Monitoring Desmoulin's Whorl Snail

Vertigo moulinsiana

Conserving Natura 2000 Rivers

Monitoring Series No. 6

Monitoring Desmoulin's Whorl Snail

Conserving Natura 2000 Rivers Monitoring Series No. 6

IJ Killeen and E A Moorkens

For more information contact:
The Enquiry Service
English Nature
Northminster House
Peterborough
PE1 1UA
Email: enquiries@english-nature.org.uk
Tel: +44 (0) 1733 455100
Fax: +44 (0) 1733 455103

This document was produced with the support of the European Commission's LIFE Nature Programme. It was published by **Life in UK Rivers**, a joint venture involving English Nature (EN), the Countryside Council for Wales (CCW), the Environment Agency (EA), the Scottish Environment Protection Agency (SEPA), Scottish Natural Heritage (SNH), and the Scotland and Northern Ireland Forum for Environmental Research (SNIFFER).

ISBN 1 85716 729 5

A full range of **Life in UK Rivers** publications can be ordered from:
The Enquiry Service
English Nature
Northminster House
Peterborough
PE1 1UA
Email: enquiries@english-nature.org.uk
Tel: +44 (0) 1733 455100
Fax: +44 (0) 1733 455103

This document should be cited as: Killeen IJ & Moorkens EA (2003). Monitoring Desmoulin's Whorl Snail, *Vertigo moulinsiana*. Conserving Natura 2000 Rivers Monitoring Series No. 6, English Nature, Peterborough.

Technical Editor: Lynn Parr
Series Ecological Coordinator: Ann Skinner

Cover design: Coral Design Management, Peterborough.
Printed by Astron Document Services, Norwich, on Revive, 75% recycled post-consumer waste paper, Elemental Chlorine Free. 1M.

Cover photo: Roger Key/English Nature

Conserving Natura 2000 Rivers

This protocol for monitoring Desmoulin's whorl snail (*Vertigo moulinsiana*) has been produced as part of **Life in UK Rivers** – a project to develop methods for conserving the wildlife and habitats of rivers within the Natura 2000 network of protected European sites. The project's focus has been the conservation of rivers identified as Special Areas of Conservation (SACs) and of relevant habitats and species listed in annexes I and II of the European Union Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) (the Habitats Directive).

One of the main products is a set of methods for monitoring species and habitats, which complements reports containing the best available information on their ecological requirements. Each report has been compiled by ecologists who are studying these species and habitats in the UK, and has been subject to peer review, including scrutiny by a Technical Advisory Group established by the project partners. In the case of the monitoring techniques, further refinement has been accomplished by field-testing and by workshops involving experts and conservation practitioners.

Conservation strategies have also been produced for seven different SAC rivers in the UK. In these, you can see how the statutory conservation and environment agencies have developed objectives for the conservation of the habitats and species, and drawn up action plans with their local partners for achieving 'favourable conservation status'.

Life in UK Rivers is a demonstration project and, although the reports have no official status in the implementation of the directive, they are intended as a helpful source of information for organisations trying to set conservation objectives and to monitor for 'favourable conservation status' for these habitats and species. They can also be used to help assess plans and projects affecting Natura 2000 sites, as required by Article 6.3 of the directive.

Favourable conservation status

The purpose of designating and managing SACs is to maintain at, or restore to, 'favourable conservation status' the habitats and species listed on annexes I and II of the directive.

The conservation status of a natural habitat can be taken as favourable when:

- Its natural range and areas it covers within that range are stable or increasing.
- The specific structure and functions necessary for its long-term maintenance exist and are likely to exist for the foreseeable future.
- The conservation status of its typical species is favourable.

The conservation status of a species may be taken as favourable when:

- Population data indicate that the species is maintaining itself on a long-term basis as a viable component of its natural habitats.
- The species' natural range is neither being reduced nor is likely to be reduced for the foreseeable future.
- There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

The conservation status of a species or habitat has thus to be assessed across its entire natural range within the European Union, in both protected sites and the wider countryside, and over the long term.

Monitoring techniques

The Habitats Directive requires the condition of the habitats and species for which an SAC has been designated to be monitored, so that an evaluation can be made of the conservation status of these features and the effectiveness of management plans. An assessment of conservation status must, therefore, be applied at both site and network level.

Standard monitoring methods and a coherent assessment and reporting framework are essential to

allow results to be both compared and aggregated within and across EU member states.

While the directive outlines the data reporting required from member states at a national level, it did not set out detailed assessment techniques for data collection at habitat and species level.

The Conserving Natura 2000 Rivers series of monitoring protocols seeks to identify monitoring methods and sampling strategies for riverine species and the *Ranunculus* habitat type that are field-tested, cost-effective, and founded on best scientific knowledge.

Titles in the monitoring and ecology series are listed inside the back cover of this report, and copies of these, together with other project publications, are available on the project website: www.riverlife.org.uk.

Contents

1. Introduction

Desmoulin's whorl snail, *Vertigo moulinsiana* (Dupuy 1849) is scheduled on Annex II of the European Habitats Directive, listed in the British Red Data Book (Bratton 1991) as an RDB 3 (Rare) species, and included on the UK Biodiversity Action Plan shortlist of priority species (HMSO 1996). There is considerable evidence that this diminutive wetland snail is declining throughout its European range (Killeen 1995).

While there are many large populations of *V. moulinsiana* in southern and southeast England, it may be the most vulnerable of the four Habitats Directive *Vertigo* species in the UK, due to pressure for water use, particularly from abstraction. The UK has an international as well as a national responsibility to conserve this species (Killeen 2003a).

Desmoulin's whorl snail inhabits calcareous wetlands mainly in southern and eastern England. It occurs in swamps, fens and marshes bordering rivers and lakes, where it is found on both the living and dead stems and leaves of tall plants. These include grasses such as reed sweet-grass (*Glyceria maxima*), sedges such as greater pond sedge (*Carex riparia*), lesser pond sedge (*C. acutiformis*) and great fen-sedge (*Cladium mariscus*), yellow flag (*Iris pseudacorus*), branched bur-reed (*Sparganium erectum*) and reeds (including *Phragmites australis*).

In spring, the snails are found low down, principally on the stems and leaves of monocotyledons. They then climb the plants during the summer and autumn, and can reach a height of up to 2 m above ground level. With the onset of winter the snails descend to lower levels again, and they over-winter in the lower leaves, stems and available litter.

Seven Special Areas of Conservation (SACs) have been proposed for this species in England, and one in Wales as follows:

England: River Avon; Kennet and Lambourn Floodplain; Norfolk Valley Fens; Waveney and Little Ouse Valley Fens; The Norfolk Broads; River Wensum; Stodmarsh.

Wales: Lleyn Fens.

This report describes a standardised protocol for monitoring the conservation status of Desmoulin's whorl snail populations in the SACs for which it is a feature, to ensure that the species is maintained at favourable conservation status, as required under the Habitats Directive. It should be read in conjunction with the ecological requirements of the species (Killeen 2003b).

The protocol has been designed to enable trained staff from the conservation agencies and skilled volunteer biologists to carry out the sampling entirely in the field. It is designed for use only in the peak *V. moulinsiana* climbing season (as outlined below) and should not be used at other times, as the snails will be low on the vegetation and surveying activities may damage the habitat.

2. Objectives and key monitoring targets

2.1 Objectives

This report aims to:

- Utilise non-destructive sampling techniques.
- Obtain immediate results from field survey.
- Confidently interpret a condition assessment.
- Provide information to enable management recommendations.

Results may be aggregated to enable the assessment of conservation status of the species across its

range in the UK and Europe. This protocol also provides a model for use at undesignated sites and in other European countries.

2.2 Key monitoring targets

Information on the ecological requirements of Annex II species has been used to derive generic conservation objectives for use in the UK. A measure of how well the conservation objectives are being met will be used for condition assessment. Conservation objectives are set for each site, and the regular examination of key population and habitat features at each site allows a judgement to be made regarding whether each site/population is in favourable condition.

Condition assessment is then recorded using one of four categories:

- Favourable
- Unfavourable
- Partially Destroyed (habitats)
- Destroyed (habitats).

The unfavourable category is further sub-divided:

- Declining
- Maintained
- Recovering.

This protocol can be used to define conservation status at each individual site, and the results for various sites can then be aggregated to assess the status of the population across the snail's UK and European range.

The key monitoring targets are given in Table 1.

Table 1. Key monitoring targets

Attribute	Target
Area of occupancy of *V. moulinsiana*	No decrease in area of occupancy.
Population density	No decrease in population density at site.
Vegetation height	No decrease in vegetation height at site.
Species composition	No reduction in class level of dominant species (see Table 3).
Ground moisture levels	No drying of ground moisture levels; no increases to level 5 (see Section 9.2).
Scrub cover of site	No increase in scrub at site.

3. Background to the protocol

This protocol is based on the best available science, and was developed following a review of European surveys and methodologies from the last 10 years, with particular emphasis on non-destructive techniques.

The basis of the protocol is that the conservation status of populations at each site will be assessed by:

- Establishing a baseline of information (area and pattern of occupancy, relative abundance and habitat quality) within each component of each SAC.
- Establishing semi-permanent transects in representative areas of each SAC.
- Carrying out yearly surveys to enable an annual comparison of the data collected in each component of each SAC with the baseline.

V. moulinsiana is an annual species, and therefore needs to reproduce successfully each year. The species may be very quickly lost from a site if conditions become unsuitable. The hydrological requirements for the species are essentially transitional between terrestrial and aquatic; and the preferred vegetation is not a climax community, so long-term maintenance is required to prevent succession. Annual survey is therefore a requirement until it is proven that a stable hydrological and management regime has been established to maintain the species in favourable conservation status at each site. The transects are semi-permanent, and remain in place unless the habitat is altered by external factors, or by excessive sampling over time. If the transect is no longer representative of the site, a new semi-permanent transect should be established.

The data generated must be robust enough to trigger alarm signals when levels of acceptable change have been reached or exceeded. These relate to the condition assessment classification of each site (Table 2). The surveys should provide a comparison with the baseline using the following measures:

Population

- Area of occupancy (number of sample points along the semi-permanent transects that have positive records for *V. moulinsiana*).
- Relative abundance of population (by classifying *V. moulinsiana* into abundance classes at each sample point along the semi-permanent transects).

Habitat

- Vegetation height (measurement made at each sample point along the semi-permanent transects).
- Vegetation species composition (by classifying species present at each sample point along the semi-permanent transects).
- Ground moisture levels (by classifying moisture levels at each sample point along the semi-permanent transects).

Scrub cover (by estimation of scrub encroachment within the overall site by aerial photography).

Other Information (for use in condition assessment and management recommendations):

- Site management (from observations during survey and from information from landowners).
- Hydrological information (records from dipwells and river gauges).

4. Survey types

4.1 Initial survey

An initial survey must first be undertaken to determine the distribution of Desmoulin's whorl snail populations within each SAC. This information will then be used to determine the number of monitoring areas, the number and type of transects, and their location (see Section 8.1).

Note: the location of Desmoulin's whorl snail populations within SACs, and their distribution within individual SAC component sites, has, to a large extent, been determined in England through surveys undertaken for English Nature in 2000/01 (see Section 15).

4.2 Full quantitative survey (Level 1)

Once the number of monitoring areas, the number and type of transects and their location have been determined, and the permanent monitoring transects have been established, a full quantitative survey of the snails (with detailed recording of environmental variables) must be undertaken. Accuracy is critical

Table 2. Condition assessment determinants.

Condition	Population	Vegetation	Ground moisture levels
Favourable	No change, increasing, or no more than 20% decrease in area of occupancy. No change, increasing, or no more than 20% decrease in population density.	Species composition – No more than 20% replacement of the baseline dominant species with a species of a lower class (see Table 3). No increase in scrub cover at site.	80% or more of baseline samples noted as 2–4* still have these ground moisture levels (*ground moisture scale): 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 5 cm deep.** 5. Site under water. Entire sampling site in standing or flowing water over 5 cm deep.
Unfavourable	Area of occupancy declined by 21–40% from baseline. Population density category lower than baseline in 21–40% of samples.	Species composition – dominant species changed from baseline to lower class in 21–40% of counts. Increase in scrub cover at site.	60–79% of samples with ground moisture levels of 2–4 in baseline still the same.
If unfavourable condition has been recorded, the following year's condition assessment is determined by the following:			
Unfavourable: declining	Area of occupancy declined by >10% from last unfavourable assessment. Population density declined by >10% from last unfavourable assessment.	Species composition – dominant species changed to a lower class in >10% of counts compared to last unfavourable assessment. Increase in scrub cover at site.	Ground moisture levels decline from last unfavourable assessment in >10% of samples.
Unfavourable: maintained	Area of occupancy <10% decline from last unfavourable assessment. Population density <10% decline from last unfavourable assessment.	Species composition <10% decline from last unfavourable assessment. Scrub cover of site not significantly changed from last unfavourable assessment.	Ground moisture levels declined <10% from last unfavourable assessment.

Condition	Population	Vegetation	Ground moisture levels
Unfavourable: recovering	Area of occupancy increasing from last unfavourable assessment. Population density increasing from last unfavourable assessment.	Species composition: higher-class species increasing in dominance from last unfavourable assessment.	Ground moisture levels closer to baseline values compared with last unfavourable assessment.
Partially destroyed	Area of occupancy reduced by >40% from baseline. Population density category lower than baseline in >40% of counts.	Species composition – dominant species changed from baseline to lower class in >40% of samples. Scrub cover dominating 40% of habitat known from initial survey.	<60% of samples with ground moisture levels of 2–4 in baseline still the same.
Destroyed	*V. moulinsiana* no longer present at site	Vegetation no longer capable of supporting *V. moulinsiana* population.	Water regime too dry or too wet to support *V. moulinsiana*.

as this will act as the baseline against which all future results will be measured. It is essential that this work is carried out during appropriate and representative weather conditions for that site (not during an unusual drought or an excessively wet period). A Level 1 survey is recommended every six years, or if triggered by a 'partially destroyed' or repeated 'unfavourable declining' assessment (see Section 13.2).

4.3 Annual survey (Level 2)

The Level 2 survey should be carried out on an annual basis, until a stable hydrological and management regime has been established that maintains the species in favourable conservation status at each site.

Information on snails is recorded using three abundance classes, with environmental variables recorded at 5 m or 10 m intervals along the transects. The combination of the data from both Level 1 and Level 2 surveys will enable the site to be placed in the condition category (Table 2).

5. Preparation

Surveyors who have had no previous experience of locating and identifying Desmoulin's whorl snail must be provided with a training course to ensure consistency in sampling and identification techniques.

All survey work should be carried out under the direction of the conservation agencies. It is essential that permission for access be obtained beforehand from the landowner(s).

Location of permanent marker posts should be agreed with the landowner(s), but must reflect the required *V. moulinsiana* transect to be surveyed. Plastic posts are less likely to rot in the wet habitats where this species is located. If cattle use the site, the posts should be fenced off, or permanent features should be used as markers.

When the locations of the semi-permanent transects have been established following the initial survey, an assessment should be made by a hydrologist to recommend the location of monitoring boreholes with shallow and/or deeper standpipes in places where their levels may be read. This will connect the transect information collected with information on the hydrogeological regime that controls the *V. moulinsiana* habitat. Dipwell levels should be read on a monthly basis or fitted with automatic

dataloggers to allow less frequent site visits. Dipwells may already be present for other purposes, and these will suffice for the purpose of this protocol only if they give information on the regime that influences the snail habitat. Dipwells should be placed approximately 10 m from the midpoint of one (or more, if the hydrological regimes governing the transect sites are different) of the transects at each site.

A water depth gauge should be located in the river at the nearest point to one transect per site and levels recorded during the annual survey in August each year, and once during the winter (high-flow) period. If gauge and flow data are available for the relevant surface water regime for a site, then this will provide the required information and additional gauges will not be required. Ambient conditions (for example, normal, drought, flood), related to water depth should be noted, as should the role of any water-level control systems affecting the site.

6. Equipment

Essential equipment for survey work is as follows:

- Large sheet of heavy-duty polythene, preferably of a light (white, blue or grey) colour. The polythene should be folded to make a sturdy but flexible sheet approximately 1.5 m x 1.5 m, sealed at the edges with wide adhesive insulating tape.
- A white plastic tray (50 x 40 cm, 2 cm deep) for initial survey.
- Hand-held Global Positioning System (GPS) receiver.
- Tape measure (30 or 50 m length) for measuring transect sampling distances.
- Cane or 2 m ruler to measure vegetation height, calibrated at 10 cm intervals.
- Identification guide.
- Field recording sheets.
- Waterproof clipboard.
- Strong protective gloves.
- Digital camera.
- Map of site showing NVC vegetation communities (if available), distribution of the snail (if known) and location of sampling areas.
- Detailed aerial photographs.
- Magnification attachment (x 2.5)*.
- Hand lens*.

*Note: Good eyesight is required to carry out the work quickly and accurately. It is not practical to use a hand lens, although this will help with field identification. Wearers of glasses will find it useful to fit a low-power (x 2.5) magnification attachment. Surveyors with good eyesight will also find it useful to wear a headband with a x 2.5 magnification attachment.

7. Timing

The methodology is designed to be used in mid- to late Summer (August) when the vegetation is at its peak, the snails are high on the leaves and the population is dominated by adult individuals. Earlier in the year the snails will be lower on the vegetation and often present in very low numbers. Later in the year (autumn), the vegetation may have started to die off, and the snail population may contain large numbers of very small juveniles. As it is most important to repeat surveys at the same time each year, it is recommended that annual surveys take place in August. Quantitative surveys (every six years)

should take place after the annual survey, to count juvenile as well as adult snails. These surveys should take place between 20th September and 31st October (after the main period of reproduction has taken place).

Sampling should **never** be carried out during the following weather conditions:

- Rainfall.
- Strong winds.
- Early morning dew cover.

In wet or dewy conditions the snails are more difficult to release from the vegetation, the seeds and plant litter coagulate or get washed off the sheet, and the snails may crawl lower down the leaves. Snails will also seek shelter during high winds, and dry snails can be blown off the sheets while they are being counted in windy conditions.

8. General methodology

8.1 Initial survey

As part of the initial survey, detailed maps should be prepared for each SAC showing the extent of suitable vegetation (in the UK, preferably describing National Vegetation Classification [NVC] vegetation type, although a JNCC Phase 1 habitat survey map may be adequate) and the known distribution of snail populations. Although the distribution within SACs may be relatively well known, some further survey will be required to determine the location and shape of the permanent monitoring lines. If components with no previous data are to be selected for monitoring, the following method should be adopted:

- Obtain a large-scale map of the site, plus, if available, vegetation maps (Phase 1 or NVC in the UK) and aerial photographs. Select areas of the most suitable Desmoulin's whorl snail habitat (wet, *Glyceria* or sedge-dominated), plus marginal habitat (for example, fen/swamp to herb fen transition). The number of locations to be sampled will be determined by the size of the area and the extent of suitable habitat, but at least 10 locations should always be sampled.
- Mark each location on the map and take a GPS (minimum 8-figure) reading.
- Choose a suitably sized area (for example, 10 m x 10 m, 10 m x 5 m) and record the principal vegetation type.
- Record ground moisture levels (see Section 9.2).
- At five places within each area, record presence/absence of Desmoulin's whorl snail by beating vegetation over a white plastic tray.

8.2 Selecting monitoring sites

At most sites it will be possible to set out linear and/or cruciform transects.

In large sites with relatively homogenous habitat, a single 100 m transect may be adequate. In smaller sites where there is greater variation in plant community, topography and hydrology, it may be more appropriate to use shorter parallel transects, cruciform transects or a combination of the two.

Examples of the different types of transect are shown in Figure 1. Whichever method is chosen, the transect lines should be long enough to enable 20–25 replicates (40–50 samples, sufficient for statistical analysis) to be taken at regular (5 or 10 m) intervals. Very large sites may require more samples.

The ends of each transect should be marked with permanent, sturdy (cattle- and vandal-proof) fence posts. If the transects are longer than 50 m, an intermediate post should be installed. The co-ordinates

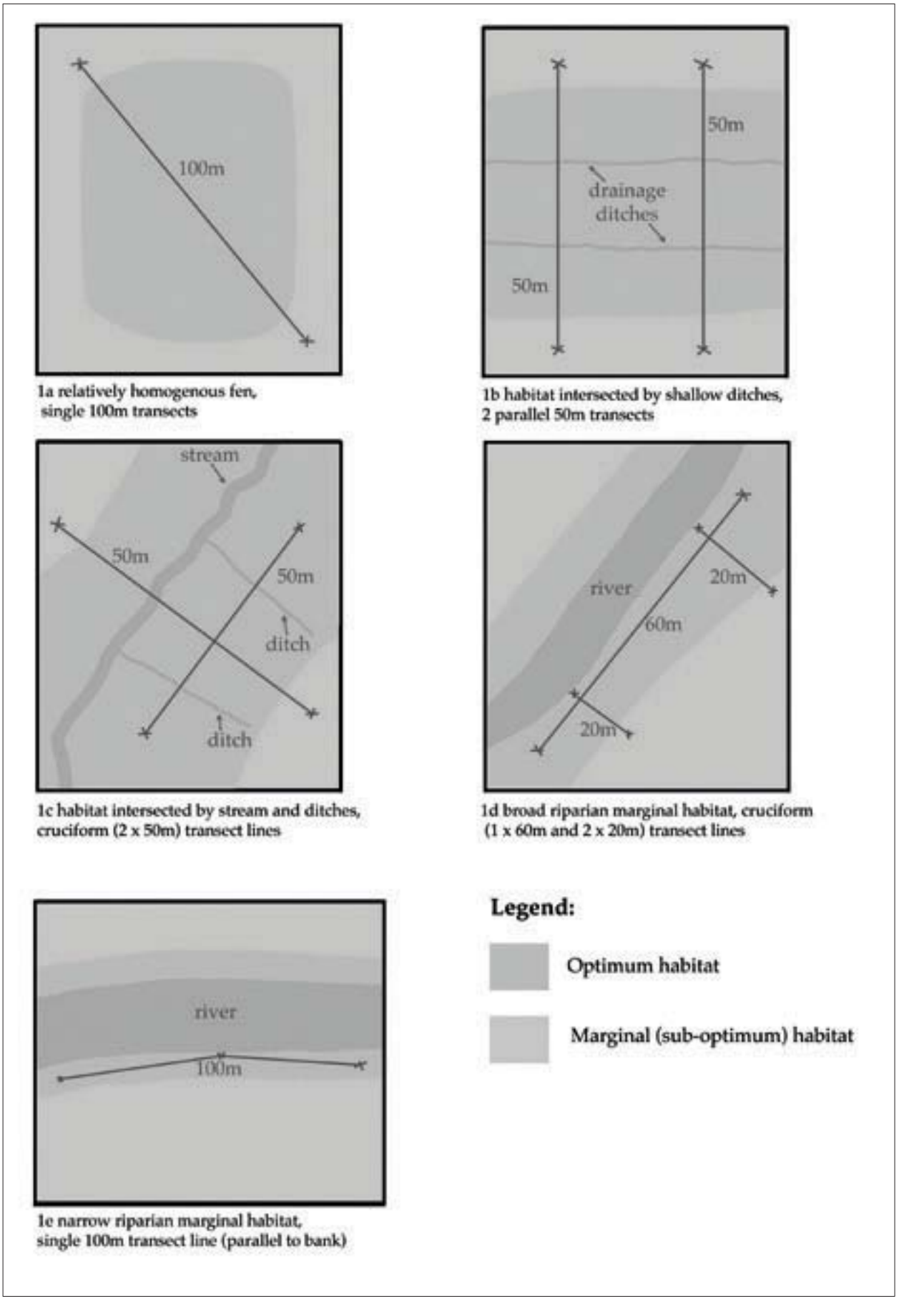


Figure 1. Examples of different types of transect.

of each marker should be accurately located with a GPS. Gauging boards and dipwells for hydrological monitoring are discussed in Section 5.

8.3 Full quantitative survey (Level 1)

Following the installation of the permanent posts, a full survey of both snails and environmental variables must be undertaken along each transect line. All Desmoulin's whorl snails in each replicate along each transect must be counted and classed as adult or juvenile. This work must be carried out by a specialist with experience of this species ideally working in conjunction with conservation agency personnel.

Take a wide-angle digital photograph of the habitat along the transect line. Stretch a tape measure (preferably 50 m long) between the permanent marker posts, taking care not to trample the ground along the transect line. Replicate snail sampling and environmental data should be recorded at either 5 m or 10 m intervals, depending upon the length of the transect and the homogeneity of the habitat. The intervals should be 5 m if the vegetation and/or topography changes along the transect, and at 10 m if vegetation and topography are similar throughout. Starting at one post (0 m), record the environmental variables (see Section 9) and sample for snails (see Section 10) at any location between 1m and 5m either side of the centre line. Repeat until the end of the transect is reached. At alternate sample locations, take a photograph of the habitat surveyed at one of the replicate points. An example of a transect with snail sampling and photograph locations is shown in Figure 2.

8.4 Level 2 survey

Carry out as for Level 1 survey, but record adult *V. moulinsiana* according to three abundance classes (0, <10 and >10) and juveniles as present/absent. At alternate sample locations, take a photograph of the habitat surveyed at one of the replicate points.

9. Survey methodology for environmental variables

Information on habitat structure and quality is required to assist with the interpretation and evaluation of the population data collected.

At each sample point, the following information should be recorded, using the standard form included in Section 12.

9.1 Vegetation

Measure the average height (m) of the main vegetation components within the sample (before beating) using a 2 m ruler or a cane calibrated to 10 cm intervals. This measurement will not be used in the condition assessment, but will give valuable information if an investigation is triggered by a negative assessment (see Section 13.2).

Record the dominant plant species, and then other plants. There will usually be no more than five plant species present. The class level of the most dominant plant species will be used in the condition assessment (Table 3).

A further check on the vegetative cover of the whole SAC should be undertaken by comparing aerial photographs (preferably colour photographs taken at 1:10,000-scale during summer) at 10-year intervals to examine the extent of scrub, tree and tall reed cover. Historical aerial photographs should be made available for comparison.

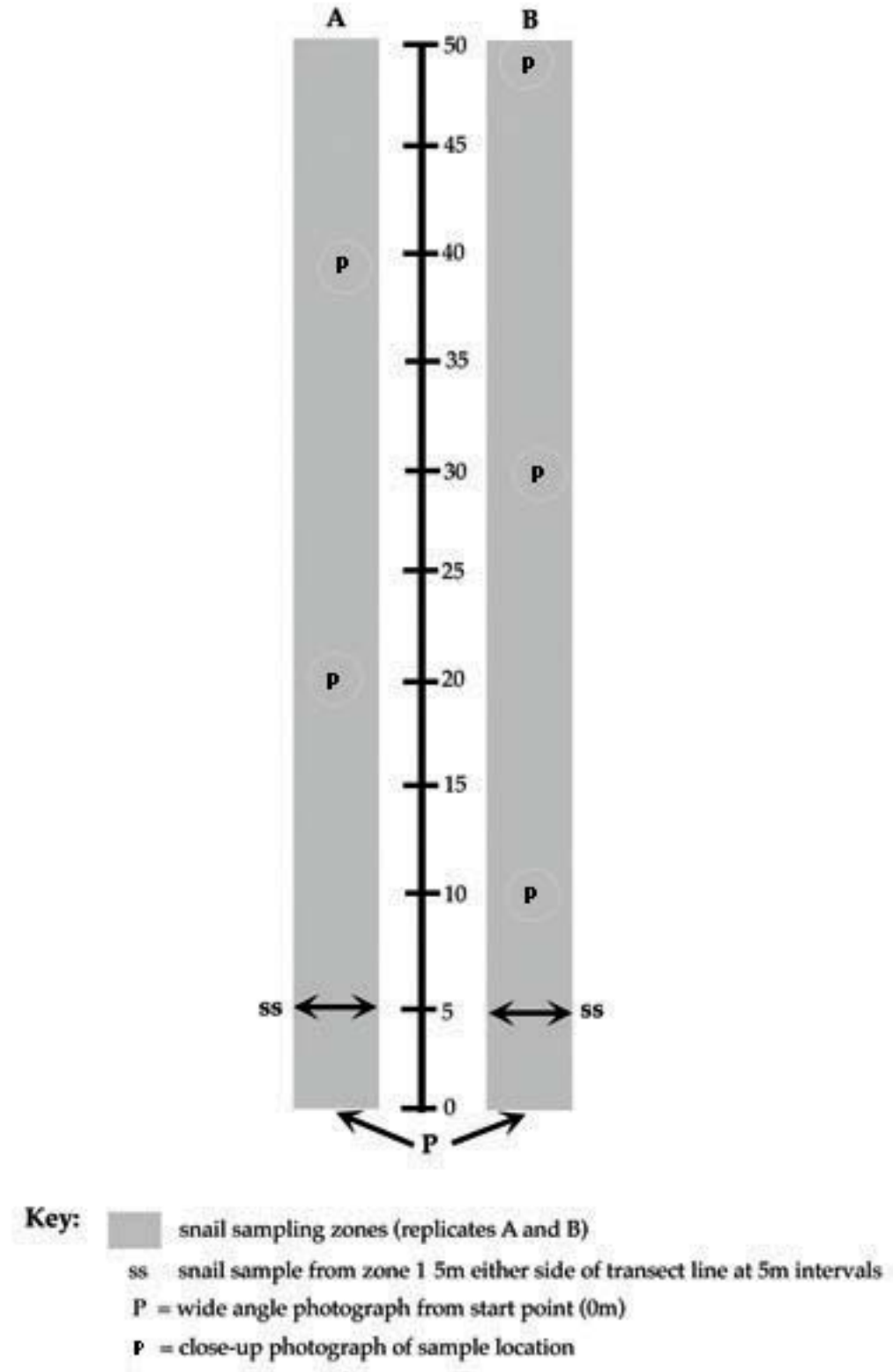


Figure 2. A typical 50 m transect.

Table 3. Classification of plant species in *V. moulinsiana* habitats.

Class I	**Class II**
Reed sweet-grass (*Glyceria maxima*) Lesser pond-sedge (*Carex acutiformis*) Tufted sedge (*Carex elata*) Greater tussock-sedge (*Carex paniculata*) Greater pond-sedge (*Carex riparia*) Great fen-sedge (*Cladium mariscus*)	Reed canary-grass (*Phalaris arundinacea*) Common reed (*Phragmites australis*) Branched bur-reed (*Sparganium erectum*) Meadowsweet (*Filipendula ulmaria*) Stinging nettle (*Urtica dioica*)
Class III	**Class IV**
Water-mint (*Mentha aquatica*) Ambibious bistort (*Persicaria amphibium*) Willowherbs (*Epilobium* spp.)	*All other species*

9.2 Ground moisture level

Ground moisture levels should be recorded on a scale of 1–5 at each replicate sampling point:

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 5 cm deep.
5. Site under water. Entire sampling site in standing or flowing water over 5cm deep.

Suitable ground moisture levels for Desmoulin's Whorl snail are levels 2–4, and compliance with this range is used in the condition assessment.

9.3 Fixed-point photography

On each monitoring occasion fixed-point photographs should be taken using a digital camera, as described in Section 8.

9.4 Timing and weather conditions

Avoid wet and windy conditions, and early mornings with dew. Date, time and weather conditions at the time of survey should be recorded, and must comply with the restrictions outlined in Section 7.

9.5 Management

Site management (grazing or mowing) at the time of survey should be recorded.

10. Sampling methodology

10.1 Initial baseline survey

Hold the white plastic tray near the base of the vegetation. Bend the vegetation over the tray and shake it vigorously. Record whether Desmoulin's whorl snail is present or absent. If present, assign to approximate abundance categories (0, <10, 10-25, >25).

10.2 Level 1 and Level 2 surveys

At the selected sample point, spread the polythene sheet at the base of a 'wall' of the vegetation and curl up the edges to prevent the sample from rolling off. Bend the vegetation from a measured strip 1 m long and 0.5 m wide over the sheet and vigorously shake or beat it for 10–20 seconds to release the adhering snails. **Note: Do not sample from wet, decaying leaf litter at ground level**.

Gather up the corners of the sheet to prevent the snails from rolling off. Either kneel on the ground or bring it up to a comfortable working height (waist level), resting it on the adjacent vegetation. Remove as much of the vegetative litter (stems and leaves) as possible, after careful inspection for adhering snails. Note that Desmoulin's whorl snail will also adhere to other species of snails in the sample.

Some samples, especially from reed sweet-grass, may contain huge numbers (sometimes thousands) of the black and orange bug *Ishnodemus sabuleti*, an introduced species. If this is the case, leave the sheet for a few minutes until they have crawled off.

If there is moisture in the sample, the snails will be spread across the sheet. If it is dry, they will tend to aggregate and should be gently redistributed to make counting easier. Alternatively, samples may be transferred to a white plastic tray for sorting and counting.

Level 1 quantitative sampling should only be carried out by molluscan specialists, experienced in surveying *V. moulinsiana*. For this survey, all Desmoulin's whorl snails (adults and juveniles separately) are counted. Numbers of juveniles will demonstrate the variation in reproductive success across the site, which can be related to the condition of the habitat. The presence/absence of other mollusc species and changes in species composition (to drier/wetter tolerant species) along the transect and over time will also aid in the assessment of habitat condition over the long term.

For Level 2 surveys, record the numbers of adult Desmoulins' whorl snails according to three abundance classes (using the standard recording form in Section 12): 0; 1–10 adult individuals, >10 adult individuals.

In Level 2 surveys juveniles are not included in counts for abundance classes, but their presence must be noted on the recording form. Juveniles are distinguishable from adults by their smaller size, flattened shape, lighter colour and the lack of a developed lip or apertural teeth (Appendix 3).

Shake the sheet carefully between each sample to return the sample and clear the debris.

11. External data requirements

To evaluate the population information it is important to obtain weather data, particularly rainfall and temperature, and information on water quality. Data should be obtained from the nearest meteorological station, and the nearest available Environment Agency gauging station (or on-site river gauge) or water quality monitoring site. Data regarding groundwater levels is obtained from dipwells, as outlined in Section 5. A file containing these external data, along with annual survey results, should be retained by the responsible agency. The data handling of the file is discussed in Section 12.2.

12. Analysing data and reporting

12.1 Standard recording forms

Standard recording forms should be compiled following the initial survey and transect set-up at each SAC. The forms should follow the format in figures 3 and 4, and be adjusted to allow for the number of sampling points and the number of transects at each site. This should be done by the responsible conservation agency, which will hold the file on an ongoing basis. The completed forms should be returned to the same office and a copy held in the file.

12.2 Data analysis

The responsible conservation agency office will transfer the dataset from the completed recording forms on to an electronic database. The data compiled each year must be compared with the baseline data (or previous years' data, if an unfavourable assessment has been made) in order to establish conservation status each year (see format of Figure 5). This must include snail occupancy and number class, vegetation dominance and moisture class, as shown in Table 2.

Site records should be in an appropriate format for input to a GIS database (MapInfo and/or Arcview), linked to data stored in Excel spreadsheets. In the UK, it is vital that data are regularly and routinely exchanged between the country conservation agencies and the Environment Agency, the local Biological Record Centre and the National Biodiversity Network.

All transect and other photographs taken at each SAC should be kept in a digital archive for future reference.

12.3 Quantitative surveys

The results of each six-year quantitative survey, and any quantitative survey initiated by a trigger as shown in Table 2, should be accompanied by a report incorporating an assessment of probable causes of changes to habitat and recommendations for remedial measures where necessary. The expert commissioned to carry out this work should be given full access to the data on file for the site. The report should also deal with the interpretation of aerial photography, with recommendations on counteracting potential problems such as scrub cover.

Name of SAC:		
Name of component site:		
Date of survey:		
Surveyor:		
Transect Number:		
GPS Co-ordinates	Start Point – 0 m	
	Mid-point e.g. 50 m	
	End point e.g. 100 m	
Weather conditions at time of survey:		
Management:	Light grazing (cattle, sheep, horse)	
	Heavy grazing/poaching	
	Weed cut	
	Mowing/cutting	
General habitat description:		

Snail and environmental data: A = replicate sample taken from left side of centre line
B = sample from right side of centre line (from 0 m)

Location	Replicate	Ht (m)	Dominant plant	Other plants in order of abundance	Moisture	Adult	Juvenile	Other molluscs	Photo
0 m A									
0 m B									
5 m A									
5 m B									
10 m A									
10 m B									
Etc.									

Moisture:

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 5 cm deep.
5. Site under water. Entire sampling site in standing or flowing water over 5 cm deep.

Dominant plant:

Gl	*Glyceria maxima*	Pg	*Phragmites australis*
Ca	*Carex acutiformis*	Ep	*Epilobium* spp.
Ce	*Carex elata*	Fi	*Filipendula ulmaria*
Cp	*Carex paniculata*	So	*Solanum dulcamara*
Cr	*Carex riparia*	Sp	*Sparganium erectum*
Cm	*Cladium mariscus*	Po	*Persicaria amphibium*
Ud	*Urtica dioica*	Ma	*Mentha aquatica*
Ph	*Phalaris arundinacea*		

Figure 3. Standard Level 1 recording form

Box 1
Level 1 survey form explanatory notes

Name of SAC:	As it appears in the Natura 2000 form.
Name of component site:	As in the notification schedule.
Date of survey:	Date, month and year of survey.
Surveyor:	Name and contact address.
Transect number:	Used if more than one transect per component.
GPS co-ordinates:	Full grid reference taken at start, end and centre marker.
Weather conditions:	Note sunny, cloudy, precipitation during day, etc.
Management:	Note grazing, cutting or mowing, etc.
Height:	Average height of vegetation sampled in cm, using calibrated cane.
Dominant plant:	Most frequent species in vegetation sampled.
Other plants:	Acronyms as detailed on form, present in vegetation sampled.
Moisture:	Classify 1–5 as detailed on form.
Adult:	Number of adult *V. moulinsiana* in sample.
Juvenile:	Number of juveniles *V. moulinsiana* in sample.
Other molluscs:	List other species of molluscs present in sample.
Photo:	State whether taken at A or B as described on form.

Name of SAC:		
Name of component site:		
Date of survey:		
Surveyor:		
Transect Number:		
GPS Co-ordinates	Start Point – 0 m	
	Mid-point e.g. 50 m	
	End point e.g. 100 m	
Weather conditions at time of survey:		
Management:	Light grazing (cattle, sheep, horse)	
	Heavy grazing/poaching	
	Weed cut	
	Mowing/cutting	
General habitat description:		

Snail and environmental data: A = replicate sample taken from left side of centre line
B = sample from right side of centre line (from 0 m)

Location (m)	Adult snails		Juvenile snails (p/a)		Moisture level		Dominant plant		Other plants in order of abundance		Vegetation height (m)		Photo
	A	B	A	B	A	B	A	B	A	B	A	B	
0													
5													
10													
15													
20													
25													
Etc.													

Moisture:

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 5 cm deep.
5. Site under water. Entire sampling site in standing or flowing water over 5 cm deep.

Dominant plant:

Gl	*Glyceria maxima*	Pg	*Phragmites australis*
Ca	*Carex acutiformis*	Ep	*Epilobium* spp.
Ce	*Carex elata*	Fi	*Filipendula ulmaria*
Cp	*Carex paniculata*	So	*Solanum dulcamara*
Cr	*Carex riparia*	Sp	*Sparganium erectum*
Cm	*Cladium mariscus*	Po	*Persicaria amphibium*
Ud	*Urtica dioica*	Ma	*Mentha aquatica*
Ph	*Phalaris arundinacea*		

Figure 4. Standard Level 2 recording form

Box 2
Level 2 survey form explanatory notes

Name of SAC:	As it appears in the Natura 2000 form.
Name of component site:	As in the notification schedule.
Date of survey:	Date, month and year of survey.
Surveyor:	Name and contact address.
Transect number:	Used if more than one transect per component.
GPS co-ordinates:	Full grid reference taken at start, end and centre marker.
Weather conditions:	Note sunny, cloudy, precipitation during day.
Management:	Note grazing, cutting or mowing, etc.
Adult snails:	Classify as 0, 1-9, 10+.
Juvenile snails:	Presence or absence.
Moisture level:	Classify 1–5 as detailed on form.
Dominant plant:	Most frequent species in vegetation sampled.
Other plants:	Acronyms as detailed on form, present in veg sampled.
Vegetation height:	Av. height of veg sampled in cm, using calibrated cane.
Photo:	State whether taken at A or B as described on form.

Transect code			Office					File manager					
	No. samples taken (N)	Year	*V. moulinsiana* occupancy		*V. moulinsiana* numbers			Vegetation class dominant				Ground moisture class	
			+	—	0	<10	>10	I	II	III	IV	1+5	2+3+4
Total number of samples, Baseline													
Percent (no./N)x100, Baseline													
Total values, Annual survey 1													
% values, Annual survey 1													
% difference from baseline													
Condition assessment													
Total values, Annual survey 2													
% values, Annual survey 2													
% difference from last survey													
% difference from baseline													
Condition assessment													
Etc.													

Figure 5. Calculations of percentage differences from baseline.

13. Interpreting the results

13.1 Factors affecting *V. moulinsiana* abundance and distribution

Desmoulin's' whorl snail populations fluctuate naturally over time as a result of its limited life span (10 to 17 months) and short-term changes in environmental conditions that rapidly influence population size. If habitat or hydrological conditions become untenable for the snail, the species can rapidly be lost from a site, but individuals may also persist for a while in less than ideal conditions, or in small suitable pockets within a predominantly declining site. A year with very low recorded numbers should not necessarily be interpreted as a long-term population decline, but should be interpreted with the benefit of all the collected snail and environmental information.

Seasonal weather conditions can have a significant impact on population levels. Population size may be higher during wet, humid summers, while periods of drought or changes to site management, such as increased grazing or mowing, result in lower population levels. For these reasons, information on the

snail's area of occupancy, vegetative habitat and hydrological conditions must be used in combination with relative abundance to assess conservation status.

Groundwater levels are one of the most important factors influencing the distribution of *V. moulinsiana*. Apparently suitable sedge-dominated habitats occur in many of the sites supporting the species, but the snail is absent. This is considered to be due to inappropriate groundwater levels, the species requiring water levels to be at or slightly above the local ground surface for at least part of the year (Tattersfield & McInnes in press).

Some general indicators of favourable habitat are:

- Average height of vegetation not less than 70 cm when measured in August.
- Plant species composition and cover: *Glyceria maxima*, *Carex* spp., *Cladium mariscus*, *Sparganium erectum* and *Iris pseudocorus* indicate favourable conditions, as can *Phalaris arundinacea*.
- Ground moisture levels between 2 and 4.
- Site management: light or rotational grazing or no grazing.

A decline in habitat condition is implicated by the following:

- A reduction in ground moisture levels.
- A significant rise in water levels due to penning so that aquatic plants such as watercress (*Rorippa nasturtium-aquaticum*), and fool's watercress (*Apium nodiflorum*) become dominant.
- An increase in rank herbs, particularly nettle (*Urtica dioica*), thistle (*Cirsium*) spp., meadowsweet (*Filipendula ulmaria*), great willow-herb (*Epilobium hirsutum*) and butterbur (*Petasites*) spp., with vegetation height increasing or decreasing beyond parameters.
- An increase in scrub cover compared to the baseline.
- A change in management regime or intensity – heavy grazing and poaching of banks indicate unfavourable management. The species is also unlikely to survive where riverbank vegetation is regularly cut for angling activities.
- A decrease in river water quality leading to eutrophication and changes in nutrient status of marginal vegetation.

13.2 Response to annual results

As Desmoulin's' whorl snail populations can vary in size very considerably from month to month and from year to year, it is important to evaluate survey results in context, and respond to triggers in a rational way. The trigger levels given in Table 2 are independent of each other – it is not acceptable to wait for a decline in all four condition assessment determinants (snail numbers, snail occupancy, vegetation plus moisture) before a response is initiated as any one of the four can individually initiate a response if they fall below the percentage threshold in comparison to their baseline values. However, the percentage declines have been designed to be generous in an acknowledgement of the wide variation from year to year. It is therefore essential that, when a threshold percentage has been reached, a response is set in motion immediately. Figures 6–9 set out the sequence.

A decline of up to 40% in any of the condition assessment determinants constitutes an 'unfavourable' assessment (see Table 2). If this decline continues, (if the next assessment is unfavourable: declining), or if any one assessment shows a decline of more than 40% (a 'partially destroyed' category), it is essential to engage a molluscan specialist (with experience of this species) to find the cause of the decline, and to recommend remedial action. The specialist must then be given the results of all surveys carried out to date, along with the hydrological (dipwell and river gauge), meteorological, and relevant management data from the site file (see Section 14.2).

When the annual survey data results return to within 20% of the baseline values, the site is deemed to be once more in a favourable condition for the species.

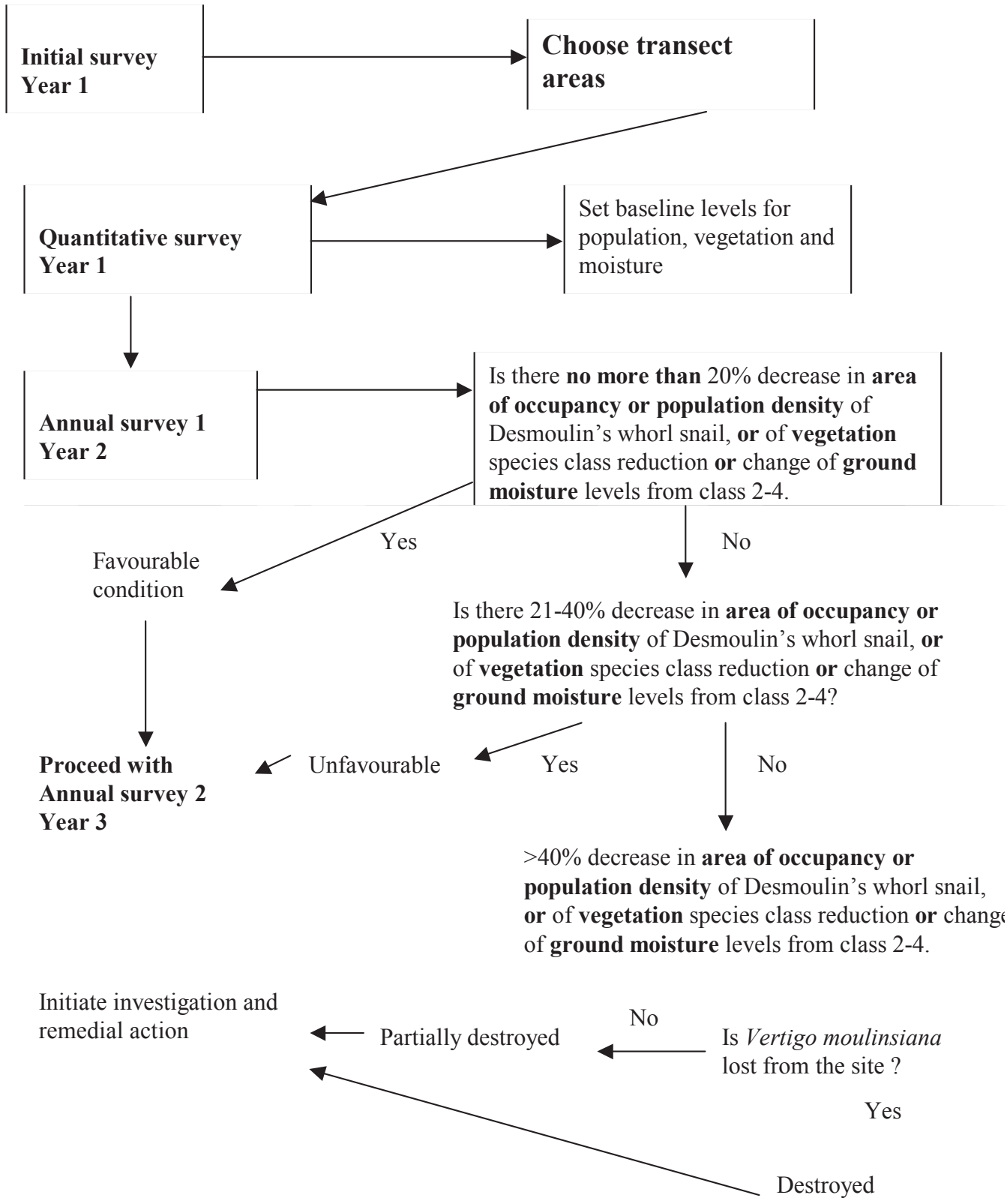


Figure 6. Actions to follow survey results, years 1–3.

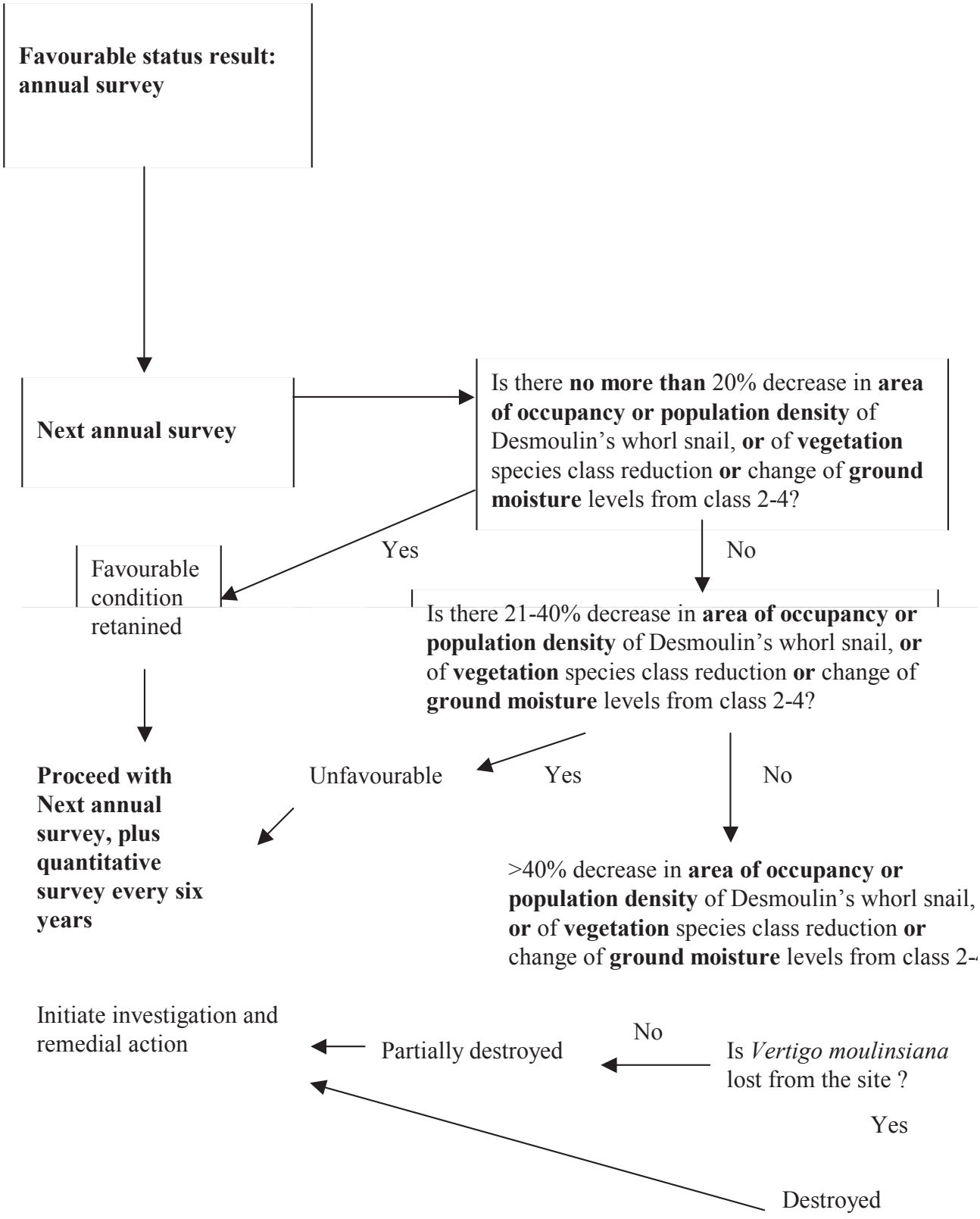


Figure 7. Actions to follow survey results for favourable condition sites.

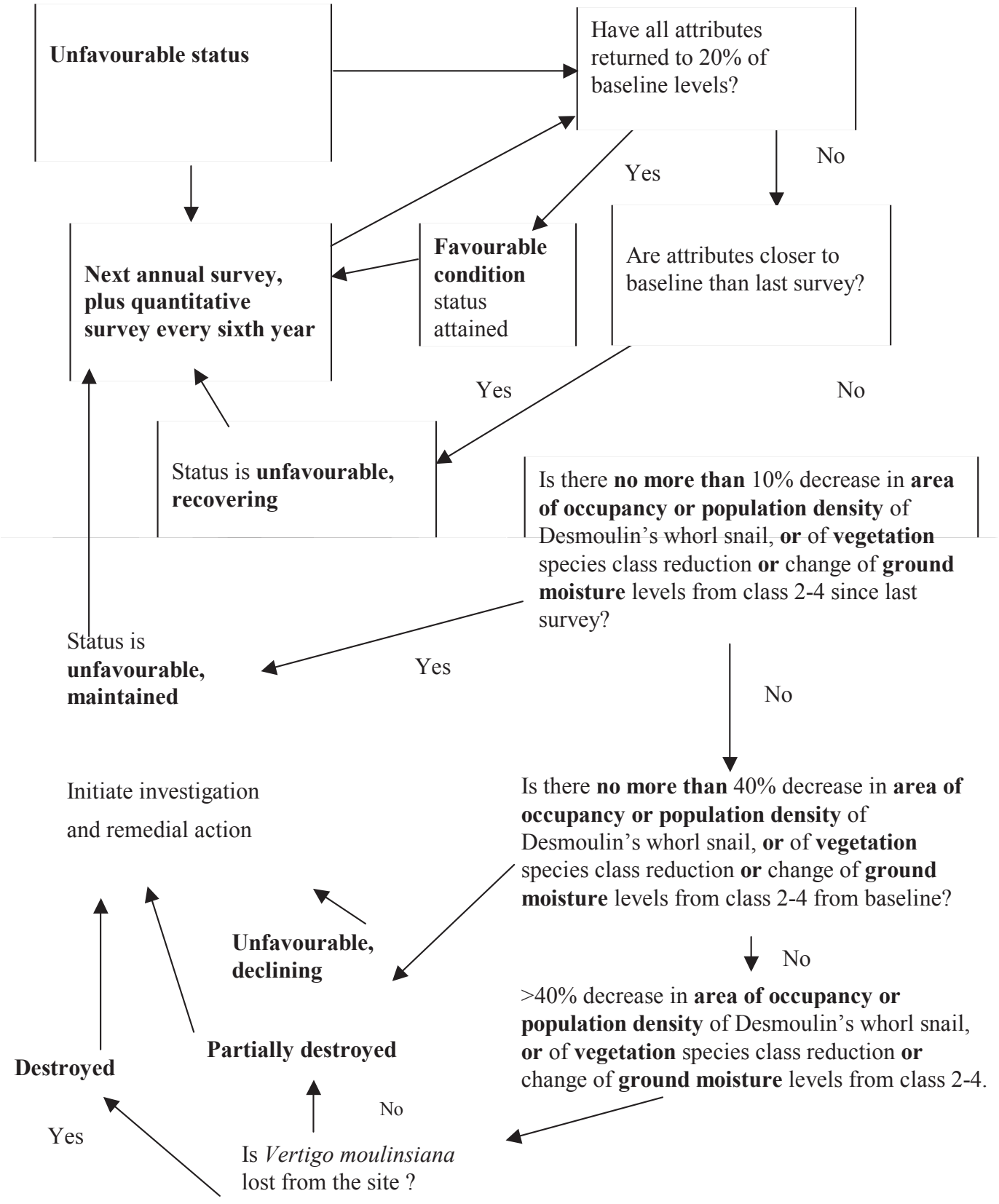


Figure 8. Actions to follow survey results for unfavourable condition sites.

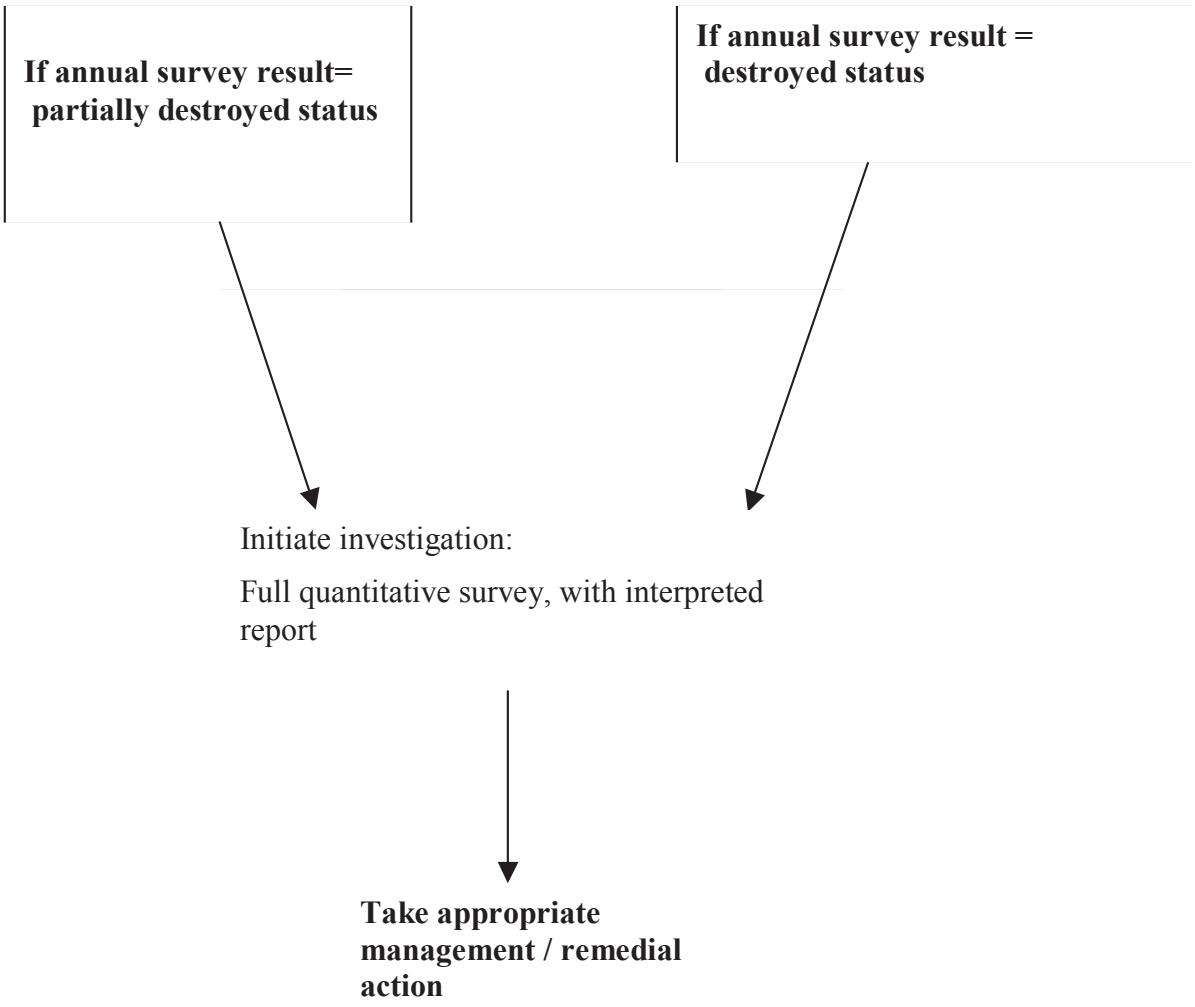


Figure 9. Actions to follow survey results for partially destroyed and destroyed sites.

14. Resources required

14.1 Surveying resources

The amount of time required to undertake this monitoring protocol will depend to some extent on site size and complexity, the ability and experience of the surveyors and their familiarity with each site. Working in pairs would allow one person to take photographs and record environmental data while the other carries out the snail sampling.

The following gives an approximate guide to the time requirements:

Initial baseline survey

- One experienced person (two people preferred if less experienced).
- To determine distribution within a site/component – about half a day.
- To determine presence/absence of Desmoulin's whorl snail – two minutes per sample.

Level 1 quantitative survey

- One experienced person plus one field assistant.
- Approximately one day to quantitatively record Desmoulin's whorl snail and environmental variables at 40–50 sample points in an SAC component site.

Level 2 survey

- Two persons.
- Approximately one day to record Desmoulin's whorl snail and environmental variables at 40–50 sample points in an SAC component site.

14.2 Management resources

The local conservation agency office responsible for each SAC will undertake overall management of the data handling and conservation response. Data to be compiled and maintained are:

- Initial survey data.
- Baseline survey data.
- Annual survey data.
- Transect photographic archive.
- Any reports by commissioned experts (six-year reports, etc.).
- Monthly dipwell data.
- Bi-annual river gauge data.
- Local meteorological data (monthly mean rainfall and temperature, number of rain days).
- Historical aerial photographs.
- Ten-yearly aerial photographs.
- NVC or other relevant survey results.
- Management history.
- GPS data for all transects.
- Standard survey forms for future years.
- Names and contact addresses of surveyors and experts.

15. References

Bratton JH (ed) (1991). *British Red Data Books: 3. Invertebrates other than insects*. Joint Nature Conservation Committee, Peterborough.

HMSO (1996). *Biodiversity: the UK steering group report (Vol 2. Action Plan)*. HMSO, London.

Kerney MP & Cameron RAD (1979). *A Field Guide to the Land Snails of Britain and North West Europe*. Harper Collins, London.

Killeen IJ (1995). *Vertigo moulinsiana. Species entry in Invertebrates of Annexes II and IV of the Habitats Directive*. Council of Europe Press, Strasbourg.

Killeen IJ (2003a). A review of EUHSD *Vertigo* species in England and Scotland (Gastropoda, Pulmonata: Vertiginidae). In: Speight MCD, Moorkens EA & Falkner G. Proceedings of the workshop on the conservation biology of European *Vertigo* species, Dublin, April 2002. *Heldia* 5, 7, 1–183.

Killeen IJ (2003b). *Ecology of Desmoulin's whorl snail* Vertigo moulinsiana. Conserving Natura 2000 Ecology Series No. 6. English Nature, Peterborough.

Tattersfield P & McInnes R (2003). Hydrological requirements of *Vertigo moulinsiana* on three candidate Special Areas of Conservation in England. In: Speight MCD, Moorkens EA & Falkner G. Proceedings of the workshop on the conservation biology of European *Vertigo* species, Dublin, April 2002. *Heldia* 5, 7, 1–183.

Publications on survey work in individual SACs

Killeen IJ (2000). *A survey of Westbere Marshes, Kent for the terrestrial mollusc* Vertigo moulinsiana. English Nature Research Reports 350, Peterborough.

Killeen IJ (2000). *Status and distribution of Desmoulin's whorl snail* Vertigo moulinsiana on Cors Geirch SSSI. CCW Contract Science. Countryside Council for Wales, Bangor.

Killeen IJ (2001). *Surveys of EU Habitats Directive* Vertigo *species in England: 3*. Vertigo moulinsiana. *Part 1: Summary and Monitoring Protocol.* English Nature Research Reports, Peterborough.

Killeen IJ (2001). *Surveys of EU Habitats Directive* Vertigo *species in England: 3*. Vertigo moulinsiana. *Part 2: The River Avon SAC*. English Nature Research Reports, Peterborough.

Killeen IJ (2001). *Surveys of EU Habitats Directive* Vertigo *species in England: 3*. Vertigo moulinsiana. *Part 3: The Kennet & Lambourn Floodplain SAC*. English Nature Research Reports, Peterborough.

Killeen IJ (2001). *Surveys of EU Habitats Directive* Vertigo *species in England: 3*. Vertigo moulinsiana. *Part 4: The Waveney and Little Ouse Valley Fens SAC*. English Nature Research Reports, Peterborough.

Killeen IJ (2001). *Surveys of EU Habitats Directive* Vertigo *species in England: 3*. Vertigo moulinsiana. *Part 5: The Norfolk Valley Fens SAC*. English Nature Research Reports, Peterborough.

Killeen IJ (2001). *Surveys of EU Habitats Directive* Vertigo *species in England: 3*. Vertigo moulinsiana. *Part 6: The Broads SAC*. English Nature Research Reports, Peterborough.

Killeen IJ (2001).*Surveys of EU Habitats Directive* Vertigo *species in England: 3*. Vertigo moulinsiana. *Part 7: The River Wensum SAC*. English Nature Research Reports, Peterborough.

Killeen IJ & Stebbings RE (1997). *A34 Newbury bypass. Results of monitoring the translocated habitat for* Vertigo moulinsiana. *First annual report*. Unpublished report. Mott MacDonald, Winchester.

Killeen IJ & Stebbings RE (in prep.). *A34 Newbury bypass. Results of monitoring the translocated habitat for* Vertigo moulinsiana. *Final report.* Mott MacDonald, Winchester.

Killeen IJ & Willing MJ (2002). *Desmoulin's whorl snail (*Vertigo moulinsiana*) Distribution survey of the River Avon cSAC*. Report to the Environment Agency, Blandford (unpublished).

Stebbings RE & Killeen IJ (1998). Translocation of habitat for the snail *Vertigo moulinsiana* in England. In: Killeen IJ, Seddon AM & Holmes AM (eds). *Molluscan conservation: a strategy for the 21st Century. Journal of Conchology Special Publication No. 2.* Conchological Society of Great Britain and Ireland, 191–204.

Appendix 1. Health and safety risk assessment

Medium-risk hazards

- Wet/cold weather.
- Work in remote areas.
- Working on unstable swampy ground.
- Working adjacent to deep or swift-flowing water.
- Lacerations from fen vegetation.
- Barbed wire fences, brambles.

Low-risk hazards

- Muddy/slippery ground.
- Carrying equipment over rough ground.
- Collecting, handling samples.
- Livestock.
- Long travel times to site, long working hours.

Precautions for lone working

- Ensure that surveyor can contact emergency services in event of an accident.
- Obtain weather forecast before setting out.
- Do not carry out survey in severe weather conditions (particularly high winds or rain).
- Ensure tetanus immunisation is up to date.
- Plan activities to include adequate rest periods travelling to and from site, and on site.
- Obtain permission before crossing private land.
- Consult farmers about possible dangerous animals before entry.
- Equipment to be portable in a backpack or similar.
- Do not enter derelict buildings.
- Do not use footpaths/bridges if structures look unsafe.

Provide and wear as necessary the following personal protective equipment:

- Tough, non-slip ankle boots/wellingtons.
- Adequate warm/tough clothing.
- Waterproofs.
- High visibility clothing.
- Gloves, barrier cream.

Provide as necessary the following safety equipment:

- Mobile phone.
- First-aid kit.

Notes

The surveyor should be aware of the dangers of working near to swiftly flowing and possibly deep-water channels, although many of the fen/swamp areas likely to be searched will not lie immediately adjacent to steep banks. Life jackets should be worn if working close to deep or swiftly flowing water. Working in fen/swamp areas sharp or needle-edged vegetation can pose a risk of skin laceration. Long-sleeved clothing and protective gloves must be worn during survey work. In tall sedges and reedbeds, eye protection should also be used.

Avoidance of risk from Leptospirosis (Weill's disease)

Surveyors should be aware of the risks from this pathogen. Consequently, gloves should be worn during survey work, and scratched skin should be covered with waterproof plasters. Avoid rubbing eyes, nose and mouth during work; wash hands thoroughly in clean water (carried specially in a rinse-water bottle) before eating and at the end of working. Wash protective clothing after field use.

Surveyors should familiarise themselves with the Environment Agency documents *Procedures for collecting and analysing macro-invertebrate samples* and *Guidelines and Safe Systems of Work for Conservation* (revised 2000).

Appendix 2. Snail identification

The best identification guide for terrestrial molluscs is Kerney & Cameron (1979).

High-quality line drawings of all the *Vertigo* species are given in Pokryszko (1990).

The diversity of molluscs that live on tall swamp vegetation is relatively low, although more species may be found in the leaf litter. Sampling from tall vegetation will therefore simplify the task of identification. The most common species encountered will be *Succinea putris* (>5 times larger than Desmoulin's whorl snail) or *Oxyloma pfeifferi*, *Ashfordia granulata* and *V. moulinsiana*, all of which are easily distinguished from each other.

Other species with a similar shell morphology to *V. moulinsiana* (particularly *Columella edentula*) may also be present. The features and habitat for these are detailed below to assist with identification.

Vertigo moulinsiana
Height 2.2–2. 7mm. Shell pale brown, smooth and glossy, but bleaches with age. Tumid with large body (last) whorl. Aperture with 4, occasionally 5, teeth (1 parietal, 2 palatal, 1 columellar).

V. antivertigo
Height 2–2.2 mm. 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.

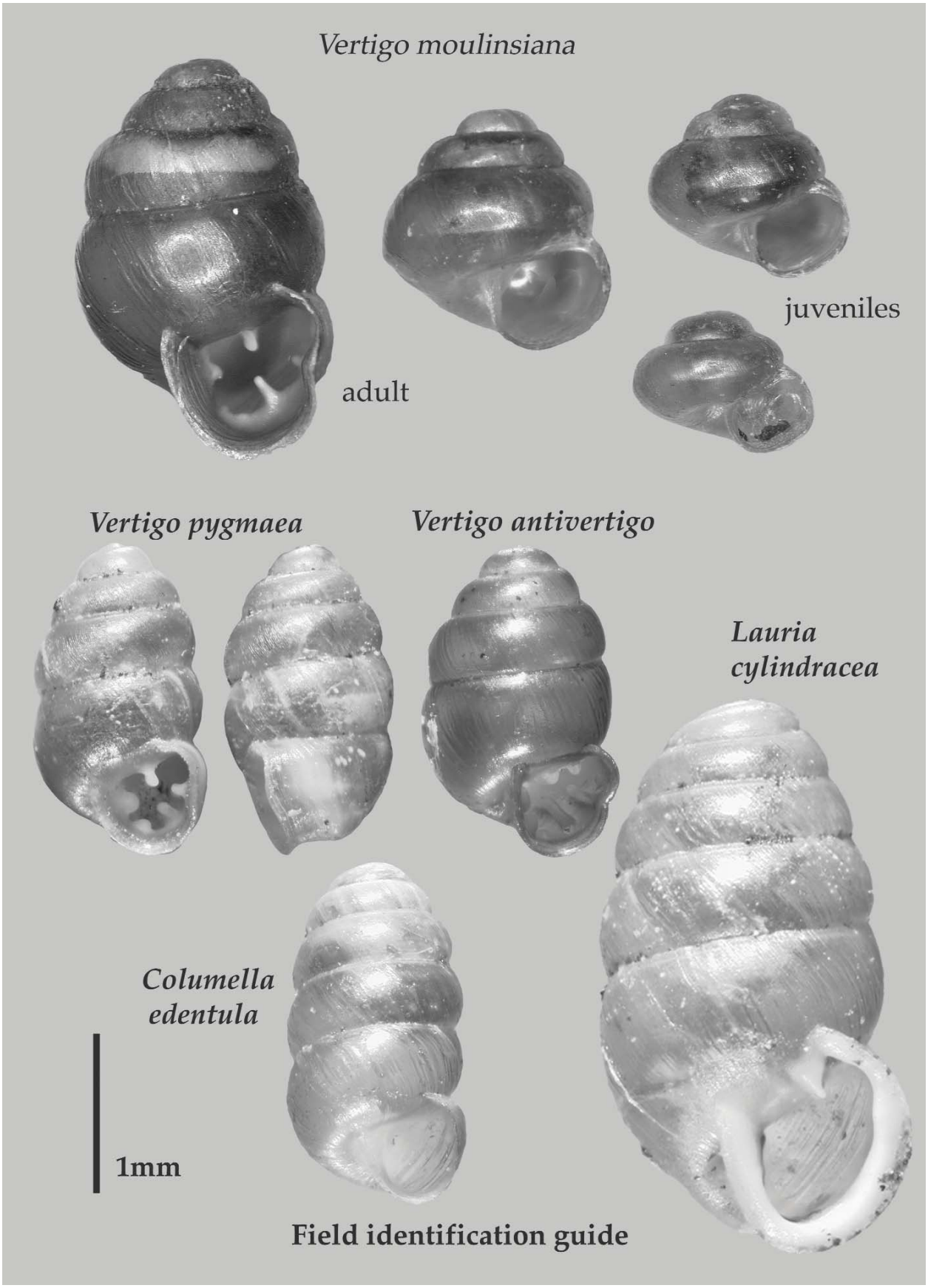
V. pygmaea
1.7–2mm. Shell dull, pale to dark brown. A strong pale transverse rib is present externally a little way behind the outer lip, separated from it by a depression. Aperture with 4–7 teeth (only 1 parietal). Lives mostly in damp grassland and less often in wet conditions with tall sedge vegetation.

Columella edentula
Slightly larger and broader than Vertigo species (height 2.5–3 mm, width 1.3–1.5 mm) 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* spp., or where there is shading.

Lauria cylindracea
Larger than any of the above (height 3–4.4 mm, width 1.8 mm). 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.

During late summer and autumn, the samples are likely to contain significant numbers of juvenile *V. moulinsiana*. Although the protocol is designed on the basis of recording adult snails, the presence of juveniles should be noted. Juveniles have a more conical shape and do not possess a developed lip or apertural teeth. Juvenile *Columella edentula* are very similar, but their numbers are comparatively much lower and can therefore effectively be ignored.

The presence of other species of mollusc in the samples may provide useful additional information and help to indicate whether the SAC is becoming ranker or drier. Ranker sites will often support much higher numbers of *Ashfordia granulata* and *Columella edentula*, while *Lauria cylindracea*, *Monacha cantiana* and *Trichia* spp. are indicators of drier or less favourable habitat.


Vertigo moulinsiana
adult
juveniles
Vertigo pygmaea
Vertigo antivertigo
Lauria cylindracea
Columella edentula
1mm
Field identification guide

The Life in UK Rivers project was established to develop methods for conserving the wildlife and habitats of rivers within the Natura 2000 network of protected European sites.

Set up by the UK statutory conservation bodies and the European Commission's LIFE Nature programme, the project has sought to identify the ecological requirements of key plants and animals supported by river Special Areas of Conservation.

In addition, monitoring techniques and conservation strategies have been developed as practical tools for assessing and maintaining these internationally important species and habitats.

Desmoulin's whorl snail is an indicator species for wetlands, requiring good water quality and specific vegetation. Because of the loss of these habitats, it is declining across Europe.

This report suggests monitoring methods that can be used to determine whether Desmoulin's whorl snail populations are in favourable condition, and what conservation action is necessary for their survival.

Information on Conserving Natura 2000 Rivers and the Life in UK Rivers project can be found at **www.riverlife.org.uk**

This document was produced with the support of the European Commission's LIFE Nature Programme and published by the Life in UK Rivers project - a joint venture involving English Nature, the Countryside Council for Wales, the Environment Agency, the Scottish Environment Protection Agency, Scottish Natural Heritage and the Scotland and Northern Ireland Forum for Environmental Research.