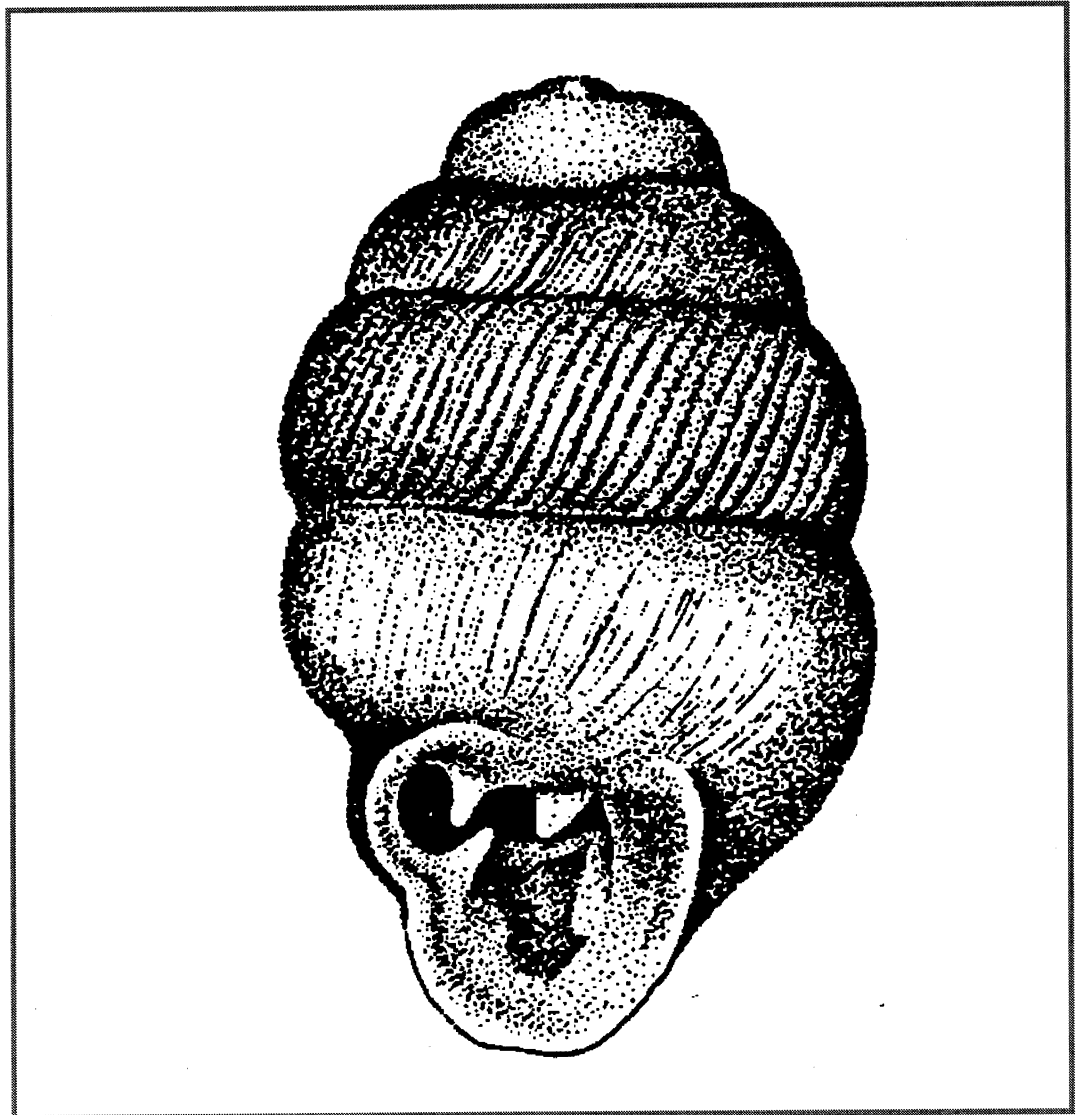


Survey of the terrestrial snail
Vertigo angustior at three sites in England
(Gait Barrows NNR, Flordon Common and Martlesham Creek)

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Pre-recovery Programme

**Survey for the terrestrial snail *Vertigo angustior* at
three sites in England (Gait Barrows NNR,
Flordon Common and Martlesham Creek)**

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1.0 SUMMARY

This survey has shown that *Vertigo angustior* is still living at the three sites investigated: Gait Barrows, Flordon Common and Martlesham Creek. These sites represent the three main habitat types supporting the species in Britain: limestone pavement, rich, marshy grassland and saltmarsh transition.

At Gait Barrows, *V. angustior* has a widespread, but patchy distribution on the western and central pavement areas. It lives amongst moss and litter in the transition zone between open pavement and areas of woodland/scrub dominated by yew, hazel and silver birch. The richest areas support population densities of greater than 1500 individuals/m².

The population at Flordon Common is restricted in extent and is confined to the northern part of the SSSI. The greatest densities of individuals (>900/m² in places) live in areas with *Iris pseudacorus* and other herbs, but are less common in closely grazed grassland.

The Martlesham Creek population of *V. angustior* is very small and restricted in area. It is confined to two small areas of *Iris pseudacorus* and *Carex riparia* in the transition zone between saltmarsh and a bracken covered slope, which cover an area of no more than 100m². The population density is very low compared with that at the other two sites, the richest areas supporting <120m².

Summary of recommendations:

Gait Barrows:

- Proceed with SAC designation
- Management of the site for the snail should focus on control and maintenance of the transition zone habitat.
- Initiate a monitoring scheme of selected areas on a rotational basis

Flordon Common:

- Management of the site for the snail should focus on control and maintenance of grazing; maintenance of ground water levels; control of scrub encroachment
- Initiate a monitoring scheme using permanent plots. It is recommended that a scheme similar to that used by Fowles & Hurford (1995) for Whiteford Burrows is employed:
- Future monitoring work should be combined with taking spot samples over a greater area to determine the precise distribution of *V. angustior* at the site.

Martlesham Creek:

- Responsibility for conservation and management of the site should be placed with the Suffolk Wildlife Trust.
- The height of the *Phalaris* grassland adjacent to the *V. angustior* rich areas should be controlled by cutting or by herbicide application on at least a biennial basis.
- The status of the snail is monitored by simple, restricted quantitative sampling.

Monitoring schemes for these, and other British sites should be coordinated and timed to obtain comparative data on the ecology and reproductive biology of the species.

2.0 BACKGROUND & OBJECTIVES

The whorl snail *Vertigo angustior* is in serious decline throughout its European range (Killeen 1996). It is classified in the British Red Data Book (Bratton 1991) as RDB1 (Endangered), it is listed on Annex II of the European Habitats & Species Directive, and is on the short list of the Biodiversity Action Plan (HMSO 1996). The BAP proposes that more detailed knowledge of the distribution of the snail within sites is needed to inform management; this is especially important on candidate SACs. A second objective proposed in the Biodiversity Action Plan is surveys of former and likely sites. An up-to-date knowledge of the occurrence of *V. angustior* on sites outside candidate SACs will form part of the obligation to report on favourable conservation status in Britain. There are eight known populations of *V. angustior* in Britain:

England	Gait Barrows, N. Lancs	(Marriot & Marriot 1982)
	Market Weston Fen, Suffolk	(Killeen 1992a & b)
	Martlesham Creek, Suffolk	(Killeen 1983)
	Fritton, Suffolk	(Killeen 1991; 1992a)
	Flordon Common, Norfolk	(Norris & Colville 1974)
Wales	Whiteford Burrows, Gower	(Preece & Willing 1984)
	Oxwich Bay, Gower	(Preece & Willing 1984)
Scotland	Whiteport	(Colville 1994)

Three of these sites: Gait Barrows, Market Weston Fen and Whiteford Burrows are candidate SACs. The Whiteford site has been the subject of trial monitoring for three years (Fowles & Hurford 1995; 1996 and Fowles in press).

This contract was issued to take forward the two BAP actions for *V. angustior* at three of the English sites: Gait Barrows, Flordon Common and Martlesham Creek. These were selected on the grounds they were considered the sites for which up-to-date information was most urgently required. Although Market Weston Fen is a candidate SAC, the most recent extensive survey (Killeen 1992b) revealed no specimens of *V. angustior*, thus the record is still based on one specimen. It was, therefore, considered that a detailed survey at this stage was not justified. The aims of the present survey were:

- To survey the three sites and estimate the population size at each site
- To describe the habitat at all three to clarify the conservation requirements of *V. angustior*
- To recommend management for each site
- To suggest monitoring protocols

This report presents the results of the survey. To facilitate use of this report, each site is treated separately with comparisons of the sites in the general discussion (section 5).

3.0 GENERAL METHODOLOGY

The sampling strategy and recording procedure were designed to provide information on the distribution, abundance and ecology of *Vertigo angustior* at each site. In order to provide baseline data and enable comparisons to be made, the methods used are similar to previous surveys and current monitoring projects (Fowles & Hurford 1995; 1996). At each site, sampling stations were selected mainly in the areas known to support the main density of the *V. angustior* population. Samples were collected quantitatively by use of a quadrat. In general, all of the dead vegetation, litter, moss etc from each quadrat was collected and taken away for analysis. Different size quadrats and slightly different sampling techniques were employed at the three sites and are described in the following sections on each site.

All of the samples were dried in the laboratory and passed over a graded stack of sieves. The residue was examined microscopically and all molluscs retained by a 0.5mm sieve were counted. Residue retained by a 0.3mm sieve was also checked for *Vertigo* apices. Live specimens of *Vertigo angustior* were recorded as adults and juveniles. Specimens with a developed lip and apertural teeth were counted as adults and all others as juveniles. All other snail species were also recorded quantitatively.

In order to obtain detailed information on the *Vertigo angustior* population structure at each site, the number of whorls of each juvenile were counted (see Kerney & Cameron 1979 for method) using a stereo microscope at x30 magnification. The specimens were assigned to half whorl size classes.

4.0 SITE SURVEYS

4.1 GAIT BARROWS

4.1.1 Previous studies

A brief survey carried out in 1990 (Colville 1991) indicated that *V. angustior* was confined to the transition zone at the north ends of the western and central pavements. There was an observed decline in abundance from previous years for which the die-back of yew was suggested as a possible cause. The distribution and ecology of *V. angustior* at Gait Barrows has been the subject of two University of Lancaster student projects Hooson (1985) and Coyle (1996). Both of these projects attempted to map the distribution of the snail within the main pavement areas and also to determine its bryophyte association. Coyle's work indicated that *V. angustior* was more widespread and abundant than previously understood.

4.1.2 Site description

Gait Barrows NNR, north Lancashire (Grid Ref. 479776) covers an area of 117 hectares and comprises an outstanding area of limestone pavement, with associated woodlands, ponds and fen. Of the three pavement areas, the eastern unit (C) and part of the western unit (A) have suffered from quarrying. However, much of the central unit (B) and the northern part of Pavement A are undamaged.

Both the pavement margins and open areas are characterised by dense zones or 'islands' of scrub. This scrub, or open woodland is dominated by yew, hazel, silver birch, and oak, with locally occurring juniper, holly and other shrubs. Maps of the western and central units showing the locations of the scrub areas were prepared by Hooson (1985) and Coyle (1996). These have been used for the present survey to select and locate the sampling stations (Figures 1 - 3).

4.1.3 Methods

For the purposes of this study, sampling was restricted mainly to the two areas of undamaged pavement: Western Pavement A and Central Pavement B. All samples were collected from the microhabitat considered likely to give the most productive results; i.e. the moss and leaf litter in the transition zone between scrub and open pavement. Sites were selected using the distribution maps given by Hooson (1985) and Coyle (1996) and from other suitable looking areas. On both Pavements A & B, ten areas of pavement margin or scrub 'islands' were chosen, many of which were initially checked for the presence of *V. angustior*. At each, three quantitative samples were collected. These were generally close together, but with a different aspect or vegetation cover.

In view of the fragile nature and limited extent of the transition zone, extensive quadrat sampling was considered to be unacceptably destructive. However, in order to obtain meaningful results for the baseline study, accurate quantitative sampling is essential. Coyle (1996) used quadrats measuring 0.25 x 0.25m, he collected his snails by field sieving only. This is subject to error, particularly as juveniles are likely to be missed.

For this survey, quadrats measuring 0.2 x 0.15m were used. All of the loose moss and litter was collected, but not the layer of soil on the pavement surface. The material was then dried and examined microscopically. Details of the dominant vegetation types in each quadrat are given in Tables 1 & 2 in the following pages. Maps showing locations of the sample stations are given in Figures 2 & 3. However, it was found that Coyle's (1996) map for the western pavement A was difficult to relate to in the field. Therefore, the approximate locations of the sampling stations are shown on the simple line drawing Figure 2. Photographs of sites are given in the Appendix. The fieldwork was carried out by Ian Killeen & Barry Colville on 17 & 18 October 1996.

4.1.4 Results

The quantitative analysis of the molluscs in each sample from Pavements A and B respectively are shown in Tables 4 & 5. These results show that *V. angustior* is widespread but patchily distributed in both the western and central pavements. Living individuals were recorded from 23 of the 30 quadrats on Pavement A and from 18 of the 30 quadrats on Pavement B. There are considerable differences in numbers of individuals between main sampling sites on each pavement, but also between the three samples from each station. On both pavements the richest samples contained from 20 to over 40 individuals. This is equivalent to densities of 700 - 1500m⁻². However, sample B9A contained 146 individuals, equivalent to a density of 4867m⁻²! These numbers and densities are far in excess of those recorded by Coyle (1996), but probably reflect the comprehensive nature of the sampling and analysis of the present survey.

Within the transition zone habitat at Gait Barrows, *Vertigo angustior* dominates the molluscan fauna. At the stations with highest counts (excluding Pave B, 9A), *V. angustior* comprised 50 - 70% of the total number of molluscs. Twenty one other species of molluscs were recorded, although only three occurred regularly and in any numbers: *Lauria cylindracea*, *Punctum pygmaeum* and *Vertigo pygmaea*.

4.1.5 Recommendations

On the basis of these results, it is clear that Gait Barrows NNR supports the largest *Vertigo angustior* population in England. It is also the only site where *V. angustior* is living in limestone pavement habitat in Britain. **It is recommended that SAC designation should proceed.**

The continued survival of *V. angustior* at Gait Barrows is dependent upon preservation of the transition zone habitat. **It is recommended that this should be achieved by preventing scrub encroachment from suppressing this habitat.**

A monitoring programme should be initiated but due to the fragile nature and limited extent of the transition zone this is probably best not done using permanent plots. The number of samples to be taken requires some compromise between taking enough to be statistically meaningful but without causing unnecessary destruction to the habitat and snail population. It is suggested that on each (western and central) pavement, six of the 'island' sites are selected for monitoring on a rotational basis. These could be the richest

sites found during this survey. Each year, three replicate samples could be taken from half (three) of the monitoring sites, giving 18 samples in total. It is recommended that the quadrat area is maintained at 20 x 15cm as used for this survey, which gives a sufficient number of individual snails to be meaningful. A larger size quadrat would result in the unacceptable overkill of animals.

Collecting and sampling methods should essentially follow those used in this survey. The time of year needs to be determined once more is known about the snail's reproductive biology. However, late April/early May might be optimum.

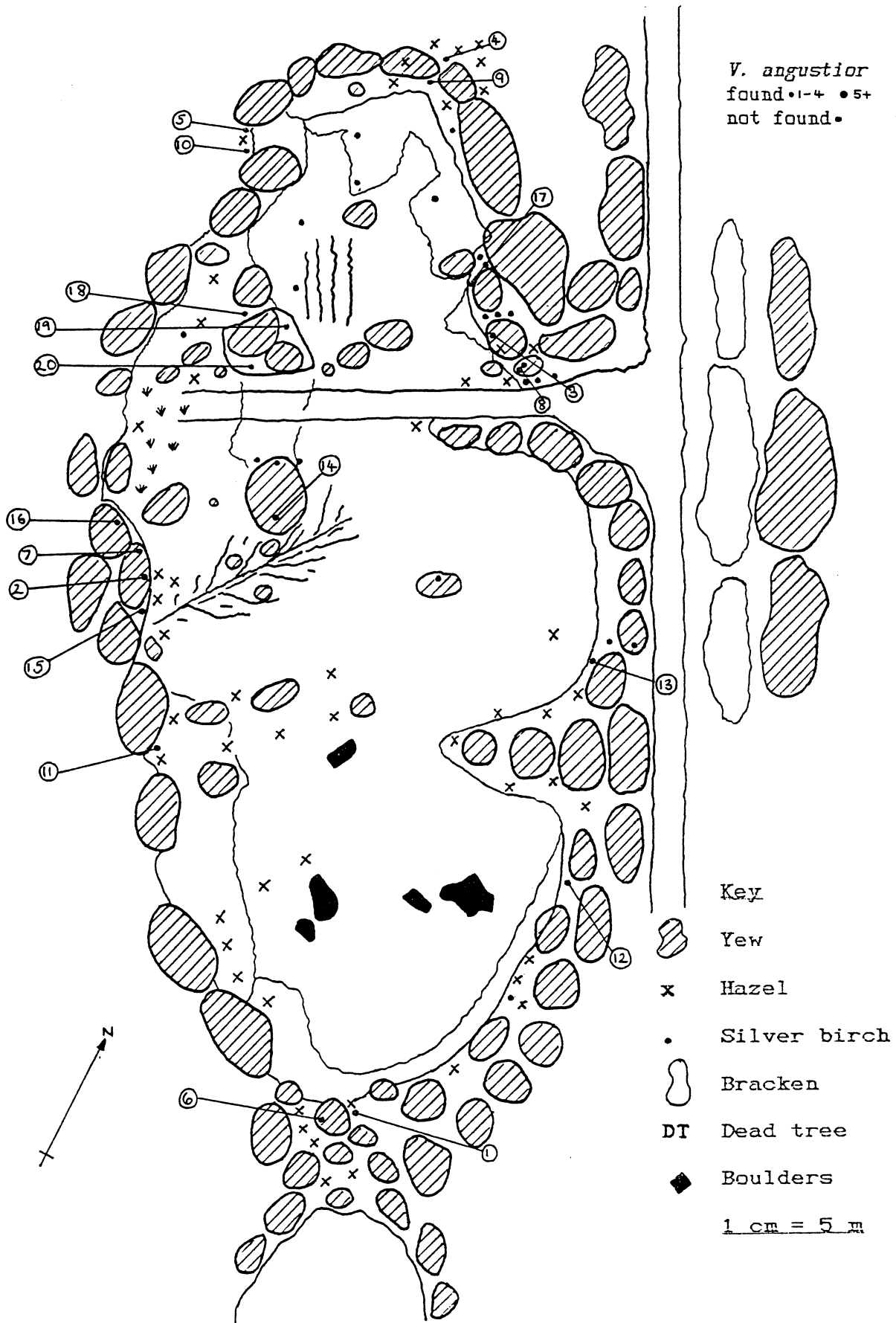


Figure 1: Map of Gait Barrows West Pavement A (after Coyle 1996)

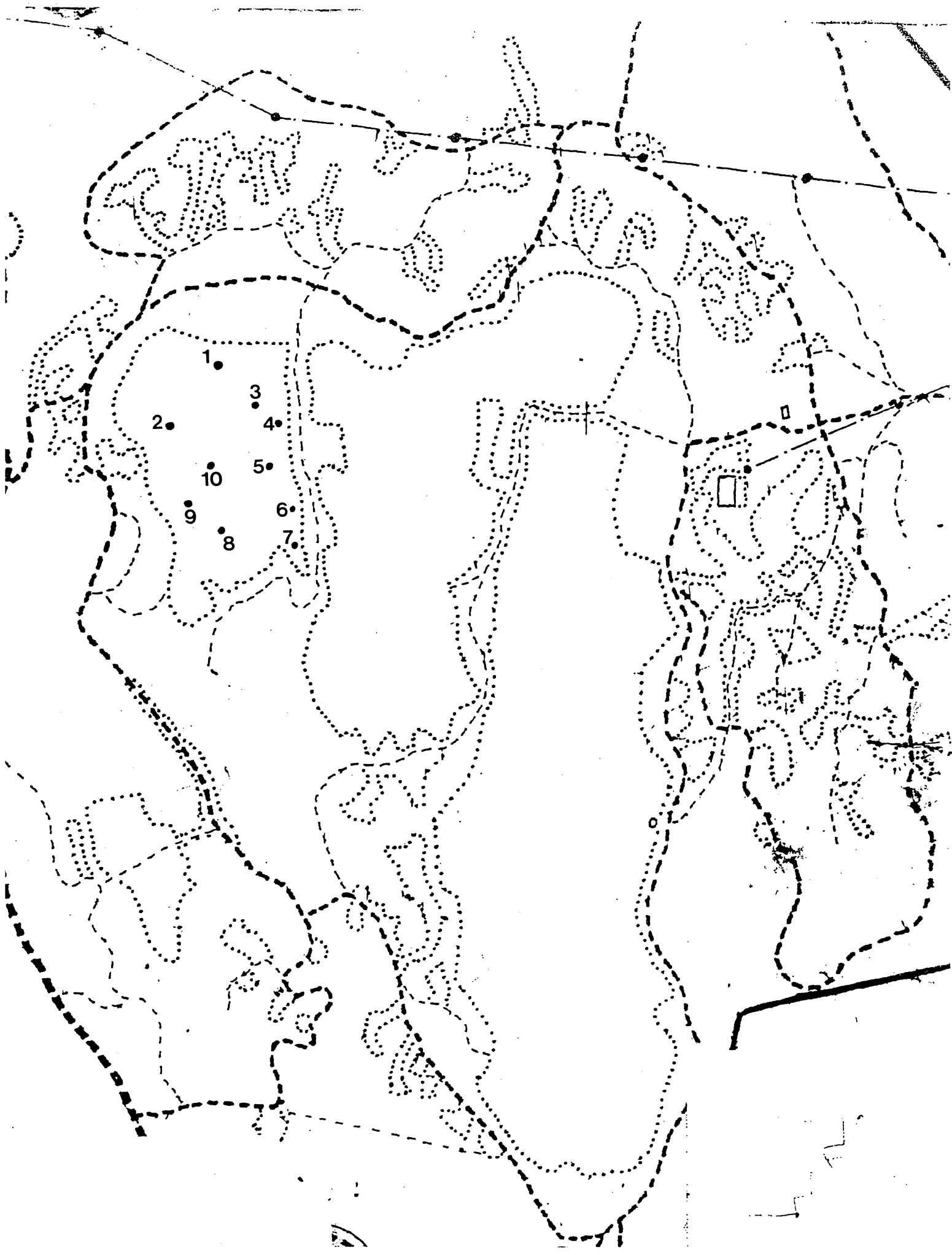


Figure 2: Map showing locations of Gait Barrows West Pavement sampling stations

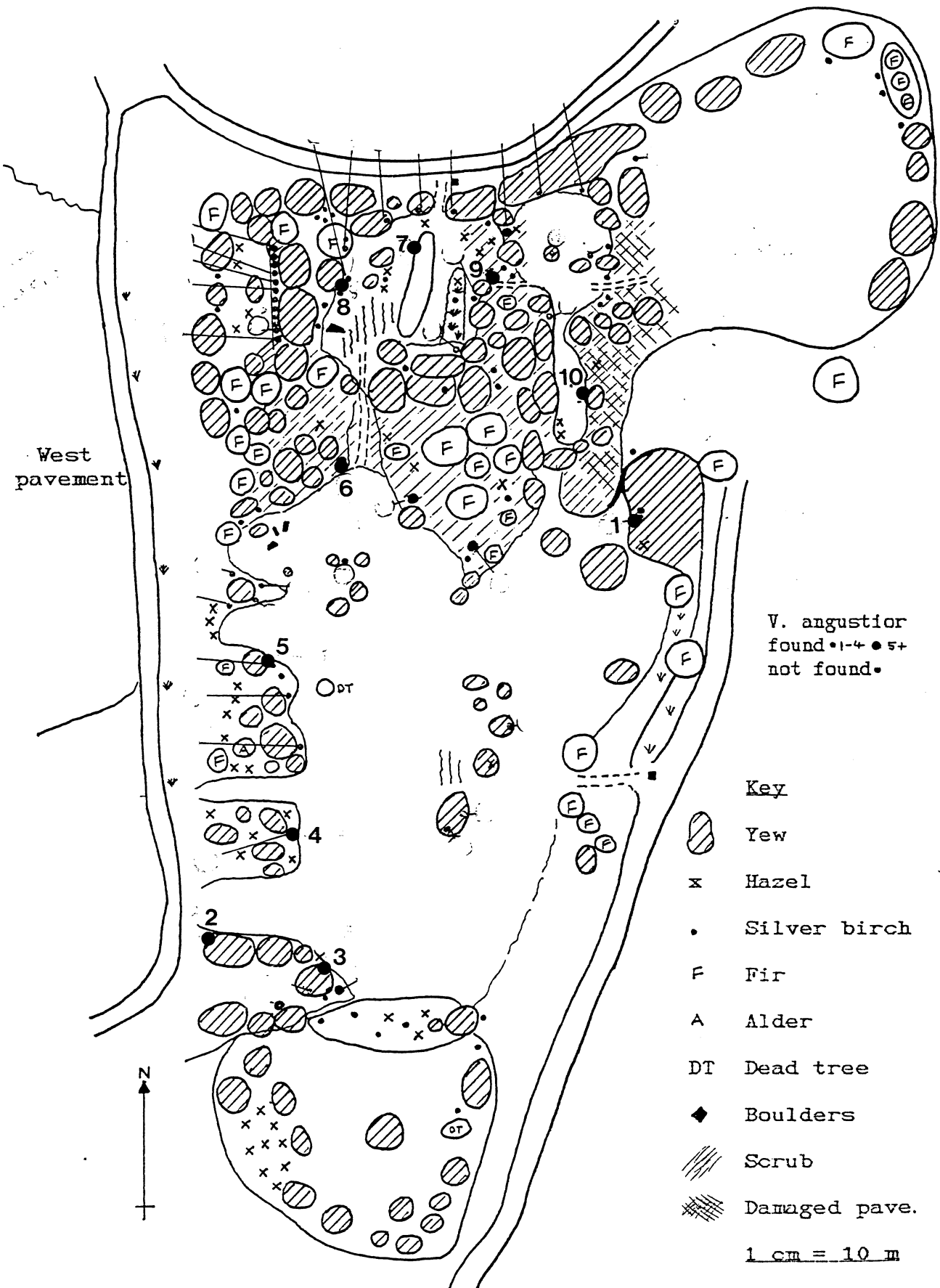


Figure 3: Map of Gait Barrows Central Pavement B (after Coyle 1996) showing location of sampling stations 1 - 10

Table 1: Gait Barrows Western Pavement A - main vegetation type at each sampling station

Station	Main vegetation	Sample	Aspect & sample vegetation
1	Grassy 'island' with 2 yew	A	N facing, moss
		B	E facing, moss
		C	S facing, moss
2	3 small yew	A	E facing, moss & leaf litter
		B	E facing, moss under yew
		C	E facing, moss & leaves under hazel
3	'Island' with 2 yew, 1 oak, 3 siver birch	A	N facing, moss
		B	NE facing, moss under low yew
		C	E facing, moss litter
4	Yew, Hazel, rose, birch at pavement margin	A	SW facing, moss & leaf litter
		B	As A
		C	As A
5	Open corner of 'island' with small yew/birch & hazel scrub	A	N facing, open area with 'bobbles' of moss on sparse leaf litter
		B	As A
		C	As A
6	Yew, hazel fringe at margin	A	W facing, moss/hazel/yew litter
		B	As A
		C	As A
7	Hazel & Yew	A	E facing, moss/hazel/yew litter
		B	As A
		C	As A
8	N facing birch & hazel fringe	A	Moss & grass under 'blackcurrant'
		B	Moss/hazel/birch litter
		C	Moss/hazel/birch litter
9	Large birch, yew & holly	A	E facing, mossy turf
		B	NW facing, open area with moss 'bobbles'
		C	NW facing, open area with moss 'bobbles'
10	N facing, hazel & yew scrub	A	Moss/hazel/yew litter
		B	As A
		C	As A

Table 2: Gait Barrows Central Pavement B - main vegetation type at each sampling station.

Station	Main vegetation	Sample	Aspect & sample vegetation
1	Birch stump, yew & Juniper	A	N facing, leaf/moss litter
		B	W facing, moss & juniper litter
		C	W facing, hollow with moss & leaves
2	Cluster of yew & hazel	A	W facing, moss & litter under yew
		B	SW facing, leaves, moss & twigs
		C	N facing, leaves/moss & twigs under hazel
3	Yew, rose & hazel scrub	A	N facing, leaf litter under rose
		B	N facing, litter under yew
		C	E facing, moss & leaf litter under yew
4	Hazel & yew	A	E facing, moss/leaves in runnel under birch
		B	S facing, soil & leaves under dead hazel
		C	N facing, moss/leaf litter under hazel/yew
5	Yew & large birch	A	NE facing, moss on pavement under yew
		B	N facing, hollow with leaf/twigs under birch
		C	SE facing, moss & litter at pavement margin
6	Yew at pavement margin	A	S facing, loose moss & leaves under yew at pavement margin
		B	As A
		C	As A
7	NW facing Juniper & hazel	A	NW facing, loose moss & leaves
		B	As A
		C	As A
8	SE facing margin of hazel & yew	A	SE facing, leaf litter under prostrate yew & hazel
		B	As A
		C	Moss & leaves in hollow under hazel
9	Hazel & yew scrub	A	S facing, runnel with leaf/moss under hazel
		B	S facing, leaves/moss under hawthorn
		C	S facing, leaf/moss in hollow under sycamore
10	Hazel & yew scrub	A	N facing, loose moss & leaf litter
		B	W facing, loose moss & leaf litter
		C	S facing, loose moss & leaf litter

TABLE 3: RESULTS: GAIT BARROWS NNR PAVEMENT A

Sample site	Vertigo angustior (adult)	Vertigo angustior (juv)	Coch lubric ella	Pyra rup	Col asp	Vert pas	Vert sub	Vert pygm	Leto ang	Laur cyl	Acant acut	Punc pygm	Vitr pell	Vit crys	Vit cont	Neso ham	Aego pura	Oxy alit	Euc futv	Clas bid	Cand int	Tric striol	Tric hisp
1A	6	1	7				1			15	1	7	1		3					1			1
1B										2		15				1				1			1
1C	7	3	3				1	1		10		7											
2A	7				2	1		2		39	1	5			1			2					3
2B	3					4		5		3			1										1
2C	10	1						5		4		2											
3A	7	1						1		4		4	5		2								
3B	1		1					3		2			1			1							
3C										8	1	8	1										
4A	6		1					5		11			1							1			
4B	11	5						10		2	1	2						1					1
4C	10									9								1					
5A	25	18						9		7		2	2						1	1			
5B	26	1						3		12		2											
5C	20	11						3		1		6	1										
6A						1				11		2											
6B								1		2	1						1						
6C	1			1				1		8			1										
7A	13	1				1				4		2											
7B	8									4													
7C	5	4				5				1		8											
8A	3							7		2		1								4			
8B	5							17		9		1								1			
8C	13	1			1	2	1	3		7	1	2	1										
9A	1							3		11		2											
9B	3							6		12		1											
9C								5		2		2											
10A						1		1		12		2											
10B	37	8				2		7		8		2			1								
10C								11		2					1								2

TABLE 4: RESULTS: GAIT BARROWS NNR PAVEMENT B

Sample site	<i>Vertigo angustior</i> (adult) (juv)	<i>Coch. lubric ella</i>	<i>Pyra rap</i>	<i>Col asp</i>	<i>Vert pus</i>	<i>Vert sub</i>	<i>Vert. pygm</i>	<i>Leio ang</i>	<i>Laur cyl</i>	<i>Acant acul</i>	<i>Punc pygm</i>	<i>Vitr pell</i>	<i>Vit crys</i>	<i>Vit cont</i>	<i>Neso ham</i>	<i>Aego pura</i>	<i>Oxy all</i>	<i>Euc fulv</i>	<i>Claus bid</i>	<i>Cand int</i>	<i>Tric striol</i>	<i>Tric hisp</i>
1A	23	1			1		1		4		4							1	1			
1B	23	4					1		4		8						1					
1C	3								5	1	2	1										
2A	3						3		4									1				
2B							10		2		2					2		1		3		
2C					2	1					5			1				1				
3A		1									3										1	
3B	4								10										1			
3C				1					1													
4A									1		1							2				
4B									2		1											
4C											1			1		1		1				
5A	6	1							1			1										
5B								2	2	3	4			3								
5C	11	5		1					4	1	5		1			1		1				
6A	5								2	2	12							1				
6B									1										1			
6C	9						2		3	2	5					1						
7A	28	3					1		3		5	1										
7B	34	3							5		3	1		10	1							
7C	5								1		2											
8A	18								16		17	4		6			1	2				
8B	9							1	7	2	3			2								2
8C	14	3								3	8			2		2		1				4
9A	110	36					10		5		8	2				1						
9B	1								1													
9C						1																
10A					2				3	1	3	1		1								
10B								9	4		1	1										
10C								8	1									1				

4.2 FLORDON COMMON

4.2.1 Previous studies

Living examples of *Vertigo angustior* were first discovered at Flordon in 1972 (Norris & Colville 1974). The snail was described as common in marshy grassland, but was mainly confined to a low lying area adjacent to the road hedgebank (B. Colville pers. comm.). The site has been visited by several malacologists over the years, but no systematic survey has been carried out. A visit by Colville (pers. comm.) in 1992 failed to reveal *V. angustior* and, therefore its present status was unknown.

4.2.2 Site description

Flordon Common is a botanically rich area of grassland and open woodland lying to the west of Flordon village, Norfolk, Grid Ref. TM182973 (Map Figure 4). From the gate entrance at the north end, the land slopes gently towards the south. A series of shallow, parallel ditches cross the Common in a NW/SE direction to the stream (tributary of R. Tas) at the southern boundary. The northern corner of the Common comprises open grassland with *Iris pseudacorus*, *Juncus* spp. and common low growing herbs (e.g. *Lotus uliginosus*, *Ranunculus acris*, *Plantago lanceolata* and *Prunella vulgaris*). To the south of the first ditch the ground is covered more by grass tussocks, and the site becomes more wooded and invaded from the south by scrub, particularly ash and alder. The Common has a long history of grazing by ponies and cattle which is still continued.

4.2.3 Methods

The main quantitative sampling was confined to the northern part of the Common, in the area adjacent to the ditch and hedgebank, where *V. angustior* was first noted by Norris & Colville (1974). A series of sixteen samples were collected from quadrat areas measuring 0.3 x 0.3m. Details of the dominant vegetation types in each quadrat are given in the table in the following section. A sketch of the locations of the sample stations are given in Figure 5. Spot samples, sieved in the field, were taken at several places to the south and east of main sampling area, but no *V. angustior* were observed. Photographs of sites are given in the Appendix. The fieldwork was carried out on 26 November 1996.

4.2.4 Results

Station	Vegetation	Station	Vegetation
1	Short grasses & <i>Juncus</i>	9	Moss & herbs on concrete
2	As 1, + moss	10	<i>Iris</i> & grasses
3	As 1	11	Grasses, <i>Iris</i> & thistles
4	As 1, + herbs & litter	12	Grass, <i>Juncus</i> , herbs
5	Moss, grass & leaf litter	13	Grasses & <i>Juncus</i>
6	Grass tussock	14	As 13
7	Grasses & <i>Juncus</i>	15	As13
8	<i>Iris</i> , grasses & herbs	16	<i>Iris</i> , grasses & herbs

Table 5: Flordon Common - main vegetation type at each sampling station

The results in Table 6 show that *V. angustior* is widespread within the sample area, being recorded from 14 of the 16 quadrats. The distribution and relative density is shown in Figure 6 below:

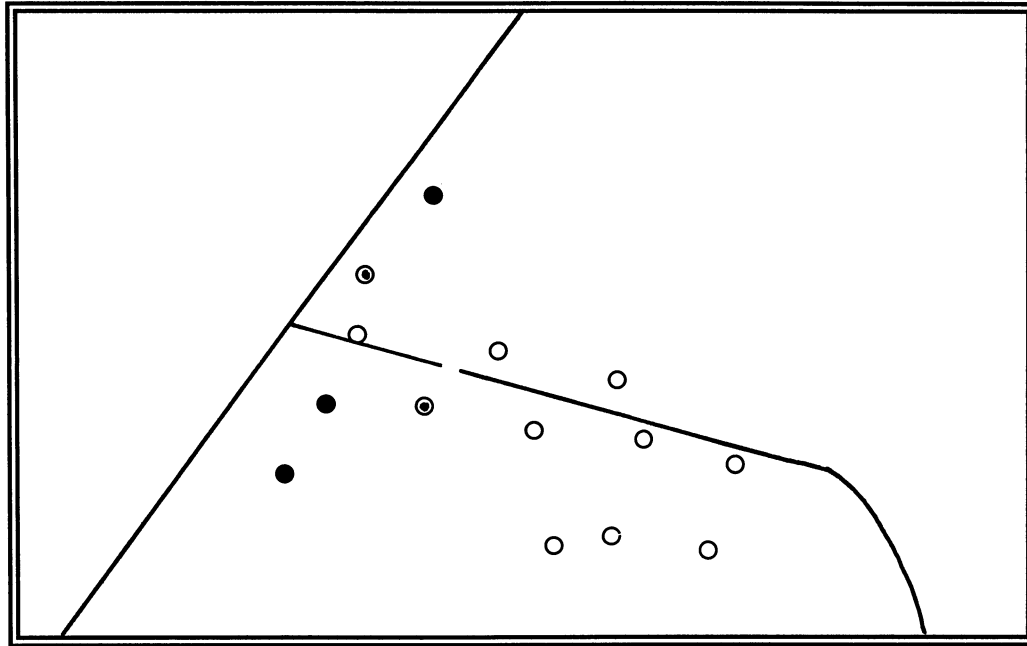


Figure 6: Flordon Common - *Vertigo angustior* location & relative density
 ● = >31, ⊙ = 10 - 30, ○ = <10

A total of 168 individuals were recorded (125 adults and 63 juveniles). The maximum number found in any one quadrat was 85 (Sample 8), indicating a maximum density of c. 950m⁻². The samples containing the highest numbers of individuals (Samples 8, 10, 11 & 16) were all from the *Iris* dominated grassland adjacent to the hedge, on both the north and south sides of the ditch.

At sites where high numbers of *V. angustior* occur, the species dominates the molluscan fauna. e.g. 54% of mollusc numbers at Site 8 and 36% at Site 16. Of the associated other mollusc species occurring at sites of high *V. angustior* density, the commonest were *Vallonia costata*, *Carychium tridentatum*, *Punctum pygmaeum* and *Trichia plebeia*. The samples with few individuals of *V. angustior* were those from areas of closely grazed, grassland turf with low botanical diversity. At these sites, all mollusc species were generally scarce, with no one particular species dominating.

4.2.5 Recommendations

The site is a SSSI, but management lies with the local landowner in conjunction with advice from English Nature (Norwich Office). The history of grazing by ponies has maintained the the community of low herbs and short turfed grassland habitat favoured by *V. angustior*. However, the apparently restricted extent of the population indicates that it is vulnerable to change. Discussion with a member of the landowner's family highlighted

three main areas of concern: changes in grazing practice, local hydrology and scrub encroachment all of which are likely to affect the snail. **It is recommended that management of the site for the snail should focus on these areas:**

- Excessive cattle grazing in the snail rich area could damage the snail population through trampling. Exclusion of cattle, but not ponies, from the area may be desirable.
- The ground water level should be maintained and, therefore, the shallow ditch which runs through the habitat should not be deepened.
- The expansion of scrub, particularly ash, towards the site needs to be halted.

The Flordon Common population of *Vertigo angustior* lends itself to a monitoring scheme using permanent plots. **It is recommended that a scheme similar to that described by Fowles & Hurford (1995) for Whiteford Burrows is employed:**

Initially, monitoring should focus in the area supporting the greatest population density i.e. the areas of *Iris* rich grassland on either side of the ditch and adjacent to the hedge. It is recommended that two permanent plots, marked with wooden posts, should be sited one on either side of the ditch. The extent of occupied habitat is considerably smaller than at Whiteford, thus, to keep damage to a minimum, it is recommended that the plots should be larger (10 x 5m or 10 x 10m). Ten samples should be taken from each, but the size of the sampling quadrats should be less than for Whiteford (say 0.25 x 0.25m). The monitoring should be carried out annually at a time of year considered optimum (April/May?). When the two monitoring plots have been located, a detailed vegetation survey should be carried out in each along with measurements of the vegetation structure (this will vary with grazing intensity and type of animals). Measurements of soil moisture and pH would also be useful.

The present survey has focussed on the area of the Common known to support *V. angustior*. **It is recommended that future monitoring work should be combined with taking spot samples over a greater area to determine the precise distribution of *V. angustior* at the site.** Note: all of the proposals will require sensitive liaison with the landowner who, whilst sympathetic towards conservation, has previously expressed concern over removal of plant and soil litter.

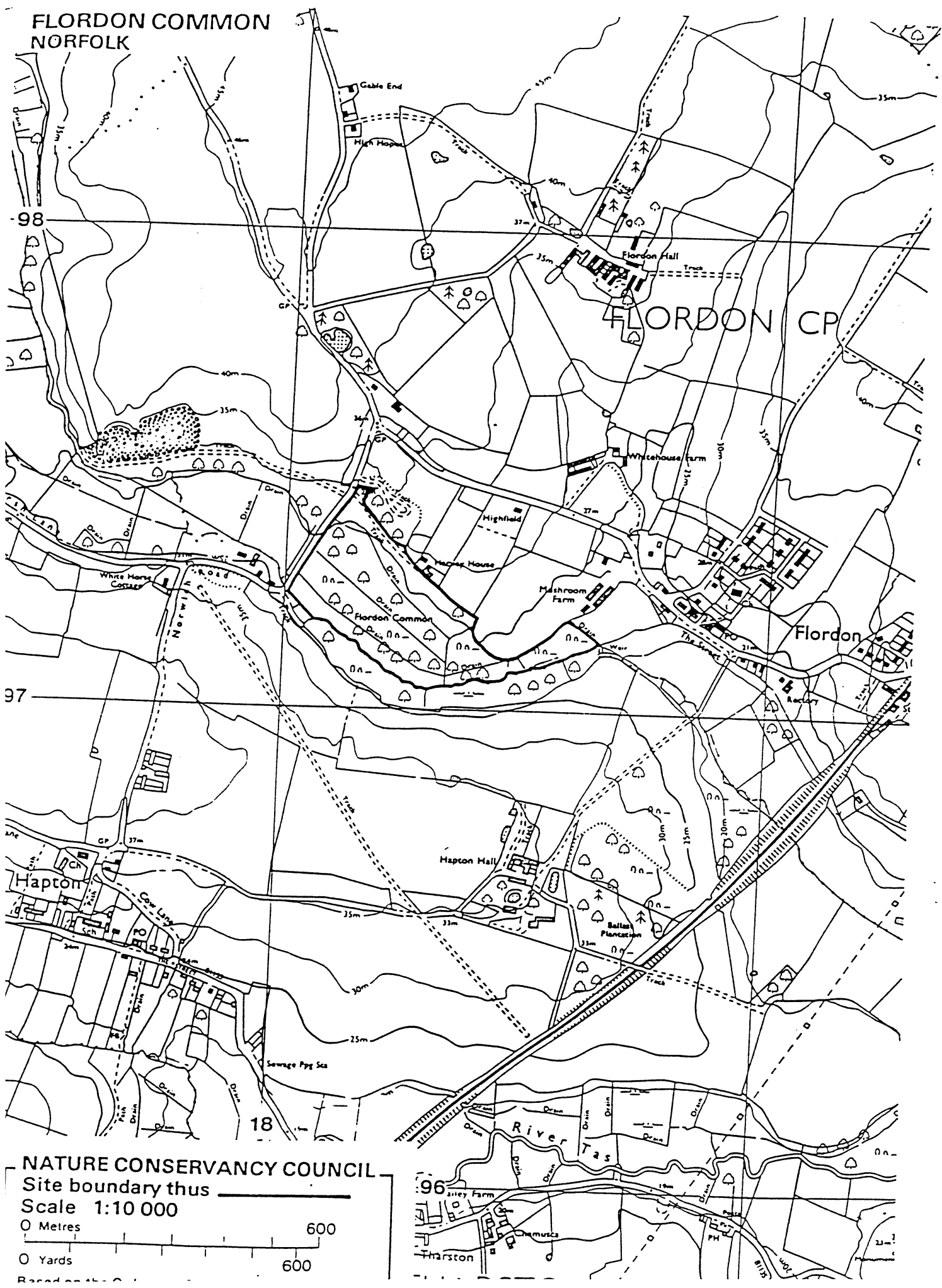


Figure 4: Location of Flordon Common

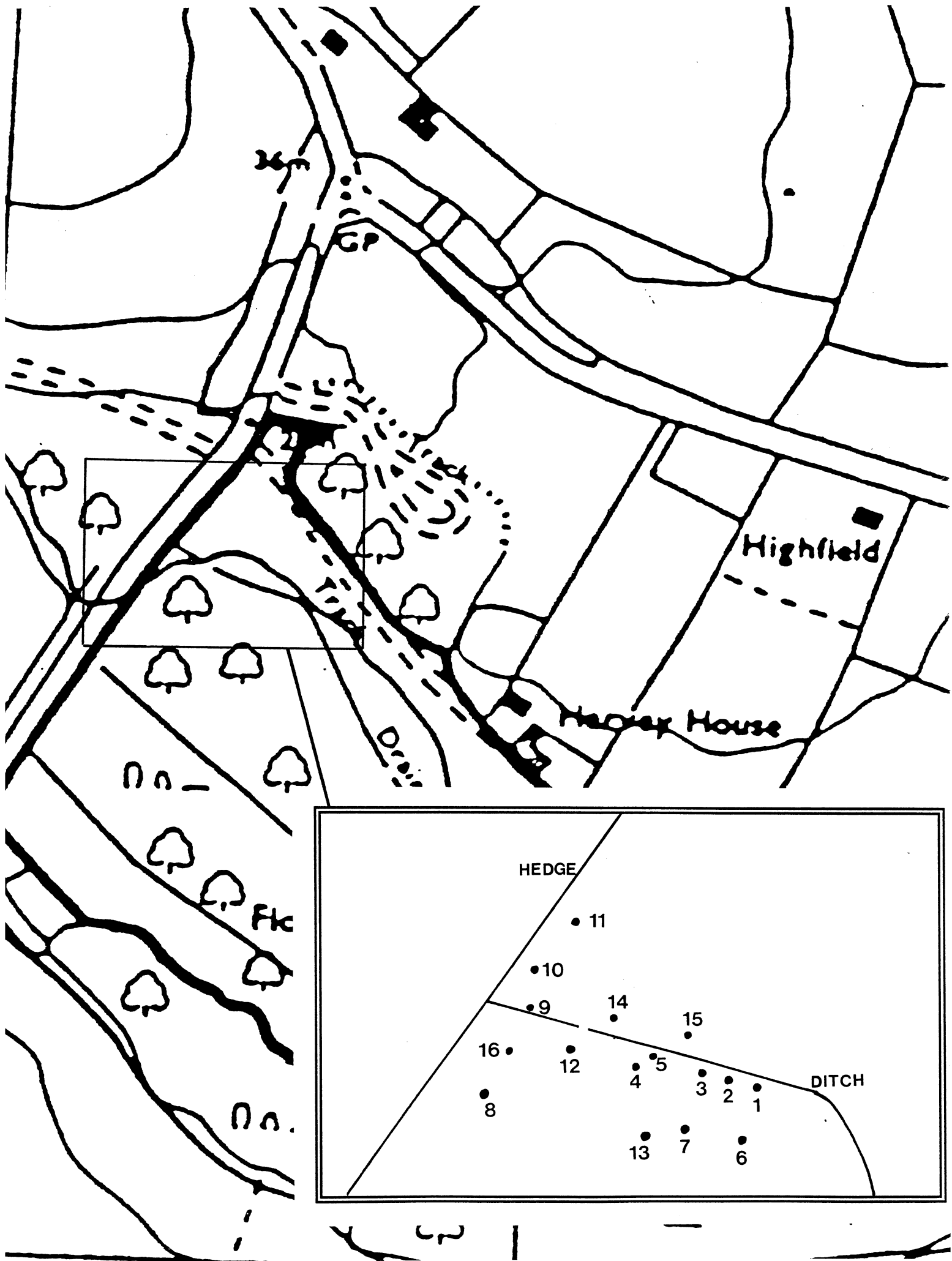


Figure 5: Location of Flordon Common sampling stations

TABLE 6: RESULTS: FLORDON COMMON

Sample site	Vertigo angustior (adult)	Car min	Car trid	Coch. lub	Suc put	Col edent	Vert sub	Vert. pygm	Acan acul	Vall cost	Vall pulc	Punc pygm	Disc rot	Vit crys	Neso ham	Aego pura	Aego nit	Euc aliter	Claus bid	Mon cant	Tric pleb	Tric striol	Cep nem
1	2		1					1				2		2	1			2			1		
2		3	3			1	3	1				5			1			3			1		
3	2	2					2					1		1	1		1	1			1		
4			2	1			1					4		2		1		1			1		
5		3		2			2	2				2			2			3			2		
6			3	4			2	1				3		3		1					3		
7	5	5	14	4			2	3				5		3				1					
8	62	23	8	2	5	4	8	11	4	3		20		2	1					2	1		4
9	1	2	2			2		6	1	6			2		1							1	
10	12	4	6	6	1	2		1		26		3	3	1	1			9	1		15		
11	10	21	3	7	6	1				50		1	6	2	2			4			16		1
12	6	4	2	9	1	1		7		3		3		1		1					2		
13	2	23	11	2		4		1				8		2	1			2			1		1
14		18		7				3			2	7		3				7			2		
15		1	7	1		7		4		2		6	7	2		1		9			5		1
16	21	6	4	1	3	3	4	6	1	13		7		1				2			2		1

4.3 MARTLESHAM CREEK

4.3.1 Previous studies

Vertigo angustior was discovered at Martlesham Creek in 1982 (Killeen 1983) during recording for the Suffolk mollusc atlas (Killeen 1992a). A further survey carried in November 1990 (Killeen 1991) on behalf of the Nature Conservancy Council indicated that the transition zone habitat was contracting in size and that *Vertigo angustior* had declined in numbers.

4.3.2 Site description

The site lies in the River Deben estuary, Suffolk (Grid Ref TM264472) on the southern side of Martlesham Creek. It consists of a small area of marsh (c. 100m²) in the transition zone between saltmarsh and a wooded field boundary. The vegetation shows a clear zonation down to the water's edge, and is essentially the same as described in Killeen 1983 & 1991:

1. Hedgerow with *Quercus robur*
2. Slope with bracken, brambles and tall herbs
3. Transition zone with two small beds of *Iris pseudacorus* and *Carex riparia*, flanked by *Phalaris arundinacea*.
4. Drift line deposits
5. Saltmarsh

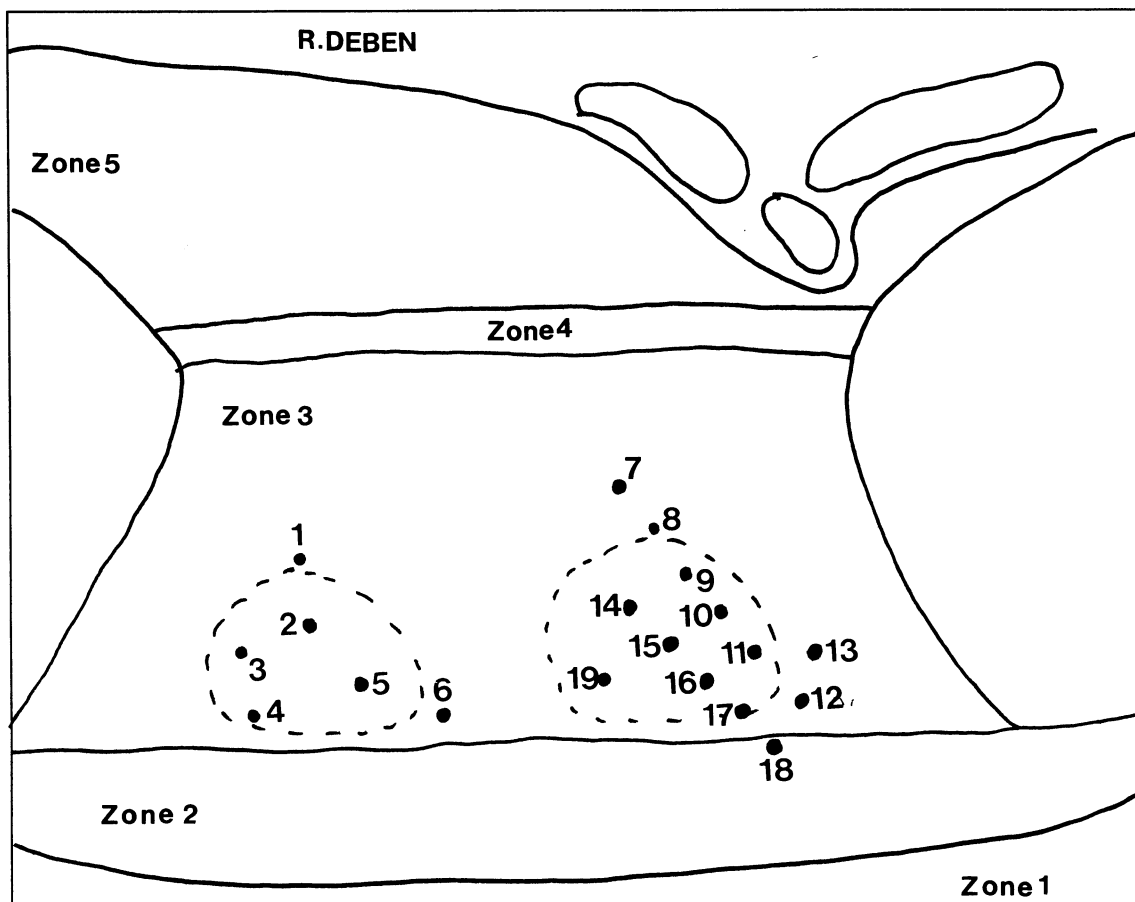


Figure 7: Map of Martlesham Creek showing sampling stations

4.3.3 Methods

The results of the previous studies had demonstrated that *V. angustior* was very localised and confined to the *Iris/Carex* dominated part of Zone 3. For the present survey, sampling was restricted to this habitat. A series of nineteen samples were collected from quadrat areas measuring 0.3 x 0.3m. Details of the dominant vegetation types in each quadrat are given in the table in the following section. A sketch of the locations of the sample stations are given in Figure 7. The fieldwork was carried out on 13 November 1996.

4.3.4 Results

Station	Vegetation	Station	Vegetation
1	<i>Phalaris</i>	11	<i>Iris & Phalaris</i>
2	<i>Iris</i>	12	Bracken, <i>Phalaris</i> , <i>Urtica</i>
3	<i>Iris & Phalaris</i>	13	<i>Phalaris & Carex</i>
4	<i>Phalaris</i>	14	<i>Iris</i>
5	<i>Phalaris & Iris</i>	15	<i>Iris</i>
6	<i>Phalaris & other grasses</i>	16	Bracken, <i>Phalaris</i> , <i>Urtica</i>
7	Grasses	17	<i>Phalaris & bracken</i>
8	Grasses	18	<i>Urtica & bracken</i>
9	<i>Carex & grasses</i>	19	<i>Iris</i> , grasses, bracken
10	<i>Carex & grasses</i>		

Table 7: Martlesham Creek - main vegetation type at each sampling station

The results in Table 8 show that *V. angustior* is patchily distributed and occurs only in very low density. This is shown in Figure 8 below:

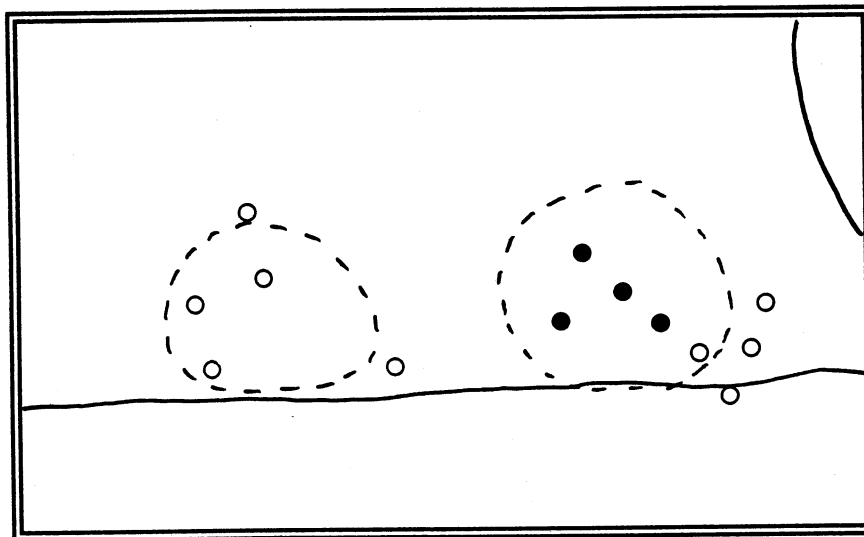


Figure 8: Martlesham Creek - Location and density of *V. angustior*
 • = 5 and over, o = 1 - 4

Although *V. angustior* was found living in both of the *Iris/Carex* beds, greater numbers were found in the eastern bed. In the western bed (Samples 1 - 6), five of the six quadrats contained *V. angustior*, but were represented by only ten individuals (3 adult, 7 juveniles). Eight of the thirteen quadrats (Samples 7 - 19) in the eastern bed contained *V. angustior*, with a total of 32 individuals (10 adults, 22 juveniles). The maximum number found in any one quadrat was 11, indicating a maximum density of c. 120m⁻². The samples containing the highest numbers of individuals (Samples 14 - 16, & 19) were all from the part of the *Iris* bed furthest from the estuary and into the bottom of the bracken/*Urtica* zone. Individuals of *V. angustior* were also recorded in the two samples taken further up the slope of this zone.

Vertigo angustior does not dominate the molluscan fauna at Martlesham Creek. At the four stations with highest counts, *V. angustior* represented only 2.3 - 4.8% of the total number of molluscs. *Clausilia bidentata* was the most abundant species in most samples with as many as 148 individuals or >60% of the mollusc numbers. The other dominant species were *Discus rotundatus*, *Eucomulus fulvus* agg. and *Trichia hispida*.

Recommendations

The site is currently not afforded any protection from SSSI or other conservation status. Whilst there is no apparent threat, the use of the River Deben estuary for boating activities mean that future extensions of boatyards or marina developments could become an issue. **It is recommended that responsibility for conservation and management of the site be placed with the Suffolk Wildlife Trust.**

The topography at the site means that there is little scope for expansion of the freshwater transition zone habitat. However, the decrease in abundance of *Vertigo angustior* since the original discovery in 1984 suggests that the site would benefit from management. There is evidence that the area of the *Iris/Carex* community has diminished in area and is becoming encroached by *Phalaris* and tall herbs and, therefore, the site may becoming too shaded to support *V. angustior*. The location and size of the site means that a grazing programme is not a viable option. **It is recommended that the height of the adjacent *Phalaris* grassland should be controlled by cutting (?strimming) or even by spot applications of herbicide on at least a biennial basis.** This may allow the snails to expand into the shorter turf habitat preferred by the species.

The site, and size of the *V. angustior* population are currently too small to support a monitoring programme of the detail recommended for Gait Barrows and Flordon. **It is recommended that the status of the snail is monitored by simple, restricted quantitative sampling.** This should be carried out initially on an annual basis by taking two samples each of 0.25 x 0.25m from the two main *Iris* beds. This should be carried out at a time of year likely to produce optimum results (May/June). More detailed lateral and vertical transect samples could be taken less regularly on, say, a three yearly basis. The frequency should be reviewed based upon the results obtained and the implementation of a management programme.

TABLE 8: RESULTS: MARTLESHAM CREEK

Sample site	<i>Vertigo angustior</i> (adult)	<i>Vertigo angustior</i> (juv)	Car min	Car trid	Coch. lubric	Vert pus	Vert pygm	Acanf acut	Punc pygm	Disc rot	Vitr pell	Vit cont	Neso ham	Aego pura	Oxy alti	Euc aid/ fuv	Claus bid	Tric hisp	Ari arb	Cep nem
1	1	1				1				1							34	1		1
2		3	1													1	48	2	1	
3	1					3	2		1	11						2	51	2		5
4		1				3	1		1	2						8	26		1	
5						1	1		3	2						1	20			
6	1	2			2				2	7			2				40	9		
7										1							6			
8										1							12			
9			1					1	1	7						2	36			4
10						1			2	5						2	57		1	
11				1		1			2	5	1					20	24	6		
12		1			2	1			4	10	1			1	3	18	12	2		
13	1								6	13						7	28			
14	2	3	4		2	4				23	3					16	140	19		2
15	2	9	9	6	7	6			3	22	2				1	22	148	9	1	2
16	1	6	2	17	9	2	1		11	13	2					51	49	32		1
17	1		4	6		2			9	17	7					28	17	24	2	
18	1			3	25	3		2	2	18	4	2	5		2	8	7	16	1	1
19	2	3		1	1	2			1	17						5	57	16		

5.0 DISCUSSION

A comparison of the results obtained show many differences and similarities between the three sites.

In the richest sample sites at Gait Barrows and Flordon, *V. angustior* dominated the molluscan fauna in terms of numbers. In these samples *V. angustior* comprised 64% at Gait Barrows and 31% at Flordon. Two of the commonest other mollusc species at both sites were *Punctum pygmaeum* and *Vertigo pygmaea*. However, *Lauria cylindracea* was the most frequent at Gait Barrows, with *Vallonia costata* and *Carychium tridentatum* the most frequent at Flordon. *Lauria cylindracea* prefers dry conditions whereas *V. costata* and *C. tridentatum* are more typical of open, herb rich habitats. The Flordon fauna is rather similar to that at Whiteford (Killeen 1993). At Martlesham Creek, however, *V. angustior* comprises less than 5% of the total number of molluscs. The associated molluscan fauna is also different in that it is dominated by *Clausilia bidentata* and *Discus rotundatus*. This is a similar association to that at Oxwich where *V. angustior* is also scarce (Killeen 1993). Both of these are shade preferring species and reflect the taller vegetation structure at the site. Survey work at Whiteford (Killeen 1993) demonstrated that areas of taller herbs supported fewer *V. angustior* than the more open grassland habitats. This reinforces the need to enhance the site for *V. angustior* by cutting the vegetation.

The reproductive biology of *Vertigo angustior* has not been studied. However, work by Pokryszko (1987;1990) on other *Vertigo* species, particularly *V. pusilla*, has indicated that maximum reproductive activity falls in spring and early summer and that eggs are laid singly, or in twos. A lifespan of 1-1.5 years is indicated by Pokryszko (op cit), however, she indicates that under favourable conditions the snails complete their growth and reach sexual maturity in 3-4 weeks!

For the three study sites we only have data from autumn/early winter, therefore, it would be unwise to place too much interpretation on the overall or the juvenile population size structures. At all sites the presence of significant numbers of juveniles indicates that the snails have continued to breed well into the autumn months. However, the higher percentage of juveniles in the populations at Flordon (34%) and at Martlesham (66%) suggest that breeding may continue longer into the year than at Gait Barrows (18% juveniles). Results for Whiteford (Fowles in press) showed that juveniles comprised 32% of the population in February 1994, 16% in May 1995 and 25% in April 1996.

The histograms in Figures 9 - 11 show the percentage of each half whorl size class for each site. The juvenile population size structures for Flordon and Martlesham are similar with most individuals in the 2 - 4 whorl class. For Gait Barrows there is a greater distribution in size from 1.5 - 5 whorls.

In his work on Whiteford Burrows, Fowles (in press) attempted to determine adult age of *V. angustior* by assigning them to three classes according to the degree of bleaching of

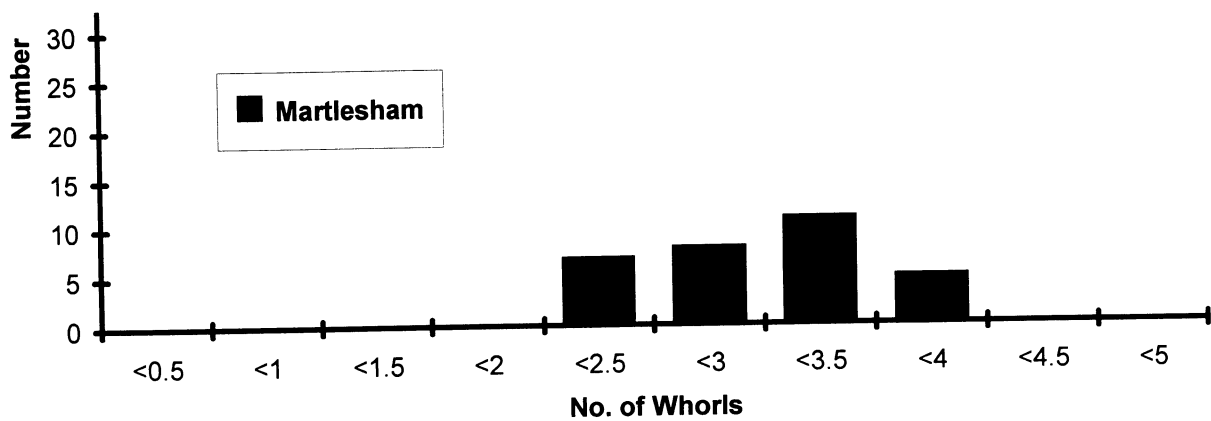
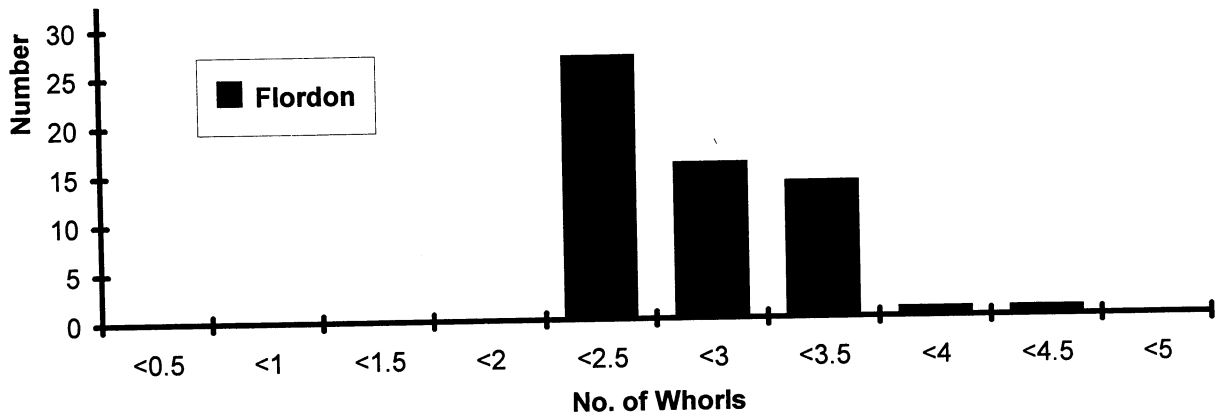
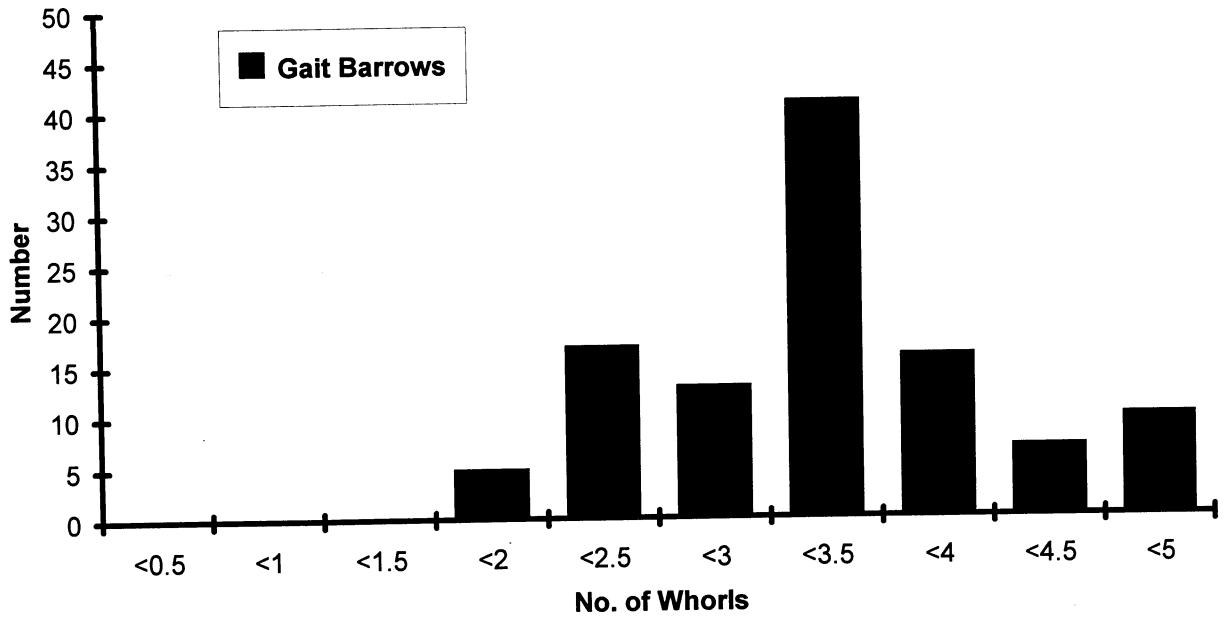
the shell. Following his criteria, the adults from the present survey were similarly assigned as Fresh, Moderate and Worn:

Site	n (live)	% of adult <i>V. angustior</i> in each wear class		
		Fresh	Moderate	Worn
Gait Barrows West Pavement	173	29.5	34.1	36.4
Gait Barrows Central Pavement	304	47.7	29.3	23.0
Flordon	116	39.7	49.1	11.2
Martlesham	13	23.1	53.8	23.1

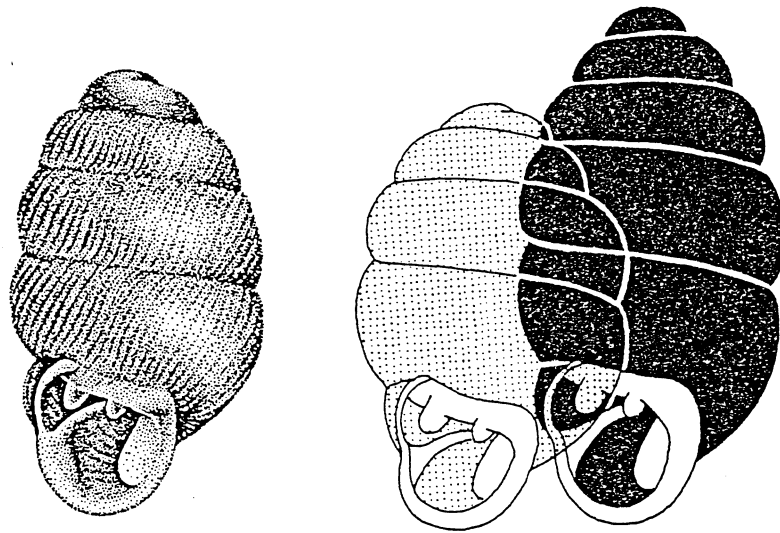
Table 9: Wear classes of live adult *Vertigo angustior*

These results are not consistent and therefore do not allow much interpretation. The higher proportion of fresh and moderately worn shells at Flordon and Martlesham, combined with the higher proportion of juvenile individuals does indicate that breeding continues later into the year than at Gait Barrows. Whilst the Martlesham sample is too small to be meaningful, at Gait Barrows more adults are worn but many juveniles are sub-adult suggesting that a new population of adults is just coming 'on stream'. At Flordon many of the adults are fresh and the juveniles younger indicating that individuals become adult later in the year than at Gait Barrows. One may speculate that this could be caused by low winter temperatures in East Anglia versus the higher humidity at Gait Barrows and effects of insulation from limestone pavement. However, the differences between the sites may also represent differences in the rate at which shells bleach due to ground pH rather than age of the shells. Fowles (in press) also noted inconsistencies at Whiteford, but there was a general trend showing that a higher proportion of adults were fresh in late winter than in early spring.

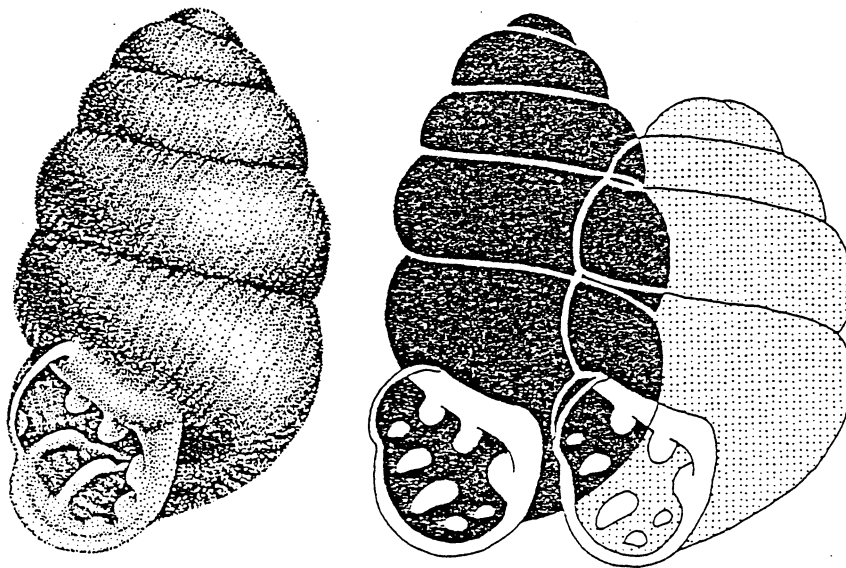
Monitoring at Gait Barrows and Martlesham Creek presents difficulties should the work be carried out by non-specialist malacologists. At both sites *Vertigo angustior* co-exists with the morphologically similar (sinistrally coiled) *V. pusilla*. High quality line drawings and descriptions of the shells may be found in Pokryszko (1990), see Figures 12 & 13. Adults may be separated by differences in shell shape, colour, the number and arrangement of apertural teeth, and surface sculpture. In particular, *V. angustior* has very distinct, strong and regular striae, whereas the striae on shells of *V. pusilla* are weaker and irregular. Separation of juveniles (<1mm in diameter) can be more difficult. Scanning electron photomicrographs of juveniles of both species are shown in Figures 14 & 15. At the 2^{1/2} to 3 whorl stage the differences in surface sculpture are clearly visible, however, at two whorls or less, these differences are much less obvious. The first 1^{1/2} whorls of both species have little or no striae such that separation is possible only by careful examination under high magnification.



FIGURES 9 - 11: Size distributions of *Vertigo angustior* juveniles



Vertigo (Vertilla) angustior



Vertigo (Vertigo) pusilla

Figures 12 & 13: Drawings of *Vertigo angustior* and *Vertigo pusilla* (reproduced from Pokryszko 1990)

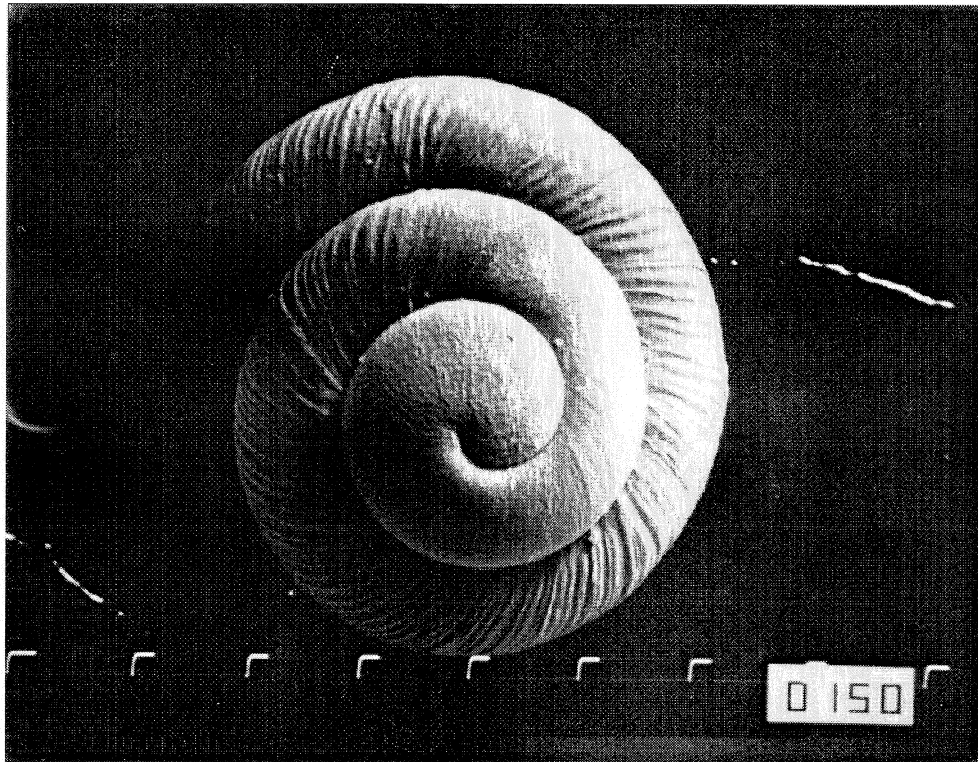


Figure 14: SEM of *Vertigo angustior* juvenile

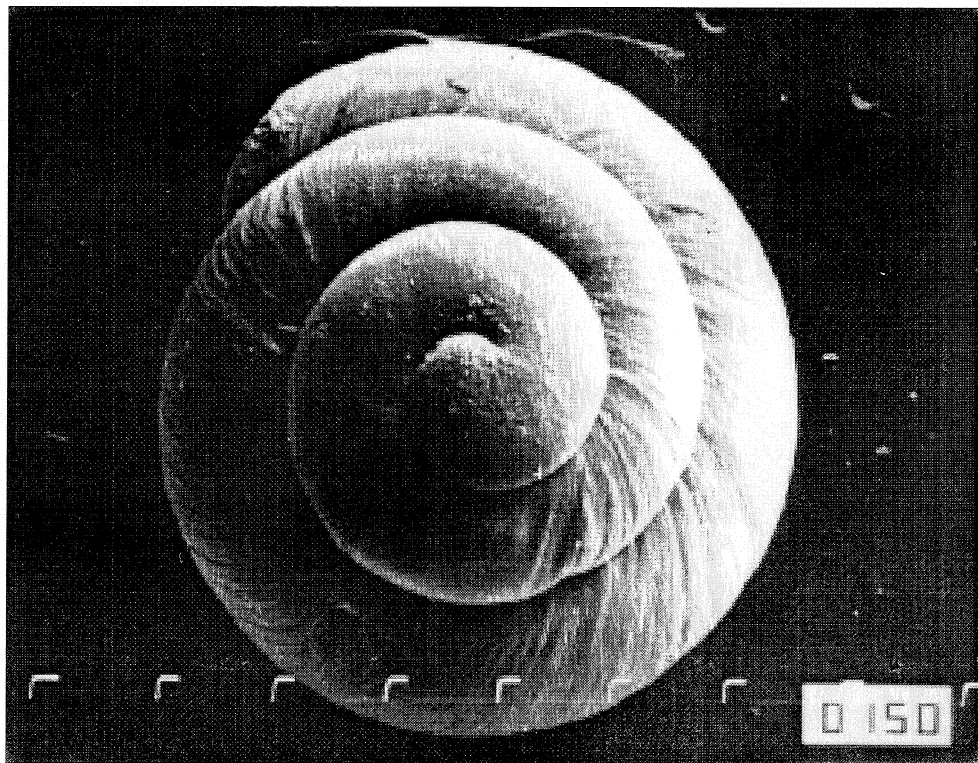


Figure 15: SEM of *Vertigo pusilla* juvenile

6.0 RECOMMENDATIONS

The rationale for monitoring and the factors which affect results are discussed in detail by Fowles (in press). Although the basis of the monitoring programmes is essentially to detect change, interpretation of results must be based on a comprehensive knowledge of the species' habitat requirements and reproductive biology. **It is recommended that all future work on *V. angustior* is coordinated between the Agencies, EN, CCW and SNH to ensure a unified approach.**

There is an urgency to obtain information on the reproductive biology of *Vertigo angustior* at its British sites. **It is recommended that during one particular year (1998 say), all of the British sites should be sampled at the same time, ideally at monthly intervals from March to November.** Two sampling stations at each site could be selected and all of the *V. angustior*, adults and juveniles counted and measured.

For the present survey recommendations are given in each of the individual site sections, but the main points are again summarised below:

Gait Barrows:

- Proceed with SAC designation
- Management of the site for the snail should focus on control and maintenance of the transition zone habitat.
- Initiate a monitoring scheme of selected areas on a rotational basis

Flordon Common:

- Management of the site for the snail should focus on control and maintenance of grazing; maintenance of ground water levels; control of scrub encroachment
- Initiate a monitoring scheme using permanent plots. It is recommended that a scheme similar to that used by Fowles & Hurford (1995) for Whiteford Burrows is employed:
- Future monitoring work should be combined with taking spot samples over a greater area to determine the precise distribution of *V. angustior* at the site.

Martlesham Creek:

- Responsibility for conservation and management of the site be placed with the Suffolk Wildlife Trust.
- The height of the *Phalaris* grassland adjacent to the *V. angustior* rich areas should be controlled by cutting/strimming or by use of herbicides on at least a biennial basis.
- The status of the snail is monitored by simple, restricted quantitative sampling.

The other English sites:

Market Weston Fen

The record of *Vertigo angustior* at this site is based on a single live specimen found in 1986 (Killeen 1992a). A subsequent comprehensive survey for *V. angustior* (Killeen 1992b) and personal observations since have failed to locate further specimens. Although it is a candidate SAC, the instigation of a monitoring programme at Market Weston is not

warranted without further evidence of the snail's presence. **It is recommended that a single day survey be carried out to determine the status of *V. angustior* at the site. This should focus on the grassland slopes (transition zone) which border the wet *Cladium mariscus* beds.**

Fritton

As with Martlesham Creek, the Fritton site has no special conservation status, although SSSI status would be desirable. The location is remote and is probably under no imminent threat, however, the transition zone habitat is very narrow and discontinuous, and the snail population is, therefore, vulnerable. **It is recommended that general responsibility for the site should be placed with the Suffolk Wildlife Trust.** The results of the most recent survey (Killeen 1991) did not indicate that any special management was required. **Information on the current status of the *V. angustior* population is required, and, therefore, a repeat of the 1991 survey is recommended.** When such information is available a monitoring programme can be devised. However, it is likely that a scheme similar to that recommended for Martlesham Creek would be most appropriate i.e. annual collection of a small number of samples from the areas of highest population density.

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Appendix - site photographs



Gait Barrows - West pavement Site 5



Gait Barrows - West pavement Site 5 detail

Appendix - site photographs

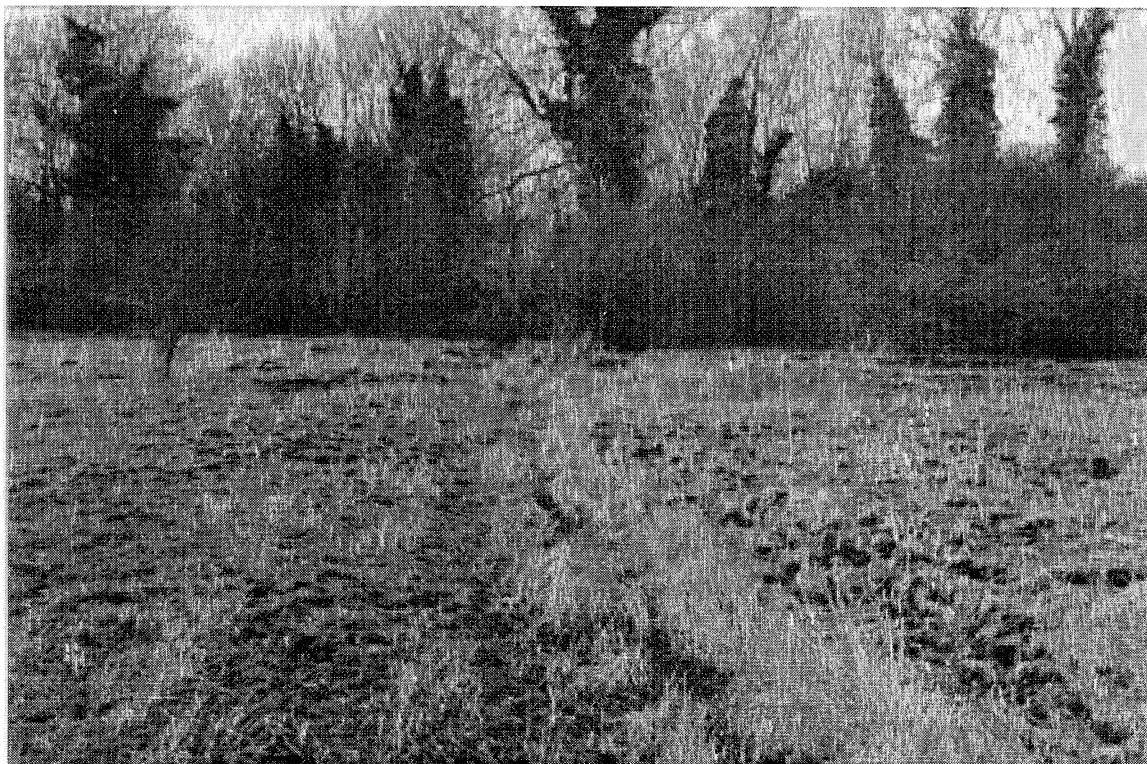


Gait barrows - Central pavement Site 1 detail

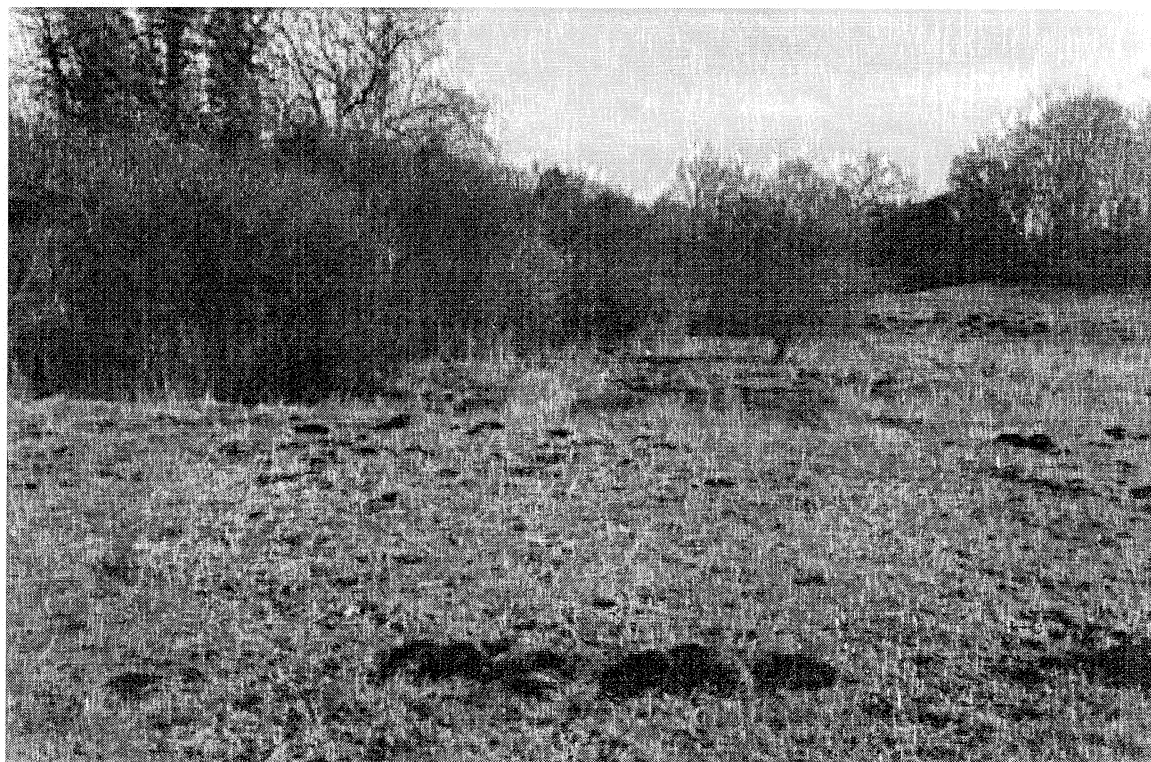


Gait barrows - Central pavement Site 7

Appendix - site photographs



Flordon - View west along ditch

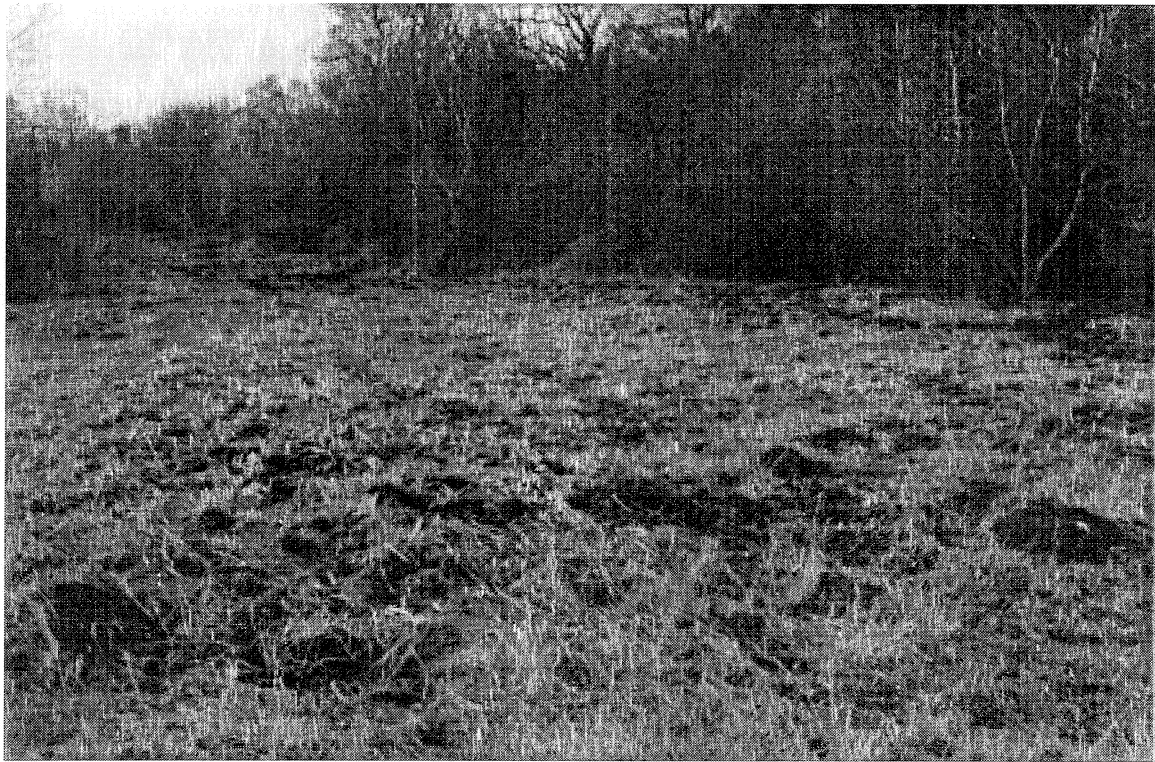


Flordon - View north-east along hedge from Site 8

Appendix - site photographs



Flordon - View south-west along hedge from Site 11



Flordon - View south-west along hedge from Site 11

Appendix - site photographs



Martlesham Creek - View north across transition zone



Martlesham Creek - Western *Iris*/*Carex* bed detail