Monitoring and Condition Assessment of Populations of *Vertigo geyeri, Vertigo angustior* and *Vertigo moulinsiana* in Ireland

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Monitoring and Condition Assessment of Populations of *Vertigo geyeri*, *Vertigo angustior* and *Vertigo moulinsiana* in Ireland

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Executive Summary

Three species of whorl snail that are known from the Republic of Ireland, *Vertigo geyeri, V. angustior* and *V. moulinsiana* are listed under Annex II of the Habitats and Species Directive [92/43/EEC]. The Directive requires surveillance of all species listed to determine whether Favourable Conservation Status has been achieved. A total of 22 *Vertigo geyeri* sites, 21 *Vertigo angustior* sites and 20 *Vertigo moulinsiana* sites were surveyed between 2008 and 2010. Each site was surveyed according to a standardised monitoring protocol. This protocol included assessment of area of occupancy and quality of habitat, survey along repeatable monitoring transects, and analysis of molluscan species from samples removed from the site (*V. geyeri* and *V. angustior*) or from snails identified and counted in the field (*V. moulinsiana*). Future prospects were assessed by identifying and quantifying pressures at each site. An overall assessment was derived for each species at each site following a rules-based assessment of population, habitat for the species and future prospects. Assessments were categorised into Favourable (Good/Green), Unfavourable Inadequate (Poor/Amber) or Unfavourable Bad (Bad/Red). Comparisons were made with previous studies where possible, and management and monitoring recommendations made.

The results found 63% of *V. geyeri* sites surveyed, 62% of *V. angustior* sites and 70% of *V.moulinsiana* sites to be in overall favourable condition, with sheep grazing being strongly positively associated with good condition in *V. geyeri* sites. The opposite was found in *V.angustior* sites, where sheep were a negative indicator on condition. These results were unduly negative in part from the inclusion of sites with single past records that were investigated as part of the study. Of the 63 sites surveyed, four sites were dismissed as suitable sites in which to conserve the relevant species.

A national conservation status assessment was made for each species; *V. geyeri* and *V. angustior* were found to be Unfavourable – Inadequate and *V. moulinsiana* was Unfavourable – Bad.

Acknowledgements

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We give thanks for the very generous help and support from the NPWS Conservation Rangers at the *Vertigo* sites and for their enthusiasm during training days.

Our greatest thanks are to the many landowners who showed interest and provided information regarding management on their sites, and who have ensured the continuity of management that has maintained populations of these rare and beautiful whorl snails in the environments that they have enjoyed since the last ice age.

Glossary

Aestivation — cessation or slowing of activity during the summer; especially slowing of metabolism in some animals during a hot or dry period.

Ecotone — a transitional zone between two ecological communities containing some characteristic properties of each.

Hydrogeology — the distribution and movement of groundwater.

Hydrosere — a transition in habitat from open water to woodland through increased siltation and vegetation growth over time.

Malacologist — specialist in the study of molluscs.

Micro-habitat — a small, localized habitat within a larger ecosystem with specific characteristics that differ from those close by.

Refugia —areas in which organisms can survive through a period of unfavourable conditions.

Tumid — descriptive term for the shape of a shell meaning swollen, with a convex profile.

Introduction

The *Vertigo* whorl snails grow to less than 3mm in height, and most are less than 2mm as full adults. There are eight species of *Vertigo* living in Ireland, none are common and some are very rare. Guides to the identification of whorl snails can be found in a range of land snail identification guides such as Kerney & Cameron (1979), and an internet guide shows photographs of some of the species (www.habitas.org.uk/molluscireland). Six of the eight *Vertigo* species are considered to be threatened in Ireland, including the three whorl snails that are protected under Annex II of the Habitats and Species Directive, *Vertigo geyeri*, *V. angustior* and *V. moulinsiana* (Byrne *et al*., 2009). All three are rare, cryptic snails, and are stringent in their requirement of even hydrogeological conditions. The specific requirements and micro-habitats of each species are different but all are sensitive to changes in drainage, grazing management and disturbance. All *Vertigo* species live to approximately 18 months, and so they are essentially annual animals, requiring to reproduce each year to replace themselves. All *Vertigo* species are opportunistic breeders, and juveniles can be found at most times of the year, but reproduction is concentrated during particularly humid conditions, in particular in the autumn breeding event of *Vertigo moulinsiana*. More details of the species' life histories can be found in Speight *et al*. (2003). Survey for all *Vertigo* species is possible at any time of the year, but monitoring survey has more restricted timing recommendations to exclude the months of the year when adults are not reproducing and are at their lowest numbers. Monitoring should be done when adults are plentiful and juveniles are also present and this corresponds to late spring to late summer for *V. angustior* and *V. geyeri*, and late summer and autumn for *V. moulinsiana*.

This report is the culmination of a project that undertook to survey at least twenty populations of each of the three Annex II *Vertigo* populations in Ireland. The objective of the study was to initiate a national monitoring programme and update the conservation status assessment for each species. It was completed over the three years 2008-2010.

In total, 63 sites were chosen, with a minimum of 20 sites per species; including all SACs that contain each species and a selection of sites without any cSAC status, and some sites that are cSACs but without *Vertigo* as a qualifying interest. Additional sites were chosen to ensure that the range (ecological & geographical) of each species was represented.

An initial survey methodology was developed by Moorkens (2007). This methodology was updated to ensure all elements of the assessment of conservation status were accounted for (including the identification of pressures & threats). A site report was written for each site, and

these are available on request to NPWS. An example of a site report for each species is provided in Appendix A-C. This report summarises the methodologies used for each species, and the results of the study.

Site data is stored in a specially developed *Vertigo* database, and the relevant site information has been digitised to GIS format compatible with standard NPWS data handling.

Assessment of Conservation Status

The background to the assessment of conservation status is explained in the NPWS (2008) report "The Status of EU Protected Habitats and Species in Ireland". It explains that the Habitats and Species Directive defines the conservation status of a species as the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within the territory of the member states.

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

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

With the above definitions in mind, a method for assessment of conservation status is needed that is appropriate to assess the correct criteria, and in a manner that is agreed and thus can be comparable across the Member States. Methods for assessing conservation status were drawn up by the European Topic Centre for Nature Conservation (ETCNC) in conjunction with the Member States represented on the Scientific Working Group of the Habitats Directive. A standard format was agreed at a European level in 2006, which is currently being updated and due to be finalised in May 2011. The format for the assessment of conservation status for species brings together information on four parameters for habitats and species: Range, Population, Habitat for the species and Future prospects.

Each parameter is classified following a rules-based approach as being "favourable" (good), "unfavourable – inadequate" (poor), "unfavourable – bad" (bad) or "unknown". Good, poor and bad assessments are colour-coded green, amber and red respectively. Favourable reference values are set for Range and Population, these values must be at least equal to the value when the

Habitats Directive came into force (1994) and were set as targets against which current values could be judged.

Favourable Reference Range is the geographic range within which all significant ecological variations of the species are included and which is sufficiently large to allow the long-term survival of the species. The Favourable Population is the value required for the long-term survival of the species in question.

The extent and quality of suitable habitat is assessed to determine whether the long-term survival of the species can be assured.

The major pressures and threats are also listed for each assessment. The impacts of these pressures and threats are used to determine the future prospects.

If any one of the four parameters is assessed as "red", the overall assessment is also "red".

Targets for Population, Habitat for the species and Future prospects can be set and assessed at a site-by-site level. The raw data for each site assessment can be used to derive a national assessment.

Assessment of Parameters in Vertigo Populations

There are a number of difficulties in addressing conservation assessment in *Vertigo* populations, and these difficulties are not restricted to snail populations but are true of other rare species that require assessment:

Favourable reference values in 1994 (i.e. when the Habitats Directive came into force)

Many of the populations of the three *Vertigo* species in Ireland were unknown in 1994. Older records for the species were based on species lists and single records, without any benefit of habitat descriptions, extent of habitat or even exact location of these records. Many new sites were added to the record through targeted survey between 1995 and 2000 (Moorkens, 1995, 1997, 1998, 1999, 2000). Therefore, the favourable reference values have been based on "best expert judgement". Where populations are in good condition, and their habitat appears to be stable and unchanged in the recent past, it was assumed that this was the likely extent and habitat condition of the site in 1994.

Space for change in extreme years

Vertigo species require very stable hydrogeological conditions, but must also have the benefit of slight variation such that in extreme wet years, the snail can move up into drier but still suitable

habitat, and in extreme drought years there is habitat that will remain saturated. Therefore, on the day of any survey, the snails will be located in the correct habitat for the weather conditions on the day, and the surveyor must be mindful of the condition of the habitat the snail will need during extreme weather events. Thus there are micro-habitat niches that are sub-optimal during normal conditions, but essential for survival during extreme conditions. Although it seems logical to assume that every site would benefit from being of consistent optimal habitat, in fact some sub-optimal habitat (both on the slightly dry and the slightly wet side of optimal) is essential in order to provide refugia to the snail in extreme conditions. Transects were chosen to represent the habitat that the species will occupy in the vast majority (99%) of any year, but for a population to be sustainable in the long term, there must be sufficient refuge habitat to survive extreme conditions (e.g. 30 year droughts, 30 year floods etc.).

Heterogeneity of habitat

In a micro-habitat structure that supports a snail that is barely 2mm high, minor topographical changes and small changes in subsurface layers and interaction with the groundwater can be substantial. Therefore, optimal, sub-optimal and unsuitable habitat can be present within a square metre of habitat. Polygons of habitat are by their nature heterogenous, and have been divided within sites into areas of significant change, and are referred to as being either: mostly optimal, mostly optimal and sub-optimal, mostly sub-optimal, mostly sub-optimal and unsuitable, and unsuitable. These definitions are discussed within the different species chapters and defined for each site in the individual site accounts.

Timing of survey

Although all three whorl snails can be found at any time during the year, there are optimum times to survey for the species. All three species live for 12-18 months, and breed opportunistically in humid weather, but with predictable times of major reproduction events, which are discussed in the individual species sections below.

Report structure

As well as individual site assessments, an overall conservation status assessment for each species was determined. The backing document, which expands on the major elements of the national assessment, is provided in in the Results section The national conservation status assessment for each species will be submitted to the EU in 2013.

This report consists of a chapter detailing background, methodologies, pressures and threats and management requirements for each of the species and a chapter summarising the results of the study.

Vertigo geyeri – Background and Methodology

Background to the species

The whorl snail *Vertigo geyeri* grows to less than 2mm in height, with a glossy tumid shell and a mouth to the right of the shell (dextral) with four narrow teeth arising directly from the inner mouth wall. Full descriptions and illustrations are in Waldén (1966) and Kerney & Cameron (1979). In April 2002, European experts on this species were gathered together for a workshop that culminated in the production of species accounts and relevant papers on *Vertigo geyeri* and the other three EU Habitats Directive *Vertigo* species. The volume that was the outcome of this workshop (Speight *et al.*, 2003) is recommended for a more detailed understanding of *V. geyeri* in Europe.

Vertigo geyeri is stringent in its requirement of saturated water conditions in calcareous, groundwater-fed flushes that are often limited in size to a few metres square. Their habitats often occur in mosaics of suitable patches within wider fen macrohabitats, that in Ireland can themselves fall within habitats as diverse as raised bog laggs, transition mires, lake shores, hill or mountain slopes, and wetlands associated with coastal dunes and machair (Moorkens, 2003b). Within these macrohabitats, however, the snail is consistent in where it lives, within the saturated and decaying roots of small calcareous sedges (particularly *Carex viridula* ssp. *brachyrrhyncha*), associated fen mosses (particularly *Drepanocladus revolvens* and *Campyllium stellatum*). The greatest indicator of optimum *V. geyeri* habitat is the presence of a tufa-forming spring.

Within its macrohabitat, the snail needs constancy of hydrogeological conditions, but with enough variation in wetness through slope and/or vegetation height to provide refugia for the meteorological extremes that the habitat must endure. It requires an openness of habitat that prevents succession by shade-loving plants and more competitive shade-loving snails. Open habitats are generally maintained by wetness, often aided by light grazing.

The protection of *V. geyeri* under the EU Habitats Directive has resulted in the designation of Special Areas of Conservation (SACs) for the snail. The maintenance of this species at favourable conservation status in its small and patchy distribution amongst larger sites that may have conflicting conservation requirements is a challenge to the conservation authority (NPWS). A further challenge is to understand and protect the resource of this species throughout Ireland outside the cSAC network. Most of the sites for *V. geyeri* are in private ownership and are being

managed as part of agricultural enterprises. Parts of Pollardstown Fen and Sheskinmore are nature reserves.

Survey methodology

Time of survey

Survey should take place between May and October inclusive in conditions that are not excessively wet, in order to minimise habitat disturbance through trampling. During this period snails are active and some breeding should have occurred.

Method

Vertigo geyeri was surveyed at 22 sites (Table 1, Figure 1). Within each site, the suitability of habitat was delimited into polygon areas containing *V. geyeri* habitat. These polygon boundaries are marked by physical barriers, such as fences and hard-surfaced paths or ecological barriers, such as a fen-grassland interface.

Where suitable, permanent transects were set up in the best habitat areas in places that are accessible and easily defined so that they can be successfully relocated in future repeat surveillance surveys. In some sites micro-habitat was fragmented and spot sampling in a series of locations was chosen as the recommended monitoring tool.

Within each polygon, specific microhabitat suitable for the snail was searched systematically by eye to confirm its presence. Samples were also removed to provide further information on the molluscan communities living at the site.

It is important to define the level of distinction made in defining the quality and extent of the habitat for the species. The macrohabitat polygons were considered to be the fen area within the larger site and within which were areas of suitable microhabitat (at the centimetre level, e.g. saturated decaying sedge leaves) for the species. Throughout this report the *Vertigo* habitat refers to a workable and distinguishable vegetation combination somewhere between the two scales that are at least a number of metres square. This is because it was considered impossible and meaningless to map out centimetre wide patches of, for example, sedge rosette bases. Instead, habitat was divided into polygons of habitat defined as: optimal and sub-optimal, and unsuitable habitat (unsuitable for *V. geyeri*), or combinations of each, as defined in Moorkens (2006d):

Optimal habitat is where *V. geyeri* could survive in a large area (at least 50%) of the habitat. This allows for areas that have, for example, *Schoenus nigricans* tussocks. The snail will not normally be

is not found high in a tussock, but the structure of the tussock provides the variation that sustains the snail within the first 5-6cm of its base, depending on the hydrological conditions on the day. Thus to provide this amplitude of habitat variation to cover annual variation, the growth of unsuitable microhabitat is necessary. Another example of optimal habitat is calcareous cropped open sedge swards and moss carpets within undulating terrain. The topographical changes provide the niches for wet and dry extremes; therefore by their provision for these extremes, there will always be some habitat within them that is at least temporarily unsuitable. These habitats should not be changed to "improve" them, e.g. to make them wetter for more of the time, as the range of microtopography is important.

Sub-optimal habitat is where there are patches of vegetation and conditions that support *V. geyeri* but the majority of the habitat cannot. This can be due to terrain being generally too high, but with small suitably wet runnel flushes occurring within, or where habitat is on the margin of base tolerance for the species, where acid influence promotes mainly calcifuge species, but where occasional groundwater seepage influence provides a suitable patch that the snail can occupy. Alternatively the snail may be restricted by succession due to lack of grazing, where the snail is shaded out of most of the area, except for patches prevented from growth by being wetter than their surroundings.

Unsuitable habitat is an area of the site where the combination of vegetation and hydrological influence is entirely outside the snail's range of tolerance.

Photographs of examples of *Vertigo geyeri* habitat are shown in Figure 2.

Within any polygon, combinations of the above are found, and thus polygons are listed as being either: optimal, optimal and sub-optimal, sub-optimal, sub-optimal and unsuitable, or unsuitable. In the field, the polygons were delimited by hand held GPS, and the management usage of each polygon area was noted. Where management was not obvious, the landowner or NPWS Conservation Ranger was asked for the management history.

Finally, the sample station, in most cases a linear transect, was recorded as a baseline for future surveillance of both the species and its habitat. This included GPS and photos of marked transect ends to be used to both record their character and relocate them subsequently. For baseline purposes, photographs along the transect were also taken for future comparison purposes. The locations of the sample stations were chosen as a representative area for the species at this site, and for convenience of access and of relocation.

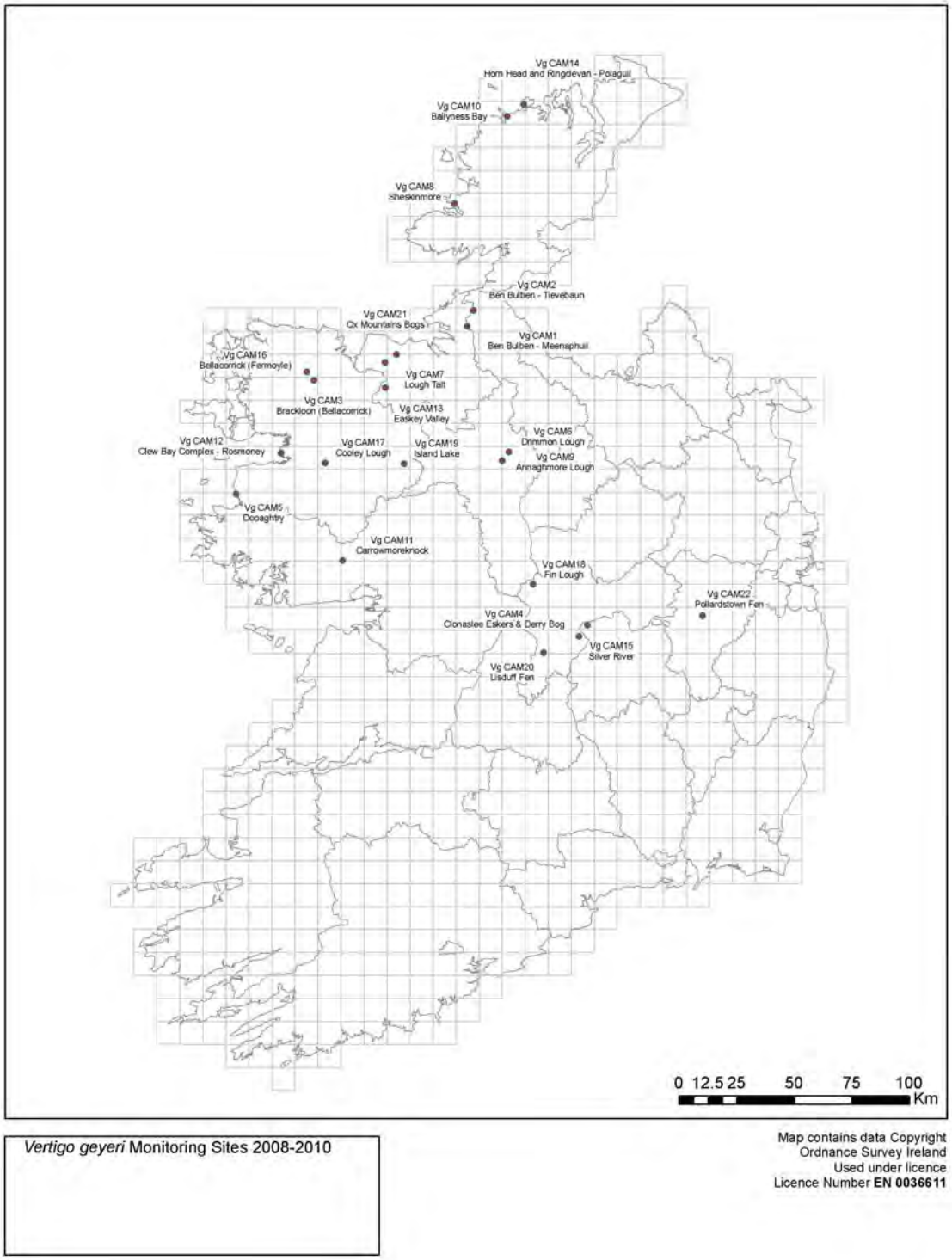

Figure 1: Map showing *Vertigo geyeri* sites surveyed 2008-2010

Table 1: *Vertigo geyeri* sites surveyed 2008-2010

Site Number	**cSAC where site is located**	**Site Name**
Vg CAM1*	00623 Ben Bulben, Gleniff and Glenade	Meenaphuil
Vg CAM2*	00623 Ben Bulben, Gleniff and Glenade	Tievebaun
Vg CAM3*	001922 Bellacorick Bog Complex	Brackloon
Vg CAM4*	00859 Clonaslee Eskers & Derry Bog	Clonaslee Esker
Vg CAM5*	001932 Mweelrea/Sheefry/Erriff Complex	Dooaghtry
Vg CAM6	No designation	Drimmon Lough
Vg CAM7*	000633 Lough Hoe Bog	Lough Talt
Vg CAM8*	00197 West of Ardara/Maas Road	Sheskinmore
Vg CAM9*	001626 Annaghmore Lough	Annaghmore Lough
Vg CAM10*	001090 Ballyness Bay	Ballyness Bay
Vg CAM11	No designation	Carrowmoreknock
Vg CAM12*	001482 Clew Bay Complex	Rosmoney
Vg CAM13*	002006 Ox Mountains Bogs	Easkey valley
Vg CAM14*	00147 Horn Head and Ringclevan	Polaguil Bay
Vg CAM15	000412 Slieve Bloom Mountains	Silver River
Vg CAM16*	001922 Bellacorick Bog Complex	Bellacorrick -Fermoyle
Vg CAM17	No designation	Cooley Lough
Vg CAM18*	00576 Fin Lough (Offaly)	Fin Lough
Vg CAM19	001910 PNHA Mannin and Island Lakes	Island Lake
Vg CAM20*	002147 Lisduff Fen	Lisduff Fen
Vg CAM21*	002006 Ox Mountains Bogs	Ox Mountains
Vg CAM22*	00396 Pollardstown Fen	Pollardstown Fen

***named feature in cSAC**

Figure 2a: *Vertigo geyeri* habitats - Upland tufaceous flush, optimal habitat, the saturated mossy runnel in the foreground is excellent habitat for *V. geyeri.* (Tievebaun).

Figure 2b: *Vertigo geyeri* habitats - Lowland tufaceous flush, optimal habitat, the brown mossy areas alongside the runnel are normally occupied with *V. geyeri,* but the higher mounds beside them provide refuge during flood conditions. The much higher *Molinia* grassland with gorse is unsuitable. (Ox Mountains).

Figure 2c: *Vertigo geyeri* habitats - Optimal lowland *Schoenus* habitat, where plants are kept well cropped by grazing allowing growth of mosses and low sedges and a wide area is well saturated. (Lisduff Fen).

Figure 2d: *Vertigo geyeri* habitats - Sub-Optimal *Schoenus* habitat, where lack of grazing has resulted in high tussocks forming and the ratio of saturated litter to higher refuge area is much lower. (Clonaslee Esker).

Figure 3 shows an example of a *V. geyeri* transect. It has a grid reference and compass orientation noted at the start and end point. The transect is divided into zones defining natural changes in ecological quality. This provides a more accurate small scale description of habitat change than can be done at the polygon scale. Zones where a sample has been removed for analysis are marked with red dots. A description of the zone is provided along with significant management notes. Each zone is colour coded as optimal, sub-optimal and unsuitable or combinations of the three. Each zone is colour coded for wetness, a key feature of *Vertigo* habitat. The transect does not have a specific width, as the zones are determined by the lengths along a narrow tape measure, and samples from these areas are taken from a location close to the tape and representative of the zone measured by the tape.

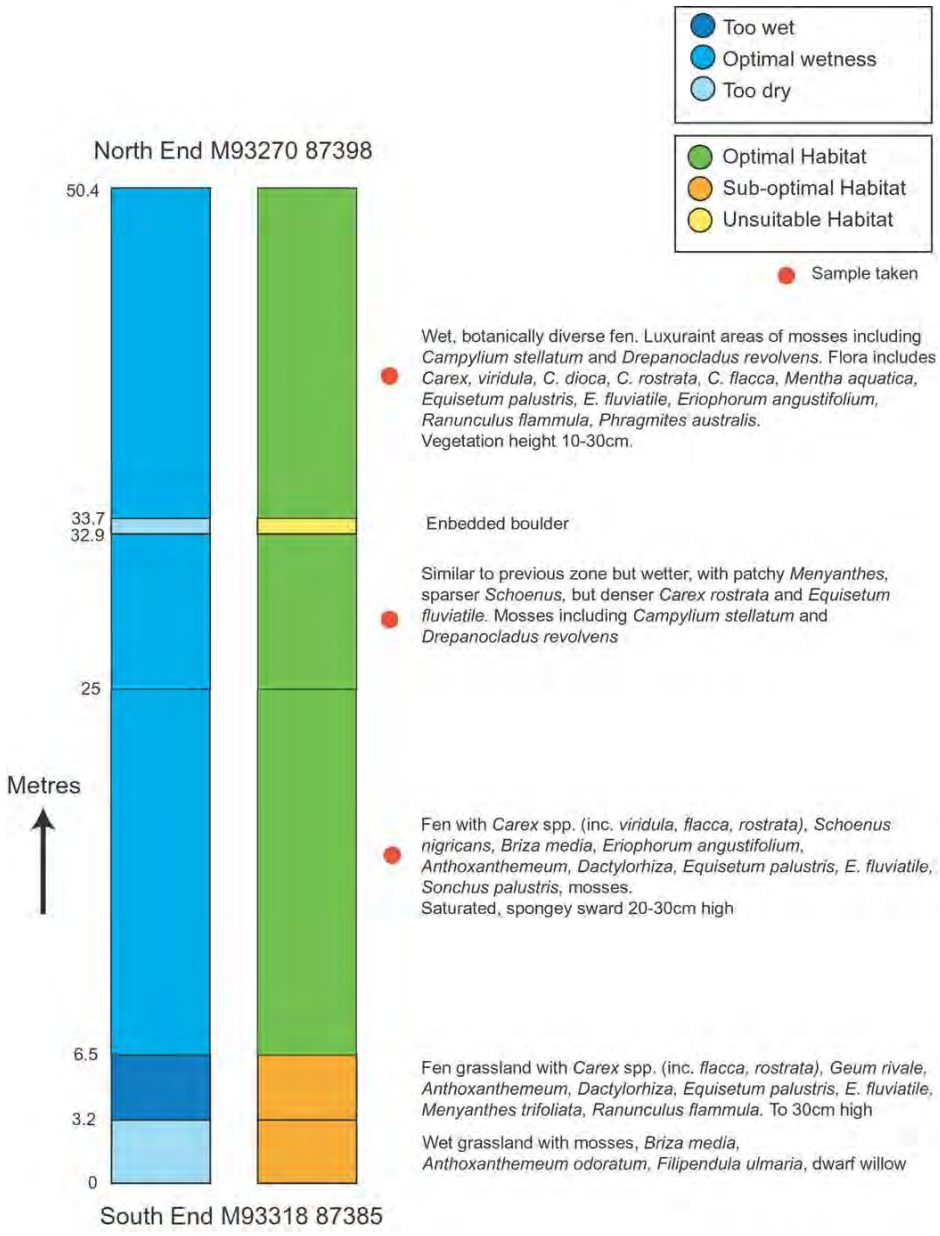

Figure 3: Example of a *Vertigo geyeri* transect (Drimmon Lough)

These permanent transects should be monitored at the regular intervals recommended in each individual site report, by setting up the transect using 30m tapes and repeating the measurement of the length of the zone demarcations by habitat, as described in the baseline transect. Wetness is assessed as either too wet (inundated), optimal wetness (saturated, water visibly rising following hand or foot pressure) or too dry (water not visibly rising following hand or foot pressure). Samples of litter should be removed from the zones marked in the baseline transect.

Approximately 3 litres of uncompacted litter should be removed in each sample. Samples should be air dried, sieved through 5mm and 0.5mm sieves, and the molluscan species then identified, those from the 0.5mm sieve residue using a binocular microscope. Nomenclature should follow Anderson (2005).

Polygon habitats should be reassessed at the regular intervals recommended in each individual site report, using best expert judgement during a walk-over survey, supplemented by identification of snails in the field or through removal of samples. Demarcation of polygon boundaries should be mapped using a hand held GPS.

Condition Assessment Analysis

Each site has been given a unique code for Condition Assessment Monitoring (CAM), and for the 22 *Vertigo geyeri* sites surveyed, the codes range from VgCAM 1 to VgCAM22. Each site report contains the transect results, the molluscan species and their numbers found in each sample, and the specific definitions of optimal and sub-optimal habitat as they relate to that site. The polygon sizes and habitat status are provided. The assessment is made as follows:

Population Assessment

The population of *V. geyeri* at each site is assessed by presence/absence at the transect level and at the site level, where appropriate. At the transect level, a target is set for the number of zones that should have *V. geyeri* in the sample taken from that zone. At the site level, the target for the number of samples positive for *V. geyeri* is also set. The targets differ between sites, and are based on best expert judgement of what that site's favourable condition should be. This is normally the baseline level in a good site.

Habitat Assessment

The habitat of *V. geyeri* at each site is assessed by the classification of the habitat into optimal, sub-optimal and unsuitable zones at the transect level and at the site level. At the transect level, a target

is set for the number of zones and the number of metres that should have optimal *V. geyeri* microhabitat. This is the "habitat extent". There is also a target for the wetness level in terms of numbers of metres of optimal wetness along the transect, known as "habitat quality". At the site level, a target is given for the number of hectares of optimal and/or sub-optimal habitat on the site.

With both population and habitat assessments, the targets for each site will either pass or fail. The combination of the number of passes and failures results in an assessment for each parameter as green, amber or red.

Future Prospects Assessment

The future prospects for *V. geyeri* at each site is assessed by listing the activities that are influencing or are likely to influence the site that could result in the status of the species changing at that site. A standard list of impacts, with their standard codes has been used (Ssymanck 2009). The location of the pressure (from inside or outside the site), its influence (positive, negative or neutral), the intensity of the pressure (low, medium or high) and the number of hectares influenced are all noted. The combination of the influences, both positive and negative is balanced to assess the site's future prospects.

If there are no significant impacts from pressures and the long term viability of the population is assured, then future prospects should be assessed as Favourable. If there are moderate impacts from pressures or management intervention is being implemented to address pressures, then future prospects should be assessed as Unfavourable Inadequate. However the intervention may be enough to warrant a Favourable assessment or inadequate and warrant an Unfavourable Bad assessment. If there are severe impacts from pressures and the viability is not assured in the long term, then future prospects should be assessed as Unfavourable Bad.

The "long term" or foreseeable future is considered to be 12 years.

Overall Assessment

The overall assessment for each site is a combination of the assessments of each attribute. Where all three attributes are green, the overall assessment is green. If one attribute is assessed as amber and the rest green, the overall assessment was deemed to be amber, and if one attribute has been assessed as red, the overall assessment was deemed to be red.

Management Prescriptions and recommendations

Each site report has information on the current and past management observed and inferred for the site. The overall quality of the site is discussed. Recommendations are made for future monitoring and the ideal management that would safeguard *Vertigo geyeri* at that site for the foreseeable future.

Vertigo geyeri recommendations in context

Each cSAC for which *V. geyeri* is a qualifying interest also has other qualifying interests that must be taken into consideration. The Annex I habitats that are normally found with *V. geyeri* are a combination of alkaline fens (Annex I habitat 7230), petrifying springs with tufa formation (Annex I habitat 7220), and transition mires and quaking bogs (Annex I habitat 7140). In the case of all of these habitats, the management prescription that is ideal for the snail should also be ideal for the habitat, and vice versa. Therefore, it is recommended that the management prescriptions from this project are transposed to the overall site conservation management plan. However, where there are multiple species and habitat interests on one site, it is recommended that there is liaison between those responsible for the various qualifying interests, in order to ensure all interests are protected. Where there is confusion or variation in management proposals between interests, a site meeting may be the most useful way to deal with ongoing management prescriptions for the site.

Vertigo angustior – Background and Methodology

Background to the species

The rare narrow-mouthed whorl snail *Vertigo angustior* grows to less than 2mm in height. It has a narrow, yellowish brown shell with its mouth opening to the left of its shell (i.e. sinistral), and with an easily identifiable set of teeth. Full descriptions and illustrations are in Kerney & Cameron (1979) and Pokryszko (1990). A colour photograph of the living snail is in Killeen (1992).

In April 2002, European experts on this species were gathered together for a workshop that culminated in the production of species accounts and relevant papers on *Vertigo angustior* and the other three EU Habitats Directive *Vertigo* species. The volume that was the outcome of this workshop (Speight *et al.*, 2003) is recommended for a more detailed understanding of *V. angustior* in Europe.

In Ireland, the habitat for *V. angustior* has been divided into two types known as "wet phase" (or "marsh phase") and "dune phase" (an apparently drier macrohabitat). At a broad level, it can be present in a very wide range of habitat categories such as dune grassland, fen, marsh, salt marsh and flood plain. However, the micro-habitat within which it is restricted means that the exact conditions which *V. angustior* demands are rare, and a lot of habitat that is "almost correct" is devoid of the snail. The largest areas of occupancy in Ireland are in damp sand dune systems in the west of the country. At other sites it is restricted to a narrow band only a few metres wide (but of variable length) where there is the appropriate ecotone. Sites where the species is widespread, especially those where a variety of suitable habitats and wetness conditions occur within the one general site are of high importance.

In wetlands, the snail is associated with decaying vegetation in the litter layer, or in damp moss, in open unshaded habitats, where the openness is maintained by wetness and/or grazing levels. Generally it occurs in open-structured, humid litter, but in very wet conditions can climb 10-15cm up the stems of plants or onto damp decaying timber. In dry conditions it may be found in the soil, just below the litter layer. In dune grassland situations it occurs at the base of tussocks and among moss patches at the edge of dune slacks. In dunes that have a naturally high water table or are subject to high levels of precipitation, it can be found higher in tussocks and more generally throughout the habitat. It may also be found in and under flood debris.

This species requires friable and permanently moist litter providing humid conditions, shaded by moderately tall herbaceous or grassy vegetation (itself in open situations). It normally occurs in

association with permanently moist but free-draining (permeable) soil, not subject to inundation. It is the latter requirement that makes seemingly suitable and widespread habitat unable to sustain a population of *V. angustior*.

The protection of *V. angustior* under the EU Habitats Directive has resulted in the designation of Special Areas of Conservation (SACs) for the snail. The maintenance of this species at favourable conservation status in its small and patchy distribution amongst larger sites that may have conflicting conservation requirements is a challenge to the conservation authority (NPWS). Most of the sites are in private ownership and some are being managed as part of agricultural enterprises. Parts of Pollardstown Fen are within a Statutory Nature Reserve, and Derrynane is part of a Historic National Park.

Survey methodology

Time of survey

Survey should take place between April and October inclusive in conditions that are not excessively wet, in order to minimise habitat disturbance through trampling. During this period snails are active and some breeding should have occurred.

Method

Vertigo angustior was surveyed at 21 sites (Table 2, Figure 4). Within each site, the suitability of habitat was delimited into polygon areas containing *V. angustior* habitat. These polygon boundaries are marked by physical barriers, such as fences and hard-surfaced paths or ecological barriers, such as a fen-grassland interface.

Where suitable, permanent transects were set up in the best habitat areas in places that are accessible and easily defined so that they can be successfully found during repeat surveillance surveys. In some sites micro-habitat was fragmented and spot sampling in a series of locations was chosen as the recommended monitoring tool.

Within each polygon, specific microhabitat suitable for the snail was searched for systematically, and the snail was searched for by eye in the field to confirm its presence. Samples were also removed to provide further information on the molluscan communities living at the site. In dry conditions, *V. angustior* can be found by hand, but in wet conditions samples need to be removed, dried and sieved for the snail.

It is important to define the level of distinction to make in defining the quality and extent of the habitat for the species. The macro habitat (polygon level) is considered to be the grassland or wetland area within the larger site and within which are areas of suitable and unsuitable microhabitat (at the centimetre level, e.g. saturated decaying *Iris* leaves) for the species.

Vertigo angustior habitat refers to a workable and distinguishable vegetation combination somewhere between the two scales that are at least a number of metres square. This is because it is impossible and meaningless to map out centimetre wide patches of, for example, *Iris* stems. In general, *V. angustior* habitat is more uniform than other *Vertigo* species, so it is less difficult to map. Instead, habitat was divided into *V. angustior* suitable habitat: optimal and sub-optimal, and unsuitable habitat (unsuitable for *V. angustior*), as follows:

Optimal habitat is where *V. angustior* could survive in a high proportion (at least 50%) of the habitat. This allows for areas that have, for example, *Iris pseudacorus* tussocks within cropped wet grassland. The snail cannot be found high in a tussock, but the structure of the tussock provides the variation that sustains the snail within the first 5–6cm of its base, depending on the hydrological conditions on the day. Thus to provide this amplitude of habitat variation to cover annual variation, the growth of unsuitable microhabitat is necessary. Another example of optimal habitat is fixed narrow grass (principally *Festuca rubra*) grey dune habitat, where natural topographic differences will place some areas outside the humidity conditions required by the snail. The topographical changes also provide the niches for wet and dry extremes; therefore by their provision for these extremes, there will always be some habitat within them that is at least temporarily unsuitable.

Sub-optimal habitat is where there are patches of vegetation and conditions that support *V. angustior*, but the majority of the habitat cannot (average 5% of the habitat). An example would be in terrain that is generally too wet, but with small areas of sloping transition edges.

Unsuitable habitat is an area of the site where the combination of vegetation and hydrological influence is outside the snail's range of tolerance. This may be natural unsuitability, e.g. due to proximity of bedrock or alternatively the snail may be restricted by excessive grazing or fertilisation of flat areas of dune grassland, or by patches of weeds arising due to enrichment, sometimes in the distant past. The exact cause of unsuitability cannot always be accurately assessed.

Examples of *V. angustior* habitats are shown in Figure 5.

Within any polygon, combinations of the above are found, and thus polygons are listed as being either: optimal, optimal and sub-optimal, sub-optimal, sub-optimal and unsuitable, or unsuitable.

In the field, the polygons were delimited by hand held GPS, and the management usage of each polygon area was noted. Where management was not obvious, the landowner or NPWS Conservation Ranger was asked for the management history.

Finally, the sample station, in most cases a linear transect, was recorded as a baseline for future surveillance of both the species and its habitat. This included GPS and photos of marked transect ends to be used to both record their character and relocate them subsequently. For baseline purposes, photographs along the transect were also taken for future comparison purposes. The locations of the sample stations were chosen as a representative area for the species at this site, and for convenience of access and of relocation.

Figure 6 shows an example of a *V. angustior* transect. It has a grid reference and compass orientation noted at the start and end point. The transect is divided into zones defining natural changes in ecological quality. This provides a more accurate small scale description of habitat change than can be done at the polygon scale. Zones where a sample has been removed for analysis are marked with red dots. A description of the zone is provided along with significant management notes. Each zone is colour coded as optimal, sub-optimal and unsuitable or combinations of the three. Each zone is colour coded for wetness, a key feature of *Vertigo angustior* habitat.

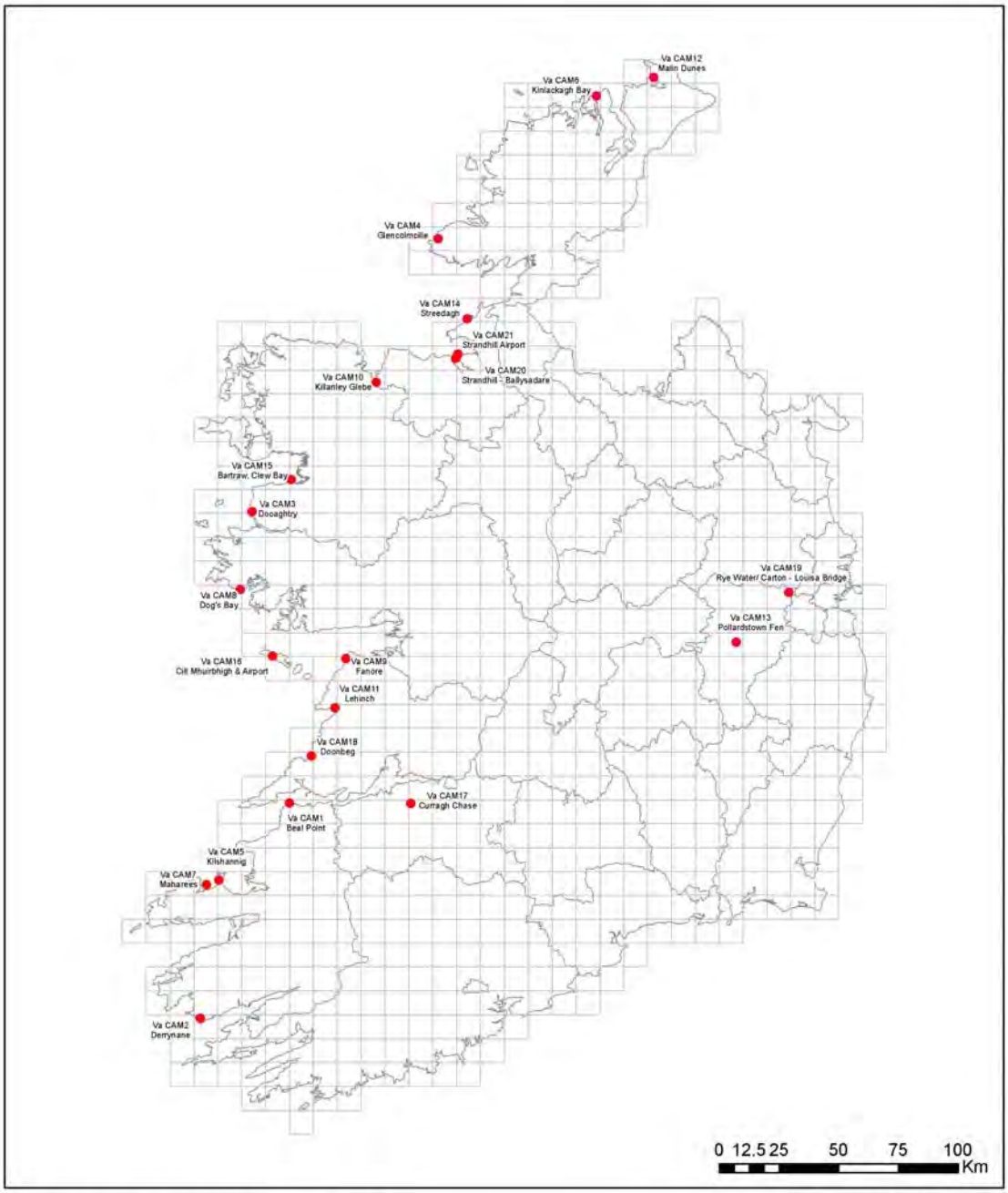

Figure 4: Map of sites surveyed for *Vertigo angustior* 2008-2010

Table 2: Sites surveyed for *Vertigo angustior* 2008-2010

Site Number	**cSAC where site is located**	**Site Name**
Va CAM1	002165 Lower River Shannon	Beal Point
Va CAM2*	002158 Kenmare River	Derrynane
Va CAM3	001932 Mweelrea/Sheefry/Erriff Complex	Dooaghtry
Va CAM4*	000190 Slieve Tooey/Tormore Island/ Loughros	Glencolmcille
Va CAM5	02070 Tralee Bay & Maharees Peninsula, W to Cloghane	Kilshannig
Va CAM6*	001975 Ballyhoorisky Point to Fanad Head	Kinlackagh Bay
Va CAM7	02070 Tralee Bay & Maharees Peninsula, W to Cloghane	Maharees
Va CAM8	001257 Dog's Bay	Dog's Bay
Va CAM9	000020 Black Head-Poulsallagh Complex	Fanore
Va CAM10*	00458 Killala Bay / Moy Estuary	Killanley Glebe
Va CAM11	000036 Inagh River Estuary (small part)	Lehinch
Va CAM12*	002012 North Inishowen Coast	Malin Dunes
Va CAM13*	00396 Pollardstown Fen	Pollardstown Fen
Va CAM14*	001680 Streedagh Point Dunes	Streedagh
Va CAM15	001482 Clew Bay Complex	Bartraw
Va CAM16*	00213 Inishmore Island	Cill Mhuirbhigh & airport
Va CAM17	000174 Curraghchase Woods (some within boundary of)	Curragh Chase
Va CAM18*	001007 White Strand / Carrowmore Marsh	Doonbeg
Va CAM19*	000398 Rye Water Valley/Carton	Louisa Bridge
Va CAM20*	00622 Ballysadare Bay	Ballysadare
Va CAM21*	00627 Cummeen Strand / Drumcliff Bay	Strandhill Airport

*named feature in cSAC

Figure 5a: *Vertigo angustior* habitats - Optimal fixed dune grassland habitat. This low, open habitat is maintained by exposure with a mix of *Festuca* root and moss understorey that is damp throughout. (Bartraw dunes).

Figure 5b: *Vertigo angustior* habitats - Sub-Optimal dune grassland habitat. The tussocks here are higher and drier than those in the picture to the left. The damp areas between the tussocks are a much lower percentage of the overall area and are shaded by the higher tussocks. (Strandhill dunes).

Figure 5c: *Vertigo angustior* habitats - Optimal *Iris* transition marsh habitat. An ecotone of damp mossy litter and root mass can be found at the base of the *Iris* tussocks and surrounding sedge-dominated maritime grassland in the foreground. In the distance the low-lying area is unsuitable, becoming frequently inundated with saline water resulting in a tight rootmass unable to support the snail. (Streedagh).

Figure 5d: *Vertigo angustior* habitats - Sub-Optimal *Iris* transition marsh habitat. A narrow ecotone of suitable damp *Iris* litter and moss is present at the base of the individual tussocks, but the closely cropped grass in the immediate surronding area to the right of the fence cannot support the snail. The fen habitat immediately to the left of the fence is too wet for *V. angustior*. (Pollardstown Fen).

These permanent transects should be monitored at the regular intervals recommended in each individual site report, by setting up the transect using 30m tapes and repeating the measurement of the length of the zone demarcations by habitat, as described in the baseline transect. Wetness is assessed as either too wet (inundated to saturated), optimal wetness (damp and humid to the touch, often markedly warm in summer) or too dry (dry to the touch). Samples of litter should be removed from the zones marked in the baseline transect, approximately 3 litres of uncompacted litter should be removed in each sample. Samples should be air dried, sieved through 5mm and 0.5mm sieves, and the molluscan species then identified, those from the 0.5mm sieve residue using a binocular microscope. Nomenclature should follow Anderson (2005).

Polygon habitats should be reassessed at the regular intervals recommended in each individual site report, using best expert judgement during a walk-over survey, supplemented by identification of snails in the field or through removal of samples. Demarcation of polygon boundaries should be mapped using a hand held GPS.

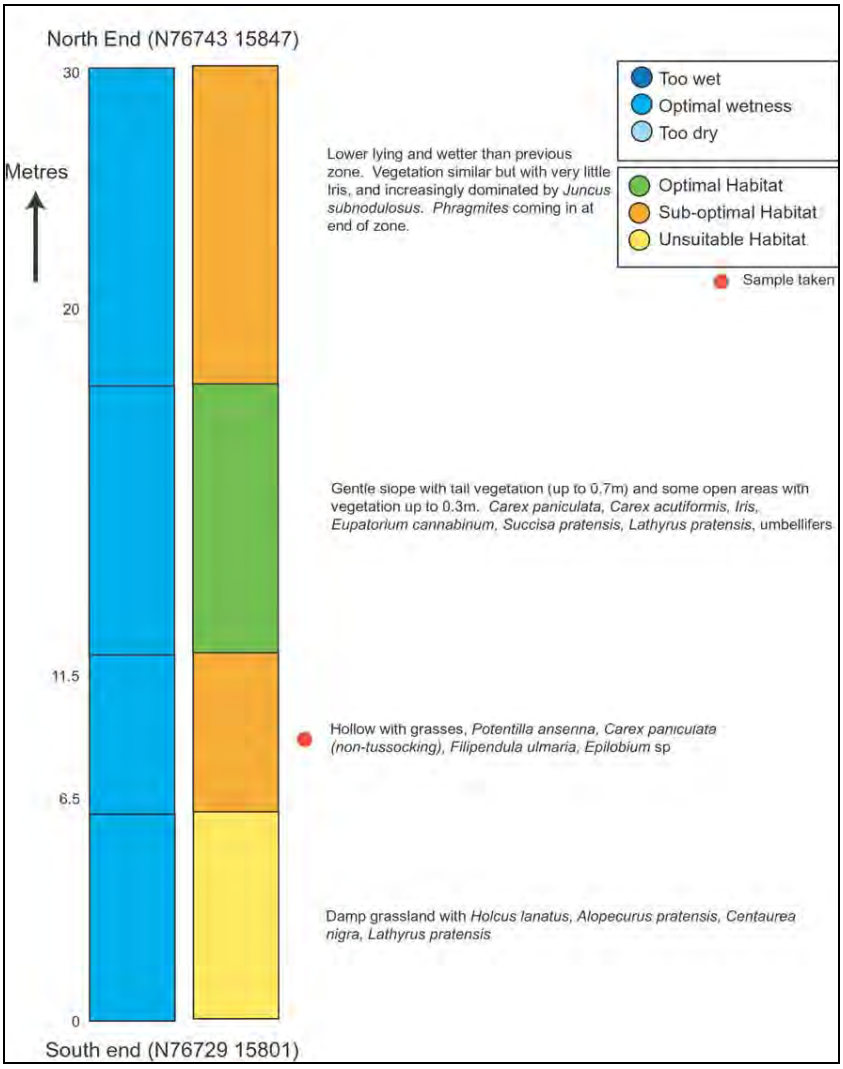

Figure 6: Example of a *Vertigo angustior* transect (Pollardstown Fen)

Condition Assessment Analysis

Each site has been given a unique code for Condition Assessment Monitoring (CAM), and for the 21 *Vertigo angustior* sites surveyed, the codes range from VaCAM 1 to VaCAM21. The locations of the sites are shown in Figure 4. Each site report contains the transect results, the molluscan species and their numbers found in each sample, and the specific definitions of optimal and sub-optimal habitat as they relate to that site. The polygon sizes and habitat status is provided. The assessment is made as follows:

Population Assessment

The population of *V. angustior* at each site is assessed by presence/absence at the transect level and at the site level. At the transect level, a target is set for the number of zones that should have *V. angustior* in the sample taken from that zone. At the site level, the target for the number of samples positive for *V. angustior* is also set. The targets differ between sites, and are based on best expert judgement of what that site's favourable condition should be. This is normally the baseline level in a good site.

Habitat Assessment

The habitat of *V. angustior* at each site is assessed by the classification of the habitat into optimal, sub-optimal and unsuitable zones at the transect level and at the site level. At the transect level, a target is set for the number of zones and the number of metres that should have optimal *V. angustior* microhabitat. This is the "habitat extent". There is also a target for the wetness level in terms of numbers of metres of optimal wetness along the transect, known as "habitat quality". At the site level, a target is given for the number of hectares of optimal and/or sub-optimal habitat on the site.

With both population and habitat assessments, the targets for each site will either pass or fail. The combination of the number of passes and failures results in an assessment for each parameter as either green, amber or red.

Future Prospects Assessment

The future prospects for *V. angustior* at each site is assessed by listing the activities that are influencing or are likely to influence the site that could result in the status of the species changing at that site. A standard list of impacts, with their standard codes has been used (Ssymank 2009). The location of the pressure (from inside or outside the site), its influence (positive, negative or

neutral), the intensity of the pressure (low, medium or high) and the number of hectares influenced are all noted. The combination of the influences, both positive and negative is balanced to assess the site's future prospects as green, amber or red.

If there are no significant impacts from pressures and the long term viability of the population is assured, then future prospects should be assessed as Favourable. If there are moderate impacts from pressures or management intervention is being implemented to address pressures, then future prospects should be assessed as Unfavourable Inadequate. However the intervention may be enough to warrant a Favourable assessment or inadequate and warrant an Unfavourable Bad assessment. If there are severe impacts from pressures and the viability is not assured in the long term, then future prospects should be assessed as Unfavourable Bad.

The "long term" or foreseeable future is considered to be 12 years.

Overall Assessment

The overall assessment for each site is a combination of the assessments of each attribute. Where all three attributes are green, the overall assessment is green. If one attribute is assessed as amber and the rest green, the overall assessment was deemed to be amber, and if one attribute has been assessed as red, the overall assessment was deemed to be red.

Management Prescriptions and recommendations

Each site report has information on the current and past management observed and inferred for the site. The overall quality of the site is discussed and the site is placed in a national and international context. Recommendations are made for future monitoring and the ideal management that would safeguard *Vertigo angustior* at that site for the foreseeable future.

Vertigo angustior recommendations in context

Each cSAC for which *V. angustior* is a qualifying interest also has other qualifying interests that must be taken into consideration. The Annex I habitat that is normally found with *V. angustior* on dune sites is fixed grey dunes (Annex I habitat 2130), but the transition zone in its wetland phase is not associated with an Annex I habitat. This is often the transition between grassland and either fen, salt marsh, freshwater marsh or a water body such as a river. These habitats are often overlooked and sometimes fall just outside cSACs that were mapped before the *V. angustior* population was discovered.

In the case of all of these habitats, the management prescription that is ideal for the snail should also be ideal for the habitat, and vice versa. Therefore, it is recommended that the management prescriptions from this project are transposed to the overall site conservation management plan. However, where there are multiple species and habitat interests on one site, it is recommended that there is liaison between those responsible for the various qualifying interests, in order to ensure all interests are protected. The change in management from cattle to sheep grazing is often associated with the loss of a *V. angustior* population. However, in dune sites where there are plant species of interest that would benefit from close cropping, sheep may be the preferred management option. Where there is confusion or variation in management proposals between interests, management may need to vary between different parts of the site and a site meeting may be the most useful way to deal with ongoing management prescriptions for the cSAC.

Vertigo moulinsiana - Background and Methodology

Background to the species

The rare Desmoulin's whorl snail *Vertigo moulinsiana* is the largest of all the *Vertigo* species, growing to between 2.2 to 2.7mm in height. Its mouth sits to the right of the shell (dextral) and contains four moderately sized teeth. Illustrations and descriptions can be found in Kerney & Cameron (1979) and Pokryszko (1990). A colour photograph of the living snail is in Killeen (1992).

In April 2002, European experts on this species were gathered together for a workshop that culminated in the production of species accounts and relevant papers on *Vertigo moulinsiana* and the other three EU Habitats Directive *Vertigo* species. The volume that was the outcome of this workshop (Speight *et al.,* 2003) is recommended for a more detailed understanding of *V. moulinsiana* in Europe. Two volumes were prepared for *V. moulinsiana* for the Life in UK rivers project on ecology (Killeen 2003b) and monitoring (Killeen & Moorkens 2003).

Vertigo moulinsiana lives on living and dead stems and leaves of tall plants in wetland situations. As well as suitable vegetation structure, *V. moulinsiana* requires a stable hydrogeology, where the water-table is at, or slightly above, the ground surface for much of the year and any seasonal flooding is of very low amplitude (Tattersfield & McInnes 2003). It climbs tall vegetation in the summer and autumn, but in severe conditions aestivates on the lower leaves of plants. In winter it descends to litter level and becomes less active.

The protection of *V. moulinsiana* under the EU Habitats Directive has resulted in the designation of candidate Special Areas of Conservation (cSACs) for the snail. The maintenance of this species at favourable conservation status in its small and patchy distribution amongst larger sites that may have conflicting conservation requirements is a challenge to the conservation authority (NPWS). Unlike the cSAC sites for the other *Vertigo* species in Ireland, most of the sites are in public ownership and are not being managed as part of agricultural enterprises, the exceptions being Lisbigney and part of Pollardstown Fen. Parts of Pollardstown Fen are a Statutory Nature Reserve, and Louisa Bridge and Ballynafagh are managed as amenity nature areas.

Survey methodology

Time of survey

Survey should take place between September and November inclusive, but before the first frost occurs (i.e. tall vegetation has collapsed) in conditions that are not excessively wet, in order to minimise habitat disturbance through trampling. During this period snails are normally active and high on the vegetation, and some breeding should have occurred.

Method

Vertigo moulinsiana was surveyed at 20 sites (Table 3, Figure 7). The survey methodology for *V. moulinsiana* differs from that of the two previous species in that transects are used with standard space samples where the snail numbers are counted and the habitat is described. The reason for this is that samples of tall vegetation are harder to remove than ground litter, but in dry conditions field counts can be made, and the snails are slightly larger and more visible than other *Vertigo* species.

Within each site, the suitability of habitat was delimited into polygon areas containing *V. moulinsiana* habitat. These polygon boundaries are marked by physical barriers, such as fences and hard-surfaced paths or the edges of ecological zones such as deep ditches.

Where suitable, permanent transects were set up in the best habitat areas in places that are accessible and easily defined so that they can be successfully found during repeat surveillance surveys. In some sites micro-habitat was fragmented and spot sampling in a series of locations was chosen as the recommended monitoring tool.

Within each polygon, habitat suitable for the snail was searched for systematically, and the snail was searched for by eye in the field to confirm its presence. Where appropriate, field sampling outside the transect was also used in the population assessment.

The definitions of habitat quality are as follows:

Optimal habitat is where *V. moulinsiana* could survive in a large area (average 50%) of the habitat. It includes a good distribution of tall *Carex* species, sometimes interspersed with *Schoenus nigricans* and *Phragmites australis.* It is wet enough for water to rise and surround the surveyor's boot under light pressure.

Sub-optimal habitat is where there are patches of vegetation and conditions that support *V. moulinsiana* (average 10% of habitat), but the majority of the habitat cannot. An example would be

in terrain that is generally too wet, but with small patches of tussocks arising out of open water, or an area of low growing *Schoenus* interspersed by a few taller tussocks. In these situations the snail uses the lower growing *Schoenus* to spread across relatively wide areas, so although they are not used every year, and are unsuitable for most of the time, they are essential to the function of the population. Sub-optimum wetness is either open water (too wet) or damp conditions where water does not rise under light pressure (too dry).

Unsuitable habitat is an area of the site where the combination of vegetation and hydrological influence is outside the snail's range of tolerance. This may be natural unsuitability (e.g. where bedrock is close to the surface), or alternatively the snail may be excluded by excessive cutting or burning of vegetation.

A range of *Vertigo moulinsiana* habitats are shown in Figure 8.

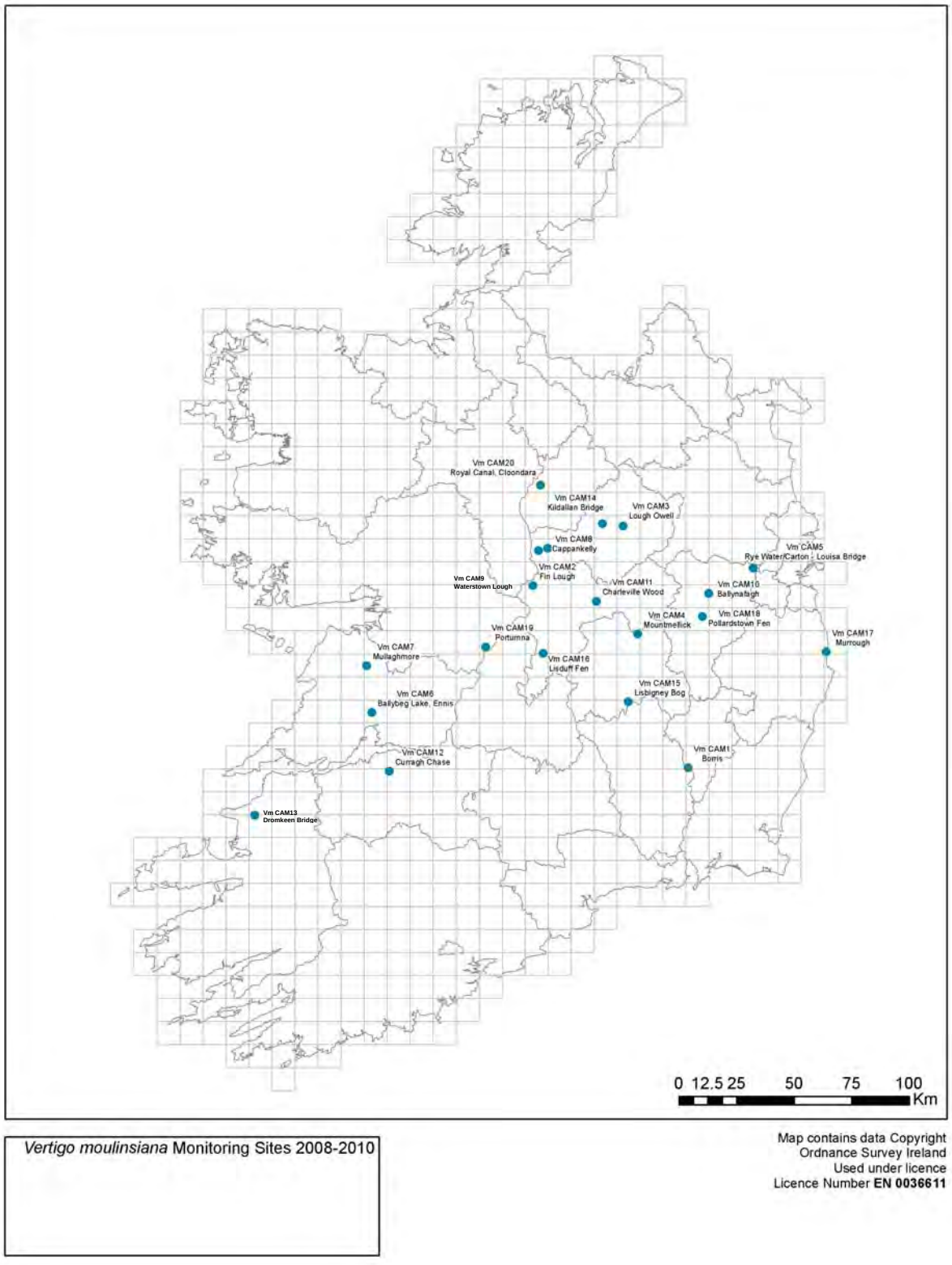

Figure 7: Map showing locations of *Vertigo moulinsiana* sites surveyed 2008-2010

Table 3: *Vertigo moulinsiana* sites surveyed 2008-2010

Site Number	cSAC where site is located	Site Name
Vm CAM1*	002162 River Barrow & River Nore	Borris
Vm CAM2	00576 Fin Lough (Offaly)	Fin Lough
Vm CAM3	Slight overlap with SAC 000688	Lough Owell
Vm CAM4*	002141 Mountmellick	Mountmellick
Vm CAM5*	000398 Rye Water Valley/Carton	Louisa Bridge
Vm CAM6	No designation	Ballybeg Lake
Vm CAM7	001926 East Burren Complex	Mullaghmore
Vm CAM8	No designation	Cappankelly
Vm CAM9	No designation	Waterstown Lough
Vm CAM10*	000391 Ballynafagh Bog	Ballynafagh
Vm CAM11*	000571 Charleville Wood	Charleville Wood
Vm CAM12	000174 Curraghchase Woods (some within boundary of)	Curragh Chase
Vm CAM13	No designation	Dromkeen Bridge
Vm CAM14	No designation	Kildallan Br
Vm CAM15*	00869 Lisbigney Bog	Lisbigney Bog
Vm CAM16	002147 Lisduff Fen	Lisduff Fen
Vm CAM17	002249 The Murrough Wetlands	Murrough
Vm CAM18*	00396 Pollardstown Fen	Pollardstown Fen
Vm CAM19	002241 Lough Derg north east shore	Portumna
Vm CAM20	No designation (Cloondara to Kilashee)	Royal Canal

*named feature in cSAC

Figure 8a: Examples of *Vertigo moulinsiana* habitats - Optimal *Glyceria* swamp habitat. The snail climbs the high vegetation in humid periods, and descends to the dense litter in harsher conditions. (Kildallan Bridge).

Figure 8b: Examples of *Vertigo moulinsiana* habitats - Optimal lake margin habitat. A similar combination of strong structural stems for climbing and dense damp litter is found here. (Fin Lough).

Figure 8c: Examples of *Vertigo moulinsiana* habitats - Sub-Optimal *Schoenus* habitat, with less dense litter and shorter vegetation. This habitat is used by *V. moulinsiana* in highly humid periods but is largely unoccupied in normal conditions. (Lisduff Fen).

Figure 8d: Examples of *Vertigo moulinsiana* habitats - Optimal *Carex paniculata* lake margin habitat. Single tussocks with deep damp litter can hold very high numbers of *V. moulinsiana*. (Ballybeg Lough).

Within any polygon, combinations of the above are found, and thus polygons are listed as being mostly optimal; mostly optimal and sub-optimal; mostly sub-optimal; mostly sub-optimal and unsuitable; or, unsuitable. In the field, the polygons were delimited by hand held GPS, and the management usage of each polygon area was noted. Where management was not obvious, the landowner or NPWS Conservation Ranger was asked for the management history.

Finally, the sample station, in most cases a linear transect, was recorded as a baseline for future surveillance of both the species and its habitat. This included GPS and photos of marked transect ends to be used to both record their character and relocate them subsequently. For baseline purposes, photographs along the transect were also taken for future comparison purposes. The locations of the sample stations were chosen as a representative area for the species at this site, and for convenience of access and of relocation.

Table 4 shows an example of vegetation and wetness classes for *V. moulinsiana* and Table 5 shows an example of a *V. moulinsiana* transect. Samples are taken at defined intervals (usually every 5 or 10m). At each interval, the average vegetation height and main vegetation species are noted, and the wetness level is attributed. A $1m^2$ beating sheet is placed on the ground and the vegetation above it is agitated for approximately 10 seconds. The snails that have come loose and fallen into the sheet are identified and counted. This process is repeated at the prescribed intervals for the length of the transect.

Table 4: Example of *Vertigo moulinsiana* vegetation and wetness classes

Vegetation Classes (For condition assessment, the plant species are classified into 4 groups): Class 1 being the most favoured plants at the site to Class 4 which are unsuitable	Class 1 tall *Carex* species *Schoenus nigricans* *Phragmites australis*	Class II *Cladium mariscus* *Equisetum fluviatile*	Class III *Juncus subnodulosus* *Menyanthes trifoliata* *Mentha aquatica* *Angelica sylvestris*	Class IV All other species
Ground Moisture classes (Ground moisture levels recorded on a scale of 1-5 at each replicate sampling point): classes 3 and 4 are usually the most favourable	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.			

Table 5: Example of a *V. moulinsiana* Transect

Number of metres from transect start (m)	**Vegetation species present (see key)**	**Vegetation height (m)**	**Ground moisture class**	**Number of *Vertigo moulinsiana***		**Number of other mollusc species (see key)**				
				Adult	Juv	Suc/ Oxy	Cep	Col edent	Vert sub	Der laeve
6	Cxa, Ma, Ag	0.4	3	0	0	1	0	0	0	0
8	Pa, Ma, Cxa, Ang	1.5	3	11	61	0	2	0	0	1
10	Pa, Ma, Eq	1.7	4	16	27	0	2	0	0	0
15	Pa, Ma, Eq	1.5	3	4	18	0	2	0	0	0
20	Pa, Ma, Jus	1.2	4	11	88	2	7	0	0	0
25	Cxa, Pa, Ma, Jus	0.4	4	95	220	0	5	0	0	0
30	Cxa, Pa, Ma, Jus	1.0	4	27	70	0	9	0	0	0
40	Jus, Pa	0.8	3	26	9	0	1	0	0	0
50	Pa, Eq, Cxa	0.8	4	19	82	2	3	0	0	0
60	Sch, Jus, Pa, Ma	0.7	4	3	7	2	0	0	0	0
70	Sch, Jus, Ma	0.9	4	0	0	0	3	0	0	0
80	Sch, Jus, Pa, Ma, Cxa	0.9	3	9	6	0	0	3	0	0
90	Sch, Pa, Eq	0.7	4	6	9		2	5	2	0
100	Sch, Jus, Pa, Ma	0.6	3	4	0	2	3	2	0	0
110	Sch, Jus, Pa, Ma	0.8	4	9	17	1	2	0	1	0

Vegetation key: Ag = *Agrostis stolonifera*, Ang = *Angelica sylvestris*, Cxa = *Carex acutiformis*, Cm = *Cladium mariscus*, Eq = *Equisetum fluviatile/palustre*, Jus = *Juncus subnodulosus*, Ma = *Mentha aquatica*, Pa = *Phragmites australis*, Sch = *Schoenus nigricans*

Other mollusc abbreviations: Suc/Oxy = *Succinea* or *Oxyloma*; Cep = *Cepaea* sp.; Col edent = *Columella edentula*; Vert sub = *Vertigo substriata*; Der laeve = *Deroceras laeve*

Condition Assessment Analysis

Each site has been given a unique code for Condition Assessment Monitoring (CAM), and for the 20 *Vertigo moulinsiana* sites surveyed, the codes range from VmCAM 1 to VmCAM20. Figure 7 shows the locations of the sites surveyed. Each site report contains the transect results, the molluscan species and their numbers found in each sample, and the specific definitions of optimal and sub-optimal habitat as they relate to that site. The polygon sizes and habitats are provided. The assessment is made as follows:

Population Assessment

The population of *V. moulinsiana* at each site is assessed by presence/absence and/or numbers of individuals at the transect level and at the site level. At the transect level, a target is set for the number of samples that should have *V. moulinsiana*. At the site level, the target for the number of positive samples for *V. moulinsiana* is also set. The targets differ between sites, and are based on best expert judgement of what that site's favourable condition should be. This is normally the baseline level in a good site.

Habitat Assessment

The habitat of *V. moulinsiana* at each site is assessed by the classification of the habitat into Classes I to IV at the transect level and into optimal and sub-optimal hectares at the site level. At the transect level, a target is set for the number of samples that should have Classes I and II vegetation. This is the "habitat extent". There is also a target (known as "habitat quality") for the wetness level in terms of numbers of samples within soil moisture classes 3-4, or 3-5 depending on the nature of the site. At the site level, a target is given for the number of hectares of optimal and/or sub-optimal habitat on the site.

With both population and habitat assessments, the targets for each site will either pass or fail. The combination of the number of passes and failures results in an assessment for each parameter as green, amber or red.

Future Prospects Assessment

The future prospects for *V. moulinsiana* at each site is assessed by listing the activities that are influencing or are likely to influence the site that could result in a change in the status of the species. A standard list of impacts, with their standard codes has been used (Ssymank, 2009). The location of the pressure (from inside or outside the site), its influence (positive, negative or neutral),

the intensity of the pressure (low, medium or high) and the number of hectares influenced are all noted. The combination of the influences, both positive and negative is balanced to assess the site's future prospects as green, amber or red.

If there are no significant impacts from pressures and the long term viability of the population is assured, then future prospects should be assessed as Favourable. If there are moderate impacts from pressures or management intervention is being implemented to address pressures, then future prospects should be assessed as Unfavourable Inadequate. However the intervention may be enough to warrant a Favourable assessment or inadequate and warrant an Unfavourable Bad assessment. If there are severe impacts from pressures and the viability is not assured in the long term, then future prospects should be assessed as Unfavourable Bad.

The "long term" or foreseeable future is considered to be 12 years.

Overall Assessment

The overall assessment for each site is a combination of the assessments of each attribute. Where all three attributes are green, the overall assessment is green. If one attribute is assessed as amber and the rest green, the overall assessment was deemed to be amber, and if one attribute has been assessed as red, the overall assessment was deemed to be red.

Management Prescriptions and recommendations

Each site report has information on the current and past management observed and inferred for the site. The overall quality of the site is discussed and the site is placed in a national and international context. Recommendations are made for future monitoring and the ideal management that would safeguard *Vertigo moulinsiana* at that site for the foreseeable future.

Vertigo moulinsiana recommendations in context

Each cSAC for which *V. moulinsiana* is a qualifying interest also has other qualifying interests that must be taken into consideration. The Annex I habitats that are normally found with *V. moulinsiana* in its wetland habitat are Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* (Annex I habitat 7210) and petrifying springs with tufa formation (Annex I habitat 7220), but the snail is also present in water fringe vegetation, reedbeds, medium-tall waterside communities and large *Carex* beds that are often overlooked as places of high quality habitat.

In the case of the Annex I habitats, the management prescription that is ideal for the snail should also be ideal for the habitat, and vice versa. Therefore, it is recommended that the management

prescriptions from this project are transposed to the overall site conservation management plan. However, where there are multiple species and habitat interests on one site, it is recommended that there is liaison between those responsible for the various qualifying interests, in order to ensure all interests are protected. The populations of *V. moulinsiana* that are in the best condition tend to be in a state of transition, such as a lake bed or unused canal that is slowly drying out. These habitats are by their nature transitory, and can only be maintained by preventing succession, introducing artificial sluice gates or by occasionally digging out and deepening areas that have accumulated depths of vegetation. Naturally, where other sensitive habitat and species occur, it is important that measures taken to actively manage *V. moulinsiana* do not harm other species and habitats. Where there is confusion or variation in management proposals between interests, management may need to vary between different parts of the site and a site meeting may be the most useful way to deal with ongoing management prescriptions for the cSAC.

Results

Vertigo geyeri results

Vertigo geyeri *individual site results*

A total of 22 sites were surveyed for *Vertigo geyeri*. This consisted of 17 sites within cSAC's with *Vertigo geyeri* listed as a qualifying feature, one site (Silver River) which is part of a cSAC that does not have *V. geyeri* as a qualifying feature, and a further 4 sites outside of cSACs . Table 6 shows the results of the condition assessment at the 22 *V. geyeri* sites. Overall, 64% of the sites were in favourable condition. The individual sites results are shown in Appendix D.

Table: 6: Condition Assessment of *Vertigo geyeri* sites

	Population	Habitat	Future Prospects	Overall
Favourable	15 (68%)	16 (73%)	14 (64%)	14 (64%)
Unfavourable (inadequate)	2	3	5	3
Unfavourable (bad)	5	3	3	5
Favourable within cSACs	76%	82%	71%	71%
Favourable outside cSACs	40%	40%	40%	40%

High quality habitat is very rare for *V.geyeri*. It is much more common to get patches of suitable seepage area within a wider area of less suitable habitat. In total, 179.59 hectares of habitat included conditions that could support the snail. Of this, 5.3 (3%) hectares was optimal, 87.33 hectares was a combination of optimal and sub-optimal habitat, 16.75ha was sub-optimal habitat and 70.11ha was sub-optimal with unsuitable habitat. A summary of the habitat quality at each site is given in Appendix E.

A summary of management of the sites is shown in Table 7. The three sites where *V. geyeri* was only recorded on one occasion and not found during this survey have been removed from management calculations. Management varied between areas of sheep grazing (63.73ha), areas of cattle grazing (22.85ha), there was a small area of mixed grazing by a combination of cattle, sheep and horses (6.33ha) and areas where there was no active management, and the habitat is maintained by wetness from the constant supply of flushing (82.94ha). The sheep grazing was almost exclusively associated with sites in favourable condition, and the result is significant at the .0005 level (χ^2 statistic). A summary of the management at each site is given in Appendix F.

Table 7: Summary of *Vertigo geyeri* site management

	Total area	No active management	Sheep	Cattle	Mixed
Total (ha)	175.85	82.94	63.73	22.85	6.33
%	100%	47%	36%	13%	4%
Favourable sites (ha)	126.6	47.61	63.65	9.01	6.33
Unfavourable (overall) (ha)	49.25	35.33	0.08	13.84	0
% in favourable sites		57.4%	99.9%	39.4%	100%
Significance			***		

*** significant at the .0005 level

Vertigo geyeri *pressures*

The list of pressures noted during the site investigations for *Vertigo geyeri* are listed in Table 8. Two were positive (where non-intensive grazing levels were optimal), 4 were neutral, and 21 were negative, mainly where grazing had been abandoned, or where grazing was too concentrated at spring areas. Drainage, wind energy operations and commercial forestry were all pressures likely to be having a negative effect on *V. geyeri* sites.

Table 8: List of Pressures noted at *V. geyeri* sites

Activity code	Activity	Location	Influence	Intensity	Area affected (ha)	No. sites
A04.02.02	non intensive sheep grazing	Inside	Positive	Low	0.082	1
A04.02.01	non intensive cattle grazing	Inside	Positive	Low	1.42	1
A04.02.02	non intensive sheep grazing	Inside	Neutral	Low	58.495	5
A04.02.01	Non intensive cattle grazing	Inside	Neutral	Low	<2.5	1
A04.02.05	non intensive mixed animal grazing	Inside	Neutral	Low	15.4	1
J02.06.02	surface water abstractions for public water supply	Outside	Neutral	Low	1	1
A04.03	Abandonment of pastoral systems, lack of grazing	Inside	Negative	Medium	19.09	6
A04.02.01	non intensive cattle grazing	Inside	Negative	Medium	27.751	5
J02.01.02	reclamation of land from sea, estuary or marsh	Inside	Negative	High	28.572	3
M01.03	flooding and rising precipitations	Inside	Negative	Medium	3.6	3
C03.03	wind energy production	Inside	Negative	High	3.335	2
G01.03.02	off-road motorized driving	Inside	Negative	Medium	26	2
B01.02	artificial planting on open ground (non-native trees)	Inside	Negative	High	28	2
M01.02	droughts and less precipitations	Inside	Negative	Medium	2.6	2
K02.01	species composition change (succession)	Inside	Negative	Medium	0.616	1
M01	Changes in abiotic conditions	Outside	Negative	Medium	0.756	1
M01.01	rise of temperature & extremes	Inside	Negative	Low	>1.6	1
A04.02.02	Low intensity sheep grazing	Inside	Negative	Low	10.3	1
D01.01	paths, tracks, cycling tracks	Inside	Negative	High	2	1
C01.03	Peat extraction	Outside	Negative	Low	>25 ha	1
K02.01	species composition change (succession)	Inside	Negative	Medium	1	1
A04.01.01	intensive cattle grazing	Inside	Negative	Medium	7	1
D01.02	roads, motorways	Outside	Negative	Medium	0.7	1
J02.02.01	dredging/ removal of limnic sediments	Inside	Negative	Medium	2.5	1
J02.03	Canalisation & water deviation	Inside	Negative	Medium	2.5	1
J02.10	management of aquatic and bank vegetation for drainage purposes	Outside	Negative	Medium	2.5	1
J02.03.01	large scale water deviation	Outside	Negative	Medium	0.7	1

Vertigo geyeri ***national conservation assessment***

The national conservation assessment for *V. geyeri* is summarised in Table 9. The results section explains how these results were obtained.

Table 9: National conservation assessment for *V. geyeri*

Range	Favourable
Population	Unfavourable - Inadequate
Range of appropriate habitat	Unfavourable - Inadequate
Future prospects	Unfavourable - Inadequate
Overall Assessment	Unfavourable - Inadequate

Vertigo angustior results

Site results

A total of 21 sites were surveyed for *Vertigo angustior*. This consisted of 12 sites within cSAC's with *Vertigo angustior* listed as a qualifying feature, and 9 sites within or partly within cSACs that do not list *V. angustior* as a qualifying feature. Table 10 shows the results of the condition assessment at the 21 *V. angustior* sites. Overall, 62% of the sites were in favourable condition. The individual sites results are shown in Appendix G.

Table 10: Condition Assessment of *Vertigo angustior* sites

	Population	Habitat	Future Prospects	Overall
Favourable	16 (76%)	13 (62%)	13 (62%)	13 (62%)
Unfavourable (inadequate)	2	5	6	4
Unfavourable (bad)	3	2	2	4
Favourable within cSACs	75%	75%	67%	67%
Favourable outside cSACs	78%	56%	56%	56%

High quality habitat is rare for *V. angustior*. Most of the habitat for the species is within a transition between areas of optimal and sub-optimal habitat, and sub-optimal and unsuitable habitat. However, in the wider picture, this covers habitat that is necessary to be present during wet and dry extremes. In total, 801.41ha of habitat included conditions that could support the snail. Of this, 52.99ha (6.7%) was optimal, 275.05ha (34.3%) was a combination of optimal and sub-optimal habitat, 120.83ha (15.1%) was sub-optimal habitat and 352.54ha (43.9%) was sub-optimal with unsuitable habitat. A summary of the habitat condition at each site is given in Appendix H.

A summary of management of the sites is shown in Table 11. Management varied between areas of no active management (302ha), areas of cattle grazing (371ha), areas managed as golf courses (105ha) and caravan sites (16ha) and small areas where there was mixed grazing by combinations of cattle, sheep and horses (7.16ha). In many sites sheep grazing was extensive, but there was no potential habitat for *V. angustior* within sheep grazed areas, so polygons with sheep grazing were not included in the results. Sites in favourable condition had significantly more land in no active management, or used as a golf course. The latter tends to have unsuitable areas in tees, greens and fairways, but is otherwise largely unmanaged. A summary of the management at each individual site is given in Appendix I.

Table 11: Summary of *Vertigo angustior* site management

	Total area	No active management	Cattle	Mixed	Golf	Caravans
Total (ha)	801	302	371	7.16	105	16
%	100%	38%	46%	1%	13%	2%
Favourable sites (ha)	483	244	155	0	85	0
Unfavourable sites (ha)	318	58	217	7.16	20	16
% in favourable sites	60%	81%	17.8%	0%	81%	0%
Significance		***			**	

* χ^2 statistic: **=.005 level; ***= .001 level

Vertigo angustior ***pressures***

The list of pressures noted during the site investigations for *Vertigo angustior* are listed in Table 12. One was positive (where non-intensive grazing levels were optimal), 8 were neutral, and 20 were negative, mainly where grazing had been abandoned, or where grazing was too intensive, or too concentrated at vulnerable transition areas. Caravan sites and stock supplementary feeding were all seen to cause deterioration in habitat quality for the species.

Table 12: List of pressures noted at *V. angustior* sites

Activity code	Activity	Location	Influence	Intensity	Area affected (ha)	No. sites
A04.02.01	non intensive cattle grazing	Inside	Positive	Low	9.67	2
A04.02.01	non intensive cattle grazing	Inside	Neutral	Medium	>43 ha	1
K02.01	species composition change (succession)	Inside	Neutral	Medium	25.9	2
G01.02	walking, horseriding and non-motorised vehicles	Inside	Neutral	Low	9.6	1
J02.09.01	saltwater intrusion	Inside	Neutral	Low	9.6	1
A04.02.02	non intensive sheep grazing	Inside	Neutral	Low	5.99	1
G05.01	Trampling, overuse	Inside	Neutral	Low	5.99	1
G02.01	golf course	Inside	Neutral	Low	119.32	3
D04.01	airport	Inside	Neutral	Medium	17.4	1
A04.02.01	non intensive cattle grazing	Inside	Negative	Moderate	287.09	9
A04.03	Abandonment of pastoral systems, lack of grazing	Inside	Negative	Medium	79.4	5
A04.01.01	intensive cattle grazing	Inside	Negative	severe	33	3
G02.07	camping and caravans	Inside	Negative	Medium	33	3
A05.02	stock feeding	Inside	Negative	Medium	3	2
M01.01	rise of temperature & extremes	Inside	Negative	Low	79.6	2
M01.02	droughts and less precipitations	Inside	Negative	Low	79.6	2

Activity code	Activity	Location	Influence	Intensity	Area affected (ha)	No. sites
M01.03	flooding and rising precipitations	Inside	Negative	Low	15.2	2
A04.02.02	non intensive sheep grazing	Inside	Negative	Medium	34.39	2
A04.01.02	intensive sheep grazing	Inside	Negative	Severe	34.71	1
J02.01	Landfill, land reclamation and drying out, general	Outside	Negative	Low	8	1
D04.01	airport	Inside	Negative	Medium	21	1
D01.01	paths, tracks, cycling tracks	Inside	Negative	Severe	2	1
D01.03	car parks and parking areas	Inside	Negative	Medium	1.5	1
J02.05.02	modifying structures of inland water courses	Outside	Negative	Medium	0.6	1
B01.02	artificial planting on open ground (non-native trees)	Inside	Negative	Severe	10	1
B06	grazing in forests/ woodland	Inside	Negative	Medium	2	1
E06	Other urbanisation, industrial and similar activities	Inside	Negative	Medium	1	1
G01.03	motorised vehicles	Inside (Area B)	Negative	Moderate	<25	1
E01.03	dispersed habitation	Outside	Negative	Low	1	1

Vertigo angustior *national conservation assessment*

The national conservation assessment for *V. angustior* is summarised in Table 13. The results section explains how these results were obtained.

Table 13: National conservation assessment for *V. angustior*

Range	Unfavourable - Inadequate
Population	Unfavourable - Inadequate
Range of appropriate habitat	Unfavourable - Inadequate
Future prospects	Unfavourable - Inadequate
Overall Assessment	Unfavourable - Inadequate

Vertigo moulinsiana results

Vertigo moulinsiana *site results*

A total of 20 sites were surveyed for *Vertigo moulinsiana*. This consisted of 7 sites within cSAC's with *Vertigo moulinsiana* listed as a qualifying feature, 7 sites partly or wholly within cSACs which do not list *V. moulinsiana* as a qualifying feature and a further 6 sites that are undesignated.

Table 14 shows the results of the condition assessment at the 20 *V.moulinsiana* sites. Overall, 65% of the sites were in favourable condition. The individual sites results are shown in Appendix J.

Table 14: Condition Assessment of *Vertigo moulinsiana* sites

	Population	Habitat	Future Prospects	Overall
Favourable	14 (70%)	16 (80%)	14 (70%)	13 (65%)
Unfavourable (inadequate)	1	0	2	2
Unfavourable (bad)	5	4	4	5
Favourable within cSACs	71%	86%	57%	57%
Favourable outside cSACs	69%	77%	77%	69%

High quality habitat is rare for *V. moulinsiana* (2.4%). Most of the habitat for the species is within a transition between areas of optimal and sub-optimal habitat (57%), or in sub-optimal habitat (33%). There is a small amount of sub-optimal mixed with unsuitable habitat (7.6%). A summary of the habitat condition at each site is given in Appendix K.

A summary of management of the sites is shown in Table 15. Management varied between areas of no active management (77ha), areas of cattle grazing (16ha), areas with horse grazing (3ha) and areas where there was mixed grazing by various combinations of cattle, horses and goats (23ha). No sites with *V. moulinsiana* had sheep grazing. Sites in unfavourable condition had very little habitat, as the sites were found to be destroyed rather than having habitat in poor condition. The single site in unfavourable (inadequate) condition is a small site (1.13ha) with no active management. A summary of the management at each individual site is given in Appendix L.

Table 15: Summary of *Vertigo moulinsiana* site management

	Total area	No active management	Cattle	Horse	Mixed
Total (ha)	119.15	77.22	15.84	3.07	23.02
%	100%	65%	13%	2.5%	19%
Favourable sites (ha)	115.95	74.72	15.14	3.07	23.02
Unfavourable sites (ha)	3.2	2.5	0.7	0	0

Vertigo moulinsiana *pressures*

The list of pressures noted during the site investigations for *Vertigo moulinsiana* are listed in Table 16. Three were positive (where non-intensive grazing levels were optimal and sluice management

of groundwater was optimal), 3 were neutral, and 14 were negative, mainly where there have been changes to the hydrogeology (often natural, but needing to be artificially maintained in order to maintain at the correct hydrosere). Drainage, canalisation and dredging were all pressures likely to be having a negative effect on *V. moulinsiana* sites.

Table 16: List of Pressures noted at *V. moulinsiana* sites

Activity code	Activity	Location	Influence	Intensity	Area affected (ha)	No. of sites
A04.02.01	non intensive cattle grazing	Inside	Positive	Low	1.49	1
J02.05	Modification of hydrographic functioning, general	Outside	Positive	Low	6.2	1
A04.02.03	non intensive horse grazing	Inside	Positive	Low	3.07	1
A04.02.01	Non intensive cattle grazing	Inside	Neutral	Low	31.06	7
A04.02.03	Non-intensive horse grazing	Inside	Neutral	Low	21.6	2
A04.02.05	non intensive mixed animal grazing	Inside	Neutral	Low	1.48	1
M01.01	rise of temperature & extremes	Inside	Negative	Low	22.08	6
M01.02	droughts and less precipitations	Inside	Negative	Low	22.08	6
M01.03	flooding and rising precipitations	Inside	Negative	Low	22.08	6
A04.03	Abandonment of pastoral systems, lack of grazing	Inside	Negative	Low	31.67	4
K02.01	species composition change (succession)	Inside	Negative	Low	20.66	4
A04.02.01	non intensive cattle grazing	Inside	Negative	severe	1.41	2
J02.05.02	Modifying structures of inland water courses	Inside	Negative	Severe	7.3km linear length of ditch	2
H01	Pollution to surface waters (limnic & terrestrial)	Outside	Negative	Low	7.2	2
J02.01.03	infilling of ditches, dykes, ponds, pools, marshes or pits	Inside	Negative	Low	2.98	2
J02.10	management of aquatic and bank vegetation for drainage purposes	Inside	Negative	Medium	*	1
J02.11	Dumping, depositing of dredged deposits	Inside	Negative	Medium	*	1
J02.01.02	reclamation of land from sea, estuary or marsh	Inside	Negative	Severe	5.78	1
J02.02.01	dredging/ removal of limnic sediments	Inside	Negative	Medium	17.4	1
J02.03	Canalisation & water deviation	Inside	Negative	Medium	17.4	1

Vertigo moulinsiana *national conservation assessment*

The national conservation assessment for *V. moulinsiana* is summarised in Table 17. The results section explains how these results were obtained.

Table 17: National conservation assessment for *V. moulinsiana*

Range	Unfavourable - Bad
Population	Unfavourable - Inadequate
Range of appropriate habitat	Unfavourable - Inadequate
Future prospects	Unfavourable - Inadequate
Overall Assessment	Unfavourable - Bad

National Conservation Status Assessment Results

Vertigo geyeri

Range

Current Range

Vertigo geyeri has been recorded from a total of 29 ten kilometre squares; however it has only been recorded in 24 ten kilometre squares since the Directive came into force in 1994. Given the small areas of micro-habitat that exists for the species within a much wider gross habitat area, the range of the animal in Ireland should include those 10km squares where potential habitat exists and where the snail may occur but is not known to do so to date. Thus the 10km squares that are not known to support *V. geyeri*, but are known to support Annex I 7220 habitat of petrifying springs with tufa formation and / or alkaline fen (Annex I 7230) and are directly adjacent to 10km squares known to support *V. geyeri* have also been added to the known distribution of the species. The current range was mapped to derive an envelope of the smallest polygon size containing all 10km grid squares identified above. This envelope was drawn using a minimum number of 90 degrees angles. Horizontal or vertical gaps in the species distribution of 3 or more grid squares or oblique gaps of 2 or more squares were deemed enough to justify a break in the range. When the ecological conditions for the occurrence of the species were deemed unsuitable, smaller gaps were chosen.

The current range is 39 ten kilometre squares. This value is higher than that recorded in 2007 due to increased knowledge through detailed monitoring field survey (2008-2010). 5 new sites have been found and a further 4 sites were checked and dismissed as not likely to have ever supported a population of the species.

Favourable reference range

The Favourable Reference Range (FRR) for *Vertigo geyeri* in Ireland is taken to be its current known range as there is no evidence of decline since the Directive came into force.

Conservation assessment of the range

Vertigo geyeri is considered to be a relict species, and unlikely to naturally colonise new sites with ease. It is therefore conservation dependent in terms of species spread (translocation is likely to be necessary if new sites are to be colonised) and protection of current sites. It is currently considered

to be threatened in the Republic of Ireland with a local IUCN status of Vulnerable (Moorkens, 2006a, Byrne *et al.,* 2009). As the Favourable Reference Range of the species is based on the recent range, and is equal to the Current Range, it is allocated a **Favourable** conservation status.

Current population

In the 2007 assessment, the number of viable populations was chosen as the best proxy to estimate population size. Following the wide-ranging survey of 2008-2010 (22 out of 24 populations were surveyed) the area of occupancy of the snail was quantified as recommended by the updated Article 17 guidelines. The same values were used for the population and habitat attributes (see section 3.1), however the attributes were assessed at each site using separate criteria.

The current population was estimated as the area of occupancy of the snail based on an average of 50% occupancy within optimal habitat (50% of 5.3Ha), 10% occupancy of sub-optimal and optimal habitat (10% of 87.33Ha), 2% occupancy of sub-optimal (2% of 16.85Ha), and 0.5% occupancy of sub-optimal and unsuitable habitat (0.5% of 70.11Ha). 1Ha occupancy was added as an estimate for non-surveyed sites. The total current population is estimated as 13 Hectares. This was based on best expert judgement following a walk-over survey, sampling live snails in the field, and the removal of samples where appropriate. Habitat definitions are as follows:

Optimal habitat is where *V. geyeri* could survive in a large area (average 50%) of the habitat. This allows for areas that have, for example, *Schoenus nigricans* tussocks. The snail is not found high in a tussock, but the structure of the tussock provides the variation that sustains the snail within the first 5 to 6 centimetres of its base, depending on the hydrological conditions on the day. Thus to provide this amplitude of habitat variation to cover annual variation, the growth of unsuitable microhabitat is necessary. Another example of optimal habitat is calcareous cropped open sedge swards and moss carpets within undulating terrain. The topographical changes provide the niches for wet and dry extremes; therefore by their provision for these extremes, there will always be some habitat within them that is at least temporarily unsuitable.

Sub-optimal habitat is where there are patches of vegetation and conditions that support *V. geyeri* (average 2% of the habitat) but the majority of the habitat cannot. This can be due to terrain being generally too high, but with small suitably wet runnel flushes occurring within, or where habitat is on the margin of base tolerance for the species, where acid influence promotes mainly calcifuge species, but where occasional groundwater seepage influence provides a suitable patch that the snail can occupy. Alternatively the snail may be restricted by succession due to lack of grazing,

where the snail is shaded out of most of the area, except for patches prevented from growth by being wetter than their surroundings.

Unsuitable habitat is an area of the site where the combination of vegetation and hydrological influence is outside the snail's range of tolerance.

Favourable reference population

The Favourable Reference Population (FRP) is 'the population in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the species' (European Commission, 2006).

Expert opinion considers that in order to conserve the long term viability of *Vertigo geyeri* in the Republic of Ireland, the population Conservation Status should be based upon maintaining the current number of sites in favourable condition and not on number of individuals which is an unreliable measure (see above). Thus sites that were classified as being in unfavourable condition for population (based on assessment of snail presence) were assessed using best expert opinion as to how much more area of occupancy they would have if they were in favourable condition. On this basis the FRP would be 14ha, based on an extra 1ha occupancy for sites that have not been assessed as favourable for the Population attribute (Lough Talt, Clonaslee and Brackloon).

Conservation assessment of the population

As the Favourable Reference Population of the species is greater than the Current Population, it is allocated **Unfavourable – Inadequate** conservation status.

Habitat for the species

In the 2007 assessment, the habitat assessment was based on making a best expert judgement on whether the habitat for *V. geyeri* on an individual site was in favourable condition. The combination of at least parts of 7 of the 14 cSACs assessed being recorded as unfavourable for habitat, combined with the lack of information on the recoverability of these sites i.e. trend data meant it was classified as Unfavourable – inadequate.

In the 2008-1010 study, much greater effort was made in classifying habitat into its optimacy categories, and polygons were calculated for each quality class. Habitat quality was also assessed by assessing optimal wetness along a transect at each site. A total of 16 out of 22 sites had good habitat quality, 3 had moderate habitat quality and 3 sites were discounted as having poor habitat

quality for the species, with no evidence that the site was ever likely to have been suitable to sustain a long term population for *V. geyeri*.

The current habitat was estimated as the area of occupancy of the snail based on an average of 50% occupancy within optimal habitat (50% of 5.3ha), 10% occupancy of sub-optimal and optimal habitat (10% of 87.33ha), 2% occupancy of sub-optimal (2% of 16.85ha), and 0.5% occupancy of sub-optimal and unsuitable habitat (0.5% of 70.11ha). 1ha occupancy was added as an estimate for non-surveyed sites. The total current Habitat for the species is estimated as 13 Hectares.

Conservation assessment of the Habitat for the species

The habitat for the species has been assessed as Unfavourable – Inadequate because of a declining trend in area of habitat for the species, and a decline in the quality of the habitat for the species at some sites. While 16 of the sites have been assessed as having habitat in good quality and are likely to be sustainable, 3 other sites should have better quality habitat in order to ensure their sustainability.

Future prospects

Pressures were assessed at each site and noted as positive, neutral or negative. These were pooled together to give a national overview of the most prevalent negative pressures. Future prospects were assessed as **Unfavourable – Inadequate,** as the main pressures are significant in sites where decline is evident, but some sites remain in very good status.

Overall status

This was assessed as **Unfavourable – Inadequate,** as there was one or more Unfavourable-Inadequate and no Unfavourable – Bad. Although there has been some decline in area of occupancy these are not large enough to warrant an Unfavourable Inadequate declining status.

Summary – Vertigo geyeri

Range	Favourable =
Population	Unfavourable – Inadequate =
Habitat for the species	Unfavourable – Inadequate=
Future prospects	Unfavourable – Inadequate=
Overall Assessment	Unfavourable - Inadequate=

Vertigo angustior

Range

Current Range

Vertigo angustior has been recorded from a total of 35 ten kilometre squares; however it has only been recorded in 34 ten kilometre squares since the Directive came into force in 1994. Given the small areas of micro-habitat that occur for the species within a much wider gross habitat area, the range of the animal in Ireland should include those 10km squares where potential habitat exists and where the snail may occur but is not known to do so to date. Thus the 10km squares that are not known to support *V. angustior* but are known to support suitable habitat and are directly adjacent to 10km squares known to support *V. angustior* have also been added to the known distribution of the species. The current range was mapped to derive an envelope of the smallest polygon size containing all 10 km grid squares identified above. This envelope was drawn using a minimum number of 90 degrees angles. Horizontal or vertical gaps in the species distribution of 3 or more grid squares or oblique gaps of 2 or more squares were deemed enough as to justify a break in the range. When the ecological conditions for the occurrence of the species were deemed unsuitable, smaller gaps were chosen.

The current range is 37 ten kilometre squares. This value is higher than that recorded in 2007 due to increased knowledge through detailed monitoring field survey (2008-2010). One site has however been lost since the Directive came into force.

Favourable reference range

The Favourable Reference Range (FRR) for *Vertigo angustior* in Ireland is taken to be its post 1994 known range (3800 km^2). This is higher than its current range as the population at Louisa Bridge has not been found since 1997 (but was present since 1994).

Conservation assessment of the range

Vertigo angustior is considered to be a relict species, and unlikely to naturally colonise new sites with ease. It is therefore conservation dependent in terms of species spread (translocation is likely to be necessary if new sites are to be colonised) and protection of current sites. It is currently considered to be threatened in the Republic of Ireland with a local IUCN status of Vulnerable (Moorkens, 2006a, Byrne *et al.*, 2009). As the Favourable Reference Range of the species is based on

the recent range, and is greater than the Current Range, it is allocated **Unfavourable - Inadequate** conservation status.

Current population

In the 2007 assessment, the number of viable populations was chosen as the best proxy to estimate population size. Following the wide-ranging survey of 2008-2010 (21 out of 40 populations were surveyed) the area of occupancy of the snail was quantified as recommended by the updated Article 17 guidelines. The same values were used for the population and habitat attributes (see section 8.1), however the attributes were assessed at each site using separate criteria.

The current population was estimated as the area of occupancy of the snail based on an average of 50% occupancy within optimal habitat (50% of 53ha), 30% occupancy of sub-optimal and optimal habitat (30% of 275ha), 5% occupancy of sub-optimal (5% of 121ha), and 1% occupancy of sub-optimal and unsuitable habitat (1% of 353ha). 2.8ha occupancy was added as an estimate for non-surveyed sites. The total current population is estimated as 121.39 Hectares.

This was based on best expert judgement following a walk-over survey, sampling live snails in the field, and the removal of samples where appropriate. Habitat definitions are as follows:

Optimal habitat is where *V. angustior* could survive in a high proportion (average 50%) of the habitat. This allows for areas that have, for example, *Iris pseudacorus* tussocks within cropped wet grassland. The snail cannot be found high in a tussock, but the structure of the tussock provides the variation that sustains the snail within the first 5 to 6 centimetres of its base, depending on the hydrological conditions on the day. Thus to provide this amplitude of habitat variation to cover annual variation, the growth of unsuitable microhabitat is necessary. Another example of optimal habitat is fixed narrow grass (principally *Festuca rubra*) grey dune habitat, where natural topographic differences will place some areas outside the humidity conditions required by the snail. The topographical changes also provide the niches for wet and dry extremes; therefore by their provision for these extremes, there will always be some habitat within them that is at least temporarily unsuitable.

Sub-optimal habitat is where there are patches of vegetation and conditions that support *V. angustior*, but the majority of the habitat cannot (average 5% of the habitat). An example would be in terrain that is generally too wet, but with small areas of sloping transition edges.

Unsuitable habitat is an area of the site where the combination of vegetation and hydrological influence is outside the snail's range of tolerance. This may be natural unsuitability, e.g. due to proximity of bedrock or alternatively the snail may be restricted by excessive grazing or

fertilisation of flat areas of dune grassland, or by patches of weeds arising due to enrichment, sometimes in the distant past. The exact cause of unsuitability cannot always be accurately assessed.

Favourable reference population

The Favourable Reference Population (FRP) is 'the population in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the species' (European Commission, 2006).

Expert opinion considers that in order to conserve the long term viability of *Vertigo angustior* in the Republic of Ireland, the population Conservation Status should be based upon maintaining the current number of sites in favourable condition and not on number of individuals which is an unreliable measure (see above). Thus sites that were classified as being in unfavourable condition for population (based on assessment of snail presence) were assessed using best expert opinion as to how much more area of occupancy they would have if they were in favourable condition. On this basis the FRP would be 137 Ha, based on an extra 15.61 Ha occupancy for sites that have not been assessed as favourable for the Population attribute (Beal Point, Glencolmcille, Kinlackagh, Maharees and Louisa Bridge).

Conservation assessment of the population

As the Favourable Reference Population of the species is greater than the Current Population, it is allocated **Unfavourable – Inadequate** conservation status.

Habitat for the species

In the 2007 assessment, the habitat assessment was based on making a best expert judgement on whether the habitat for *V. angustior* on an individual site was in favourable condition. The combination of at least parts of 1 of the 12 cSACs assessed being recorded as unfavourable for habitat, and another 5 had unknown habitat status it was classified as Unfavourable – inadequate.

In the 2008-1010 study, much greater effort was made in classifying habitat into its optimacy categories, and polygons were calculated for each quality class. The same calculations were used as for population, although individual sites were classified with their own separate criteria, which were different for population and habitat. Habitat quality was also assessed by assessing optimal wetness along a transect at each site. A total of 14 out of 21 sites had good habitat quality, 5 had

moderate habitat quality and 2 sites had bad habitat quality for *V.angustior*, but had better habitat quality in the past.

The current habitat was estimated as the area of occupancy of the snail based on an average of 50% occupancy within optimal habitat (50% of 53Ha), 30% occupancy of sub-optimal and optimal habitat (30% of 275Ha), 5% occupancy of sub-optimal (5% of 121Ha), and 1% occupancy of sub-optimal and unsuitable habitat (1% of 353Ha). 2.8Ha occupancy was added as an estimate for non-surveyed sites. The total current habitat for the species is estimated as 121.39 Hectares.

Conservation assessment of the habitat

The habitat for the species has been assessed as Unfavourable – Inadequate because of a declining trend in area of habitat for the species, and a decline in the quality of the habitat for the species at some sites. While 14 of the sites have been assessed as having habitat in good quality and are likely to be sustainable, 5 other sites should have better quality habitat in order to ensure their sustainability, and 2 sites have had a severe decline in habitat quality.

Future prospects

Pressures were assessed at each site and noted as positive, neutral or negative. These were pooled together to give a national overview of the most prevalent negative pressures. Future prospects were assessed as **Unfavourable – Inadequate,** as although most of the large coastal sites are in good status, the inland marsh sites are threatened by hydrogeological (mainly drainage) and trampling pressures.

Overall status

This was assessed as **Unfavourable – Inadequate,** as there was one or more Unfavourable-Inadequate and no Unfavourable – Bad. Range, Population and Habitat for the species were assessed as Unfavourable – Inadequate due to the loss of a population. However as most of the populations are in relatively good condition the future prospects and the overall assessments are not considered to be declining.

Summary – Vertigo angustior

Range	Unfavourable – Inadequate 🡻
Population	Unfavourable – Inadequate 🡻
Habitat for the species	Unfavourable – Inadequate 🡻
Future prospects	Unfavourable – Inadequate =
Overall Assessment	Unfavourable – Inadequate =

Vertigo moulinsiana

Range

Current Range

Vertigo moulinsiana has been recorded from a total of 54 sites; however it has only been recorded from 29 sites in 23 ten kilometre squares since the Directive came into force in 1994. Given the small areas of micro-habitat that exist for the species within a much wider gross habitat area, the range of the animal in Ireland should include those 10km squares where potential habitat exists and where the snail may occur but is not known to do so to date. Thus the 10km squares that are not known to support *V. moulinsiana* but are known to support suitable habitat and are directly adjacent to 10km squares known to support *V. moulinsiana* have also been added to the known distribution of the species. The current range was mapped to derive an envelope of the smallest polygon size containing all 10 km grid squares identified above. This envelope was drawn using a minimum number of 90 degrees angles. Horizontal or vertical gaps in the species distribution of 3 or more grid squares or oblique gaps of 2 or more squares were deemed enough as to justify a break in the range. When the ecological conditions for the occurrence of the species were deemed unsuitable, smaller gaps were chosen.

The current range is 37 ten kilometre squares. This value is higher than that recorded in 2007 due to increased knowledge through detailed monitoring field survey (2008-2010). One site has however been lost since the Directive came into force.

Vertigo moulinsiana has been recorded mostly from sites in the Midlands and the Shannon Basin from Lough Derg to Longford, with outlying sites from Kerry found to be destroyed and in Wicklow to be still extant. Based on an assessment of connecting and surrounding 10km squares with potential to have populations of the species, the current range has been estimated as 38 ten kilometre squares.

Favourable reference range

The favourable reference range for *V. moulinsiana* Ireland is difficult to estimate with certainty. If all current populations of the snail are protected and maintained in favourable condition, this may be sustainable in the long term. However, it may be that this species is more dynamic than is currently scientifically understood, and may require large-scale functioning corridors in order to sustain a sufficient number of sites on a long term basis. A large number of former sites have been lost

relatively recently, particularly in the corridor of the two major canals, and thus the favourable reference range reflects this and is set at 55 ten kilometre squares.

Conservation assessment of the range

It is currently considered to be threatened in the Republic of Ireland with a local IUCN status of endangered (Byrne *et al.*, 2009). As the Current range is more than 10% less than the Favourable Reference Range of the species, it is allocated **Unfavourable - Bad** conservation status.

Current population

In the 2007 assessment, the number of viable populations was chosen as the best proxy to estimate population size. Following the wide-ranging survey of 2008-2010 (20 out of 26 populations were surveyed) the area of occupancy of the snail was quantified as recommended by the updated Article 17 guidelines. The same values were used for the population and habitat attributes (see section 13.1), however the attributes were assessed at each site using separate criteria.

The current population was estimated as the area of occupancy of the snail based on an average of 50% occupancy within optimal habitat (50% of 2.91Ha), 20% occupancy of sub-optimal and optimal habitat (20% of 67.5Ha), 10% occupancy of sub-optimal (10% of 39.7Ha), and 1% occupancy of sub-optimal and unsuitable habitat (1% of 9.04Ha). 5Ha occupancy was added as an estimate for non-surveyed sites. The total current population is estimated as 24 Hectares.

This was based on best expert judgement following a walk-over survey, sampling live snails in the field, and the removal of samples where appropriate. Habitat definitions are as follows:

Optimal habitat is where *V. moulinsiana* could survive in a large area (average 50%) of the habitat. It includes a good distribution of tall *Carex* species, sometimes interspersed with *Schoenus nigricans* and *Phragmites australis.* It is wet enough for water to rise and surround the surveyor's boot under light pressure.

Sub-optimal habitat is where there are patches of vegetation and conditions that support *V. moulinsiana* (average 10% of habitat), but the majority of the habitat cannot. An example would be in terrain that is generally too wet, but with small patches of tussocks arising out of open water, or an area of low growing *Schoenus* interspersed by a few taller tussocks. In these situations the snail uses the lower growing *Schoenus* to spread across relatively wide areas, so although they are not used every year, and are unsuitable for most of the time, they are essential to the function of the population. Sub-optimum wetness is either open water (too wet) or damp conditions where water does not rise under light pressure (too dry).

Unsuitable habitat is an area of the site where the combination of vegetation and hydrological influence is outside the snail's range of tolerance. This may be natural unsuitability (e.g. where bedrock is close to the surface), or alternatively the snail may be restricted by excessive cutting or burning of vegetation.

Favourable reference population

The Favourable Reference Population (FRP) is 'the population in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the species' (European Commission, 2006).

Expert opinion considers that in order to conserve the long term viability of *Vertigo moulinsiana* in the Republic of Ireland, the population Conservation Status should be based upon maintaining the current number of sites in favourable condition and not on number of individuals which is an unreliable measure (see above). Thus sites that were classified as being in unfavourable condition for population (based on assessment of snail presence) were assessed using best expert opinion as to how much more area of occupancy they would have if they were in favourable condition. On this basis the FRP would be 25.5 Ha, based on an extra 1.5ha occupancy for sites that have not been assessed as favourable for the Population attribute (Borris, Curragh Chase, Lisbigney, Royal Canal). Additional areas will also need to be restored across the Favourable Reference Range; it is difficult however to quantify these additional areas.

Conservation assessment of the population

As the Favourable Reference Population of the species is greater than the Current Population (but not by more than 25%), it is allocated **Unfavourable – Inadequate** conservation status.

Habitat for the species

In the 2007 assessment, the habitat assessment was based on making a best expert judgement on whether the habitat for *V. moulinsiana* on an individual site was in favourable condition. The classification of Unfavourable – inadequate was based on the poor condition of Lisbigney Bog for the species.

In the 2008-1010 study, much greater effort was made in classifying habitat into its optimacy categories, and polygons were calculated for each quality class. The same calculations were used as for population, although individual sites were classified with their own separate criteria, which were different for population and habitat. Habitat quality was also assessed by assessing optimal

wetness along a transect at each site. A total of 16 out of 20 sites had good habitat quality, 3 had bad habitat quality for *V.moulinsiana,* but had better habitat quality in the past. One site is unlikely to have ever supported a population of *V. moulinsiana.*

The current habitat was estimated as the area of occupancy of the snail based on an average of 50% occupancy within optimal habitat (50% of 2.91Ha), 20% occupancy of sub-optimal and optimal habitat (20% of 67.5Ha), 10% occupancy of sub-optimal (10% of 39.7Ha), and 1% occupancy of sub-optimal and unsuitable habitat (1% of 9.04Ha). 5Ha occupancy was added as an estimate for non-surveyed sites. The total current habitat for the species is estimated as 24 Hectares.

Conservation assessment of the habitat

The habitat for the species has been assessed as Unfavourable – Inadequate because of a declining trend in area of habitat for the species, and a serious decline in the quality of the habitat for the species at some sites. While 16 of the sites have been assessed as having habitat in good quality and are likely to be sustainable, 3 other sites have had a severe decline in habitat quality and are likely to be no longer sustainable for the species.

Future prospects

Pressures were assessed at each site and noted as positive, neutral or negative. These were pooled together to give a national overview of the most prevalent negative pressures. Future prospects were assessed as **Unfavourable – Inadequate,** as the main pressures are significant in sites where decline is evident, but some sites remain in very good status.

Overall status

This was assessed as **Unfavourable – Bad,** as the range was in Unfavourable – Bad condition and the rest were Unfavourable – Inadequate. The overall trend was assessed as Unfavourable – Bad but stable as many sites were in good condition.

Summary – Vertigo moulinsiana

Range	Unfavourable – bad =
Population	Unfavourable – Inadequate =
Habitat for the species	Unfavourable – Inadequate U
Future prospects	Unfavourable – Inadequate U
Overall Assessment	Unfavourable – bad =

Discussion

Similarities and differences between sites

Although there is interaction between the habitats of the three Annex II *Vertigo* species, it is important to recognise the snails operate at the micro-habitat level, and there can be sites with populations of two or three of the species, each of which can be at different levels of conservation assessment and being subject to different pressures. An example is Pollardstown Fen, where the transition status of parts of the fen favours *V. moulinsiana* but the instability of wetness at the fen margins has negatively affected the *Vertigo geyeri* and *V. angustior* populations there. This does not mean that *V. moulinsiana* is incompatible with other *Vertigo* species, but rather that suitable habitat function is necessary at the very local level (metres squared), which in turn can be influenced by a much wider area (the wetland catchment).

In general, the micro-habitat of *Vertigo geyeri* at its sites is very uniform, reflecting the very narrow niche of habitat that can sustain it. The wider sites within which the snail habitat is found are much more varied, and can be divided into spring seepages a) at the edge of lowland fens; b) at spring lines in upland mountain ranges; c) in stable seepages associated with lakes; and, d) in stable coastal fen systems. The conservation status at each of these wider habitats was linked to the level of naturalness of the systems. Where the wider catchment in which the wetland lay was rural and with little intensification, particularly by drainage, *V. geyeri* was most widespread and the populations most robust. Examples of this are the Ox Mountains flushes, the Ben Bulben, Gleniff and Glenade flushes, and the coastal systems of Sheskinmore and Dooaghtry. In contrast, where human pressure on groundwater has intensified (e.g. for water supplies), *V.geyeri* populations and habitats are less extensive. Examples of this are at Pollardstown Fen which has had considerable in-combination pressures resulting in reduced spring flow, and Brackloon (Bellacorrick Bog Complex), which has had a lot of drainage for peat extraction and afforestation purposes in its catchment.

The micro-habitat of *V. angustior* falls into two categories, called the "dune phase" and the "wet phase". The former micro-habitat, the root area of fixed dune grassland, particularly *Festuca rubra*, can extend into large areas of macro-habitat and thus support enormous numbers of the snail. In contrast, the "wet phase" habitat tends to occur within a narrow ecotone, of either the transition zone between grassland and fen, or between grassland and stream, in both cases within the decaying leaves of *Iris* plants. Here the snail is restricted in area and numbers and these sites are more vulnerable. The best wet phase populations are associated with large dune phase habitats,

and the ability for the dune areas to help replenish the wet phase populations, and possibly vice versa, appears to be an important part of overall site function. An excellent example is Carrowmore Dunes, where snail numbers in the wet phase and dune phase vary with prevailing annual weather conditions (Moorkens & Gaynor, 2003).

Like *V. angustior*, *V. moulinsiana* habitat is divided into two types, although there is a lot of interconnection between them. Both types have micro-habitats of stiff vegetation with a deep litter layer and the snail moves up and down between stem and litter. Stable *V. moulinsiana* habitat is associated with open water, and the snail is well supported along vegetated ditches with open water, or lake edges with a wide fringe of tall vegetation. The snail is also found in fens and drying lakes, in these cases the snail inhabits a zone of transition where the vegetation is strong enough to support the species but still wet enough to provide the humidity to support a snail that has climbed into the vegetation. The problem with large habitats that are in the process of drying out is that they will eventually become unsuitable for the snail, unless management can be employed to stabilise the stage of the hydrosere that supports the snail on a long term basis. An example of a large site in transition is Ballynafagh Fen, and a restricted but stable site is the edge habitat of Charleville Lake. Both are currently in favourable conservation status, but maintainance of habitat will probably be much easier at Charleville as the lake level is maintained at a stable level, whereas at Ballynafagh conservation management will be needed in the future within a wider catchment that has a number of private abstractions and a large bog that has been drained for peat cutting and has undergone afforestation in places.

The individuality of each site is underlined by the wide range of habitat mixes, the differing threats, the very different population sizes at each site and the other requirements needed from the site, particularly those in private ownership operating agricultural enterprises.

Sites with very poor populations or spurious records

The sites in Table 17 only have single records of the species with no information on habitat quality or population size.

Table 17: Single site records

Species	**Site**	**County**
Vertigo geyeri	Carrowmoreknock	Galway
Vertigo geyeri	Rosmoney	Mayo
Vertigo geyeri	Cooley Lough	Mayo
Vertigo geyeri	Mannin Lake	Mayo
Vertigo moulinsiana	Mullaghmore	Clare

These five sites had very little and very poor habitat for the species recorded, and evidence from the site suggested that this was the natural situation for that site and was not due to loss of habitat.

None of the sites would be likely to support a substantial population for the species, or to be improved with conservation management to become a good site for the species. Where the sites are within cSACs, the sites would be better served in conservation efforts for other habitats and species, and thus they should not be part of the Natura 2000 network for whorl snails. Only one of these sites (Rosmoney, 001482 Clew Bay Complex) is listed with *V. geyeri* as a qualifying feature, and it is recommended that this is delisted. While the snail is present at the Mannin Lake site, the habitat for the species is very marginal and it is not recommended to include *V. geyeri* as a qualifying interest within any cSAC there.

Loss of sites

The sites in Table 18, in contrast to those above, have deteriorated to the extent that the whorl snails they supported appear to be no longer extant.

Table 18: Sites from which the species has, or appears to have been lost

Species	**Site**	**County**	**Date last recorded**
Vertigo geyeri	Clonaslee Esker	Laois	1998
Vertigo angustior	Louisa Bridge	Kildare	1997
Vertigo moulinsiana	Dromkeen Bridge	Kerry	1971
Vertigo moulinsiana	Lisbigney Bog	Laois	1998
Vertigo moulinsiana	Royal Canal Cloondara	Longford	2003

These five sites had extensive and excellent habitat for the species in the past, and evidence from all of the sites suggest that there has been extensive loss of habitat. With the exception of the Louisa Bridge *V. angustior* site, which was always a narrow transition area, all of the sites would have been likely to support a substantial population for the species in the past. Drainage has been the main cause of the habitat destruction in the case of Lisbigney Bog and Clonaslee, while drainage and very severe intensification of land surrounding the drain habitat has destroyed the Dromkeen Bridge site, which was the only known site for *V. moulinsiana* in County Kerry. The Longford *V. moulinsiana* site was destroyed by dredging and rewetting of the Royal Canal. Other canal losses have resulted in a constriction of the range of *V. moulinsiana* in Ireland.

Conservation status inside and outside of cSACs.

A summary of the differences between the overall conservation status inside and outside cSACs for the species is summarised in Table 19. As the spurious sites with only single records should not be used to determine the national overview, they have been removed from this analysis. Sites for *V. geyeri* and *V. angustior* did slightly better inside rather than outside of cSACs, whereas *V. moulinsiana* sites outside cSACs were more frequently in favourable condition. However, the

differences may be due partly to the small numbers of sites involved outside cSACs in the case of *V. geyeri* and *V. angustior*, and inside cSACs in the case of *V. moulinsiana*.

The surprising result from Table 19 is that *Vertigo geyeri* has the most sites in favourable condition (75% overall), then *V. moulinsiana* with 68% and lastly *V. angustior*, which has the majority of the very large dune sites, has the poorest percentage of sites in favourable condition (62%).

Table 19: Overall conservation status inside and outside cSACs. The analysis for *V. geyeri* and *V. moulinsiana* excludes the sites listed in Table 17 which have single records.

	Number of sites assessed	**Population**	**Habitat**	**Future Prospects**	**Overall**
Vertigo geyeri					
Favourable total	(19)	15 (75%)	16 (80%)	14 (75%)	14 (75%)
Favourable within cSACs	(16)	13 (81%)	14 (88%)	13 (81%)	13 (81%)
Favourable outside cSACs	(3)	2 (67%)	2 (67%)	2 (67%)	2 (67%)
Vertigo angustior					
Favourable total	(21)	16 (76%)	13 (62%)	13 (62%)	13 (62%)
Favourable within cSACs	(12)	9 (75%)	9 (75%)	8 (67%)	8 (67%)
Favourable outside cSACs	(9)	7 (78%)	5 (56%)	5 (56%)	5 (56%)
Vertigo moulinsiana					
Favourable total	(19)	14 (71%)	16 (86%)	14 (71%)	13 (68%)
Favourable within cSACs	(7)	5 (69%)	6 (77%)	4 (77%)	4 (69%)
Favourable outside cSACs	(12)	9 (75%)	10 (83%)	10 (83%)	9 (75%)

Table 20 shows the changes in individual site overall conservation status since the 2007 conservation assessment (Moorkens, 2007 f,g,h). Three sites were found to be in better condition, three had declined since the last assessment, and three sites had their status confirmed, two out of the three being positive assessments. However, all cSACs need to be brought up to favourable conservation status, and sites outside the Natura 2000 network should also be maintained, therefore it can be concluded that there is a considerable amount of conservation management to be carried out in a wide range of sites. A total of 9 cSACs, 3 for *V. geyeri*, 4 for *V. angustior* and 2 for *V. moulinsiana* need to improve their conservation status. An additional 8 sites that are outside cSAC sites or within cSACs but without *Vertigo* listed as a qualifying feature are not in favourable condition.

Table 20: changes in individual site overall conservation status

Site	Species	2007 status	2010 Status	Change
Fin Lough VgCAM18	*V. geyeri*	Unfavourable	Favourable	Positive
Lough Talt VgCAM7	*V. geyeri*	Favourable	Unfavourable bad	Negative
Ballyness Bay VgCAM10	*V. geyeri*	Unfavourable	Favourable	Positive
Dooaghtry VgCAM5	*V. geyeri*	Unfavourable	Favourable	Positive
Glencolmcille VaCAM4	*V. angustior*	Favourable	Unfavourable bad	Negative
Pollardstown VaCAM13	*V. angustior*	Unknown	Unfavourable declining	-
Dooaghtry VaCAM3	*V. angustior*	Unknown	Favourable	-
Derrynane VaCAM2	*V. angustior*	Unknown	Favourable	-
Ballynafagh VmCAM10	*V. moulinsiana*	Favourable	Unfavourable declining	Negative

Management of sites

The management of sites had a strong influence on the condition of each site. For *V. geyeri*, either sheep grazing or absence of grazing, where sites were wet enough not to succeed to less open vegetation were the most favourable management practiced at the sites. Low intensity sheep grazing is associated with the best habitat in upland areas. Where sites are wetter, particularly lowland sites, with undulating topography, there may be pools of open water that would make grazing difficult and potentially dangerous for the animals, the sites need to be assessed to ensure that succession will not occur. Experimental brush-cutting of vegetation by NPWS at Pollardstown Fen appears to be having a positive impact on the habitats and species at the site (Moorkens & Duff, 2010). Blocking of drains may also help, as long as it does not result in loss of sloping spring emergence. Management needs to be carefully documented and monitored on a long-term basis to ensure it is optimal for all site interests.

In contrast to *V. geyeri*, sheep grazing is the single most serious negative indicator for *V. angustior*. Many dune systems have shell pockets containing large quantities of dead *Vertigo angustior* shells (Welch, 1898). These show that *V. angustior* was once widespread in these systems in the past (e.g. Rossapenna, County Donegal) but as they are closely cropped by sheep no habitat for *V. angustior* now exists. In other dune sites where *V. angustior* is currently severely restricted (e.g. Dooaghtry, Derrynane, Dog's Bay), the site may also have supported a dune phase population before intensive sheep grazing was introduced. Whether elements other than intensive sheep grazing have contributed to the loss of the species from sites of former populations is difficult to speculate.

Cattle grazing was the dominant activity in sites supporting *V. angustior*, but absence of grazing was the management most associated with sites in favourable condition, demonstrating that if the site is wet enough and exposed enough to be maintained by the elements alone, this has a positive

effect on the snail population. However, absence of grazing is also associated with poorer botanical richness, as it allows marram and narrow grasses to dominate, and their deep litter favours large numbers of *V. angustior*. The absence of knowledge of past management is a problem, but it can be reasonably assumed that perhaps the current sites with cattle grazing and smaller snail numbers may be more sustainable in the long term than the ungrazed sites which may eventually become unsuitable for the snail through succession to scrub. The monitoring transects have been designed to assess over the medium term whether ungrazed, exposure-dependent sites are being maintained by the natural elements sufficiently well, and whether the sites with grazing have appropriate levels of stock. The early results of transect assessment show that there are sites such as Lehinch golf roughs that have had little grazing for 100 years where exposure alone seems to be maintaining the snail habitat. Sites that are in unfavourable condition with the absence of grazing tend to have other problems, for example at Louisa Bridge. This riparian habitat appears to have undergone a change in exposure to include excessive inundation, perhaps through bank changes elsewhere in the catchment. Experimental vegetation cutting in this habitat by Kildare County Council did not achieve any improvement in snail habitat in this case.

The successful management of *Vertigo moulinsiana* sites is absolutely dependent on maintaining habitat within the narrow wetness transition that favours the snail. The dominant land use in *V. moulinsiana* sites was found to be an absence of active management with no grazing. This may be somewhat skewed by the two large sites in public ownership, Pollardstown Fen and Ballynafagh Lake and canal feeder. As the snail requires strong vegetation, ideally tall sedges with a deep litter and open water nearby, this is a habitat that can go from being highly suitable to completely unsuitable in a relatively short time if succession to a drier, scrub dominated community is allowed to progress. For this reason, *V. moulinsiana* will remain a conservation-dependent species and rely on the management of the water table in the habitats in which it lives. Hydroseres will require management by for example sluice systems to prevent the habitat from drying beyond the level of tolerance of the snail. In some sites with strong spring flows, such as at Louisa Bridge, the hydrosere appears to be reasonably stable without excessive intervention, although the sluice system in place may be a key factor in habitat maintenance. This species is therefore one that benefits from land in public ownership, where light management of water resources can be more easily managed in this respect than private land within an agricultural enterprise.

Assessment of methodology

The methods selected for this study were based on methods and protocols which had been designed and piloted for *Vertigo geyeri* and *V. moulinsiana* sites in England and Wales with

monitoring of condition following the common standards approach outlined by the Joint Nature Conservation Committee (see Williams, 2006).

Vertigo geyeri in particular can be difficult to locate in the field, and requires considerable experience to confidently identify specimens. For pragmatic reasons, attributes have to be chosen that are defined by measurable vegetation characteristics, along with presence or absence of the snail. It is considered to be important for a competent malacologist to ascertain that the snail itself is still present rather than just its required habitat. This is especially important at many of the Irish sites where a small, atypical form of *V. pygmaea* which has only 4 weakly developed teeth and bears a strong resemblance to *V. geyeri* often occurs.

For *V. geyeri*, Killeen (2001) designed a protocol for application at the Sunbiggin Tarn & Moors SAC in north-western England which included use of linear transects. This method was subsequently refined for use at Corsydd Môn/Anglesey Fens SAC in north Wales (Killeen & Moorkens 2004, 2008). It was during the first survey that delineating uniform plant community zones along the transect was tested and then adopted as a method for setting targets for habitat extent and habitat quality, and for snail presence/absence.

The method for monitoring *Vertigo moulinsiana* was originally developed for use on sites along the route of the proposed Newbury bypass in southern England (e.g Stebbings & Killeen 1998). This was subsequently further developed by Killeen & Moorkens (2003) as part of the *Conserving Natura 2000 rivers* UK LIFE project, and which has subsequently been adopted as the protocol for monitoring English and Welsh *V. moulinsiana* sites.

No specific method had been developed for monitoring *Vertigo angustior* in Britain, but Killeen had trialled the use of transects in East Anglian sites (e.g Killeen & Moorkens in press). Subsequently, the *V. geyeri* transect methodology was applied to Irish *V. angustior* SACs (Moorkens 2007b) and found to be a good method for assessment.

The use of these methods in Ireland commenced in 2005 with a survey on behalf of NPWS of *Vertigo geyeri* at selected SAC sites (Moorkens 2006d), and then in 2006 for *V. geyeri, V. angustior* and *V. moulinsiana* at most other SACs (Moorkens 2007a, b, c).

To assess the condition of each for the *Vertigo* species present, the principal objectives were to identify a set of attributes that described the condition of that *Vertigo* population. For all three species, the methods are designed to assess both habitat and the snail species. Measurable attributes chosen were: area of occupancy of snail habitat, area of occupancy of snail, number of overall positive recordings per number of field samples, and hydrological field assessment.

For *V. moulinsiana*, a greater emphasis is placed on quantitative measurements of the snail population. This is to some extent an artefact of the relative abundance of the snail and the ease by which it can be found and counted in the field. The other 2 species can be much more difficult to locate in the field, and therefore assessment is made by analysis of a small number of samples taken from the site. As such methods are destructive, the removal of a large number of samples from the frequently fragile and small-sized *V. geyeri* sites would be unacceptable.

Based upon an appraisal of all the methods and results from previous Irish, English and Welsh surveys, it was considered that the transect approach offered the most reliable means of monitoring site condition and the snail populations. These methods were therefore employed at the majority of sites for the present Condition monitoring survey. The exception to the use of standard transect methodology was at sites where the gross distribution of the species was virtually unknown (e.g. *V. moulinsiana* at Portumna), or sites where the habitat was very small in area (e.g. *V. geyeri* at Easkey Valley or Ox Mountains), or sites where the optimal habitat was fragmented over a very large area (e.g. *V. geyeri* at Bellacorrick Fermoyle). In such places the methodology was altered to suit the conditions, and usually comprised assessments of discrete flushes (for *V. geyeri*) of spot sample counts over a wider area (for *V. moulinsiana*). Usually it was possible to use linear transects for *V. angustior*.

For many of the 2005 and 2006 survey sites of Irish SACs it has been possible to carry out a retrospective Condition Assessment by using the attributes and targets set in 2008-2010 and allowing change to be determined. However the main purpose of the 2005/2006 work was to compile management prescriptions, although some general survey and setting up of baseline monitoring transects was carried out at all sites. When these were revisited during the 2008-2010 survey, it was found that at several sites, insufficient data had been gathered previously to enable a full retrospective Condition Assessment to be carried out, although the data were in general adequate to enable any gross changes to be detected.

National Conservation Assessment

As in 2007, all three species have been found to be in overall unfavourable conservation status, with *V. geyeri* and *V. angustior* continuing to be Unfavourable – Inadequate due to lost or poor condition sites, and *V. moulinsiana* continuing to be Unfavourable – Bad. While *V. geyeri* has maintained its Favourable Range, this is the only favourable result that was determined at national level.

Conclusions and Recommendations

The future for Vertigo sites in Ireland

The future for populations of *Vertigo geyeri, V. angustior* and *V. moulinsiana* must be assessed in the context that none of these species are likely to be able to easily colonise new areas of habitat, and therefore their current locations are of high conservation value. New sites for all three species continue to be discovered but these are not examples of spread, but rather the finding of previously undocumented wetlands. All three species for this reason are considered to be dependent on the conservation of a diminishing resource of sites.

New sites for *V. geyeri* are found through wider habitat surveys such as environmental impact studies (EIS), as tufa-forming springs are readily identified during field survey. Sites for *V. angustior* and *V. moulinsiana* may be under-recorded as they are easily overlooked during wider habitat surveys, falling into common Phase 1 habitat categories such as "marsh-marshy grassland" (*Vertigo angustior*). The absence of categorisation of ditches in most surveys makes it difficult to assess whether *V. moulinsiana* may be likely to be present. Where any three of these Annex II species has potential to occur, through underlying geology and known records from a nearby 10km square, Phase I surveys should include an assessment of whether the habitat surveyed could have potential for one or more of these three *Vertigo* species.

While *V. geyeri* is the most demanding of the three species in terms of narrowness of wetness and habitat requirements, the nature of its habitat within active spring/flush zones means that if there is no adverse impact on the groundwater quantity and quality, and no excessive poaching of the sensitive vegetation it lives within, long term prospects for this species are good. However, knowledge of the groundwater sources may be an essential future requirement to its protection and thus planning authorities should be provided with a zone of groundwater influence for each cSAC population. Where drainage has already become a problem, such as at Clonaslee, some drain blockage is recommended in order to attempt to restore springs that are currently not emerging at the surface in suitable habitat areas for the snail.

The status of *V. angustior* is highly dependent on the absence of sheep grazing, and this should be reflected in management agreements and conservation farm plans in cSACs in receipt of conservation funding. Sites with an absence of grazing need transects and snail counts repeated regularly with a clear emphasis on checking that exposure is maintaining vegetation at appropriate levels, and that removal of grazing does not end up with over rank conditions. While Beal Point is

not designated with *V. angustior* as a qualifying interest, it is a cSAC site and needs to be urgently reassessed to determine if the site is progressively becoming unsuitable for the snail and whether this is negatively affecting the qualifying interests of the site. As with most sites, a reasonably rapid repeat of transects will indicate sites that are more stable from those that may be requiring improved management.

The conservation dependence of *V. moulinsiana* within its specific hydrosere places a high responsibility on the public owners of the largest sites. Where the snail is occurring on private property, management agreements and conservation farm plans in cSACs should be utilised to formalise water and/or grazing management to maintain these hydroseres, for example in the unused canal feeder at Mountmellick. Sites that have had serious drainage in the past, particularly Lisbigney Fen, need to be assessed on site with the landowner to determine whether drain blockage may restore this habitat in the long term. Highly enriched sites such as Dromkeen, Co. Kerry should be considered to be destroyed, and while dredging and rewetting of the Royal Canal has destroyed excellent *V. moulinsiana* habitat, there is scope for some pockets of canal edge to be restored. The drains close to the canal should be managed in a manner that could allow a necklace of *V. moulinsiana* sites to spread down the length of both canals and thus restore the presence of *V. moulinsiana* in some of the many 10km square areas of the midlands that the snail once occupied. A discrete project to identify a series of sites for restoration is recommended.

Recommendations for future Vertigo monitoring

All populations of *Vertigo geyeri, V. angustior and V. moulinsiana* fluctuate naturally over time and short term changes in environmental conditions can rapidly influence population size. A year with very low recorded numbers should not necessarily be interpreted as a population decline, especially if meteorological conditions have been unfavourable in the months preceding the survey. However, the snail may also persist for a while in less than ideal conditions and changes in vegetation and moisture conditions of the habitat that are heading in one direction in spite of meteorological fluctuations should be cause for concern. Thus, the factors to be used for assessing condition and conservation status must take into consideration this variation. It is important to be careful not to make a false negative condition assessment where the fluctuations are only temporary, and equally important not to make a false positive condition assessment where the snail is persisting but facing continuous decline. Assessment of population trends in conjunction with survey weather conditions is essential.

At the majority of sites where there is good comparative data from 2005/2006 and 2008-2010, there has been relatively little change in Condition of either the habitat or the feature between the

surveys. There are exceptions, for example, both Beal Point and Kinlackagh Bay (*V. angustior*) have changed from Favourable to Unfavourable Inadequate, both resulting from management changes. More dramatic is the change for *V. moulinsiana* on the Royal Canal near Longford which has gone from Favourable in 2005 to Unfavourable, and possibly extinct. Not all change has been decline; Ballyness Bay (*V. geyeri*) has changed from Unfavourable Inadequate to Favourable also as a result of improved management. At all of the non-SAC sites the present survey has provided the baseline and there is little or no previous data from which to determine whether there has been any change in recent years.

The recommendations for all of the *Vertigo* SAC and non-SAC sites is for a full repeat survey 3 years after the last. It is considered that the 6 years between Article 17 reporting is too long, particularly at sites which are small and fragile (e.g. vulnerable to relatively small changes in management). At 20 of these sites, this will become due in 2011. At sites where the target species could not be found (e.g. *V. geyeri* at Cooley Lough and Carrowmoreknock) a second survey could be undertaken to fully establish the status of the species, but this is a lower priority as these sites will never be of high conservation value. At some sites (e.g. The Murrough and at Portumna), additional survey work is required to determine the full extent of the species and its habitat. Table 21 summarises the next recommended years for individual site surveys (on a 3 yearly basis). Table 22 gives the sites where *Vertigo* is not likely to be of conservation importance, but if desired one further survey could be undertaken to confirm this.

Finally, following survey, condition assessment and interpretation of results, it is important that action is taken where possible to improve sites that have been found to be declining in conservation value for the species, most particularly in cSACs where the snails are a qualifying interest. As much of the results of this study have been baseline in nature, ideally a second round of sampling should be undertaken before drawing conclusions regarding apparent declines. However, for precautionary purposes, a negative assessment should instigate a more rapid repeat survey and if the result is still unfavourable, trigger an investigation by NPWS local staff, such as meeting with a landowner with a view to introducing more favourable management (if this is the likely problem) or the reversal of other actions that are deemed to have caused the decline. For this reason, sites that have resulted in amber assessments have been listed for the earliest resurvey.

A condition assessment of Unfavourable-Bad should trigger an investigative response from NPWS local staff. Some of these investigations are already underway, and this has been most helpful. There should be interaction and discussion between NPWS and land owners at Clonaslee, Lough Talt (*Vertigo geyeri*), at Glencolmcille, Kinlackagh, Maharees and Louisa Bridge (*Vertigo angustior*), and Curraghchase, Lisbigney. It is particularly important to encourage a good conservation

working relationship between NPWS and Waterways Ireland with a view to identifying conservation areas along the two canals for *Vertigo moulinsiana,* as this is an area of key losses for the species since the introduction of the Habitat's Directive.

Table 21: Recommended survey schedule 2011-2013

2011	**2012**	**2013**
Meenaphuil VgCAM1	Annaghmore Lough VgCAM9	Bellacorrick -Fermoyle VgCAM16
Tievebaun VgCAM2	Ballyness Bay VgCAM10	Fin Lough VgCAM18
Brackloon VgCAM3	Easkey valley VgCAM13	Lisduff Fen VgCAM20
Clonaslee Esker VgCAM4	Polaguil Bay VgCAM14	Ox Mountains VgCAM21
Pollardstown Fen VgCAM22	Silver River VgCAM15	Dooaghtry VgCAM5
Lough Talt VgCAM7	Sheskinmore VgCAM8	Drimmon Lough VgCAM6
Beal Point VaCAM1	Curragh Chase VaCAM17	Bartraw VaCAM15
Derrynane VaCAM2	Dooaghtry VaCAM3	Inishmore VaCAM16
Fanore VaCAM9	Louisa Bridge VaCAM19	Dog's Bay VaCAM8
Glencolmcille VaCAM4	Lehinch VaCAM11	Doonbeg VaCAM18
Kilshannig VaCAM5	Malin Dunes VaCAM12	Killanley Glebe VaCAM10
Kinlackagh Bay VaCAM6	Pollardstown Fen VaCAM13	Ballysadare VaCAM20
Maharees VaCAM7	Streedagh VaCAM14	Strandhill Airport VaCAM21
Borris VmCAM1	Ballybeg Lake VmCAM6	Kildallan Br VmCAM14
Curragh Chase VmCAM12	Cappankelly VmCAM8	Lisbigney Bog VmCAM15
Lough Owell VmCAM3	Murrough VmCAM17	Lisduff Fen VmCAM16
Mountmellick VmCAM4	Ballynafagh VmCAM10	Pollardstown Fen VmCAM18
Louisa Bridge VmCAM5	Charleville Wood VmCAM11	Waterstown Lough VmCAM9
Portumna VmCAM19	Fin Lough VmCAM2	
Royal Canal VmCAM20*		

*Wider survey needed

Table 22: Sites where *Vertigo* is not likely to be of conservation importance

Vertigo geyeri	***Vertigo moulinsiana***
Rosmoney VgCAM12	Mullaghmore VmCAM7
Carrowmoreknock VgCAM11	
Cooley Lough VgCAM17	
Island Lake VgCAM19	

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Appendix A: Example of *Vertigo geyeri* Site Report

Implementation of a *Vertigo* monitoring programme: *Vertigo geyeri* monitoring at Pollardstown Fen

A1. SITE CODE AND LOCATION DETAILS

A1.1 Site code and location

Vertigo Site code:	VgCAM22
SAC Site code:	00396 Pollardstown Fen
County:	Kildare
Location:	The habitat that supports *Vertigo geyeri* within this cSAC is the fen margin along the calcareous spring seepage lines to the north and south of this large fen area. The main access to Pollardstown Fen is via the public Nature Reserve entrance which is on the south side of the fen. However, most of the *V. geyeri* habitat is in private ownership.
Date	29/06/10
Surveyors	Evelyn Moorkens & Ian Killeen

A1.2 General habitat description

Pollardstown Fen is a very large fen, the area of which extends to 235 hectares, of which approximately 60% is state owned. The main habitat in the central area is tall fen with *Cladium mariscus*, but it is the shorter alkaline fen in the spring seepage margins of the site that support *V. geyeri*.

EU habitats present at *V. geyeri* habitat are Alkaline fens: low sedge-rich communities (Annex I Habitat 7230), rich fens of CORINE 54.2 and fen-sedge beds of CORINE 53.3 (Romão, 1996; Devillers *et al*., 1991).

The specific areas that are within a wider mosaic, but that form specific *V. geyeri* habitat are mostly around *Schoenus nigricans* growth, fitting the Rodwell M13 characteristic vegetation classification (Rodwell, 1991). The best *V. geyeri* habitat is in areas of lower and more tightly cropped sward, where the habitat falls into the Rodwell M10 Pinguiculo-Caricetum dioicae Caricion davallianae

group, characteristically being distinguished by *Carex viridula, C. panicea, Parnassia palustris, Campylium stellatum, Pinguicula vulgaris,* and *Drepanocladus revolvens.* They fall within the more general habitat of rich fen and flush (PF1) of Fossitt (2000).

A2. KNOWN STATUS OF VERTIGO GEYERI ON SITE

Vertigo geyeri was first discovered at Pollardstown Fen in 1969 by G.Visser (Norris & Pickrell 1972). Since 2000 the site has been the subject of extensive molluscan studies as part of mitigation for the Kildare bypass. This included identification of all areas of *V. geyeri* habitat at the site. In November 2006, two monitoring transects were set up and a management prescription prepared (Moorkens 2007a). At this time *V. geyeri* occurred on both transects but was rather uncommon.

A3. DETAILS OF TRANSECT AND OTHER SAMPLING SITES

Figure 1 shows Pollardstown Fen with the transects, sample locations and boundaries of each habitat unit with *V. geyeri* habitat.

A3.1 Transect 1:

Start Point:	Transect 1 starts at the corner of the southernmost wooden fence which protects a dipwell at N76398 15911
End point:	A ditch at N76416 15966
Transect Length:	59.7m
Description:	The transect runs down a gentle slope with a mosaic of calcareous flush habitat and less suitable *Schoenus* fen
Direction:	South to north
Sampling frequency:	Starting at the 0 metre end, the habitat (at the plant community level) along the tape was described and the linear distance of that habitat type measured. This was repeated every time the habitat changed, thereby delineating uniform plant community zones along the transect. Five samples were taken at various intervals along the transect principally from zones with optimal and sub-optimal habitat and analysed in the laboratory for their snail composition

A3.1 Transect 2:

Start Point:	Transect 2 starts at a spring seepage at N77747 16039 (a large sycamore lies at the field boundary to the north)
End point:	A clump of gorse bushes at N77695 16018
Transect Length:	60m
Description:	The transect starts at the spring head and runs through a flush slope and into the main fen
Direction:	North to south
Sampling frequency:	Three samples were taken (as above)

A3.2 Other sample sites

The distribution of *Vertigo geyeri* at Pollardstown Fen had been identified in previous surveys. For the purposes of Condition Assessment, two areas with Optimal and/or Sub-optimal flush habitat were selected for monitoring.

Site	Grid Ref	Description
1	N 76913 16900	Flush with tall carices and under-storey of saturated moss
2	N 76908 16503	Flush with tall carices and under-storey of saturated moss

A4. RESULTS

A4.1 General

Table A1 shows the specific habitat definitions for Pollardstown Fen.

Table A1: Specific habitat definitions for Pollardstown Fen for *V. geyeri*

Definition of Optimal habitat	Flushed fen grassland with sedge/moss lawns 5-20cm tall, containing a high diversity with species such as *Carex viridula, C. rostrata, Equisetum palustre, Juncus articulatus* and the mosses *Drepanocladus revolvens, Campylium stellatum*, with scattered tussocks of *Schoenus nigricans* no greater than 80cm tall. During sampling the water table should be between 0- 5cm of the soil surface, or in small scattered pools.
Definition of Sub-optimal habitat	Vegetation composition as above but either vegetation height is less than 5cm or greater than 20cm, or the *Schoenus* tussocks are >1m tall, or the water table is below 5cm or ground is flooded at the time of sampling.

Eight habitat polygons with *V. geyeri* habitat were identified as follows (see Section 7.21 for descriptions):

Polygon	Area (ha)	Description
A	0.747	Sub-optimal -
B	0.479	Sub-optimal -
C	1.692	Sub-optimal -
D	0.259	Sub-optimal -
E	0.942	Sub-optimal -
F	4.333	Sub-optimal -
G	0.217	Sub-optimal -
H	3.041	Sub-optimal -
Total	**11.71**	

The molluscan composition of the samples taken along the Transect and from other samples is given in Table A2.

The delineated habitat zones along the transect are shown in Figure A2. Photographs of locations along the transect and elsewhere are provided in a photographic record.

Table A2: Molluscan composition of samples on Transects and at other sites

	Transect 1					Transect 2			Other sites	
	17m	24m	33m	53m	57m	26m	35m	57m	Q5, R6	Q8, R5
Species										
Galba truncatula			1	2		10				
Stagnicola fuscus		1			2		3		4	
Bathyomphalus contortus		1								
Acicula fusca						1				
Carychium minimum		26	11	28		17	2	2	34	34
Carychium tridentatum	20					2				
Cochlicopa lubrica	2	3	6	12	14	1		1	4	5
Oxyloma elegans	1	1	3	3	4	3	9	1		1
Columella aspera					1				4	16
Columella edentula						1				
Vertigo geyeri		12	2	7	6		1		9	8
Vertigo antivertigo		8	5	12	2	4	6		5	5
Vertigo substriata	24	6	1	15	8	7	2	1	5	15
Vertigo moulinsiana					2		2		5	3
Vertigo pygmaea	1									
Leiostyla anglica		3	2	2		1			1	5
Vallonia pulchella		2				1				
Acanthinula aculeata			1						2	
Punctum pygmaeum		1		2			1		11	13
Discus rotundatus	2	1		2	1					3
Zonitoides nitidus						1	1			
Vitrea crystallina									1	3
Nesovitrea hammonis	3	3		4	6		4	4	2	33
Aegopinella pura										2
Euconulus alderi	4	11	2	8	10	1	2	1	7	27
Pisidium personatum		8	1	19			5	8	3	
Pisidium obtusale		1								
Total No. of Species	8	16	11	13	11	13	12	7	15	15

A5. CONDITION ASSESSMENT

A5.1 Population Assessment

Indicator	Target	Result	Pass/Fail
Presence/absence (Transect)	Adult or sub-adult snails are present in 2 samples on Transect 1 (minimum 4 samples taken) and 1 sample on Transect 2 (minimum 2 samples taken)	Present in 4 samples on T1 and 1 sample on T2	Pass
Presence/absence (Site level)	Adult or sub-adult snails are present in sites 1 and 2	Present at 2 other locations	Pass

2 passes Favourable (green); 1 pass Unfavourable Inadequate (amber); 0 passes Unfavourable Bad (red)

5.2 Habitat for the Species Assessment

Indicator	Target	Result	Pass/Fail
Habitat extent and quality: (transect 1)	At least 30m of Transect 1 is classed as Optimal and sub-optimal and Soils, at time of sampling, are optimal wetness for 30m of the transect	12.3m is optimal & sub-optimal and 12.3m is optimal wetness	Fail
Habitat extent and quality: (transect 2)	50m of Transect 2 is classed as Optimal or sub-optimal and Soils, at time of sampling, are optimal wetness for 50m of the transect	60m is sub-optimal habitat and 50m is optimal wetness	Pass
Habitat extent: (Site level)	At least 2 ha or 2 habitat polygons are dominated by optimal habitat	0 ha and no polygons dominated by optimal habitat	Fail

3 passes green; 1-2 passes amber; 0 passes red

5.3 Future Prospects Assessment

Activity code	Activity	Location	Influence	Intensity	Area affected ha)
A04.03	Abandonment of pastoral systems, lack of grazing	Inside	Negative	Medium	4
A04.01.01	intensive cattle grazing	Inside	Negative	Medium	7
D01.02	roads, motorways	Outside	Negative	Medium	0.7
J02.02.01	dredging/ removal of limnic sediments	Inside	Negative	Medium	2.5
J02.03	Canalisation & water deviation	Inside	Negative	Medium	2.5
J02.10	management of aquatic and bank vegetation for drainage purposes	Outside	Negative	Medium	2.5
J02.03.01	large scale water deviation	Outside	Negative	Medium	0.7

Future Prospects have been assessed by examining how the impacts are affecting the other attributes (i.e. population and habitat for the species) and their impact if they continue unchecked.

The seven impacts noted above are lack of grazing through abandonment in the upper margin habitats, excessive grazing and grazing with cattle rather than sheep on the northern margin habitats, motorway building techniques used which included temporary pumping of groundwater which may have residual future effects, including changed spring pathways at the fen margin, severe dredging of canal feeder drains with vegetation removal which has occurred in the past and may occur again, resulting in lowered drains and increased groundwater movements away from the springline surface. The effects of the canal feeders may not remain in a sustainable balance if pressure on abstraction from the aquifer source increases or canal traffic increases (resulting in higher numbers of lock openings). The canal and Milltown Feeder have management of aquatic and bank vegetation, which if excessive can allow higher draws of water from the fen, and finally

the large scale (compared to the fen margin *V. geyeri* requirements) deviation refers to the changes in drain levels and pathways associated with the motorway design. Permanently lowered drains at the site of the road may have a long term effect on water reaching the ground surface at the springs where *V. geyeri* formerly had excellent habitat at the southern margin of the fen.

Future prospects should balance positives and negatives to determine whether the species will survive at this site for the foreseeable future. As the impacts are all negative, Future prospects have been assessed as Unfavourable inadequate (amber).

5.4 Overall Assessment

The baseline condition assessment at Pollardstown Fen can be determined by how well the site meets the key targets for the attributes associated with this species. Whilst potential *V. geyeri* habitat occurs over a wide area, very little is in good condition for *V. geyeri*. However, the snail is present over a wide area and mostly in rather low numbers. The overall assessment is Unfavourable Inadequate (amber).

Attribute	Assessment
Population	Green
Habitat for the species	Amber
Future Prospects	Amber
Overall	Amber

A6. DISCUSSION

The Condition of the site and the feature based upon the 2010 survey has been assessed as Unfavourable (inadequate).

Pollardstown Fen is a very large and ecologically significant natural resource that is located in what is becoming an increasingly urbanised area close to Dublin. The suites of rare habitats and plant species, and the rare invertebrate species that are characteristic of these habitats, are reliant on the continuation of both the hydrogeological conditions that allow the spring seepages to saturate the fen margin, and the grazing management that optimizes the low growing moss-rich alkaline fen zones. To date, Pollardstown has not suffered from significant scrub encroachment due to the combination of wetness and management within these habitat areas.

Grazing management at Pollardstown Fen is currently unfavourable due to lack of management in areas where it is needed, and use of cattle in areas where sheep would be preferable.

Further intensification of land use in the zone of influence of the regional aquifer feeding the springs to Pollardstown Fen may result in a lowering of the water table to such an extent that

water may no longer emerge at current spring lines. This would result in a loss of *V. geyeri* habitat. If the SAC is to be protected and remain sustainable for the species and its interrelated community of species, it will be necessary to understand the activities that would influence drawdown of water feeding these springs and protect this resource. The legacy of the Kildare Bypass construction, the ongoing demands on the Kildare aquifer, coupled with future demands for the Grand Canal, means that understanding the wider hydrogeological catchment and protecting hydrogeological consistency and water levels are essential to the continuing function of a sustainable *V. geyeri* population, along with the suite of Annex I habitats and Annex II species that this rich site supports.

Frequency	**Next monitoring due 2013**
Methods (see Section 2 of main report for full details)	Assessment of the transect and other locations with snail sampling, plus assessment of condition of polygon. Prescription as follows: Repeat transect 1, delineate the plant community/habitat zones, and assign the habitat and wetness in each zone as Optimal, Sub-optimal or Unsuitable Take at least 4 samples from the most suitable habitat on Transect 1and analyse for molluscan composition Repeat transect 2, delineate the plant community/habitat zones, and assign the habitat and wetness in each zone as Optimal, Sub-optimal or Unsuitable Take at least 2 samples from the most suitable habitat on Transect 2 and analyse for molluscan composition Describe habitat and take 1 sample from the most suitable habitat in each of polygons B and H of this survey and analyse for molluscan composition Re-determine boundary of habitat polygons A, B and H and assign habitat to either Optimal, Optimal & Sub-optimal, Sub-optimal, Sub-optimal and Unsuitable, or Unsuitable Assess the management regime and impacts upon the habitat for *V. geyeri* Use results to determine overall condition assessment

Some of the *V.geyeri* habitat is owned by the nation as a Statutory Nature Reserve. In acquiring land, the responsibility for its management through grazing or otherwise falls to the public owners. The NPWS have instigated a series of experimental vegetation cutting and removal to assess which management tools are most appropriate for the habitats at the fen margins.

There are many reports documenting the baseline and monitoring that has taken place at Pollardstown Fen over the years, and on the results of the experimental conservation cutting measures. A bibliography is presented below.

A7. RECOMMENDATIONS

A7.1 Monitoring

Given the evidence for an overall deterioration in the Condition of the site, both in terms of habitat and *Vertigo geyeri* distribution and abundance, it is recommended that monitoring is carried out at a minimum of 3 yearly intervals. This should be re-assessed in light of any deterioration of Condition or any changes to site management:

Additional work in 2015

Frequency	Monitoring for 2015 and at subsequent 5 yearly intervals
Methods (see Section 2 of main report for full details)	Prescription as follows: Describe habitat and take 1 sample from the most suitable habitat in each of the other 5 polygons (C, D, E, F, G) of this survey and analyse for molluscan composition Re-determine boundary of these 5 habitat polygons and assign habitat to either Optimal, Optimal & Sub-optimal, Sub-optimal, Sub-optimal and Unsuitable, or Unsuitable Assess the management regime in these 5 polygons and impacts upon the habitat for *V. geyeri* Use results to determine overall condition assessment

A7.2 Management

7.2.1 Existing Management

The *V. geyeri* habitat has been divided for the purposes of this report into eight management units, marked 1-8 in Figure 1. These are areas of different ownership, although within the larger areas are further fence divisions that are opened and closed to animals at various times.

Area A is currently owned by the farmer that also owns the fields upslope, but may be subject to a forthcoming land swap to NPWS. Currently, some of the area is fenced off as part of a research project, and the rest has had both sheep and cattle grazing in the past, most recently grazing has been by occasional straying sheep and goats. The upper margin is currently drier than in the recent past.

Area B is mainly unmanaged, but is occasionally trampled by cattle that move across the soldiers bridge from their grazing zone to the south.

Area C has very little *V. geyeri* habitat, is further towards the fen flat, and is unmanaged by grazing, but the habitat present is maintained by wetness from the hydrogeological conditions present.

Area D is a shallow ditch along a spring line. It is unmanaged and maintained by wetness levels of the continuously flowing springs.

Area E is towards the eastern margin of the fen and has had disruption by both fire and flooding over the last ten years. It is managed by occasional grazing of horses from the fields nearby.

Area F has widespread *V. geyeri* habitat. It has in the past been managed by sheep grazing and low numbers of horses. These animals were freely able to move between the drier fields above the margin down to the fen, therefore the grazing in the delicate habitat was sporadic. In the last year cattle grazing has been introduced with resultant trampling to the delicate spring line.

Area G is a small area which has been unmanaged in recent years. The *V. geyeri* habitat consists of a short margin of ideal habitat, with a much wetter area just down slope where, depending on the prevailing conditions, *V. geyeri* can be eradicated by excess wetness, or spread and thrive.

Area H is a large area of *Schoenus*-dominated fen margin. It has a number of barbed wire fences, some of which are lowered at different times of year to allow cattle access. The upper slope area is maintained by cattle grazing, but much of the uppermost potential habitat is over cropped and trampled. The lower slope areas are maintained by wetness, and the western end of the area has very little grazing and is essentially unmanaged.

A7.2.2 Proposed management prescription for site

Pollardstown Fen is currently (as a general rule) under-grazed, but over-trampled in places where cattle are being used as grazers. Thus it is important that a five year grazing plan is carefully implemented and documented so that the ideal regime can be reached in the shortest possible time.

In the wettest part of the *V. geyeri* habitat, grazing is not an issue as the habitat is maintained by the hydrogeological regime. However, closer to the margin where the ideal wetness should be saturation without inundation, the nutrient levels allow higher vegetation to grow and out-compete the yellow sedge and moss habitat that is required by the snail. Therefore appropriate grazing is essential to maintain this low growth. This is best carried out by sheep, although low numbers of horses can be an alternative. Cattle are not beneficial to *V. geyeri* habitats such as this, as they trample between the *Schoenus* tussocks and destroy the saturated delicate moss and yellow sedge runnels. The most ideal sheep grazing regime is one in which there is open movement between the field above and the fen below, i.e. the animals should never be corralled into sensitive fen habitat. Longer periods of extensive grazing are better than shorter periods of intensive grazing. Thus summer sheep grazing by fence removal (between the fen and upper field) from approximately June to October should be started, but carefully monitored. This is particularly recommended for areas 1, 2, 6, 7 and 8. Areas 3 and 4 are likely to be marginal and could be damaged by grazing management. Area 5 is likely to be satisfactorily maintained by the current

regime of occasional horse grazing. The wettest parts of Areas 7 and 8 could remain fenced off, but it is likely that in an extensive regime that sheep would avoid these wettest areas anyway.

There should be no supplementary feeding of animals. There should be no improvement with fertiliser or drainage of any of the habitat area.

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Figure A1: Map of Pollardstown Fen showing sample sites, transects and habitat polygons

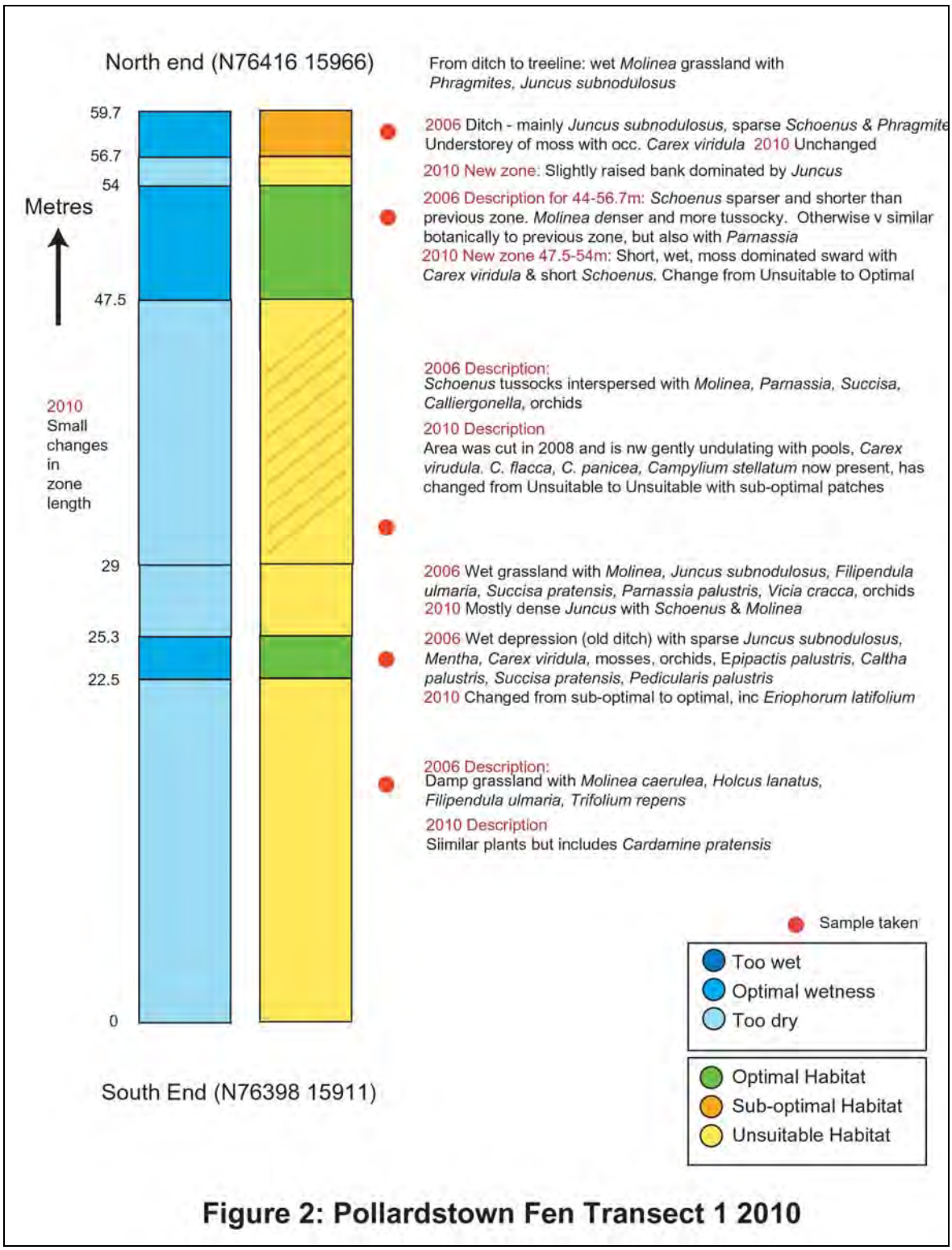

Figure 2: Pollardstown Fen Transect 1 2010

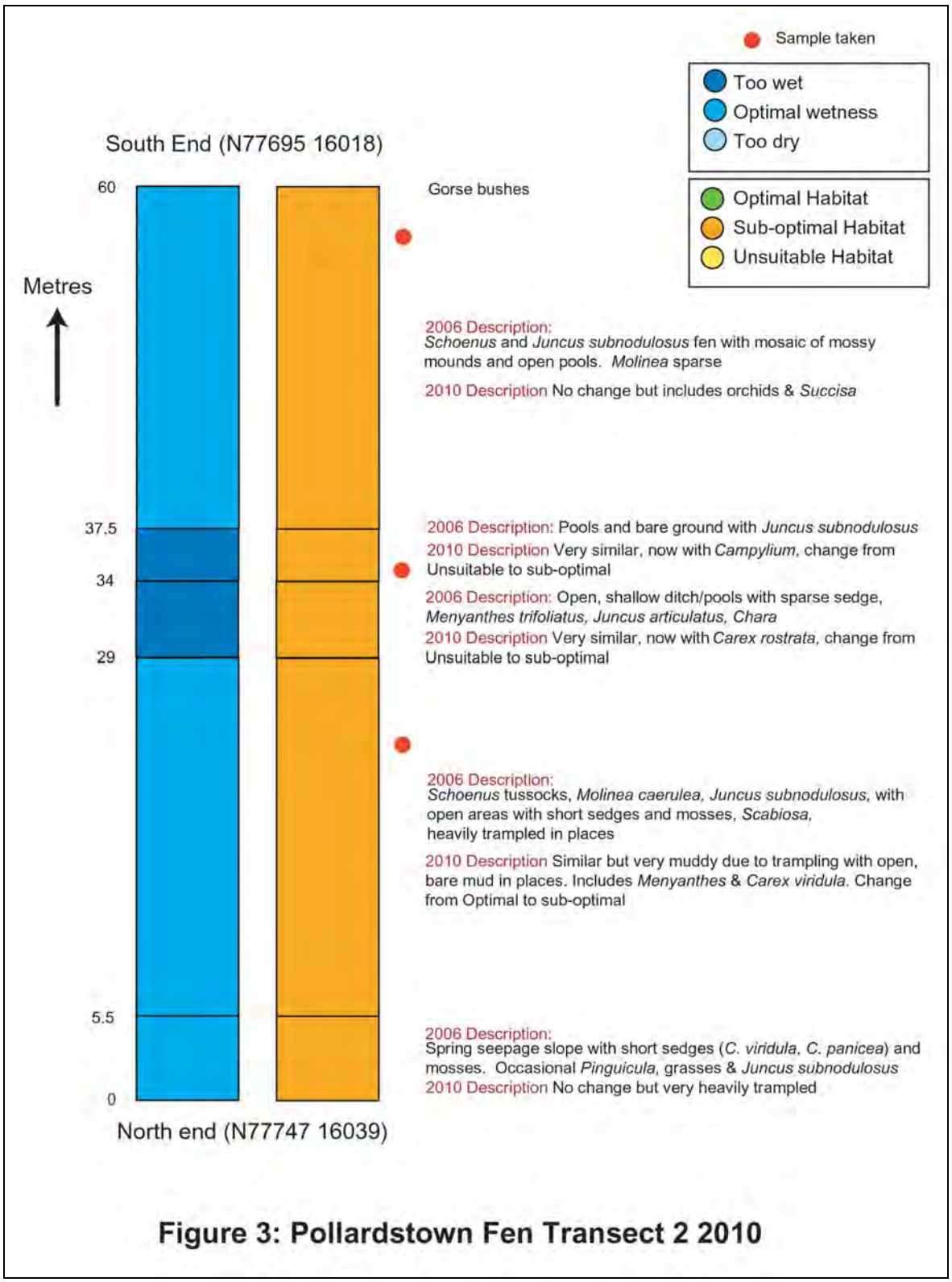

Figure 3: Pollardstown Fen Transect 2 2010

APPENDIX A1: 2005 RESULTS & CONDITION ASSESSMENT: POLLARDSTOWN FEN

The site was visited in the week beginning 30 October 2005.

	Transect 1				**Transect 2**		
	11m	**24m**	**51m**	**58m**	**25m**	**40.5m**	**52m**
Stagnicola fuscus				X			
Acicula fusca		X					
Carychium minimum		XXX	X	XXX	XX	XXX	XXX
Carychium tridentatum	XX					X	X
Oxyloma pfeifferi		X		X	X	XX	
Cochlicopa lubrica	XX	XX	X	XX	X	XXX	X
Columella aspera			X	X		X	XX
Vertigo geyeri		XX		X		X	
Vertigo moulinsiana				X			
Vertigo antivertigo		X		X	XX	X	
Vertigo substriata	XX	X	XX	X	X	XXX	XX
Vertigo pygmaea							
Leiostyla anglica	XX	X	X	XX	X	X	XX
Vallonia pulchella		XX			X		
Acanthinula aculeata	XX	X	X			X	
Punctum pygmaeum	X	X	X	X	X	XX	X
Discus rotundatus			X	X			
Vitrea crystallina	X			X		X	X
Nesovitrea hammonis	XXX	XX	X	XXX	X	X	X
Aegopinella pura	X			X	X	X	
Euconulus praticola	X	XXX		X	X	XXX	XX
Pisidium personatum		X			X		X
Pisidium obtusale		X					
Total No. of species	10	15	9	16	12	15	11

Key: x = 1 – 5 specimens; xx = 6 – 14 specimens; xxx = 15 or more specimens

No quantitative data was obtained for sites 1 and 2 in 2005 but it is likely that the Condition would still be assessed as Favourable.

A5.1 Population Assessment

Indicator	**Target**	**Result**	**Pass/Fail**
Presence/absence (Transect)	Adult or sub-adult snails are present in 2 samples on Transect 1 (minimum 4 samples taken) and 1 sample on Transect 2 (minimum 2 samples taken)	Present in 2 samples on T1 and 1 sample on T2	Pass
Presence/absence (Site level)	Adult or sub-adult snails are present in sites 1 and 2	Present at 2 other locations	?

A5.2 Habitat for the Species Assessment

Indicator	Target	Result	Pass/Fail
Habitat extent and quality: (transect 1)	At least 30m of Transect 1 is classed as Optimal and sub-optimal and Soils, at time of sampling, are optimal wetness for 30m of the transect	5.8m is optimal & sub-optimal and 12.3m is optimal wetness	Fail
Habitat extent and quality: (transect 2)	50m of Transect 2 is classed as Optimal or sub-optimal and Soils, at time of sampling, are optimal wetness for 50m of the transect	51.5m is optimal & sub-optimal habitat and 51.5m is optimal wetness	Pass
Habitat extent: (Site level)	At least 2 ha or 2 habitat polygons are dominated by optimal habitat	0 ha and no polygons dominated by optimal habitat	Fail

Appendix B Example of *Vertigo angustior* Site Report

Implementation of a *Vertigo* monitoring programme: *Vertigo angustior* monitoring at Pollardstown Fen

B1. SITE CODE AND LOCATION DETAILS

B1.1 Site code and location

Vertigo Site code:	VaCAM13
SAC Site code:	00396 Pollardstown Fen
County:	Kildare
Location:	The habitat that supports *Vertigo angustior* within this cSAC is the ecotone above the fen margin below the esker ridge at the south east of the fen, and the small mineral marsh in the centre south of the fen below the graveyard. Access to both is through private property, or the public entrance and through the fen.
Date	12/05/09
Surveyors	Evelyn Moorkens and Ian Killeen

B1.2 General habitat description

The general habitat in which *Vertigo angustior* is present here in different areas is grassland marsh transition, grassland pond transition, or grassland marsh fen transition, but in each case permanently waterlogged but not inundated ground on mineral soil, mostly the ecotone between *Potentilla anserina* dominated wet grassland and the *Iris* marsh. These are not Annex I nor CORINE listed habitats, but they are important in that they support the so called "marsh phase" or inland habitat of *Vertigo angustior*. The habitat at the eastern site is more suitable for the snail than the site below the graveyard, and locations of suitable ecotone include combinations of *Potentilla anserina, Iris pseudacorus, Carex paniculata, Carex acutiformis, Triflium pratense,* and *Ranunculus repens* communities. This comprises ecotones that include the Rodwell categories of M28, MG10 and MG11 (Rodwell, 1991, 1992). The microhabitat of the snail is the decaying vegetation and living and decaying moss in the litter layer of this unshaded habitat. The habitat falls within the more general habitat of freshwater marsh (GM1) and wet grassland (GS4) of Fossitt (2000).

B2. KNOWN STATUS OF VERTIGO ANGUSTIOR ON SITE

Vertigo angustior was first recorded by Killeen at the site in a small area of *Iris*/fen transition habitat in April 2002 (Speight *et al.* 2003). A more widescale survey was carried out in 2002 (Killeen & Moorkens, 2002) which showed the potential and actual *V. angustior* habitat at this site was extremely restricted. Two monitoring transects were set up in September 2006 (Moorkens 2007b).

B3. DETAILS OF TRANSECTS AND OTHER SAMPLING SITES

Figure 1 shows the Pollardstown Fen site with the transects, sample locations and boundaries of each habitat type.

B3.1 Transect 1: (In polygon A)

Start Point:	From a small willow tree at N76729 15801
End point:	The end of the sedge fen at N76743 15847
Transect Length:	30m
Description:	The transect runs through a transition from wet grassland to *Iris* marsh to sedge fen
Direction:	South to north
Sampling frequency:	Starting at the 0 metre end, the habitat (at the plant community level) along the tape was described and the linear distance of that habitat type measured. This was repeated every time the habitat changed, thereby delineating uniform plant community zones along the transect. Three samples were taken at various intervals along the transect from optimal and sub-optimal habitat, and analysed in the laboratory for their snail composition

B3.2 Transect 2: (In polygon B)

Start Point:	From the second fence post east of the gate at N77794 15239
End point:	A mound (spoil heap) at N77790 15218
Transect Length:	12m
Description:	The transect runs from the fence to the main fen across an *Iris* transition marsh and up a slope into rough cattle pasture
Direction:	North to south
Sampling frequency:	As above. Two samples were taken at various intervals along the transect from optimal and sub-optimal habitat, and analysed in the laboratory for their snail composition

B3.3 Other sample sites

One sample was taken from the eastern habitat east of Transect 2 in Polygon C at N77782 15227. Polygon D was not sampled as the habitat was fragmented and *V. angustior* had previously been found there.

B4. RESULTS

B4.1 General

Table B1 shows the specific habitat definitions for *V. angustior* at Pollardstown Fen.

Table B1: Specific habitat definitions for Pollardstown Fen

Definition of Optimal habitat	*Iris* marsh and wet grassland with *Potentilla anserina, Carex paniculata, Carex acutiformis* at the fen margin, with an open structured, damp, humid thatch of decaying vegetation with living and decaying moss in the litter layer of this unshaded habitat
Definition of Sub-optimal habitat	As above but habitat is more shaded or with *Filipendula*, or thatch and moss layer is sparse, or there are pools of standing water

The site was divided into four main habitat polygons as follows:

Polygon	**Area (ha)**	**Description**
A	0.5911	Sub-optimal - transition from wet grassland to *Iris* marsh to sedge fen
B	0.1534	Sub-optimal – small area of *Iris* marsh between the fen and rough cattle grazed slope
C	0.7866	Sub-optimal – small strip of *Iris* marsh between the fen and rough cattle grazed slope
D	0.7880	Sub-optimal – small strip of *Iris* marsh between the fen and rough cattle grazed slope

The molluscan composition of the samples taken along the Pollardstown Fen Transects and the other sites is given in Table B2.

Figure B1 shows Pollardstown Fen with the transects, sample locations and boundaries of optimal and sub-optimal habitat. The delineated habitat zones along the transect are shown in Figure B2. Photographs of locations along the transect and elsewhere are shown in the photographic record.

Table B2: Molluscan composition of samples

	Transect 1			Transect 2		Other site
Species	**7.3m**	**12.4m**	**18.5m**	**2.8m**	**5.4m**	**1**
Bathyomphalus contortus			1	1		
Galba truncatula			1	5	1	4
Acicula fusca		18	15			
Carychium tridentatum	10	12	23	9	7	12
Carychium minimum	6	12	3			5
Succinea putris	6	2	1	1		2
Cochlicopa lubrica	8	8	3	1	4	3
Columella edentula	45	60	8			
Vertigo antivertigo	14		1	5		6
Vertigo moulinsiana			13			
Vertigo pygmaea	1		1	1	2	5
Vertigo substriata	17	16	12			
Vertigo angustior		1	5	2	3	4
Leiostyla anglica	5	12	4			
Lauria cylindracea		1				
Vallonia costata		4				
Vallonia pulchella			1		1	2
Acanthinula aculeata	4	5	5			2
Punctum pygmaeum	10	4				1
Discus rotundatus	7	2	13			1
Vitrea crystallina	3	8	1			1
Nesovitrea hammonis	8	7	3		1	3
Aegopinella pura	2	5	3			
Euconulus alderi	18	20	8	1		4
Clausilia bidentata		3	1			
Trochulus hispidus			3	5	7	10
Cepaea hortensis		1				
Pisidium personatum	2	1		8		18
Pisidium obtusale			1	7		
Total No. of Species	**17**	**21**	**24**	**12**	**8**	**17**

B5. CONDITION ASSESSMENT

B5.1 Population Assessment

Indicator	Target	Result	Pass/Fail
Presence/absence (Transect)	Adult or sub-adult snails are present in at least 1 sample taken from Optimal or Sub-optimal habitat on Transect 1 (minimum 3 samples)	*V. angustior* found in 2 of the 3 samples	Pass
Presence/absence (Transect)	Adult or sub-adult snails are present in at least 1 sample taken from Optimal or Sub-optimal habitat on Transect 2 (minimum 2 samples)	*V. angustior* found in the 2 samples	Pass

2 passes Favourable (green); 1 pass Unfavourable Inadequate (amber); 0 passes Unfavourable Bad (red)

B5.2 Habitat for the Species Assessment

Indicator	Target	Result	Pass/Fail
Habitat extent and Quality: (transect)	At least 20m of habitat along Transect 1 is classed as Sub-Optimal or Optimal and Soils, at time of sampling, are damp (optimal wetness) and covered with a layer of humid thatch for at least 20m of Transect 1	23.5m is Sub-Optimal or Optimal and 30m is optimal wetness	Pass
Habitat Extent and Quality: (transect)	At least 6m of habitat along Transect 2 is classed as Sub-Optimal or Optimal and Soils, at time of sampling, are damp (optimal wetness) and covered with a layer of humid thatch for at least 6m of Transect 2	6.6m is Sub-Optimal or Optimal and 6m is optimal wetness	Pass
Habitat extent: (Site level)	At least 2 ha of the site sub-optimal with optimal areas	2.32 ha	Pass

B5.3 Future Prospects Assessment

Activity code	Activity	Location	Influence	Intensity	Area affected (ha)
A04.02.01	Non intensive cattle grazing	Inside	Negative	High	1.7

Future Prospects have been assessed by examining how the impacts are affecting the other attributes (i.e. population and habitat for the species) and their impact if they continue unchecked. Although the number of cattle is relatively low, because the area of *V. angustior* habitat is extremely small, the intensity within the habitat is high.

Future prospects should balance positives and negatives to determine whether the species will survive at this site for the foreseeable future. Overall for the site the impact has been assessed as moderate rather than severe, therefore Future prospects have been assessed as Unfavourable inadequate (amber). However, unless the grazing is urgently addressed, the impact would have to be assessed as severe.

B5.4 Overall Assessment

The baseline condition assessment at Pollardstown Fen can be determined by how well the site meets the key targets for the attributes associated with this species. The habitat at the site is extremely small in area and much of it is not in good condition for *V. angustior* due to grazing pressure. However, the snail is scattered in its distribution and present in rather low numbers. The overall assessment is Unfavourable (Amber).

Attribute	Assessment
Population	Green
Habitat for the species	Green
Future Prospects	Amber
Overall	Amber

B6. DISCUSSION

Vertigo angustior was first discovered at Pollardstown Fen in 2002, and was the subject of a survey of the entire fen margin during that year. This showed that the snail was found only in the transition zone lying between the sloping grazed grassland with herbs, and the wetter fen dominated by *Filipendula ulmaria, Juncus* spp., and grasses. The transition zone was fragmented and discontinuous, and rarely more than 3-4 metres wide. The habitat within the zone was characterised principally by stands of *Iris pseudacorus* with grasses (e.g. *Holcus lanatus* and *Phleum pratense*), and low-growing herbs, particularly *Potentilla anserina* and *Ranunculus repens*. The survey demonstrated that the distribution of *Vertigo angustior* at Pollardstown Fen is very restricted, apparently only occurring at the south-eastern end of the site over a distance of approximately 800 metres, in a zone mostly less than 4 metres wide, and in a small clump of *Iris* dominated vegetation below the graveyard. Within the latter site, *V. angustior* is only occasionally found to be present, suggesting it is restricted to a very small areas of micro habitat for the majority of time, spreading more widely (a few metres square) during times of high humidity. The entire habitat for *V. angustior* at the fen equates to a maximum area of potential occupancy of 2.3 ha, whereas in reality, the area of suitable micro habitat is considerably less.

Transition zone habitat comprising grassland with herbs occurs around most of the fen perimeter. However, the combination of suitable vegetation composition and ground moisture only occurs at a few locations. These are mainly on banks and mounds along the southern perimeter. Throughout most of the northern fen perimeter the transitional grassland is both tall and rank, or the land has been intensively managed up to the fen margin, such that the transition zone is too wet.

There are very few "marsh phase" or inland *V. angustior* habitat locations known in Ireland. While *Iris* marsh is very common in the country, this habitat is mainly subject to inundation in winter. Inundated habitat cannot support this species; it requires a wet but free-draining substrate. The combination of high water table and free draining esker ridge at Pollardstown accounts for its rare presence here.

This rare habitat needs to be carefully maintained into the future, especially in the light of its recent trampling damage. This site should therefore be monitored regularly, both for correct management maintenance and to assess other likely impacts caused by increased pressure on the greater Dublin area, and by the consequences of climate change.

B7. RECOMMENDATIONS

B7.1 Monitoring

Given the overall assessment of the Condition of the habitat and the feature of the site as Unfavourable Inadequate, it is recommended that monitoring is carried out at a minimum of 3 yearly intervals. This should be re-assessed in light of any deterioration of Condition or any changes to site management:

Frequency	Next monitoring due 2012
Methods (see Section 3 of main report for full details)	Assessment of the transect and other locations with snail sampling, plus assessment of condition of polygon. Prescription as follows: Repeat transect 1, delineate the plant community/habitat zones, and assign the habitat and wetness in each zone as Optimal, Sub-optimal or Unsuitable Take 1 sample each from at least 3 of the main zones with the most suitable habitat on the transect and analyse for molluscan composition Repeat transect 2, delineate the plant community/habitat zones, and assign the habitat and wetness in each zone as Optimal, Sub-optimal or Unsuitable Take 1 sample each from at least 2 of the main zones with the most suitable habitat on the transect T2 and analyse for molluscan composition Re-determine boundary of the habitat polygons and assign habitat to either Optimal, Optimal & Sub-optimal, Sub-optimal, Sub-optimal and Unsuitable, or Unsuitable Assess the management regime and impacts upon the habitat for *V. angustior* Use results to determine overall condition assessment

Additional work at 6 yearly intervals:

Frequency	Next monitoring due 2015
Methods (see Section 3 of main report for full details)	Prescription as follows: Describe habitat and take 2 samples from the most suitable habitat in each of Polygons C and D and analyse for molluscan composition

7.2 Management

B7.2.1 Existing Management

The *V. angustior* habitat below the graveyard has occasional grazing by cattle during times of movement, and low intensity grazing by goats. The eastern habitat is grazed by cattle, the intensity of grazing can be high at dry times when the animals congregate around the wettest area and nearby ponded water, and this has led to (sometimes severe) poaching of the habitat.

B7.2.2 Proposed management prescription for site

The management of the western habitat area in the vicinity of Transect 1 should be maintained for the 2010-2013 period. The occasional grazing by goats and cattle is not poaching the habitat, which itself is maintained by the wetness and transition of mineral to peat soils in the area.

The management of the eastern end in the vicinity of Transect 2 needs to be more carefully controlled. The habitat forms a narrow zone at the base of three large interconnected fields of improved grassland, where the interconnecting gates can be opened or closed. The improved grassland has a high carrying capacity for grazing cattle, and lowering the current intensity is not necessary most of the time. However, in dry periods, the cattle congregate in the important habitat area to gain moisture from the vegetation, and water from the ponds. In order to protect the habitat, the cattle should either be removed during dry periods, or else, more sensibly, the *V. angustior* habitat should be fenced off using temporary electric fencing during dry periods, leaving one approach to a drinking pond, or else by placing a drinking trough higher in the field. The electric fence should be removed at the end of the dry spell to allow for less intensive periods of grazing of the habitat, where the grazing pattern is more random and suitable for the maintenance of favourable condition.

B8.0 REFERENCES

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APPENDIX B1: 2006 RESULTS & CONDITION ASSESSMENT

The site was visited 9/10 September 2006.

Insufficient data, particularly on *V. angustior* population, was collected in 2006 to allow a full retrospective Condition Assessment to be constructed. However, the Habitat assessment is given below:

Habitat for the Species Assessment

Indicator	Target	Result	Pass/Fail
Habitat extent and Quality: (transect)	20m of habitat along Transect 1 is classed as Sub-Optimal or Optimal and Soils, at time of sampling, are damp (optimal wetness) and covered with a layer of humid thatch for 20m of Transect 1	23.5m is Sub-Optimal or Optimal and 30m is optimal wetness	Pass
Habitat Extent and Quality: (transect)	6m of habitat along Transect 2 is classed as Sub-Optimal or Optimal and Soils, at time of sampling, are damp (optimal wetness) and covered with a layer of humid thatch for 6m of Transect 2	6m is Sub-Optimal or Optimal and 7m is optimal wetness	Pass
Habitat extent: (Site level)	>2 ha of the site sub-optimal with optimal areas	2.32 ha	Pass

Figure B1: Map of Pollardstown Fen showing sample sites, transects and habitat polygons: *Vertigo angustior*

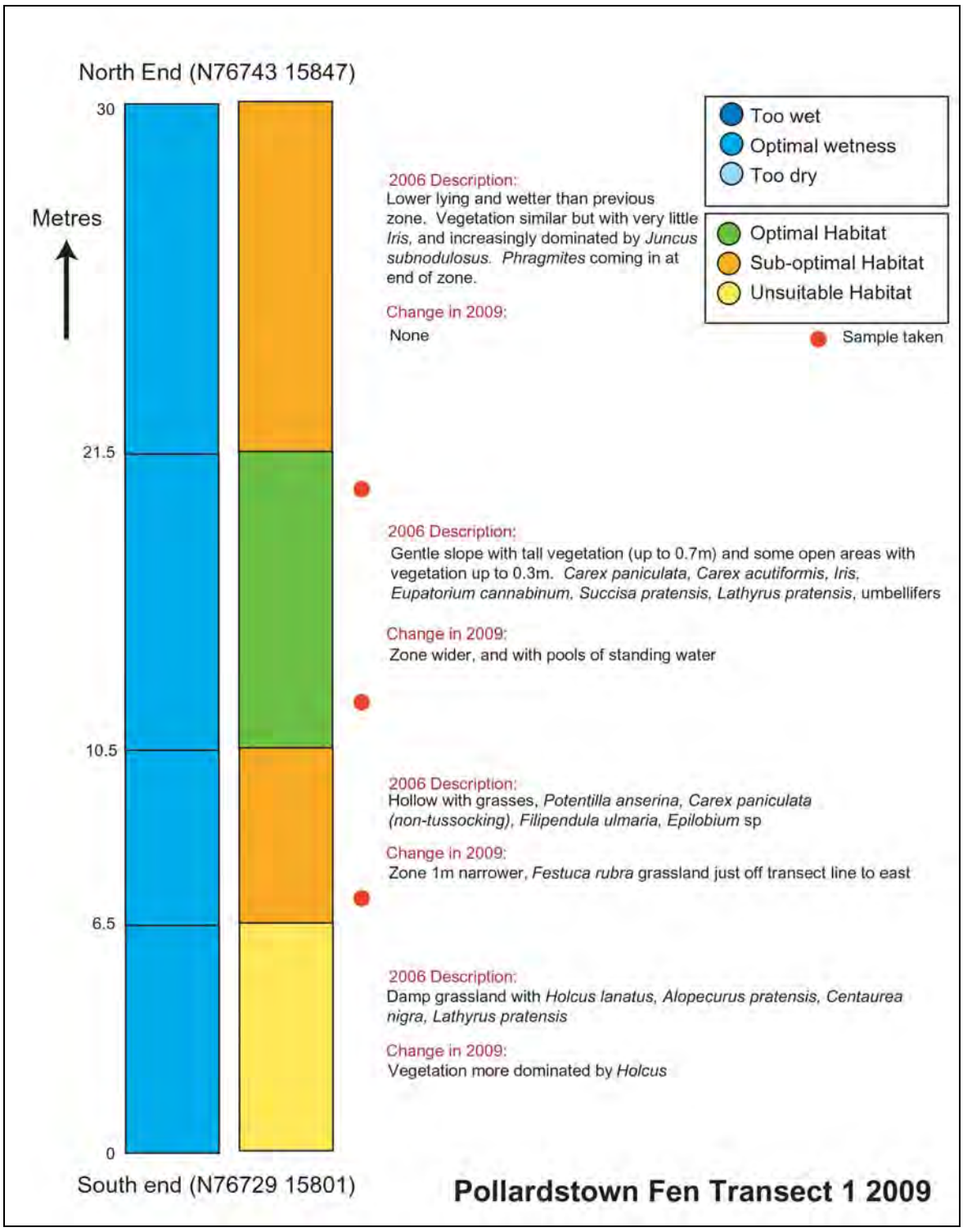

Figure B2: Pollardstown Fen Transect 1 *Vertigo angustior*

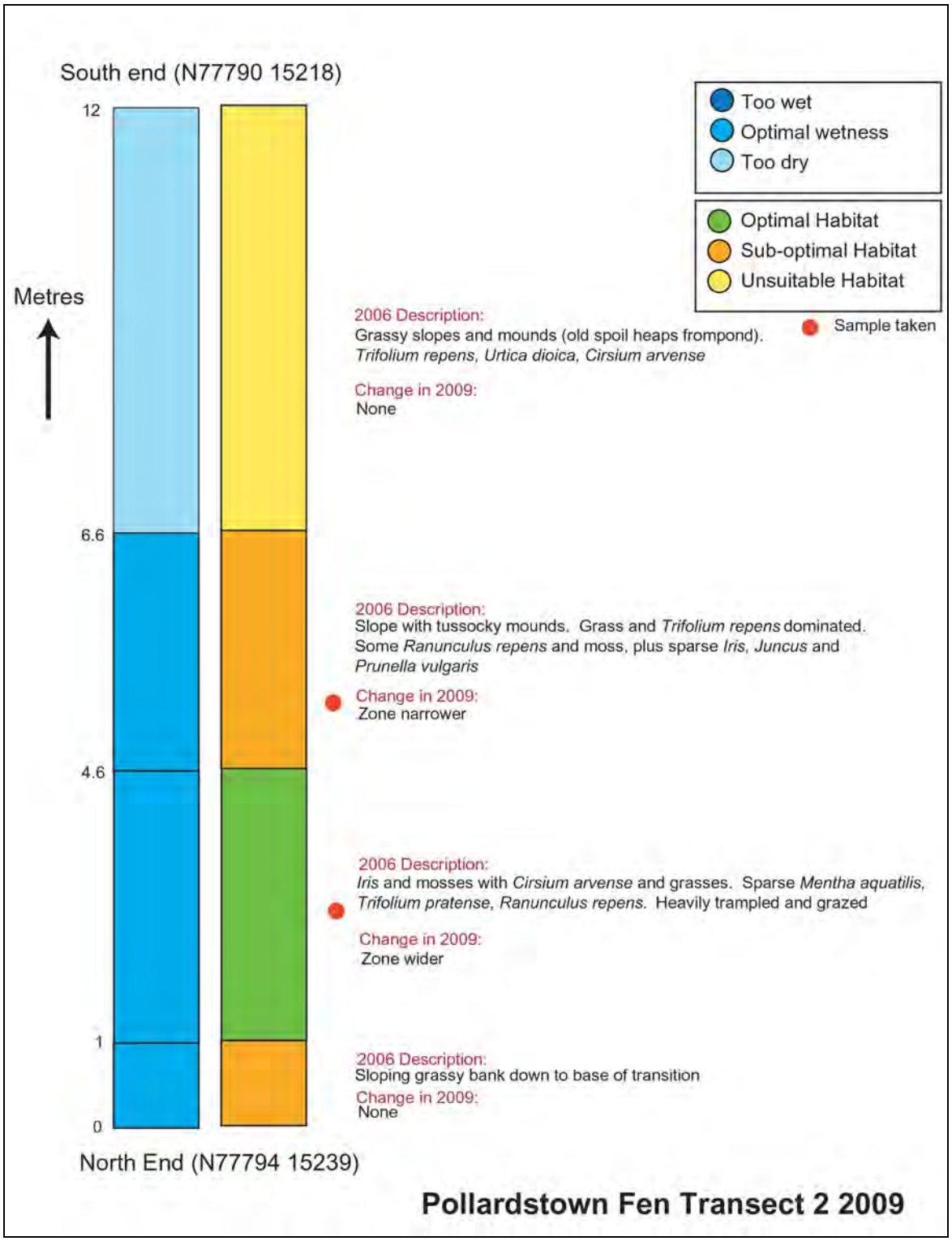

Figure B3: Pollardstown Fen Transect 2 *Vertigo angustior*

Appendix C: Example of *Vertigo moulinsiana* Site Report

Implementation of a *Vertigo* monitoring programme: Vertigo moulinsiana monitoring at Pollardstown Fen

C1. SITE CODE AND LOCATION DETAILS

C1.1 Site code and location

Vertigo Site code:	VmCAM18
SAC Site code:	000396 Pollardstown Fen
County:	Kildare
Location:	The habitat that supports *Vertigo moulinsiana* within this cSAC is the tall fen habitat including shallow ditches from the fen margin into the centre of the fen. During wet periods the alkaline fen with *Schoenus nigricans* becomes habitat for the snail. Access is from the public entrance at the south of the fen.
Date	12/09/10
Surveyor	Evelyn Moorkens & Ian Killeen

B1.2 General habitat description

The general habitat in which *Vertigo moulinsiana* is present at Pollardstown Fen is Calcareous Fen (HD Annex I Habitat 7230; CORINE 54.2), Calcareous Fen with *Cladium mariscus* (HD Annex I Habitat 7210; CORINE 53.3), petrifying springs with tufa formation (HD Annex I Habitat 7220; CORINE 54.12), ditch and waterside communities including most communities of CORINE 53 (Romão, 1996; Devillers *et al*., 1991). The snail is widespread around the wetter ditch areas, becoming less dense as habitat becomes drier away from saturated groundwater.

The specific areas that are within a wider mosaic, but that form specific *V. moulinsiana* habitat fit the *Cladium* and *Schoenus* communities of M13, *Filipendula* mire of the M27 and the tall *Carex* M9 Rodwell characteristic vegetation classification (Rodwell, 1991). This falls within the more general habitat of rich fen and flush (PF1), reed and large sedge swamps (FS1) and tall herb swamps (FS2) of Fossitt (2000).

C2. KNOWN STATUS OF VERTIGO MOULINSIANA ON SITE

Vertigo moulinsiana was first found at the site in April 1971 by A. Norris & M.P. Kerney (Conchological Society records). Since 1997 the site has been the subject of extensive molluscan studies as part of mitigation for the Kildare bypass. This included identification of all areas of *V. moulinsiana* habitat at the site. In November 2006 a monitoring transect was set up and a management prescription prepared (Moorkens 2007e). At this time *V. moulinsiana* occurred all along the transect and was present in relatively high abundance.

C3. DETAILS OF TRANSECT AND OTHER SAMPLING SITES

Figure 1 shows Pollardstown Fen with the transect, sample locations and boundaries of each habitat type.

C3.1 Transect 1:

Start Point:	Fence post by canal feeder at N76320 16015
End point:	N76417 15964
Transect Length:	113m
Description:	Transect follows the line of a west/east ditch. The first 5.4m are grassland until the corner where the E/W and N/S ditches meet. The western end of the ditch is dominated by *Phragmites* whereas the eastern end is vegetated by *Schoenus* and *Juncus subnodulosus*. An open swampy area with *Chara* occurs between 21 and 28m.
Direction:	East to west
Sampling frequency:	Fifteen samples were taken at (mostly 10m) intervals along the transect

C3.2 Other sample sites

The distribution of *Vertigo moulinsiana* at Pollardstown Fen had been identified in previous surveys. For the purposes of Condition Assessment, in addition to the transect, a single area of *Carex*-dominated fen at the south-eastern end of the fen (N77870 15209) was selected for monitoring.

C3.3 Keys to table abbreviations

Vegetation key: Ag = *Agrostis stolonifera*, Ang = *Angelica sylvestris*, Cxa = *Carex acutiformis*, Cm = *Cladium mariscus*, Eq = *Equisetum fluviatile/palustre*, Jus = *Juncus subnodulosus*, Ma = *Mentha aquatica*, Pa = *Phragmites australis*, Sch = *Schoenus nigricans*

Other mollusc abbreviations: Suc/Oxy = *Succinea* or *Oxyloma*; Cep = *Cepaea* sp.; Col edent = *Columella edentula*; Vert sub = *Vertigo substriata*; Der laeve = *Deroceras laeve*

Ground moisture level: 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.

C4. RESULTS

C4.1 General

Table C1 shows the specific habitat definitions for Pollardstown Fen.

Table C1: Specific habitat definitions for Pollardstown Fen

Vegetation Classes (For condition assessment, the plant species are classified into 4 groups): Class 1 being the most favoured plants at the site to Class 4 which are unsuitable	Class 1 tall *Carex* species *Schoenus nigricans* *Phragmites australis*	Class II *Cladium mariscus* *Equisetum fluviatile*	Class III *Juncus subnodulosus* *Menyanthes trifoliata* *Mentha aquatica* *Angelica sylvestris*	Class IV All other species
Soil Moisture classes (Ground moisture levels recorded on a scale of 1-5 at each replicate sampling point): classes 3 and 4 are usually the most favourable	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.			

Two main polygons (A and B) with good (optimal and sub-optimal) *V. moulinsiana* habitat have been identified on the south side of the main feeder. All other potentially suitable habitat covers an area of 17.4 ha in 9 habitat blocks. However, actual habitat comprises significantly less than 17.4 ha and therefore for Condition Assessment purposes this is classed as sub-optimal.

Polygon	Area (ha)	Description
A	3.029	Optimal and sub-optimal habitat. Network of ditches and wet *Schoenus*-dominated fen
B	0.8533	Optimal and sub-optimal habitat. Flush area with dense stands of *Carex acutiformis*
All other areas	17.43	Sub-optimal habitat. Wide range of habitats with *V. moulinsiana* habitat including ditches, open fen and flushes, with *Schoenus*, tall *Carex* spp. and *Cladium*

The molluscan composition of the samples taken along the Pollardstown Fen Transect is given in Table 2 and those for the other site in Table 3. Photographs of locations along the transect are provided in the photographic record.

Table C2: Molluscan composition of samples on Transect 1

Sample (m)	**Vegetation**	**Veg Ht (m)**	**Ground Moisture**	**Vertigo moulinsiana**		**Suc/ Oxy**	**Cep**	**Col edent**	**Vert sub**	**Der laeve**
				Adult	**Juv**					
6	Cxa, Ma, Ag	0.4	3			1				
8	Pa, Ma, Cxa, Ang	1.5	3	11	61		2			1
10	Pa, Ma, Eq	1.7	4	16	27		2			
15	Pa, Ma, Eq	1.5	3	4	18		2			
20	Pa, Ma, Jus	1.2	4	11	88	2	7			
25	Cxa, Pa, Ma, Jus	0.4	4	95	220		5			
30	Cxa, Pa, Ma, Jus	1.0	4	27	70		9			
40	Jus, Pa	0.8	3	26	9		1			
50	Pa, Eq, Cxa	0.8	4	19	82	2	3			
60	Sch, Jus, Pa, Ma	0.7	4	3	7	2				
70	Sch, Jus, Ma	0.9	4				3			
80	Sch, Jus, Pa, Ma, Cxa	0.9	3	9	6			3		
90	Sch, Pa, Eq	0.7	4	6	9		2	5	2	
100	Sch, Jus, Pa, Ma	0.6	3	4		2	3	2		
110	Sch, Jus, Pa, Ma	0.8	4	9	17	1	2		1	

Table C3: Molluscan composition of samples at Site 1

Sample (m)	**Vegetation**	**Veg Ht (m)**	**Ground Moisture**	***Vertigo moulinsiana***		**Suc/ Oxy**	**Cep**	**Col edent**	**Der laeve**
				Adult	Juv				
1	Cxa	1.0	4	9	23	3			
2	Cxa, Ma	1.2	4	29	18		2		
3	Cxa, Pa	1.1	3			1		3	
4	Cxa	1.1	4	14	66				1
5	Cxa, Pa	1.1	4	7	3	2	1		
6	Cxa, Pa	1.0	4	35	40	4			
7	Cxa	0.9	3			7	1		1
8	Cxa, Pa	0.9	4	11	19	1		2	
9	Cxa, Ma, Pa	1.0	4	6	29	3		1	
10	Cxa, Pa	1.2	4	18	35				

C5. CONDITION ASSESSMENT

C5.1 Population Assessment

Indicator	Target	Result	Pass/Fail
Presence/absence (Transect)	*V. moulinsiana* is present in 11 samples (or 75% of a minimum of 15 samples) on Transect 1	Present in 13 samples	Pass
Abundance (Transect)	At least 7 (50% of a minimum of 15) samples on Transect 1 should have >20 *V. moulinsiana* individuals	9 samples with >20 individuals	Pass
Presence/absence (Site level)	Adult or sub-adult snails are present in 6 of the samples at Site 1 (minimum 10 samples)	Present in 8 of the 10 samples	Pass

3 passes Favourable (green); 2 passes Unfavourable Inadequate (amber); 0 to 1 passes Unfavourable Bad (red)

C5.2 Habitat for the Species Assessment

Indicator	Target	Result	Pass/Fail
Habitat Extent (Transect)	Over 75% of the samples on Transect 1 are dominated by suitable vegetation (Classes I & II)	93% of samples	Pass
Habitat Quality (Transect)	Over 75% of the samples on Transect 1 fall within soil moisture classes 3-5	100% of samples	Pass
Habitat Quality & Extent (Site level)	Over 80% of the samples at site 1 are dominated by suitable vegetation (Classes I & II) and fall within soil moisture classes 3-5	100% of samples	Pass

3 passes Favourable (green); 2 passes Unfavourable Inadequate (amber); 0 to 1 passes Unfavourable Bad (red)

C5.3 Future Prospects Assessment

Activity code	Activity	Location	Influence	Intensity	Area affected (ha)
A04.03	Abandonment of pastoral systems, lack of grazing	Inside	Negative	Low	17.4
J02.02.01	dredging/ removal of limnic sediments	Inside	Negative	Medium	17.4
J02.03	Canalisation & water deviation	Inside	Negative	Medium	17.4

Future Prospects have been assessed by examining how the impacts are affecting the other attributes (i.e. population and habitat for the species) and their impact if they continue unchecked.

Future prospects should balance positives and negatives to determine whether the species will survive at this site for the foreseeable future. Pollardstown Fen has had reduced grazing levels in recent years, but the affects of this on *V. moulinsiana* would be lower than they would be on *V. geyeri* and open habitats, as *V. moulinsiana* can live in rank vegetation as long as the habitat remains wet enough. The level of drainage from the fen into the canals has been maintained in a state of

equilibrium that has kept a sustainable population of this species at the fen. However, if abstraction of water from the greater aquifer catchment were to increase, this may cease to be the case. In addition, previous drainage maintenance within the fen site has been carried out in a damaging manner with loss of *V. moulinsiana* habitat as a result. It remains to be concluded whether this was temporary and recovery occurs. For the present, all the above remain within the tolerance of the snail, and Future prospects have been assessed as Favourable (green).

C5.4 Overall Assessment

The baseline condition assessment at Pollardstown Fen can be determined by how well the site meets the key targets for the attributes associated with this species. Much of the habitat at the site appears to be in good condition for *V. moulinsiana*, the snail is scattered in its distribution and is locally common. The overall assessment is Favourable.

Attribute	Assessment
Population	Green
Habitat for the species	Green
Future Prospects	Green
Overall	Green

C6. DISCUSSION

Pollardstown Fen is currently in excellent condition for *Vertigo moulinsiana*. If the fen was to be maintained solely for the conservation of this species, it would be quite easy, as the snail favours wet, humid conditions in ungrazed tall vegetation habitats. However, Pollardstown Fen is a very important site for a number of Annex I habitats and Annex II species. Species such as *V. geyeri* require short open alkaline fen habitat, dominated by yellow *Carex* species and brown mosses, and these are generally best managed by sheep grazing, so some compromise in management between the two qualifying features is needed. In the best habitats for these species, they rarely coincide in area of occupancy, except in very wet conditions when *V. moulinsiana* spreads over shorter vegetation. *Vertigo moulinsiana* is less demanding in constancy of supply of water compared with *V. geyeri,* yet it will live in wetter conditions than the latter if there is enough build up of litter, as is has good climbing abilities. It can also live in drier conditions than *V. geyeri* if there is enough humidity in autumn to allow it to climb and reproduce. The very favourable conditions therefore at Pollardstown must be taken in the context that a spread of *V. moulinsiana* into habitat formally occupied by *V. geyeri* can be a negative trend that indicates an active transition towards drier conditions which would ultimately end up with the collapse both snail populations. There is evidence that some negative changes have occurred at the southern margin of the fen. However, in

the *V. moulinsiana* habitat to the north and more central areas of the fen there does not appear to be any tendency towards succession to dryness. Due to the importance of the fen internationally and the fact that the species can be rapidly lost from sites when the groundwater recedes below surface levels, regular monitoring is recommended. Ongoing interpretation of the changes in the populations of the Habitats Directive Annex II *Vertigo* species have been aided by studies over the last 10 years as part of the Kildare Town Bypass project (e.g. Anon., 2004). These have included regular groundwater monitoring across the fen, which currently indicate that water levels are suitable for *V. moulinsiana* occur.

C7. RECOMMENDATIONS

C7.1 Monitoring

Although Pollardstown Fen has been assessed as Favourable, both in terms of habitat and *Vertigo moulinsiana* distribution and abundance, it is still recommended that monitoring is carried out at a minimum of 3 yearly intervals. This should be re-assessed in light of any deterioration of Condition or any changes to site management:

Frequency	Next monitoring due 2013
Methods (see Section 4 of main report for full details)	Prescription as follows: Repeat transect 1, in field record: vegetation height, vegetation composition, ground moisture class, numbers of *V. moulinsiana* (adult & juvenile) and other molluscs, minimum 15 samples Take 10 samples from Site 1 of this survey, record information as above Re-determine boundary of the habitat polygons and assign habitat to either Optimal, Optimal & Sub-optimal, Sub-optimal, Sub-optimal and Unsuitable, or Unsuitable Assess the management regime and impacts upon the habitat for *V. moulinsiana* Use results to determine overall condition assessment

Additional surveillance at 6 yearly intervals:

Frequency	Next monitoring due 2016
Methods (see Section 4 of main report for full details)	Prescription as follows: In all other polygon areas not covered by the regular monitoring - Take 5 samples at each from at least 3 other locations with optimal habitat within each polygon areas at the site, record information as above

C7.2 Management

C7.2.1 Existing Management

Polygon Area A is intermittently grazed by cattle and sheep, for no more than 2 weeks of cattle grazing and occasional wandering sheep grazing in any one year. Polygon area B has occasional cattle grazing and some horse grazing by wandering individual animals. Most other areas on the

south side of the main feeder have been ungrazed for 20 years, apart from occasional wandering goats. The area at the northern end is largely ungrazed except for occasional wandering livestock. The main block on the north side of the main feeder has had extensive low density sheep grazing until 2006, when cattle were introduced for summer and autumn grazing. The remaining ditch habitats are unaffected by grazing.

C7.2.2 Proposed management prescription for site

The management requirements at Pollardstown Fen for *V. moulinsiana* are largely dependant on the ability of the habitat to be maintained by wetness alone. The ditch areas and their immediate surroundings do not need grazing, and animals tend to avoid these areas at wet times, but at very dry times the succulent wet ditch areas can prove very attractive to a group of grazers that could otherwise be more extensively distributed. The current levels of grazing in different management blocks is not causing any damage to the snail.

The best management for *V. moulinsiana* is by wetness, where water levels are wet enough to prevent succession of habitat. The species is best managed in areas that are completely free of grazing animals, as the vegetation needs to remain high and very wet during the climbing season (Spring to Autumn). Where grazing is needed for other purposes (e.g. for nearby *V. geyeri* habitats), the very vulnerable wet areas of *V. moulinsiana* habitat may need to be fenced off during dry periods.

The management prescription for 2010 – 2013 is therefore no introduction of further active grazing management for *V. moulinsiana,* but if the area needs grazing to be introduced for other purposes, its effects on *V. moulinsiana* should be monitored and temporary fencing introduced where necessary.

C8.0 REFERENCES

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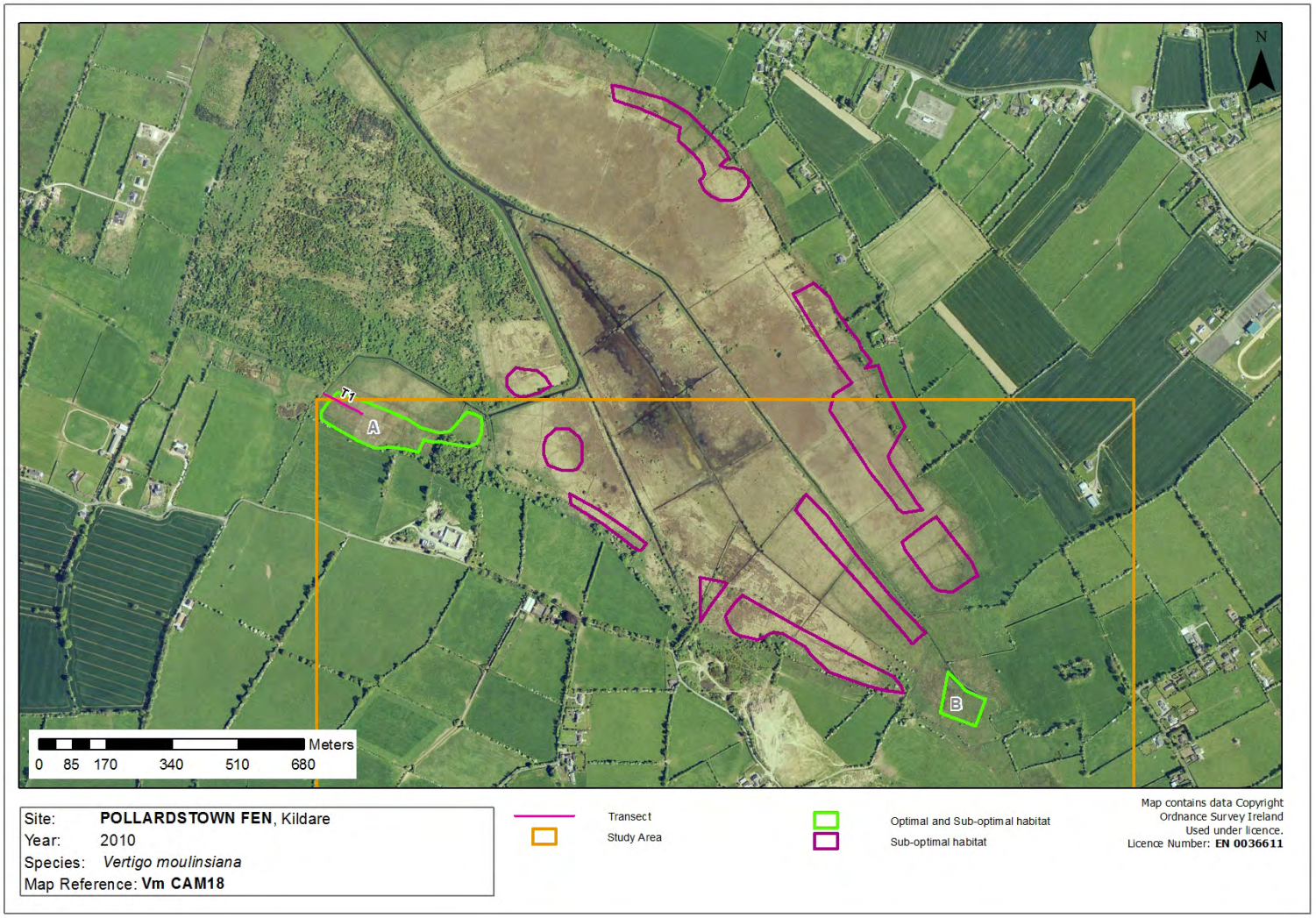

Figure C1: Map of Pollardstown Fen showing sample sites, transects and habitat polygons for *Vertigo moulinsiana*

APPENDIX C1: 2006 RESULTS & CONDITION ASSESSMENT

The site was surveyed on 2 November 2006

Sample Distance (m)	Vegetation	Veg Ht (m)	Ground Moisture	*Vertigo moulinsiana*		Suc/ Oxy	Cep	Others
				(ad)	(juv)			
5.4	Cxa, Ep, Pa	0.6	3	11	98	2	1	2 Trichia hispida
7	Pa, Cxa, Sol	2	4/5	16	150	2	5	
11	Jus, Cxa, Pa, Ma, Ag	1.7	4	15	260	4	1	
15	Jus, Cxa, Pa, Ma, Ag, Eq	0.5	4	7	95	9	2	
20	Pa, Cxa, Jus, Ma	0.5	4	32	400	7	3	1 Trichia hispida
30	Pa, Cxa, Jus, Ma	0.8	4	35	375		7	
40	Pa, Jus, Eq	0.6	4	14	39	1	1	
50	Pa, Jus, Eq, Cxa	0.5	3	5	49		1	
60	Pa, Jus, Eq, Cxa, Ma	0.4 sh	4	1	9			
70	Jus, Pa, Sch	0.5	4	0	4		2	
80	Sch, Jus, Pa, Cxa	0.5 sh	3	9	5		2	6 Asfordia granulata
90	Jus, Sch	0.5 sh	3	2	17		3	
100	Cxa, Pa, Eq, Ma	0.3	4	7	4			
110	Jus, Sch, Eq	0.5	4	6	29			

No quantitative data was obtained for site 1 in 2006 but it is likely that the Condition would still be assessed as Favourable.

C5.1 Population Assessment

Indicator	Target	Result	Pass/Fail
Presence/absence (Transect)	*V. moulinsiana* is present in 11 samples (or 75% of samples) on Transect 1	Present in 14 samples	Pass
Abundance (Transect)	At least 7 (50%) samples on Transect 1 should have >20 *V. moulinsiana* individuals	9 samples with >20 individuals	Pass
Presence/absence (Site level)	Adult or sub-adult snails are present in 6 of the 10 samples at site 1	Not sampled	?

3 passes Favourable (green); 2 passes Unfavourable Inadequate (amber); 0 to 1 passes Unfavourable Bad (red)

C5.2 Habitat for the Species Assessment

Indicator	Target	Result	Pass/Fail
Habitat Extent (Transect)	Over 75% of the samples on Transect 1 are dominated by suitable vegetation (Classes I & II)	100% of samples	Pass
Habitat Quality (Transect)	Over 75% of the samples on Transect 1 fall within soil moisture classes 3-5	100% of samples	Pass
Habitat Quality & Extent (Site level)	Over 80% of the samples at site 1 are dominated by suitable vegetation (Classes I & II) and fall within soil moisture classes 3-5	Not sampled	?

Appendix D: *Vertigo geyeri* condition assessment summary

Sites marked with * denote *V. geyeri* listed as a qualifying feature of the cSAC.

Code	SAC	Site	Date	Population	Habitat	Future Prospects	Overall
Vg CAM1*	00623 Ben Bulben, Gleniff and Glenade	Meenaphuil	2008				
Vg CAM2*	00623 Ben Bulben, Gleniff and Glenade	Tievebaun	2008				
Vg CAM3*	001922 Bellacorick Bog Complex	Brackloon	2008				
Vg CAM4*	00859 Clonaslee Eskers & Derry Bog	Clonaslee Esker	2008				
Vg CAM5*	001932 Mweelrea/Sheefry/Erriff Complex	Dooaghtry	2008				
Vg CAM6	Drimmon Lough – no designation	Drimmon Lough	2008				
Vg CAM7*	000633 Lough Hoe Bog	Lough Talt	2008				
Vg CAM8*	00197 West of Ardara/Maas Road	Sheskinmore	2008				
Vg CAM9*	001626 Annaghmore Lough	Annaghmore Lough	2009				
Vg CAM10*	001090 Ballyness Bay	Ballyness Bay	2009				
Vg CAM11	Carrowmoreknock – no designation	Carrowmoreknock	2009				
Vg CAM12*	001482 Clew Bay Complex	Rosmoney	2009				
Vg CAM13*	002006 Ox Mountains Bogs	Easkey valley	2009				
Vg CAM14*	00147 Horn Head and Ringclevan	Polaguil Bay	2009				
Vg CAM15	000412 Slieve Bloom Mountains	Silver River	2009				
Vg CAM16*	001922 Bellacorick Bog Complex	Bellacorrick -Fermoyle	2010				
Vg CAM17	Cooley Lough - No designation	Cooley Lough	2010				
Vg CAM18*	00576 Fin Lough (Offaly)	Fin Lough	2010				
Vg CAM19	001910 PNHA Mannin and Island Lakes	Island Lake	2010				
Vg CAM20*	002147 Lisduff Fen	Lisduff Fen	2010				
Vg CAM21*	002006 Ox Mountains Bogs	Ox Mountains	2010				
Vg CAM22*	00396 Pollardstown Fen	Pollardstown Fen	2010				

Appendix E: *Vertigo geyeri* condition assessment – habitat summary

				Area of habitat (hectares)			
Code	**SAC**	**Site**	**Date**	**Optimal**	**Optimal & Sub-optimal**	**Sub-optimal**	**Sub-optimal & Unsuitable**
Vg CAM1	00623 Ben Bulben, Gleniff and Glenade	Meenaphuil	2008		0.48		
Vg CAM2	00623 Ben Bulben, Gleniff and Glenade	Tievebaun	2008		13.43		
Vg CAM3	001922 Bellacorick Bog Complex	Brackloon	2008			0.62	
Vg CAM4	00859 Clonaslee Eskers & Derry Bog	Clonaslee Esker	2008			0.76	
Vg CAM5	001932 Mweelrea/Sheefry/Erriff Complex	Dooaghtry	2008		31.48		19.81
Vg CAM6	Drimmon Lough – no designation	Drimmon Lough	2008		1.42		
Vg CAM7	000633 Lough Hoe Bog	Lough Talt	2008		1.00	0.08	0.58
Vg CAM8	00197 West of Ardara/Maas Road	Sheskinmore	2008		2.46		
Vg CAM9	001626 Annaghmore Lough	Annaghmore Lough	2009		7.35	2.91	
Vg CAM10	001090 Ballyness Bay	Ballyness Bay	2009		0.47		0.29
Vg CAM11	Carrowmoreknock – no designation	Carrowmoreknock	2009				1.14
Vg CAM12	001482 Clew Bay Complex	Rosmoney	2009				0.98
Vg CAM13	002006 Ox Mountains Bogs	Easkey valley	2009		0.58	0.10	3.06
Vg CAM14	00147 Horn Head and Ringclevan	Polaguil Bay	2009	4.47			5.83
Vg CAM15	000412 Slieve Bloom Mountains	Silver River	2009	0.30			1.68
Vg CAM16	001922 Bellacorick Bog Complex	Bellacorrick -Fermoyle	2010		26.8		
Vg CAM17	Cooley Lough - No designation	Cooley Lough	2010			0.46	1.16
Vg CAM18	00576 Fin Lough (Offaly)	Fin Lough	2010	0.19	0.38	0.21	1.08
Vg CAM19	001910 PNHA Mannin and Island Lakes	Island Lake	2010				34.5
Vg CAM20	002147 Lisduff Fen	Lisduff Fen	2010		1.48		
Vg CAM21	002006 Ox Mountains Bogs	Ox Mountains	2010	0.34			
Vg CAM22	00396 Pollardstown Fen	Pollardstown Fen	2010			11.71	

Appendix F: *Vertigo geyeri* condition assessment – management summary

Site Code	Site	Habitat	Area	None	Sheep grazed	Cattle grazed	Horse grazed	Mixed grazed
Vg CAM1	Meenaphuil	Optimal						
Vg CAM1	Meenaphuil	Optimal & Sub-optimal	0.48		0.48			
Vg CAM1	Meenaphuil	Sub-optimal						
Vg CAM1	Meenaphuil	Sub-optimal & Unsuitable						
Vg CAM2	Tievebaun	Optimal						
Vg CAM2	Tievebaun	Optimal & Sub-optimal	13.43		13.43			
Vg CAM2	Tievebaun	Sub-optimal						
Vg CAM2	Tievebaun	Sub-optimal & Unsuitable						
Vg CAM3	Brackloon	Optimal						
Vg CAM3	Brackloon	Optimal & Sub-optimal						
Vg CAM3	Brackloon	Sub-optimal	0.62	0.62				
Vg CAM3	Brackloon	Sub-optimal & Unsuitable						
Vg CAM4	Clonaslee Esker	Optimal						
Vg CAM4	Clonaslee Esker	Optimal & Sub-optimal						
Vg CAM4	Clonaslee Esker	Sub-optimal	0.76	0.6		0.16		
Vg CAM4	Clonaslee Esker	Sub-optimal & Unsuitable						
Vg CAM5	Dooaghtry	Optimal						
Vg CAM5	Dooaghtry	Optimal & Sub-optimal	31.48		31.48			
Vg CAM5	Dooaghtry	Sub-optimal						
Vg CAM5	Dooaghtry	Sub-optimal & Unsuitable	19.81	10	9.81			
Vg CAM6	Drimmon Lough	Optimal						
Vg CAM6	Drimmon Lough	Optimal & Sub-optimal	1.42			1.42		

Site Code	Site	Habitat	Area	None	Sheep grazed	Cattle grazed	Horse grazed	Mixed grazed
Vg CAM6	Drimmon Lough	Sub-optimal						
Vg CAM6	Drimmon Lough	Sub-optimal & Unsuitable						
Vg CAM7	Lough Talt	Optimal						
Vg CAM7	Lough Talt	Optimal & Sub-optimal	1	1				
Vg CAM7	Lough Talt	Sub-optimal	0.08		0.08			
Vg CAM7	Lough Talt	Sub-optimal & Unsuitable	0.58	0.58				
Vg CAM8	Sheskinmore	Optimal						
Vg CAM8	Sheskinmore	Optimal & Sub-optimal	2.46			2.46		
Vg CAM8	Sheskinmore	Sub-optimal						
Vg CAM8	Sheskinmore	Sub-optimal & Unsuitable						
Vg CAM9	Annaghmore Lough	Optimal						
Vg CAM9	Annaghmore Lough	Optimal & Sub-optimal	7.35			2.5		4.85
Vg CAM9	Annaghmore Lough	Sub-optimal	2.91	2.91				
Vg CAM9	Annaghmore Lough	Sub-optimal & Unsuitable						
Vg CAM10	Ballyness Bay	Optimal						
Vg CAM10	Ballyness Bay	Optimal & Sub-optimal	0.47			0.47		
Vg CAM10	Ballyness Bay	Sub-optimal						
Vg CAM10	Ballyness Bay	Sub-optimal & Unsuitable	0.29	0.29				
Vg CAM11	Carrowmoreknock	Optimal						
Vg CAM11	Carrowmoreknock	Optimal & Sub-optimal						
Vg CAM11	Carrowmoreknock	Sub-optimal						
Vg CAM11	Carrowmoreknock	Sub-optimal & Unsuitable	1.14	0.57		0.57		
Vg CAM12	Rosmoney	Optimal						
Vg CAM12	Rosmoney	Optimal & Sub-optimal						
Vg CAM12	Rosmoney	Sub-optimal						

Site Code	Site	Habitat	Area	None	Sheep grazed	Cattle grazed	Horse grazed	Mixed grazed
Vg CAM12	Rosmoney	Sub-optimal & Unsuitable	0.98	0.98				
Vg CAM13	Easkey valley	Optimal						
Vg CAM13	Easkey valley	Optimal & Sub-optimal	0.58		0.58			
Vg CAM13	Easkey valley	Sub-optimal	0.1	0.1				
Vg CAM13	Easkey valley	Sub-optimal & Unsuitable	3.06		3.06			
Vg CAM14	Polaguil Bay	Optimal	4.47		4.47			
Vg CAM14	Polaguil Bay	Optimal & Sub-optimal						
Vg CAM14	Polaguil Bay	Sub-optimal						
Vg CAM14	Polaguil Bay	Sub-optimal & Unsuitable	5.83	5.83				
Vg CAM15	Silver River	Optimal	0.3	0.3				
Vg CAM15	Silver River	Optimal & Sub-optimal						
Vg CAM15	Silver River	Sub-optimal						
Vg CAM15	Silver River	Sub-optimal & Unsuitable	1.68			1.68		
Vg CAM16	Bellacorrick -Fermoyle	Optimal						
Vg CAM16	Bellacorrick -Fermoyle	Optimal & Sub-optimal	26.8	26.8				
Vg CAM16	Bellacorrick -Fermoyle	Sub-optimal						
Vg CAM16	Bellacorrick -Fermoyle	Sub-optimal & Unsuitable						
Vg CAM17	Cooley Lough	Optimal						
Vg CAM17	Cooley Lough	Optimal & Sub-optimal						
Vg CAM17	Cooley Lough	Sub-optimal	0.46	0.46				
Vg CAM17	Cooley Lough	Sub-optimal & Unsuitable	1.16	1.16				
Vg CAM18	Fin Lough	Optimal	0.19	0.19				
Vg CAM18	Fin Lough	Optimal & Sub-optimal	0.38	0.3		0.08		
Vg CAM18	Fin Lough	Sub-optimal	0.21	0.17		0.04		
Vg CAM18	Fin Lough	Sub-optimal & Unsuitable	1.08	0.72		0.36		

Site Code	Site	Habitat	Area	None	Sheep grazed	Cattle grazed	Horse grazed	Mixed grazed
Vg CAM19	Island Lake	Optimal						
Vg CAM19	Island Lake	Optimal & Sub-optimal						
Vg CAM19	Island Lake	Sub-optimal						
Vg CAM19	Island Lake	Sub-optimal & Unsuitable	34.5	27.82		6.68		
Vg CAM20	Lisduff Fen	Optimal						
Vg CAM20	Lisduff Fen	Optimal & Sub-optimal	1.48					1.48
Vg CAM20	Lisduff Fen	Sub-optimal						
Vg CAM20	Lisduff Fen	Sub-optimal & Unsuitable						
Vg CAM21	Ox Mountains	Optimal	0.34		0.34			
Vg CAM21	Ox Mountains	Optimal & Sub-optimal						
Vg CAM21	Ox Mountains	Sub-optimal						
Vg CAM21	Ox Mountains	Sub-optimal & Unsuitable						
Vg CAM22	Pollardstown Fen	Optimal						
Vg CAM22	Pollardstown Fen	Optimal & Sub-optimal						
Vg CAM22	Pollardstown Fen	Sub-optimal	11.71	4.71		7		
Vg CAM22	Pollardstown Fen	Sub-optimal & Unsuitable						

Appendix G: *Vertigo angustior* condition assessment summary

Sites marked with * denote *V. angustior* listed as a qualifying feature of the cSAC.

Code	SAC	Site	Date	Population	Habitat	Future Prospects	Overall
Va CAM1	002165 Lower River Shannon	Beal Point	2008				
Va CAM2*	002158 Kenmare River	Derrynane	2008				
Va CAM3	001932 Mweelrea/Sheefry/Erriff Complex	Dooaghtry	2008				
Va CAM4*	000190 Slieve Tooey/Tormore Island/ Loughros	Glencolmcille	2008				
Va CAM5	02070 Tralee Bay & Maharees Peninsula, W to Cloghane	Kilshannig	2008				
Va CAM6*	001975 Ballyhoorisky Point to Fanad Head	Kinlackagh Bay	2008				
Va CAM7	02070 Tralee Bay & Maharees Peninsula, W to Cloghane	Maharees	2008				
Va CAM8	001257 Dog's Bay	Dog's Bay	2009				
Va CAM9	000020 Black Head-Poulsallagh Complex	Fanore	2009				
Va CAM10*	00458 Killala Bay / Moy Estuary	Killanley Glebe	2009				
Va CAM11	000036 Inagh River Estuary (small part)	Lehinch	2009				
Va CAM12*	002012 North Inishowen Coast	Malin Dunes	2009				
Va CAM13*	00396 Pollardstown Fen	Pollardstown Fen	2009				
Va CAM14*	001680 Streedagh Point Dunes	Streedagh	2009				
Va CAM15	001482 Clew Bay Complex	Bartraw	2010				
Va CAM16*	00213 Inishmore Island	Cill Mhuirbhigh & airport	2010				
Va CAM17	000174 Curraghchase Woods (some within boundary of)	Curragh Chase	2010				
Va CAM18*	001007 White Strand / Carrowmore Marsh	Doonbeg	2010				
Va CAM19*	000398 Rye Water Valley/Carton	Louisa Bridge	2010				
Va CAM20*	00622 Ballysadare Bay	Ballysadare	2010				
Va CAM21*	00627 Cummeen Strand / Drumcliff Bay	Strandhill Airport	2010				

Appendix H: *Vertigo angustior* condition assessment – habitat summary

				Area of habitat (hectares)			
Code	**SAC**	**Site**	**Date**	**Optimal**	**Optimal & Sub-optimal**	**Sub-optimal**	**Sub-optimal & Unsuitable**
Va CAM1	002165 Lower River Shannon	Beal Point	2008		21.09		10.14
Va CAM2	002158 Kenmare River	Derrynane	2008			1.94	
Va CAM3	001932 Mweelrea/Sheefry/Erriff Complex	Dooaghtry	2008	0.23		0.44	
Va CAM4	000190 Slieve Tooey/Tormore Island/ Loughros	Glencolmcille	2008			7.16	
Va CAM5	02070 Tralee Bay & Maharees Peninsula,	Kilshannig	2008		24.23		21.83
Va CAM6	001975 Ballyhoorisky Point to Fanad Head	Kinlackagh Bay	2008			17.93	
Va CAM7	02070 Tralee Bay & Maharees Peninsula,	Maharees	2008		31.47	20.26	170.4
Va CAM8	001257 Dog's Bay	Dog's Bay	2009	0.04			5.95
Va CAM9	000020 Black Head-Poulsallagh Complex	Fanore	2009			10.13	23.99
Va CAM10	00458 Killala Bay / Moy Estuary	Killanley Glebe	2009		1.46		
Va CAM11	000036 Inagh River Estuary (small part)	Lehinch	2009		19.80		24.03
Va CAM12	002012 North Inishowen Coast	Malin Dunes	2009		31.72		21.35
Va CAM13	00396 Pollardstown Fen	Pollardstown Fen	2009			2.32	
Va CAM14	001680 Streedagh Point Dunes	Streedagh	2009		34.54	45.64	25.51
Va CAM15	001482 Clew Bay Complex	Bartraw	2010		8.81		0.83
Va CAM16	00213 Inishmore Island	Cill Mhuirbhigh & airport	2010		16.93	2.43	
Va CAM17	000174 Curraghchase Woods	Curragh Chase	2010		3.19		
Va CAM18	001007 White Strand / Carrowmore Marsh	Doonbeg	2010		66.39		
Va CAM19	000398 Rye Water Valley/Carton	Louisa Bridge	2010				0.61
Va CAM20	00622 Ballysadare Bay	Ballysadare	2010	38.99	15.42		38.45
Va CAM21	00627 Cummeen Strand / Drumcliff Bay	Strandhill Airport	2010	13.73		12.58	9.45

Appendix I: *Vertigo angustior* condition assessment – management summary

Site Code	Site	Habitat	Area	None	Sheep grazed	Cattle grazed	Horse grazed	Mixed grazed	Golf	caravans
Va CAM1	Beal Point	Optimal								
Va CAM1	Beal Point	Optimal & Sub-optimal	21.09	21.09						
Va CAM1	Beal Point	Sub-optimal								
Va CAM1	Beal Point	Sub-optimal & Unsuitable	10.14	10.14						
Va CAM2	Derrynane	Optimal								
Va CAM2	Derrynane	Optimal & Sub-optimal								
Va CAM2	Derrynane	Sub-optimal	1.94	1.94						
Va CAM2	Derrynane	Sub-optimal & Unsuitable								
Va CAM3	Dooaghtry	Optimal	0.23			0.23				
Va CAM3	Dooaghtry	Optimal & Sub-optimal								
Va CAM3	Dooaghtry	Sub-optimal	0.44			0.67				
Va CAM3	Dooaghtry	Sub-optimal & Unsuitable								
Va CAM4	Glencolmcille	Optimal								
Va CAM4	Glencolmcille	Optimal & Sub-optimal								
Va CAM4	Glencolmcille	Sub-optimal	7.16					7.16		
Va CAM4	Glencolmcille	Sub-optimal & Unsuitable								
Va CAM5	Kilshannig	Optimal								
Va CAM5	Kilshannig	Optimal & Sub-optimal	24.23			24.23				
Va CAM5	Kilshannig	Sub-optimal								
Va CAM5	Kilshannig	Sub-optimal & Unsuitable	21.83			21.83				
Va CAM6	Kinlackagh Bay	Optimal								

Site Code	Site	Habitat	Area	None	Sheep grazed	Cattle grazed	Horse grazed	Mixed grazed	Golf	caravans
Va CAM6	Kinlackagh Bay	Optimal & Sub-optimal								
Va CAM6	Kinlackagh Bay	Sub-optimal	17.93	1.5		16.43				
Va CAM6	Kinlackagh Bay	Sub-optimal & Unsuitable								
Va CAM7	Maharees	Optimal								
Va CAM7	Maharees	Optimal & Sub-optimal	31.47			31.47				
Va CAM7	Maharees	Sub-optimal	20.26						20.26	
Va CAM7	Maharees	Sub-optimal & Unsuitable	170	24		146				
Va CAM8	Dog's Bay	Optimal	0.04	0.04						
Va CAM8	Dog's Bay	Optimal & Sub-optimal								
Va CAM8	Dog's Bay	Sub-optimal								
Va CAM8	Dog's Bay	Sub-optimal & Unsuitable	5.95		5.95					
Va CAM9	Fanore	Optimal								
Va CAM9	Fanore	Optimal & Sub-optimal								
Va CAM9	Fanore	Sub-optimal	10.13			10.13				
Va CAM9	Fanore	Sub-optimal & Unsuitable	23.99			8				16
Va CAM10	Killanley Glebe	Optimal								
Va CAM10	Killanley Glebe	Optimal & Sub-optimal	1.46			1.46				
Va CAM10	Killanley Glebe	Sub-optimal								
Va CAM10	Killanley Glebe	Sub-optimal & Unsuitable								
Va CAM11	Lehinch	Optimal								
Va CAM11	Lehinch	Optimal & Sub-optimal	19.8						19.8	
Va CAM11	Lehinch	Sub-optimal								
Va CAM11	Lehinch	Sub-optimal & Unsuitable	24.03						24.03	
Va CAM12	Malin Dunes	Optimal								
Va CAM12	Malin Dunes	Optimal & Sub-optimal	31.72	31.72						

Site Code	Site	Habitat	Area	None	Sheep grazed	Cattle grazed	Horse grazed	Mixed grazed	Golf	caravans
Va CAM12	Malin Dunes	Sub-optimal								
Va CAM12	Malin Dunes	Sub-optimal & Unsuitable	21.35	21.35						
Va CAM13	Pollardstown Fen	Optimal								
Va CAM13	Pollardstown Fen	Optimal & Sub-optimal								
Va CAM13	Pollardstown Fen	Sub-optimal	2.32	0.62		1.7				
Va CAM13	Pollardstown Fen	Sub-optimal & Unsuitable								
Va CAM14	Streedagh	Optimal								
Va CAM14	Streedagh	Optimal & Sub-optimal	34.54			34.54				
Va CAM14	Streedagh	Sub-optimal	45.64			45.64				
Va CAM14	Streedagh	Sub-optimal & Unsuitable	25.51	25.51						
Va CAM15	Bartraw	Optimal								
Va CAM15	Bartraw	Optimal & Sub-optimal	8.81	8.81						
Va CAM15	Bartraw	Sub-optimal								
Va CAM15	Bartraw	Sub-optimal & Unsuitable	0.83	0.83						
Va CAM16	Inishmore	Optimal								
Va CAM16	Inishmore	Optimal & Sub-optimal	16.93			16.93				
Va CAM16	Inishmore	Sub-optimal	2.43	2.43						
Va CAM16	Inishmore	Sub-optimal & Unsuitable								
Va CAM17	Curragh Chase	Optimal								
Va CAM17	Curragh Chase	Optimal & Sub-optimal	3.19			3.19				
Va CAM17	Curragh Chase	Sub-optimal								
Va CAM17	Curragh Chase	Sub-optimal & Unsuitable								
Va CAM18	Doonbeg	Optimal								
Va CAM18	Doonbeg	Optimal & Sub-optimal	66.39			9			2.6	

Site Code	Site	Habitat	Area	None	Sheep grazed	Cattle grazed	Horse grazed	Mixed grazed	Golf	caravans
Va CAM18	Doonbeg	Sub-optimal								
Va CAM18	Doonbeg	Sub-optimal & Unsuitable								
Va CAM19	Louisa Bridge	Optimal								
Va CAM19	Louisa Bridge	Optimal & Sub-optimal								
Va CAM19	Louisa Bridge	Sub-optimal								
Va CAM19	Louisa Bridge	Sub-optimal & Unsuitable	0.61	0.61						
Va CAM20	Ballysadare	Optimal	38.99	38.99						
Va CAM20	Ballysadare	Optimal & Sub-optimal	15.42	15.42						
Va CAM20	Ballysadare	Sub-optimal								
Va CAM20	Ballysadare	Sub-optimal & Unsuitable	38.45						38.45	
Va CAM21	Strandhill Airport	Optimal	13.73	13.73						
Va CAM21	Strandhill Airport	Optimal & Sub-optimal								
Va CAM21	Strandhill Airport	Sub-optimal	12.58	12.58						
Va CAM21	Strandhill Airport	Sub-optimal & Unsuitable	9.45	9.45						

Appendix J: *Vertigo moulinsiana* condition assessment summary

Sites marked with * denote *V. moulinsiana* listed as a qualifying feature of the cSAC.

Code	SAC	Site	Date	Population	Habitat	Future Prospects	Overall
Vm CAM1*	002162 River Barrow & River Nore	Borris	2008				
Vm CAM2	00576 Fin Lough (Offaly)	Fin Lough	2008				
Vm CAM3	Slight overlap with SAC 000688	Lough Owell	2008				
Vm CAM4*	002141 Mountmellick	Mountmellick	2008				
Vm CAM5*	000398 Rye Water Valley/Carton	Louisa Bridge	2008				
Vm CAM6	No designation	Ballybeg Lake	2009				
Vm CAM7	001926 East Burren Complex	Mullaghmore	2009				
Vm CAM8	No designation	Cappankelly	2009				
Vm CAM9	No designation	Waterstown Lough	2009				
Vm CAM10*	000391 Ballynafagh Bog	Ballynafagh	2010				
Vm CAM11*	000571 Charleville Wood	Charleville Wood	2010				
Vm CAM12	000174 Curraghchase Woods (some within boundary of)	Curragh Chase	2010				
Vm CAM13	No designation	Dromkeen Bridge	2010				
Vm CAM14	No designation	Kildallan Br	2010				
Vm CAM15*	00869 Lisbigney Bog	Lisbigney Bog	2010				
Vm CAM16	002147 Lisduff Fen	Lisduff Fen	2010				
Vm CAM17	002249 The Murrough Wetlands	Murrough	2010				
Vm CAM18*	00396 Pollardstown Fen	Pollardstown Fen	2010				
Vm CAM19	002241 Lough Derg north east shore	Portumna	2010				
Vm CAM20	Cloondara to Kilashee – no designation	Royal Canal	2010				

Appendix K: *Vertigo moulinsiana* condition assessment – habitat summary

				Area of habitat (hectares)			
Code	**SAC**	**Site**	**Date**	**Optimal**	**Optimal & Sub-optimal**	**Sub-optimal**	**Sub-optimal & Unsuitable**
Vm CAM1	002162 River Barrow & River Nore	Borris	2008			1.13	
Vm CAM2	00576 Fin Lough (Offaly)	Fin Lough	2008		16.55		
Vm CAM3	Slight overlap with SAC 000688	Lough Owell	2008		21.54		
Vm CAM4	002141 Mountmellick	Mountmellick	2008	1.49			
Vm CAM5	000398 Rye Water Valley/Carton	Louisa Bridge	2008		0.20		0.47
Vm CAM6	No designation	Ballybeg Lake	2009		1.87		5.50
Vm CAM7	001926 East Burren Complex	Mullaghmore	2009	0	0	0	0
Vm CAM8	No designation	Cappankelly	2009	0.19	0.22		
Vm CAM9	No designation	Waterstown Lough	2009		13.82		
Vm CAM10	000391 Ballynafagh Bog	Ballynafagh	2010	0.73	1.06	10.62	
Vm CAM11	000571 Charleville Wood	Charleville Wood	2010		6.2		
Vm CAM12	000174 Curraghchase Woods	Curragh Chase	2010			2.07	
Vm CAM13	No designation	Dromkeen Bridge	2010	0	0	0	0
Vm CAM14	Non-SAC - 002103 Royal Canal pNHA	Kildallan Br	2010	0.5			
Vm CAM15	00869 Lisbigney Bog	Lisbigney Bog	2010	0	0	0	0
Vm CAM16	002147 Lisduff Fen	Lisduff Fen	2010		1.48		
Vm CAM17	002249 The Murrough Wetlands	Murrough	2010			6.36	3.07
Vm CAM18	00396 Pollardstown Fen	Pollardstown Fen	2010		3.85	17.43	
Vm CAM19	002241 Lough Derg north east shore	Portumna	2010		0.71	2.09	
Vm CAM20	Non-SAC - 002103 Royal Canal pNHA	Royal Canal	2010	0	0	0	0

Appendix L: *Vertigo moulinsiana* condition assessment – management summary

Site Code	Site	Habitat	Area	None	Sheep grazed	Cattle grazed	Horse grazed	Mixed grazed
Vm CAM1	Borris	Optimal						
Vm CAM1	Borris	Optimal & Sub-optimal						
Vm CAM1	Borris	Sub-optimal	1.13	1.13				
Vm CAM1	Borris	Sub-optimal & Unsuitable						
Vm CAM2	Fin Lough	Optimal						
Vm CAM2	Fin Lough	Optimal & Sub-optimal	16.55	16.55				
Vm CAM2	Fin Lough	Sub-optimal						
Vm CAM2	Fin Lough	Sub-optimal & Unsuitable						
Vm CAM3	Lough Owell	Optimal						
Vm CAM3	Lough Owell	Optimal & Sub-optimal	21.54					19.6
Vm CAM3	Lough Owell	Sub-optimal						
Vm CAM3	Lough Owell	Sub-optimal & Unsuitable						
Vm CAM4	Mountmellick	Optimal	1.49	1.49				
Vm CAM4	Mountmellick	Optimal & Sub-optimal						
Vm CAM4	Mountmellick	Sub-optimal						
Vm CAM4	Mountmellick	Sub-optimal & Unsuitable						
Vm CAM5	Louisa Bridge	Optimal						
Vm CAM5	Louisa Bridge	Optimal & Sub-optimal	0.2	0.2				
Vm CAM5	Louisa Bridge	Sub-optimal						
Vm CAM5	Louisa Bridge	Sub-optimal & Unsuitable	0.47	0.47				
Vm CAM6	Ballybeg Lake	Optimal						
Vm CAM6	Ballybeg Lake	Optimal & Sub-optimal	1.87			1.87		
Vm CAM6	Ballybeg Lake	Sub-optimal						

Site Code	Site	Habitat	Area	None	Sheep grazed	Cattle grazed	Horse grazed	Mixed grazed
Vm CAM6	Ballybeg Lake	Sub-optimal & Unsuitable	5.5			5.5		
Vm CAM7	Mullaghmore	Optimal	0					
Vm CAM7	Mullaghmore	Optimal & Sub-optimal	0					
Vm CAM7	Mullaghmore	Sub-optimal	0					
Vm CAM7	Mullaghmore	Sub-optimal & Unsuitable	0					
Vm CAM8	Cappankelly	Optimal	0.19	0.19				
Vm CAM8	Cappankelly	Optimal & Sub-optimal	0.22	0.22				
Vm CAM8	Cappankelly	Sub-optimal						
Vm CAM8	Cappankelly	Sub-optimal & Unsuitable						
Vm CAM9	Waterstown Lough	Optimal						
Vm CAM9	Waterstown Lough	Optimal & Sub-optimal	13.82	12.82		1		
Vm CAM9	Waterstown Lough	Sub-optimal						
Vm CAM9	Waterstown Lough	Sub-optimal & Unsuitable						
Vm CAM10	Ballynafagh	Optimal	0.73	0.73				
Vm CAM10	Ballynafagh	Optimal & Sub-optimal	1.06	1.06				
Vm CAM10	Ballynafagh	Sub-optimal	10.62	10.21		0.41		
Vm CAM10	Ballynafagh	Sub-optimal & Unsuitable						
Vm CAM11	Charleville Wood	Optimal						
Vm CAM11	Charleville Wood	Optimal & Sub-optimal	6.2	6.2				
Vm CAM11	Charleville Wood	Sub-optimal						
Vm CAM11	Charleville Wood	Sub-optimal & Unsuitable						
Vm CAM12	Curragh Chase	Optimal						
Vm CAM12	Curragh Chase	Optimal & Sub-optimal						
Vm CAM12	Curragh Chase	Sub-optimal	2.07	1.37		0.7		
Vm CAM12	Curragh Chase	Sub-optimal & Unsuitable						

Site Code	Site	Habitat	Area	None	Sheep grazed	Cattle grazed	Horse grazed	Mixed grazed
Vm CAM13	Dromkeen Bridge	Optimal	0					
Vm CAM13	Dromkeen Bridge	Optimal & Sub-optimal	0					
Vm CAM13	Dromkeen Bridge	Sub-optimal	0					
Vm CAM13	Dromkeen Bridge	Sub-optimal & Unsuitable	0					
Vm CAM14	Kildallan Br	Optimal	0.5	0.5				
Vm CAM14	Kildallan Br	Optimal & Sub-optimal						
Vm CAM14	Kildallan Br	Sub-optimal						
Vm CAM14	Kildallan Br	Sub-optimal & Unsuitable						
Vm CAM15	Lisbigney Bog	Optimal	0					
Vm CAM15	Lisbigney Bog	Optimal & Sub-optimal	0					
Vm CAM15	Lisbigney Bog	Sub-optimal	0					
Vm CAM15	Lisbigney Bog	Sub-optimal & Unsuitable	0					
Vm CAM16	Lisduff Fen	Optimal						
Vm CAM16	Lisduff Fen	Optimal & Sub-optimal	1.48					1.48
Vm CAM16	Lisduff Fen	Sub-optimal						
Vm CAM16	Lisduff Fen	Sub-optimal & Unsuitable						
Vm CAM17	Murrough	Optimal						
Vm CAM17	Murrough	Optimal & Sub-optimal						
Vm CAM17	Murrough	Sub-optimal	6.36			6.36		
Vm CAM17	Murrough	Sub-optimal & Unsuitable	3.07				3.07	
Vm CAM18	Pollardstown Fen	Optimal						
Vm CAM18	Pollardstown Fen	Optimal & Sub-optimal	3.85	3.85				
Vm CAM18	Pollardstown Fen	Sub-optimal	17.43	17.43				
Vm CAM18	Pollardstown Fen	Sub-optimal & Unsuitable						
Vm CAM19	Portumna	Optimal						
Vm CAM19	Portumna	Optimal & Sub-optimal	0.71	0.71				

Site Code	Site	Habitat	Area	None	Sheep grazed	Cattle grazed	Horse grazed	Mixed grazed
Vm CAM19	Portumna	Sub-optimal	2.09	2.09				
Vm CAM19	Portumna	Sub-optimal & Unsuitable						
Vm CAM20	Royal Canal	Optimal	0					
Vm CAM20	Royal Canal	Optimal & Sub-optimal	0					
Vm CAM20	Royal Canal	Sub-optimal	0					
Vm CAM20	Royal Canal	Sub-optimal & Unsuitable	0					