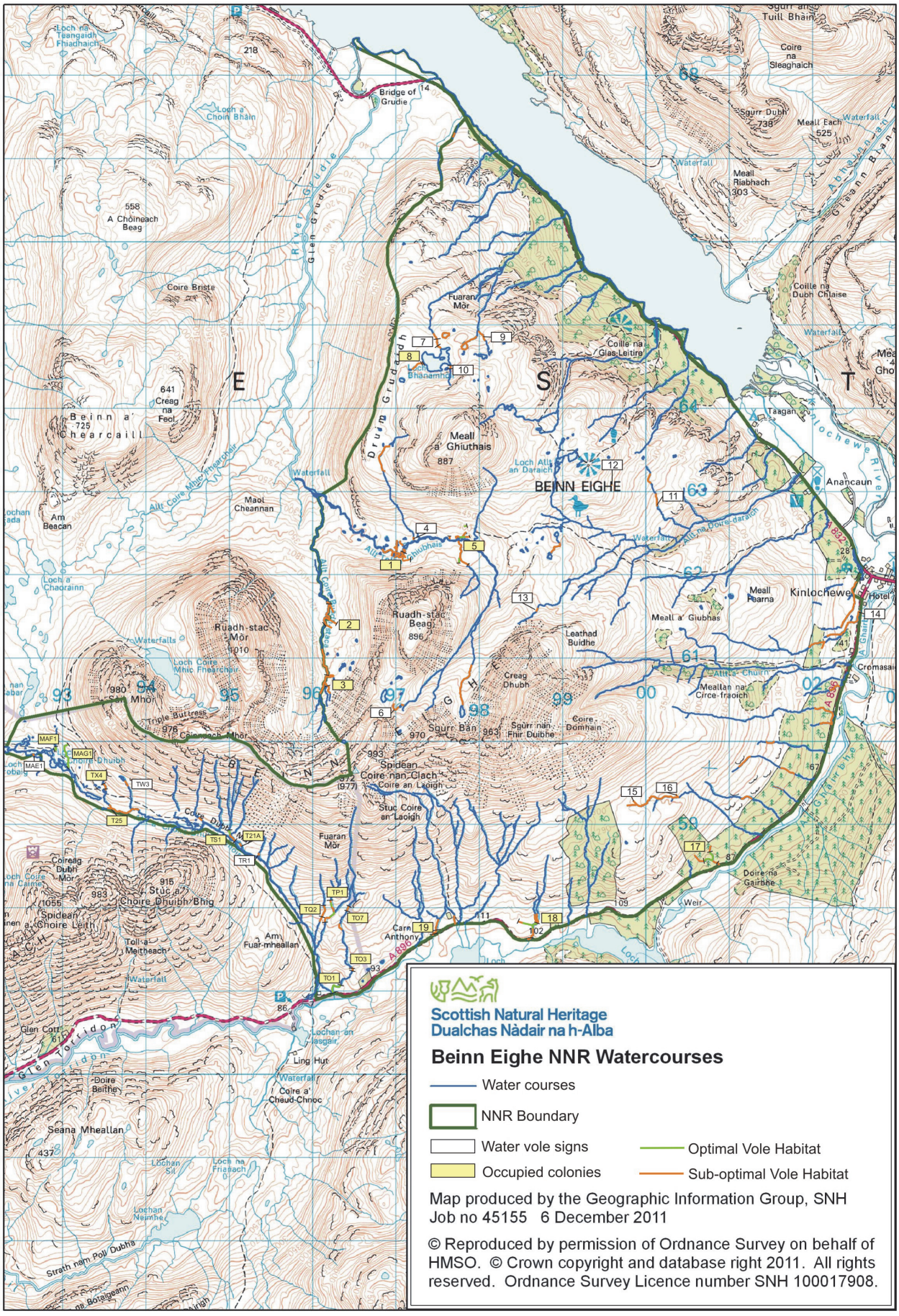
Code	Catchment	Tributary	Grid ref start signs	Grid ref end signs	WATER VOLE SIGNS							
					Latrines (n)	Active burrows (n)	Old burrows (n)	Tracks	Runs	Feeding Remains (species)	Lawns	Sightings
E8	Diabaigas Airde	Allt Clac nam Fuaran	8311 6118				1					
SA2	Camasdrol Stream	East tributary left fork	8235 5804				2					
AG8	Abhainn Alligin	An Coire Beag tributary	8296 5959				1					
AF1	Abhainn Alligin	Upper ford tributary	8395 5896				2					
AK3	Abhainn Alligin	Braigh Eireann west	8361 6027				5					
AL1	Abhainn Alligin	Braigh Eireann unnamed tributary	8375 6022				6					
AM3	Abhainn Alligin	B. Alligin summit stream	8515 6089	8524 6089			2					
MB3	Coire Mhic Nobuil	A Toll a Mhadaidh main	8745 5946				2					
BE1	CM Allt a Bhealaich	East trib north of BD	8837 6101	8842 6108	1	19	4		Y			
BH2	CM Allt a Bhealaich	Suileagan Bhealaich stream	8835 6126			21	5			*Molinia*	1	
BH4	CM Allt a Bhealaich	Suileagan Bhealaich stream	8820 6163	8822 6168		5	2			*Molinia*		
MD1/MD2	Coire Mhic Nobuil	First sth upst Bhealaich	8857 5911	8861 5913	6	14	3	Y	Y	Y	2	
MF1	Coire Mhic Nobuil	Between fords trib	8855 5926				5					
MP1	Coire Mhic Nobuil	North shore path stream	8994 5953				3					
MP1	Coire Mhic Nobuil	North shore path stream	9016 5963				2					
MP1	Coire Mhic Nobuil	North shore path stream	9024 5962				1					
MS1	Coire Mhic Nobuil	Short north bank stream	9052 5964			2	10					
MV2	Coire Mhic Nobuil	Forked north bank burn	9089 6001	9089 6001			1					
MX1	Coire Mhic Nobuil	Short north bank stream	9126 5980	9123 5983		7	3		Y	Y	1	
MAB1	Coire Mhic Nobuil	Small north bank stream	9168 5996	9168 5996			1					
MAE1	Coire Mhic Nobuil	South tributary L.Choire D	9265 982	9264 984		1	2					
MAF1	Coire Mhic Nobuil	North tributary L.Choire D	9288 990	9293 5990	2	1	4		Y			
MAG1	Coire Mhic Nobuil	Loch inflow north shore	9309 5994	9309 5970	2	24	3		Y		2	
CV1	Stream C, village	Field east school	8974 5611				1					
DV1/2	Steam D, village	Below hall	8982 5552	9002 5584	12	12	1		Y	Y		
TE1	Torridon	Allt Doire na Caillich	9245 5602	9240 5595			2					

Contd.

Appendix 8.7 National Trust data contd.

					WATER VOLE SIGNS							
Code	Catchment	Tributary	Grid ref start signs	Grid ref end signs	Latrines (n)	Active burrows (n)	Old burrows (n)	Tracks	Runs	Feeding Remains (species)	Lawns	Sightings
TF1	Torridon	Allt Doire Voluich	9259 5607	9259 5607	2				Y			
TH1	Torridon	Burn east of enclosure	9317 5642	9315 5635	1	1			Y			
TI1	Torridon	Small burn at Parking	9344 5663	9341 5646	2	1	2		Y		1?	
TJ1	Torridon	Allt D Ghairbh west	9354 5655	9354 5656	1	1			Y			
TL2/3	Torridon	Allt a Gharaidh Dhuibh	9522 5791	9522 5200			2		old			
T18	Torridon	Mainstem	9527 5649		4	6	5		Y	soft rush	1	
TN1	Torridon	Feith Ghlas	To TN2	9607 5685	5	5	4		Y			
TN2	Torridon	Feith Ghlas	9675 5711	To TN1	34	14	0	Y	Y	Y		1
TO1	Torridon	Allt Slugach	9625 5688	9634 5708	28	53	0		Y	soft rush, *Molinia*	1	
TO3	Torridon	Allt Slugach	9648 5723	for 30m	3	2	0		Y	soft rush		
TO7	Torridon	Allt Slugach	9643 5801	9640 5794	3	4	3		Y	*Juncus*		
TP1	Torridon	Allt na Fhuarain Mhoir	9613 5777	to TP2	8	9	3		Y		1	
TP2	Torridon	Allt na Fhuarain Mhoir	from TP1	9622 5808	20	19	21		Y	soft rush	2	
TQ2	Torridon	Unnamed west Fh Mhoir	9610 5786	9614 5803			5			*Molinia*, soft rush		
TR1	Torridon	Tiny north tributary					1					
T21A	Torridon	A. C. an A. backchannel	9516 5873	9515 5874	2		2			*Molinia*		
TS1	Torridon	Lower trib north bank	9505 5882		1		1		Y			
TS1	Torridon	Lower trib north bank	9502 5884				2					
TS2	Torridon	West branch of tributary	9499 5891	9500 5889	2 old		5					
TS3	Torridon	East branch of tributary	9502 5885	9501 5887			4					
TS3	Torridon	East branch of tributary	9502 5885	9502 5887			5					
TW3	Torridon	DS high lochan	9375 5952				1					
TX4	Torridon	Us of small lochan	9353 5943	9350 5947	3	2		Y				
T25	Torridon	Allt a Choire Dhuibh Mhoir	9356 5917	9360 5912	1	1		1	?			

Appendix 8.8 All Water Vole habitat and signs in Beinn Eighe NNR (including NT data).



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