



**Mollusc report on the Little Ouse  
Headwater Project sites, Suffolk and  
Norfolk**

**21<sup>st</sup> – 22<sup>nd</sup> September 2010  
and  
14<sup>th</sup> - 15<sup>th</sup> October 2012**

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## Executive summary

The seven Little Ouse Headwater Project sites surveyed for this report showed that there were 39 species of mollusc present across the sites. This included two Red Data Book (RDB) species.

*Vertigo moulinsiana* **RDB3**; was found in one sample in Betty's Fen in 2010 and in three samples in 2012. Four additional samples were taken within one of these sampling sites (BF6) in 2012, indicating that the population has expanded within the last two years, with up 97 animals in a sample which equates to a possible 900 animals in a single square metre over an area of 100 metres<sup>2</sup>. *Vertigo moulinsiana* can be found at densities of up to 5000 per metres<sup>2</sup> (Abrehart – Quoisley Mere, Cheshire 2012).

The main reasons for original low numbers of *Vertigo moulinsiana* at Betty's Fen (2010) is likely to include a reduction in ground moisture levels and possibly the flooding from the Little Ouse River adding eutrophic waters to the site. This increased eutrophication will change the nutrient loading across the site affecting vegetation stands and the delicate micro-environment required for *Vertigo moulinsiana*. In 2012 the ground moisture level, though still relatively dry, was showing an increase in moisture from two years earlier. This will have greatly aided the start of the recovery for *Vertigo moulinsiana*. Moisture levels are critical to this species where they are able to increase rapidly when conditions are suitable. The majority of the animals found were juveniles indicating a rapid breeding in the summer of 2012. This demonstrates the importance of higher water levels across this site.

The Little Ouse River population of *Vertigo moulinsiana* may have suffered in the past due to a decrease in river water quality leading to eutrophication and changes in nutrient status of marginal vegetation. Though the water quality has improved since 2008 the status of *Vertigo moulinsiana* has not, and none were found along the river margins. *Vertigo moulinsiana* was known from the Little Ouse River vegetation in 2008 (Abrehart) and was not re-found during this survey.

*Vertigo angustior* **RDB1**; was found in five sample sites taken from The Lows in 2010 and in four sample sites in 2012 at reduced numbers in the most favourable conditions. Increased levels of grazing in this marsh were having an impact on this species.

These surveys have shown that this newly discovered site holds a healthy population of *Vertigo angustior* at Blo' Norton's, The Lows.

In 2010 a maximum number of 153 *Vertigo angustior* was found in a single sample. The overall site size was large with approximately 2155m<sup>2</sup> of marsh holding a low density (under 10 animals per m<sup>2</sup>) and 1000m<sup>2</sup> holding a higher density population (11-400 per m<sup>2</sup>), within this latter area a core of 377m<sup>2</sup>, held a high density population of approximately 3000 per square metre (2010). The 2010 survey did not cover the site as thoroughly as in 2012, where transects were established. The area that held *Vertigo angustior* in 2010 was likely to have been much larger than was found at the time of the initial search.

In 2012 the area holding *Vertigo angustior* was approximately 4294m<sup>2</sup> of marsh at a low density and 900m<sup>2</sup> holding a higher density population, within this latter area is a core of 380m<sup>2</sup>, holding a

population of approximately 450 per square metre. Here the density is reduced from a much higher previous level, this is an indication of the habitat being degraded with a possibility of the site losing this species if continued regimes are maintained. It is very important to have a mixture of habitats that can be used for this species, where reducing the connected tussocky nature of the site will have a detrimental effect on this population.

The population estimate in 2010 was 1.3 million animals, in 2012 there were approximately 213,000 animals, this is a reduction of nearly 84% in two years. Though there are variations in population density within sites, this is a considerable change in a site compared to others in a comparable time scale.

In 2012 the survey has shown that the site still held a fairly healthy population of *Vertigo angustior* though the density of animals is greatly reduced from 2010. Changes in grazing have subtly changed the habitat which may have had an effect on the population.

In 2010 there were large areas of fairly un-compacted ground with a loose grassland sward; this habitat held the important damp micro-climate that is very important for *Vertigo angustior*. The areas holding the highest populations were the areas of least disturbance on the site.

In 2012 the entire site has been grazed, with a low density of cattle. This appears to have decreased the density of the population, though allowed *Vertigo angustior* to inhabit more of the site, though only in the one field at the moment. Transects were established in 2012 so to enable monitoring of the population changes at The Lows.

#### Management:

##### *Vertigo angustior*:

The current grazing on the site is the maximum that should be carried out. With monitoring, this regime may be guided better. Maintaining the damp grassland is ideal for this site with occasional flooding, the raised tussocks hold the greatest complex of habitat for this species and should not be mown.

##### *Vertigo moulinsiana*:

The main management tool for *Vertigo moulinsiana* at Betty's Fen is to maintain as high a water level as possible on the site without completely flooding it, a water level where the water rises around your feet is a good basic level to establish across is much of the sedge habitats of the site. There should be limited cutting of the sedge beds, the willow scrub in the area of the main population should not be allowed to increase across more of the site. This reduces the open character of the sedge beds and will reduce the vegetation density, which is very important for this species.

#### Monitoring:

Both the sites will need to be monitored annually to establish population growth or reductions, especially the *Vertigo angustior* population at The Lows. The establishment of three more transects (across the last two fields) should be considered.

## 1. Background and objectives

This work was carried out as part of the LOHP's biodiversity survey programmes in 2010 and 2012. It was funded by Biffaward and the HB Allen Charitable Trust. The seven sites (figure 1a)

This survey was carried out from 21<sup>st</sup> September 2010 and 14<sup>th</sup> October 2012:

- to survey the seven sites for RDB molluscs concentrating on the most suitable habitats;
- to identify RDB species present at the sites;
- to take samples from seven sites;
- to identify and map the rich mollusc habitats; and
- to advise on improving sites for RDB species found.

## 2. General methodology

### 2.1 Molluscs

The sampling strategy and recording procedures were designed to provide baseline information on the distribution of all molluscs on each site. Each sampling station across the site was selected to make sure the extent of the population could be determined.

At most of the sites the method of vigorously shaking the vegetation over a large white tray and beating the animals out of the vegetation or litter was undertaken. This was then inspected in the field for all species of mollusc, this then indicated as to whether more detailed samples should be taken.

At suitable RDB mollusc habitats the vegetation within a 20cm x 20cm quadrat was cut to ground level with a sharp serrated knife, placing all the material carefully into sealable plastic bags.

All the samples were dried in the laboratory and hand-picked for the larger species, the rest of the frass was passed through a stack of sieves, with differential sieving at 5mm, 1mm and then 0.5mm to refine the samples. The residue was examined with the use of X10 powered binocular microscope and all molluscs picked out were identified counted and stored. All specimens are stored in the Abrehart Collection Numbered - TRA 2010.222.1-6. and TRA 2012.132.3-4.

### 2.2 Botanical methodology

Vegetation composition was desirably a uniform stand of vegetation around the mollusc sample sites. Here, frequency determinations were made for the transect data recording sites on a compartment basis.

In this survey, the emphasis was on covering the area immediately around the mollusc sample sites and detecting as many of the species as possible. At each site chosen by the surveyor for detailed mollusc searches an NVC assessment of the habitat was made, this was assessed by the surveyor at the time of the survey through experience of the habitats.

Each area had estimates of vegetation cover:

D – Dominant (over 70% cover)

A – Abundant (70-50% cover)

C – Common (50–30 % cover)

- F – Frequent (10-30% cover)
- O – Occasional (3-10% cover)
- R – Rare (less than 3% cover)

The exact mid-point to a survey area was determined by GPS co-ordinates by ten figure grid references.

### 3. Results

#### 3.1 Parker's Piece and Bleyswyck's Bank

##### 3.1.1 Site description

Bleyswycks Bank and Parkers Piece were purchased by the LOHP in autumn 2007 and named after their former owners. The 5.3ha of land is managed for wildlife by the Little Ouse Headwaters Project. There were over 500m of river-front and a former tree nursery on Bleyswycks Bank that has now been removed. When the LOHP bought the site it was so deeply shaded by rows of scots pine and other species that even stinging nettles struggled to survive. On Parkers Piece the lowering of the land surface by removal of degraded and rotted surface peat was completed in March 2009. Parkers Piece is centred at TM 012790 with Bleyswycks Bank at TM 014789.

The vegetation on the site is starting to re-establish after the necessary removal of degraded and rotted surface peat, this has rejuvenated the land. With the work having recently been carried out the vegetation is new and as such has not yet had sufficient time to generate a rich mollusc fauna. This base line look over of these sites is important to be able to establish an idea of how the site develops over the coming years. It is possible that nearby Thelnetham Fen may provide a source for populating this site, though this site has suffered from the past few dry years. *Vertigo moulinsiana* was not located despite extensive searches in 2011 (Abrehart).

The vegetation establishing at Parkers Piece has a matrix of S4 reed-bed around the new scrape. The scrape has an establishing aquatic *Charophyte* flora and the lowered fen is establishing an M22 *Juncus subnodulosus* – *Cirsium palustre* fen meadow with some developing M24 *Cirsio* – *Molinietum caerulea* fen meadow within this fen area.

Bleyswycks Bank was cleared of a tree nursery at the end of February 2008 where only some native species were left behind. The land was cleared of stumps, much of it scraped to a depth of 20cm, and allowed to recolonize with fen species again. At the time of the survey the land was being grazed by Norfolk Sheep and very dry.

Along the river margin there were S4 *Phragmites australis* swamp and reed-beds, S5 *Glyceria maxima* swamp, with some S6 *Carex riparia* swamp with MG1b *Arrhenatherum elatius*, *Urtica dioica* sub-community along the banks of the river.

##### 3.1.2 Results

The land at Parkers Piece was species poor for molluscs with only 20 species found in 2010. The river margin held 8 species of mollusc and Bleyswycks Bank held 1 species of mollusc. None of the land had been established for long enough for any RDB species to have re-colonised. These sites held a poor selection of molluscs in general but with continued management and increased water levels these sites will develop a rich flora and establish a litter layer that is so important to

maintaining a level of moisture in the micro-climates needed for molluscs to inhabit a site. The lack of a litter layer denies molluscs of somewhere to move to in warm dry periods such as this year (2010). These sites will benefit from having Thelnetham fen nearby from where some of the more unusual mollusc species (*Vertigo moulinsiana*) will naturally move from into newly established healthy systems. Five aquatic sweeps were taken from around the new pool in Parker's Piece with only two molluscs found; both were old *Planorbis carinatus*. Sweeps from the river produced a small number of molluscs with four species being found, none were of conservation concern. In 2008 *Vertigo moulinsiana* was found during a survey of Suffolk (Abrehart Ecology 2008) within this section of the river.

In 2012 the sites all held a very similar matrix of species though generally at lower numbers than in 2010. This can often happen across sites over a period of time, the important factor here is that the number of species was relatively similar across the survey period.

The Little Ouse River still did not hold any *Vertigo moulinsiana* and may currently be lost from this habitat. There has been a large scale decrease in the riverine populations of *Vertigo moulinsiana* across large areas of the UK, with it nearly disappearing from the Black Borne river and the lower reaches of the Little Ouse in Suffolk. This may be due to the recent dry periods, though so little regular surveying is carried out it will be difficult to demonstrate any causes currently.





Figure 1a – An overview map of the Little Ouse Headwater Project (LOHP) sites surveyed.  
 (Aerial image copyright Google Earth; for illustrative purposes only)



Figure 1b - Map of Betty's Fen, showing location of the sample sites assessed during the ecological survey undertaken by Abrehart Ecology on 21<sup>st</sup> September 2010. Red outlined area indicates lands most suitable for *Vertigo moulinsiana*.  
(Aerial image copyright Google Earth; for illustrative purposes only)



Figure 1c - Map of Betty's Fen, showing location of the sample sites assessed during the ecological survey undertaken by Abrehart Ecology on 12<sup>th</sup> October 2012. Red outlined area indicates lands most suitable for *Vertigo moulinsiana*.  
 (Aerial image copyright Google Earth; for illustrative purposes only)

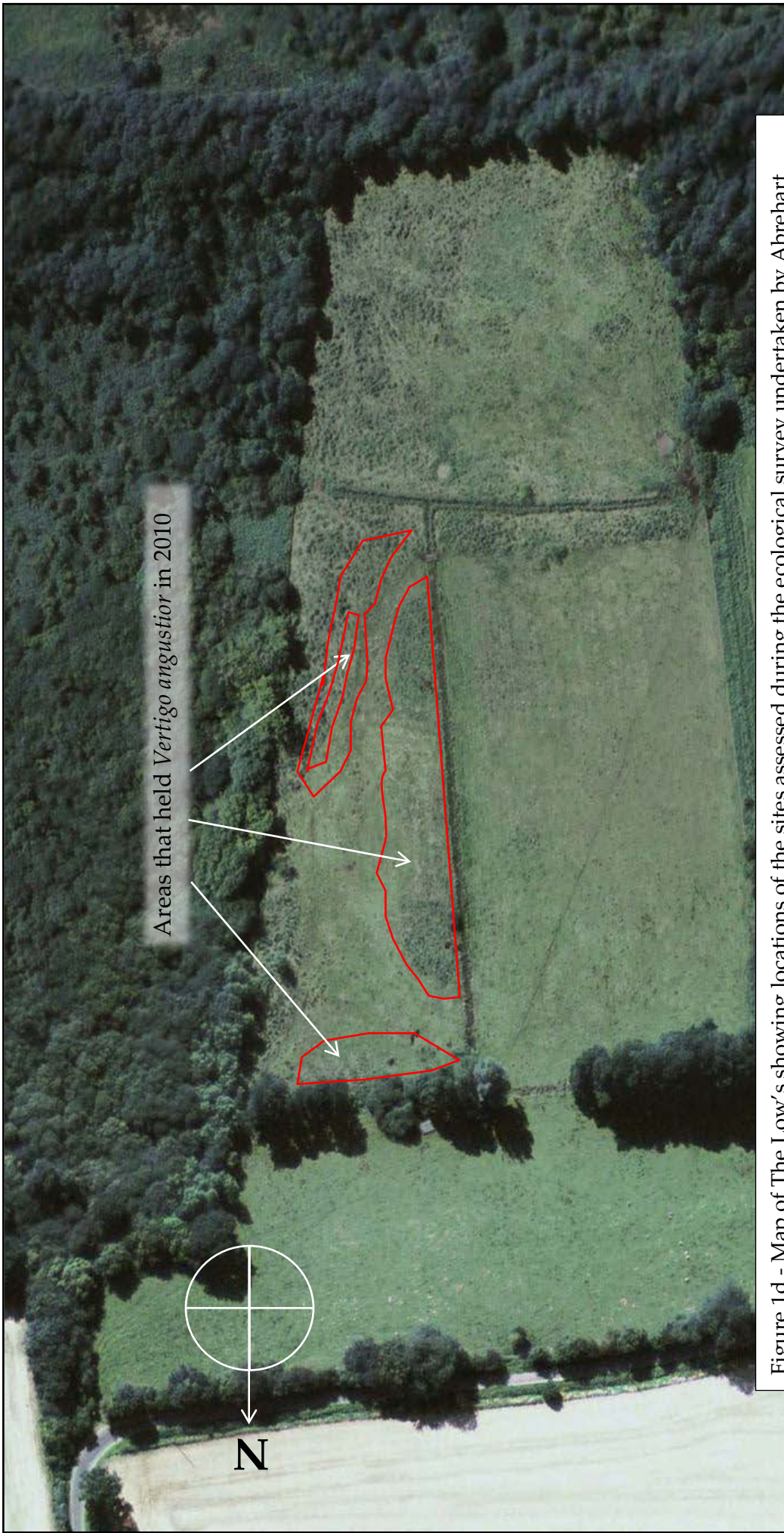


Figure 1d - Map of The Low's showing locations of the sites assessed during the ecological survey undertaken by Abrehart Ecology on 21<sup>st</sup> September 2010. Red outlined area indicates lands most suitable for *Vertigo angustior*.

(Aerial image copyright Google Earth; for illustrative purposes only)

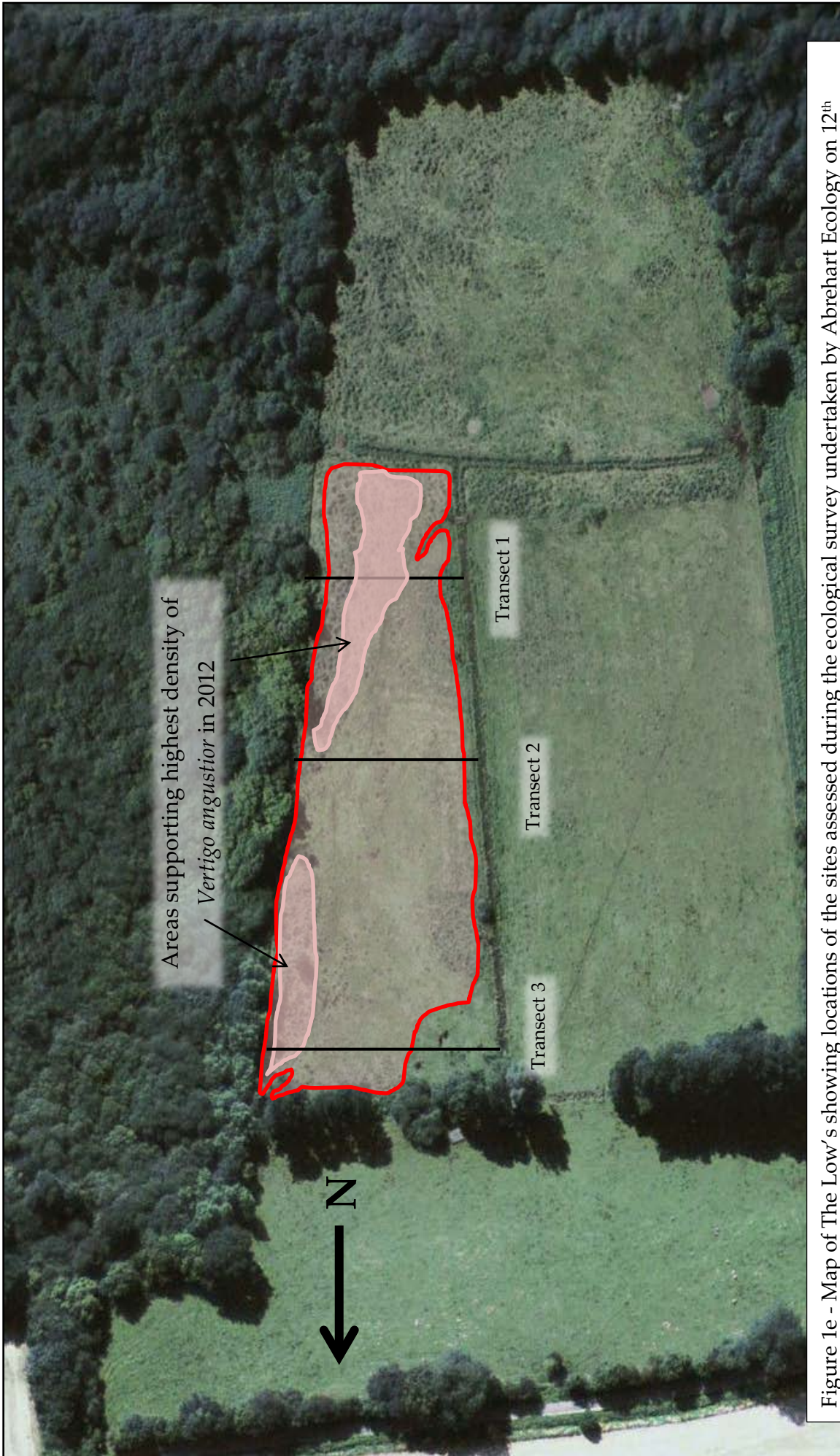


Figure 1e - Map of The Low's showing locations of the sites assessed during the ecological survey undertaken by Abrehart Ecology on 12<sup>th</sup> October 2012. Red outlined area indicates habitat most suitable for *Vertigo angustior*. (Aerial image copyright Google Earth; for illustrative purposes only)

## 3.2 Betty's Fen and Blo' Norton Fen

### 3.2.1 Site description

Betty's Fen forms the western third of Blo' Norton Fen SSSI and Natura 2000 site. Unlike the remainder of the fen, which belongs to the village Poors' Trust, the 2.2ha of Betty's Fen was in private ownership until 2003 when it became the first piece of land to be purchased by the LOHP.

In 1997 village residents leased Blo' Norton Fen from the village 'poor's trust', the Blo' Norton Fuel Allotment Charity. The fen is designated as a Site of Special Scientific Interest (SSSI) and forms part of the Waveney and Little Ouse Valley Fens Special Area of Conservation (SAC).

Blo' Norton and Betty's fen would have originally had peat dug for fuel. The main conservation interest of the fen lies in the open areas supporting saw sedge and other wetland plants. Historically this plant community would have been maintained by regular mowing, with grazing along the drier fen edges. However, in recent times, as a result of a lowering of the water levels, a succession of very dry years, and a lack of any regular management, much of this open fen community had been lost as trees and scrub invaded, shading out the characteristic fen vegetation.

At Betty's Fen a thin layer of degraded surface peat was removed from the central area to create a shallow turf pond this spoil was used to make a raised footpath running north-south through the site. The fen areas around the turf pond was S25 *Phragmites australis* – *Eupatorium cannabinum* tall-herb fen that had been cut in 2010 with the majority of the rest of this eastern fen being uncut. The turf pond had been dry during the summer and there was very little leaf litter in the pool margins. To the west of the footpath were more S25 herb fens with some hand cut peat pools, half of these meadows had been cut during the summer leaving a smaller area to take samples from. The woodlands around Betty's and Blo' Norton fen were dominated with W5 *Alnus* – *Carex paniculata* community. In the western area of Blo' Norton Fen was an area of S25c *Phragmites australis* – *Eupatorium cannabinum* tall-herb fen *Cladium mariscus* sub-community. About half of this area had been cut in 2010 revealing some small areas of open water, with the rest of the fen being very dry.

### 3.2.2 Results

The RDB 3 mollusc *Vertigo moulinsiana* was found in one of the samples collected from Betty's Fen (Figure 1b) in 2010. This small area of uncut S25 *Phragmites australis* – *Eupatorium cannabinum* tall-herb fen held only one juvenile in the vegetation surrounding a small body of standing water adjacent to the footpath. The remaining area around this site was too dry for the mollusc to survive. Extensive sampling across Betty's Fen produced no more specimens indicating that this species is at critically low numbers this site, due to the current dry conditions. In 2008 *Vertigo moulinsiana* was found in small numbers on Betty's Fen during a survey of Suffolk (Abrehart Ecology).

In 2012 the area was searched again, this revealed that there was still a very low population at the original site. At Site 6 there was wetter ground than in 2010, here sampling showed that there was a small though healthy population of *Vertigo moulinsiana* within the *Carex acutiformis* bed adjacent to the *Salix* scrub. Within this small area (100m<sup>2</sup>) there was a density of up to 900 animals per m<sup>2</sup>. This was a great improvement for the population over two years. The surrounding vegetation to this core habitat was suitable in its species composition and density, the main difference being it was far too dry still. The wetting of this site is still the main important factor in aiding the recovery of this species in the LOHP reserves.

At Blo' Norton Fen there is a very large area of very suitable habitat for *Vertigo moulinsiana* but, here too the site is still far too dry, even after a very wet year. Once the water regime is more stable and wetter through these sites then there is a very high possibility for *Vertigo moulinsiana* to spread back through these excellent marshes. The alder carr between Betty's Fen and Blo' Norton Fen may be able to support *Vertigo moulinsiana* too, as there is a considerable spread of sedges in the understory, this may act as a conduit for the species between the sites once a higher water level is established.

Of note from the other samples taken here was the relative abundance of *Euconulus alderi* in the fen areas across the site and in the woodlands it is an uncommon species in the UK though more frequent in the Little Ouse. Other than these two species 27 other species were found across the sites. This number and variety of species was to be expected in these habitats though the sites were all still dry, the fluctuating water levels will always create difficult conditions for the rarer species on the site, notably *Vertigo moulinsiana*. Water level stability is important at these sites.

### 3.3 Blo' Norton The Lows, Blo' Norton Little Fen and The Frith

#### 3.3.1 Site description

Blo' Norton Lows comprises of three fields that stretch from the Blo' Norton Banks road to the Little Ouse River. The field adjacent to the road slopes steeply to the valley floor and is heavily grazed improved grassland; this field retains some old hedges. An alder-lined ditch marks the start of the middle field which was divided by a recently cleared ditch, the eastern marsh comprises rough, wet pasture, dominated by sedges and rushes and the western field is dryer and more heavily grazed. Only the lowest field, beyond another reed-filled ditch, appears never to have been ploughed. Although dominated by reeds, rushes and sedges, it retains remnants of a formerly rich fen flora, including early marsh orchids.

Blo' Norton Little Fen was a 4.17 ha wet 'carr' woodland on the north bank of the Little Ouse River, immediately east of the Blo' Norton Lows. It is a designated County Wildlife Site and like the other fens in the area, it used to supply local people with peat for fuel. Its surface is still pitted with the remains of deep peat diggings. The cessation of management has resulted in the loss of the open fen to invading alder and willow scrub. The progressive lowering of the water-table had resulted in the loss of virtually all of the open fen and its associated rarities. A limited amount of tree clearance was undertaken by Blo' Norton Fen Conservation group in the late 1990s, but the site is currently maintained as 'non-intervention' woodland.

The Frith was a 10.7 ha of rough pasture on the north bank of the Little Ouse River, the source of which was at the south-east corner of the field. It forms the first critical link in the chain of sites between Redgrave and Lopham Fen at the head of the Waveney valley and the fenland remnants of the Little Ouse valley. The sources of the two rivers are separated only by the low sandy ridge that carries the B1113 between South Lopham and Redgrave. Other than the low south-east corner the remaining areas on the site are all recovering acid grasslands, with some areas of woodland, species rich hedges and an area of Scots Pines to the south.

#### 3.3.2 Results

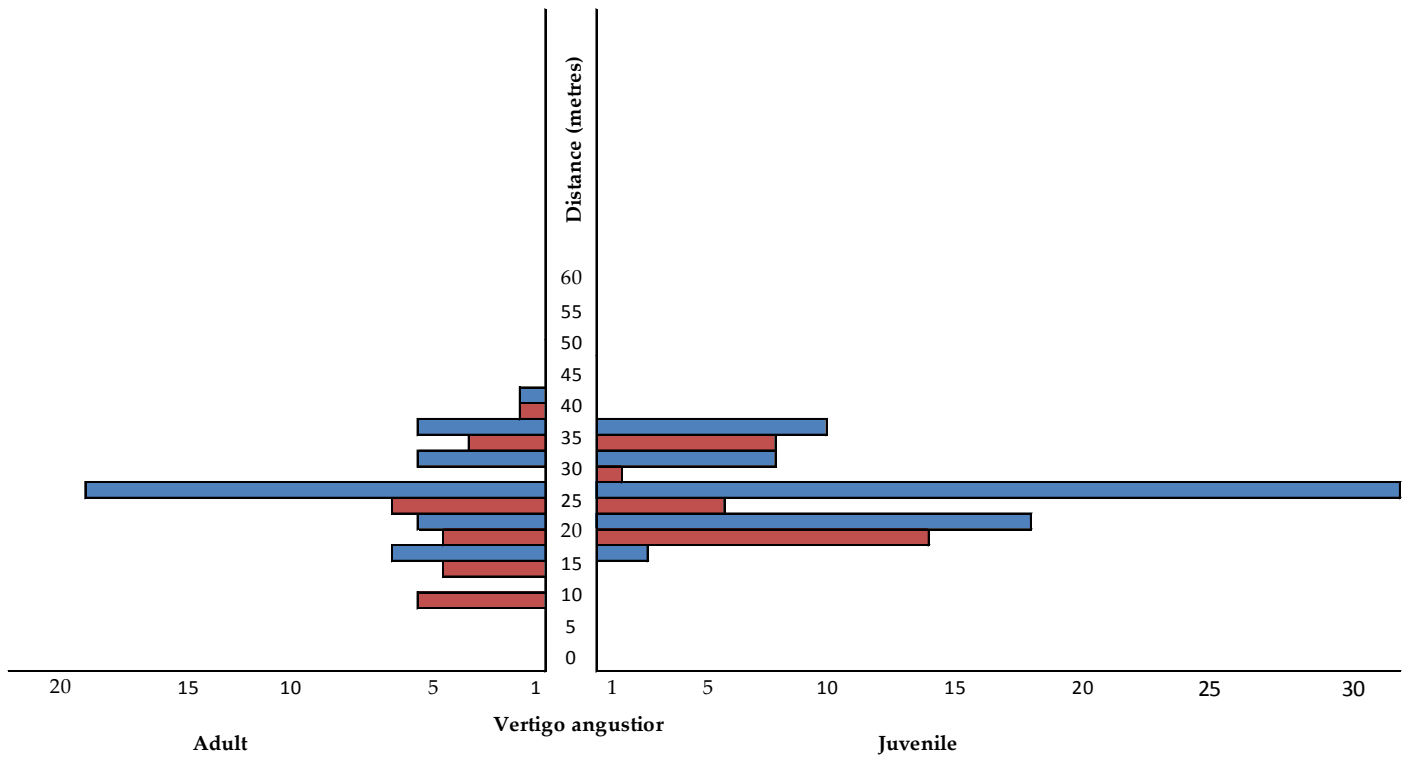
Across these three sites 23 species of molluscs were found in 2010. Only one species was of importance, this was in The Lows which held an important new population of *Vertigo angustior*

*RDB1*. The molluscs were found across the eastern marsh (figure 1d), with greatest density in the south-east corner.

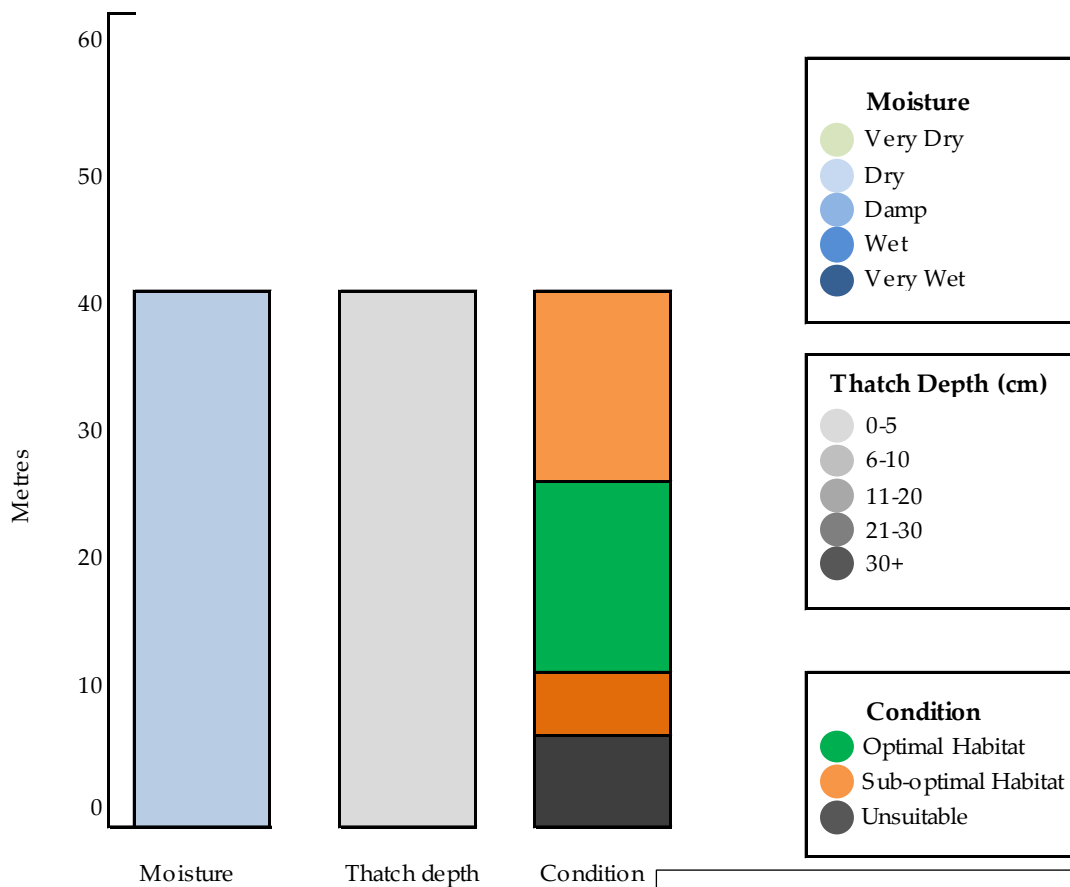
In 2012 all the sites were re-surveyed, with particular attention being paid to The Lows, where the *Vertigo angustior* population was searched, then three transects were established to enable closer monitoring in the future.

Below are the sets of transect data for the survey work carried out in 2012, 0 is the start of the transect and replicates were taken from each side of the transect line.

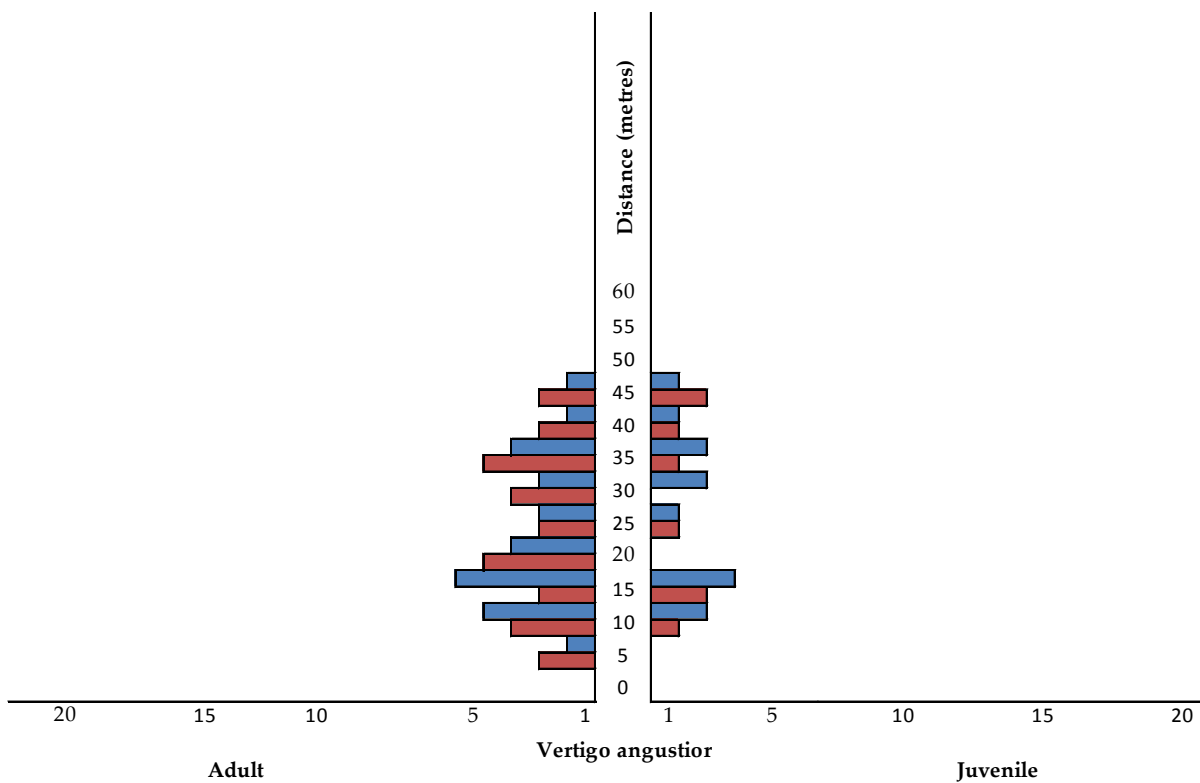




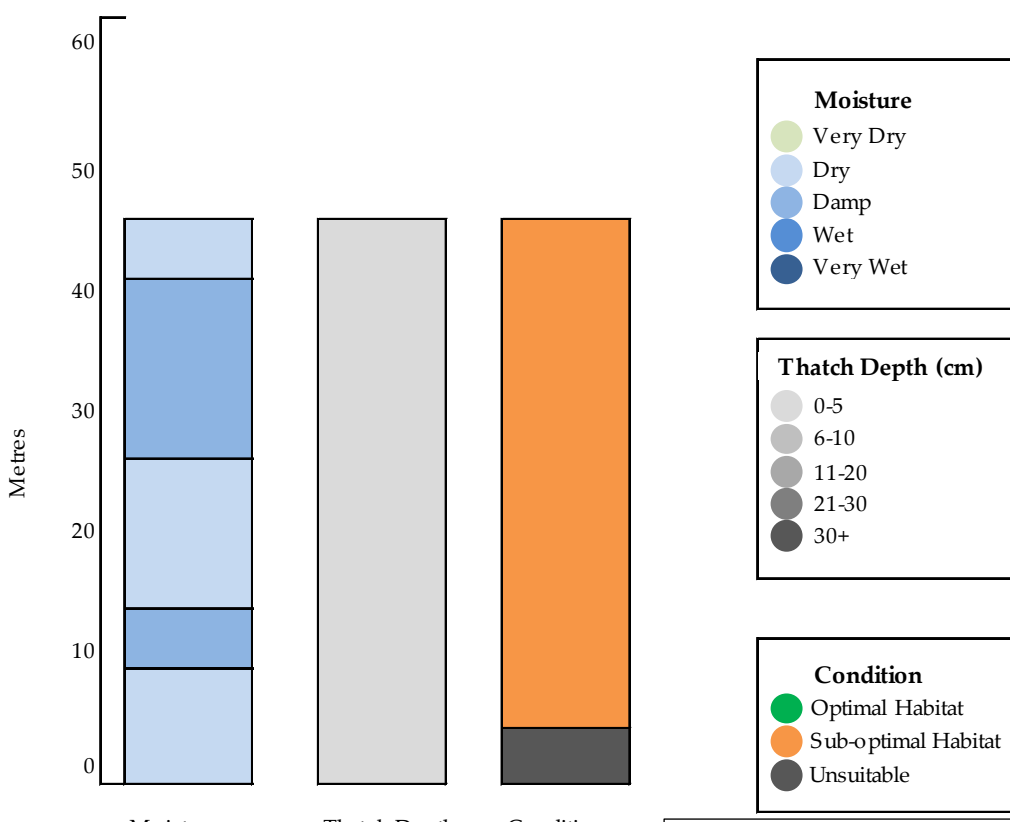
● A= replicate from left of Transect line  
● B= replicate from right of Transect line



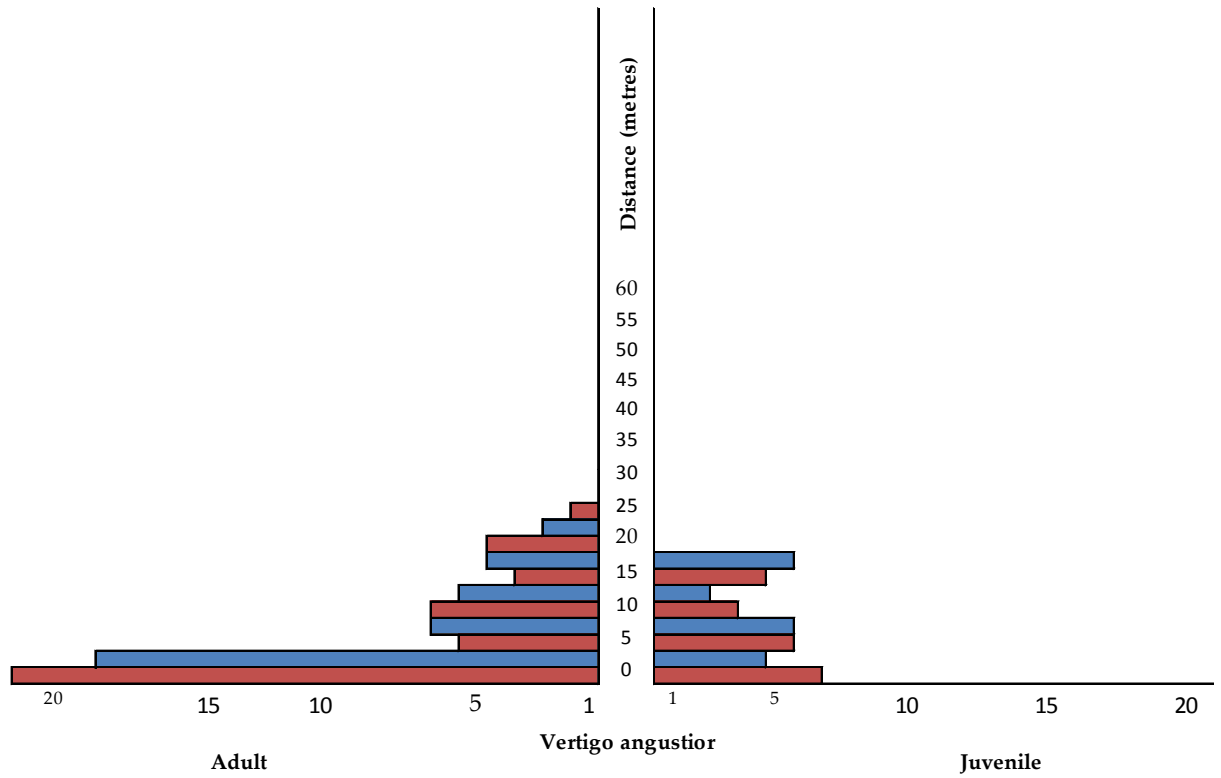
**Blo' Norton, The Lows – Transect 1-2012**  
 Grid Reference: TM 0332179120  
 Length: 40 metres  
 Bearing: North-east to South-west - 252°



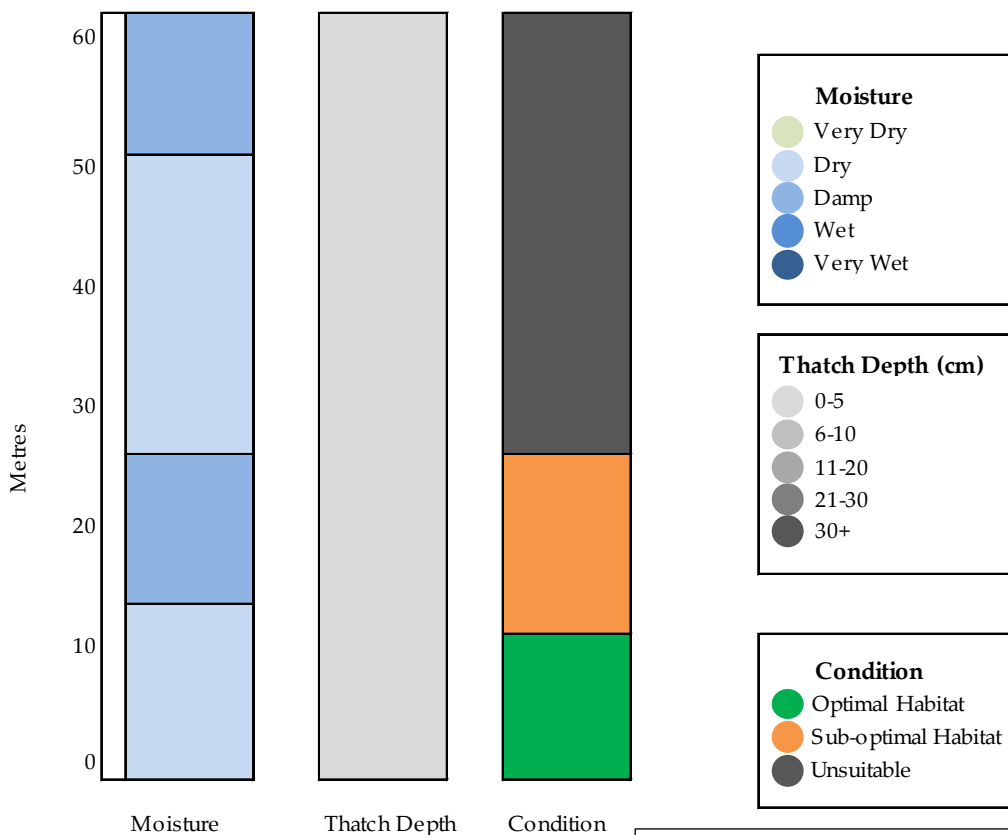
● A= replicate from left of line  
● B= replicate from right of line



**Blo' Norton, The Lows – Transect 2-2012**  
 Grid Reference: TM 0330679186  
 Length: 45 metres  
 Bearing: North-east to South-west - 252°



● A= replicate from left of line  
● B= replicate from right of line



**Blo' Norton, The Lows – Transect 3-2012**  
 Grid Reference: TM 0329179240  
 Length: 60 metres  
 Bearing: North-east to South-west - 252°

## 4. General discussion

### Importance of the LOHP reserves for *Vertigo angustior*

Inland sites for *Vertigo angustior* are very important nationally, as the majority of the known sites are along the sea walls of the Suffolk and Norfolk estuaries. These habitats are under considerable threat from coastal squeeze and sea defence management. Many of the newly discovered sites in Suffolk (Abrehart 2010) have already been lost to these factors. Currently there are only three sites away from the coast in Suffolk. Lopham and Redgrave has a very small population along the margin of River Waveney (Abrehart 2008), a large population was been discovered at Market Weston Fen (Abrehart) and The Lows (LOHP) site in 2010. These are the only sites not under direct threat from coastal processes and are very important to monitor in the future.

These surveys have shown that there was a very healthy population of *Vertigo angustior* at Blo' Norton Lows with a maximum number of 153 *Vertigo angustior* found in a single 20cm x 20cm sample in 2010. The overall site size was large with approximately 2155m<sup>2</sup> of marsh holding a low density and 1000m<sup>2</sup> holding a higher density population, within this latter area is a core of 377m<sup>2</sup>, holding a population of approximately 3000 per square metre (2010).

In 2012 the area holding *Vertigo angustior* was approximately 4294m<sup>2</sup> of marsh at a low density and 900m<sup>2</sup> holding a higher density population, within this latter area is a core of 380m<sup>2</sup>, holding a population of approximately 450 per square metre (Figure 1e).

Although this sounds like a lot of animals, *Vertigo angustior* inhabits a delicate ecosystem that requires careful management with little human disturbance.

### Transect discussion:

The transects have shown that the site is still an import one within the UK, with a potential population of almost 300,000 animals on the site.

It was apparent during the transect survey that the habitat had changed considerably since 2010. The large areas of loose tussocky grassland and sedge beds had been grazed. This left the heavily grazed sections of grass in between the tussocks. It was in the un-grazed grasses of these *Juncus* tussocks that the greatest numbers of animals were found, with very low numbers across the rest of the habitat on the site. The poaching of the ground by the cattle can create an interesting diversity to the habitat, as long as the grazing is no higher than it is at present.

The main need for *Vertigo angustior* is a damp sward that is lightly grazed with a developed thatch layer and limited flooding.

A total of 64 samples were taken during the transect survey with a total of 331 animals found.

### *Vertigo angustior*

#### Status

*Vertigo angustior* is listed under Annex II of the EU Habitats Directive. The Directive requires EU States to designate Special Areas of Conservation (SACs) and to maintain 'at a favourable conservation status those species listed in Annex II. *Vertigo angustior* is placed in the RDB 1 (endangered) for the UK It is a UK Biodiversity Action Plan (BAP) species; refer to National, Norfolk and Suffolk Action Plans.

#### Reproduction and growth

Narrow-mouthed whorl snails are hermaphrodite, but studies have shown that all species of *Vertigo* exhibit both a euphallic condition (individuals with normally developed male genitalia) and an aphyallic condition (individuals devoid of a penis) (Pokryszko 1987, 1990, 1992). The only species of *Vertigo* whose life history has been studied in detail is *V. pusilla* (Pokryszko 1992). Although this is a dry-habitat species, the information on reproduction and growth is likely to be applicable to other *Vertigo* species including *V. angustior*. Under laboratory conditions it was observed that copulation was rare, but when it did occur, the euphallic individuals acted as 'males' and the aphyallic individuals as 'females'. Eggs were either laid following copulation or without it, with most resulting from self-fertilisation, three or four generations were possible in a year. The ability of *Vertigo* species to self-fertilise significantly aids the life strategy. At the end of winter, when adult individuals may be relatively few and widely dispersed, the probability of two individuals meeting is at its lowest. By self-fertilisation, the low numbers of individuals are able to reconstruct the population in a few weeks (Pokryszko 1987). Moreover, a single coloniser is able to establish a new population.

#### Habitat requirements

*Vertigo angustior* is restricted to moist places which are affected neither by periodic desiccation nor by flooding. It requires open conditions quickly warmed by the sun, inhabiting short vegetation of grasses, mosses or low herbs, such as damp meadows.

#### **Importance of the LOHP reserves for *Vertigo moulinsiana***

In 2008 *Vertigo moulinsiana* was found during a survey of Suffolk within the vegetation in the Little Ouse River to the north of Parkers Piece marshes. During the 2010 survey it was not relocated in this area. At Betty's Fen *Vertigo moulinsiana* was found in only one sample; this juvenile was found in the only suitable habitat on the site.

At Site 6 in Betty's Fen the wetter ground had created ideal conditions for *Vertigo moulinsiana*, here sampling showed that there was a healthy population of *Vertigo moulinsiana* (Table A1.8) within the damp *Carex acutiformis* bed adjacent to the *Salix* scrub. Within this small area (100m<sup>2</sup>) there was a density of up to 900 animals per m<sup>2</sup> indicating that there are up to 55,000 animals in this small area alone. This was a great improvement for the population over two years. The surrounding vegetation to this core habitat was suitable in its species composition and density, the main difference being it was far too dry still. The wetting of this site is still the main important factor in aiding the recovery of this species in the LOHP reserves. This shows that with an increased water level where this species can hang on there is a chance for rapid increases in the populations. This though is

true of a massive decline too through a lower water level; water level stability and a low canopy density are essential for this species at this site.

At Blo' Norton Fen there is a very large area of very suitable habitat for *Vertigo moulinsiana* but, here too the site is still far too dry, even after a very wet year. Once the water regime is more stable and wetter through these sites then there is a very high possibility for *Vertigo moulinsiana* to spread back through these excellent marshes. The alder carr between Betty's Fen and Blo' Norton Fen may be able to support *Vertigo moulinsiana* too, as there is a considerable spread of sedges in the understory, this may act as a conduit for the species between the sites once a higher water level is established.

#### Status

Desmoulin's whorl snail, *Vertigo moulinsiana* (Dupuy 1849) is scheduled on Annex II of the European Habitats Directive, listed in the British Red Data Book (Bratton 1991) as an RDB 3 (Rare) species, and included on the UK Biodiversity Action Plan short-list of priority species (HMSO 1996).

#### Habitat requirements

There is considerable evidence that this diminutive wetland snail is declining throughout its European range (Heaver pers comm). While there are many large populations of *V. moulinsiana* in southern and southeast England, it has become apparent that in the last few years many of these populations have crashed, with it nearly disappearing from several previous strongholds in Wiltshire, Suffolk and Norfolk, it may be the most vulnerable of the four Habitats Directive *Vertigo* species in the UK, due to pressure for water use, particularly from abstraction. The UK has an international as well as a national responsibility to conserve this species. Desmoulin's whorl snail inhabits calcareous wetlands mainly in southern and eastern England. It occurs in swamps, fens and marshes bordering rivers and lakes, where it is found on both the living and dead stems and leaves of tall plants. These include sedges such as greater pond sedge (*Carex riparia*), lesser pond sedge (*C. acutiformis*) and great fen sedge (*Cladium mariscus*), yellow flag (*Iris pseudacorus*), branched bur-reed (*Sparganium erectum*) and reeds (including *Phragmites australis*). In spring, the snails are found low down, principally on the stems and leaves of monocotyledons. They then climb the plants during the summer and autumn, and can reach a height of up to 2 m above ground level. With the onset of winter the snails descend to lower levels again, and they over-winter in the lower leaves, stems and available litter.

#### 5.1 Factors affecting *V. moulinsiana* abundance and distribution

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

increased grazing or mowing, result in lower population levels. For these reasons, information on the snail's area of occupancy, vegetative habitat and hydrological conditions must be used in combination with relative abundance to assess conservation status.

**Groundwater levels are one of the most important factors influencing the distribution of *V. moulinsiana*.** Apparently suitable sedge-dominated habitats occur in many sites but the snail is absent. This is considered to be due to a number of factors that are poorly understood. Inappropriate groundwater levels are a main issue, the species requiring water levels to be at or slightly above the local ground surface for at least part of the year.

**Some indicators of favourable habitat are:**

- Average height of vegetation not less than 70 cm when measured in August.
- Plant species composition and cover: *Carex* spp., *Cladium mariscus*, *Sparganium erectum* and *Iris pseudacorus* indicate favourable conditions, as can *Phalaris arundinacea*.
- Ground moisture levels between 2 and 4.

2-Damp. Ground visibly damp, but water does not rise under pressure.

3-Wet. Water rises under light pressure.

4-Very wet. Pools of standing water, generally less than 5 cm deep.

- Site management: light or rotational grazing or no grazing.

- **A decline in habitat condition is implicated by the following:**

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

**Limitations of the survey**

This survey was a brief overview of seven sites under the management of the LOHP and as such there is only limited mapping of species found on the sites.

Finally, there are known to be wide temporal fluctuations in numbers of molluscs of different species at different seasons. Due to this, the sampling certainly will underestimate populations of *Vertigo angustior* and *Vertigo moulinsiana*, but it is possible the systems here are richer than the results of this survey might suggest, though the long period of dry weather earlier in the year in 2010 and 2012 will have had an effect on population density across the sites.

## 5 References

*This report to be cited as:*

Abrehart Ecology (2012). *A Malacological Survey of the Little Ouse Headwaters Project sites Suffolk and Norfolk*. An ecological overview of the mollusc species found within several sites under the management of LOHP.

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## 6 Acknowledgements

I would like to thank Helen Smith and Mike Harding for commissioning the report on behalf of the Little Ouse Headwater's Project and for showing me around these wonderful sites.



# *Appendices*

## Appendix A:

Site by site results of molluscs identified from samples on 21<sup>st</sup> to 22<sup>nd</sup> September 2010 and 14<sup>th</sup> to 15<sup>th</sup> October 2012

2012

2010

Species	2010										2012									
	BF1	BF2	BF3	BF4	BF5	BF6	BF7	BF8	BF9	BF10	BF1	BF2	BF3	BF4	BF5	BF6	BF7	BF8	BF9	BF10
<i>Vertigo moulinsiana</i> adult																				
<i>Vertigo moulinsiana</i> juvenile						1	1							1		5	1			
<i>Arion ater</i>						1														
<i>Ashfordia granulata</i>	1						1							3	10					
<i>Carychium tridentatum</i>			42	28				1												
<i>Cepaea hortensis</i>				1				1							1					
<i>Cepaea nemoralis</i>	3	2	4	1	1	2	3	2	3		2	3			1		1			
<i>Cochlicopa lubrica</i>		1																		
<i>Cochlicopa lubricella</i>			3	3	2							1		1						
<i>Deroceras laeve</i>	2	1		2	2		3	1			16	2	2	2	8	3	1			
<i>Discus rotundatus</i>																				
<i>Euconulus fulvius</i>																				
<i>Euconulus alderi</i>	4	1	4	5	10		1	4	2		7	3	5	5						
<i>Gymnulus albus</i>																				
<i>Lymnaea palustris</i>									1											1
<i>Radix peregra</i>									3											4
<i>Lymnaea truncatula</i>			5						1		18	26	1	2			1			2
<i>Monacha carthusiana</i>				1											1					
<i>Oxychilus allarius</i>						1														
<i>Oxychilus cellarius</i>									1											1
<i>Planorbis carinatus</i>																				
<i>Punctum pygmaea</i>	1		3	3									1	3	1					
<i>Succinea putris</i>	4	2	3	3	5	3	25	5	12		3	2	2	3	2	2	5	3		
<i>Trichia hispida</i>					1															
<i>Vitrea crystallina</i>																				
<i>Zonitoides nitidus</i>			2	10	12		1	2	6		1	1	1	2	3	1	2			
<i>Anisus vortex</i>																				
<i>Physa fontinalis</i>																				

**Table A1.1 – Betty’s Fen**, relative abundances for the molluscs found at each sample location during the survey at Betty’s Fen, during this survey undertaken by Abrehart Ecology for the Little Ouse Headwater Project on 22<sup>nd</sup> September 2010 and 14<sup>th</sup> October 2012.

Species	2010										2012									
	BN1	BN2	BN3	BN4	BN5	BN6	BN7	BN8	BN9	BN10	BN1	BN2	BN3	BN4	BN5	BN6	BN7	BN8	BN9	BN10
<i>Ariton ater</i>				1	1								12	1						
<i>Ashfordia granulata</i>			2	1	3								1	3						
<i>Cepaea nemoralis</i>	2	1				3	3					1			1	2				
<i>Cochlicopa lubrica</i>							2									1				
<i>Deroceras laeve</i>	1					4	4					3	5		1	2				
<i>Discus rotundatus</i>						3	3								2	2				
<i>Euconulus fulvus</i>						1	1								1	1				
<i>Euconulus alderi</i>											2	1	2		1					
<i>Gymaulus albus</i>		1																		
<i>Lymnaea palustris</i>							2	2									3	1		
<i>Radix peregra</i>							10		1								5			
<i>Lymnaea truncatula</i>		1					1						1				1			1
<i>Monacha carthusiana</i>																3				
<i>Oxychilus allarius</i>																1				
<i>Oxychilus cellarius</i>																3				
<i>Planorbis carinatus</i>								4	1									3	2	
<i>Succinea putris</i>	8	4	8	6	5	12	2				3	5	3	5	12	2				
<i>Vitrea crystallina</i>							2									2				
<i>Zonitoides nitidus</i>																				2
<i>Anisus vortex</i>								1	2		1								1	1
<i>Physa fontinalis</i>								5	1											1

**Table A1.2 – Blo’ Norton Fen**, relative abundances for the molluscs found at each sample location during the survey at Blo’ Norton Fen, during this survey undertaken by Abrehart Ecology for the Little Ouse Headwater Project on 22<sup>nd</sup> September 2012 and 14<sup>th</sup> October 2012.

Species	2010												2012											
	PP1	PP2	PP3	PP4	PP5	PP6	PP7	PP8	PP9	PP10	PP11	PP12	PP1	PP2	PP3	PP4	PP5	PP6	PP7	PP8	PP9	PP10	PP11	PP12
<i>Asifonia granulata</i>																	1							2
<i>Arion ater</i>					1	8	5													1				
<i>Arion intermedius</i>	1		1		2								2			4	2			1				
<i>Carychium tridentatum</i>							1										2			6				
<i>Cepaea hortensis</i>																								
<i>Cepaea nemoralis</i>	1	1	3	2	2	3						3	5	3	3	2	4		1			2	4	
<i>Clausilia bidentata</i>						1																		1
<i>Cochlicopa lubrica</i>			2	1								3				2	4							2
<i>Cochlicopa lubricella</i>					1						2						1							4
<i>Deroceras reticulata</i>																								
<i>Discus rotundatus</i>												1				3			5					2
<i>Euconulus aldeni</i>					2		1				2									1				1
<i>Lymnaea palustris</i>											3	2										1		2
<i>Radix peregra</i>											1													1
<i>Lymnaea truncatula</i>											7											3		3
<i>Monacha cantiana</i>												1												1
<i>Oxychilus allarius</i>											2	1				1				1				4
<i>Oxychilus cellarius</i>																3								1
<i>Planorbis carinatus</i>											2	3	1								1			2
<i>Punctum pygmaea</i>											3									1				
<i>Succinea puris</i>	3	2	2	2							5	2		20	7	2	8				2			3
<i>Trichia hispida</i>							3																	1
<i>Vitrea crystallina</i>																2				1				1
<i>Zonitoides nitidula</i>												4				1	4	3		2				9

**Table A1.3 – Parker’s Piece**, relative abundances for the molluscs found at each sample location during the survey at Parker’s Piece, during this survey undertaken by Abrehart Ecology for the Little Ouse Headwater Project on 22<sup>nd</sup> September 2012 and 14<sup>th</sup> October 2012.

Species	2010				2012			
	BB1	BB2	BB3	BB4	BB1	BB2	BB3	BB4
<i>Ashfordia granulata</i>						1		
<i>Arion ater</i>	6				2			
<i>Arion intermedius</i>			3				1	
<i>Anisus vortex</i>		1						
<i>Carychium tridentatum</i>								
<i>Cepaea hortensis</i>			2				2	
<i>Cepaea nemoralis</i>		4				5		
<i>Clausilia bidentata</i>		2		2		1		2
<i>Cochlicopa lubrica</i>								
<i>Cochlicopa lubricella</i>		2				1		
<i>Deroceras reticulata</i>								
<i>Discus rotundatus</i>			2	4			2	4
<i>Euconulus alderi</i>		1		1		5		1
<i>Lymnaea palustris</i>	10							
<i>Radix peregra</i>								
<i>Lymnaea truncatula</i>		1	2					
<i>Monacha cantiana</i>						1		
<i>Oxychillus allarius</i>								
<i>Oxychillus cellarius</i>				1				1
<i>Planorbis carinatus</i>								
<i>Punctum pygmaea</i>			1				1	
<i>Succinea putris</i>		3	3	1				
<i>Trichia hispida</i>				2				2
<i>Vitrea crystallina</i>							1	
<i>Zonitoides nitidula</i>								

**Table A1.4 – Bleyswyck’s Bank**, relative abundances for the molluscs found at each sample location during the survey at Bleyswyck’s Bank, during this survey undertaken by Abrehart Ecology for the Little Ouse Headwater Project on 22<sup>nd</sup> September 2012 and 14<sup>th</sup> October 2012.

2012

2010

Species	2010								2012							
	TL1	TL2	TL3	TL4	TL5	TL6	TL7	TL8	TL1	TL2	TL3	TL4	TL5	TL6	TL7	TL8
<i>Vertigo angustior</i>	2	5	105	2	4				2	4	5	5				
Juveniles			48						5	4	3	9				
<i>Aegopinella pura</i>					3											
<i>Arion ater</i>				1												
<i>Arion intermedius</i>																
<i>Candidula interrescta</i>							1									
<i>Carychium minima</i>	2	4	16	5					4	5	2	1	3		5	
<i>Cepaea hortensis</i>																1
<i>Cepaea nemoralis</i>																
<i>Clausilia bidentata</i>																
<i>Cochlicopa lubrica</i>	1	1	2	1			2		2	3	2		2		3	
<i>Deroceras laeve</i>									1				1		1	
<i>Deroceras reticulatum</i>																
<i>Discus rotundatus</i>					2									3		
<i>Euconulus alderi</i>			4	1							4					
<i>Lauria cylindracea</i>																
<i>Monacha cantiana</i>																
<i>Nesovitrea hammonis</i>								1					1			
<i>Oxychillus allarius</i>			1	1	2		1				2				1	
<i>Punctum pygmaeum</i>		8	4	5	3		1		5	4	2	5	6		6	
<i>Succinea putris</i>				3			3	1				1			2	1
<i>Trichia striolata</i>																
<i>Vertigo pygmaea</i>	4	7	2	4	4		1			2	1	2	2		3	
<i>Zonitoides nitidula</i>	1	1	2		5		3						2	2	3	

**Table A1.5 – The Lows, relative abundances for the molluscs found at each sample location during the survey at The Lows, during this survey undertaken by Abrehart Ecology for the Little Ouse Headwater Project on 22<sup>nd</sup> September 2012 and 15<sup>th</sup> October 2012.**

Species	2010								2012								
	TF1	TF2	TF3	TF4	TF5	TF6	TF7	TF8	TF1	TF2	TF3	TF4	TF5	TF6	TF7	TF8	TF9
<i>Aegopinella pura</i>				2					1		1		2				
<i>Arion ater</i>	1										1						
<i>Arion intemedius</i>	1		1								1						
<i>Candidula intersesta</i>				1									2				
<i>Carychium ninina</i>	3								4								
<i>Cepaea hortensis</i>	1	1				1			2	2				2			
<i>Cepaea nemoralis</i>	2	2	3	2	2	3		7			3		2	3	4	5	
<i>Clausilia bidentata</i>			2	1	1	1					1		2		1		2
<i>Cochlicopa lubrica</i>					5									7		1	
<i>Deroceras laeae</i>	1	3								4							
<i>Deroceras reticulatum</i>		1							1	2							6
<i>Discus rotundatus</i>				4									5				
<i>Euconulus alderi</i>	1																
<i>Lauria cylindracea</i>				3									2				
<i>Monacha cantiana</i>	1								2								
<i>Oxychillus allarius</i>			1	1	1	2					1	2	1		1		
<i>Punctum pygmaeum</i>	3	4			4	3			4	5			7		6		
<i>Succinea putris</i>	1								2								
<i>Trichia striolata</i>		2				3			1								2
<i>Vertigo pygmaea</i>			1								2						
<i>Zonitoides nitidula</i>	4		2	2					2	1	1						

**Table A1.6 – The Lows,** relative abundances for the molluscs found at each sample location during the survey at The Lows, during this survey undertaken by Abrehart Ecology for the Little Ouse Headwater Project on 22<sup>nd</sup> September 2012 and 14<sup>th</sup> October 2012.

Species	2010				2012			
	LF1	LF2	LF3	LF4	LF1	LF2	LF3	LF4
<i>Aegopinella pura</i>	2	3		1	1	2		1
<i>Carychium minima</i>	3	1	7	12	1		2	5
<i>Discus rotundatus</i>	3		2	1	4		3	1
<i>Euconulus alderi</i>		1		1		1		2
<i>Oxychillus allarius</i>		1				2		
<i>Succinea putris</i>			1				1	
<i>Zonitoides nitidula</i>	7	3	9	1	2	1	3	1

**Table A1.7 – Blo’ Norton Little fen**, relative abundances for the molluscs found at each sample location during the survey at Blo’ Norton Little Fen, during this survey undertaken by Abrehart Ecology for the Little Ouse Headwater Project on 22<sup>nd</sup> September 2012 and 15<sup>th</sup> October 2012.

Species	2012			
	BF6a	BF6b	BF6c	BF6d
<i>Vertigo moulinsiana</i> adults	27	6	24	15
Juveniles	53	5	73	42
<i>Euconulus alderi</i>	2	1	3	2
<i>Punctum pygmaea</i>		2		1
<i>Succinea putris</i>	1		1	1

**Table A1.8 – Betty’s Fen**, relative abundances for the molluscs found at each sample location holding *Vertigo moulinsiana* during the survey at Betty’s Fen, during this survey undertaken by Abrehart Ecology for the Little Ouse Headwater Project on 15<sup>th</sup> October 2012.



<b>Transect 1:</b>	
Start Point:	Adjacent to the stock fence, TM 0332179120
End point:	at the dyke edge, TM 0328379111
Transect Length:	40m
Description:	The transect runs across the lower end of the marsh.
Direction:	North-east to South-west - 252°
Sampling frequency:	Every five metres
Results:	<p>The vegetation along this transect was a matrix of rush grasslands with a section of S4 <i>Phragmites australis</i> and an area of grazed Sedges.</p> <p>This showed that there is a low to medium density population of <i>Vertigo angustior</i> in the middle section of the transect. The areas close to the footpath (in the loose tussock vegetation) held the highest density of 40 animals in a sample giving an approximate population density of over 360 animals per m<sup>2</sup></p>

Location	Thatch depth	Ht (cm)	Dominant plants														Other plants		V. angustior		Other molluscs																
			Moisture	Carex riparia	Carex acutiformis	Phragmites australis	Glechoma hederacea	Juncus effusus	Juncus inflexus	Veronica beccabunga	Galium aparine	Holcus lanatus	Agrostis stolonifera	Cirsium palustre	Carex sp	Mentha aquatica	Equisetum palustris	Solanum dulcamara	Cirsium arvensis	Epilobium hirsutum	Descampsia caespitosa	Festuca rubra	Urtica dioica	Adult	Juvenile	Vertigo pygmaea	Vertigo antiverigo	Carychium minimum	Codlicopa cf. lubrica	Ashfordia granulata	Monacha carthiasiana	Euconulus alderi	Cepaea nemoralis	Functum pygmaeum			
0m A	0	60	2			D			O	O					R	R		R					O		0	0			5	1					2		
0m B	0	65	2																						0	0		3	5						6		
5m A	0	40	2			F	O	R			F	O											F		0	0	2		2	1				1	3		
5m B	0	35	2																					0	0	2		2	3					2			
10m A	0	20	2			F	O	F		R	F												O		5	0			7					1	3		
10m B	5	20	2																						0	0			5	2					1	2	
15m A	5	20	2			O		A			A	O	O	O									R		4	0			2	1	3			1	1	3	
15m B	0	15	2																						6	2			6	3	1			1		4	
20m A	0	20	2			R		A			A	O											R		4	13			5	2				1	1	3	
20m B	0	20	2																						5	17			2	1	1					3	
25m A	0	60	2			O		O			A	F						R					R		6	5	1		1							2	
25m B	0	65	1																				R		18	32			5	1					1	4	
30m A	0	10	2	F		R					F	R													0	1			3	1						3	
30m B	0	15	2																				R		5	7			2							4	
35m A	0	40	2	D		R		R	R		O														3	7			1							5	
35m B	5	40	2																						5	9			1	1							2
40m A	5	40	2	D				R	R		R												O		1	0			2	2						1	
40m B	5	40	2																				O		1	0				1							1

A= replicate from left of line  
 B= replicate from right of line

**Table A2.1 – Transect 1**, relative abundances for the vegetation and numbers of *Vertigo angustior* found at each sample location during the mollusc survey at The Low’s, during this survey undertaken by Abrehart Ecology for the Little Ouse Headwater Project on 22<sup>nd</sup> September 2012.

<b>Transect 2:</b>	
Start Point:	Adjacent to the stock fence, TM 0330679186
End point:	at the dyke edge, TM 0325779165
Transect Length:	45m
Description:	The transect runs across the middle section of the marsh.
Direction:	North-east to South-west - 252°
Sampling frequency:	Every five metres
Results:	<p>The vegetation along this transect was a matrix of rush grasslands with a section of S4 <i>Phragmites australis</i> and an area of grazed Sedges.</p> <p>This showed that there is a low density population of <i>Vertigo angustior</i> across this section of the transect. The areas in the loose tussock vegetation held the highest density of 8 animals in a sample giving an approximate population density of over 72 animals per m<sup>2</sup></p>

Location	Thatch depth	Ht (cm)	Moisture	Dominant plants										Other plants		V. angustior		Other molluscs						
				Carex riparia	Carex acutiformis	Phragmites australis	Clethra hederacea	Juncus effusus	Juncus inflexus	Ranunculus repens	Folcus lanatus	Agrostis stolonifera	Mentha aquatica	Epilobium palustre	Urtica dioica	Adult	Juvenile	Vertigo pygmaea	Vertigo antvertigo	Carychium minimum	Cochlicopa cf. lubrica	Oxychilus sp	Euconulus alderi	Deroceras sp
0m A	0	40	2	O	F	R					F	R	O		0	0			1					1
0m B	0	40	2	O	F	R					F	R	O		0	0								3
5m A	0	30	2	F	O	R		R		A			O		2	0			1		2		1	3
5m B	0	30	2	F	F	R		R		A			O		1	0			1					4
10m A	0	25	2			R	O	O	A	R	F	D			3	1			1					3
10m B	0	25	3			F	O	A		F	D				4	2			3					1
15m A	0	30	2			O	F	A		O	D				2	2							1	1
15m B	0	30	2			O	O	F		F	D				5	3			2					2
20m A	0	20	2			R	F	A		F	A				4	0			1					2
20m B	0	20	2			O	O	A	R	O	D				3	0			1					1
25m A	0	10	2			O	O	F		F	D				2	1							2	3
25m B	0	10	2			F	O	A		F	A				2	1			1		1			4
30m A	0	15	2	D							R	O			3	0			2		1			1
30m B	0	15	2	D								R	O		2	2			2		1			1
35m A	0	20	3	D									O		4	1			2		1			1
35m B	0	20	3	D								R	O		3	2			1		2			1
40m A	0	35	3	D								R	O		2	1	1	1	2					1
40m B	0	35	3	D									O		1	1	1	3						1
45m A	0	40	2	O	R							R			2	2					1			
45m B	0	25	2	O	R		R			O	O				1	1	3							3

A= replicate from left of line

B= replicate from right of line

**Table A2.2 – Transect 2**, relative abundances for the vegetation and numbers of *Vertigo angustior* found at each sample location during the mollusc survey at The Low's, during this survey undertaken by Abrehart Ecology for the Little Ouse Headwater Project on 22<sup>nd</sup> September 2012.

<b>Transect 3:</b>	
Start Point:	Adjacent to the stock fence, TM 0329179240
End point:	at the dyke edge, TM 0323579211
Transect Length:	60m
Description:	The transect runs across the upper section of the marsh
Direction:	North-east to South-west - 252°
Sampling frequency:	Every five metres
Results:	<p>The vegetation along this transect was a matrix of rush grasslands with a section of S4 <i>Phragmites australis</i> and an area of grazed Sedges.</p> <p>This showed that there is a low to moderate density population of <i>Vertigo angustior</i> across the eastern section of the transect. The areas in the damp rank vegetation held the highest density of 27 animals in a sample giving an approximate population density of over 243 animals per m<sup>2</sup></p>

Location	Thatch depth	Ht (cm)	Moisture	Dominant plants														Other plants		V. angustior		Other molluscs											
				Carex riparia	Carex acutiformis	Phragmites australis	Glechoma hederacea	Juncus effusus	Juncus inflexus	Ranunculus repens	Galium aparine	Holcus lanatus	Agrostis stolonifera	Festuca rubra	Carex sp	Mentha aquatica	Urtica dioica	Adult	Juvenile	Vertigo pygmaea	Vertigo antiverigo	Carychium minimum	Cochlicopa cf. lubrica	Oxychilus sp	Deroceras sp	Cepaea nemoralis	Cepaea hortensis	Punctum pygmaeum	Arion sp				
0m A	0	30	2	O	F	F	O											A	21	6													4
0m B	0	30	2	O	F	F	O											A	18	4			3					1					
5m A	0	65	2	R	F	R	O	O	O								O	5	5													2	1
5m B	0	65	2	R	F	R	O	O	O								O	6	5			1										3	
10m A	0	40	2	R	O	R		F				F	F					6	3			2									4		
10m B	0	40	2	R	O	R		F				F	F					5	2					1							4		
15m A	0	5	2	O	O		R	O	O	F		F	A	R		R	R	3	4			3									2		
15m B	0	40	2	O	O		R	O	O	F		F	A	R		R	R	4	5			1					1						
20m A	0	5	3	F	F				O		D	A	R			R		4	0					1							1		
20m B	0	40	3	F	F				O		D	A	R			R		2	0			4											
25m A	0	20	3	F	F				O		A	A		F				1	0			1											
25m B	0	40	2	F	F				O		A	A		F				0	0												3		
30m A	0	5	2	O	R				F		A	D		F				0	0											3	1		
30m B	0	5	2	O	R				F		A	D		F				0	0			1									2		
35m A	0	70	2	O	R				A	F	F	F		F				0	0												4		
35m B	0	70	2	O	R				A	F	F	F		F				0	0			1									5		
40m A	0	60	2	O	R		R		F	F	O	F						0	0					1							3		
40m B	0	5	2	O	R		R		F	F	O	F						0	0					1	1								
45m A	0	60	2	O	R		R		F	O	O	F						0	0			1									2		
45m B	0	5	2	O	R		R		F	O	O	F			R			0	0												2		
50m A	0	60	2	D	R		R		O	O	O	F		F	R			0	0	1											3		
50m B	0	5	3	D	R		R		O	O	O	F		F	R			0	0			1									3		
55m A	0	60	3	D	O		R		R	O	O	A						0	0	1					1						4		
55m B	0	60	3	D	O		R		R	O	O	A						0	0			2	1								4	1	
60m A	0	20	3	D	O		R		O	O	F			R				0	0												1		
60m B	0	20	3	D	O		R		O	O	F			R				0	0			1											

A= replicate from left of line  
 B= replicate from right of line

**Table A2.3 – Transect 3**, relative abundances for the vegetation and numbers of *Vertigo angustior* found at each sample location during the *Vertigo angustior* survey at The Low’s, during this survey undertaken by Abrehart Ecology for the Little Ouse Headwater Project on 22<sup>nd</sup> September 2012.

Site	Grid reference - TM	National vegetation community (NVC)
PP1	01325-78954	S4 <i>Phragmites australis</i> swamp
PP2	01216-79086	S5 <i>Glyceria maxima</i> swamp
PP3	01216-79069	S5 <i>Glyceria maxima</i> swamp
PP4	01263-79079	MG1b <i>Arrhenatherum elatius</i> , <i>Urtica dioica</i> sub-community
PP5	01336-78932	S4 <i>Phragmites australis</i> swamp
PP6	01308-78936	W5 <i>Alnus</i> – <i>Carex paniculata</i> community
PP7	01412-78901	W5 <i>Alnus</i> – <i>Carex paniculata</i> community
PP8	01494-78858	W5 <i>Alnus</i> – <i>Carex paniculata</i> community
PP9	01356-78999	S6 <i>Carex riparia</i> swamp
PP10	01445-78976	S6 <i>Carex riparia</i> swamp
PP11	01484-78969	MG1b <i>Arrhenatherum elatius</i> , <i>Urtica dioica</i> sub-community
PP12	01427-78978	MG1b <i>Arrhenatherum elatius</i> , <i>Urtica dioica</i> sub-community
BB1	01555-78956	MG1b <i>Arrhenatherum elatius</i> , <i>Urtica dioica</i> sub-community
BB2	01575-78985	S25 <i>Phragmites australis</i> – <i>Eupatorium cannabinum</i> tall-herb fen
BB3	01639-78944	W5 <i>Alnus</i> – <i>Carex paniculata</i> community
BB4	01538-78921	MG1b <i>Arrhenatherum elatius</i> , <i>Urtica dioica</i> sub-community
BF1	01615-79030	S5 <i>Glyceria maxima</i> swamp
BF2	01601-79028	S5 <i>Glyceria maxima</i> swamp
BF3	01581-79024	S26 <i>Phragmites australis</i> - <i>Urtica dioica</i> tall herb fen
BF4	01557-79036	S6 <i>Carex riparia</i> swamp
BF5	01591-79063	S4 <i>Phragmites australis</i> swamp
BF6	01601-79079	S6 <i>Carex riparia</i> swamp
BF7	01617-79084	S6 <i>Carex riparia</i> swamp
BF8	01627-79083	S26 <i>Phragmites australis</i> - <i>Urtica dioica</i> tall herb fen
BF9	01631-79050	S6 <i>Carex riparia</i> swamp
BF10	01595-79054	S26 <i>Phragmites australis</i> - <i>Urtica dioica</i> tall herb fen
BN1	01826-79051	W5 <i>Alnus</i> – <i>Carex paniculata</i> community
BN2	01823-79024	W5 <i>Alnus</i> – <i>Carex paniculata</i> community
BN3	01766-79026	W5 <i>Alnus</i> – <i>Carex paniculata</i> community
BN4	01850-78983	W5 <i>Alnus</i> – <i>Carex paniculata</i> community with S7 <i>Carex acutiformis</i> swamp
BN5	01866-78951	MG1b <i>Arrhenatherum elatius</i> , <i>Urtica dioica</i> sub-community
BN6	01984-78961	S25c <i>Phragmites australis</i> – <i>Eupatorium cannabinum</i> tall-herb fen <i>Cladium mariscus</i> sub-community
BN7	01943-78981	S25c <i>Phragmites australis</i> – <i>Eupatorium cannabinum</i> tall-herb fen <i>Cladium mariscus</i> sub-community
BN8	02023-78833	MG1b <i>Arrhenatherum elatius</i> , <i>Urtica dioica</i> sub-community
BN9	01968-78846	MG1b <i>Arrhenatherum elatius</i> , <i>Urtica dioica</i> sub-community
BN10	01901-78859	MG1b <i>Arrhenatherum elatius</i> , <i>Urtica dioica</i> sub-community
TL1	03266-79231	S7 <i>Carex acutiformis</i> swamp
TL2	03250-79196	S7 <i>Carex acutiformis</i> swamp and S6 <i>Carex riparia</i> swamp
TL3	03300-79147	MG11 <i>Festuca rubra</i> - <i>Agrostis stolonifera</i> - <i>Potentilla anserina</i> grassland
TL4	03287-79113	S7 <i>Carex acutiformis</i> swamp and S6 <i>Carex riparia</i> swamp
TL5	03266-79063	S25 <i>Phragmites australis</i> – <i>Eupatorium cannabinum</i> tall-herb fen
TL6	03301-79065	S7 <i>Carex acutiformis</i> swamp and S6 <i>Carex riparia</i> swamp
TL7	03275-79085	S7 <i>Carex acutiformis</i> swamp and S6 <i>Carex riparia</i> swamp
TL8	03259-79067	S7 <i>Carex acutiformis</i> dkye margin
LF1	03467-79025	W5 <i>Alnus</i> – <i>Carex paniculata</i> community
LF2	03411-79052	W5 <i>Alnus</i> – <i>Carex paniculata</i> community
LF3	03401-79111	W2 <i>Salix cinerea</i> - <i>Betula pubescens</i> - <i>Phragmites australis</i> woodland
LF4	03392-79212	W2 <i>Salix cinerea</i> - <i>Betula pubescens</i> - <i>Phragmites australis</i> woodland
TF1	03898-79026	MG10 <i>Holcus lanatus</i> - <i>Juncus effusus</i> rush pasture
TF2	03901-79037	MG10 <i>Holcus lanatus</i> - <i>Juncus effusus</i> rush pasture
TF3	03884-79036	MG10 <i>Holcus lanatus</i> - <i>Juncus effusus</i> rush pasture
TF4	03876-79022	MG10 <i>Holcus lanatus</i> - <i>Juncus effusus</i> rush pasture
TF5	03835-79058	U1 <i>Festuca ovina</i> - <i>Agrostis capillaris</i> - <i>Rumex acetosella</i> grassland
TF6	03793-79032	U1 <i>Festuca ovina</i> - <i>Agrostis capillaris</i> - <i>Rumex acetosella</i> grassland
TF7	03766-79006	U1 <i>Festuca ovina</i> - <i>Agrostis capillaris</i> - <i>Rumex acetosella</i> grassland
TF8	03696-78957	MG1b <i>Arrhenatherum elatius</i> , <i>Urtica dioica</i> sub-community
TF9	03640-78969	MG1b <i>Arrhenatherum elatius</i> , <i>Urtica dioica</i> sub-community

# Appendix B:

Full taxonomic list for the mollusc species recorded in the samples collected from the sites within the LOHP reserves.

## Order Gastropoda

### Family

#### Ellobiidae

*Carychium*  
*tridentatum*  
*Carychium minimum*

### Family Physa

*Physa fontinalis*

### Family Lymnaea

*Lymnaea truncatula*  
*Lymnaea palustris*  
*Lymnaea peregra*

### Family

#### Planorbidae

*Planorbis carinatus*  
*Anisus vortex*  
*Gyraulus albus*

### Family

#### Succineidae

*Succinea putris*

### Family

#### Colchicopidae

*Colchicopa lubrica*  
*Colchicopa lubricella*

## Family

## Vertiginidae

*Vertigo pygmaea*  
*Vertigo moulinsiana*  
*Vertigo angustior*

## Family

## Pupillidae

*Lauria cylindracea*

## Family

## Punctidae

*Punctum pygmaeum*

## Family Discidae

*Discus rotundatus*

## Family

## Arionidae

*Arion ater*  
*Arion intermedius*

## Family Zonitidae

*Aegopinella pura*  
*Aegopinella nitidula*  
*Oxychilus cellarius*  
*Oxychilus alliarius*  
*Vitrea crystallina*  
*Zonitoides nitidula*  
*Nesovitrea hammonis*

## Family

## Agriolimacidae

*Deroceras laeve*  
*Deroceras reticulatum*

## Family

## Euconulidae

*Euconulus alderi*

*Euconulus fulvus*

## Family

## Clausiliidae

*Clausilia bidentata*

## Family Helicidae

*Monacha cantiana*

*Trichia hispida*

*Trichia striolata*

*Cepaea nemoralis*

*Candidula intersecta*

*Cepaea hortensis*

*Monacha cantiana*

*Trichia hispida*

*Ashfordia granulata*

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