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Monitoring populations of *Anisus vorticulus* (the little whirlpool ramshorn snail) in West Sussex

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Monitoring populations of *Anisus vorticulus* (the little whirlpool ramshorn snail) in West Sussex (May-November 1998)

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Contents

1. Background

Anisus vorticulus is a rare (RDB category 2: vulnerable) water snail and one appearing on the U.K. Biodiversity Priority Species List (Anon, 1995 & Anon., 1998). It lives in the clean, often calcareous water, of well vegetated marsh drains, in association with a rich assemblage of other aquatic invertebrates which often includes RDB molluscs such as *Segmentina nitida, Valvata macrostoma* and *Pisidium pseudosphaerium*. The Species Action Plans for *Anisus vorticulus* calls for research into the precise distribution and ecology of the species (Anon, 1995; Willing, 1997). This survey follows on from two previous studies:

- In 1996 (Killeen & Willing, 1997) a fairly brief ditch survey of Amberley Wildbrooks was undertaken in August/September as part of a national survey of the status of *Anisus vorticulus* and another rare water snail, *Segmentina nitida* .

- In 1997 (Willing & Killeen, 1998) a more detailed *Anisus vorticulus* survey was undertaken on Amberley Wildbrooks and other areas of the Arun Valley together with monthly population monitoring at two Amberley ditches for a 5 month period (parallel survey and monitoring work was also undertaken in areas of Suffolk and Norfolk).

This study monitored population changes of the snail on an approximately monthly basis from May - November 1998 in a single ditch at both Amberley Wildbrooks and Pulborough Brooks. Ditches were studied at each location because although they are relatively close together (3km apart) these two areas are isolated from each other.

The study has sought to:

- undertake monthly population counts of *Anisus vorticulus* from May - October using survey techniques identical to those of the 1997 survey;

- remove samples of *A. vorticulus* for biometric analysis;

- record the abundance of all other Mollusca recovered during the survey process;

- measure other environmental factors including monitoring ditch dimensions, maximum water depth and depth where samples were taken; water hardness/pH and the vegetation structure and identification of dominant/frequent plants.

2. Summary

2.1 1998 populations of *Anisus vorticulus* in the Amberley monitoring ditch show some early season similarities with the 1997 results, but significant differences throughout the rest of the monitoring programme. Thus:

- Both years produced low numbers of snails in June with the lowest counts seemingly as a result of adult mortality, in July.

- The 1997 August population increase of juvenile snails was also apparent in 1998.

- Population counts in the 1998 September - early November period produced fewer snails than in 1997.

The apparent lack of mortality in the Amberley monitoring ditch between late Autumn 1997 and May 1998 may indicate that:

- *either* further breeding had occurred in the October - May period (which would disprove the suggestion made following last years survey, that breeding occurs annually in late Spring/early Summer.

- *or* sampling procedures used, in some way fail to represent the actual population changes in the ditches.

The seemingly low breeding success in the Amberley ditch is tentatively suggested, in the absence of any ditch management, to be due to either partial ditch shading, lower summer temperature or a combination of both factors.

2.2 The Pulborough population, which started the monitoring season with larger number of snails than were found at Amberley, showed a fall in July but, unlike Amberley, a sharp rise in numbers in the period August - September. As with Amberley, the final early November count showed a sharp fall in snail numbers. When compared to the Amberley populations those at Pulborough also differed in that:

- throughout the monitoring period numbers of snails and mean shell diameters were greater, suggesting more favourable conditions in the Pulborough ditch;

- adult and young snails co-exist during July and August;

- there appeared to be a very rapid growth rate of at least some snails between June and July;

- the presence of many small snails < 1.5 mm between July - September implies a staggered breeding period.

2.3 Difficulty in separating some overwintering snails from the fastest grown new recruits to the population made the calculation of snail growth rates from the 1998 Pulborough data problemmatic.

3. Methods

Two monitoring ditches selected for this study were those found to support the largest populations of *Anisus vorticulus* during the 1997 survey. These were Amberley Ditch 5, (Fig. 1) which was also one of the 1997 monitoring ditches and Ditch 28 (Fig. 2) from Pulborough.

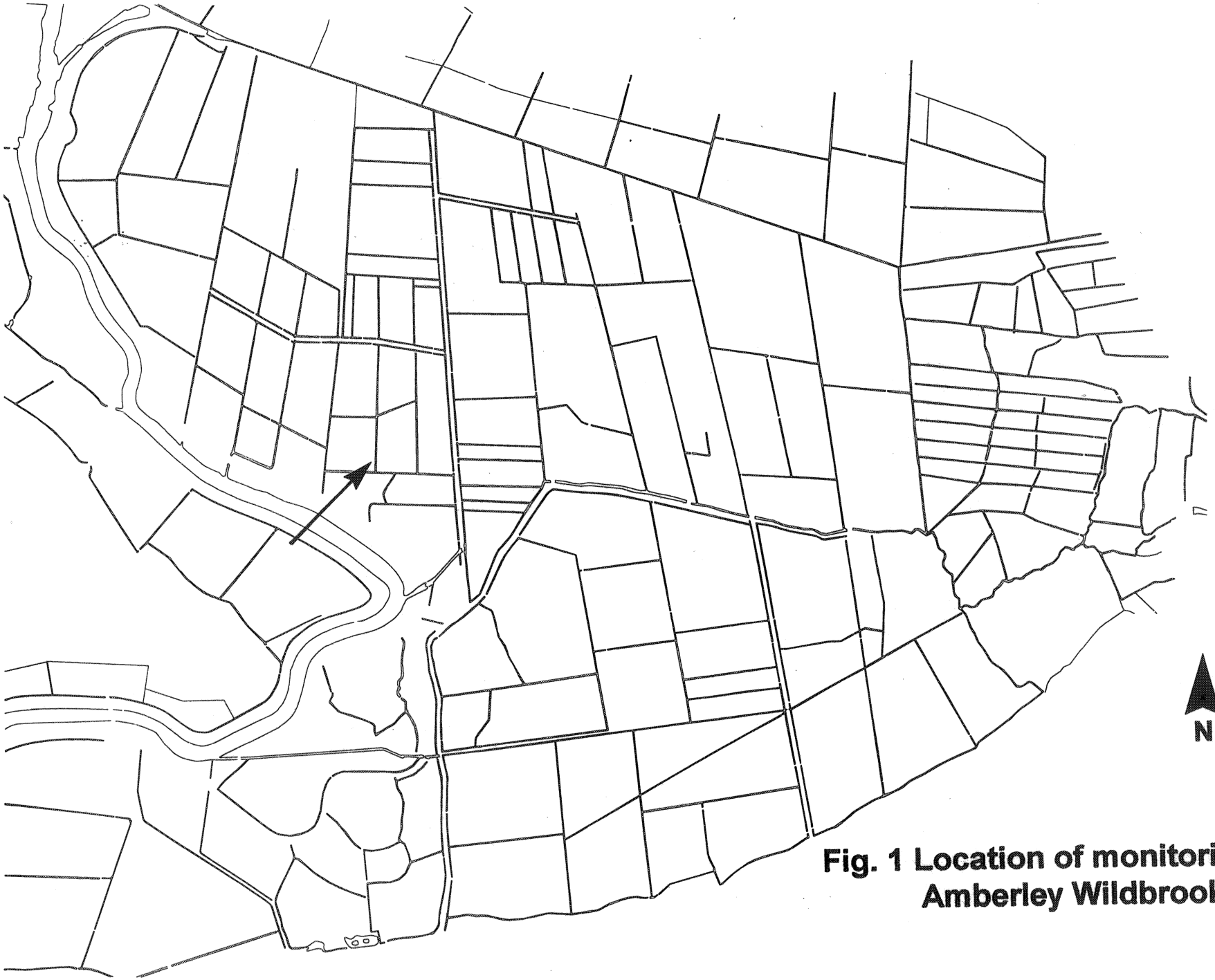


Fig. 1 Location of monitoring ditch Amberley Wildbrooks

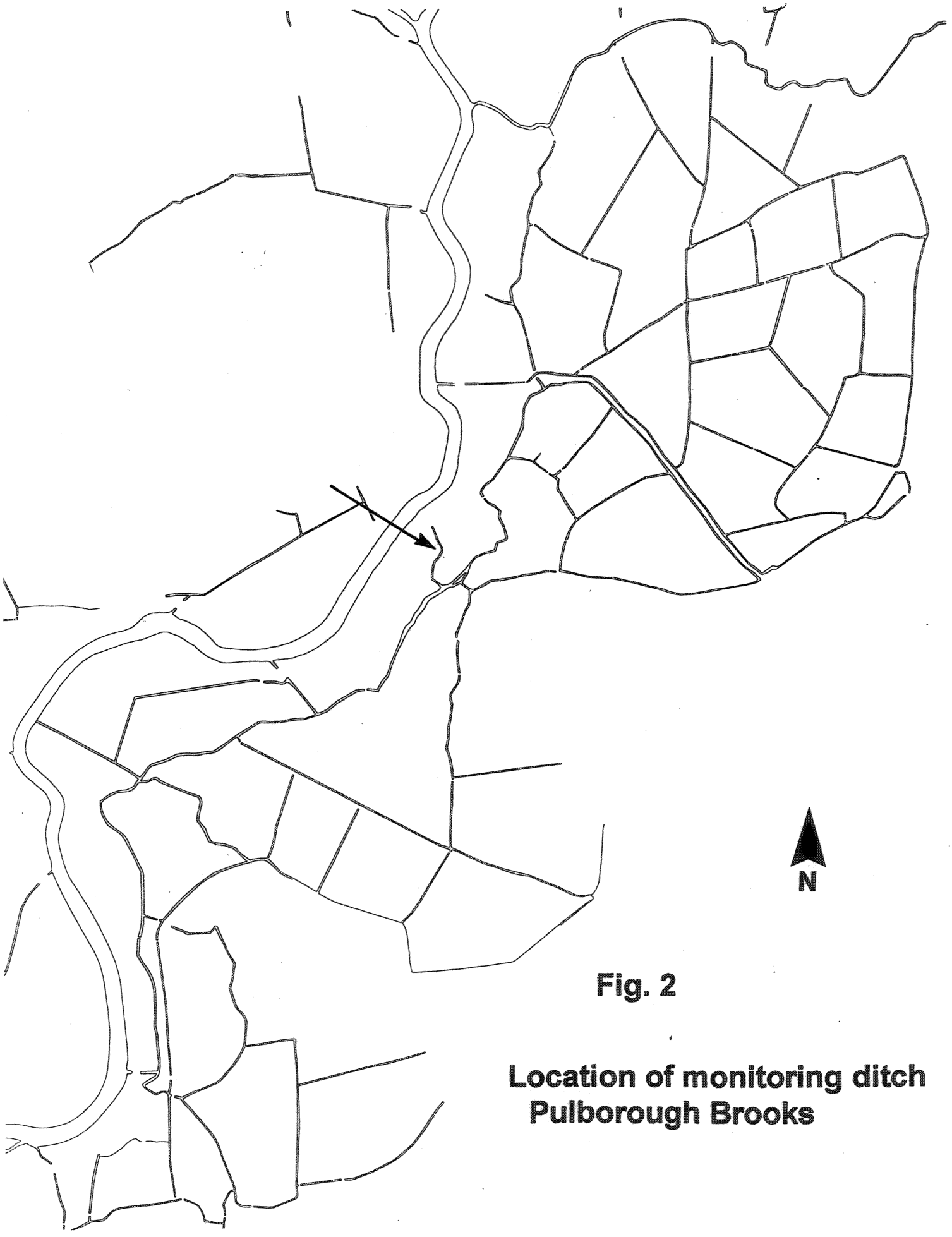


Fig. 2

Location of monitoring ditch Pulborough Brooks

Freshwater areas were sampled using a telescopic pole-mounted, 17 cm diameter sieve with a 0.5mm mesh. This was used to sweep areas of the water body near to the surface, in mid-water and close to the bottom to include all parts of the ditch. A standard technique was adopted that had been used in the previous surveys work at Amberley and the Arun Valley (Killeen & Willing, 1997; Willing & Killeen, 1998). This employed ten net-sweeps per site to allow approximately quantitative comparisons of mollusc populations to be made between sites. In order to recover all small species and juveniles, 'bulk samples' of aquatic vegetation and ditch sediments were removed from each site for later laboratory extraction through sieves. This involved washing vegetation and sediments to retain all molluscan remains > 0.5mm. Residues were examined on gridded white trays and smaller samples inspected microscopically using an Olympus x10 - x40 binocular microscope.

Species recovered from aquatic samples have been recorded in abundance classes thus:

R=	*rare*	(1 - 5 specimens recovered)
O =	*occasional*	(6 -15 specimens recovered)
F =	*frequent*	(16 - 50 specimens recovered)
C =	*common*	(51 - 100 specimens recovered)
A =	*abundant*	(> 101 specimens recovered)

At each sampling site, ditch dimensions (width and approximate maximum depth at the sampling point) were recorded together with dominant macrophytic and marginal vegetation, the physical nature of ditch margins, and adjacent land use. The pH, was measured using a portable meter whilst approximate water hardness was estimated using Merke 'Merkoquant Gesamthärte-Test' analytical test strips. The management of the ditches has been given as estimates following ditch observation as well as the 'management regime' suggested by the local farmers or land mangers. All sampling sites were also photographed on 35mm Fujichrome ASA 100 colour slide film.

The maximum diameter of each recovered *Anisus vorticulus* shell was measured using fine vernier callipers. The accuracy and repeatability of this technique was checked by re-measuring a selection of shells using a microscope with a calibrated slide and eyepiece graticule.

4. Results & discussion

4.1 Mollusca in monitoring ditches

Monthly results of all Mollusca recovered from the Amberley and Pulborough are displayed in Appendix Tables 1 and 2.

At Amberley a total of 17 species were found throughout the survey. Of these 9 were also recorded in the monitiring Ditch 5 in 1997. A further 8 species were also recovered and these included *Valvata piscinalis, Lymnaea stagnalis, Hippeutis complanatus, Planorbarius corneus, Pisidium obtusale, P. milium, P. pulchellum* and *P. nitidum*. All of these species, which often occurred in low numbers, were found in 1997 in neighbouring ditches.

The Pulborough monitoring ditch had 9 species in common with the October 1997 survey. A further 8 were found during the 1998 programme and these included *Bithynia tentaculata, Lymnaea stagnalis, Acroloxus lacustris, Pisidium obtusale, P. milium, P. hibernicum* and *P.nitidum*. All of these species are found elsewhere on Pulborough Brooks.

4.2 Plants

Appendix table 6 lists the dominant plants recorded in the monitoring ditches in August 1998. As would be expected the Amberley ditch flora was very similar to last year with many species being found in both surveys.

It is not possible to compare the Pulborough floras with summer 1997 data as this ditch was not studied in that year until late October.

4.3 Ditch pH, hardness

The water in the Amberley ditch was (in common with 1997 readings) mostly rather softer and with a lower mean pH than that at Pulborough. The lowered water hardness at both Amberley and Pulborough on 8.11.98. is thought to be due to heavy rain inflow at the time of sampling.

4.4 Ditch dimensions and management

In both monitoring ditches the dimensions and management were the same as last year as neither ditch had been managed since the 1997 survey. The accumulation of unconsolidated organic sediments at the bottom of both ditches means that depth data is only approximate.

4.5 Comparison of Amberley Ditch 5 populations with 1997 results

Appendix tables 3 and 4 give the monitoring data for the Amberley and Pulborough ditches whilst Figures 3 and 4 display numbers of snails within 0.5mm size clsses.

Appendix Table 5 compares summary statistics for the Amberley and Pulborough monitoring ditches.

No comparisons are possible for the May sample from Ditch 5 as this ditch was not sampled during May 1997. Amberley Ditch 1 was however studied in 1997 when only 2 *A. vorticulus* were recovered (of 2 & 2.7 mm diameter) whereas Ditch 5 at this time in 1998 produced 50 individuals ranging in diameter (D) from 2.2 - 4mm.

In June of both years Ditch 5 produced low numbers 9 (mean D 3.9mm) and 12 specimens (mean D 3.8mm) from 1997 & 1998 respectively. July produced the lowest counts in both monitoring years, with 6 snails in 1997 and only one in 1998. August shows differences between the two years with 87 (mean D 1.65mm) specimens being recorded in 1997, but only 5 (mean D 1.6mm) in 1998. These differences between the two years are maintained throughout the September to early November period with considerably larger numbers of snails being recovered in 1997, 303 in September (mean D 2.18mm) and 46 in late October (mean D 2.19mm) compared to 11 (mean D 1.58mm) in September 1998 and 2 (mean D 1.85mm) in early November of 1998.

These results broadly reflect the population cycle suggested for the 1997 period with maturing (and possibly over-wintering) adult snails being recorded in May and June followed by adult mortality in July. The appearance of much smaller snails in August and September implies that breeding, possibly over a staggered period, had occurred.

Figure 3: Numbers & size classes of Anisus vorticulus recovered in Amberley monitoring ditch, May - Nov 1998

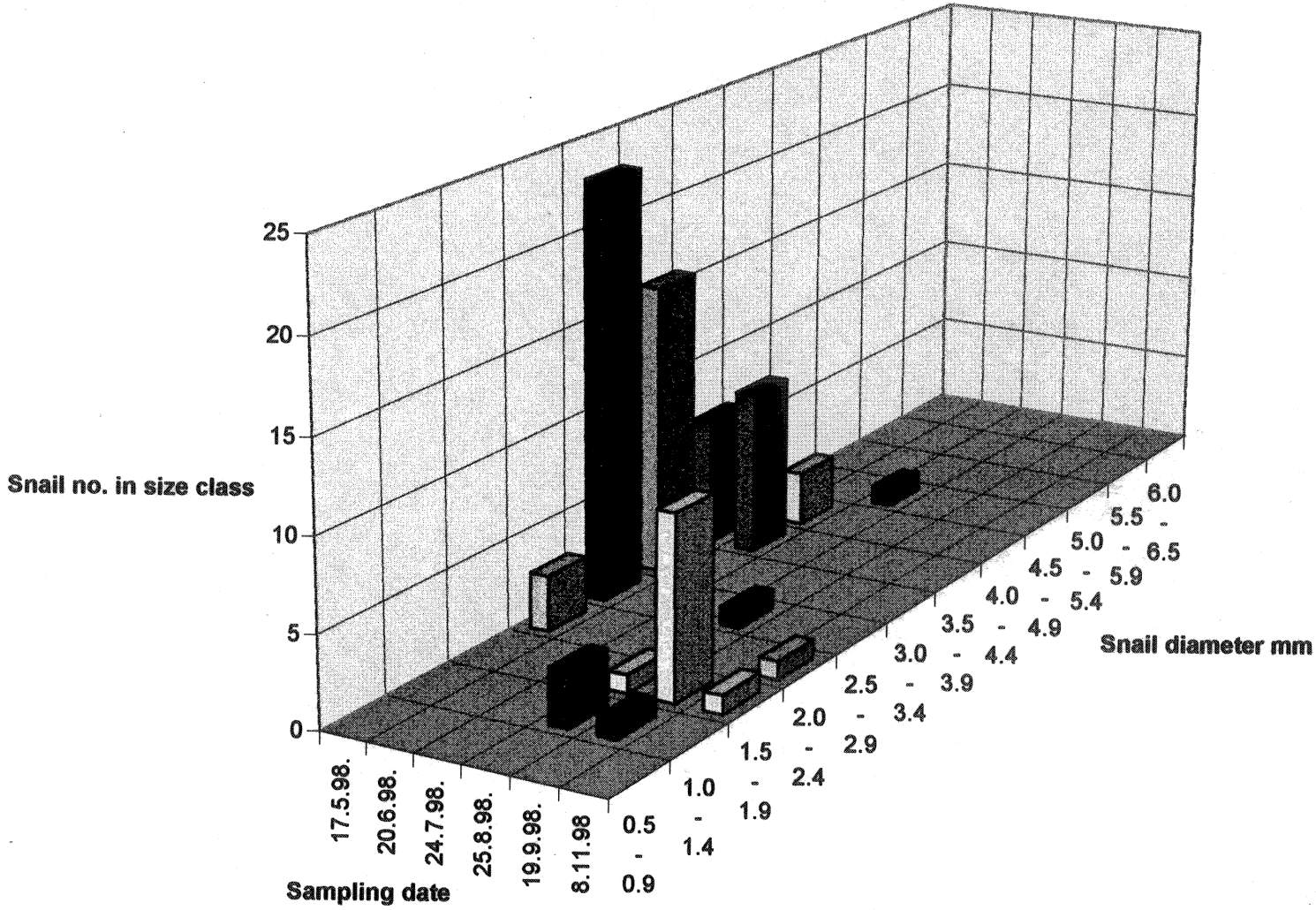
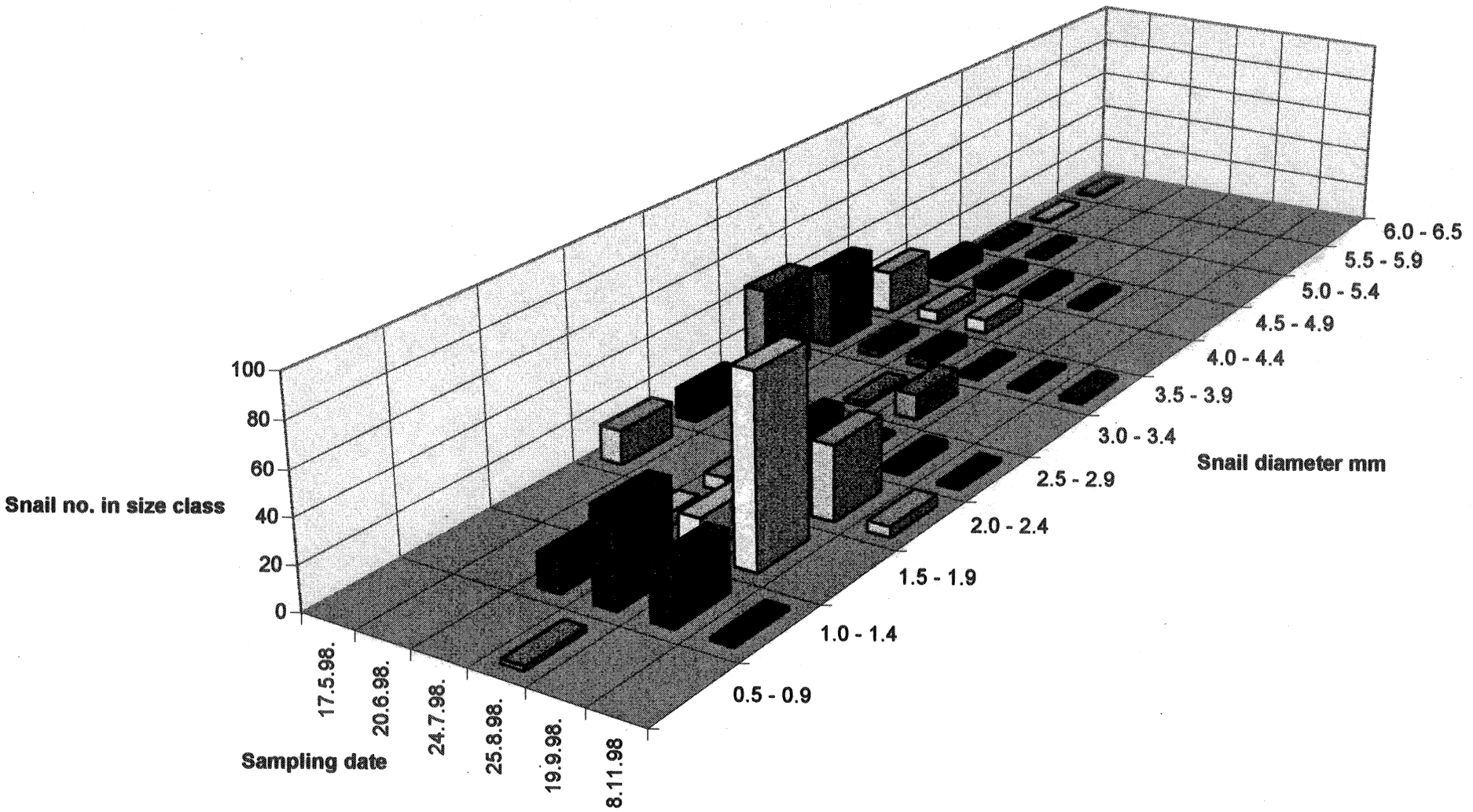


Figure 4: Numbers and size classes of Anisus vorticulus recovered in Pulborough monitoring ditch, May - Nov 1998.



It is not clear why, in comparison to 1997, the 1998 numbers of snails were so much lower and the mean diameter smaller in the August - November period in 1998. Ditch 5 had not been disturbed since the previous year and the frequent - dominant plants were similar. Possible differences between the two years were:

- 1998 was a cooler and wetter Summer. However climatic differences equally affected the Pulborough Brooks ditches in this period and the monitoring Ditch 28 did not show lower populations at this time.

- In 1997 both sides of ditch 5 were grazed and consequently there was little shading bankside vegetation. In 1998, although the western bank was cattle grazed the eastern side was not, the field being left for hay, which was not cut until early Autumn. The partial over shading of this small ditch may have been sufficient to lower water temperature or produce some other effect to the detriment of the snail.

If the annual population cycle hypothesis (Willing & Killeen, 1998) is correct then a fall would be expected in the *A. vorticulus* population size in Ditch 5 between the monitoring sample of late October 1997 and that of May 1998. Unusually the data shows no apparent decline, with 46 snails taken on 29.10.97. compared to 50 in the 17.5.98. It is, of course, most unlikely that there would be no mortality in this sixth month period. Possible reasons for this apparent anomaly include:

- The sampling routine and net size currently employed is not removing a sufficiently large *A. vorticulus* sample to accurately represent the population at any one sampling time.

- Snails in the late season are somehow under represented in the sampling (e.g. occupying locations in the ditches such as the bottom sediments).

- There is further breeding at some point between late October and May.

4.6 Comparison of Amberley Ditch 5 with Pulborough Brooks Ditch 28

The largest monthly population total was found in May in the Amberley ditch, with 50 specimens, whereas the Pulborough ditch yielded 148 *A. vorticulus*, nearly three times this number. The Pulborogh mean D size was also greater at 3.5mm as compared with 3.01mm at Amberley. Pulborough produced some particularly large specimens with one shell reaching 6mm in diameter (Macan, 1977 & Janus, 1982 both give the maximum diameter of *A. vorticulus* as 3.5 - 5mm).

June saw an increase in the mean D in both ditches with the Amberley population reaching 3.8mm and Pulborough 4.2mm. Both areas also showed large population falls to 15 and 12 snails for Amberley and Pulborough respectively with the latter area experiencing the greatest reduction from the previous month. These falls are presumed to be due to the death of overwintering adults.

July only produced a single mature snail (D 4.6mm) at Amberley whereas by contrast Pulborough had 53 snails. This number included a broad spread of sizes ranging from D 1 - 4.8mm. This is almost certainly a mixture of mature and young shells. What is less clear is which are the juveniles in the population. The population almost appears to be trimodal (Fig 4 & Apppendix Table 4) with a cluster of 21 undoubtedly young snails in the 1 - 1.8mm range, a middle size 'band' of 15 snails ranging between D 2.2 - 2.9mm and a further 17 snails ranging between D 3.3 - 4.9mm. The middle sized snails are puzzling. If these are new recruits to the population from the previous

month then they have grown to half sized individuals in only one month. Due to the uncertainty of being able to separate old snails from young additions to the population, it is not possible to calculate meaningful growth rates for the Pulborough snails using the current data.

Comparisons between Amberley and Pulborough samples continue to be difficult to make in the period August to late October/early November chiefly because of the low population numbers from the Amberley ditch. In August the Amberley population consists of only 5 snails (mean D 1.6mm) compared to 91 from Pulborough of a marginally greater size (mean D 1.7mm). The Pulborough population also includes a batch of slightly larger snails (D 3 - 3.6mm). It is unclear if these are 'new season' snails that had grown from the young of July or older 'last season' individuals. The absence of middle sized snails of this size suggests that they are in fact younger snails, as does their appearance which does not have the encrusted and often corroded appearance of the early season (May) adults.

September also has a low number of snails from Amberley (11, mean D 1.58mm) compared to the largest population taken from Pulborough of 153 individuals (mean D 1.75mm). The numbers of young appearing at Pulborough in July and increasing steadily to September may indicate a staggered breeding period, a suggestion that was made for the Amberley populations in 1997.

The early November samples show major population falls at both Amberley and Pulborough with counts of 2 (mean 1.85mm) and 9 (mean 2.5mm) snails respectively. If these low counts are the basis for the 1999 populations then one would expect even lower counts in the spring. If this is not the case then, as discussed in 5.3 above, then either these low late autumn counts are, (a) in some way unrepresentative of the *A. vorticulus* population at this time or (b) further breeding occurs between this late Autumn period and the following May. In order to resolve these uncertainties sampling needs to be maintained in both monitoring ditches at 4 - 6 weekly intervals between November 1998 and May 1999.

5. Recommendations

5.1 Monitoring will continue at approximately 6-weekly intervals from the end of the EN monitoring programme until May 1999 in order to complete an unbroken 'monitoring year'. This should possibly detect:

- if further breeding occurs
- if the predicted low population levels materialise in May 1999.

5.2 A further year of monitoring the survey ditches at Amberley and Pulborough should help to clarify differences between the 1997 and 1998 surveys. A larger net size is suggested in order to recover larger, possible more reliable, sample sizes (using professional 25 X 25cm square frame net).

5.3 In October 1998 monitoring Ditch 1 from the 1997 survey was totally cleared of weed and sediments (unfortunately this clearance did not occur in short sections as recommended in the 1997 report). This unfortunate incident provides an ideal opportunity to assess the ability of *Anisus vorticulus* to re-establish itself in a formerly occupied ditch in the post-clearance period.

5.4 A further general survey of ditch systems (a) along the Arun to Wisborough Green and (b) along the lower parts of the River Rother (which joins the Arun at Pulborough) would establish the upstream limits of distribution in the Arun corridor.

5.5 Casual investigation of a few Pulborough Brooks ditches in June 1998 located a further two *Anisus vorticulus* occupied ditches. Proposals to convert the northern parts of this SSSI from grazing marsh to reedbed means that the full distribution of the snail in the area needs to be established. This would provide base-line data for later environmental impact assessment of land management changes on the Brooks.

5.6 Alisa Watson, a Ph.D. student studying the autecology of *Anisus vorticulus* and *Segmentina nitida* needs to be taken to the Arun Valley sites to assist in the choice of study ditches.

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7. Acknowledgements

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Manager, is to be thanked for permission to visit the reserve and for his interest in the project. Useful discussions were also held with Francis Abraham and Simon Allen.

8. Appendices

Appendix Table 1 Amberley Wildbrooks, Amberley, West Sussex
Field Survey Conducted: May - November 1998

	Field sampling dates					
	17.5.98	**20.6.98**	**24.7.98**	**25.8.98**	**19.9.98**	**8.11.98**
Valvata cristata	C	F	O	F	O	F
Valvata piscinalis	R	R				
Bithynia tentaculata	C	C	F	C	A	
Physa fontinalis		R	O	R	R	R
Lymnaea palustris			R		R	
Lymnaea stagnalis		R			R	
Lymnaea peregra	R	R	R	O	O	R
Planorbis planorbis	O	O	O	F	F	O
Anisus vortex	R	R	R	O	O	R
Anisus vorticulus (+ snail no.)	F(50)	O(12)	R(1)	R(1)	O(11)	R(2)
Hippeutis complanatus	O	A	O			
Planorbarius corneus				R	R	
Sphaerium corneum	O	C	O	O	O	O
Pisidium obtusale	O	O	O			
Pisidium milium	O	O	R	R	R	
Pisidium pulchellum						R
Pisidium pseudosphaerium	C	F	F	C	F	O
Pisidium nitidum	R?			R	R	
TOTAL SPECIES NUMBER	13	14	13	12	14	9

Abundance Scale: A = 100+, C = 51 - 100, F = 16 - 50, O = 6 - 15, R = 1 - 5.

Appendix Table 2 Pulborough Brooks, West Sussex
Field Survey Conducted: May - November 1998

	Field sampling dates					
	17.5.98	20.6.98	24.7.98	25.8.98	19.9.98	8.11.98
Valvata cristata	F	O	R	F	F	O
Bithynia tentaculata	O		F	F	F	R
Physa fontinalis	R	O		R		
Lymnaea palustris			R	R	O	O
Lymnaea stagnalis				R		
Lymnaea peregra	R		R	O	O	
Planorbis carinatus/planorbis	O	R	O	O	O	R
Anisus leucostoma						
Anisus vortex	O	R	O	F	O	R
Anisus vorticulus (+ snail no.)	A(148)	O(15)	C(53)	C(91)	A(153)	O(9)
Hippeutis complanatus	O	R	R			R
Acroloxus lacustris	R	O	R		O	R
Sphaerium corneum	F	R	R	F	F	O
Pisidium obtusale	R			R	R	R
Pisidium hibernicum				R?		
Pisidium milium	O			R	R	
Pisidium pseudosphaerium	C	O	F	F	O	O
Pisidium nitidum	R?		R?	R		
TOTAL SPECIES NUMBER	14	9	12	15	12	11

Abundance Scale: A = 100+, C = 51 - 100, F = 16 - 50, O = 6 - 15, R = 1 - 5.

Appendix Table 3 ***Anisus vorticulus*** **- monthly population monitoring (shell counts per monthly sample): Amberley Ditch**

	Sampling date					
size mm	17.5.98	20.6.98	24.7.98	25.8.98	19.9.98	8.11.98
0.8						
0.9						
1.0				1		
1.1						
1.2						
1.3				1		
1.4				1	1	
1.5				1	2	
1.6					7	
1.7						1
1.8					1	
1.9						
2.0						1
2.1						
2.2	1					
2.3	1					
2.4	1					
2.5	2					
2.6	4					
2.7	6					
2.8	10			1		
2.9	1					
3.0	5					
3.1	2					
3.2	1					
3.3	6					
3.4	2					
3.5	1					
3.6	1	3				
3.7	1	3				
3.8	3	2				
3.9	1	1				
4.0	1	1				
4.1		2				
4.2						
4.3						

	Sampling date					
size mm	**17.5.98**	**20.6.98**	**24.7.98**	**25.8.98**	**19.9.98**	**8.11.98**
4.4						
4.5						
4.6			1			
4.7						
4.8						
4.9						
5.0						
5.1						
5.2						
5.3						
5.4						
5.5						
5.6						
5.7						
5.8						
5.9						
6.0						
TOTAL	**50**	**12**	**1**	**5**	**11**	**2**

Appendix Table 4 *Anisus vorticulus* - monthly population monitoring (shell counts per monthly sample): Pulborough Ditch

	Sampling date					
size mm	17.5.98	20.6.98	24.7.98	25.8.98	19.9.98	8.11.98
0.8						
0.9				2		
1.0			2	13	1	
1.1			2	8	5	
1.2			4	6	6	
1.3			2	12	11	
1.4			5	4	4	1
1.5			1	7	19	
1.6			1	5	13	
1.7			3	1	15	
1.8			1	1	23	
1.9				3	17	
2.0	2			5	19	1
2.1				2	3	2
2.2	3		3	5	5	
2.3	5			1	5	2
2.4	6		4	1	3	
2.5	1		3	1		
2.6	5		2		2	
2.7	2		1		1	1
2.8	4		1			
2.9	2		1			
3.0	14			8		
3.1	3			1		
3.2	9			1		
3.3	9		1	1		
3.4	11		1	1		
3.5	7	2	1			
3.6	12		2	1		1
3.7	4	1				
3.8	9		2			
3.9	6	1			1	1
4.0	4	1	2			
4.1	2	2	1			
4.2	3	2	1			
4.3	6		2			

	Sampling date					
size mm	**17.5.98**	**20.6.98**	**24.7.98**	**25.8.98**	**19.9.98**	**8.11.98**
4.4	6	1	1			
4.5	4	3	1			
4.6	1					
4.7	1		1	1		
4.8	1	1				
4.9	1		1			
5.0	2	1				
5.1						
5.2						
5.3						
5.4	1					
5.5						
5.6	1					
5.7						
5.8						
5.9						
6.0	1					
TOTAL	**148**	**15**	**53**	**91**	**153**	**9**

Appendix Table 5 Summary of comparitive statistics for Amberley and Pulborough monitoring ditches 1998

	17.5.98	20.6.98	24.7.98	25.8.98	19.9.98	8.11.98
Amberley Ditch						
snail total	50	12	1	5	11	2
mean diameter mm	3.01	3.8	4.6	1.6	1.58	1.85
range mm	1.8	0.5	0	1.8	0.4	0.3
minimum mm	2.2	3.6	4.6	1	1.4	1.7
maximum mm	4	4.1	4.6	2.8	1.8	2
standard deviation	0.44	0.19	n/a	0.7	0.1	0.21
Pulborough Ditch						
snail total	148	15	53	91	153	9
mean diameter mm	3.5	4.2	2.5	1.7	1.75	2.5
range mm	4	1.5	3.9	3.8	2.8	2.5
minimum mm	2	3.5	1	0.9	1	1.4
maximum mm	6	5	4.9	4.7	3.8	3.9
standard deviation	0.74	0.44	1.17	0.77	0.37	0.8

Appendix Table 6 Dominant plants recorded in Amberley & Pulborough Monitoring Ditches August 1998

Emergent Plants	Amberley	Pulborough
Berula erecta	✓	
Carex riparia		✓
Equisetum fluviatile	✓	✓
Filipendula ulmaria	✓	
Glyceria maxima	✓	✓
Hydrocharis morus-ranae	✓	✓
Juncus effusus		✓
Myosotis scorpioides	✓	
Phalaris arundinacea	✓	
Sagittaria sagittifolia	✓	
Submerged & floating plants		
Elodea nuttalli	✓	
Lemna minor	✓	
Lemna trisulca		✓
Potamogeton acutifolia	✓	✓
Potamogeton lucens	✓	
Potamogeton natans		✓
Riccia fluitans	✓	✓
Spirodella polyrhiza	✓	

Appendix Table 7 Water hardness and pH in monitoring ditches

	17.5.98	20.6.98	24.7.98	25.8.98	19.9.98	8.11.98
Amberley pH	-*	-*	7.3	6.86	7.04	6.89
Amberley water hardness	1/5	1/5	1/5	1/5	1/5	0.5/5
Pulborough pH	-*	-*	7.1	7.28	7.14	7.26
Pulborough water hardness	1.5/5	1.5/5	1.5/5	2/5	1.5/5	0.5/5

* pH meter problems leading to unreliable & therefore discounted readings

Key to hardness strip readings: These measure the total dissolved salts in the water (mainly calcium and magnesium).

Strip score	Hardness (mg/l Ca CO3)	Water description
0/5	< 89	soft
1/5	89	medium soft
2/5	178	slightly soft
3/5	267	medium hard
4/5	356	hard
5/5	445	very hard

Appendix Table 8 Ditch dimensions at monitoring locations

Survey ditch	% macrophyte cover @ 25.8.98	Width x depth m & ditch margins	Ditch management cycle details (estimated)	Adjacent land use
Amberley Ditch	70 - 80%	1.3/0.5 slightly poached west bank	last cleared < 5 - 7 years	semi-improved cattle grazed grassland on west bank; hay meadow on east bank
Pulborough Ditch	90%	2.5 / 0.5 extensive poaching	last cleared > 5 - 7 years	semi-improved cattle grazed grassland