Water Shrews in Danby Dale, North Yorkshire, - Their Diet and Habitat

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Abstract

The report firstly describes work carried out to try to establish a clearer picture of the distribution of the Water Shrew in the northern part of the North York Moors, and then goes on to examine in greater depth their distribution in Danby Beck; a small tributary of the Yorkshire Esk. Further sections draw together data from different sources to describe aspects of their diet, and how it may be influenced by the local environmental conditions.

1 Mammal Society National Water Shrew Survey 2004/2005

1.1 Introduction

The Water Shrew *(Neomys fodiens*) is the largest of three shrew species found on mainland Britain. It is readily distinguished from the other two species by its almost piebald pelage of dark upper parts and lighter underside.

The Mammal Society organised their national survey because there was a great deal of uncertainty about the distribution of the Water Shrew in the UK, and to try to establish a baseline to determine possible future variations in range. More locally, "Yorkshire Mammals" by Delaney, shows 28 records for VC62 and a further 10 for VC61, and there are also records held by the Yorkshire Naturalists Union (1) Many of these records have been collected over a period of many years and may not reflect the present day distribution. Furthermore, there would appear to be large areas of Yorkshire from which the species has not been recorded. Whether this reflects a real absence of water shrews in these areas or a lack of recording activity is unclear.

Having encountered the water shrew at three different sites around Great Ayton, North Yorkshire, while carrying out Longworth trapping for small mammals, the writer decided to take part in the Mammal Society National Survey.(2)

1.2 Method

The method was devised by Dr Sara Churchfield (3), and used 200mm lengths of approximately 38mm diameter plastic drainage pipe with a fine gauge net baffle attached to one end, with the other end left open. The tubes were baited with about two dozen blowfly pupae (casters), and four baited tubes were positioned at approximately 10 m intervals at ground level under the cover of waterside vegetation or rocks at each site under investigation. Small animals were able to enter the tubes to consume the bait and in so doing, usually defecated and were free to leave the tube. After a period of two weeks the tubes were collected and the contents dried and examined for any scats deposited. The bait may be taken by rodents, terrestrial shrews or water shrews, and close examination of the scats was necessary to distinguish the presence of aquatic invertebrate remains in them which would confirm water shrew origin. After personal examination, the scats from the four tubes were amalgamated to form one sample representative of that site, and forwarded to the Mammal Society for official confirmation of identity.

In each of the two years, surveying was carried out in two periods, December to April and July to September. The sites surveyed were principally streams rising in the northern part of the North York Moors and discharging into the Rivers Esk and Leven or directly into the North Sea. In total, 32 sites were surveyed including five areas of still water, four used for

angling and the other a small pond created some twelve years ago by a local farmer as a conservation project. The survey sites are shown in Fig. 1.

1.3 Results

Scats with remains indicating water shrew presence were found in samples from 6 of the 32 sites (18.8%). All were from sites with running water. Scats of terrestrial shrews and rodents were found in 11 (34.3%) and 6 (18.8%) samples respectively. The results are shown in Table 1, and Fig 1.

1.4 Discussion

The survey was successful in identifying sites where water shrews were present. However the fact that water shrews scats were not obtained does not necessarily rule out the possibility that they may be present. Indeed, two of the sites where water shrews had been captured earlier in Longworth traps failed to produce positive results in the National Survey.

The sites from where water shrew scats were taken when using tubes would all appear to be generally similar in character with shallow runs among rocks and stones with gravel beds and deeper pools. Aquatic vegetation was largely absent. They were all in narrow wooded valleys at altitudes ranging from 10m to170m. There were several sites which appeared to have similar characteristics to those which gave positive results, yet did not provide evidence of water shrew activity.

The value of 18.8% positive sites for the North York Moors was broadly similar to that achieved nationally of 17.4%.

No attempt was made in this survey to identify the invertebrates on which the water shrews were feeding, but the number and size of scats obtained suggest that food was in plentiful supply – at least in time of the survey in 2006. At the site in Danby Dale, the total number of scats (including significant fragments of scats) from the four tubes was more than 50, when the normal yield might be less than a fifth of that value, and was the largest number from a single site that the survey co-ordinator Phoebe Carter and Sara Churchfield had seen.(4)

1.5 Conclusion

The survey showed that the water shrew was widely distributed in the selected area, but that much work remained to be done to establish a clearer picture of the current status, and many areas remain to be surveyed.

2 Local Survey for Water Shrews, Danby Dale, 2006

2.1 Introduction

As a result of questions arising from the earlier work, it was decided that further surveying work might provide more information on the distribution of water shrews within a single stream system and over a longer time period. The choice of Danby Beck was made because it offered a range of differing sites in a reasonably compact area.

2.2 Description of Sites

Danby Dale is a valley in the North York Moors formed by glacial action on Jurassic sandstone and shales. The source of the Beck is at an altitude of 400m draining the peat moorland soil of the surrounding Danby High Moor, and flowing north to join the Yorkshire Esk, approximately 4 miles away at Castleton, 130m above sea level.

Initially 6 sites were selected although one, Site A furthest downstream, was soon abandoned due to summer growth of vegetation making access very difficult. The remaining

5 were used throughout the survey of 7 visits at fortnightly intervals from mid-July until mid-October. Sites C, D and F were on the beck itself at altitudes of 170, 210 and 290 m respectively. Site B was on a tributary of the beck at 165m altitude and was the same site used the in previous year for the National Survey. Site E at an altitude of 300m was a large pond with water flowing through it, close to the adjacent Site F on the Beck.

From its source the beck falls approximately 100m in about half a mile of open moorland to the head of the dale where Sites E and F were located. The pond has some emergent aquatic vegetation and bordered by a grassy margin, is almost surrounded by coniferous woodland. From Site F the stream tumbles steeply over rocks and boulders, with coniferous and mixed woodlands on the steep sides of the ravine, dropping 50m in less than a quarter of a mile.

From this point, the stream flows along the bottom of the dale on a substrate of rocks, sand, and gravel past sites D and C, bordered by several varieties of trees and shrubs including alder, ash, birch, oak, hazel, holly, and sycamore, all of various ages. At these lower levels, the land is cultivated with "improved" grassland and dairy farming is practiced.

Site B is a tributary of the beck in which the stream flows over boulders and rocks on a gravel bed in a steeply sided ghyll shaded by a conifer plantation also containing a few deciduous trees.

2.3 Method

The method was exactly the same as in the previous year, except that scats were not sent to the Mammal Society for confirmation of identity (although verification was forthcoming as described later in Section 3).

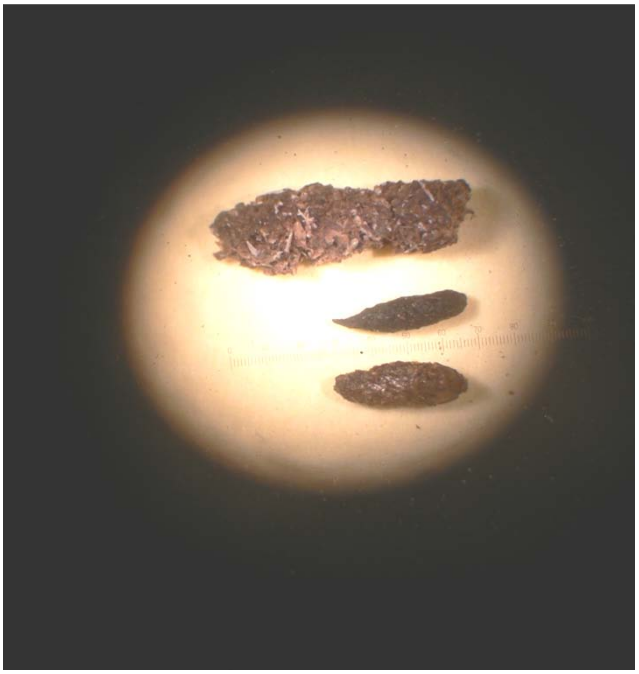

Fig 1-Illustration of Scats:
Top : Water Shrew
Middle : Rodent
Bottom : Terrestrial Shrew

2.4 Results of Survey

The results of the survey are given in Table 2.

The presence of water shrews was detected by scat deposition in the tubes at all 5 survey sites; indeed at 6, because they were also found at Site A which was subsequently abandoned.

In terms of the numbers of scats generated, the results are complicated to some extent because there were times when rainy conditions caused water levels to rise and some bait tubes were lost or inundated. However, Site B, the tributary, which had produced an exceptionally high number of scats in 2005, had consistent activity, generating scats in all 7 periods, and in this survey, the highest total from all sites of 11 scats for a single fortnightly period. High levels of activity were also evident at Site F, the beck at the head of the dale with a positive result in all 7 periods, but not in the same numbers as Site B.

The least productive site was the pond at the head of the dale and next to Site F, where the maximum number of scats in any one period was 4, with 3 single scat periods and two negative ones.

Sites C and D appeared to be intermediate between the highest and lowest activity levels, but also suffered more than the other sites from high water levels leading to loss of tubes.

There was some tentative evidence to indicate that the numbers of scats being deposited were higher towards the end of September and early October, which could correlate to a higher shrew population at the end of the breeding season.

2.5 Discussion

Six sites with a variety of differing characteristics were initially selected for the survey, and at all 6 sites some evidence of water shrew activity was found. If the animal were to live in separate discreet pockets, it would be most unlikely to have randomly located 6 such groups at the first attempt, and would therefore indicate that the water shrew is far from uncommon here and may have a wide distribution along the length of the beck.

The values for the number of scats obtained cannot be taken as any other than broadly indicative because the quantity of casters used for bait was not precisely measured and scatting activity is unlikely to be consistent. In any event it is clear that traffic in and out of the tubes results in scats being crushed and fragmented, and possibly being displaced from the tube.

It is interesting to consider how this small mammal can survive in what would appear to be quite a physically hostile environment. Although the higher parts of the North York Moors have a relatively low rainfall (1000 – 1,200mm/annum) compared with other upland areas in Britain, persistent wet winter weather and summer storms can both lead to swollen turbulent streams and flooding. All shrews have to eat very frequently to sustain their high metabolic rate, and it has been calculated that a water shrew needs to eat approximately half its body weight in food every 24 hours (5). Under such adverse conditions the water shrew will presumably consume a lower proportion of aquatic prey and rely more on terrestrial invertebrates.

3. Diet

During the microscopic examination of scats to determine their providers identity, it was noted that the exoskeletal remains of one particular prey item, characterised by parallel fluting perpendicular to the circular cross section of the exoskeleton, was regularly encountered, but its identification was beyond the skill of the writer. So frequently did it occur that it was considered to be the principal prey item.

3.1 Scat examination and freshwater invertebrate survey

To assist in the task of prey identification, contact was established with Mr Leslie Magee of the Freshwater Ecology Section of the Yorkshire Naturalists Union, who most kindly offered his services and the benefit of his long experience in the field.

Several samples of water shrew scats were sent to him for examination.

Among the prey items he identified from the scats were empty caddis cases of several species, terrestrial beetle chitin, aquatic helminthid beetles, a large millipede, several woodlice, a large spider, summer mayfly larvae, fragments of small black riffle beetles, a terrestrial black beetle and a small orange coloured beetle.

It has to be appreciated that it can be difficult enough to make an accurate identification when the specimen being examined is intact and in good condition, but when the sample has been killed, chewed and passed through the digestive system of a water shrew, then a different approach may be required.

In 2006 therefore, 8 surveys were carried out by Mr. Magee at several of the sites in late Spring and Summer to determine the species of freshwater invertebrates present and potentially available as water shrew prey items. These surveys identified :-

6 species of Tricoptera,
4 species of Ephemeroptera,
3 species of Plecoptera,
3 species of Coleoptera,
and unidentifiable larvae of Chironomids.

His report (6) however, noted that “the populations were sparse both in the numbers of species and the populations, although the latter vary at different seasons.”

These comments refer to the fact that a complete assessment of the freshwater invertebrates would require sampling to be extended over a much longer period of time to accommodate the various stages in the life cycle of certain species. However, the results would be pertinent to the period during which the water shrew work was carried out. The identity of the principal prey item was still unknown and yet it was clearly abundant enough to sustain many animals over at least the period of the survey.

3.2 Further scat examination

During the course of the survey, the writer had been in contact with Dr Churchfield about some aspects of the work, and she too kindly offered to look at some of the scats and give an opinion on their content.

A total of 22 water shrew scats were examined by her, with a minimum of 3 samples from each site, and from these, 76 prey items were identified. A broad division of the prey items showed that 64 were terrestrial, 6 were aquatic and 6 contained snail shell remains but it was not possible to determine whether these were of terrestrial or aquatic origin.

Of the 22 scats examined, 17 contained Diplopoda (millipede) remains, and in 10 of these scats they were present in large amounts and represented a high proportion of the scat content. Isopoda (woodlice) were present in 10 scats, 4 of which also showed high numbers. The next most populous orders were Coleoptera (beetles) and Araneae (spiders) found in 10 and 9 scats repectively.

The only aquatic prey remains found were from Trichoptera larvae (caddis) in 2 scats and Asellus (water slater) found in 4 scats. A total of 17 scats contained no aquatic prey at all, and a further 4 contained just one order. Although the sample is too small to draw conclusions, it is of interest that none of the scats obtained at the head of the dale from the pond or the beck nearby contained any aquatic prey.

The full results of the examination by Dr Churchfield are given in Table 3.

Comments accompanying the results (7) referred to the incidence of aquatic prey being very low and that the water shrews appeared to be subsisting largely on a poor quality prey (millipedes) with lots of indigestible exoskeleton and low energy value. These prey are mostly rejected by Common and Pygmy Shrews, presumably because millipedes have the ability to discharge distasteful fluids to deter predators, and terrestrial shrews only eat them as a last resort in cold winters when other prey is in short supply. Millipede remains however, were not uncommon in water shrew scats.

4 Rainfall & Water Quality

In order to provide supporting information, data on rainfall and pH values during the period of the survey were obtained from Mr Tom Chadwick. The data were the results of a local monitoring group, Environet which has been recording the pH of rainfall, and in Danby Beck and Brown Hill Spring, as well as the pond at the head of the dale since1990 (8).

By chance, two of the stations used for these recordings were the sites E, the pond, and F, Danby Beck close to it at the head of the dale, used in the water shrew survey.

Figures relating to rainfall, and pH at these sites in the months leading up to and including the water shrew survey period are given in Table 4.

The table shows the wide range of rainfall in this upland area, and also the low pH values which can be experienced in Danby Beck. On face value the high acidity may not seem surprising given the peat beds and underlying sandstone on the moor catchment area. The data recorded by Environet show that the pH recorded in the headwaters of Danby Beck has been less than 4.0 for 75% of the time since 1990, rising perhaps to between 5 and 6 during the summer months.

In March 2005 the Centre for Ecology and Hydrology also surveyed the water quality of Danby Beck as part of a larger survey of the North York Moors (9). They measured low pH (4.08), and a strongly negative acid neutralizing capacity. It would appear that the high acidification is probably derived from a combination of the naturally occurring acidic nature of the surface peat layer and the sandstone rock strata below, and additionally, a high concentration of airborne sulphate deposits. In forested streams, nitrate leaching and aluminium concentrations were at higher levels than considered compatible with sustainable populations of fish and invertebrate life.

The causes given for the highly acidic airborne deposits affecting Danby Beck (and many other becks rising on the North York Moors) were in the location of the Moors in relation to the relative close proximity of several large coal-fired power stations along the River Ouse to the South West, and the steel and chemical industries to the North, all with their associated airborne sulphur emissions, coupled with the prevailing wind directions.

5 Concluding Comments

The work has shown that water shrews are present and widespread along Danby Beck. This is despite a physically demanding environment of fast flowing, turbulent water and periodic flood conditions. Under favourable conditions their diet might comprise 50% to 67% of freshwater invertebrate prey (5). The evidence here however, would suggest that the underlying acid nature of the terrain, exacerbated by very high levels of atmospheric acid deposition, create a poor quality of surface water draining into the Beck, and may be a significant factor in reducing the amount of freshwater invertebrate life available for the water shrews consumption. Micro-examination of the scats showed that a high proportion contained little or no aquatic prey at all.

There would however, appear to be an anomalous factor with the pond which showed a consistently higher pH than any of the other sites. In theory, this might be expected to favour a higher population of invertebrate life, but in fact this site produced fewer scats, which contained no freshwater invertebrates during the survey period. This may be connected with the surrounding coniferous woodland but clearly more extensive work would be needed to provide an explanation.

The shrews appear to have adapted to a diet of largely terrestrial prey, which although plentiful, is of low nutritional value. This would imply that the volume of food taken would need to increase markedly to compensate for additional foraging energy requirements.

The work has opened up opportunities for further investigations, eg is the diet of water shrews different in streams arising in the limestone areas of the North York Moors but still influenced by similar prevailing winds with their associated acidic deposition, or indeed in other areas such as the Pennines which may be less affected by the same atmospheric conditions.

This is obviously based on the assumption that water shrews are present in these other areas, although there would appear to be a dearth of recent records of water shrew (and many other mammals) throughout North Yorkshire and especially from the Yorkshire Dales region (10).

References

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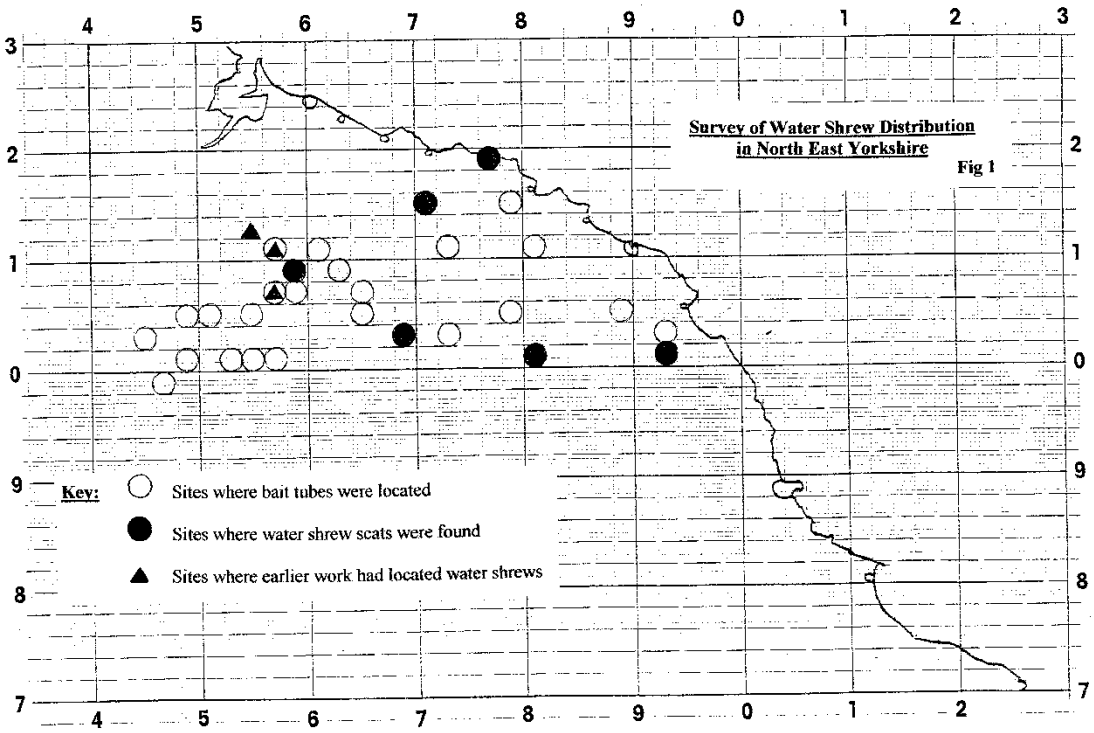
Survey of Water Shrew Distribution
in North East Yorkshire
Fig 1
Key:
Sites where bait tubes were located
Sites where water shrew scats were found
Sites where earlier work had located water shrews

Date	Site	Map Ref	Alt (m)	NP	Result
2004					
23.4.	Great Ayton (S)	NZ 579 105	130	*	-
23.4.	Ingleby Greenhow	NZ 578 065	120	*	Rodent
25.4.	Kildale, Dundale Beck	NZ 593 082	130	*	Terrestrial Shrew
23.4.	Kildale, River Leven	NZ 599 097	140	*	Water Shrew
25.4.	Sleddale Beck	NZ 637 099	180	*	-
25.4.	Baysdale Beck	NZ 651 074	160	*	Terrestrial Shrew
19.7.	Battersby	NZ 598 077	135	*	-
22.7.	Seave Green , Bilsdale	NZ 573 001	270	*	-
2005					
25.4.	Ingleby Arnecliffe	NZ 452 004	75	*	Terrestrial Shrew
25.4.	Oakdale, Osmotherly	SE 475 961	190	*	T. Shrew & Rodent
25.4.	Scugdale, Swainby	NZ 491 005	130	*	Terrestrial Shrew
25.4.	Alum Beck, Carlton	NZ 496 061	70	-	Rodent
25.4.	Carlton (S)	NZ 503 061	70	-	-
25.4.	Faceby (S)	NZ 497 021	140	*	Terrestrial Shrew
22.7.	Littlebeck	NZ 897 049	60	*	Terrestrial Shrew
22.7.	Fylingthorpe,Ramsdale Beck	NZ 942 038	40	*	Terrestrial Shrew
22.7.	Fylingthorpe, Stoupe Beck	NZ 937 019	80	*	Water Shrew
9.8.	Liverton, Mill Beck	NZ 701 154	100	-	Water Shrew
9.8.	Staithes, Easington Beck	NZ 770 181	10	*	Water Shrew
9.8.	Newton Mulgrave	NZ 789 157	70	*	Terrestrial Shrew
9.8.	West Barnby, East Row Beck	NZ 821 112	70	*	-
9.8.	Scaling, Boghouse Beck	NZ 741 119	180	*	-
17.9.	Goathland, West Beck	NZ 814 004	130	*	Water Shrew
17.9.	Glaisdale,	NZ 786 062	80	*	Terrestrial Shrew
17.9	Great Fryup Dale	NZ 729047	140	*	Terrestrial Shrew
17.9.	Danby Dale	NZ 693 060	170	*	Water Shrew
17.9.	Westerdale	NZ 663 061	150	*	Rodent
19.9.	Ingleby Greenhow	NZ 581 063	120	*	
19.9	Seave Green, Bilsdale	NZ 563 003	165	*	Rodent
19.9	Raisdale	NZ 540 006	185	*	-
19.9	Kildale, New Row (S)	NZ 614 102	170	*	Rodent
24.9	Great Broughton (S)	NZ 556 069	85	-	-

Key: (S) – Still water NP – North York Moors National Park

Details of scats obtained in blowfly pupae baited tubes, North East Yorkshire, 2004 & 2005
Table 1

Site B-Between Church House & Lumley House-NZ 693 060

Position	**1**	**2**	**3**	**4**	**Total**
3)12 July - 26 July	1	F	3 & F	4 & F	8 & F
4) 26 July – 8 Aug	3 & F	F	1 & F	0	4 & F
5) 8 Aug – 26 Aug	2	2 & F	1	0	5 & F
6) 26 Aug – 7 Sept	1	2	F	F	3 & F
7) 7 Sept – 19 Sept	2 & F	1 & F	1 & F	0	4 & F
8) 19 Sept – 1 Oct	0	3 & F	1 & F	2 & F	6 & F
9) 1 Oct – 15 Oct	2	5 & F	3 & F	1	11 & F
					41 & F

Site C-Stormy Hall Bridge NZ 693 045

Position	1	2	3	4	Total
3)12 July - 26 July	0	0	0	0	0
4) 26 July – 8 Aug	X	1	X	0	1
5) 8 Aug – 26 Aug	0	X	X	X	0
6)26 Aug – 7 Sept	3	X	5	X	8
7) 7 Sept – 19 Sept	0	2	3	0	5
8) 19 Sept – 1 Oct	5 & F	0	2 & F	1	7 & F
9) 1 Oct – 15 Oct	0	F	1 & F	2 & F	3 & F
					24 & F

Site D-Honey Bee Nest Farm-NZ 690 034

Position	1	2	3	4	Total
3)12 July - 26 July	0	0	F	F	F
4) 26 July – 8 Aug	X	0	0	0	0
5) 8 Aug – 26 Aug	F	X	X	0	F
6)26 Aug – 7 Sept	X	X	X	0	0
7) 7 Sept – 19 Sept	1 & F	2 & F	2 & F	3 & F	8 & F
8) 19 Sept – 1 Oct	2 & F	1 & F	1 & F	1 & F	5 & F
9) 1 Oct – 15 Oct	3 & F	2 & F	3 & F	2 & F	10 & F
					23 & F

Site E Pond – Head of Dale-NZ 692 025

Position	1	2	3	4	Total
3)12 July - 26 July	0	0	X	0	0
4) 26 July – 8 Aug	F	F	0	0	F
5) 8 Aug – 26 Aug	1	0	F	0	1 & F
6)26 Aug – 7 Sept	F	0	1	0	1 & F
7) 7 Sept – 19 Sept	0	0	0	0	0
8) 19 Sept – 1 Oct	3 & F	F	F	1 & F	4 & F
9) 1 Oct – 15 Oct	F	0	0	1	1 & F
					7 & F

Site F-Beck– Head of Dale-NZ 693 025

Position	1	2	3	4	Total
3)12 July - 26 July	0	1	0	0	1
4) 26 July – 8 Aug	1	X	F	0	1
5) 8 Aug – 26 Aug	1	X	F	1 & F	2 & F
#6)26 Aug – 7 Sept	X	0	X	3 & F	3 & F
7) 7 Sept – 19 Sept	1	0	F	1	2 & F
8) 19 Sept – 1 Oct	3 & F	2	3	1	9 & F
9) 1 Oct – 15 Oct	3 & F	0	F	0	3 & F
					21 & F

Key : F – Significant Fragment
X - Tubes Lost/Inundated

Numbers of Water Shrew Scats taken at Five Sites in Danby Dale, North Yorkshire, 2006-Table 2

Site/Sample No.	B/5	B/6	B1/7	B2/7	B3/7	B8	B9	B9		C/6	C/7	C/8	C/9		D4/5	D/8	D/9		E/6	E/8	E/9		F1/5	F/6	F/7	F/8
Terrestrial Prey																										
Coleoptera adults (beetles)	X					X	X	X		X		X					X		X	X				X		
Coleoptera larvae (beetle larvae)												X														
Formicidae (ants)										X																
Other Hymenoptera	X	X								X																
Heteroptera (bugs)													X													
Lithobiomorpha (centipedes)	X																									
Diplopoda (millipedes)	X X	X					X	X		X X	X X		X		X	XX	XX		X	X X	X X		XX	X	X X	X X
Isopoda (woodlice)		X X	X	XX	XX	X X	X	X			X		X											X		
Araneae (spiders)	X				X	X													X	X			X	X	X	X
Opiliones (harvestmen)	X											X					X		X				X			
Acarina (mites)	X																									
Lumbricidae (earthworms)	X	X		X												X	X									
Terrestrial/Aquatic Prey ?																										
Gastropoda (snails)	X				X	X		X											X	X						
Aquatic Prey																										
Tricoptera larvae (caddis)	X																X									
Asellus (water slaters)	X		X					X				X														

Water Shrew Scat Analysis – Danby Dale – 2006 -Table 3

Key: X – Present XX- Present in Large Quantities

	Rainfall Mm	pH	Site E pH an Range	Site F pH Mean Range
March	115	5.1	6.0	3.9
		3.7-6.6	5.3-6.7	3.7-4.2
April	51	5.7	6.3	3.8
5.1-6.9		6.0-6.6	3.8-3.9	
May	126	5.0	6.5	4.0
		4.0-6.4	6.1-6.7	3.9-4.2
June	20	6.3	6.6	4.7
		5.9-6.6	6.6-6.7	4.5-4.9
July	39	6.3	6.9	5.4
		5.8-6.9	6.9 6.7	5.2-5.5
August	173	5.4	6.7	3.9
		4.1-6.4	6.2-7.1	3.6-4.1
September	55	5.5	6.2	3.9
		4.8-6.1	5.4-6.7	3.4-4.2
October	73	6.0	6.5	4.0
		5.4-6.3	6.1-6.8	3.9-4.1

Rainfall and pH Values Measured at the Pond (Site E) and Danby Beck (Site F) at the Head of Danby Dale, 2006-Table 4