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Surveys of EU Habitats Directive *Vertigo* species in England: *Vertigo moulinsiana*
Part 1: Summary and monitoring protocol

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Surveys of EU Habitats Directive *Vertigo* species in England:

3. *Vertigo Moulinsiana*

Part 1: Summary and monitoring protocol

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1. Background and objectives

Four species of the snails in the genus *Vertigo* are listed on Annex II of the European Habitats and Species Directive. This places an obligation on the British government to maintain the species in favourable conservation status and to report on this. To this end, several Special Areas of Conservation (SAC) have been proposed. The responsibilities are expanded in the UK Biodiversity Action Plan which requires additional survey to establish the species' status and further studies on the ecological requirements to help form decisions about management (UK Biodiversity Steering Group (1995). This report describes the survey work on *Vertigo moulinsiana* in seven SAC:

Vertigo moulinsiana is an inhabitant of mainly calcareous fens and marshes. It occurs in swamps, fens and marshes usually bordering rivers and lakes. It lives on both living and dead stems and leaves of tall plants: grasses (eg *Glyceria maxima*), sedges (eg *Carex riparia, C. acutiformis, C. paniculata* and *Cladium mariscus*), and reeds (eg *Phragmites australis*). The species shows a preference for taller vegetation upon which it climbs during the season and is rarely found in litter. In Britain *V. moulinsiana* is locally distributed across southern and eastern England from Dorset to north Norfolk with a few isolated colonies elsewhere (see Kerney 1999; Drake 1999).

In 2000-2001, English Nature commissioned a wide-ranging study of this species with three principal objectives:

- To determine precisely the distribution and abundance of *Vertigo moulinsiana* in SAC component sites known to support populations, to act as a baseline for future monitoring (River Avon, Kennet & Lambourn Floodplain, Waveney & little Ouse Valley Fens).
- To survey sites within SAC where the *V. moulinsiana* distribution was poorly known (Norfolk Valley Fens, The Broads, River Wensum and Stodmarsh) to determine the snail's distribution within each SAC in order to make a rational selection of sites to monitor, and to confirm which components support the snail.
- To establish a protocol for monitoring *V. moulinsiana* at the seven SAC for which it is a feature.

The report on this study comprises eight parts; This part, Part 1 being the summary on the status and distribution of *Vertigo moulinsiana* at all SAC, and monitoring protocols. Parts 2 - 8 comprise detailed reports on the surveys within each separate SAC:

Part 2 - River Avon
Part 3 - Kennet and Lambourn Floodplain
Part 4 - Waveney and Little Ouse Valley Fens
Part 5 - Norfolk Valley Fens
Part 6 - The Broads
Part 7 - River Wensum
Part 8 - Stodmarsh = *English Nature Research Reports,* No. 350

2. Methodology

2.1 Snail sampling

Experience elsewhere had revealed that close examination of the stems and leaves of sedges and *Glyceria* in the field is both time consuming and not always reliable at sites where *V. moulinsiana* was living at low density. To maximise productivity on this survey the snails were sought using only a beating technique. A large sheet of heavy duty, blue polythene was spread on the ground at the base of the vegetation. A strip of living and dead vegetation approximately 1.0 x 0.5m was bent over the sheet and shaken vigorously to release adhering snails. Very wet, decaying litter at ground level was not sampled as this habitat has been found to not support *V. moulinsiana* in the active season.

At sites where the data was to act as a baseline for future monitoring, the samples were analysed quantitatively in the field. Specimens of *V. moulinsiana* were recorded as adults or juveniles. Specimens with a developed lip and apertural teeth were counted as adults and others as juveniles. All other mollusc species were identified, counted and recorded. To enable comparison, this quantitative method was also employed at most other locations, however, at some sites, the snail was recorded either on a presence/absence basis or quantified by a simple ACFOR scale.

2.2 Vegetation

Within each 1m x 0.5m sampling site the dominant plant species were recorded, together with vegetation height, density and structure.

2.3 Moisture

Ground moisture levels at each sampling site were recorded using an arbitrary scale from 1-5.

1 Dry. No visible moisture on ground surface.
2 Damp. Ground visibly damp, but water does not rise under pressure
3 Wet. Water rises under light pressure.
4 Very wet. Pools of standing water, generally less than 5cm deep.
5 Site under water. Entire sampling site in standing or flowing water over 5cm deep.

2.4 Timing

Work carried out within the original contract specification was done principally in September and October 2000. Further work was subsequently added to the original contract in order to include additional sites in the Broads SAC, and to survey Thompson Common and the River Wensum. However, as a result of winter flooding in late 2000 followed by the outbreak of foot & mouth disease in early 2001, the remaining work was carried out between late July and early October 2001. The work on Stodmarsh was carried out under a separate contract in late 1999, but for completion, the summary is included in this report.

3. Results

Tables 2 - 8 give a summary of the results from each survey site within each SAC. Full details of the surveys, results, site specific conservation, management and monitoring are given within the individual SAC reports.

The results of this work has shown that *Vertigo moulinsiana* is widespread and locally abundant within all of the SAC for which the snail is a named feature. In the Kennet & Lambourn Floodplain and the Broads SACs, for example, the species occurs at numerous sites over a wide geographical area. Given the recorded decline of *V. moulinsiana* elsewhere (see Seddon 1999), it is considered that England supports the greatest number of sites and the densest populations of the snail within its European (virtually global) range.

The distribution within all the sites coincides with areas of permanently wet habitat (ground moisture levels of 3 or 4 on the arbitrary scale) which are predominantly vegetated by *Glyceria maxima*, tall *Carex* species (C. *riparia, C. acutiformis, C. paniculata, C. elata*), and *Cladium mariscus*, and which are little affected by management.

The mean numbers of individual *V. moulinsiana* per sample can give an indication of the relative abundance and population density of a site compared with another. However, the figures need to be viewed with caution. Work on the Newbury bypass sites in the Kennet & Lambourn Floodplain SAC has shown that the abundance of *V. moulinsiana* can fluctuate greatly from month to month, and from year to year (eg Killeen & Stebbings 2000, Stebbings & Killeen 1998). This detailed monitoring has shown that whilst the snail may be found throughout the year, numbers are generally low from late spring to mid summer, but may increase dramatically through September and October following the species' main breeding event. However, the results from 3 monitoring sites (Bagnor Island, south of Speen and at Thatcham) have shown that within a small geographical area, the population structure at each site is usually very similar at the same time of year.

The data from the present surveys clearly show the differences in population structures between sites sampled in July or August with those sampled between early September and late October. In general, at the sites sampled in July/August, *V. moulinsiana* was not found in particularly high numbers, and the population was dominated by adult individuals. Sites sampled in late October have a high number of individuals per sample and the population is usually dominated by juveniles. Differences in population structure from year to year may be seen in sites in the Kennet & Lambourn Floodplain SAC (see Table 3). On 7 September 2000 a site in the Chilton Foliat component had a adult: juvenile ratio of 0.68, whereas at 3 other nearby sites sampled between 10-12 September 2001 all had an adult: juvenile ration of c. 1.6. Data from the Newbury bypass monitoring sites confirmed that in 2001, the snail's main breeding event occurred approximately six weeks later than had been observed in previous years. Therefore, results from a monitoring programme which includes comparison of abundance of individuals or the structure of the population need to be evaluated in light of potentially significant seasonal and year on year differences (see Section 5).

Table 2: River Avon SAC

Component	Site/Habitat	Grid Ref	Survey Date	No. of samples	No. of +ve samples	Mean No. of *V. moulinsiana* per sample	*V. moulinsiana* Adult: Juvenile ratio	Comments
Jones's Mill (R. Avon)	Extensive area of fen and grazing marsh	SU168613	26 Oct 2000	32	20	31.7	1.08	Occurs throughout the site. Abundant in central 'wilderness fen'. Distribution elsewhere patchy and coincident with intensity of grazing
Figheldean (R. Avon)	*Glyceria* filled ditch and sedge swamp in poplar woodland	SU153470	26 Oct 2000	6	6	38.2	0.94	Occurs throughout the wetter areas of the plantations in moderate numbers
Lower Woodford (R. Avon)	Small island between 2 channels	SU127349	29 Oct 2000	13	5	7.38	0.88	Found in a small swampy ditch in the central part of the site where it occurred in moderate numbers, and in low numbers in marginal fen at the north end of the site
Little Wishford (R. Wylye)	Margins of river and channels	SU075360	28 Oct 2000	24	18	14.9	1.01	Distribution patchy and discontinuous. Found along the denser *Carex* fringe of the river but the core of the population lies in the marginal swampy areas dominated by *Glyceria* just to the south and south-west of the farm
Berwick St James (R. Till)	Margins of river and channels, ditches & adjacent fens	SU074396	27 Oct 2000	16	12	26.7	1.45	Occurred more-or-less throughout the sample area but the distribution was patchy.
Winterbourne Gunner (R. Bourne)	Small *Glyceria* and sedge swamp	SU180354	29 Oct 2000	17	14	98.4	0.69	Although small, the site supports a thriving population of *V. moulinsiana*

Table 3: Kennet and Lambourn Floodplain SAC

Component	Site	Grid Ref	Survey Date	No. of samples	No. of +ve samples	Mean No. of *V. moulinsiana* per sample	*V. moulinsiana* Adult: Juvenile ratio	Comments
Eddington Marsh		SU345687	25 Oct 2000	19	19	23.9	0.81	Restricted to wettest depressions and the ditch network. Site heavily grazed
Speen		SU450567 47	05 Sept 2000	13	13	47.8	3.63	Broad strip of *Carex* alongside leat of the R. Kennet
Boxford Water Meadows		SU428719	21 Oct 2000	26	24	120.4	0.61	Most abundant in ungrazed sedge fen in the northern half of the site
Hunt's Green		SU435702	24/25 Oct 2000	22	20	76.2	0.90	Core of the population lies within the swampy raft of riparian vegetation adjacent to the River Lambourn
Rack Marsh	Bagnor Island	SU452693	21 Oct 2000	23	18	201.2	0.34	Locally abundant in sedge filled depressions and in *Glyceria* rafts by river. Much of site covered in rank herb fen.
Weston		SU403737	07 Sept 2001	12	12	46.3	1.60	Small island between 2 channels of R. Lambourn. Common around margins.
Thatcham			31 Aug/01 Sept 2001	98	79	43.9	2.00	Widespread across the entire site in a range of habitats.
Chilton Foliat Meadows	i) Chilton Marsh	SU327700	10 Sept 2001	21	20	28.7	1.56	Very localised at the site - confined mainly to the wettest swamps and fens. Rare or absent from most of the rank fen areas.
	ii) Chilton Foliat	SU316705	07 Sept 2000	20	19	104.4	0.68	Common throughout in *Glyceria* dominated swamp and fen
	iii) Chilton Foliat Meadows	SU306704 to 322703	10/12 Sept 2001	67	56	38.0	1.62	Locally abundant in the wettest swamps and fens, and unpoached stream & ditch margins

Table 4: Waveney and Little Ouse Valley Fens SAC

Component	Site	Grid Ref	Survey Date	No. of samples	No. of +ve samples	Mean No. of *V. moulinsiana* per sample	*V. moulinsiana* Adult: Juvenile ratio	Comments
Market Weston Fen	Range of wetland habitats: fen, pingo and fen/heath transition, swamp alder carr etc. Survey focused on fen communities dominated by *Cladium.*	TL981787	8 Sept, 5 & 6 Oct 2000	76	76	27.8	1.49	Widespread in the wet fen areas throughout the site

Table 5: Norfolk Valley Fens SAC

Component	Site/Habitat	Grid Ref	Survey Date	No. of samples	No. of +ve samples	Mean No. of *V. moulinsiana* per sample	*V. moulinsiana* Adult: Juvenile ratio	Comments
Thompson Water, Carr and Common	Pingo pools, with and without standing water, with large tussocks of *Carex elata* around the margins and in the centre of the pools. Wet pingo pools with dense mixed fen.	TL930955	9, 10 Sept, 11 Oct and 4, 5 Nov 2000	126	98	19.1	1.48	Widespread, occurring in virtually all of the sites which are permanently wet and vegetated by a tall fen community. The snail is most common in the pingo pools with large *Carex elata* tussocks and in the pools with dense fen vegetation.

Table 6: Broads SAC

Component	Site	Grid Ref	Survey Date	No. of samples	No. of +ve samples	Mean No. of *V. moulinsiana* per sample	*V. moulinsiana* Adult: Juvenile ratio	Comments
Broad Fen, Dilham		TG34-25-	09 Aug 2001	16	6	1.56	all adult	Very local - mostly in fen-filled ditches
Ant Broads & Marshes	Great Fen	TG368213	02 Oct 2001	Qualitative				Relatively common in *Cladium* fen
Alderfen Broad		TG354196	04 Aug 2001	13	11	6.77	13.7	Mostly in *C. paniculata* swamp by broad
Crostwick Marsh	East end	TG264165	04 Aug 2001	15	15	69.3	15.7	Abundant in *Glyceria* & sedge swamp
	West end		04 Aug 2001	15	3	2.67	3.64	Uncommon - in mixed fen
Bure Broads & Marshes	Woodbastwick Fen	TG332516 45	04 Aug 2001	8	8	9.88	2.04	
	Woodbastwick Fen	TG334164	04 Aug 2001	Qualitative				Frequent on margins of ditches & rides
	Woodbastwick Fen	TG336165	04 Aug 2001	5	5	9.0	6.5	Frequent in *Cladium* fen
	Cockshoot Dyke	TG346159	05 Aug 2001	6	6	15.2	4.69	Fen along river and in alder carr
	Ferry Road	TG342163	05 Aug 2001	Qualitative				Common in roadside fens
	Ranworth Broad	TG358150	05 Aug 2001	8	8	18.5	8.25	Frequent to common in mixed fen
Shallam Dyke Marshes	Riverside ronds	TG400160 to 400172	09 Aug 2001	17	13	7.12	29.3	Frequent on *Glyceria* and sedge, rare on *Phragmites*
Trinity Broads	Filby Broad (south)	TG460133	09 Aug 2001	8	8	58.4	5.51	Abundant in mixed fen at broad margins
	Filby Broad (west)	TG453136 to 453133	09 Aug 2001	8	7	10.7	5.61	Locally frequent in mixed fen and in alder carr margins
Burgh Common & Muckfleet Marshes	Little Broad & end of Filby Broad	TG448129	10 Aug 2001	Qualitative				Frequent around Little Broad, and rare in margins of Filby Broad.
Upton Broad & Marshes		TG13-39-	10 Aug 2001	25	20	9.8	6.66	Common in swamp around broad and in ditches, rarer in open mixed fen

Component	Site	Grid Ref	Survey Date	No. of samples	No. of +ve samples	Mean No. of *V. moulinsiana* per sample	*V. moulinsiana* Adult: Juvenile ratio	Comments
Yare Broads & Marshes	Riverside ronds	TG368032 to 376030	12 Aug 2001	7	7	15.9	11.3	Note difference between sampling date of following site
	Riverside ronds	TG362046 to 364042	02 Oct 2001	11	11	114.2	2.67	See above
	Buckenham Carrs	TG366054	12 Aug 2001	5	5	23.4	8.0	Fen in alder carr
	Strumpshaw	TG342058	12 Aug 2001	6	6	20.3	11.2	Fen margins of ditches & filled ditches
Hardley Flood		TG375994	02 Aug 2001	35	31	11.7	33.2	Widespread in range of habitats
Geldeston Meadows		TM396916	31 Jul 2001	Qualitative				Very local in wet fen and filled ditches
Stanley & Alder Carrs, Adleby		TM432927	31 Jul 2001	21	19	13.2	8.55	Frequent in mixed fens at western end of site
Barnby Broad & Marshes		TM482906	31 Jul 2001	8	7	9.88	25.3	Locally common in fen in alder carr

Table 7: River Wensum SAC

Location	Habitat Type	Grid Ref	Survey Date	No. of samples	No. of +ve samples	Mean No. of *V. moulinsiana* per sample	*V. moulinsiana* Adult: Juvenile ratio	Comments
Sculthorpe Moor	Dryish mixed fen	TF902300	01 Oct 2001	20	1	0.05	adult	Single individual at TF90322992
Fakenham	*Glyceria* & sedge fen	TF91342981	26 Jul 2001	10	8	8.0	19	Locally frequent
Fakenham	Rich grazing marsh with areas of fen	TF91562966	26 Jul 2001	11	9	9.0	15.5	Locally common
Fakenham	Small fen	TF91402971	26 Jul 2001	5	4	7.2	35	Occasional
Fakenham/Hempton	Sedge & reed fen	TF91442950	26 Jul 2001	8	5	5.75	10.5	Locally common
Gt Witchingham Common	Riverside riparian margins	TG09371784 to 09781772	25 Jul 2001	8	1	0.38	all adult	Occasional
Gt Witchingham Common	Extensive mixed fen	TG097178	25 Jul 2001	11	10	23.2	22.2	Common throughout
Ringland	*Glyceria* & sedge swamp	TG14071369	25 Jul 2001	6	6	36.2	14.5	Common throughout
d/s Ringland	Fen in poplar woodland	TG14191256	25 Jul 2001	4	3	2.75	all adult	Occasional
Taverham	Marginal *Glyceria* swamp	TG15661356 to 16001369	27 Jul 2001	10	6	2.4	23	Occasional
Costessey	Riparian margins of river	TG17601263	27 Jul 2001	6	5	2.17	all adult	Occasional
Drayton	Dense riparian margins of river & adjacent fen	TG18881257 to 18791224	27 Jul 2001	10	8	12.1	19.2	Locally common
Rogers Farm	Riverside ronds	TG193114	01 Oct 2001	6	6	63.5	0.95	Frequent/common on ronds
Hellesdon N of fish farm	*Glyceria* & sedge fen	TG197110	01 Aug 2001	5	5	12.6	all adult	Frequent
Hellesdon	Dense fen in ditch system backing river	TG197110	01 Aug 2001	5	5	27.8	11.6	Frequent or common throughout.
Hellesdon	Riparian margins of river	TG198106	01 Aug 2001	5	5	11.0	17.3	Frequent

Table 8: Stodmarsh SAC

Component	Site	Grid Ref	Survey Date	No. of samples	No. of +ve samples	Mean No. of *V. moulinsiana* per sample	*V. moulinsiana* Adult: Juvenile ratio	Comments
Westbere Marshes	South of River Great Stour	TR202234	14 Nov 1999	39	20	55.2	0.46	Whilst the snail was widespread across the site, the core of the population was located along three ditches in the central part of the area. Although all of these ditches had been recently cleared, broad fringes of *Carex acutiformis* and *Glyceria* remained undamaged.
Westbere Marshes	North of River Great Stour	TR199606	14 Nov 1999	14	9	qualitative		*V. moulinsiana* was found to be widespread and locally common. It was found in a range of habitats including overgrown ditches, fen/carr at the lake margins, and open areas of reedbed with *Glyceria*.

4. Conservation and management

Vertigo moulinsiana may be considered to be a species that is dependent upon conservation and preservation of habitat and is especially vulnerable to a lowering of the water table. Details of suggestions for conservation and management at individual sites are given in the Appendices to this report, but there are a number of general factors applicable at any site which would adversely affect the *V. moulinsiana* populations:

- Changes in hydrology such as water abstraction from rivers or boreholes, deepening of drainage channels, impoundment of river banks, drainage of wetlands generally.
- Changes in land use, eg from rough pasture or meadow to improved grassland.
- Encroachment by scrub which may result in too much shade and drying out of the habitat.
- Over grazing or excessive poaching of ditch margins.
- Introduction of cutting programmes at sites where there is no history of this activity.

As swampy, usually unshaded ground with tall waterside plants is the snail's basic requirement, management should be directed at maintaining these conditions. The water level must remain close to the surface so that the ground remains at least moist for most of the summer, although some seasonal drying appears to be acceptable. The snail will disappear from areas where conditions become dry enough for plants such as nettle (*Urtica dioica*) and great willowherb (*Epilobium hirsutum*) to become frequent. Conversely, conditions must not become so wet that aquatic plants such as watercress (*Rorripa nasturtium-aquatilis*) and fools watercress (*Apium nodiflorum*) take over. High ground-water will contribute to maintaining a high humidity in the vegetation.

Ideally there would be no grazing by domestic stock, although it does live where grazing intensity is low and patchy. Cutting or mowing will remove the tall vegetation that the snail requires. Some fens that are infrequently mown continue to support the snail since the plants are given time to grow up for most of the time. Over-cutting of riparian margins of rivers and tidying of riverside paths are also likely to adversely affect the snail populations.

Light shade is tolerated but scrub, tall trees and tall reed that cast deeper shade may discourage the snail. Scrub on fens may also lead to faster drying-out in summer. The snail is found less commonly in beds of *Phragmites australis*, so this plant should not be encouraged where a good population of the snail lives. A feature of some sites, particularly in the Broads SAC is the presence of populations of *Vertigo moulinsiana* in areas of alder carr. Usually these habitats would be considered to be heavily shaded. However, if the carr remains very wet and is still vegetated by relatively dense areas of sedge, a legacy from when the sites were sedge swamp at the edge of water, the snail continues to survive. Some partial felling may, in the short term, allow the snail's habitat to flourish but in the longer term with advancing succession, such sites are likely to become drier and too shaded to support the snail.

5. Monitoring protocol for *Vertigo moulinsiana*

This section has been written to act as an instruction manual for monitoring the populations of *Vertigo moul;insiana* in the SACs for which the snail is a feature. It has been designed to enable English Nature personnel and skilled volunteer biologists to carry out the sampling entirely in the field. A training course will need to be provided prior to monitoring. This protocol is also being developed and adapted in collaboration with the Environment Agency and English Nature for use in the LIFE in UK Rivers project handbook.

1. Timing and Frequency

Frequency of monitoring is likely to tie in with BAP and Habitats Directive reporting, which are on six year cycles, so either a 3 or 6 year cycle is possible for species monitoring. A 3-year cycle is recommended for *V. moulinsiana* monitoring but the decision remains with English Nature. It is recommended that a more detailed survey is carried out by an independent specialist every 10-15 years.

To enable comparison with the present baseline studies, the samples should be collected between mid- September and late October when the vegetation is tall (prior to collapse by frosts), the snails are high on the vegetation, and the population is usually at its peak.

2. Equipment

The samples are best collected over a plastic sheet. White trays are less suitable as they are not flexible and cannot be manoeuvred into position at the base of dense vegetation. The ideal is a sheet of multi-layered, preferably coloured, heavy-duty polythene, 1.5m x 1.5m in area, sealed at the edges with wide adhesive insulating tape.

Prepare a field recording sheet similar to that used throughout this report.

The blades of *Glyceria* and sedges (especially *Cladium mariscus*) are very sharp and to avoid cuts and lacerations the sampler should have covered arms and wear gloves.

To enable the work to be carried out quickly and accurately requires good eyesight. It is not practical to use a handlens. Wearers of glasses will find it useful to fit a low power (x 2.5) magnification attachment.

3. Monitoring method

There are 3 options for assessing the *V. moulinsiana* population at a site, and the method selected will inevitably depend on time and manpower resources:

1. Simply determine if *V. moulinsiana* is present.
2. Estimate abundance using an ACFOR scale
3. Count individual snails.

Presence/absence assessment (Option 1) can be carried out rapidly and is adequate to confirm the continued survival of *V. moulinsiana* at a given site. The method is also suitable for determining any distributional changes, as more locations in a site can be sampled. Estimating abundance (Option 2) on its own is subjective and actual numbers are invariably

higher than they appear. Option 3 provides the most reliable means of determining the population status, enables comparison with the baseline survey, and any change to be detected. However, abundance data should be evaluated with caution (see section 8 below).

It is recommended that monitoring is carried out principally by a presence/absence assessment but that at least two samples are analysed quantitatively. The number of locations in each site to be sampled are given in the individual SAC site sections, but a minimum of (5-8 presence/absence plus 2 quantitative) is suggested. Larger individual sites (eg Market Weston Fen, Thompson Common, Jones's Mill) may require additional samples to adequately cover the area.

4. Recording environmental variables

Select sample locations with suitable *V. moulinsiana* habitat. At each location record the following:

Vegetation height (m) using a calibrated cane.
Vegetation - principal species composition in order of abundance.
Ground moisture level on a scale of 1-5.

1 Dry. No visible moisture on ground surface.
2 Damp. Ground visibly damp, but water does not rise under foot pressure
3 Wet. Water rises under light pressure.
4 Very wet. Pools of standing water, generally less than 5cm deep.
5 Site under water. Entire sampling site in standing or flowing water over 5cm deep.

5. Snail sampling

Avoid collecting during rainfall or early in the morning when there is a covering of dew. In wet conditions the snails (plus seeds and litter) coagulate or get washed off the sheet.

Spread the sheet at the base of the vegetation and curl up the edges to prevent the sample from rolling off. Bend the vegetation from a strip c. 1 metre wide and 0.5m deep over the sheet and vigorously shake it to release the adhering snails.

Gather up the corners of the sheet to prevent snails from rolling off and bring it up to a comfortable working height (waist level) and resting it on adjacent vegetation.

Remove as much of the vegetative litter (stems and leaves) as possible but inspect it first for adhering snails.

Some samples especially from *Glyceria* may contain huge numbers (sometimes thousands) of the black and orange bug *Ishnodemus sabuleti*. If this is the case, leave the sheet for a few minutes so that they crawl off.

6. Sample analysis

If there is moisture in the sample, the snails will be spread across the sheet. If it is dry then they will tend to aggregate and should be redistributed to make counting easier.

a) Qualitative samples

Record if *V. moulinsiana* is present and note whether the sample contains adults and/or juveniles.
Estimate the abundance using a simple ACFOR scale (e.g <10, 11-50, 51 -100, >100)

b) Quantitative samples

Count all *V. moulinsiana*

The best identification guide for terrestrial molluscs is: *A field guide to the land snails of Britain and north-west Europe* by M.P. Kerney & R.A.D. Cameron, Harper Collins 1979. High quality line drawings of all *Vertigo* species are given in: Pokryszko, B.M., 1990. The Vertiginidae of Poland (Gastropoda: Pulmonata: Pupilloidea) - a systematic monograph. *Annales Zoologici, Warsaw*, **43**: 134-257.

The diversity of molluscs which live on tall, swamp vegetation is relatively low although more may be found in the ground litter. The most common will be succineids (either *Succinea putris* or *Oxyloma pfeifferi*), *Ashfordia granulata*, and *Vertigo moulinsiana*, all of which are easily separable from each other. However, other species with a similar shell morphology to *V. moulinsiana* (particularly *Columella edentula*) may also be present. The features and habitat for these are as follows. *Vertigo* shell nomenclature is shown in Figure 1:

V. moulinsiana	Height 2.2 - 2.7mm. Shell pale brown, smooth, glossy but bleaches with age. Tumid with large body (last) whorl. Aperture with 4, occasionally 5 teeth (1 parietal, 2 palatal, 1columellar)
V. antivertigo	Height 2-2.2mm. Shell dark chestnut to reddish brown. Aperture with 6-10 teeth (at least 2 parietal, 2 palatal, 2 columellar). Lives amongst wet, decaying vegetation on the ground but occasionally climbs on the lower stems and leaves of tall vegetation.
V. pygmaea	1.7-2.2mm. Shell dull, pale to dark brown. A strong, pale transverse rib is present externally a little way behind the outer lip, separated from it by a depression. Aperture with 4-7 teeth (only 1 parietal). Lives mostly in damp grassland and rarely in wet conditions with tall sedge vegetation.
Columella edentula	Larger and broader than Vertigo species (Ht 2.5-3mm, width 1.3-1.5mm), with a cylindrical, pale brown shell. No teeth in aperture. Can be common in V. moulinsiana sites where there are more herbs such as Filipendula or there is shading.
Lauria cylindracea	Larger than any of above (ht 3-4.4mm, width 1,8mm). Pale brown shell with a distinct whitish lip and a single angular tooth linked to the outer lip. Generally lives in much drier or shaded habitats.

In late summer/early autumn the samples are likely to contain significant numbers of juvenile *V. moulinsiana* which should be counted separately from the adults. Juveniles have a more conical shape and do not possess a developed lip or apertural teeth. Juvenile *Columella edentula* are very similar, but normally their numbers are comparatively much lower and, therefore can be ignored.

It is not crucial to record or count the other species of molluscs present in the samples although it would provide useful additional information and in some cases may indicate if the site is becoming ranker or drier. Succineids and *Ashfordia granulata* are common associates and will occur in prime *V. moulinsiana* habitats but also in less favourable. However, ranker sites will often support much higher numbers of *Ashfordia* and also *Columella*. Good indicators of drier or less favourable habitat would be *Lauria cylindracea, Monacha cantiana, Trichia* spp.

7. Monitoring report

A short report should be produced. This should comprise the tables of results along with comparisons of those for all previous years. Until there is information for at least the next ten years it is unlikely that there will be enough data to detect any trends or changes in the *Vertigo moulinsiana* population.

8. Evaluating change

The objective of any monitoring programme is to allow any change to be detected and to ensure that 'favourable conservation status' (FCS) is maintained. A decline in FCS will be apparent from changes to the habitat. Many *V. moulinsiana* sites appear to be relatively homogenous with respect to vegetation, however, the actual distribution and abundance of the snail within the sites is coincidental mostly with the wettest areas. To monitor relatively subtle habitat change on a large-scale would require a detailed baseline survey to map out the site topography and hydrology, botanical community and vegetation structure. Such a proposal is unrealistic and impractical.

A decline in FCS will be evident principally from:

1. A reduction in ground moisture levels below 3 - 5 on the arbitrary scale (i.e. wet or moist conditions with the water level close to the surface for most of the year).

2. An increase in rank herbs such as *Urtica dioica, Petasites hybridus, Epilobium hirsutum* or *Filipendula ulmaria.*

[Most fen or swamp habitats have an undulating topography with small mounds which support patches of *Urtica dioica.* Although these mounds may gradually build-up, it is not considered a problem provided that wetter depressions remain. However, if rank herb species appear in the depressions where none occurred previously, there is strong evidence of drying-out. This should be evident from observed ground moisture levels. A coverage of >10% rank herbs in sites where only sedge and/or *Glyceria* existed would indicate a decline in FCS]

3. A significant rise in water levels or flow rate such that aquatic plants such as Watercress (*Rorripa nasturtium-aquatilis*) and Fools Watercress (*Apium nodiflorum*) take over.

[Evidence from sites along the Newbury by-pass has shown that an increase in these species may only be a temporary phenomenon during periods of high water flow. However, growth is rapid with the effect that it smothers, and in some cases, kills off *Glyceria.* When flow rates subside, the cress dies back and the *Glyceria* recovers. If flow rates of water through a

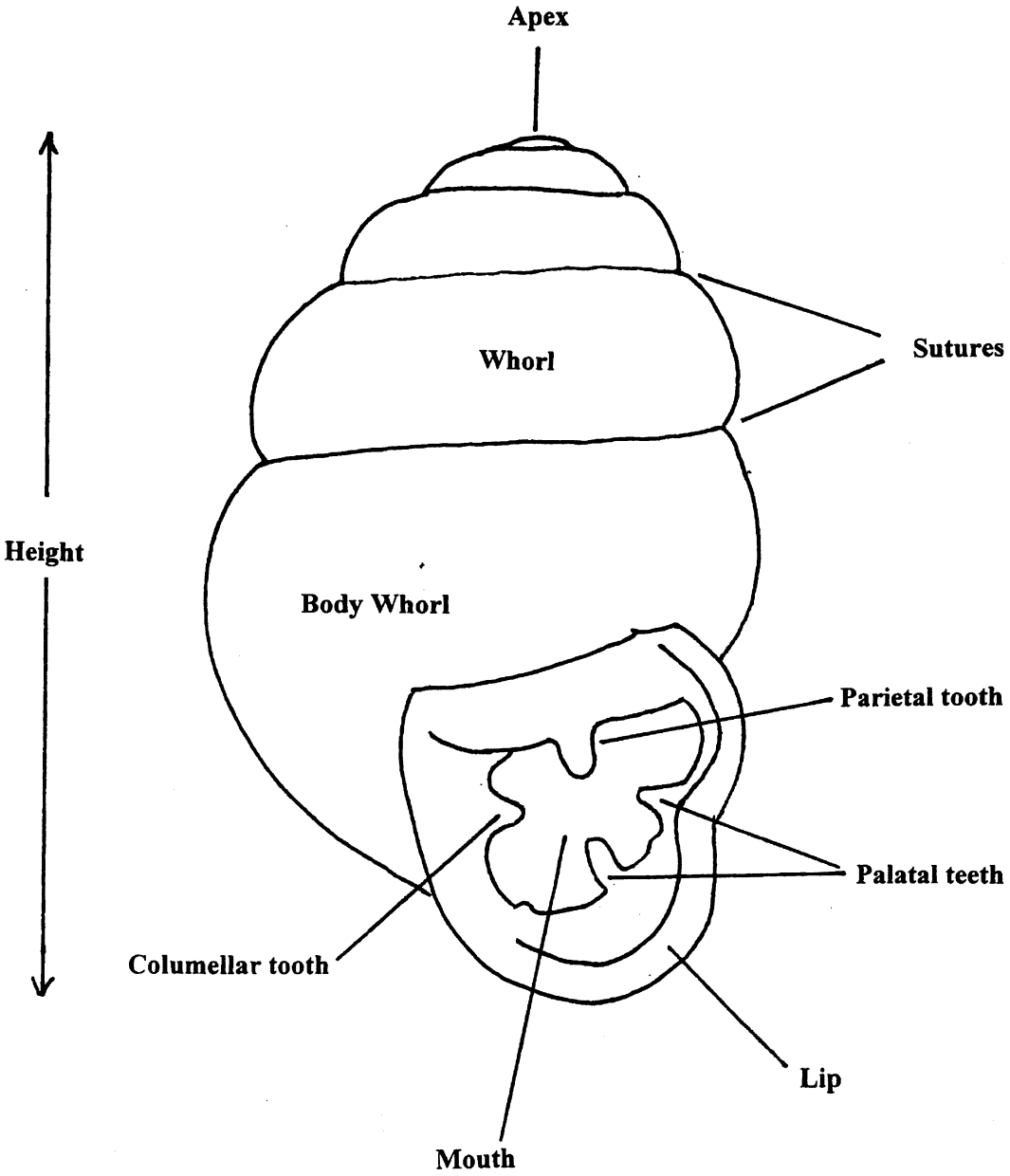
site are permanently increased, cress may become more of a problem and some remedial action such as clearance or control of the water may be required]

The *Vertigo moulinsiana* populations are very likely to have good years, eg during wet, humid summers, or bad years particularly during periods of drought or following grazing or mowing. Fluctuations in abundance are naturally occurring phenomena and therefore a year with very low numbers recorded should not necessarily be interpreted as a long-term population decline. This does, however, present problems with monitoring intervals of 6 years.

Work on the Newbury bypass sites in the Kennet & Lambourn Floodplain SAC has shown that the abundance of *V. moulinsiana* can fluctuate greatly from month to month, and from year to year (eg Killeen & Stebbings 2000, Stebbings & Killeen 1998). This detailed monitoring has shown that whilst the snail may be found throughout the year, numbers are generally low from late spring to mid summer, but may increase dramatically through September and October when high numbers of juveniles are present, following the species' main breeding event. Therefore, results from a monitoring programme which includes comparison of abundance of individuals or the structure of the population need to be evaluated in light of potentially significant seasonal and year on year differences (see Section 3).

The abundance of *V. moulinsiana* varies from site to site and therefore no single figure can be used to determine an acceptable lower limit for the mean number of snails per sample. A reduction in abundance of greater than 75% of those recorded in the 2000 and 2001 baseline surveys may indicate a decline, but may merely be indicative of a 'bad year'. If significantly lower numbers of individuals are recorded in a year where there are no long periods of drought, and there is no change in habitat FCS, then the monitoring should be repeated the following year. If the low numbers persist then there may be cause for concern.

Figure 1: *Vertigo* shell nomenclature



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