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# Knepp Castle Estate baseline ecological survey

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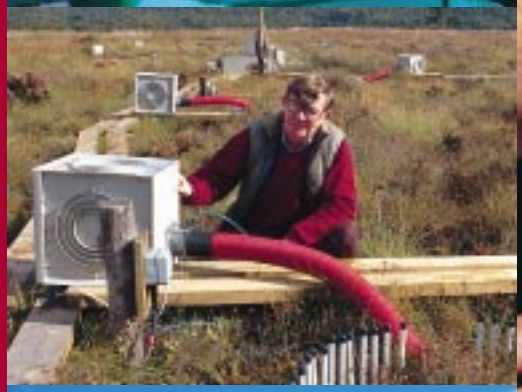

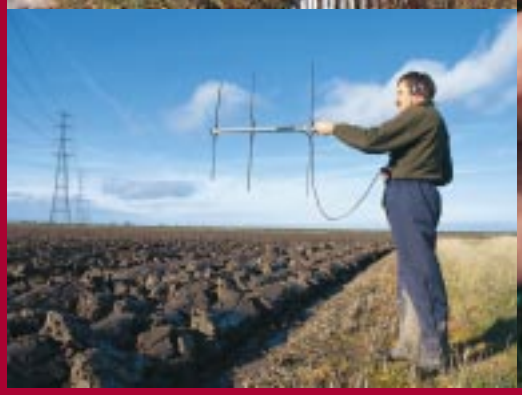

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# Knepp Castle Estate baseline ecological survey

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# Cover note

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# Preface

Using grazing animals as a management tool is widespread across the UK. However allowing a mixture of large herbivores to roam freely with minimal intervention and outside the constraints of livestock production systems in order to replicate a more natural, pre-industrial, ecosystem is not as commonplace. The Knepp Castle Estate project provides the opportunity to study and evaluate habitat and biodiversity changes that may result in one area of southern England when a more natural grazing regime is implemented.

Such changes cannot be assessed if there is no knowledge of the area of habitat types at the outset of a project and if there is similarly no knowledge of its flora and fauna. This report presents a baseline study of the ecology of Knepp Castle and is as comprehensive as the available resources would permit.

# Acknowledgements

Many people have contributed both to this report and to the Knepp Castle Estate project. I would first like to thank all those who carried out fieldwork or specimen identification in 2005, sometimes in weather conditions that were less than ideal. In alphabetical order, these are:

Professor Paul Buckland, Charlie Burrell, Mike Edwards, Mark Elliott, Dr Tim Freed, Peter Hodge, Rich Howorth, Paul James, Alexander Kent, Dr Gerald Legg, Andy Phillips, Yohanna Regis, Dr Patrick Roper, Kate Ryland, Anne Sanders, Fran Southgate, Dr Jacqui Middleton, Antonio Uzal, Dr Barrie Watson, Daniel Whitby and Dr Martin Willing.

Thanks also to those who read through the report, in particular Henri Brocklebank, Charlie Burrell, Jason Emrich, Rich Howorth, Dr Keith Kirby and Dr Tony Whitbread. Dr Anita Diaz helped with the planning of some of the fieldwork and gave advice on statistical analysis. Cath Laing produced the maps, and Charles Roper was always there to unravel technical difficulties.

Although already mentioned, particular thanks must be given to Charlie and Isabella Burrell, whose hospitality has been generous and without whom this project would not have been possible. On behalf of Tim Freed, Anne Sanders and Antonio Uzal, I would like to express thanks and gratitude to Charlie and Isabella for kindly putting them up overnight. Jason Emrich provided invaluable assistance in ensuring the fieldwork could take place; and finally, thanks also to the staff in the Estate Office for their help.

# Summary

Following World War II, the Knepp Castle Estate was, in common with much of southern England, under increasingly intensive arable management. The decision of its owner, Charlie Burrell, to return the Estate to a more natural environment has resulted in some 322 hectares being taken out of arable cultivation and instead grazed with a low number of cattle, pigs, ponies and deer. Intervention is minimal within compliance with UK legislation.

The interest in conservation grazing and near-natural grazing and the differences between these two systems is currently high, following Frans Vera's book *Grazing Ecology and Forest History* and the debate that this publication has subsequently engendered. However there are many as yet unanswered questions regarding how a near-natural system might operate in 21st Century Europe, despite the seminal example of Oostvaardersplassen in the Netherlands. By moving a considerable way towards near-natural grazing, the Knepp Castle Estate presents the chance to explore some of these issues.

Baseline ecological information is a prerequisite to evaluating the short, medium and long term changes that more natural grazing might drive on the Knepp Estate. Commissioned and voluntary fieldwork carried out in the summer of 2005 covered the following:

- Habitat survey
- NVC and vascular plant survey of the River Adur corridor across Knepp
- Lichen survey
- Fixed point photography
- Wetland Mollusca
- Odonata
- Lepidoptera
- Wetland Coleoptera
- Ant survey
- Pitfall trap invertebrates
- Amphibian survey
- Reptile survey
- Breeding bird survey
- Barn owls
- Bat survey
- Water vole survey
- Water shrew survey
- Dormouse survey
- Other small mammals (shrews, voles, mice) survey

Each of these surveys is presented in this report, although for reasons of size, much of the raw data is not presented here. As indicated throughout the report, this raw data and the digital photographs are available from the Record Centre Survey Unit.

The results of the surveys are discussed and future lines of research and surveillance are recommended. Although an objective of this report is that the information contained in it should be used to guide future research, surveillance and monitoring, it is not within its remit to develop such a strategy here. This study will provide a baseline against which any ecological changes resulting from a more natural grazing regime can be measured.

## Contents

# 1 Introduction

## 1.1 The Knepp Castle Estate

The Knepp Castle Estate lies to the south of Horsham, West Sussex (Figure1.1). Its long history has resulted in a number of features of archaeological, cultural and geological interest, including the remains of the original 11th century castle. Knepp Castle Estate originated in the Middle Ages, when it was one of King John's hunting parks. It now extends to a total of 1,416 hectares (3,500 acres). The original Estate seems to have been a hunting park throughout the mediaeval period, following which the land was used for iron working in the 16th century. Since this industry fell into decay, the Estate has been an area of farmland and woods (Knepp Castle Fact Sheet, 2005). Following World War II, it was increasingly under intensive farming. An unusual feature of the Estate is that its historic field system has largely been retained. Many fields are 4 hectares (10 acres) or less, and are still bordered by hedgerows.


**Figure 1.1** Location of Knepp Castle Estate.

The Estate lies within the Low Weald Natural Area (English Nature, 1997) and has a heavy clay soil. It is traversed by the River Adur and some of its tributaries. Kneppmill Pond is a hammer pond constructed for nearby iron workings prior to 1568. It is, at the time of this Report in 2005, currently the subject of an Environmental Assessment prior to major dredging works that are essential to prevent further reduction in the area of open water caused by progressive siltation (Chris Blandford Associates, 2003). There are two Sites of Nature Conservation Interest (SNCI) on the Estate - H18 Kneppmill Pond, the River Adur and Lancing Brook, Shipley; and H30 Horsham Common, Alder Copse, Coate's Furzefield and Constable's Furze, Southwater. These were designated in 1992 by West Sussex County Council. SNCIs are non-statutory designations.

## 1.2 Vision for Knepp Castle Estate

### 1.2.1 Development of the vision

Charlie Burrell, the present owner, has had a life-long ambition to recreate the landscape designed by Humphry Repton. This was probably laid out when the modern Knepp Castle was built by the architect John Nash in about1806 (Knepp Castle website, www.knepp.co.uk). As steps were taken to achieve this restoration, the project grew and developed into a far more ambitious scheme to create a landscape-scale park in which a variety of large herbivores would roam freely. As far as possible, these animals would be 'de-domesticated'. Near-natural grazing would be replicated with the animals utilising the land with as little human intervention as possible. The intention is that this near-natural grazing system will ultimately include a large part of the Knepp Castle Estate.

The River Restoration Centre, in conjunction with the Environment Agency and Defra, also proposes to're-wild' part of the River Adur as it crosses the Estate. This involves restoring the Adur floodplain to its natural function and the river itself as far as possible to its original course before it was subjected to canalisation.

### 1.2.2 The first stages

Knepp Castle Park has 'historic parkland' status, and it has thus been possible to revert large areas from arable to parkland under Defra's Countryside Stewardship Scheme (CSS), a reversion of historical relevance (Knepp Castle Fact Sheet, 2005). Further historic and location details are available in the Register of Parks and Gardens of Special Historic Interest, 2000.

The restoration of the deer park began in 2001, when some 202 hectares (500 acres) of this former park were taken out of arable and commercial grassland. This land was deer fenced and internal boundary fences were removed (Knepp Castle Fact Sheet, 2005). The ground was 'sterilised' by continual cultivation and spraying with herbicide, and subsequently planted with native grasses. This seed mix comprised:

| | |
|---|---|
| Cocksfoot | *Dactylis glomerata* |
| Common bent | *Agrostis capillaris* |
| Creeping bent | *Agrostis stolonifera* |
| Crested dog's tail | *Cynosurus cristatus* |
| Large-leaved Timothy | *Phleum pratense* |
| Meadow fescue | *Festuca pratensis* |
| Red fescue | *Festuca rubra ssp. rubra* |
| Sheep's fescue | *Festuca ovina* |
| Smooth meadow grass | *Poa pratensis* |
| Sweet vernal grass | *Anthoxanthum odoratum* |
| Velvet bent | *Agrostis canina* |
| Yorkshire fog. | *Holcus lanatus* |
| Essex broadleaf red clover | *Trifolium pratense cv* |

About 28 hectares (70 acres) sown with the above also included the following wild flower seed mix:

Betony *Stachys officinalis*
Black knapweed *Centaurea nigra*
Bulbous buttercup *Ranunculus bulbosus*
Common bird's-foot trefoil *Lotus corniculatus*
Greater bird's-foot trefoil *Lotus pedunculatus*
Cat's ear *Hypochaeris radicata*
Common mouse ear *Cerastium fontanum*
Common sorrel *Rumex acetosa*
Devil's-bit scabious *Succisa pratensis*
Lesser stitchwort *Stellaria graminea*
Meadow buttercup *Ranunculus acris*
Meadow vetchling *Lathyrus pratensis*
Mouse-ear hawkweed *Pilosella officinarum*
Ox-eye daisy *Leucanthemum vulgare*
Ribwort plantain *Plantago lanceolata*
Red clover *Trifolium pratense*
Tufted vetch *Vicia cracca*
Yarrow *Achillea millefolium*
Yellow rattle *Rhinanthus minor*

Fallow deer were introduced from Petworth and Gunton Parks in February 2002, longhorn cattle in June 2003, followed by six Exmoor ponies in November 2003 and a stallion in 2005. Roe deer were already present on the Estate and in the wider countryside, and special gates allow them freedom to roam. There are probably about a dozen within the deer fence at any one time (Jason Emrich, Knepp Estate Manager, pers. comm.).

In 2004, the deer park was extended by a further 106 hectares (261 acres). About 35 hectares (86 acres) of this were already in CSS, and the remainder was entered into CSS at this time. This brought the size of the deer park to over 283 hectares (700+ acres). The additional area of land entered into CSS in 2004 was treated differently. Following the removal of wheat and rape, the seed beds were cultivated, sprayed with herbicide and drilled with the following mixture of stewardship grasses:

20% chewings fescue *Festuca rubra* ssp *commutata*, meadow fescue *Festuca pratensis.*

15% smooth stalked meadow grass *Poa pratensis.*

10% crested dog's tail *Cynosurus cristatus*, tall fescue *Festuca arundinacea*, cocksfoot *Dactylis glomerata*, common bent *Agrostis capillaris*, small timothy *Phleum bertolinii*, applied at 20kg/ha.

In addition, this land was broadcast with Essex broadleaf red clover at 0.5kg/ha, and a mixture of:

| | |
|---|---|
| Oxeye daisy | *Leucanthemum vulgare* |
| Birdsfoot trefoil | *Lotus corniculatus* |
| Black knapweed | *Centaurea nigra* |
| Ladies bedstraw | *Galium verum* |
| Ragged robin | *Lychnis flos-cuculi* |
| Agrimony | *Agrimonia eupatoria* |
| Sweet vernal grass | *Anthoxanthum odoratum* |
| Quaking grass | *Briza media* |

applied at 250g/ha (Knepp Castle Fact Sheet, 2005).

In early January 2005, two Tamworth sows and their eight piglets were introduced. This brought the stocking levels up to an estimate of around 550 animals for summer 2005 (Jason Emrich, pers. comm.) – about 500 deer, 6-10 ponies, 16 cattle with 13 calves and 10 sows.

At the time this report was prepared (December 2005), a further area north of the A272 had also been entered into CSS and is currently undergoing 'reversion' to parkland. This brings the project area to approximately 322ha.

## 1.3 Rational and background

### 1.3.1 Landscape-scale ecology

Much attention has traditionally been given to studies on the ecology and behaviour of individual species or small communities, typically on timescales of three years or less and spatial scales of 10m or less. This may accord well with constraints integral to the timescale and funding of academic research but today, the pressing concerns of conservation biology are on longer time scales, and vastly greater spatial scales (May 1994).

The 'Single large or several small' debate has been going on since the 1970s and the limitations of both options were summarised by Rosenweig (1995). The concept of 'stewardship' (Whitbread and Jenman, 1995) accords well with the management of small reserves. However, doubts about the effectiveness of this strategy to conserve biodiversity, and the high economic cost of maintaining small areas of habitats and populations of species of high conservation concern, are resulting in increasing support for large-scale areas in which natural or near-natural processes drive biodiversity conservation. Linking nature and planning on a landscape scale has numerous advantages over conservation in small fragmented reserves, and is now considered to be an essential approach in the conservation of biodiversity in Europe (Hodder & Bullock 2005).

One of the drivers progressing landscape-scale conservation in Europe has been Natura 2000 which in turn derived from the Habitats Directive (Council Directive on the Conservation of Natural Habitats and Wild Fauna and Flora 92/43/EEC) and the Birds Directive (79/409/EEC). This initiated a European network of protected nature areas. In the Netherlands, the National Ecological Network comprises a spatially coherent network of existing and new nature areas that should be ready by 2018 (Anon 2004). In Britain, the concept of restoring near-natural ecosystems by near-natural processes was expounded by Whitbread and Jenman in 1995.

### 1.3.2 Grazing as a driver for landscape scale ecological processes

Frans Vera's study of the effects of grazing on forest history (Vera 2000) has excited much interest, invoked much support, raised a number of issues and provoked considerable discussion if not dissent - all of which have served to enliven and enrich ecological theory and, it is to be hoped, practice. This report is not the place to engage upon an evaluation of Vera's lengthy dissertation, but quoting the null and alternative hypotheses may be useful:

> Null hypothesis: "That pedunculate and sessile oak and hazel survive in a closed forest and regenerate in gaps in the canopy in accordance with Watt's gap phase model (1947) and Leibundgut's cyclical model (1959, 1978). Large herbivores present in the natural state are dependent on the developments of the vegetation. According to this hypothesis, they do not have an influence on the course of the succession and regeneration of forests."
>
> Alternative hypothesis: "That the natural vegetation consists of a mosaic of large and small grasslands, scrub, solitary trees and trees growing in groups (groves), in which the indigenous fauna of large herbivores is essential for the regeneration of species of trees and shrubs which are characteristic in Europe. According to this hypothesis, wood-pasture should be seen as the closest modern analogy of this landscape."

Vera's thesis itself was based largely on a literature search. English Nature's interest in Vera's theories resulted in an initial evaluation of his seminal work (Kirby 2003) followed by a further report by Hodder and others (2005), which concluded that the case for Vera's alternative hypothesis was not proven. Apart from the historical validity (or not) of this hypothesis, there is, however, considerable interest in the use of grazing as a way of generating diverse modern landscapes, inspired to some extent by the Dutch Oostvaardersplassen reserve.

Oostvaardersplassen is one component of the Dutch ecological network. Derived from reclaimed polderland in 1968, it is now a 5,600ha nature reserve (Whitbread & Jenman 1995) that has become one of the most influential examples of management by the implementation of near-natural processes. The role of free-ranging herbivores in this system has inspired a huge amount of interest, influencing theoretical ecology as well as practical conservation. However Oostvaardersplassen is unlikely to have any direct analogue in the UK. It started from a low-biodiversity baseline of reclaimed land, inheriting no protected species or priority habitats. The grazing can truly be said to be 'near-natural' grazing rather than 'conservation grazing'. By contrast, in the UK, conservation grazing has tended to be implemented to maintain specific open landscapes or historical pasture woodlands.

It might be useful at this point to summarise what is meant by 'naturalistic' or 'near-natural' grazing and 'extensive' or 'conservation' grazing. These terms do not have formal definitions but depend on compliance or otherwise with the adherence to natural processes, and the following summary is based on Hodder & Bullock (2005). Thus in naturalistic grazing, there would be no specified grazing density, the grazing animals would be the key ecosystem drivers and natural processes would be allowed to proceed. Herbivore populations would be limited by resources, fluctuating according to the amount of food available, the vicissitudes of climate and the impacts of parasites and pathogens. The natural process would be seen as an aim in itself. By contrast, the practice of extensive or conservation grazing systems acts as intervention that is aimed at achieving targets for habitat and species composition.

In practice, grazing regimes such as that currently in place at Knepp lie somewhere between these two ends of the scale. The main reason for this is that although large in the context of lowland England reserves, the Knepp Estate is still too small to allow 'natural' population fluctuation, especially in the absence of large predators. The term 'more natural', despite its lack of definition, is therefore used in this report, indicating the intention to allow grazing that is as naturalistic as possible within certain constraints.

### 1.3.3 The need for more research

Although giving a stimulating incentive to ecological theory, relating Vera's theory to biodiversity conservation is fraught with complexity. Kirby (2003) cites Olff and others (2002), who question whether releasing free-ranging large grazers in former agricultural areas will really counteract the ongoing loss of biodiversity, as it is intensive agricultural practices themselves that have contributed to this loss. Putting a number of large grazers onto arable reversion land thus feeds into the Vera cycle on a far more impoverished level than would have been the case in pre-industrialised Europe. Rewilding including the restoration of 'naturalistic' grazing may be the optimal conservation strategy for the maintenance and restoration of biodiversity in Europe (Vera 2000), but in the short term, it may be unrealistic to expect much increase in biodiversity, certainly as far as the less mobile species are concerned.

The impacts of a given cattle grazing regime on a particular woodland cannot yet be predicted, and Armstrong and others (2003) collated information from cattle-grazed woodlands across the UK. Although focussing on conservation grazing by one kind of herbivore (cattle), this study nevertheless gives a large amount of information gleaned from visited and unvisited grazed woodland sites. Much of this information is subjective and the authors observe that at many sites some form of quantitative monitoring was undertaken but results seldom analysed or written up.

The primary objectives for grazing sites may be very different – for example, wilderness creation, biodiversity conservation or enhancement or to maintain an open habitat such as heathland or wood pasture. In Holland as well as in the UK, grazing has been used as a conservation tool, particularly on open biotopes such as grasslands and heath (Ausden and Treweek 1995; Kuiters 2002; Symes & Day 2003), and increasingly, grazing in woodlands is being considered (Armstrong and others 2003). Extracting rigorous scientific information from these, or monitoring the effects of grazing is hampered both because there has been no inventory of the site prior to the introduction of grazing and also because other management measures are implemented at the same time (Kuiters 2002; Sutherland 1995). Kuiters also comments that there has been little research on the effects of grazing on the underlying processes of soil microclimate, and the resultant knock-on effects on seed germination, seedling recruitment, invertebrates and reptiles. Studies are often limited spatially and temporally, and their results may appear contradictory. Further knowledge is needed on the underlying mechanisms driving habitat dynamics and diversity both with and in the absence of grazing, and this is relevant to all sites at all scales. Grazing-related issues identified by Kuiters (2002) as needing further research can be summarised as follows:

- Research into underlying processes influenced or affected by grazing.
- Evaluation of effects of grazing on flora, in relation to soil type, topography and other factors.
- Research on effects of grazing on fauna.
- Further exploration of Vera's work
- Role of thorny scrub in woodland regeneration in relation to soil type.
- Grazing density and timing.

### 1.3.4 Other issues

Apart from the issues raised above, near-natural grazing brings with it a number of other issues that need to be addressed. Many of these have been identified, and continue to be appraised, in the Oostvaardersplassen project (Van Leewen and others 2003).

- Animal health – risk to farm livestock from spread of diseases such as foot-and-mouth disease.
- Human health – transference of diseases such as anthrax to humans.
- Animal welfare – issues include loss of condition in winter, supplementary feeding that reduces the 'near-natural' ethic; dealing with ill, injured or very old animals; use of preventative treatments such as antihelminthetics.
- Control of animal numbers - lack of predators means less fit animals are not weeded out of the system naturally. Stock may suffer progressive loss of condition and health unless they are 'artificially' culled.
- Herbivore corpses - by law these have to be removed.
- Public acceptance – people often reluctant to embrace changes in what they perceive as their 'natural' surroundings.
- Potential danger to humans – some breeds are more aggressive, or more aggressive at particular times of year, than others.

Reconciling the needs of a near-natural grazing regime with these issues is likely to be difficult. Should the aim be for a consistent number year after year, or should an attempt be made to replicate 'boom and bust' cycles that may have existed naturally? Hard winters, parasite load, predators and summer drought would all have taken their toll in a natural situation, though seasonal migration would have helped to mitigate the adverse impacts of these. Overmars and others (2003) discuss social structure and heredity in natural grazing. However the more intervention there is with regard to animal numbers and so on, the less the system can be regarded as near-natural.

Koene (2003) explores what is meant by 'de-domestication'. This is an important issue. Humans like the idea of 'natural' herds of large herbivores but we do not want them to kill us. In the original plans for park restoration, Charlie Burrell rejected red deer introduction because of the danger they might pose to his children. So it is essential in order to gain and maintain public support to differentiate 'wild' in the sense of 'untamed' but not 'wild' in the sense of 'savage'. Koene asks whether we want the animals to adapt to their natural surroundings or do we want to adapt the surroundings to the animals?

Charlie Burrell also has other factors to take into consideration. Running a large estate requires a large income and involves numerous liabilities such as inheritance tax, which are a drain on resources both now and in the future. With these in mind, as well as the drive to reinstate near-natural grazing, the Estate also needs other income-raising ventures. Some of these, such as the possibility of developing a natural environment tourist experience, are compatible with more exclusively ecological interests. Other activities such as polo, deer stalking and pheasant shooting, although all traditional rural pursuits, do not have quite the same compatibility. Programmes for ecological research and monitoring long-term ecological changes should take these other functions of the Estate into account.

## 1.4 Near-natural grazing at Knepp

The area at Knepp currently under restoration stands at about 322ha, which is just under a quarter of the entire Estate. It is projected that the area under near-natural grazing will increase, and an additional 1,000ha (approximate) may have potential for inclusion. However, although the area considered for the baseline survey work is already far larger than each of the largest three Sussex Wildlife Trust reserves (Malling Downs 215.5ha, The Mens 159.4ha and Ebernoe / Butcherlands 158ha), it is still comparatively small. Even if the entire Estate were put under a more natural grazing regime, the area involved would only be a quarter of the size of Oostvaardersplassen. Nevertheless, this site provides an opportunity for exploring more naturalistic grazing in the short, medium and long-term.

Despite its small size relative to reserves in mainland Europe, Knepp has attracted keen interest from a number of experts, many of who have visited Knepp since the first moves to reinstate the mediaeval deer park. The opinions and advice of those such as Hans Kampf (Senior Policy Adviser, Ecosystem and the Environment), Frans Vera (Staatsbasbeheer / National Forest Service), Keith Kirby (English Nature), Tony Whitbread (Acting Chief Executive, Sussex Wildlife Trust), Paul Buckland (University of Bournemouth), Ted Green and Jill Butler (Veteran Tree Initiative), Julian Smith (landowner) and others have all helped to shape the direction in which the project has developed.

The rationale outlined by Whitbread and Jenman (1995) has guided the development of much of Sussex Wildlife Trust's recent conservation thinking and has resulted in a number of initiatives that are particularly complementary to the Knepp project. The major project that the Trust is leading is the West Weald Landscape Project, which is primarily funded by English Nature, the Heritage Lottery Fund, Sussex Wildlife Trust and the Environment Agency. This project is focused on a 23,820ha area at the western end of the Low Weald in the Surrey and West Sussex border area. It encompasses Ebernoe Common and The Mens, two SACs that are owned by Sussex Wildlife Trust. Chiddingfold Forest SSSI, in the north of the area, straddles the county boundaries and is owned and managed by Forest Enterprise. This project is focused promoting the integrated management of the landscape for the benefit of the people and wildlife that live there. It is also working towards using more naturalistic grazing systems in some areas with the ultimate aim of reconnecting isolated landscape features to create an interconnected mosaic of dynamic habitats across core parts of the project area.

The Ebernoe reserve now includes a series of old arable fields purchased from Butcherland Farm in 2001 with the help of the Heritage Lottery Fund. The aim of this acquisition is to enable the expansion of pasture woodland into the surrounding landscape, taking the pressure off Ebernoe Common SAC where a number of species with conflicting interests occur. The West Weald project is using this area to demonstrate how processes such as more natural, extensive grazing can be employed to restore this type of landscape. Being able to carry out long-term surveillance on Ebernoe/Butcherlands and Knepp together to explore the effects that more natural grazing has on vegetation process and biodiversity will be of considerable scientific interest. This work should contribute significantly to our understanding of the role that less rigidly structured grazing systems may play in 21st century landscape management and conservation.

The advantages of the Knepp Estate as a site to explore more extensive grazing may be summarised as follows:

- With the exception of 2 SNCIs and a few COGS (County Geological Sites) and English Heritage features, no part of Knepp Estate is designated SSSI, SAC or has other protected landscape status.
- There are no rare or protected species for which conservation management measures have already been introduced on site.
- It benefits from an owner who is extremely enthusiastic about and supportive of naturalistic grazing and re-wilding schemes .
- The intention to introduce a more natural grazing regime is highly complementary to SWT's West Weald Landscape Project and the restoration of the Butcherlands acquisition by natural processes.
- The grazing project will run in tandem with the River Restoration Centre's and the Environment Agency's plans to restore and 're-wild' the stretch of the River Adur that crosses the Estate.
- Knepp Castle Estate presents an opportunity for exploring some of the issues raised in both landscape scale conservation and the issues of 're-wilding' and 'naturalistic grazing'.

It is understood that the Estate is also hoping to qualify for grants under Defra's new Higher Level Stewardship (HLS) scheme. Biodiversity and habitat information obtained during this project will be used to produce a Farm Environment Plan in the event that the Estate applies for this.

## 1.5 The aim of Knepp Castle project

### 1.5.1 The aim

The overall aim of the Knepp Castle near-natural grazing project is to record and evaluate changes in the biodiversity and vegetation structure following the reversion of land under intensive arable management to a more natural grazing regime. The research emphasis will be the processes driving such changes and their effects at a landscape scale.

It is very rare, especially in southeast England, to have the opportunity to evaluate ecological changes and issues on a site as large as Knepp. This opportunity is immeasurably enhanced by the vision and active participation of its owner. However, such good fortune brings with it certain difficulties. With so much potential for research and survey, keeping this project running along the original brief (Appendix I) has not been straightforward, and indeed, as the baseline study progressed, it has been advantageous to modify and extend the brief.

### 1.5.2 Objectives to achieve the aim

- Preparation of a baseline biological inventory.
- Development of a monitoring strategy, including the recording and evaluation of:
  - changes in vegetation structure and communities;
  - changes to habitat pattern and distribution;

    - changes to vegetation species composition with time;
    - changes to habitat pattern across zones of likely change;
    - changes in the abundance and distribution of key plant species / groups with habitat change over time;
    - changes in the abundance and distribution of key animal species / groups with habitat change over time;
    - the impacts, positive and negative, of near-natural grazing on the Estate over time.
- Inform the River Adur restoration project and contribute to its subsequent evaluation.
- Identification of appropriate areas of research.

**Actions taken:**

- Phase 1 Baseline report (Greenaway 2005).
- Planning, commissioning and carrying out fieldwork during 2005.

**Targets facilitated by 2005 baseline surveys:**

- Interpretation of baseline information.
- Guidance of research initiatives.
- Planning of long-term monitoring strategy.
- Instigation of monitoring programme with appropriate resources.
- Evaluation of effects of near-natural grazing on existing biodiversity / landscape.
- Evaluation of effects on rare / protected species.
- Evaluation of effects on hedgerows.
- Evaluation of effects on woodland community and structure.
- Evaluation of scrub development.
- Evaluation of tree regeneration with relation to scrub development.

Although not part of the overall aim of this project, within these objectives there is considerable scope for additional studies including those involving single species or taxa and small-scale habitats.

## 1.6 Project management

### 1.6.1 Organisation

The Record Centre Survey Unit was commissioned by Sussex Wildlife Trust and English Nature to carry out an initial desk study and scoping report (Greenaway 2005), followed by a baseline ecological survey. The fieldwork commissioned as part of this baseline survey forms the main component of this report. The maps presented in both the main report and the Appendix were prepared by Cath Laing, Sussex Biodiversity Record Centre, who digitised field data using GIS Arc View 8 software. Technical support was provided by Charles Roper, SxBRC.

The scoping report (Greenaway 2005) collated all existing biological information held on the Knepp Castle Estate. This historical information was at best patchy and incomplete, although there were some good datasets. In order to fulfil the aims of this project, it was considered that that a baseline ecological audit of the estate was essential if monitoring was to be meaningful and the effects of the proposed near-natural grazing were to be correctly assessed.

The Knepp Castle Estate is large, and despite generous funding, there was simply not enough financial resource to cover all taxa. Baseline audit requirement had thus to be strictly prioritised. Parts of the Estate likely to provide the most useful ecological information were selected and a number of surveys were commissioned (Table 2.2.a) by the Survey Unit in spring 2005.

Concurrently, Charlie Burrell invited Professor Paul Buckland (University of Bournemouth) to Knepp in order to discuss the project. This resulted in the collaboration of the Estate, the University of Bournemouth and the Survey Unit in the organisation and management of additional field survey work. In addition, the West Weald Landscape Project contributed 17.5 days of survey time. Other individuals have also volunteered their time and expertise. These contributors are also shown Table 2.2.a. This additional participation has augmented the ecological audit considerably. Each individual report is presented in Chapter 3. References are given at the end of each section except for Section 3, where they are placed at the end of each survey report.

The Survey Unit feels immensely privileged to have been able to participate in the Knepp project. With so much waiting to be explored, surveyed, assessed and evaluated, keeping the work within budget has been a difficult task that has required ruthless prioritisation. Those who have been commissioned have worked far beyond what was strictly required in their short contracts. Those who have given their time and expertise freely have made a most valuable contribution to the amount of information collected. On behalf of the RCSU and SWT, I would like to thank everyone who has contributed to the work that has now been incorporated into this report. I hope that all will feel that the time spent was worthwhile, and that all will be pleased to see the results of their own and other people's endeavours.

### 1.6.2 Funding

This project has been generously funded by Sussex Wildlife Trust, English Nature, Charlie Burrell and the Environment Agency.

# 2 Field survey work 2005

## 2.1 Selection process - rationale

A baseline biological inventory would ideally cover all taxa, but this is very rarely achievable. Even on a small site, there is seldom sufficient financial resource to cover professional costs, and insufficient time even for willing volunteers to survey all groups of flora, fauna and fungi. The Knepp Castle Estate was no exception, and survey work had to be strictly prioritised.

The decision process was guided by the need to meet the objectives stated in Section 1.5.2. The following questions were postulated in order to identify the priority data requirements:

- What ecological information is currently available?
- What further information is required to enable monitoring the effects of a) more natural grazing on arable reversion land; b) the restoration of natural watercourse and floodplain of the River Adur?

The intention was to target those specific areas of information collection that would be most valuable in terms of guiding ecological research and preparing a monitoring strategy. However, it takes time to carry out effective fieldwork, and the extent to which this could be commissioned was limited. The contributions of the University of Bournemouth and the enthusiastic volunteers have significantly enhanced the extent of information collected. A list of all those who contributed to this project in 2005 can be seen in Table 2.2.a.

## 2.2 People and organisations involved

**Table 2.2.a Surveys and surveyors**

| Fieldwork | Surveyor | Status |
|---|---|---|
| Extended Phase I habitat | Kate Ryland | Contractor |
| Belt transects | ditto | ditto |
| Aquatic vascular plants | ditto | ditto |
| Lichens | Sussex Lichen Group | Voluntary |
| Soils & vegetation analysis* | Anne Sanders | Student, Univ. of Bournemouth |
| Pond condition survey | Mark Elliott | WWLP ** |
| NVC Floodplain | Rich Howorth | WWLP |
| Fixed point photography | Rich Howorth | WWLP |
| Wetland Mollusca | Martin Willing | Contractor |
| Spiders* | Andy Phillips | Voluntary |
| Collembola | Gerald Legg | Voluntary |
| Odonata | Paul James | Contractor |
| Lepidoptera – moths | Tim Freed | Contractor |
| Lepidoptera - butterflies | Rich Howorth | WWLP |
| Diptera | Patrick Roper | Voluntary |
| Wetland beetles | Peter Hodge | Contractor |
| Grassland beetles | Paul Buckland | Univ. of Bournemouth |
| Hymenoptera | Mike Edwards | Voluntary |
| Ants | Alex Kent | Voluntary |

| Fieldwork | Surveyor | Status |
|---|---|---|
| Amphibians | Mark Elliott | SWT |
| Reptiles | Charlie Burrell | KCE |
| Breeding birds | Paul James | Contractor |
| Barn owls | Barrie Watson | SOS |
| Bats | Daniel Whitby | Contractor |
| Water voles & otters | Fran Southgate | SORP |
| Dormouse | Rich Howorth | WWLP |
| Small mammals | Yohanna Regis | Student, Univ. of Brighton |
| Pigs & patch dynamics* | Antonio Uzal | Student, Univ. of Bournemouth |

*These survey reports have not yet been received
**West Weald Landscape Project

When setting the methodology for each survey, the aims were that it should follow recognised procedures wherever possible and that it should be scientifically robust and repeatable. Seven of these were commissioned by Survey Unit and all others were voluntary. Each report is presented in Section 3. Any raw data not included is available from the Record Centre Survey Unit.

# 3 Survey reports

The parts of Knepp Castle Estate in which most of the surveys took place are shown on Map 1. This map shows land that was taken out of arable, reseeded in 2001 and put to grazing in 2002 (Area A); land that was taken out of arable, reseeded in 2004 and grazed in 2005 (Area B), land that was taken out of arable in 2004 but not scheduled for naturalistic grazing until 2006 (Area C) and land taken out of arable plus some semi-improved grassland (Area D). The stretch of the River Adur and its floodplain that was surveyed lies within Area B. Other parts of the site are either woodland, or are still under arable, still grazed by farm livestock or have been taken out of arable with no further treatment.

## 3.1 Vegetation and vascular plant surveys

### 3.1.1 Survey brief

Habitat mapping has never been carried out on the Estate, and neither has it been the subject of a full botanical survey. The areas designated as SNCIs (Horsham Common Complex and River Adur and its tributaries) were surveyed in the 1980s, and there are also a number of other casual vascular plant records. A comprehensive habitat survey was considered to be a key element of the baseline inventory.

Kate Ryland (Dolphin Ecological Surveys) was commissioned to:

- Carry out a habitat survey of the entire area that was proposed for near-natural grazing at May 2005.
- Record vascular plants along eight 30m belt transects in four selected areas.
- Record aquatic and bankside vascular plants along the stretch of the River Adur crossing Knepp Castle Estate (commissioned by Fran Southgate, Sussex Otters and Rivers Project Officer).

### 3.1.2 Methodology

**Habitat survey**

The habitat survey was extended Phase I methodology plus target notes. This survey was carried out in May and June 2005. Where possible, the Higher Level Stewardship (HLS) Farm Environment Plan feature codes were used so that the map produced would be useful not only to ecological objectives but also in the event that the Estate submits an application for a grant under this scheme. The habitat survey was carried out prior to the rest of the planned fieldwork and it also provided guidance for some of it, for instance indicating sites where surveys for dormouse *Muscardinus avellenarius* surveys might best be focussed.

**Belt transects**

Two 30m belt transects were set up in each of the four areas A, B, C and D (Map 1, Table 3.1.a). These areas were selected because they each had different treatments: Area A (reseeded 2001, grazed 2002), Area B (reseeded 2004, grazed 2005), Area C (reseeded 2004, grazing 2006); Area D (semi-improved grassland). Initially it was intended to survey

eighteen 2m x 2m contiguous quadrats along these transects. This was subsequently reduced to fifteen quadrats. The contiguous quadrats were laid out from the transect marker post in the direction indicated on the post.

All vascular plants were recorded on the separate recording sheets with species abundance estimated in each using the DOMIN scale. The average height of the vegetation within each quadrat was also measured (Appendix II). These belt transects were planned to enable changes in vegetation structure and species composition of vascular plants to be monitored over time. The detailed information obtained will also facilitate changes in the abundance and distribution of key plant species to be monitored. Digital photographs were taken along the line of each transect. These, and the raw transect data, are available from the Record Centre Survey Unit.

**Table 3.1.a Position of transects**

| Transect Number | Location | Direction of Transect | Description of Location |
|---|---|---|---|
| A1 | TQ15272 22284 | East | South end of Matches Wood, approximately 9m into woodland over an open bank |
| A2 | TQ15184 22346 | North-north-east | North edge of Spring Wood, approximately 10m into woodland |
| B1 | TQ15752 20553 | West | Mid point on the western edge of Jacksons Wood, approximately 10m into the woodland over a bank and ditch |
| B2 | TQ16067 20643 | North | North edge of Swallows Furzefield, ¼ of the way from the western edge of the wood, approximately 10m into the woodland over a bank |
| C1 | TQ16146 23713 | East | Eastern edge of Coates Furzefield, ½ way along the edge, approximately 12m into the wood on the ride edge near a tall birch tree. A fallen branch from the wood edge into the field crosses the barbed wire fence and marks the location |
| C2 | TQ15756 23624 | East | Eastern edge of Alder Copse, approximately 10m into the woodland at a path into the wood |
| D1 | TQ14810 20106 | East-north-east | Western side of lagg on the southern edge, approximately 1m from the hedgerow and approximately 7m north of a mature oak tree. Transect hits the ditch to the south of the hawthorn shrub |
| D2 | TQ14427 20225 | North | South edge of Lancing Brook lagg, approximately 1m from the hedge |

**Botanical survey of River Adur and Lancing Brook**

A botanical survey of stretches of the River Adur and Lancing Brook running through the Estate was carried out on 17 August 2005 in hot, dry weather conditions. The survey covered aquatic plants found within the channel, marginal species and plants growing on the banks of the watercourses up to the change of slope at the top of the banks. Aquatic vegetation was sampled at regular intervals along the watercourses using a grapnel. A list of vascular plant species observed in these zones was prepared for each distinct section of the watercourses and a measure of their abundance given on the DAFOR scale (D = Dominant, A = Abundant, F = Frequent, O = Occasional, R = Rare and L = Locally).

The aquatic and bankside flora survey was requested by the River Restoration Centre in order to provide a baseline against which any benefits from re-wilding the river and its floodplain

could be measured. These botanical surveys will also facilitate the evaluation of the effects of grazing on any species of conservation interest recorded, and identify any potential conflicts of interest.

### 3.1.3 Constraints

The habitat survey took longer than initially projected, due entirely to the size of the area surveyed. Because of this, the transects were shortened from the original, planned 50m to 30m and the number of quadrats was reduced to 15. This was felt to be sufficient to record the sward composition within the fields and cover the important ecotone between woodland and grassland areas.

Grassland management had included both mowing and grazing prior to transect recording, which in some cases made species identification difficult. This is especially true in transects D1 and D2 that were horse grazed during the survey and were also very parched. There are likely to be omissions in the species lists for these two transects in particular.

On the recording sheets bent-grasses *Agrostis spp.* are usually grouped together due to impracticality in the time available of separating the species where both occur within quadrats. Timothy and lesser cat's-tail *Phleum pratense* and *P. bertolonii* are also grouped together.

The botanical survey of the River Adur and the Lancing Brook was carried out on only one day in late summer, and the results are thus subject to seasonal bias. The most likely omissions from the species lists will include the early flowering wetland species, such as cuckoo-flower *Cardamine pratensis,* that may occur on the river and stream margins and in the fen around the Hammer Pond. Early flowering grasses and herbaceous plants from the riverbanks are also likely to be under-recorded.

Submerged vegetation was found to be very patchy in distribution along both the river and the Lancing Brook and had low species diversity. While this may be a reflection of the usual aquatic plant communities within these stretches of river and stream, 2005 was a year of very low rainfall, with consequently very low water levels across many catchments, including the Adur. This was well illustrated by the extraordinary low water levels at the confluence of the River Adur and the Lancing Brook near Tenchford Bridge, where almost the whole of the riverbed was exposed. There have also been periods of high temperature during the year. In other sites across Sussex, 2005 appears to have been a poor year for aquatic plants, especially the fine-leaved pondweeds *Potamogeton spp*. (Alan Knapp, BSBI county recorder for West Sussex pers. comm. with Kate Ryland).

### 3.1.4 Results

**Vegetation and vascular plant surveys**

Map 2 shows the results of the extended Phase I habitat survey carried out by Kate Ryland. This map was digitised using ArcView 8, which permitted the calculation of the area of each habitat mapped (Table 3.1.b).

**Table 3.1.b Area of habitats, 2005**

| Code* | Habitat | Area (ha) | % |
|---|---|---|---|
| A01 | Arable | 70.08 | 5.6 |
| AR | Arable reversion | 381.36 | 30.4 |
| AR/G02 | Arable reversion/semi-improved grassland | 27.30 | 2.2 |
| T10 | BAP ancient semi-natural woodland | 32.44 | 2.6 |
| T13 | BAP wet woodland | 13.37 | 1.1 |
| T04 | Broadleaved plantation | 3.72 | 0.3 |
| T05 | Conifer plantation | 21.99 | 1.8 |
| Excl. | Excluded area – tenanted land | 91.38 | 7.3 |
| W04 | Fen vegetation | 7.15 | 0.6 |
| G01 | Improved grassland | 207.49 | 16.5 |
| T02 | Mature or over-mature tree | 0.35 | 0.03 |
| T06 | Mixed plantation | 60.53 | 4.8 |
| W03 | Open water | 19.34 | 1.5 |
| Orchard | Orchard | 0.25 | 0.02 |
| T06/T10 | Plantation and ancient semi-natural mosaic | 6.98 | 0.6 |
| Rank | Rank vegetation | 1.42 | 0.1 |
| V04 | Scrub | 13.85 | 1.1 |
| G02 | Semi-improved grassland | 133.26 | 10.6 |
| T08 | Semi-natural woodland | 37.81 | 3.0 |
| G03 | Species-rich grassland | 0.88 | 0.1 |
| G02 | Wet semi-improved grassland | 1.12 | 0.1 |
| T03 | Wood pasture and parkland | 122.41 | 9.8 |
| | Total | 1254.45 | 100.0 |

* Higher Level Stewardship feature codes

**Arable reversion field assessment**

- These have had different treatments at different times, which makes classifying them for the Phase I survey both difficult and likely to be inaccurate even in the short term since they will change more rapidly than many other habitats.
- Some reversion fields have been sown and others left to natural regeneration.
- The older, sown fields have developed a more or less intact sward and are therefore classified as grassland. Some have developed a rushy sward, for example at Swallows Farm and Oaklands Farm.
- More recent reversion fields still have mainly annuals and pioneer species, along with a high proportion of volunteer crops in some cases, though others are developing a more closed sward with longer lived plants colonising. These are classified as Arable Reversion (AR) on the phase I maps, but this classification covers a range of different plant communities.
- Species typically found in the reversion fields include black grass, docks, forget-me-nots, willowherbs, ragwort, creeping buttercup, sow-thistles, scentless mayweed, hairy buttercup, creeping thistle, bristly ox-tongue, meadow grasses, parsley-piert, plantains, Yorkshire fog, fleabane and many more.
- The reversion fields represent an excellent source of nectar and pollen for insects in their earliest, most flower-rich years.

- Some of the reversion fields have had their margins ploughed, presumably to sow a gamebird/wildbird cover crop. This is most marked around New Barn Farm.

**Hedgerow assessment**

- Hedgerows across the estate are in a wide range of states, from dense, intact and trimmed to gappy and grazed out, with all stages in between.
- There are some wide, unmanaged hedges that are spreading into bands of scrub with hedgerow trees, for example adjoining some of the laggs.
- Many of the hedges are hawthorn and/or blackthorn dominated, but across the estate there are also some very species rich hedges with different locally dominant shrubs including elm, field maple and dogwood.
- Associated ditches and banks are quite frequent.
- Hedgerow trees are frequent and a valuable feature of the hedgerow network.
- Some hedges, for example around Church North Farm, are old and of mixed species on banks but have grazed bottoms and have become very gappy, eventually reverting to lines of hedgerow trees and sparse shrubs.

**Woodland assessment**

- Most of the woodland areas appear to be of ancient origin with reasonable numbers of ancient woodland indicator species and old banks, but most have also been re-planted to some extent or otherwise modified by management.
- Management for game birds also affects most of the woodland areas and some contain pheasant pens as well as feeders (see below).
- Rhododendron occurs in some of the woods and should ideally be removed, especially in the more semi-natural areas where it will eventually spread and reduce biodiversity.
- There are also some areas of unmanaged conifer plantation within broadleaved woodland, for instance in Coates Wood, that could be enhanced by thinning or removal of the conifers to allow natural regeneration of broadleaved species.
- In some of the woods ride management has maintained a good network of open areas, but in others there is scope to carry out selective ride and glade management for structural diversity.

**Impact of pheasant rearing**

- Pheasant rearing is at a relatively small scale, so any negative impacts are likely to be balanced by the benefits of establishing game crops.
- However, woodland habitats may be affected by the presence of rearing/release pens and feeders, which affect native species by increasing levels of invertebrate predation and localised soil enrichment. Disturbance of the ground flora may also result from other woodland pheasant rearing activities such as straw spreading.
- Predator control for the benefit of game birds may also have an impact on the native fauna.

**Assessment of wet grassland areas – laggs and streamsides**

- Many of the wet grassland fields (locally known as laggs) that lie alongside streams are not especially botanically diverse and usually contain a tall, lush grass dominated sward with species such as meadow foxtail, marsh foxtail, floating sweet-grass, cocks-foot, creeping bent and Yorkshire fog predominating.
- Common herbaceous species are associated with these grasslands, including common cleavers, cow parsley, nettle, creeping buttercup, hairy sedge, silverweed, hemlock water-dropwort and cuckoo flower.
- These wet grasslands are potentially excellent habitat for invertebrates, small mammals, amphibians and reptiles.
- They are classified in the phase I survey as G02 (though they are quite species poor and could arguably be classified as G01 instead), but they will continue to improve in diversity whilst water is retained in the laggs and their wildlife value is best reflected by classifying them as semi-improved rather than as improved grassland.

**Assessment of River Adur**

- An important feature that bisects the southern part of the estate.
- Varied bankside, marginal and aquatic flora that should be surveyed in more detail, especially the aquatics.
- The river has been straightened and over-engineered in places but is subject to plans for restoration to a more natural shape and function.

**Assessment of parkland**

- The parkland grassland has mostly been re-sown and has a species rich sward, especially to the north of the castle. It currently has an unnaturally high proportion of white clover in places but this should reduce over time.
- Some species rich semi-natural fragments remain, often around the edges of the parkland, for instance adjoining Brickyard Wood and on the millpond edge.

**Arable field assessment**

- Some areas in the south west of the estate remain in arable production, and will continue to be under arable at least in the short term. WM1 strips will be established; this is an ELS option designed to provide seeds, invertebrates and shelter for wild birds.
- Some of the fields have grassy margins, but others are cultivated to the boundaries.
- Low intensity arable, with appropriate uncultivated margins, potentially adds to the overall diversity of habitats on the estate and provides additional niches not found elsewhere in the reverted areas.

**Assessment of new woodlands**

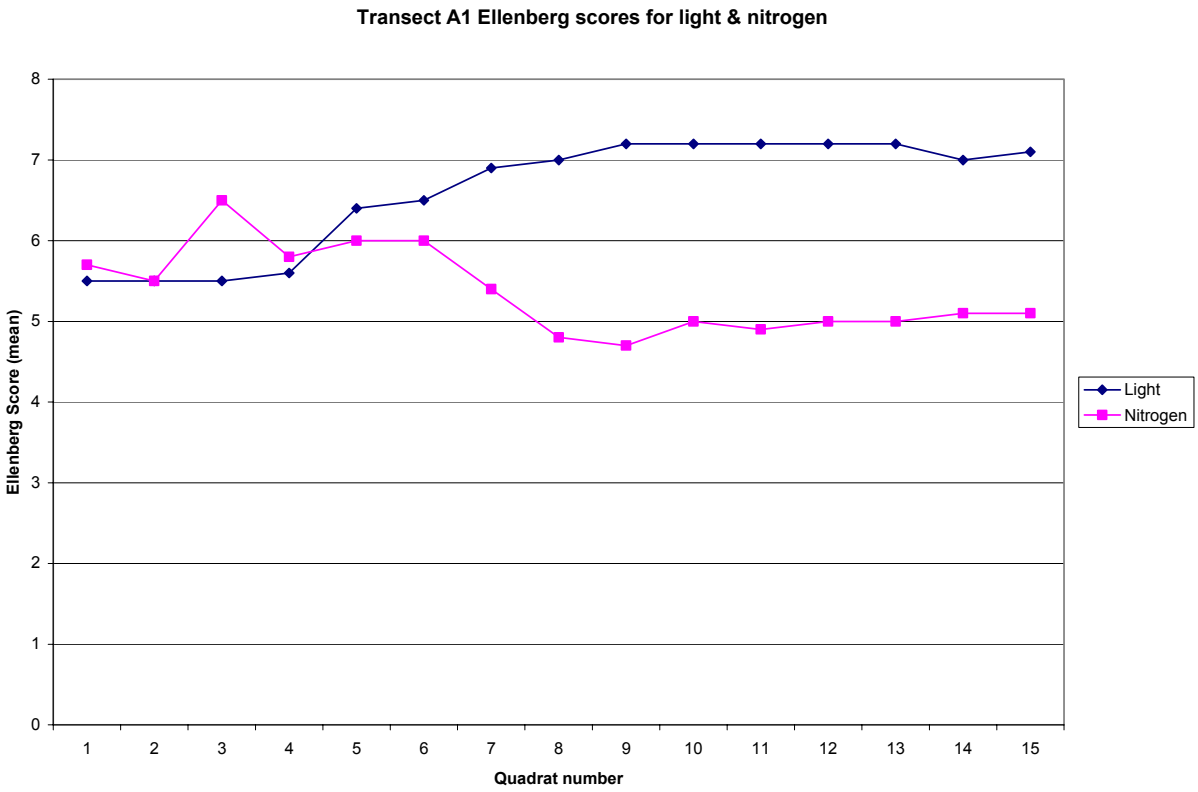
- Wagstaffs Wood and Woggs Bottom are newly planted blocks of woodland on land that was under arable until about 10 years ago. They contain a mixture of species but as the trees were planted in straight lines for ease of management, these woodlands do have an artificial appearance at present.
- The plantations have been sited on grassy areas and could be very slow to develop a woodland ground flora, although there is already an abundance of early purple orchids (Jason Emrich, pers. comm. with Theresa Greenaway).
- There is some scope to enhance these plantations for wildlife in the long term by selective removal of trees and shrubs to create more sinuous margins, small glades and generally improve structural diversity, however it is the intention to allow this to happen as a result of the more natural grazing.

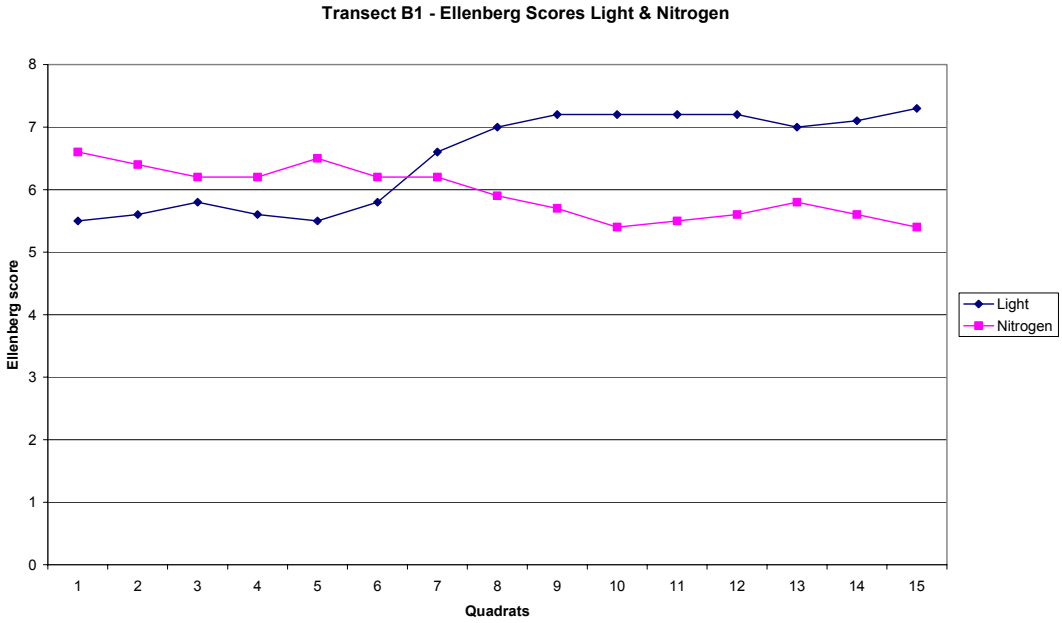
**Transects**

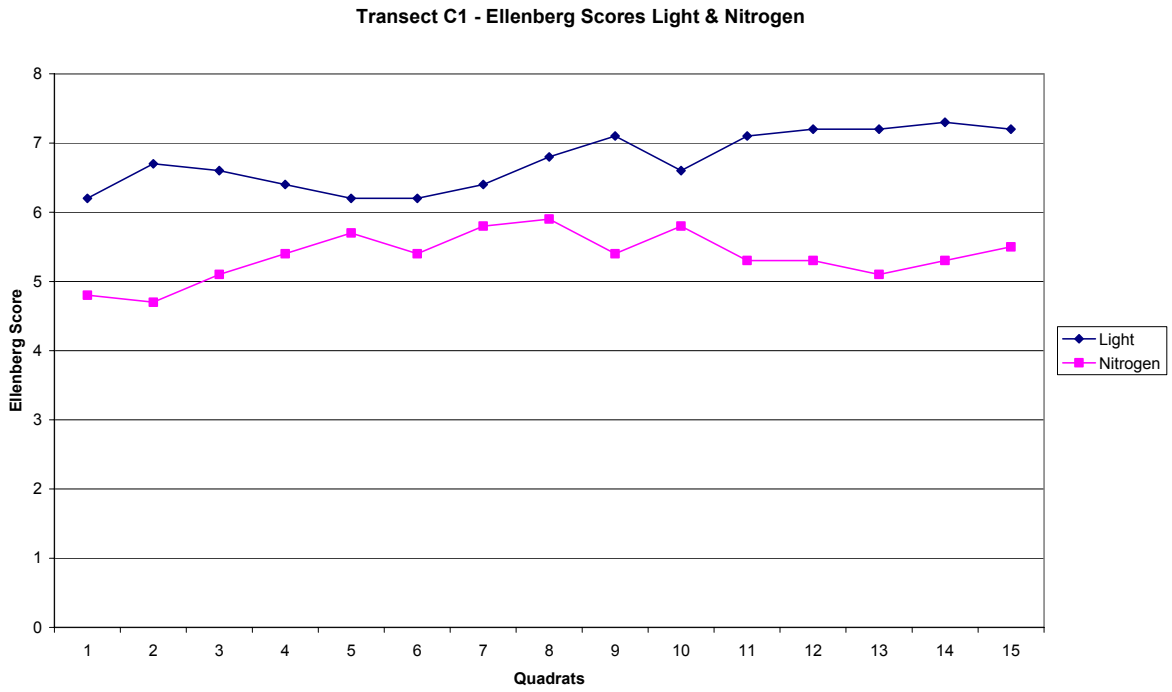
Species recorded range from those typical of deciduous woodland to those expected to flourish on open, arable or improved grassland. No species of conservation importance were recorded. Areas A,B and C have all been reseeded, which the species composition reflects. This work represents baseline conditions on ex-arable land at Knepp and its importance will increase with the comparison of this dataset with repeat samples into the future. Full species lists are available from the Record Centre Survey Unit.

**Analysis of data**

An analysis of the quadrat data using multivariate ordination software was not attempted at this stage because of format difficulties (see Section 3.3) and time constraints. Instead as a demonstration, graphs were prepared of the average Ellenberg scores for light and nitrogen values for each quadrat along one transect (Figures A1, B1, C1 and D1) from each area. For areas A and B, these graphs show a distinct transition from shade-tolerant plants requiring medium soil nitrogen levels (quadrats placed in the woodland) to plants requiring high light levels but tolerant of lower nitrogen levels towards the centre of the ex-arable land. Area C (north of the A272) showed less clear trends and Area D, which was heavily horse-grazed, not reseeded and with no woodland component, also showed no clear trend except for a tendency for plants requiring higher nitrogen levels towards wetter ground.


Transect A1 Ellenberg scores for light & nitrogen
Ellenberg Score (mean)
Quadrat number
Light
Nitrogen


Transect B1 - Ellenberg Scores Light & Nitrogen
Ellenberg score
Quadrats
Light
Nitrogen




## Botanical survey of River Adur and Lancing Brook

The surfaces of both the river and the brook supported dense rafts of duckweed in many of the sections that were not shaded by trees and shrubs. Common duckweed *Lemna minor* is present in places, but much more commonly fat duckweed *Lemna gibba* was the dominant floating aquatic. Low flow rates in the watercourses will have promoted the development of dense stands of duckweeds and both these species are characteristic of eutrophic waters though *Lemna gibba* has a higher phosphorus requirement than *Lemna minor* and may be more associated with greater levels of eutrophication. *Lemna gibba* is also thought to be associated with warmer conditions than *Lemna minor*, so its abundance in 2005 may be linked with the warm weather conditions in combination with the low water levels. This survey was carried out in four sections, this results of which are summarised below. The full species list is given in Appendix II.

### Section 1 River Adur, Shipley Windmill to Capps Bridge (TQ144217 to TQ148217)

The river from Shipley Windmill to Capps Bridge varies in width from an average of 3-4m to wider sections of up to 8m in places. The banks are generally steep and are eroded and cracked in many places. A total of 55 vascular plant species was recorded from this section, none of which are species of conservation importance.

Trees and shrubs occur on the banks near Church Farm South and the channel is most densely wooded near the windmill. The banks tend to support a rather coarse flora with abundant nettle *Urtica dioica*, bramble *Rubus fruticosus*, broad-leaved dock *Rumex obtusifolius* and creeping thistle *Cirsium arvense*, though there are more grassy stretches with common herbs such as common knapweed *Centaurea nigra*, yarrow *Achillea millefolium* and meadow vetchling *Lathyrus pratensis*, especially towards Capps Bridge. Creeping bent *Agrostis stolonifera* is also abundant here.

The river has an almost continuous strip of marginal vegetation that extends across the channel in places, especially downstream towards Capps Bridge. Reed canary-grass *Phalaris arundinacea*, branched bur-reed *Sparganium erectum* and bulrush *Typha latifolia* are the most prominent species.

The aquatic vegetation includes extensive stands of fat duckweed *Lemna gibba* with some patches of common duckweed *Lemna minor*. Yellow water-lily *Nuphar lutea* and arrowhead *Sagittaria sagittifolia* also occur throughout much of this section and a small amount of unbranched bur-reed *Sparganium emersum* was observed.

**Section 2 River Adur, Capps Bridge to A24 (TQ148217 to TQ164207)**

The river varies in width along this section but is on average about 4-5m wide with a significantly narrower stretch upstream of Tenchford Bridge. 97 vascular plant species were recorded, of which great yellow-cress *Rorippa amphibia* is scarce in Sussex.

From Capps Bridge to the confluence of the River Adur and Lancing Brook at Tenchford Bridge the main river has a more or less continuous band of trees and shrubs on its western bank casting shade onto parts of the channel. The bankside flora is for the most part quite coarse with abundant creeping thistle and nettle.

Downstream of the confluence the banks are generally more open, though there are still occasional grey willows *Salix cinerea* and patches of scrub, especially where a footpath crosses the river. The banks from the confluence to the A24 tend to have a rather grassy flora with a range of common herbaceous species. Stone parsley *Sison amomum* is quite prominent in a band along the top of the bank and the less common pepper-saxifrage *Silaum silaus* is present in small quantities. In many places the banks are very steep and there are frequent signs of slip causing areas of bare soil and deep fissures.

There is an abundance of marginal, emergent vegetation throughout this section of the river comprising predominantly reed canary-grass and branched bur-reed with common club-rush *Schoenoplectus lacustris* especially in the eastern section, a stand of reed sweet-grass *Glyceria maxima* in the west and associated species including hemlock water-dropwort *Oenanthe crocata*, purple loosestrife *Lythrum salicaria* and marsh woundwort *Stachys palustris*. The presence of flowering rush *Butomus umbellatus* in several places along the margins in this section of the river is notable and the Sussex-scarce plant great yellow-cress occurs just upstream of Tenchford Bridge.

The water level in this section of the river is variable with particularly low levels near Tenchford Bridge. Aquatic vegetation was found to be quite limited with large quantities of fat duckweed over much of the water's surface, especially in the downstream part of this reach. Yellow water-lily and arrowhead occur throughout and there are large patches of shining pondweed *Potamogeton lucens* at intervals along the river. Fringed water-lily *Nymphoides peltata* occurs in the easternmost part of this section.

**Section 3 Lancing Brook, Hammer Pond (TQ148208 to TQ144208)**

The Hammer Pond is a large body of open water with an extensive fringe of marginal vegetation that includes a variety of wetland species. Common club-rush, reed canary-grass and bulrush are very prominent along with yellow loosestrife *Lysimachia vulgaris*, hemlock water-dropwort and marsh woundwort.

The only aquatic vegetation recorded from the Hammer Pond was large mats of amphibious bistort *Persicaria amphibia*. Despite searches with a grapnel there appeared to be no submerged vegetation, at least within reach of the bank.

Upstream the Hammer Pond grades into a wide area of fen on the banks of the Lancing Brook where silverweed *Potentilla anserina*, hairy sedge *Carex hirta*, reed canary-grass and floating sweet-grass *Glyceria fluitans* are very frequent along with stands of nettle and hedge bindweed *Calystegia sepium*. Fools water-cress *Apium nodiflorum* and common duckweed occur in the brook in this area. A total of 55 species of vascular plant was found in this section, none of which were of conservation importance.

**Section 4 Lancing Brook, Hammer Pond to Tenchford Bridge/Adur confluence (TQ148208 to TQ15321)**

This section of the Lancing Brook comprises two channels; a small feeder stream from the Hammer Pond and the main tributary that flows from the south via New Barn Farm. The survey extended along the whole of the smaller stream to the Hammer Pond and along the main tributary where it adjoins a poplar plantation (TQ150208). Beyond this point the Lancing Brook flows through heavily grazed horse pasture and although there are sections that have a diverse emergent flora it is generally very narrow, shallow and in places severely poached (see above). A total of 49 vascular plant species was recorded, none of which were of conservation importance.

From the Hammer Pond the minor channel flows into a small pond then under a track and into a wider, shaded pool with mature oaks on the banks. From this point downstream to the confluence of the two tributaries the minor channel is generally shaded by trees and scrub with little aquatic vegetation apart from common duckweed and only small patches of emergent vegetation where light reaches the channel. Parts of the minor channel were dry at the time of the survey.

The main tributary adjoining the poplar plantation has a dense stand of common reed, the only location for this species on the sections of river surveyed. Nettle and hedge bindweed are also frequent along the banks in this section. Downstream of the confluence of the two channels the Lancing Brook has a varied emergent flora with frequent reed canary-grass, branched bur-reed and hemlock water-dropwort. Yellow water-lily is present in the eastern part of this section and there are areas where common duckweed is present in some abundance.

The width of the main channel ranges from approximately 1 - 2m and the banks are generally steep. The minor channel is around 1m wide for most of its length but widens considerably towards the Hammer Pond. The Lancing Brook runs through pasture in this section and the banks have a fairly coarse flora dominated by nettle or are grazed and sometimes poached by horses.

### 3.1.5 Discussion

These habitat and vegetation surveys are key components of the baseline survey, and will be the data against which future changes in vegetation structure and composition will be measured and analysed. Given the recent past history of the land, it is not surprising that vascular plant diversity across the transects is fairly low. Quadrats positioned in the woodland indicate a typical if impoverished community of neutral woodland species. Further out into the grassland, the quadrats are more species-rich, including common grassland species and arable weeds such as annual poa *Poa annua*, knotgrass *Polygonum aviculare,* sharp-leaved fluellen *Kickxia elatine* and round-leaved fluellen *Kickxia spuria.* A number of species in the mix with which the land was reseeded, notably in Area B, have apparently failed to persist. These include yarrow, betony, yellow rattle and devil's bit scabious. Random quadrats across these sites may have provided evidence of persistence. Any change in soil fertility may influence species composition of this sward; so too will changes in light levels caused by changes in vegetation structure caused by scrub development. Observing dynamic changes in species composition will be of considerable interest.

## 3.2 Lichen survey

### 3.2.1 Survey brief

Knepp Park Estate has never been surveyed extensively for lichens, although Francis Rose recorded 21 species between 1967-1969, including the Nationally Scarce *Gyalecta flowtowii* and *Anaptychia ciliaris ciliaris* (vulnerable, declining). Sussex Lichen Group agreed to carry out a one-day lichen survey on the Estate. Clearly one day is not nearly enough time to cover the entire Estate, and so it was decided to focus effort on parkland trees in the original deer park area, Brickyard Wood and Spring Wood.

### 3.2.2 Methodology

The survey was carried out on 26 November 2005 by 5 members of SLG and three MSc students (University of Sussex). In the morning, a route from the Castle north-west towards Brickyard Wood was followed, identifying lichens epiphytic on parkland trees and those along the edge of Brickyard Wood. In the afternoon, lichens on the stone dog statue opposite the Castle were recorded, and then those on trees bordering part of the Knepp Mill Pond. Some specimens were removed for further inspection under the microscope.

### 3.2.3 Constraints

The 26 November was exceedingly cold, and lichen surveying involves much standing still. By 15.00hrs, the low temperature and falling light levels drew the survey to an early close.

### 3.2.4 Results

A total of 50 species were identified (Table 3.2.a)

**Table 3.2.a Lichens on trees and statue, Knepp**

| On trees | | On statue |
|---|---|---|
| *Arthonia radiata* | *Parmelia sulcata* | *Aspicilia calcarea* |
| *Chrysothrix candelaris* | *Parmotrema chinense* | *Caloplaca citrina* |
| *Cliostomum griffithii* | *Pertusaria albescens* | *Caloplaca flavescens* |
| *Diploicia canescens* | *Pertusaria amara* | *Candelariella medians* |
| *Evernia prunastri* | *Pertusaria coccodes* | *Candelariella vitellina* |
| *Flavoparmelia caperata* | *Pertusaria flavida* | *Lecanora muralis* |
| *Flavoparmelia soredians* | *Pertusaria hymenea* | *Lecanora sulphurea* |
| *Hyperphyscia adglutinata* | *Pertusaria pertusa* | *Tephromela atra* |
| *Hypogymnia physodes* | *Physcia adscendens* | *Verrucaria nigrescens* |
| *Hypogymnia tubulosa* | *Physcia tenella* | *Xantoparmelia mougeotii* |
| *Hypotrachyna revoluta* | *Physconia grisea* | |
| *Lecanora chlarotera* | *Placynthiella icmalea* | |
| *Lecanora expallens* | *Punctelia reddenda* | |
| *Lecanora symmicta* | *Punctelia subrudecta* | |
| *Lecidella elaeochroma* | *Pyrrhospora quernea* | |
| *Melanelia fuliginosa glabratula* | *Ramalina farinacea* | |
| *Melanelia subaurifera* | *Ramalina fastigiata* | |
| *Opegrapha atra* | *Ramalina fraxinea* | |
| *Opegrapha rufescens* | *Xanthoria parietina* | |
| *Opegrapha vulgata* | *Xanthoria polycarpa* | |

### 3.2.5 Discussion

This single, short survey confirmed that the Knepp Castle Estate has potentially high lichen interest, although a number of individual parkland trees have very poor lichen floras (T. Greenaway, pers obs), possibly reflecting the results of many years of intensive arable management. The woodlands inspected have a far richer lichen flora, supporting species typical of woodlands in areas of reasonably good air quality, for example *Parmotrema chinense, Ramalina fastigiata* and *Ramalina fraxinea*. Further survey work would be expected to increase the list of lichens considerably.

## 3.3 Vegetation survey of the River Adur floodplain

### 3.3.1 Survey brief

A vegetation survey of the River Adur floodplain as it crosses the Estate was carried out by Rich Howorth (West Weald Landcape Project) in August 2005. This survey was specifically carried out in order to contribute to the baseline data required by the River Restoration Centre and the Environment Agency prior to river restoration work to be carried out on the heavily modified River Adur corridor. It was also considered important to obtain information on the vegetation composition of the floodplain grassland of the River Adur as part of the extensive baseline studies of the Knepp Estate.

### 3.3.2 Methodology

Two methods were used to characterise the vegetation of the floodplain as follows:

- Phase 2 (NVC) survey and mapping
- Transect survey

**Phase 2 survey and mapping**

The majority of the River Adur floodplain within the wider Knepp Estate was subject to a detailed survey of its vegetation communities between the points of Kingsbridge Lane at Shipley upstream and Bay Bridge at the A24 road downstream, taking the lateral boundaries of the floodplain as an area of flood risk mapped by the Environment Agency. The entire selected area was walked over the course of 3 days (16, 17 and 23 August 2005) and its distinct vegetation communities were mapped and sampled using quadrats, focussing on open grassland stands and ditchline vegetation. The woody vegetation communities of semi-natural woodland, plantation, hedgerows and scrub areas were generally marked on the map but were not sampled for their vegetation, with a similar basic treatment of tall ruderal vegetation. Aquatic and river-marginal vegetation was not inspected, since this was subject to a separate survey by Kate Ryland and Alan Stubbs, and an open-water pond present was also not accessed.

Vegetation survey and sampling followed the National Vegetation Classification system, using 2 x 2m quadrat sizes for grassland communities, 4 x 4m for swamp, 10m linear samples for ditch vegetation and one 30/10m linear sample for wood edge (sampled as a hedgerow). An attempt was made to obtain five replicate samples of the prevalent grassland communities present, whereas for most vegetation types just one or two quadrat samples were obtained.

An ideal method to delineate distinct communities could be to analyse the quadrat data using multivariate ordination software such as TWINSPAN or DECORANA, however it has not been possible to arrange the data from Excel in the required formats. Thus the quadrat data has been sorted into communities subjectively based upon dominant species, using the NVC grassland and swamp tables to assign NVC (sub-) communities as possible.

**Transect survey**

Five pairs of transects were established by siting tall marked wooden stakes at either side of the floodplain where the land was considered to rise up from the relatively flat valley base, sited at the locations given in Table 3.3.a and Map 3.

**Table 3.3.a Transect details**

| Transect name | Transect no. | Transect point | Bearing (degrees) | Altitude (m) | Length (m) | POINT_X | POINT_Y |
|---|---|---|---|---|---|---|---|
| **Bay Bridge W** | 1 | south | 352 | 13 | 124.7 | 516174 | 120631 |
| **Bay Bridge W** | 1 | north | | 14 | | 516169 | 120757 |
| **Knepp Mill** | 2 | south | 25 | 0 | ? | 515312 | 120916 |
| **Knepp Mill** | 2 | north | | 13 | | 515360 | 121019 |
| **Pound Bridge S** | 3 | west | ? | 15 | ? | 515138 | 121294 |
| **Pound Bridge S** | 3 | east | | 19 | | 515243 | 121347 |
| **Tenchford** | 4 | north | | 14 | ? | 515076 | 120989 |
| **Tenchford** | 4 | south | 32 | 0 | | 515110 | 120933 |
| **Capps Bridge W** | 5 | south | ? | 0 | ? | 514635 | 121675 |
| **Capps Bridge W** | 5 | north | | 6 | | 514617 | 121759 |

The co-ordinates and altitudes were recorded with a Garmin GPS unit using the British National Grid, and all of the transect end-point location data was entered into ArcView GIS. A compass bearing was taken between the two endpoints and a 30 m tape measure laid out continually along this path including crossing the River Adur itself at a perpendicular angle. A 2x2 m quadrat was then laid out contiguously along the transect line and all vascular plant species identified and assessed for their percentage cover within the quadrat, as well as recording dead vegetation litter and bare ground (including animal dung). The quadrats terminated as close to the riverbanks as possible, such that no quadrat sampling was carried out of the river itself. The height of grassland vegetation at its upper and lower levels was recorded in centimetres in each quadrat. Notes were made of land management practices including grazing animals, and digital photographs were taken along the transect from each end.

Due to the significant time involved in measuring the vegetation using this belt transect methodology, as well as the relatively late stage of the season, only the first transect 'Bay Bridge West' was sampled over three days from 26 July to 2 August 2005.

### 3.3.3 Results and discussion

**1. Phase 2 survey and mapping**

The descriptions of the quadrats and linear strips sampled are given in Appendix III, Table 1, organised by distinct communities and including an assignment to a NVC (sub-) community where possible. Species domin values in each quadrat is provided in Appendix III, Table 2. A total of eleven main distinct communities of grassland (6), swamp vegetation in ditches (4) and woodland (1) were identified from the quadrat data, with a number of additional sub-divisions as follows:

- *Holcus lanatus* dominated/mixed species grassland – no NVC community.
- *Agrostis stolonifera* dominated/mixed species/with an other species grassland - mostly MG13.
- *Lolium perenne* improved grassland - MG7 (d).
- *Arrhenatherum elatius –Dactylis glomerata* rank grassland – MG1.
- *Deschampsia caespitosa* dominated grassland - MG9.

- Various seeded grassland mixes, largely as arable reversion.
- *Carex riparia* swamp - S6.
- *Glyceria fluitans* swamp - S22.
- *Phalaris arundinacea* swamp - S28b.
- Wet tall herbs (2 types) with much nettle – no NVC community.
- *Quercus robur* woodland (fringe) - W10 (a?).

At least two communities could not be assigned easily to a particular NVC type, and a greater number of individual quadrats had little affinity to any NVC (sub-) community. The *Holcus lanatus* dominated and the *Agrostis stolonifera* dominated MG13 were the most prevalent, especially the former. Improved grassland areas were quite widespread, whereas MG1 was locally abundant only and MG9 was restricted to small patches. All the swamp communities were confined to particular ditches with the exception of S22 that is also found as a wet grassland in isolated low-lying areas. The W10 woodland predominates throughout the estate, but only a small part of one wood occurs within the mapped floodplain.

The vegetation types encountered are largely widespread with relatively low diversity and conservation interest, although the MG13 type is more restricted to river valleys in southern England. The swamp communities of the ditches are of greater botanical and conservation interest, with S6 believed to be declining in central lowland England and currently with a very restricted distribution at Knepp. One of the wet tall herb undefined stands was quite species-rich (Strip 6) but contained much nettle indicating the nutrient-rich status of inflow water.

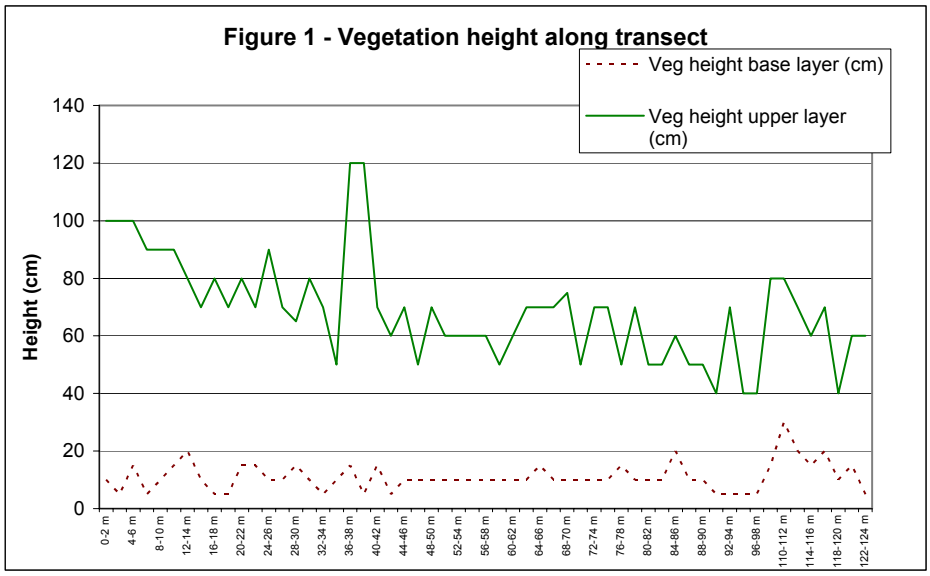
**2. Transect survey**

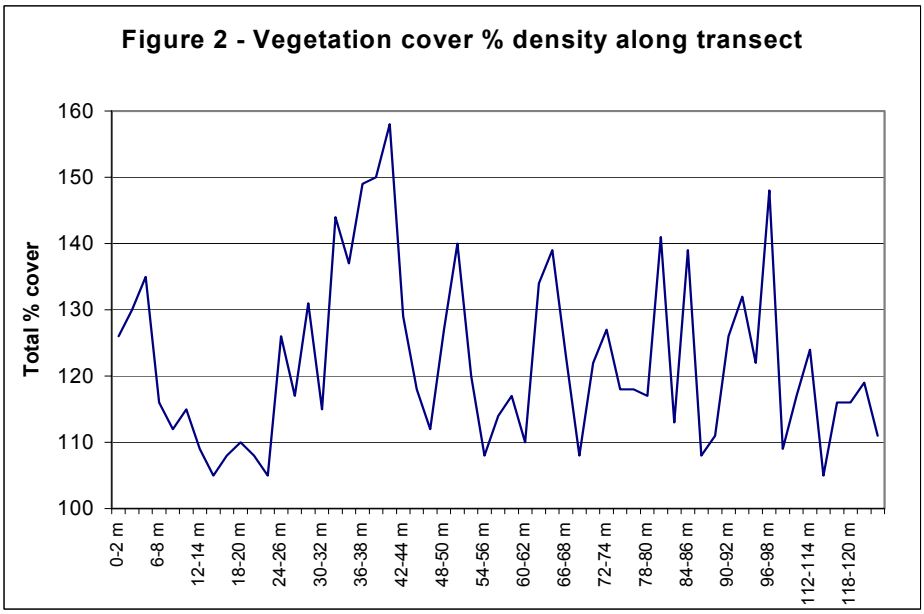
A total of 57 quadrats were sampled along the transect length. Vegetation heights varied within the ranges of 40-120 cm in the upper tier and 5-30 cm in the lower tier along the transect, and lacked an obvious pattern, except for a peak around 36-40 m distance where a thistle patch occurred (Figure 1). The basal layer of vegetation appeared to be slightly taller on the narrow north side of the river. Vegetation density was similarly variable along the transect length, varying between 105-158% total cover, with a peak again occurring at the thistle patch around 36-40 m distance (Figure 2).

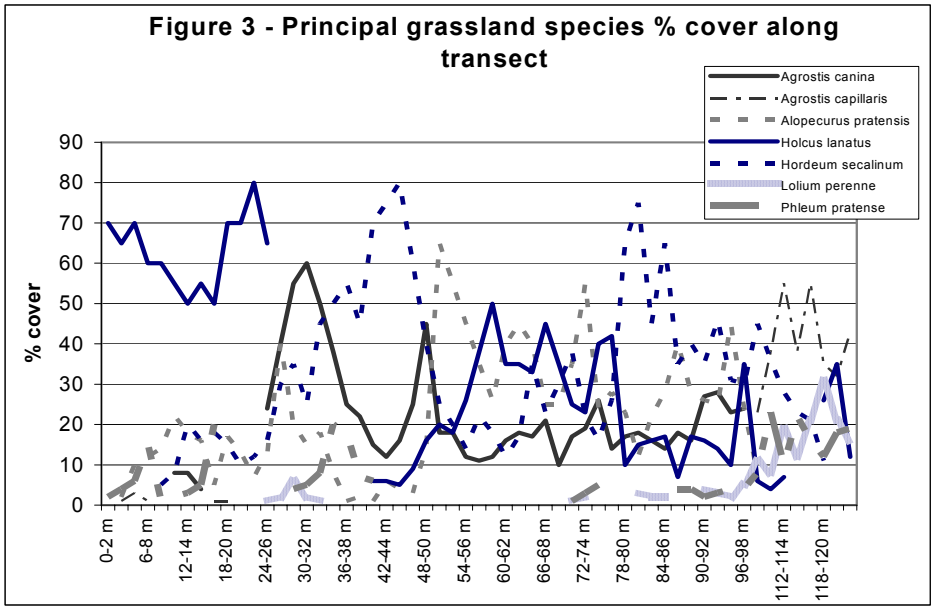
A total of 24 vascular plant species was found along transect length. Of these, just five species were found in over half of the quadrats in the following (descending) order of frequency: *Hordeum secalinum*, *Alopecurus pratensis, Holcus lanatus, Agrostis canina* and *Phleum pratense*. In terms of average percentage cover dominance, *Holcus lanatus* exceeded that of *Alopecurus pratensis*. On a first inspection of the main grass species (Figure 3), without any statistical analysis, a few patterns of grass species dominance are apparent along the transect. Yorkshire Fog *Holcus lanatus* occurred at relatively high frequency throughout the transect, especially at the southern end consisting of more rank vegetation, except for a patch from 30-40 m length from which it was entirely absent. Here it was replaced by *Agrostis canina* in particular, this area apparently being the old river course (pre-channelisation) where the vegetation appeared to consist of lusher growth as well as being of a different composition. *Agrostis canina* was then present up to the riverbank, but was absent from the north side (where sown *Agrostis capillaris* dominated instead), as well as from the southern end of the transect. The agricultural grasses *Lolium perenne* and *Phleum pratense*

were most prevalent on the north bank of the river also. The most dominant grass species *Hordeum secalinum* was present at variable frequency along almost the entire transect length, at times peaking at very high frequencies of *c.* 80%.

The transect survey suffered from a number of problems, taking a lot of field time and being done later than ideal for adequate assessment of species cover based on flowering grass heads. As a result of summer wind and rain, much material had lodged making accurate cover assessment more problematic. It is thus recommended that this belt transect method is reviewed before conducting future repeat surveys and completing the four unsurveyed transect lines. If it is decided to pursue this technique in future then survey would be better carried out around mid-June for better grass cover assessment. It does however represent a possible detailed technique to record future vegetation change in the floodplain.






## 3.4 Fixed-point photography

### 3.4.1 Survey brief

In order to monitor the anticipated vegetation changes following the institution of an extensive semi-naturalistic grazing regime on the core part of the Estate, fixed-point photography was selected as one of the methods used. This technique is widely used in site monitoring studies of ecological change over time, and is capable of detecting such changes in a qualitative, highly visual manner. Fixed-point photographs provide a quick and theoretically repeatable means of monitoring vegetation over time. Aerial photographs taken in 2001 and supplied by WSCC were available, but without ground-truthing and interpretation at the time they were taken are of limited use. It was also considered that the aerials were not at a sufficiently high resolution to allow fine detail of scrub to be correctly interpreted. Rich Howorth (West Weald Landscape Project) carried out the fixed-photography for this baseline study, and the photographs are available on request from the Record Centre Survey Unit.

### 3.4.2 Methodology

The whole of the project area (Map 1) was walked around as part of a survey of butterflies conducted at the same time, and a selection of views and orientation were chosen for digital photographs to represent the different areas and habitats of the Estate. A particular focus was dedicated to views along linear boundaries between habitats (eg woodland/grassland) and different management regimes (eg fencelines separating grazed and ungrazed areas), the areas where change to vegetation ecotones might be expected and where the effects of management are easiest to detect. In addition some general vistas were taken of the landscape of the site, from relatively higher ground where possible, including the River Adur floodplain valley.

An Olympu Mju-zoom 300 digital camera was used, with the camera always at the widest angle (35 mm equivalent) and shots taken at high quality (3.2 megapixels, 2048 x 1536 pixel size) in a landscape orientation (with one exception) and angled down slightly to take in as much ground as possible with the sky horizon as a narrow band only. The direction of each

shot was recorded by taking an approximate compass bearing to the nearest 5-10 degrees along the orientation of the camera. The location of each photograph was also recorded using the British National Grid system on a Garmin Mk 3 GPS unit, with typical accuracy of *c*. 5-10m, supplemented by a written description of the point. See Table 1 below for the photographic register.

**Table 1 – Photographic register of Knepp Estate, 19-20 July 2005**

| Photo no | JPEG file no | Description | Compass Bearing | POINT_X | POINT_Y |
|---|---|---|---|---|---|
| 1 | 719002 | N view W of Kneppmill Pond | 5 | 515739 | 121680 |
| 2 | 719003 | E view W of Kneppmill Pond at S wood boundary | 100 | 515684 | 121923 |
| 3 | 719004 | SW view within glade/ride of mixed woodland | 230 | 515586 | 122072 |
| 4 | 719005 | E view at S boundary of Merrik Wood on wooden steps | 100 | 515736 | 122284 |
| 5 | 719006 | W view at N boundary of Merrik Wood on wooden steps | 280 | 515770 | 122429 |
| 6 | 719007 | W view along ditch by marshy grassland patch (image cropped slightly at LHS) | 270 | 516064 | 122601 |
| 7 | 719008 | S view at NE field corner by wood and road | 200 | 516105 | 122726 |
| 8 | 719009 | W view at N fence along A272 road at oak tree (image cropped slightly at base & RHS) | 280 | 515808 | 122817 |
| 9 | 719010 | S view at N fence by planted cherry tree copse by lodge | 180 | 515663 | 122818 |
| 10 | 719011 | E view along road hedge boundary | 90 | 515653 | 122856 |
| 11 | 719012 | N view half way up W margin of Cricketing Field | 10 | 515232 | 122934 |
| 12 | 719013 | S view at end of T junction of forest track between pine-ash & oak blocks (N.B. portrait layout) | 200 | 515228 | 123230 |
| 13 | 719014 | E view at S boundary of pylon field beneath oak near gateway | 90 | 515397 | 123327 |
| 14 | 719015 | N view along woodland ride at Horsham Common by pheasant coup | 10 | 515718 | 123736 |
| 15 | 719016 | E view at rides crossroad, Horsham Common | 100 | 515740 | 123837 |
| 16 | 719017 | S view of more acid grassland at NE end of wood by pheasant coup | 220 | 516044 | 124021 |
| 17 | 719018 | S view at field margin with Bar Furzefield wood | 200 | 516375 | 123884 |
| 18 | 719019 | ENE view at 4th oak from boundary at N end of large field to Pondtail Farm | 60 | 516298 | 123313 |
| 19 | 719020 | N view on W side of entrance drive by shaded pond | 10 | 515554 | 122370 |
| 20 | 719021 | NNW view from pond E of Spring Wood at E end | 330 | 515335 | 122103 |
| 21 | 719022 | S view from pond E of Spring Wood at E end | 210 | 515335 | 122103 |
| 22 | 719027 | W view at S boundary of Spring Wood, hedgerow removed, adj to corner of deer fence in wood | 290 | 515077 | 122180 |
| 23 | 719029 | E view along pheasant fence just W of forest tracks intersection in Spring Wood | 110 | 514981 | 122292 |

| Photo no | JPEG file no | Description | Compass Bearing | POINT_X | POINT_Y |
|---|---|---|---|---|---|
| 24 | 719030 | N view along deer fence inside Matches Wood at SW end | 10 | 515243 | 122330 |
| 25 | 719031 | W view along deer fence inside matches Wood at N end at track junction | 280 | 515420 | 122612 |
| 26 | 719035 | E view at path through wood at S end of field by Spring Wood | 95 | 515142 | 122345 |
| 27 | 719036 | E view from N bank of R Adur at W end of field just below Capps Bridge | 95 | 514919 | 121835 |
| 28 | 719039 | N view from E bank of R Adur at midpoint of track to Pounds Bridge | 350 | 515181 | 121409 |
| 29 | 719040 | S view from E bank of R Adur at midpoint of track to Pounds Bridge | 170 | 515181 | 121409 |
| 30 | 719041 | W view from S bank of R Adur at end of line of oak trees from bridge track | 280 | 516293 | 120648 |
| 31 | 719042 | N view along deer fence in field bordering A24 road | 10 | 516295 | 120471 |
| 32 | 719043 | E view near gate in field just E of Swallows Farm | 110 | 515711 | 120190 |
| 33 | 719045 | S view from old trackway by E edge of Jackson's Wood by boundary oak tree | 190 | 515804 | 120508 |
| 34 | 719047 | NW view from road gate near Medlays on old brick foundation | 310 | 515338 | 120877 |

### 3.4.3 Results

All information was entered onto ArcView GIS as a data layer marking the 34 fixed point photo locations (Map 4). The photographs are available from the Record Centre Survey Unit.

### 3.4.4 Discussion

Although fixed-point photography has a number of advantages, there are problems associated with it:

- The Knepp Estate is large – complete coverage is unrealistic.
- Each ‘fixed point’ needs to be GPS referenced.
- Making exact repeats in practice would be very time-consuming (time spent searching and locating exact point, getting compass direction accurate etc).
- Maintaining a usable library of resultant large number of digital photographs could become prohibitive.

Before deciding on the monitoring strategy, other options, such as satellite imaging, should be explored. It is probable that for optimum results, satellite imaging should be used in conjunction with fixed-point photography as they give different perspectives.

## 3.5 Wetland mollusca

### 3.5.1 Survey brief

A wetland mollusc survey was required to contribute to the baseline data required by the River Restoration Centre and the Environment Agency prior to river restoration work to be carried out on the River Adur corridor. Dr Martin Willing was commissioned to carry out a survey of aquatic and wetland Mollusca in the river and on the floodplain and banks of the River Adur (Area B, Map 1).

### 3.5.2 Methodology

Fieldwork was undertaken on 23 October 2005 along the length of the River Adur corridor between approximately TQ 164207 (southeast) and TQ 149217 (northwest). Mollusca were sampled at 7 sites; 5 aquatic in the River Adur and two terrestrial in damp ditches / hollows on the river floodplain. In addition, one extra (un-commissioned) site at the head of Knepp Mill Pond was sampled.

**Survey sites**: The survey focussed on taking aquatic samples at regular intervals along the River Adur and terrestrial samples from the only two pockets of wetland located. Fieldwork was undertaken on 23 October 2005 with bulk sample processing, specimen extraction and identification taking a further day immediately following this field visit.

**Aquatic sampling**: River waters were sampled using a standard (EA approved) FBA-pattern extendable-handled freshwater sampling net with a 0.5mm mesh, supplied by GB Nets. This was used to sweep areas of water near to the surface, in mid-water and close to the bottom. A total of about three - four 'sweeps' were taken at three different locations at each site separated by about 10m. The samples removed were amalgamated before processing. This procedure allowed approximately quantitative comparisons of mollusc populations to be made between sites. In order to recover all small species and juveniles, 'bulk samples' of aquatic vegetation and ditch sediments were removed from each site for later laboratory sieve extraction. Before samples were bagged, larger snails (eg *Planorbarius corneus*, adult *Lymnaea peregra*) were identified, counted and returned to the sample site. Sample sites were digitally photographed. Laboratory processing involved washing vegetation and sediments through a sieve-tier to retain all molluscan remains > 0.5mm. Residues were examined on gridded white trays and smaller samples inspected microscopically using a x5 - x56 binocular microscope. A selection of *Pisidium* spp. from all sites were disarticulated in bleach and shell hinge characteristics studied microscopically to confirm identifications.

Species recovered from aquatic samples have been recorded in abundance classes thus:

R = ***r****are* (1 – 2 specimens recovered)
F = ***f****requent* (3 - 30 specimens recovered)
A = ***a****bundant* (> 30 specimens recovered)
*X* = dead shell only found

**Terrestrial sampling**: Areas of fen and river bank grassland were surveyed by the field examination of vegetation litter and soil surfaces together with the field sieving of vegetation litter and mosses to inspect remains >0.5mm. Bulk samples of moss/vegetation litter were removed from a selection of sites in each of the survey locations in order to record the

smallest species, which can easily be under-recorded in the field. The bulk samples were air dried in muslin bags for two weeks and then dry sieved to remove all remains >0.5mm. Residues were examined on gridded white trays and smaller samples inspected microscopically using a x5 - x56 stereoscopic binocular microscope.

### 3.5.3 Results

A total of 23 aquatic and 7 terrestrial species were recorded (Table 3.5.a). No Red Data species or Biodiversity Steering Group (BAP) Priority Species were found on the survey. Brief descriptions of sites together with GPS derived national grid references are given in Table 3.5.c.

**Table 3.5.a Samples – River Adur corridor – Knepp Castle Estate**

| **Site number** | **1 (A*)** | **2 (A*)** | **3 (A*)** | **4 (A*)** | **5 (T*)** | **6 (A*)** | **7 (T*)** |
|---|---|---|---|---|---|---|---|
| **Aquatic species (A*)** | | | | | | | |
| *Valvata piscinalis* | F | R | R | F | | X | |
| *Valvata cristata* | F | R | | R | | | |
| *Bithynia tentaculata* | F | F | | F | | F | |
| *Physella acuta* | F | F | | F | | | |
| *Lymnaea stagnalis* | | | | X | | X | |
| *Lymnaea peregra* | R | R | | F | | R | |
| *Lymnaea palustris/fuscus* (agg) | R | | | | A | | |
| *Planorbis planorbis* | | | | X | | | |
| *Planorbis carinatus* | R | | | | | | |
| *Anisus vortex* | R | | | | | | |
| *Bathyomphalus contortus* | R | | | | | | |
| *Gyraulus crista* | | | | | | | |
| *Gyraulus albus* | R | R | X | R | | **X** | |
| *Hippeutis complanatus* | F | F | X | | | | |
| *Planorbarius corneus* | | | | | | F | |
| *Acroloxus lacustris* | R | R | | | | | |
| *Spaerium corneum* | F | F | X | F | | F | |
| *Musculium lacustre* | R | R | | | | | |
| *Pisidium henslowanum* | | F | | F | | R | |
| *Pisidium milium* | | | | | | F | |
| *Pisidium subtruncatum* | F | F | | F | | F | |
| *Pisidium nitidum* | F | R | X | R | | **A** | |
| *Pisidium personatum* | | | | | **F** | | **F** |
| **Terrestrial species (T*)** | | | | | | | |
| *Carychium minimum* | | | | | F | | F |
| *Succinea putris* | | | | | | | R |
| *Vertigo pygmaea* | | | | | | | R |
| *Zonitoides nitidus* | | | | | F | | R |
| *Nesovitrea hammonis* | | | | | | | R |
| *Deroceras reticulatum* | | | | | R | | |
| *Monacha cantiana* | | | | | R | | |

*naming follows Kerney 1999

**Table 3.5.b Samples – fen / carr (head of Kneppmill Pond – Knepp Castle Estate)**

| Site number | 8 (T*) |
|---|---|
| **Aquatic species (A*)** | |
| *Lymnaea palustris / fuscus* (agg) | R |
| *Pisidium personatum* | F |
| **Terrestrial species (T*)** | |
| *Carychium minimum* | F |
| *Succinea putris* | F |
| *Vertigo antivertigo* | F |
| *Zonitoides nitidus* | F |
| *Nesovitrea hammonis* | R |
| *Aegopinella nitidula* | F |
| *Oxychilus alliarius* | R |
| *Euconulus fulvus* (agg) | X |

**Table 3.5.c Habitat descriptions**

| Site | Brief habitat description (freshwater & aquatic) | Grid reference. (central position of site) |
|---|---|---|
| 1 | Steep banked vegetated predominately with nettles and *Phalaris arundinacea* ; very slow flowing; little aquatic vegetation except filamentous algae; water sampled from margins to central channel (approx 3m depth); river bed predominately hard clay with a small amount of over-lying silt. | TQ 16026 20746 |
| 2 | Steep bank to south, more gently sloping to north, apart from some *Lemna* spp. no aquatic vegetation; bordered by *Scirpus lacustris*; water sampled from margins to central channel (approx 1m depth) | TQ 15538 20964 |
| 3 | Steep banks immediately below Environment Agency Weir, little aquatic vegetation except filamentous algae; water sampled from margins to central channel (approx 0.7m depth), ); river bed predominantly soft clay with no over-lying silt. | TQ 15389 20971 |
| 4 | Steep banks leading into relatively shallow, slow flowing water > 1m depth; little aquatic vegetation, soft clay bottom to channel. | TQ 15217 21235 |
| 5 | Damp *Juncus* lined ditch on flood plain adjacent to site 4. | TQ 15217 21235 |
| 6 | Steep banks leading into slow flowing water up to 1.2m depth; soft clay bottom overlain with organic silt; water surface partly covered with Lemna spp, channel bordered by *Phalaris arundinacea* and *Sparganum* sp. | TQ 15013 21793 |
| 7 | Damp *Carex* and *Juncus* lined ditch lined ditches on flood plain close to Site 2. | TQ 15622 20947 |
| 8 | Alder / willow carr and associated marginal fen (*Carex* spp, *Typha, Sparganium* sp*)* | TQ 15909 22065 |

### 3.5.4 Discussion

The River Adur supports small numbers of a relatively few common mollusc species found frequently elsewhere in Sussex. The improved and semi-improved grassland that borders the River Adur contains only a few remnant pockets of wetland vegetation. These support a low diversity community of common wetland and catholic species.

**Freshwater**: A total of 23 aquatic molluscan species were found during the survey. All of these species are common and widespread elsewhere in Sussex and southeast England (Kerney 1999, personal observations at many freshwater sites in Sussex and Hampshire). In overall terms the freshwater molluscan community present in the survey area is one of low diversity and common taxa dominated by the five species; *Lymnaea peregra, Physella acuta*, *Bithynia tentaculata, Sphaerium corneum* and *Pisidium nitidum*. These five species are all tolerant of a wide range of different freshwater habitats including stagnant and slightly polluted ones. *P. acuta* is an introduced species (Anderson 2003). Surprisingly no living representatives of the large unionid freshwater bivalves were located on the survey although a small shell fragment believed to be from such a mussel was found in sediments at site 5. The Adur in the survey corridor appears to occupy an artificially deepened channel. The lack of extensive shallow marginal areas may have reduced molluscan diversity as might eutrophication, which may also account for the relative lack of macrophytic vegetation.

**Terrestrial faunas**: Field searches and bulk litter samples (of rush / sedge debris) from a two sites reveals an impoverished wetland fauna, which may have been more extensive in the past. All species recovered are common and widespread elsewhere in Sussex and southeast England. *Lymnaea palustris* (agg.) *Succinea putris, Carychium minimum, Zonitoides nitidus* and *Pisidium personatum* are typical wetland species. The remaining species found at the two terrestrial sites are all rather 'catholic', being found in a wide variety of both open habitats.

Two bags of moss, sedge and alder leaf litter were collected at the head of Kneppmill Pond. These produced a wetland fauna typical of rather neutral / acidic conditions. Most of the species were also recorded from the small wetland 'relict' sites adjacent to the River Adur. One species of note is *Vertigo antivertigo*. This species, which is local but widespread in the county, has been used as one of a suite of species typical of old wetland sites (Kerney & Stubbs 1980).

## 3.6 Odonata survey

### 3.6.1 Survey brief

The purpose of this survey was to provide a baseline against which changes in populations and distribution can be measured following the restoration of the floodplain to a more natural state. Paul James was commissioned to carry out an Odonata survey along the River Adur corridor within the Knepp Castle Estate (Area B, Map 1).

### 3.6.2 Methodology

The survey was carried out on 10 June and 21 July as follows:

| Date | Start | Finish | Weather |
|---|---|---|---|
| 10 June | 10:00 | 13:30 | Warm and sunny with scattered broken cloud, wind N2 |
| 21 July | 09:45 | 13:00 | Hot in bright sunshine, scattered cloud, wind W2 |

On each visit an initial assessment of the species present was made by walking the stretch of the River Adur between Pound Lane and the A24. On the return walk a note was made of the approximate numbers of each species, using a pair of close focusing binoculars to confirm identification. No attempt was made to net any species.

### 3.6.3 Results

**Species recorded**

A total of 14 species was recorded during the survey (Table 6.1.a). Two of these, hairy dragonfly and ruddy darter, are listed in the *Sussex Rare Species Inventory*.

**Table 6.1.a – Numbers of Odonata recorded on the Knepp Castle Estate, summer 2005**

| Species | Status in Sussex* | Number recorded | |
|---|---|---|---|
| | | 10 June | 21 July |
| Beautiful demoiselle *Calopteryx virgo* | Widespread across the county except for the Downs and southwards. | 40 | - |
| Banded demoiselle *C splendens* | Locally common north of the Downs, most notably along the River Arun. | 9 | 5 |
| Large red damselfly *Pyrrhosoma nymphula* | Common. Very well distributed over the county; found almost anywhere there are suitable water bodies. | 6 | - |
| Red-eyed damselfly *Erythromma najas* | Locally common across the county. | 7 | - |
| Azure damselfly *Coenagrion puella* | The most commonly recorded species in Sussex. Very well distributed across the whole of the county. | 100 | 8 |
| Blue-tailed damselfly *Ischnura elegans* | Common. Very well distributed across the whole county. | - | 5 |
| Brown hawker *Aeshna grandis* | More common towards the east of the county. Much more local in West Sussex, apart from a strong presence on the River Arun. | - | 1 |
| Emperor dragonfly *Anax imperator* | Common all over the county wherever there is suitable habitat. | 1 | 4 |
| Hairy dragonfly *Brachytron pratense* | Rather patchily distributed along the county's river systems and in its coastal wetlands, but slowly expanding its range. Listed in the *Sussex Rare Species Inventory*. | 10 | - |
| Four-spotted chaser *Libellula quadrimaculata* | Patchily distributed and locally common across the county. | - | 1 |
| Broad-bodied chaser *Libellula depressa* | Common. Well distributed over the whole of the county, even in urban areas and across the south Downs. | - | 1 |
| Black-tailed skimmer *Orthretum cancellatum* | Locally common across the whole of the county. | 25 | |
| Common darter *Sympetrum striolatum* | Common. Well distributed over the whole of the county, especially in the east. | - | 1 |
| Ruddy darter *S. sanguineum* | Locally common but not nearly as widespread as Common Darter. Listed in the *Sussex Rare Species Inventory*. | - | 1 |

* from Belden and others (2004)

### 3.6.4 Discussion

The stretch of the River Adur that passes through the Knepp Castle Estate supports a good variety of Odonata. It was noticeable however that the numbers of some species were low with just single sightings of five species. By far the most productive area surveyed was the more open eastern most stretch of the Adur within 1km of the A24 where typical species include banded demoiselle, hairy dragonfly, emperor dragonfly and black-tailed skimmer. Red-eyed damselfly was found mainly on the extensive lily pads near where the Adur runs alongside Swallow Lane whereas Beautiful demoiselle occurs further west towards Shipley where the river is less open and more tree-lined.

The survey gives a good indication of the species present and their approximate numbers, though it provides a 'snapshot' rather than a detailed picture given that only two field visits were made to the site. Although the numbers of dragonflies recorded are likely to be quite accurate, those for the damselflies are likely to be underestimates given their habit of sheltering in dense aquatic vegetation. Further fieldwork would very likely record other species including common blue damselfly *Enallagma cyathigerum*, migrant hawker *Aeshna mixta* and southern hawker *A. cyanea.*

## 3.7 Lepidoptera – moths

### 3.7.1 Survey brief

The purpose of the survey was to gather baseline information on moth populations in these areas in order to monitor effects of current and future management. Dr Tim Freed was commissioned to carry out a moth survey on the sites indicated on Map 5.

### 3.7.2 Constraints

Visits were made when conditions were favourable for surveying and when a broad diversity of moths was likely to be flying. It was unfortunate that 2005 was one of the poorest years since 1973 (at least) for both quantity and diversity of native species in Sussex (C. Pratt and R. Radford pers. comm. with Tim Freed). One reason for this could have been the very dry May in 2005. This is thought to have been disadvantageous for emergence of adults from chrysalides.

The national status for moth species follows the latest appraisal for macromoths (Waring 1994, 1999). Micromoth status is more difficult to deduce; evaluations from the following publications have been used in this report (Parsons 1984, 1993, 1995; Surry & Parsons, in prep.).

### 3.7.3 Methodology

Two areas of the estate, Sites A and B (Map 5), were surveyed for moths using mercury vapour light-traps. Site A was the reseeded grassland lying to the immediate east of Spring and Matches Woods, and Site B was part of the River Adur floodplain near Pound Farm. Each site was to be visited once at least (twice if possible) between mid-June and mid-August.

Both sites were visited on 5 May 2005 noting vegetation and habitat quality, and suitable places were selected for positioning traps. Due to the presence of grazing livestock, care was taken to minimise the risk of animals entangling with electric cables. On 10 August cables and traps were placed at the foot of the riverbank at Site B because of the presence of cattle. On the previous visit, livestock were absent and cables and traps were positioned at the top of the riverbank.

Site A was surveyed on three dates, and Site B on two dates. At Site A, two visits involved light-traps and one was a daytime survey, and at Site B, only light-traps were used. Two further visits were made outside the prescribed areas to look for the rush wainscot (RDB3) at Kneppmill Pond. Details of each visit, grid references and methods used are given below and trap locations are drawn on the maps provided.

**Table 3.7.a details of survey dates, methods, locations, and times**

| Date | Site | Trap /method | Grid location | Survey time |
|---|---|---|---|---|
| 14 July 2005 | A<br>B | Robinson mv<br>Robinson mv | TQ 153222<br>TQ 152214 | 2130 - 0444<br>2205 - 0515 |
| 2 August 2005 | A | Daytime | TQ 154223 | 1600 - 1715 |
| 10 August 2005 | A<br>B<br>B | Heath Portable<br>Robinson mv<br>Robinson mv | TQ 154221<br>TQ 152214<br>TQ 152215 | 2159 - 0520<br>2124 - 0538<br>2124 - 0540 |
| 23 August 2005 | Kneppmill Pond | Robinson mv<br>Robinson mv | TQ 156212<br>TQ 157211 | 2100 - 2320 |
| 9 September 2005 | Kneppmill Pond | Robinson mv | TQ 157211 | 2100 - 2240 |

Two 'Robinson' pattern moth-traps fitted with 125 watt MB/U mercury vapour lamps were employed to capture moths. At Site A power was supplied by mains DC from the log cabin in Spring Wood, and at Site B by a Honda EU10i generator. White sheets were placed beneath traps and pyrex bowls positioned over lamps when precipitation was anticipated. A Heath Portable trap fitted with a 9 inch actinic tube and powered by a 12 volt scooter battery, was employed at Site A on 10 August. Weather conditions including maximum and minimum temperatures were recorded for each session, and traps were run from dusk to dawn. The date given for each nocturnal session refers to the date on which the traps were set.

**Table 3.7.b Weather conditions**

| Date | Temperature | Conditions |
|---|---|---|
| 14 July 2005 | 17.5ºC at light up; 8.5ºC at dawn | Clear; moon ⅓ full; very feint breeze; dry |
| 2 August 2005 | 24ºC at start; 23ºC at finish | Daytime, hot, sunny; light southerly breeze |
| 10 August 2005 | 20.5ºC at light up; 8.5ºC at dawn | Clear with intermittent cloud; sickle moon; no wind, dry |
| 23 August 2005 | 16ºC at light up; 12ºC at finish | Intermittent cloud; moon ¾ full; slight south westerly, dry |
| 9 September 2005 | 20ºC at light up; 16ºC at finish | Very mild; dry |

Moths were recorded and counted at the end of each survey. Specimens inside and outside the trap (resting on the trap, sheet or nearby foliage) were included in the total and any additional

species seen visiting the trap during the session were also recorded. All moths were released alive with the exception of about 25 worn specimens and 'critical species' that warranted dissection for identification purposes.

**Daytime survey at Site A**

A daytime survey was carried out at Site A on 2 August to record crambid moths (Pyralidae) which are commonly found in grassland habitats at this time of year. Although mostly nocturnal in habit, crambids are readily 'put up' when walking through grassland in daytime. A butterfly net was used to disturb the sward immediately in front of the walker and to capture certain specimens for identification. Seven linear transect walks were made through the reseeded grassland on the east side of Spring and Matches Woods. Times and weather conditions were noted. A number of other Lepidoptera (including butterflies) were recorded during the walks, and wildflowers in bloom were noted. A table showing the start and finish points and distance of each walk is given below; the points are drawn on the map (not to scale). Descriptions of the locations are as follows:

A = on the left hand verge of the road to North Lodge, 64 metres north of woodland.
B = solitary tree with ladder up it near pond.
C = location beside the pond opposite the pontoon.
D = clump of three trees in open grassland.
E = clump of two trees in open grassland.
F = solitary oak tree in open grassland.
G = northeast corner of Matches Wood.
H = water-trough diagonally northwest across field.

**Table 3.7.c details of Line Transect Walk at Site A**

| **SITE A 02/08/05 Daytime survey<br>Line Transect Walks 1600 - 1715 hours (see map)** | | |
|---|---|---|
| WALK 1 | A to B | 130 metres |
| WALK 2 | B to C | 43 metres |
| WALK 3 | C to D | 85 metres |
| WALK 4 | D to E | 102 metres |
| WALK 5 | E to F | 95 metres |
| WALK 6 | F to G | 165 metres |
| WALK 7 | G to H | 200 metres |

**Additional survey for Rush Wainscot**

Two additional survey visits were carried out at the southern end of Kneppmill Pond after the completion of the commissioned fieldwork. This was to ascertain whether rush wainscot (RDB3) was breeding in the *Typha* beds around the lake. On the first visit, two Robinson moth traps were operated, being powered by generator, and on the second visit just one trap was used. On both occasions traps were run for approximately a couple of hours from dusk and the catch was recorded by the lakeside. Grid references, times and weather conditions are given in Table 3.7.a.

Nomenclature and ordering of Lepidoptera follow Bradley (2000); common names are used where extant, otherwise scientific names are given. All Lepidoptera recorded during this survey are listed alphabetically with both common and scientific names in the Appendix

(produced separately). Nomenclature of plants follows Stace (1991, 3rd ed.) Entries for plants used as hostplants are for principle larval foodplants only. The use of the generic name alone signifies that all or most members of that genus may be used, whilst the addition of 'spp.' indicates that only certain members of a genus are accepted.

### 3.7.4 Results

A total of 1,331 moths comprising 159 species and representing 19 families, were recorded during visits to Sites A and B, 63 at Site A and 139 at Site B (Appendix IV). 43 species were recorded at both sites. Three Nationally Scarce/Notable and 32 Local species were recorded. Species recorded are listed in the Appendices together with their national status, date of capture, number recorded, hostplant(s), and usual habitat.

National status is signified by the following abbreviations:

**C** = Common, recorded from over 300 10km squares in Great Britain since 1 January 1960.
**L** = Local, recorded from 101- 300 10km squares in Great Britain since 1 January 1960.
**Nb** = Nationally Scarce B, recorded from 31-100 10km squares in Great Britain since 1 January 1980.
**RDB3** = Red Data Book Category 3. A rare species with very restricted distribution.
**I** = Immigrant. Some resident populations may be supplemented by immigrants.

Hostplant(s) given are for principle larval foodplants only (Appendix IV). The use of the generic name alone signifies that all members of that genus may be used, whilst the addition of 'spp.' indicates that only certain members are accepted. Genus and species names together indicates that only that plant is used.

**Site A (reseeded grassland)**

Of the 63 species of moth recorded at Site A, 20 (c.32%) were predominantly grassland species, of which *Cnephasia pasiuana* (Local) is of particular interest. About 22 species (*c.*35%) were woodland moths, of which *Dichomeris alacella* (Nationally Notable) is of particular interest.

Since the light-trap was placed near the pond on the east side of Spring Wood, wetland species were also captured, including *Calamotropha paludella* (Nationally Scarce Nb). *Catoptria falsella* (Local) a moth of gardens, parks, and orchards, was also recorded.

**Site B (River Adur floodplain)**

139 species of moths were recorded at Site B. Of these 31 (*c.*22%) were predominantly species of riverbanks, ditches and damp pasture including a *Gynnidomorpha* sp. [possibly *alismana* (Nationally Scarce Nb) or *vectisana*], small scallop (Local), gothic (Local), southern wainscot (Local), double kidney (Local) and olive (Local), all of particular interest. Other significant moths from Site B were 8 woodland species having Local status of which lunar-spotted pinion was of particular note. Interesting grassland species from Site B were: clover case-bearer (Local), *Aethes smeathmanniana* (Local), and *Celypha rosaceana* (Local).

**Kneppmill Pond**

Although not part of the main survey, 42 species were recorded from this site including 10 not recorded at Sites A or B. Of these, there were 2 Nationally Scarce/Notable, 6 Local, and 1 RDB species. *Cryptoblabes bistriga* (Local), hoary footman (Nationally Scarce B), Webb's wainscot (Nationally Scarce B), and rush wainscot (RDB3), were all of particular interest.

**Nationally Scarce/Notable species recorded at Sites A and B, and Kneppmill Pond**

2 (possibly 3*) Nationally Scarce species were noted from Sites A and B, and 2 Nationally Scarce and 1 RDB species were noted at Kneppmill Pond. All have conservation significance. * a tortrix moth of genus *Gynnidomorpha* was taken at Site B, being either G. *vectisana* or G. *alismana*. The latter is a Nationally Notable species and its details are therefore given below.

**Nationally Notable** *Dichomeris alacella* (Gelechiidae) Site A

A dark, grey-brown micromoth of woodland habitat. Widespread but local in southern England. Recent analysis shows that this species has contracted its range in the last 30 years. One male recorded on 14 July (determined by dissection). Ovum laid on lichens on tree-trunks in August. Adults are nocturnal, flying between July and August.

**Nationally Notable Nb** *Calamotropha paludella* (Pyralidae) Site A

A pale, silvery white micromoth of fen, marsh and riverbank. Scarce and locally distributed in south and south-east England. One recorded 14 July. Ovum laid on *Typha* spp. and larva mines dead leaves. Adult nocturnal, flying in July and August. Evidently breeding around the pond on east side of Spring Wood.

***Nationally Notable Nb** *Gynnidomorpha alismana* (Tortricidae) Site B

A small, attractively marked micromoth of stream margins, ponds, ditches, fens and other wet places where *Alisma* spp. grow. Widely distributed in southern England though infrequently recorded and exact status unknown. One male recorded on 10 August (see comment above). Adults mainly crepuscular, flying in July and August.

**Nationally Scarce B** Hoary footman *Eilema caniola* (Arctiidae) Kneppmill Pond

Silvery, slim (when at rest) macromoth. Usually found in coastal areas in the west and south of England and Wales; rare elsewhere. Thought to be resident in one or two locations in East Sussex; records from other places are considered be immigrants. One recorded on 9 September. Larvae feed on lichens and algae growing on rocks and similar substrate. Another hoary footman was recorded in Wadhurst, East Sussex on the same night (A. Adams pers. comm.).

**Nationally Scarce B** Webb's wainscot *Archanara sparganii* (Noctuidae) Kneppmill Pond.

Macromoth found locally in coastal marshes and reedbeds in southern and eastern England, Wales and Ireland. Increasingly recorded from inland sites. One recorded in A trap on 23 August. Overwinters as an ovum on leaves of *Typha* spp., *Iris pseudocorus*, *Sparangium erectum* and others growing around ponds and marshes. Larvae feed internally in stems of these plants. Pupa formed head upwards in stems. Adult nocturnal, flying between August

and early October. [5 were recorded on 23 August 1995 at northwestern end of the pond by S. Curson].

**RDB3** Rush wainscot *Archanara algae* (Noctuidae) Kneppmill Pond

Similar to Webb's wainscot in appearance, and also found in marginal habitats where *Typha* spp., *Iris pseudocorus*, *Schoenoplectus* spp. and others grow. Occurs locally in Suffolk, Norfolk, Lincoln, East and West Sussex, and a few other places, chiefly in southern counties. In Sussex it is mainly confined to a few lakes and ponds at Bignor, Burton Mill, Ansty, and Rye. One male recorded in B trap on 23 August. Overwinters as an ovum on hostplant. Larvae feed internally in stems and pupa formed internally head upwards. Adult nocturnal, flying in August and September.

A survey by S. Curson at the northwestern end of the pond on 23 August 1995 did not find the moth.

**Local** species of Conservation Significance recorded from Sites A and B

*Cnephasia pasiuana* (Tortricidae) Site A

A grey-brown micromoth of rough fields and marshes. Locally found in England and possibly overlooked. Best identified by the examination of its genitalia (as was this Knepp specimen). One male recorded on 14 July. Larvae feed on flowers of various Compositae and *Ranunculus*. A species to look out for in future surveys at Site A. Adults nocturnal flying in June and July.

Double kidney *Ipimorpha retusa* (Noctuidae) Site B

Finely marked, olive-grey macromoth of damp woodland, riverbanks, fens and marshes. Local in south and west England, and Wales. Two recorded on 14 July. Larvae feed on *Salix* spp. Adults nocturnal flying from mid July to early September.

Other invertebrates - Many grasshoppers (Orthoptera), and several damselflies (Odonata: Coenagrionidae) observed in the reseeded grassland at Site A on 2 August. Brown hawker dragonfly (Odonata: *Aeshna grandis*), noted at Site B on 14 July, and two hornets (Hymenoptera: *Vespa crabro*) in A trap by Kneppmill Pond on 23 August.

### 3.7.5 Discussion

2005 was regarded by experienced Sussex moth recorders as possibly the worst for resident species in over 30 years of recording (C. Pratt and J. Radford pers. comm. with Tim Freed). Nevertheless relatively good numbers of moths were trapped during this survey, providing an indication of habitat quality and species diversity of the sites investigated.

**Reseeded grassland site**: the Robinson trap used on the first visit was replaced due to problems associated with running unattended light-traps in areas where livestock were roaming freely. It was considered more practicable to use a Heath Portable trap, which could be placed way out in open grassland without the need for extra cable and a generator. It was also decided to employ line transect walk methodology to monitor typical grassland moths in daytime. These methods recorded a smaller diversity of moths than the Robinson trap, eliminating most of the woodland and wetland species. The daytime search recorded

colourful zygaenids, and numerous crambid moths were also noted together with 5 species of butterfly typically found in grassland. It is suggested that these methods are used in future monitoring of the reseeded grassland for moths, and if desirable, for butterflies also.

**River Adur Floodplain**: this part of the survey was more straightforward and although roaming livestock were present, equipment was arranged to eliminate risk of interference. A good diversity of typical riverside and wetland moths were found including several species having Local status. Many of the trees and bushes growing along the riverbank provide larval foodplant for moths. Oak and sallow (and related *Salix* spp.) each host over 100 macromoth species nationally, many of which might be breeding here. Birch is another highly palatable plant and a number of birch feeding moths were recorded here. However the surveyor did not locate any birches in the vicinity of the floodplain. Hawthorn and blackthorn each host over 60 macromoth species nationally, whilst alder has about 28, and ash and field maple about 12 and 5 respectively. Nevertheless, moths using these last mentioned trees include Local species such as coronet and maple prominent (which may breed here).

The absence of common reed from all but one part of the River Adur (near Tenchford) in Site B is considered to reduce the potential for diversity of moths in the area. Common reed is hostplant for a number of significant wetland moths and other fauna. Future landscaping plans might consider its introduction to other parts of the site.

With an abundance of blackthorn bushes along the riverbank and adjacent hedgerows, Site B incorporates ideal breeding habitat for the brown hairstreak butterfly, previously recorded only once at Knepp Castle. One adult female was observed ovipositing on blackthorn twigs towards Capp's Bridge on 23 August at 11.30 hours. Blackthorn hedges and bushes are also important for sloe carpet, a Nationally Scarce B species recorded at Knepp by D. Buckingham in 1995. Its range in Sussex has contracted dramatically towards the north and west in recent years and therefore it would be desirable to survey Site B during its flight period from late March to late April.

The additional survey of the southern end of Knepp Mill Pond for rush wainscot (RDB3) was successful with one male being recorded on 23 August.

## 3.8 Lepidoptera – butterflies

### 3.8.1 Survey brief

Butterflies are popular and easily identifiable insects, with a history of casual recording effort on the Knepp Estate by Butterfly Conservation (BC) Sussex Branch lepidopterists (David Buckingham in particular) since 1995 at least. Twenty-six butterfly species have been previously recorded on the site according to the BC. Rich Howorth (West Weald Landscape Project) carried out this butterfly survey.

### 3.8.2 Methodology

Butterfly Conservation's standard methodology for 'Butterfly Site Recording' was used as the basis to carry out a simple quantitative survey of the site to estimate population densities of species apparent at the time. The three main grazing treatment areas of the site (ie the deer-fenced areas subject to introduction of semi-natural herbivores) were briefly walked

around, taking in features of potential interest to butterflies including linear boundaries such as hedgerows. The site was divided into 27 discrete parcels according to blocks of similar vegetation, habitat and management, and the length of time spent and the individual numbers (avoiding double-counting as far as possible) seen of each butterfly species in each was recorded. A butterfly net was used to capture individuals as necessary, for example to separate small and Essex skippers. The weather conditions operating at the time of survey of each parcel were recorded, and a summary of maximum temperature, wind speed and direction and amount of sunshine over each of the two days' survey was noted. The walking route taken and parcel approximate boundaries (indicating visual survey range) were marked on a map and later entered onto ArcView GIS as a data layer (Map 6).

### 3.8.3 Results and discussion

Just over fifteen hours were spent walking around the site in total, with total survey time spent recording butterflies being just over eight hours (499 minutes), covering a total distance of 21.0 kilometres at an average movement speed of 3.6 km/h according to the GPS unit.

**Species diversity**

Of the 26 species previously recorded, half of these (13 species) were observed in this survey – see Table 3.8.a and Appendix V, Table 1. This lower figure may be explained by the timing and limited period of survey, as well as by the fact that the weather prevalent at the time of survey was not ideal. Moderate to strong gusts of wind predominated, undoubtedly reducing butterfly species and numbers apparent considerably, although conditions on the second day of survey were a little better than the first.

**Table 3.8.a Butterflies recorded on Knepp 2005**

| Species | Recorded 2005 | Individuals (2005) | Recorded pre-2005 |
|---|---|---|---|
| Small skipper | Yes | 35 | Yes |
| Essex skipper | Y | 3 | Y |
| Large skipper | Y | 2 | Y |
| Brimstone | Y | 2 | Y |
| Large white | Y | 9 | Y |
| Small white | Y | 15 | Y |
| Green-veined white | | 0 | Y |
| Orange-tip | | 0 | Y |
| Green hairstreak | | 0 | Y |
| Brown hairstreak | * | 1 | Y |
| Purple hairstreak | | 0 | Y |
| Small copper | Y | 0 | Y |
| Brown argus | | 0 | Y |
| Common blue | Y | 0 | Y |
| Holly blue | | 0 | Y |
| White admiral | | 0 | Y |
| Red admiral | Y | 0 | Y |
| Painted lady | | 0 | Y |
| Small tortoiseshell | | 0 | Y |
| Peacock | Y | 1 | Y |
| Comma | Y | 2 | Y |
| Silver-washed fritillary | Y | 13 | Y |

| | | | |
|---|---|---|---|
| Speckled wood | Y | 5 | Y |
| Marbled white | Y | 0 | |
| Gatekeeper | Y | 198 | Y |
| Meadow brown | Y | 611 | Y |
| Ringlet | Y | 5 | Y |
| **Total** | | **902** | |

* Observed by Dr Tim Freed during moth survey (Section 3.7)

The greatest diversity of species in a survey parcel was 6 species found in the woodland of Horsham Common. Four parcels in contrast contained just one species at the time of survey.

Additional survey work by RH on the Knepp Estate added a further 4 species to provide a total of 17 species recorded by RH for this season - common blue, small copper, red admiral and marbled white, this last species indicating relatively unimproved grassland and not having been previously recorded by BC at Knepp. An additional species believed by the ex-gamekeeper John Lazell to have occurred quite recently on the Knepp Estate, and also not recorded on the BC inventory, is the declining species grizzled skipper (unconfirmed).

The only species recorded in this survey of some conservation interest were the silver-washed fritillary *Argynnis paphia*, listed as a Species of Conservation Concern in the UK Biodiversity Action Plan, and brown hairstreak *Thecla betulae,* which is on the Sussex Rare Species Inventory. This species had a good year during 2005, and was detected in an additional two woods – Spring Wood and Bar Furzefield - from those of previous BC records that list five records from just two sites.

**Butterfly densities**

A total of 901 individual butterflies were recorded across the whole site, two-thirds (611 individuals) of these being meadow browns followed by 198 gatekeepers. Other species were relatively scarce in individual numbers, generally being found in single figures (eg ringlet) or low double figures (eg small skipper).

Densities of all butterflies were generally relatively low, averaging c 1.81 individuals per minute of recorded survey across the whole site. In the majority of parcels, less than 3 individuals/min were sighted although a few areas had greater numbers with the highest relative abundance being found in the arable fallow (Parcel 23) with greater than 15 individuals/min recorded, apparently due to its abundance of nectar sources and dense structure. Abundance was lowest in the expanse of recently cut grassland at the southern end of the site that had been arable fields just a year previously (Parcel 22). These abundance trends tended to be reflected in the numbers of the two main species meadow brown and gatekeeper in each parcel. Table 1 (Appendix V) details the results of the timed survey by discrete area.

An additional analysis could include a GIS-based assessment of parcel area (assuming that the whole area was within visual range) against relative butterfly species numbers to better identify relative hotspots of numbers, as opposed to diversity, and relate this to site management practices.

## 3.9 Wetland Coleoptera

### 3.9.1 Survey brief

A wetland beetle survey was required to contribute to the baseline data required by the River Restoration Centre and the Environment Agency prior to river restoration work to be carried out on the River Adur corridor as it crosses the Knepp Estate. Peter Hodge was commissioned to carry out a wetland beetle survey on the site indicated on Map 1, Area B.

### 3.9.2 Methodology

The River Adur and areas of adjacent wetland were sampled using standard techniques, checking for species of conservation interest in particular.

### 3.9.3 Results

The results of just two day's fieldwork resulted in a total of 118 species of Coleoptera (beetles). These were recorded at four locations –

Ditch TQ1565 2100 (1 June)
R. Adur: south bank TQ1520 (1 June and 23 July)
R. Adur: north bank TQ1520 (1 June and 23 July)
R. Adur: east bank TQ1521 (1 June and 23 July)

In addition, 21 species of Hemiptera-Heteroptera (bugs), 5 species of Hemiptera-Homoptera (bugs), 15 species of Diptera (flies), 11 species of Lepidoptera (10 butterflies and 1 moth), 5 species of Orthoptera (grasshoppers and crickets), 4 species of Hymenoptera (bees and wasps) and 1 species each of Odonata (dragonflies and damselflies), Neuroptera (lacewings) and Dermaptera (earwigs). This list included 10 species of conservation interest (Table 3.9.a). Full lists of species are presented in Appendix VI .

**Table 3.9.a. Species of Conservation Importance**

| Species | Common name | Status | Comment |
|---|---|---|---|
| *Longitarsus rutilus* | A leaf beetle | **Na** | Widely distributed but very local in southern England. Phytophagous. Found near ponds or streams and in damp woodland, appearing to prefer partial shade. Associated with water figwort *Scrophularia aquatica* and balm-leaved figwort *S. scorodonia*. Larvae probably develop at the roots of the foodplant. Listed as **RDB2** in Shirt (1987); the status now revised to **Na** (Hyman, 1992). |
| *Notaris scirpi* | A weevil | **Nb** | Widespread but local in England and Wales and not recorded from southwest England. Associated with Lesser Pond Sedge *Carex acutiformis* and reedmace *Typha latifolia*. |
| *Pelenomus comari* | A weevil | **Nb** | Widely distributed in England, Wales and southwest Scotland. Found in wetland habitats. Phytophagous. Associated with marsh cinquefoil *Potentilla palustris* and sometimes with purple loosestrife *Lythrum salicaria*. The larvae feed externally on the leaves. |
| *Melegethes gagathinus* | A pollen beetle | **N** | Very local in southern England and also recorded from North-east England. Found in wetlands beside ponds and ditches. Associated with flowers of water mint *Mentha aquatica*. |

| Species | Common name | Status | Comment |
|---|---|---|---|
| *Melegethes ochropus* | A pollen beetle | **N** | Very local with a scattered distribution in England. The larvae develop in the flowers of marsh woundwort *Stachys palustris*. |
| *Ishnomera cyanea* | A flower beetle | **Nb** | Two species (*I. caerulea* and *I. cyanea*) were previously confused in Britain under the name *I. Caerulea*. *I. cyanea* is by far the most frequent and is widely distributed though local in England and Wales. Mainly in ancient broad-leaved woodland, pasture-woodland and old hedgerows. Adults frequently visit flowers, including hawthorn and hogweed. The larvae develop in dead wood of a variety of tree species. |
| *Oliarus panzeri* | A leaf-hopper bug | **N** | A very local species confined to South-east England. The ecology is poorly understood - it may prefer areas that are periodically waterlogged but which dry out and crack in summer. The foodplants are unknown but the nymphs are thought to be root feeders. |
| *Odontomyia tigrina* | A soldier fly | **N** | Widespread but local, mostly in the southern half of England and Wales. Associated with wetland, especially ancient fens and grazing marshes. The aquatic larvae have been found in shallow water at the margins of both freshwater and slightly brackish ponds and ditches. |
| *Macropis europaea* | A solitary bee | **Na** | Restricted to southern England. Closely associated with yellow loosestrife *Lysimachia vulgaris*, in fens and beside ponds and rivers. Nests excavated in the ground, generally well concealed by overhanging vegetation. It is not so rare as once thought and has recently been recorded from a number of new sites. Its status has been revised from **RDB3 (Rare)** in Shirt (1987) to **Nationally Scarce Category A (Na)** in Falk (1991). |
| *Conocephalus discolor* | Long-winged cone-head (bush cricket) | **Na** | Formerly very local near the coast of Sussex, Hampshire, Isle of Wight and Dorset, this species has been slowly extending its range and now occurs in many inland localities in southeast England. Found in areas of long grass, reeds or rushes. |

### 3.9.4 Discussion

With 118 species of beetles recorded in 2 days, the results of this limited survey were promising. A more extensive survey of wetland beetles could only be expected to augment these results considerably. This baseline information will be an important component of the monitoring strategy subsequent to river restoration. A wider, shallower river allowed to flow in a naturally meandering channel will provide considerably enhanced habitat for aquatic and wetland beetles, and changes in the beetle fauna will be interesting.

## 3.10 Ant survey

### 3.10.1 Survey brief

The Survey Unit was contacted in June 2005 by Alex Kent, who had recently completed an MSc including a dissertation territory size of wood ants. He expressed an interest in voluntary work, specifically involving ant survey, which was a good opportunity to obtain a further contribution to the Knepp baseline inventory.

### 3.10.2 Methodology

A series of transects were set up in two sites as indicated on Map 7, Area A and Area B. Six transects were set up in Site A and eleven transects in Site B. In addition, *ad lib* samples were collected as transects were laid and pitfall traps were collected.

Each transect was 30 metres long with nine pitfall traps. Originally, it was intended to place 12 pitfall traps along each transect. This was reduced to nine per transect due to economic constraints. Pitfall traps were placed as in Figure 1 in groups of three 15m horizontally apart and 2m vertically apart.

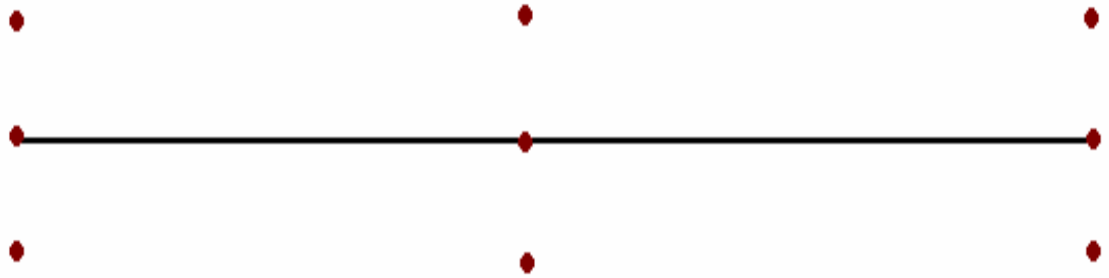


**Figure 1**. Arrangement of pitfall traps in each transect. The line represents the transect; dots represent pitfall traps.

In Site B, some transects were laid nearer to the river, so that information on ant species diversity would be available to the Environment Agency prior to river restoration work. Otherwise, transects were placed within each site in a variety of habitats in an evenly dispersed manner. Pitfall traps were left for three days, from which the caught ant individuals were collected and then identified.

### 3.10.3 Constraints

This was a voluntary survey with considerable financial constraints, and as Alex Kent's endeavours to get employment were successful, he had to limit the time spent on this survey. Nevertheless, his contribution to this baseline survey is both interesting and valuable.

### 3.10.4 Results

A total of eight ant species was found over both sites A and B (Table 3.10.a).

**Table 3.10.a Number of species**

| Species | Area A | Area B | Total |
|---|---|---|---|
| *Lasius flavus* | | 2 | 2 |
| *Lasius fuliginosus* | | 5* | 5 |
| *Lasius mixtus* | | 5* | 5 |
| *Lasius niger* | 7 | 168 | 175 |
| *Myrmica rubra* | 19 | 1 | 20 |
| *Myrmica ruginodis* | 7 | 18 | 25 |
| *Myrmica sulcinodis* | 1 | 1 | 2 |
| *Stenamma westoodii* | | 16 | 16 |

* Numbers of ants taken directly from a nest.

In Area A (Table 3.10.b), *Myrmica rubra* was the most abundant species. In Area B, the results of the transect work (Table 3.10.c) show that *Lasius niger* was the most abundant ant species. The third most abundant ant was *Myrmica ruginodis*. It can be observed in tables 3.10.b and 3.10.c that *Lasius niger* and *Myrmica ruginodis* were not specifically found in either site, whereas *Myrmica rubra* was predominantly found in site A.

**Table 3.10.b Individuals and species caught in Area A (Grass 01 Animals 02)**

| Species | Transect 1 | Transect 2 | Transect 3 | Transect 4 | Transect 5 | Transect 6 | Total |
|---|---|---|---|---|---|---|---|
| *Lasius niger* | | | 2 | 2 | 3 | | 7 |
| *Myrmica rubra* | | 8 | 1 | | 5 | 5 | 19 |
| *Myrmica ruginodis* | 1 | | | | 6 | | 7 |
| *Myrmica sulcinodis* | | | 1 | | | | 1 |

**Table 3.10.c Individuals and species caught in Area B (Grass 04 Animals 05)**

| | Transect | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **Total** |
| *Lasius niger* | | | | | 42 | | 19 | 3 | 2 | | 89 | 155 |
| *Myrmica rubra* | | | | | | | | | | | 1 | 1 |
| *Myrmica ruginodis* | | | 1 | 3 | | | | | 4 | 3 | 4 | 15 |
| *Myrmica sulcinodis* | | | | | 1 | | | | | | | 1 |
| *Stenamma westoodii* | | 1 | | | 15 | | | | | | | 16 |

From additional observations, it was found that there was a very large cluster and population of *Lasius niger* nests at TQ1600 2070 indicating a large population of these ants at this site. A large cluster of *Lasius flavus* nests was also found close to Knepp Castle TQ1630 2080. A large cluster is defined here as an estimation of over 10 nests.

**Table 3.10.d Individuals and species caught from *ad lib* sampling**

| Species | Total |
|---|---|
| *Lasius flavus* | 2 |
| *Lasius fuliginosus* | 5 |
| *Lasius mixtus* | 5 |
| *Lasius niger* | 13 |
| *Myrmica ruginodis* | 3 |

### 3.10.5 Discussion

The three most abundant species found across both sites were *Lasius niger, Myrmica ruginodis,* and *Myrmica rubra*, although *Lasius niger* and especially *Myrmica rubra* were unequally distributed across the two sites. *Myrmica ruginodis* was more uniformly distributed over both sites, but in lower numbers. These patterns may have occurred due to habitat and ecological differences across the two sites, but further survey work with a larger sample size may be required to clarify this. *Lasius* niger is one of the commonest, if not the most common, British ant, occupying open, sunny habitats such as grassland, heaths and gardens. *Myrmica ruginodis* and *Myrmica rubra* are also common species especially in southern England. *Myrmica rubra* prefers damp habitats and *Myrmica ruginodis* is an ant of shaded woodland with dead wood litter. The occurrence of the cluster of meadow ant *Lasius*

*flavus* close to the Castle confirms that this is an area of undisturbed grassland. This species might be expected to colonise across the Estate in time.

A colony of *Lasius fuliginosis* was found in Area B (TQ16350 20900) in an old (unidentified) tree. This species, along with several other species, has very specific habitat requirements and is frequently found in old dead trees or tree stumps. These features should be maintained in order to preserve the habitat for the more sensitive species. Less common ant species recorded include *Lasius mixtus, Myrmica sulcinodis*[1] and *Stenamma westwoodi.* This latter species has only been recorded previously from one site on the East Sussex / Kent border, but due to the small size of its nests and its predominantly subterranean habit, is likely to be very under-recorded (Mike Edwards, pers. comm. with Theresa Greenaway).

This study successfully determined the presence of a number of ant species. However, there were fewer species than expected. This could be due to constraints limiting the survey (S.3.10.4), affecting particularly the number of transects and the types of collection methods employed. Other factors could also have had a negative impact, including the frequent heavy rainfall at the time of the survey, which may have limited ant activity. Some of the pitfall traps were found to have been pulled up and thus disabled, particularly in transect 4, Area B where only two pitfall traps were found as they were set up. This was a preliminary survey and further work would be required to confirm ant diversity and status across the Estate.

## 3.11 Pitfall trap invertebrates

### 3.11.1 Survey brief

Professor Paul Buckland has an ongoing research interest in the Knepp grazing project and agreed to contribute to the invertebrate survey effort by setting up pitfall traps. His interest is primarily in the coleopteran fauna.

### 3.11.2 Methodology

Four pitfall traps were put in place in each of three sites (Table 3.11.a). Each trap site was photographed (photographs available in the separately produced Appendix), and each contained water plus a drop of wetting agent to kill the invertebrates trapped. Pitfall traps were emptied on a weekly basis by Charlie Burrell, who transferred to contents to tubes that were then forwarded to P. Buckland for sorting. Other taxa caught were passed on to relevant invertebrate experts (Table 3.11.b) in West Sussex who kindly agreed to identify as much as possible within the constraints of their own time. Specimens obtained from sweep netting were also forwarded to P. Buckland.

In addition to the pitfall traps, beetles were collected and identified from dung and corpses.

[1] Probable mis-identification of *Myrmica scabrinodis*

**Table 3.11.a Site of pitfall traps**

| Site No. | Traps | Location (field or wood) | Site description |
|---|---|---|---|
| A1 | 2 | Coates Furzefield | Edge of young oak plantation by ride |
| A2 | 2 | Constable | Edge of woodland in field on old farm track |
| A3 | 2 | Long Eight / Hilly | In ley sown Oct. 2004, one under tree |
| A4 | 2 | Long Eight | In old hedgeline next to leys sown Oct. 2004 |
| B1 | 2 | North Drive West | New ley in 2001 – wildflower mix and CSS grass |
| B2 | 2 | Matchetts Wood | |
| B3 | 2 | Spring Wood Corner | New ley in 2001 – CSS grass only used |
| B4 | 2 | Spring Wood | 150 year old oak plantation |
| B5* | | Knepp Mill Pond | Top of pond |
| B6* | | Knepp Mill Pond | Top of pond |
| C1 | 2 | Tumbledown Lagg | Old water meadow next to hedge |
| C2 | 2 | Jackson's Wood | 300 year old oak wood |
| C3 | 2 | Sherwoods | New ley 2004 – wildflower mix and CSS grasses |
| C4 | 3 | Middle Brook | Old lagg grassland by River Adur |

* Added later.
A = Pondtail survey area
B = Knepp Park survey area
C = Swallows survey area

**Table 3.11.b Invertebrate experts to whom pitfall material was sent**

| Taxon | Sent to | Results received |
|---|---|---|
| Arachnida (spiders) | Andy Phillips | No |
| Coleoptera (beetles) | Paul Buckland | Yes (incomplete) |
| Collembola (springtails) | Gerald Legg | Yes (incomplete) |
| Diptera (flies) | Patrick Roper | Yes |
| Hymenoptera (ants, bees, wasps) | Mike Edwards | Yes |

### 3.11.3 Results

**Coleoptera – beetles**

To date (January 2006), Paul Buckland has identified approximately 190 species of beetles, and more are still awaiting identification. Six of these species are of conservation interest (Notable B):

*Notiophilus quadripunctatus*
*Pterostichus longicollis*
*Pterostichus anthracinus*
*Chlaenius nigricornis*
*Badister dilatatus*
*Cercyon ustulatus*

These beetles all belong to the ground beetle family (Carabidae) except for *Cercyon ustulatus*, family Hydrophilidae.

The raw data are held by the Record Centre Survey Unit. A full evaluation of the beetle fauna will be produced when the identification is completed.

**Collembola**

Initial work on the material collected identified 12 fairly common species of springtails:

*Ptenothrix atra*
*Orchesella villosa*
*Dicrotoma fusca*
*Dicrotoma ornate*
*Isotomodes productus*
*Isotomodes minor*
*Anurida granaria*
*Micranurida pygmaea*
*Kalaphorura burneisteri*
*Brachystomella parvula*
*Pseudosinella alba*
*Lepidocrytus cyaneus*

**Diptera – flies**

Patrick Roper has identified forty-three species of flies from Knepp. This includes material from the pitfall traps and from a day's voluntary survey work that he carried out (Table 3.11.c).

**Table 3.11.c Fly species recorded, 2005**

| Family | Species | Common name | Status |
|---|---|---|---|
| Limoniidae | *Limonia nubeculosa* | a short-palped cranefly | |
| Limoniidae | *Erioptera lutea* f. *taenionota* | a short-palped cranefly | |
| Ptychopteridae | *Ptychoptera contaminata* | a ptychopterid cranefly | Local |
| Bibionidae | *Bibio reticulatus* | a st mark's fly | |
| Sciaridae | *Schwenckfeldina carbonaria* | a black fungus gnat | |
| Stratiomyidae | *Chloromyia formosa* | broad centurion | |
| Stratiomyidae | *Oplodontha viridula* | common green colonel | Local |
| Rhagionidae | *Chrysopilus cristatus* | black snipefly | |
| Asilidae | *Leptogaster cylindrica* | striped slender robberfly | |
| Hybotidae | *Drapetis ephippiata* | a dance fly | Local |
| Hybotidae | *Platypalpus calceata* | a dance fly | |
| Empididae | *Empis praevia* | a dance fly | Local |
| Dolichopodidae | *Dolichopus plumipes* | a dolichopodid fly | |
| Dolichopodidae | *Dolichopus virgultorum* | a dolichopodid fly | Notable/Nb |
| Dolichopodidae | *Rhaphium appendiculatum* | a dolichopodid fly | |
| Dolichopodidae | *Syntormon denticulatus* | a dolichopodid fly | Local |
| Dolichopodidae | *Chrysotus collini* | a dolichopodid fly | Local |
| Dolichopodidae | *Chrysotus cupreus* | a dolichopodid fly | Local |
| Lonchopteridae | *Lonchoptera furcata* | a lonchopterid fly | |
| Phoridae | *Megaselia* sp. | a scuttle fly | |
| Syrphidae | *Platycheirus clypeatus* | a hoverfly | |
| Syrphidae | *Melanogaster hirtella* | a hoverfly | |
| Syrphidae | *Pipiza lugubris* | a hoverfly | Notable/Nb |
| Tephritidae | *Tephritis formosa* | a picture-wing fly | |
| Sepsidae | *Themira lucida* | a sepsid fly | |

| Family | Species | Common name | Status |
|---|---|---|---|
| Sepsidae | *Themira minor* | a sepsid fly | |
| Sepsidae | *Themira superba* | a sepsid fly | Local |
| Sepsidae | *Sepsis cynipsea* | a sepsid fly | |
| Sepsidae | *Sepsis punctum* | a sepsid fly | |
| Sciomyzidae | *Limnia unguicornis* | a snail-killing fly | |
| Sphaeroceridae | *Leptocera lutosa* | a lesser dungfly | |
| Sphaeroceridae | *Opacifrons humida* | a lesser dungfly | |
| Ephydridae | *Notiphila cinerea* | a shore fly | |
| Ephydridae | *Notiphila dorsata* | a shore fly | |
| Ephydridae | *Hydrellia nasturtii* | a shore fly | |
| Ephydridae | *Coenia palustris* | a shore fly | |
| Diastatidae | *Diastata adusta* | a diastatid fly | |
| Agromyzidae | *Cerodontha denticornis* | a leaf-mining fly | |
| Sarcophagidae | *Sarcophaga dissimilis* | a flesh fly | |
| Scathophagidae | *Scathophaga stercoraria* | yellow dung fly | |
| Anthomyiidae | *Hylemya vagans* | a woodfly | |
| Fanniidae | *Fannia serena* | a lesser housefly | |
| Muscidae | *Phaonia tuguriorum* | a muscid fly | |

**Hymenoptera - Ants, bees and wasps**

Three species of ant and twelve species of bee were identified from the pitfall traps (Table 3.11.d).

**Table 3.11.d Hymenoptera recorded from pitfall traps**

| Trap No. | Group | Species | Conservation status |
|---|---|---|---|
| A1 | Ant | *Myrmica ruginodis* | Commonly found in many habitats |
| | Cuckoo bee | *Nomada flavoguttata* | Common parasite of *Andrena* spp. |
| A2 | None recorded | | |
| A3 | Bumblebee | *Bombus terrestris* | Widespread and abundant |
| | Solitary bee | *Lasioglossum fulvicorne* | Locally common on more basic soils |
| | Solitary bee | *Lasioglossum malachurum* | Nationally Scarce A, southern, restricted |
| | Cuckoo bee | *Nomada flava* | Common parasite of Andrena spp. |
| A4 | Ant | *Myrmica ruginodis* | Commonly found in many habitats |
| | Ant | *Myrmica scabrinodis* | Commonly found in many habitats |
| B1 | Solitary bee | *Lasioglossum lativentre* | Widespread & frequent, especially on heathlands |
| | Solitary bee | *Lasioglossum pauxillum* | Nationally Scarce A, prefers sandy clays to nest |
| | Solitary bee | *Lasioglossum puncticolle* | Nationally Scarce B, clay meadows & woodland rides |
| B2 | Ant | *Myrmica rubra* | Locally common in damp, sheltered habitats |
| B3 | Ant | *Myrmica scabrinodis* | Commonly found in many habitats |
| | Solitary bee | *Lasioglossum fulvicorne* | Locally common on more basic soils |
| | Solitary bee | *Lasioglossum lativentre* | Widespread & frequent, especially on heathlands |
| | Solitary bee | *Lasioglossum malachurum* | Nationally Scarce A, southern, restricted |
| | Solitary bee | *Lasioglossum pauxillum* | Nationally Scarce A, prefers sandy clays to nest |
| B4 | Ant | *Myrmica ruginodis* | Commonly found in many habitats |

| Trap No. | Group | Species | Conservation status |
|---|---|---|---|
| | Solitary bee | *Andrena chrysosceles* | Abundant in south, especially in clay woodlands |
| | Solitary bee | *Andrena nitida* | Abundant in south, meadows |
| | Solitary bee | *Andrena subopaca* | Widespread & abundant, especially in clay woodlands |
| | Cuckoo bee | *Nomada fabriciana* | Common parasite of Andrena spp. |
| | Cuckoo bee | *Nomada flavoguttata* | Common parasite of Andrena spp. |
| C1 | Ant | *Myrmica ruginodis* | Commonly found in many habitats |
| | Cuckoo bee | *Nomada flavoguttata* | Common parasite of Andrena spp. |
| C2 | None recorded | | |
| C3 | Ant | *Myrmica ruginodis* | Commonly found in many habitats |
| | Solitary bee | *Lasioglossum fulvicorne* | Locally common on more basic soils |
| | Solitary bee | *Lasioglossum malachurum* | Nationally Scarce A, southern, restricted |
| C4 | None recorded | | |

### 3.11.4 Discussion

The pitfall survey was limited in scope, but nevertheless produced so much material that getting it identified was problematic. Some of those who volunteered to identify various groups were simply unable to because of other demands on their time. In spite of these limitations, the results are useful and will enable the identification of promising lines of research for the future.

The Coleoptera is a notoriously species-rich order of insects, and the identification of at least 190 species from the pitfall traps comes as no great surprise. Further survey and evaluation of the beetle fauna would be of considerable interest.

Of the forty-three species of fly recorded, 10 were of conservation interest (Table 3.11.c). These totals would be expected to increase with further survey effort.

The records of Hymenoptera are interesting, not only because three species of conservation interest were found - *Lasioglossum malachurum, Lasioglossum pauxillum* (both Nationally Scarce A) and *Lasioglossum puncticolle* (Nationally Scarce B), but because of the overall range of habitat preferences of the recorded species. Many, for example the ant *Myrmica ruginodis*, are widespread and abundant throughout the UK, but others have more specialised habitat requirements. The bee *Lasioglossum fulvicorne* is generally found on more basic soils, whereas *Lasioglossum lativentre* is more typical of heathlands. Predictably other species are those of meadows (*Andrena nitida*) or clay woodlands (*Andrena chrysosceles* and *Andrena subopaca*).

It is felt (Gerald Legg, pers. comm.) that the full list of Collembola (springtails) could well reveal the presence of rarities, in addition to the 12 more common species. However, this is an under-recorded group that would benefit by further study. Gerald Legg hopes to continue identifying the pitfall material has time allows.

## 3.12 Amphibian survey

### 3.12.1 Survey brief

David Buckingham carried out an extensive survey of the condition of the ponds on the Estate in 1992 (Buckingham 1992), recording details of all amphibians. It was decided to repeat this as part of the baseline survey. Ponds are an important component of habitat diversity and have high biodiversity potential. As well as other amphibians, the great crested newt *Triturus cristatus* was recorded by Buckingham, and one of the reasons for assessing the condition of the ponds was to identify those that might currently support this species, protected under Schedule 5 of the Wildlife & Countryside Act 1981.

Additionally, ponds are likely to be used by herbivores, and the state of these ponds in 2005 was considered a useful baseline against which to monitor and evaluate changes caused by near-natural grazing.

### 3.12.2 Methodology

The position of all ponds on the Pond Inventory of Sussex (Sussex Biodiversity Record Centre 2002) and those surveyed by David Buckingham in 1992 were digitised on ArcView GIS, retaining Buckingham's numbering system for ease of comparability (Map 8). On 4 May 2005 Mark Elliott (Sussex Wildlife Trust) and Theresa Greenaway (Record Centre Survey Unit) visited as many of these ponds as possible. The condition of each was assessed using Sussex Great Crested Newt Site Inventory survey forms, which included full site details plus Grid Reference. These hand-written pond condition assessment cards are kept in the Record Centre Survey Unit, Woods Mill. Digital photographs of each pond were taken by T.Greenaway. These photographs are available from the Record Centre Survey Unit. Ponds likely to support amphibians were identified for subsequent search by means of torchlight.

### 3.12.3 Constraints

Time was a limiting factor within the period that ponds can be surveyed for great crested newts. Out of a total of 54 ponds recorded by Buckingham in 1992, only a total of 21 were revisited on 4 May.

### 3.12.4 Results

Entries on the Pond Condition forms are summarised on Table 3.12.a. The ponds were very variable in character.

**Table 3.12.a Pond Condition Assessment summary May 2005**

| Pond No. | Grid Ref (TQ) | Size (m) | Max depth (m) | Tree shading (%) | Species |
|---|---|---|---|---|---|
| 1 | 15312 21754 | 20 x 15 | 1 + | 20 | 10 + smooth newt male & female |
| | | | | | 10 + palmate newt male & female |
| 2 | 15309 22002 | 15 x 15 | 0.5 | 70 | 2 female smooth or palmate newts |
| 3 | 15305 22113 | 60+ x 30 | ? | 10 | Abundant marsh frogs |
| 4 | Non-existent | | | | |
| 5 | | 20 x 20 | deepish | 70 + | 2 female smooth or palmate newts |
| 6 | 15507 22086 | 10 x 5 | unknown | 100 | smooth newts |

| Pond No. | Grid Ref (TQ) | Size (m) | Max depth (m) | Tree shading (%) | Species |
|---|---|---|---|---|---|
| A* | 15118 22274 | 5 x 5 | 0.3 | 100 | None |
| 7 | 15291 22630 | 10 x 10 | 1? | 5 | None |
| 8 | 15113 22877 | 5 x 3 | 0.3 | 100 | None |
| 15 | 14515 23205 | 25 x 15 | unknown | 80 | None |
| 16 | 14607 23219 | 15 x 10 | less than 1 | 90 | None |
| 17 | 14859 23181 | 30 x 10 | unknown | 80 | Abundant female smooth newts |
| | | | | | great crested newt 2 male, 6 female |
| 27 | 14603 22916 | 10 x 10 | unknown | 5 | 1 female smooth newt |
| 29 | 14424 22733 | 10 x 5 | unknown | 100 | None |
| 30 | 14425 22733 | 30 x 20 | deep | 100 | None |
| 48 | 15554 20408 | 10 x 10 | unknown | 10 | None |
| 50a | 15797 20374 | 30 x 10 | 1 + | 20 | None |
| 50b | bnth power line | 25 x 25 | 1 + | 10 | Unsuitable |
| 54 | 15818 22248 | 8 x 8 | less than 1 | one huge oak | None |

* Pond not recorded by Buckingham

### 3.12.5 Discussion

Out of the 21 ponds visited, only 7 were confirmed as supporting amphibians. The presence of great crested newts in pond 17 was very satisfactory, especially as this was the only pond in which this species was recorded by D. Buckingham in 1992. The most distinctive aspect of the pond condition survey was the high degree of variability seen in all the ponds visited. This is a valuable feature of the Estate as a whole, making a significant contribution to habitat diversity.

## 3.13 Reptile survey

### 3.13.1 Survey brief

Slow worm *Anguis fragilis,* common lizard *Lacerta vivipara,* grass snake *Natrix natrix* and adder *Vipera berus* have all been recorded from Knepp Castle Estate (Greenaway, 2005). These are all protected under Schedule 9 of the Wildlife and Countryside Act 1981. A case could be made for a complete reptile survey. As funds were limited, it was felt that the presumption should be made that these reptiles would be present at varying numbers across the Estate and their habitat needs, although not a prime objective of this stage of the project, could be taken into consideration in any future development. However, Charlie Burrell offered to record all those reptiles found underneath corrugate iron roof sections already in place.

### 3.13.2 Methodology

Corrugated iron roof sections in Coates Furzefield, Knepp Mill Pond Pleasure Grounds, near Springwood Pond and near Swallows Pond were inspected weekly.

### 3.13.3 Results

Coates Furzefield Pond – Most weeks 4 or 5 grass snakes were seen. On 27 July, one slow worm and one common lizard were seen.

Knepp Mill Pond Pleasure Ground – Both grass snakes and slow worms have been present under all three iron sheets. Common lizards have also been seen under these sheets this summer by Bob Lack (Knepp Estate employee).

Springwood Pond – Nothing seen.

Swallows Pond – No reptiles seen, but one vole observed.

### 3.13.4 Discussion

Reptiles are likely to occur across the Estate, and, although the intention is not to manage for particular groups, it would be beneficial to ensure that there are plenty of sites suitable for them to hibernate. In general, this means not being too tidy, leaving heaps of cut rushes for grass snakes and stacks of wood, bricks or broken concrete etc for this purpose.

## 3.14 Breeding bird survey

### 3.14.1 Survey brief

A survey of the breeding bird communities present within two areas of the Knepp Castle Estate was carried out in spring 2005. The purpose of this survey was to provide a baseline against which changes in populations and distribution can be measured following the conversion of the estate from intensive arable to a near-natural grazing system. Paul James was commissioned to carry out a survey of breeding birds along transects in these areas.

### 3.14.2 Methodology

Two transects were surveyed: the first in the area north of the A272 and east of Shipley Road (area A) on 23 May and 21 June, and the second in the area south of Countryman Lane and west of New Barn Farm (area B) on 6 May and 25 May (Maps 9a & 9b). Each visit was made in good weather and commenced one hour after sunrise. The survey was conducted by following the transects and recording the species encountered (by sight or sound) on large scale maps using the standard Common Birds Census species and activity codes (Marchant 1983). Note was also made of the occurrence of species of conservation concern encountered in parts of area B not covered by the transect.

### 3.14.3 Results

**Species recorded**

A total of 57 species was recorded on the Estate, 34 in area A and 46 in Area B (Maps 9a & 9b), which was searched more extensively. The details of the number of registrations of each species along each transect are shown in Appendix VII.

**Species of Conservation Concern**

Of the 57 species recorded during the survey, eight were Red List Species of High Conservation Concern and a further 15 were Amber List Species of Medium Conservation Concern (see Table 3.14.a). Red list species are those that are globally threatened according to IUCN criteria; those whose population or range has declined rapidly in recent years; and those that have declined historically and not shown a substantial recent recovery. Amber list species are those with an unfavourable conservation status in Europe; those whose population or range has declined moderately in recent years; those whose population has declined historically but made a significant recent recovery; rare breeders; and those with internationally important or localised populations. Species that fulfil none of the criteria are green listed (Gregory and others 2002), Appendix VII.

**Table 3.14.a Red and Amber species recorded, 2005**

.

| Amber List | Red List |
|---|---|
| Mute swan | Turtle dove |
| Red kite | Skylark |
| Kestrel | Marsh tit |
| Lapwing | House sparrow |
| Stock dove | Linnet |
| Cuckoo | Bullfinch |
| Barn owl | Yellowhammer |
| Green woodpecker | Reed bunting |
| Meadow pipit | |
| Dunnock | |
| Nightingale | |
| Song thrush | |
| Willow warbler | |
| Goldcrest | |

### 3.14.4 Discussion

The results of the survey reveal that the estate supports a rich breeding bird community, including a significant number of species of both medium and high conservation concern. There are however marked differences between the communities present within the two study areas. Woodland species such as great spotted woodpecker, marsh tit and nuthatch were only recorded in area A whereas species characteristic of overgrown hedgerows such as nightingale, whitethroat and yellowhammer were more a feature of area B.

Although the survey carried out gives a good indication of the species present and the approximate number of breeding territories along the transects, it should be seen as providing a 'snapshot' rather than a detailed picture given that only two field visits were made to each transect. By comparison, the BTO's Common Birds Census (CBC), which is a mapping census during which all contacts with birds are plotted on a map, involves ten or more visits to a site in the breeding season (Marchant 1983). It should also be noted that the survey did not start until May when some species (eg nuthatch) have largely stopped singing and are thus more difficult to locate.

## 3.15 Barn owls

### 3.15.1 Survey brief

Barn owls are on RSPB's Amber List of Conservation Concern. Dr Barrie Watson (President of SOS) monitors the barn owls on the Knepp Castle Estate annually, and holds an English Nature licence permitting him to count and ring chicks. He has kindly agreed to make available the results for 2005, but has requested that the precise locations should be kept Confidential.

### 3.15.2 Methodology

Barn owl nest boxes are positioned in three sites on the Knepp Estate – Barn A on the north side of the A272 and Barns B and C in the southern part of the Estate. These were inspected on 30 May 2005. Barn A was also inspected on 25 July and again on 21 August.

### 3.15.3 Results

**Barn A** – On 30 May and adult female barn owl was present but there were broken eggshells in the nest box, indicating predation by perhaps a crow or magpie. On 25 July there were about four tiny chicks that were not disturbed and B.Watson left the barn immediately. On 21 August there were three chicks that were then ringed.

**Barn B** – On 30 May and adult female and six chicks with an age range of 16-29 days were found. The chicks were ringed. The adult female had been ringed as a chick just south of Partridge Green in July 2003.

**Barn C** – no barn owls have nested in this barn to date, although a barn owl was observed roosting here on 13 January 2005.

### 3.15.4 Discussion

Breeding barn owls regularly use Barns A and B. Barn owls feed largely on small mammals such as voles, mice and shrews, but will also take a range of other prey items including insects and amphibians. Their continued success on the Knepp Estate will depend on both the retention of their traditional, undisturbed nest sites and also on prey availability. The near-natural grazing regime, with such a large area of land taken out of intensive arable production, should result in increased prey abundance for barn owls. The barn owls on the Estate are not used to disturbance, so any increase in use of the barns in which they breed would have a negative impact.

## 3.16 Bat survey

### 3.16.1 Survey brief

A bat survey was required both as part of the baseline information needed by the River Restoration Centre and the Environment Agency prior to river restoration and as part of the overall baseline inventory of the Knepp Castle Estate. The aim of this survey was to identify bat species and habitat use in different parts of the Estate. Daniel Whitby (Whitby Wildlife Conservation) was commissioned to carry out this survey. Daniel Whitby is covered by an English Nature licence that permits the methodology specified in this survey.

### 3.16.2 Methodology

The Estate was surveyed on 4 occasions. All surveys were carried out under favourable weather conditions at a time of year when bats are active. Different areas and habitats were selected in order to improve the chances of recording a wide range of bats with different ecological requirements. A number of survey methods were utilised, in order for as much information as possible to be obtained in the short time available for surveying and to ascertain the sex and breeding status of at least some bats.

Time-expanded recordings were taken with a handheld Peterson D240x bat detector, which were recorded onto minidisk. Automatic bat loggers were also used to record any bats that passed a selected point. Any recordings taken were analysed on Bat-Sound software, which facilitates identification.

Mist netting and harp trapping were used to catch bats so the species, sex and breeding status of bats present could be identified. An acoustic lure was used to attract bats for capture by playing a number of species social calls.

**1 August** – Two nets and one harp trap were erected in Northern Wood (TQ139200). One Autobat was used to attract bats to a net. In addition a bat detector was used and the results logged.

**12 August** – Two automatic bat loggers were used to record bat activity along different sections of the river Adur.

**29 August** – One net and one harp trap was used in Great Cockshill Wood (TQ152231).

**8 September** - One net and one harp trap were used in Renche's Wood (TQ148232)

### 3.16.3 Results

A total of eight species of bat was recorded:

| | |
|---|---|
| 45khz pipistrelle | *Pipistrellus pipistrellus* |
| 55khz pipistrelle | *Pipistrellus pygmaeus* |
| Serotine | *Eptesicus serotinus* |
| Natterer's bat | *Myotis nattereri* |
| Whiskered bat | *Myotis mystacinus* |
| Daubenton's bat | *Myotis daubentonii* |
| Bechstein's bat | *Myotis bechsteinii* |
| Brown long-eared bat | *Plecotus auritus* |

The location and breeding status of the bats, where known, is given in Table 3.16.a.

**Table 3.16.a Location and breeding state of bats recorded**

| Date | Site | Species | Sex | State |
|---|---|---|---|---|
| 01/08/05 | Northern Wood | 45kz pipistrelle | male | Juvenile |
| | | serotine | female | Lactating |
| | | Bechstein's bat | male | Juvenile |
| | | Natterer's bat | female | Lactating |
| | | Whiskered bat | male | Adult |
| | | 55khz pipistrelle | Unknown* | |
| 12/08/05 | River Adur TQ156201 | 45khz pipistrelle | Unknown | |
| | TQ142213 | Serotine | Unknown | |
| | | Daubenton's bat | Unknown | |
| | | 55khz pipistrelle | Unknown | |
| | | Natterer's bat | Unknown | |
| 29/08/05 | Gt Cockshill Wood | Brown long-eared bat | male | Juvenile |
| | | Bechstein's bat | 2 females | |
| | | Brandt's/ whiskerd bat | Female | Juvenile |
| | | 45khz pipistrelle | Unknown | |
| | | 55khz pipistrelle | Unknown | |
| | | serotine | Unknown | |
| 08/09/2005 | Renche's Wood | Brown long-eared | male | Adult |
| | | | female | adult |
| | | | male | Juvenile |
| | | Whiskered bat | female | Post-lactating |
| | | Natterer's bat | female | Post-lactating |
| | | 45khz pipistrelle | male | adult |

* bats recorded on bat detector

### 3.16.4 Discussion

The Estate does not have a substantial amount of woodland, and none of the woods is particularly large. Many of these woodlands are rather isolated and scattered, but whereas a number of the oak woodlands appear likely to be very suitable for bats, others have less potential. To some extent compensating for the scattered nature of the woodlands, habitat suitable for bat flightline throughout the Estate is good with a number of large hedgerows, tree lines and double-hedged tracks and bridle paths connecting fragmented copses and small woods.

Automatic bat loggers positioned along the River Adur did not indicate high bat use especially by commuting bats, although the river is very likely to be used for foraging bats at times throughout the year. This was confirmed by information obtained on nights spent netting, when the numbers of bats observed along flightlines away from the river were always much higher than those seen or recorded along the river. This is largely because much of the river has little tree or shrub growth along its banks and so offers little protective cover for commuting bats.

Different species of bats travel, or commute, varying distances from their roosts to their foraging areas. For this reason bats caught may not necessarily be roosting on the Estate, and may be commuting on, off or through the Knepp Estate. However, those species that do not commute far to foraging sites and individuals caught early in the evening are more likely to be roosting on the Estate.

Of the eight species recorded, individuals of five species were identified as breeding females (serotine, Natterer's bat, Bechstein's bat, brown long-eared bat and whiskered bat) and it is likely that further surveys would reveal the presence of others, especially pipistrelle species and Daubenton's bats. The presence of female Bechstein's bats in Great Cockshill Wood is of particular conservation interest as this is one of Britain's rarest mammals. While many species may breed and roost either in buildings or trees, Bechstein's bats almost exclusively roost in trees and do not commute far from roost site to foraging areas, therefore it is very likely that there may be a maternity roost in the Estate. The presence of serotine bats is also of interest. This species has declined severely in southeast England over the past decade. It is a bat that breeds in buildings and which forages over open ground as well as in woodlands, feeding largely on large insects such as dung beetles, cockchafers and stag beetles. Under more natural grazing, the number of dung beetles could be expected to rise, which could benefit serotine bats. Identifying the exact location of bat nursery roosts would require radio-tracking caught individuals.

All bats and their roosts are protected under Schedule 5 of the Wildlife and Countryside Act 1981. Because of its rarity in Europe and the UK, Bechstein's bat has additional protection. It is classified as *Vulnerable* (VU - A2c) on the 2000 IUCN Red List of Threatened Animals and protected by legislation in Annexes II and IV of the European Community Habitats and Species Directive and in Annexes II of the Bonn and Berne Conventions respectively.

### 3.16.5 Constraints

Bats are difficult to locate especially in their foraging areas and being highly mobile may arrive on a site after it has been surveyed. Bats also utilise different parts of their foraging habitat according to season and weather conditions. Only 4 nights survey were carried out, which is inadequate for such a large area with so many different habitats. For these reasons, some additional species may forage in Knepp whose presence remained undetected during this survey.

The deer park was not included as it was surveyed using a bat detector in 2002 (Whitby, unpublished report). This area includes a number of large ponds and a very large lake. It is known that there are Daubenton's bats present in this area, though this species was only detected once in the 2005 survey.

The acoustic lure used to attract bats for capture by playing social calls can be selective so the species and numbers of bats caught may not be a complete representation of the present populations.

## 3.17 Water vole survey

### 3.17.1 Survey brief

As part of the ongoing work of Fran Southgate (Sussex Otters and Rivers Partnership Officer), it was considered that watercourses in the vicinity of Kneppmill Pond, the River Adur and Lancing Brook should be surveyed for water vole *Arvicola terrestris.* As well as providing a valuable contribution to the Knepp Estate baseline inventory, this research will contribute information to the restoration of the River Adur project. The water vole is protected under Schedule 5 (Section 9) of the Wildlife & Countryside Act.

### 3.17.2 Methodology

A preliminary survey of water vole presence and absence was carried out as a walkover survey of Knepp Estate over the summer period 2005. Water vole signs were recorded using a GPS hand held with additional notes for each location checked. Signs of otter presence were also searched for during this survey.

### 3.17.3 Results

Evidence of water vole presence is summarised in Table 3.17.a and presented on Map 10. It can be seen that although there was no sighting of a water vole, there was a fair amount of evidence of water vole activity. Mink *Mustela vison* scats were also found at three locations..

**Table 3.17.a Signs of water vole presence**

| Date | GPS (Accuracy in ft) | Signs found |
|---|---|---|
| 18.5.05 | TQ 15779 21581(21') | Low density presence, limited feeding stations and runs |
| 18.5.05 | TQ 15726 21426 (20') | Large feeding stations under small willow<br>Latrines, feeding remains and probably burrows around jetty.<br>Potential otter spraint found on jetty (TBC by G Roberts) |
| 18.5.05 | TQ 15632 21161 (20') | Large feeding station at downstream end of Kneppmill pond , slightly E of main outflow |
| 18.5.05 | TQ 15597 21152 (18') | Feeding station (rush cut at angle to approx 6cm long) |
| 18.5.05 | TQ 15619 21117 (18') | Multiple feeding stations and latrine in water mint, soft rush and hemlock water dropwort |
| 18.5.05 | TQ 15616 21052 (34') | Latrines, runs and feeding stations |
| 18.5.05 | TQ 15620 20963 (16') | Latrine and feeding remains in field drain approx 50 yds from river |
| 18.5.05 | TQ 15675 20885 (15') | Probable latrine on silt banks at edge of river, downstream of footpath bridge. |
| 18.5.05 | TQ 15884 20801 (16') | Feeding stations |
| 18.5.05 | TQ 15017 20859 (20) | Feeding remains |
| 18.5.05 | TQ 15022 20857 (25') | Feeding remains |
| 18.5.05 | TQ 14791 20829 (28') | Feeding stations on stream feeding out of hammer pond. |
| 18.5.05 | TQ 14726 20848 (23') | Extensive feeding station |
| 18.5.05 | Transect between 14 & 16 | Intermittent feeding stations |
| 18.5.05 | TQ 14096 20789 (21') | Large runs with multiple feeding stations in hemlock water dropwort |
| 17.6.05 | TQ 1535 2215 | Run , but no definite signs |
| 17.6.05 | TQ 15288 22171 | One possible latrine – probably field vole |
| 17.6.05 | TQ 15145 22243 (25') | Possible feeding remains but very few – probably field vole |
| 17.6.05 | TQ 15295 22144 (22') | Feeding station and latrine between blackthorn and oak |
| 17.6.05 | TQ 15206 21978 | Almost dry, silty base, steep sided, 2m ditch<br>2 x feeding stations |
| 17.6.05 | TQ 15082 21773 (22') | Several feeding stations where tributary joins main channel |
| 17.6.05 | TQ 15020 21791 (25') | Feeding station and droppings |
| 17.6.05 | TQ 14810 21818 (38') | 3 x burrows near telegraph pole |
| 17.6.05 | TQ 14706 21791 (20.6') | Multiple feeding stations next to weir |
| 17.6.05 | TQ 14603 21729 (16.6') | Multiple feeding stations – a stretch of good habitat. Lush plants, good banks and stable water levels |

| Date | GPS (Accuracy in ft) | Signs found |
|---|---|---|
| 17.6.05 | TQ 15189 21492 (16.5') | Grip going across floodplain<br>Feeding station and large latrine |
| 13.7.05 | TQ 163 207 | 1 possible burrow with a potential old latrine on top |
| | TQ 158 208 | Possible water vole run and feeding evidence but not enough to be sure |
| | TQ 156 209 | Dry latrine and old water vole feeding remains - at least one week old |

### 3.17.4 Discussion

The presence of water vole in the area surveyed is encouraging and the re-naturalisation of the River Adur as it crosses the Knepp Estate could be expected to improve the conditions for water voles further. However, the additional observation of mink scats is less welcome. This situation should be monitored, and the feasibility of removing mink from the site explored.

## 3.18 Water shrew survey

### 3.18.1 Survey brief

This survey was carried out by Fran Southgate (Sussex Otters and Rivers Project Officer) and Yohanna Regis (Student, Brighton University). As well as providing a valuable contribution to the Knepp Estate baseline inventory, this research will contribute to the Restoration of the River Adur project. The water shrew *Neomys fodiens* is protected under Schedule 6 of the Wildlife and Countryside Act 1981.

### 3.18.2 Methodology

In order to survey for water shrews at Knepp Estate, bait tubing was employed. In a total of eleven sites across the Estate (Map 10), tubes baited with castors were placed at approximately 10m intervals, with 10 tubes per site. Where possible, tubes were placed within 2m of the watercourse in locations with good bankside plant cover. Some tubes may be exposed to poaching and trampling. Prevailing weather at the time of tubing was dull with periods of intense rain (predicted to last for 2 days after tubing). Tubes were left in place for 2 weeks then collected individually in bags, air died and processed for scats at Brighton University.

Water shrew territories are generally believed to be under 270m and the distance they will migrate to new territories is thought to be up to 3km, but is generally no more that 500m. For this reason, where possible, tube sites were kept at 500m or more from another site. This provides a rough idea of the distribution of separate individuals across the Estate.

### 3.18.3 Results

Of the eleven sites surveyed, evidence of water shrews was found in at least some of the tubes in nine sites (Table 3.18.a & Map 10). Scats from other species of shrew (common shrew *Sorex araneus* or pygmy shrew *Sorex minutus*) were also found at nine sites.

**Table 3.18.a Occurrence of water shrews**

| Scat presence/absence | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Transect** | **Tube number** | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | TOTAL |
| 1 | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 2 | 1 | L | 1 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | L | 1 & 2 | 1 |
| 3 | 0 | 1 & 2 | 0 | 1 & 2 | 1 & 2 | 1 & 2 | 1 | 1 | 0 | 2 | 6 |
| 4 | 1 | L | 2 | 2 | 2 | 1 | 2 | 1 & 2 | 1 & 2 | 2 | 4 |
| 5 | 1 & 2 | 0 | 2 | 2 | 2 | 1 | 2 | 0 | 0 | 0 | 2 |
| 6 | 0 | 1 & 2 | 2 | 1 & 2 | 2 | 1 | 1 | 0 | 2 | 2 | 4 |
| 7 | 1 | 1 & 2 | 1 & 2 | 0 | 1 | 2 | 2 | 2 | 1 & 2 | 1 | 6 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | L | 2 | L | L | 0 | 2 | L | 0 | 2 | 1 & 2 | 1 |
| 10 | 0 | 1 & 2 | 0 | 0 | 1 | 2 | 0 | 1 & 2 | 1 & 2 | 1 & 2 | 5 |
| 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

0 = No scats 1 = Water shrew scats 2 = Other shrew scat
L = Lost M = Tube moved

### 3.18.4 Discussion

At the time of survey, it was seen that the Knepp Estate has the required habitat to support a reasonable population of water shrews. Whether this is higher or lower than would be predicted from a habitat evaluation alone is unclear, largely because of the lack of information on water shrew density and population size over West Sussex as a whole. Provided that this habitat, with suitable bankside vegetation, persists and is not eroded by poaching caused by over-grazing or other changes, there is no reason at present to doubt their continued presence.

## 3.19 Dormouse survey

### 3.19.1 Survey brief

The dormouse is a nocturnal, arboreal rodent whose distribution has declined significantly over the past century and they are now considered a flagship species for nature conservation. This species is fully protected under Schedule 5 of the Wildlife & Countryside Act 1981. One previous record of dormice exists for the Knepp Estate from the late 1980s, hence two surveys using special dormice nest tubes and searching for opened hazel nuts were initiated late in their activity season in 2005 to seek to establish whether they were still present. Rich Howorth (West Weald Landscape Project) carried out this preliminary dormouse survey.

### 3.19.2 Methodology

Four woods were selected for detailed survey in the centre and north parts of the Knepp Estate. Their potential suitability for dormice was based on their structure and composition including hazel and other potential food sources. One of these woods (Horsham Common) was the location of the old dormouse record. In selecting woods for survey it was decided to concentrate on larger stands within the Estate (north of the A272 and close to Knepp Castle) given the preference of dormice for woods over 20ha in size. An initial investigation of those woods identified as potential dormouse habitat in the Phase 1 survey by Kate Ryland was made during September 2005 to assess their suitability to install nest tubes as well as searching for opened nuts. The smaller woods examined in the south of the site, including

Newbarn Wood and Northern Wood, were not pursued further, due to their general lack of suitable habitat and absence of any dormouse-opened hazel nuts detected in a brief search. The green lane Penbridge Lane was not investigated either although it appeared to be of potential interest.

Dormice nest tubes were obtained from the Mammal Society. These consist of a plastic surround and plywood tray insert, and were set out in the selected woods largely following the guidelines of the People's Trust for Endangered Species (PTES) who lead on dormouse work nationally. In each wood a grid of 16 (4 x 4) tubes were sited at approximately 20m measured intervals and attached to the underside of horizontal branches at various heights using wire. In addition two linear strips of a woodland and hedgerow were sampled by placing nest tubes subjectively along their length. The characteristics of each site were noted, along with the location of the grid, as well as the height, orientation and tree/shrub species attachment of each tube being recorded. Two return visits were then made at approximately monthly intervals to check each tube for dormouse presence or evidence of use, recording any other wildlife usage, at the same time cleaning them out and carrying out any maintenance necessary.

A second method to detect dormouse presence was also used. This consisted of a search for characteristically opened hazelnuts in a range of woods including all of those with nest tube grids. The search was undertaken on 4 November 2005 over half a day. It was both subjective and qualitative, with no timed fixed-area search made as described in PTES methods sheet since there were insufficient dense stands of fruiting hazel in the woods surveyed.

### 3.19.3 Results

No dormice were found using the nest tubes set up in the four grids and two strips. A range of other wildlife was found utilising the nest tubes, principally woodland birds (tit species presumed) and various invertebrates particularly earwigs and woodlice as well as spiders, centipedes and millipedes. Once birds have occupied a tube it becomes less suitable for dormice, possibly due to the prevalence of maggots in the abundant bird droppings. It is unlikely that use by different invertebrates deters dormice. The position of each nest tube grid is given in Table 3.19.a; full tube site details are available from the Record Centre Survey Unit.

**Table 3.19.a Location of nest tube grids**

| Site | Grid ref |
|---|---|
| Horsham Common | TQ158 239 |
| Spring Wood | TQ150 224 |
| Bar Furzefield | TQ165 236 |
| Merrik Wood | TQ157 224 |

In the 14 sites where opened hazelnuts were inspected, there was no evidence of dormice (Table 3.19.b). Grey squirrels were ubiquitous in eating hazel nuts in all but two woods examined, with just one other mammal species identified from nut evidence, a wood mouse in Bar Furzefield near Plot 2. Although it was certain that dormice had not opened a few of the nuts inspected, the identity of the animal(s) that had opened them could not be established. This was the case particularly in Plot 3 Spring Wood. Hazel nut abundance was

low overall in all areas surveyed that contained hazel, with most nuts apparently at least one year old and no green fallen nuts observed at all. Thus it seems that most of the hazel stands at Knepp have not produced many nuts this year at least. Some may be too young in the coppice cycle while others may be too shaded by the tree canopy. A limited number of hazel stools near the Castle have also been bark-stripped by deer, which may reduce their productivity.

**Table 3.19.b Sites of hazelnut inspection**

| Site | Survey area | Hazel characteristics | Opened nuts by rodent species |
|---|---|---|---|
| Brickyard Wood | N half | Sparse, limited nuts | - |
| Knepp Castle wood | NW section | Stools mainly at boundaries | Grey squirrels |
| Merrik Wood (incl. Plot 4) | E half | Some nut patches | Grey squirrels |
| Matches Wood | Fenced & unfenced areas | Mostly young non-fruiting stands | Grey squirrels |
| Spring Wood (incl. Plot 3) | NW coup & wood bank | NW – dense hazel but little fruiting; bank – more mature fruiting shrubs | Grey squirrels |
| Horsham Common | S small block & wood bank | Mature fruiting shrubs on bank only | Grey squirrels |
| - ditto - | SE quarter | Young coppice, few nuts | Grey squirrels |
| - ditto - | NW quarter | Mature fruiting stools in N especially | Grey squirrels |
| - ditto - | NE quarter (incl. Plot 1) | Some mature shrubs with nuts on ground | Grey squirrels |
| - ditto - | Linear strip along stream | Few nuts | Grey squirrels |
| Constable's Furze | Inside & outside of fenced pheasant coup | Very little hazel, almost no nuts | - |
| Bar Furzefield | N section | Young hazel coppice under pine plantation, few nuts | Grey squirrels |
| - ditto - | Central area (incl. Plot 2) | Hazel at N & W sides mainly, very few nuts | Grey squirrels + 1x Wood Mouse nut by footpath W of Tube 1 |
| - ditto - | S lateral strip W of conifer plantation | Some quite young hazel stools, few nuts | Grey squirrels |

### 3.19.4 Discussion

It cannot be said from this limited survey that dormice are definitively absent from the surveyed parts of the Knepp Estate, since the sampling period has been relatively short and the number of tubes set out was also limited (just 74 in total). Channin and Woods (2003) set out an index of probability of finding dormice present in nest tubes (in SW England) for each month, finding September to be the most likely month. However, they have been recorded generally rather late in the year across England during 2005 (PTES pers. comm.). Channin and Woods also recommend that a search effort score of at least 20 is obtained in order to assume that dormice are absent from a locality, with a score of less than 15 suggesting that negative results may not be very meaningful. The search effort score of this survey for the **whole** Estate was 16.5, not sufficient to assume absence, with individual woods having a much reduced score of just 3.66 each! Hence it is recommended to continue monitoring

during 2006 (April-November inclusive) to arrive at a search score of 37.5 for the whole site. This would still be just 8.33 per wood because of the relatively small number of tubes set out according to this research.

## 3.20 Other small mammals survey

### 3.20.1 Survey brief

This survey was carried out by Fran Southgate (Sussex Otters and Rivers Project Officer) and Yohanna Regis (Student, Brighton University). Its purpose was to provide preliminary information on small mammals (voles, shrews and mice) within the constraints of the available resources.

### 3.20.2 Methodology

Three areas of Knepp Estate were selected for survey (Areas A, B and C, Map 11) and within each area, as far as possible, four habitats were identified in which to place traps – grassland, woodland, hedge and wetland. Ten live traps were set and baited with seeds and castors at these sites, which are shown on Map 11. These were checked twice a day between 15 and 27 August 2005. Captured animals were weighed and measured, and their age and sex recorded.

### 3.20.3 Results

A total of seven species was recorded, and these results are summarised in Table 3.20.a. Full details of all the animals captured, including their sex, breeding status, age and weight are shown in Appendix VIII.

**Table 3.20.a Summary of small mammal captures**

| Area | Habitat | Species | Number |
|---|---|---|---|
| A. | Grassland | Wood mouse | 2 |
| | Hedgerow | Bank vole | 2 |
| | | Field vole | 3 |
| | | Wood mouse | 5 |
| | Woodland | Bank vole | 5 |
| | Wetland | Common shrew | 1 |
| | | Bank vole | 1 |
| | | Field vole | 3 |
| | | Wood mouse | 4 |
| B. | Grassland | *No data available* | |
| | Hedge | *No data available* | |
| | Wetland | *No data available* | |
| C. | Grassland | Bank vole | 2 |
| | | Wood mouse | 3 |
| | Hedgerow | Common shrew | 2 |
| | | Bank vole | 7 |
| | | Wood mouse | 8 |
| | Woodland | Pygmy shrew | 1 |
| | | Common shrew | 1 |
| | | Bank vole | 4 |
| | | Wood mouse | 16 |
| | Wetland | Water shrew | 1 |
| | | Common shrew | 4 |
| | | Bank vole | 7 |

| Area | Habitat | Species | Number |
|---|---|---|---|
| | | Field vole | 4 |
| | | Yellow necked mouse | 1 |
| | | Wood mouse | 3 |

### 3.20.4 Discussion

This is a fair start to the monitoring of small mammal populations and it will be interesting to observe the effects of near-natural grazing on voles, shrews and mice. The occurrence of only one yellow-necked mouse from a trap set in wetland is interesting; this species is generally less common than wood mouse, and typically found in the dryer habitat of open woodlands.

# 4 Discussion

## 4.1 Review of objectives

It is apparent to anyone visiting the Estate that Knepp is made up of a variety of habitat mosaics within the broad categories of 'woodland', 'grassland' and 'wetland'. The previous intensive arable management of the fields, and woodlands that were largely managed plantations, resulted in clearly defined boundaries between vegetation types. Allowing more natural processes is expected to result in the broadening of ecotones between different components of the habitat mosaic, as well as influencing shifts in the vegetation composition and structure in what are at present readily identifiable as fields and woods.

The baseline field surveys have also indicated considerable biodiversity. Some of the Estate has now been out of intensive arable for some five years. This is long enough for changes in plant species composition to become evident and for more mobile fauna to spread into the area under more natural grazing. Charlie Burrell and others living or working on the Estate feel that wildlife is already becoming much more evident (Knepp Castle website[2]). The scientific exploration of the dynamics of these changes is likely to prove instructive.

The restoration of Repton's historic park landscape and the implementation of low-level grazing across the Estate was not initiated to drive research, but it has provided a unique opportunity to study the effects of such grazing in the Low Weald of West Sussex. The interest in near-natural grazing in relation to landscape scale ecology is currently strong, but there is relatively little published on its effects on biodiversity or vegetation structure. Oostvaardersplassen is a source of inspiration, but this project started on reclaimed land, where the effects on existing biodiversity were not an issue. The need to consider biodiversity conservation at a landscape scale is paradoxically directly proportional to the increase in development in the UK, as the greater the pressure for development, the less effective is conservation in protected areas such as nature reserves likely to be. Reserves may become islands providing no opportunities for dispersal, gene flow or climatic adaptation for many species of flora and fauna. The Knepp project has therefore attracted much interest and indeed support. Charlie Burrell has been indefatigable in his efforts to enlist the participation of a wide range of experts and this has resulted in constructive and lively debate.

The research aim of the Knepp Castle project is to record and evaluate changes in the biodiversity and vegetation structure that take place subsequent to the reversion of intensive arable to a system of more natural grazing. Objectives to achieve this aim, detailed in Section1.5, are firstly to improve the baseline biological information and secondly to monitor whether near-natural grazing causes changes to the habitats, flora and fauna in Knepp over time.

Scientifically robust monitoring cannot be undertaken without an appropriate level of baseline biological information. Providing such information is the chief function of this report. The baseline surveys carried out in Summer 2005 will thus facilitate the development of the monitoring strategy necessary to achieve these objectives.

[2] http://www.knepp.co.uk

## 4.2 Survey evaluation and recommendations

Over 900 species have been recorded during the course of the 2005 fieldwork, including 71 species of conservation interest (Table 4.2.i). These data will shortly be entered onto Sussex Biodiversity Record Centre database using Recorder 6. This is a fair total considering the 2005 fieldwork was limited by the available resources and until recently, the land was under intensive arable with all that such management entails.

**Table 4.2.i Species of conservation interest recorded in 2005**

| Group | Species | Common name | Status |
|---|---|---|---|
| Vascular plant | *Rorippa amphibia* | great yellow-cress | Sussex Scarce |
| Mollusca | *Vertigo antivertigo* | | Local significance |
| Orthoptera | *Conocephalus discolor* | long-winged cone-head | Nationally Scarce A |
| Odonata | *Brachytron pratense* | hairy dragonfly | RSI |
| | *Sympetrum sanguineum* | ruddy darter | RSI |
| Lepidoptera | *Dichomeris alacella* | a moth | Nationally Notable |
| | *Calamotropha paludella* | a moth | Nationally Notable Nb |
| | *Eilema caniola* | hoary footman | Nationally Scarce B |
| | *Archanara sparganii* | webb's wainscot moth | Nationally Scarce B |
| | *Archanara algae* | rush wainscot moth | RDB 3 |
| | *Gynnidomorpha alismana** | a moth | Nationally Notable NB |
| | *Cnephasia pasiuana* | a moth | Local |
| | *Ipimorpha retusa* | double kidney moth | Local |
| | *Argynnis paphia* | silver-washed fritillary | Conservation concern |
| | *Thecla betulae* | brown hairstreak | RSI |
| Coleoptera | *Longitarsus rutilus* | a leaf beetle | Nationally Scarce A |
| | *Notaris scirpi* | a weevil | Nationally Scarce B |
| | *Pelenomus comari* | a weevil | Nationally Scarce B |
| | *Melegethes gagathinus* | a pollen beetle | Notable |
| | *Melegethes ochropus* | a pollen beetle | Notable |
| | *Ishnomera cyanea* | a flower beetle | Nationally Scarce B |
| Hemiptera | *Oliaris panzeri* | a leaf-hopper bug | Notable |
| Diptera | *Odontomyia tigrina* | a soldier fly | Notable |
| | *Ptychoptera contaminata* | a cranefly | Local |
| | *Oplodontha viridula* | common green colonel | Local |
| | *Drapetis ephippiata* | a dance fly | Local |
| | *Empis praevia* | a dance fly | Local |
| | *Dolichopus virgultorum* | a dolichopodid fly | Notable/Nb |
| | *Syntormon denticulatus* | a dolichopodid fly | Local |
| | *Chrysotus collini* | a dolichopodid fly | Local |
| | *Chrysotus cupreus* | a dolichopodid fly | Local |
| | *Pipiza lugubris* | a hoverfly | Notable/Nb |
| | *Themira superba* | a sepsid fly | Local |
| Hymenoptera | *Macropis europaea* | a solitary bee | Nationally Scarce A |
| | *Lasioglossum malachurum* | a solitary bee | Nationally Scarce A |
| | *Lasioglossum pauxillum* | a solitary bee | Nationally Scarce A |
| | *Lasioglossum puncticolle* | a solitary bee | Nationally Scarce B |
| Amphibia | *Triturus cristatus* | great crested newt | WCA Sch. 5 |

| Group | Species | Common name | Status |
|---|---|---|---|
| Reptilia | *Anguis fragilis* | slow-worm | WCA Sch. 9 |
| | *Natrix natrix* | grass snake | WCA Sch. 9 |
| Aves | *Steptopelia turtur* | turtle dove | Red list |
| | *Alauda arvensis* | skylark | Red list |
| | *Parus palustris* | marsh tit | Red list |
| | *Passer domesticus* | house sparrow | Red list |
| | *Acanthis cannabina* | linnet | Red list |
| | *Pyrrhula pyrrhula* | bullfinch | Red list |
| | *Emberiza citrinella* | yellowhammer | Red list |
| | *Emberiza schoeniclus* | reed bunting | Red list |
| | *Cygnus oleracea* | mute swan | Amber List |
| | *Milvus milvus* | red kite | Amber List |
| | *Falco tinnunculus* | kestrel | Amber List |
| | *Vanellus vanellus* | lapwing | Amber List |
| | *Columba oenas* | stock dove | Amber List |
| | *Cuculus canorus* | cuckoo | Amber List |
| | *Tyto alba* | barn owl | Amber List |
| | *Picus viridis* | green woodpecker | Amber List |
| | *Anthus pratensis* | meadow pipit | Amber List |
| | *Prunella modularis* | dunnock | Amber List |
| | *Luscina megarhynchos* | nightingale | Amber List |
| | *Turdus philomelos* | song thrush | Amber List |
| | *Phylloscopus trochilus* | willow warbler | Amber List |
| | *Regulus regulus* | goldcrest | Amber List |
| Mammalia | *Pipistrellus pipistrellus* | 45khz pipistrelle | WCA Sch. 5 |
| | *Pipistrellus pygmaeus* | 55khz pipistrelle | WCA Sch. 5 |
| | *Eptesicus serotinus* | serotine | WCA Sch. 5 |
| | *Myotis bechsteini* | Bechstein's bat | WCA Sch. 5 & Habs. Dir. |
| | *Myotis nattereri* | natterer's bat | WCA Sch. 5 |
| | *Myotis mystacinus* | whiskered bat | WCA Sch. 5 |
| | *Myotis daubentonii* | Daubenton's bat | WCA Sch. 5 |
| | *Plecotus auritus* | brown long-eared bat | WCA Sch. 5 |
| | *Neomys fodiens* | water shrew | WCA Sch. 6 |

* unconfirmed - see text.

### 4.2.1 Vegetation survey

**Habitat survey**

The extended Phase 1 habitat survey together with detailed target notes is the key component of the baseline information, guiding the 2005 fieldwork that in turn will guide the monitoring strategy. The habitat classification followed, as far as possible, that used in Defra's Higher Level Scheme. This habitat survey gives a broad-brush overview that can be repeated at set intervals, and a 'snapshot' assessment of the Estate at the beginning of the near-natural grazing regime. It shows that nearly 60% or the project area is grassland, some 21% is woodland including wood pasture / parkland and just 1.1% is scrub. As the more natural grazing takes effect, the amount of scrub (especially consisting of thorny and unpalatable species) might be expected to increase.

**Recommendations**

- Repeat habitat survey at regular intervals.
- Monitor and evaluate scrub development.
- Monitor and evaluate tree regeneration.

**Botanical survey of River Adur and Lancing Brook**

This survey indicated a fair diversity of vascular plants that could be predicted to rise in the event of a spring survey. However, the abundance of duckweed, especially *Lemna gibba,* was evidence of eutrophication, and *Rorippa amphibia* was the only species of conservation interest (Table 4.2.i). Changes over time will be of great ecological interest.

**Recommendation**

- Repeat survey following river restoration.

**Transects**

The data obtained from contiguous quadrats is essential for statistical analysis that will enable rigorous interpretation of the effects of near-natural grazing. The species recorded along these transects include those that were in the seed bank or that have colonised following reseeding as well as those that were in the seed mixes sown in 2001 and 2004.

**Recommendation**

- It is suggested that recording along these transects should be repeated at regular intervals into the future, either at 1, 2 or 5-yearly intervals. Analysis of the results could be performed using Ellenberg's indicator values for British Plants (Hill and others 1999), which is relatively quick and easy, but a more rigorous analysis would be to use a non-parametric statistical test such as Kruskal-Wallis or a multi-variate test such as Principal Components analysis, to test whether more natural grazing causes significant differences over time.

### 4.2.2 Lichen survey

Lichen surveys notoriously take a long time – a mature tree with a good epiphytic flora can take up to 2 hours to survey thoroughly. In the extremely limited survey that was undertaken, the 50 species recorded were largely the more common lichens that are typical of open woodlands in areas with reasonably good air quality.

**Recommendation**

- Further surveys to search for the less common species of both woodland and parkland.

### 4.2.3 Fixed-point photography

Fixed-point photography, although an inexpensive technique, does take a considerable length of time to carry out in an area as large as Knepp. Managing an increasingly large library of

digital pictures could also present problems. Nevertheless, such images constitute an easily interpreted, qualitative method of monitoring vegetation change over time. The fixed-point photographs taken by Rich Howorth are augmented by others taken by Charlie Burrell, Theresa Greenaway, Kate Ryland and Fran Southgate. Copies of these photographs are available from the Record Centre Survey Unit.

**Recommendations**

- Address the practicality of compiling an increasingly large library of digital pictures.
- Agree a consensus of the suitability of this method over time.
- Explore other options such as satellite imaging.

### 4.2.4 Wetland molluscs

The River Adur and associated wetlands surveyed support small numbers of relatively common species. This low mollusc diversity may well be the result of river canalisation and the recently abandoned intensive arable regime. It is likely that run-off from arable practices caused some degree of eutrophication. This is indicated by the dominance of five species (*Lymnaea peregra, Physella acuta, Bithynia tentaculata, Sphaerium corneum* and *Pisidium nitidum*), all of which are tolerant of slightly polluted or eutrophic waters. Molluscs in general are unable to move rapidly and rely on events such as flooding to disperse them. It will be of great interest to monitor the effect that restoring a more natural river canal has on mollusc diversity. This mollusc survey is a good baseline against which to monitor this. Knepp Mill pond could hold important mollusc species, including freshwater mussels (M. Willing, pers. comm.), and a survey to confirm this would be advisable.

**Recommendations**

- To repeat this survey following river restoration, and subsequently at regular intervals.
- Carry out a freshwater mollusc survey of Knepp Mill pond.

### 4.2.5 Dragonflies and damselflies

The desk study of existing records (Greenaway, 2005) indicated that the records of Odonata constituted one of the better datasets. Twenty species of damselflies and dragonflies, including five species of conservation interest, have been recorded prior to the 2005 survey. In 2005, only fourteen were recorded, with just two species of conservation interest, hairy dragonfly and ruddy darter (Table 4.2.i). No species were recorded in 2005 that had not previously been recorded. If it had been possible to allow more time for this survey in 2005, further species may well have been seen.

**Recommendation**

- To repeat this survey following river restoration, and subsequently at regular intervals.

### 4.2.6 Moths

Any evaluation of the 2005 moth records must take account of the fact that this year was considered the worst for resident species in over 30 years. With a total of 63, predominantly grassland, species recorded on the reseeded grassland area, this habitat exhibits a fairly average total in comparison with neutral, unimproved grassland (Tim Freed, pers. comm.). Species diversity was higher in the sampling site in the River Adur floodplain, with 139 predominantly wetland species recorded. It will be of interest to observe any changes and rate of change, especially in the reseeded grassland area, over time.

**Recommendation**

- Carry out a wider survey across the Estate in 2006, and use this as a definitive baseline against which to monitor changes.

### 4.2.7 Butterflies

For unavoidable reasons, the butterfly survey started rather late in the season with the result that just 17 species were recorded, plus an additional species recorded by Dr Tim Freed. Two of these species, silver-washed fritillary and brown hairstreak are of conservation interest (Table 4.2.i). Previous to 2005, a total of 26 species has been noted. One species, marbled white, was a first record for Knepp. There is also an unconfirmed record of grizzled skipper. The greatest diversity was observed in the Horsham Wood complex. The present range of habitats already has the potential to support a rich diversity of butterflies. The abundance of most of the species recorded is currently low – with meadow browns and gatekeepers comprising two-thirds of the 900 or so individuals recorded. A good nectaring resource will be essential to maintain and increase many of the species present but in low numbers, and this depends on grazing pressure. On a walk around Knepp in June during sunny weather, the number of butterflies present in a flowery strip between a boundary hedge and the deer fence was far higher than the numbers seen within the grazed area (Theresa Greenaway, pers. obs.).

**Recommendations**

- The ideal would be to walk set transects every week during summer, in accordance with Butterfly Conservation methodology. Unfortunately, the time required for this means that few people are able to make the necessary commitment.
- It may be more feasible to select one species of butterfly and monitor the effects of long-term near natural grazing on its population dynamics.

### 4.2.8 Beetles

A total of 308 species of beetle has been recorded, including those from the river and its floodplain and those extracted from the pitfall traps. Although a considerable number, this can only be considered as a very incomplete record of beetles. The wetland beetle records do provide a fair baseline against which to monitor the effects of river restoration, but in order to use beetle diversity as a baseline against which to monitor the effects of near-natural grazing will involve further survey work. Knepp Mill pond would also be expected to support a rich diversity of beetle species. This would be of considerable relevance to dredging work, but is not strictly relevant to evaluating the effects of grazing.

**Recommendations**

- To repeat the wetland beetle survey following river restoration and at regular intervals thereafter.
- To carry out further survey work in 2006, extending the survey of grassland beetles across the Estate, and also surveying the woodlands, dead wood beetles and dung beetles.

### 4.2.9 Ants

The ant survey, though limited, has considerable potential interest. They are in many ways ideal study material, as there are relatively few species (about 30 in southern England) and they are reasonably easy to locate. Ants are social insects, many with specific habitat requirements, and winged queens are able to effect dispersal. Results from Alex Kent's work and the pitfall traps set up by Paul Buckland have identified eight ant species. Most of these are common in southern England. The exceptions are *Myrmica* rubra, (a local species of damp sites) which was also recorded in Pitfall trap B2, *Stenamma westwoodi,* and *Myrmica sulcinodis*. *Stenamma westwoodi* has only been previously recorded twice in Sussex but this very underrecorded species (Pontin 2005) may not be as rare as this lack of records implies. It is likely that A. Kent's record of *Myrmica sulcinodis,* an ant of wet heathland, should in fact be *Myrmica scabrinodis,* which was also identified from pitfall traps by Mike Edwards.

Intensive arable management results in an absence of ants (Pontin, 2005). Now that this has ceased over large area of Knepp, the rate of re-colonisation of ants and the dynamics of ant diversity over land now under near-natural grazing will be well worth studying. Such research will make a considerable contribution to our understanding of the natural processes that are driven by large unmanaged herbivores.

**Recommendations**

- Extend baseline survey of ants, and subsequently develop strategy to correlate ant diversity and population dynamics with grazing.
- Monitor the rate of dispersal of meadow ant *Lasius flavus* into the reseeded areas by plotting the formation of anthills.

### 4.2.10 Amphibians and pond condition

The Knepp ponds are an important part of the overall habitat diversity of the Estate. As well as the number of amphibians that some support, many ponds are also likely to support diverse invertebrate communities. Ponds also contribute to the attractive appearance of the landscape. All the amphibians found on the Estate have protected status, with great crested newt enjoying particular protection. This species was recorded by Buckingham in the 1990s (Buckingham 1992), and again in 2005. It is intended to survey those ponds not inspected in 2005 in May 2006. It is not the function of this report to suggest management for particular species, however, ponds where great crested newts have been found should be noted and the implications of their protected status heeded. It may be necessary to fence off such ponds and their immediate surroundings if grazing pressure becomes a threat.

**Recommendations:**

- Survey the outstanding ponds in May 2006.
- Supply information regarding the location of great crested newt ponds and responsibilities under the Wildlife & Countryside Act 1981 to the Estate.
- Resurvey for amphibians at regular intervals into the future.

### 4.2.11 Reptiles

All reptiles are also protected under the Wildlife and Countryside Act 1981. Reptiles were not specifically surveyed for reasons outlined in S.3, but at least three species are known to occur on the Estate, all of which were seen in 2005. At low levels of near-natural grazing, there is unlikely to be a significant adverse effect on reptiles. Indeed, as the vegetation develops away from intensive arable to a more natural structure, reptile populations could be expected to increase, especially if there is suitable hibernation habitat.

**Recommendations**

- Improve baseline information of reptile populations either by commissioned survey or student / volunteer involvement.
- Supply the Estate with information regarding reptile hibernation habitat requirements.

### 4.2.12 Birds

Sussex Ornithological Society undertakes a Wetland Bird survey every winter, and this information is available as necessary. The breeding bird survey of 2005 was, as were other commissioned surveys, severely limited by the amount of funding available. However, the results showed that the Estate supports a rich community of breeding birds, including 14 species of medium conservation concern (Amber List) and 8 of high conservation concern (Red List). This is an encouraging start to the re-wilding project. Most of the Amber and Red list birds recorded could well increase as near-natural grazing progresses, although over-grazing could have a negative impact if scrub and hedge habitats decline and cease to be able to support those such as nightingales and yellowhammers.

The maintenance of a favourable status for breeding birds is of paramount importance, as this will be a key factor in identifying any improvements in biodiversity as a result of the near-natural grazing regime. If bird population numbers or diversity fall, it will be a firm indicator that biodiversity as a whole is falling, as breeding birds require resources such as nest sites (scrub, hedgerows, trees, tussocky grassland etc) and food (invertebrates, seed, fruit etc).

**Recommendations**

- Commission annual breeding bird surveys over a greater area of the Estate.
- Start surveys earlier in the year to pick up early breeders.
- Possibly focus particular research on species of conservation concern such as yellowhammer, nightingale and green woodpecker, all of which could potentially be affected either positively or negatively according to the level of grazing.

### 4.2.13 Bats

The confirmation of 8 species of bats on the Estate was encouraging, given the fragmented nature of the woodlands. Good connectivity provided by the hedgerows does provide flightlines for commuting bats. The adult female bats recorded had all either given birth in 2005 or in previous years. This could indicate the presence of nursery roosts on the Estate, either in woodlands or buildings, depending on species. The presence of female Bechstein's bats was of particular interest, as this is one of the rarest bats in the UK.

**Recommendations**

- Survey Great Cockshill Wood and adjacent woodland in May / June 2006 using radio-tracking to identify Bechstein's bat nursery roosts.
- Provide information to the Estate regarding bats and tree work.

### 4.2.14 Water voles and water shrews

The presence of both these protected species has been confirmed. Further survey may well refine any population estimate obtained as a result of fieldwork 2005, but as far as the maintenance of these species on the Estate is concerned, ensuring that there is always as much suitable habitat as possible will be essential. This should develop naturally, although too high a level of grazing pressure may cause poaching.

**Recommendations**

- Check watercourses for poaching, especially those known to have signs of water vole and water shrew.
- Check all watercourses for signs of otter at least annually.

### 4.2.15 Other small mammals – shrews, voles, mice and dormice

Shrews, bank and field voles, woodmice and yellow-necked mice are all expected to undergo population increases in the continued absence of arable cultivation. This in turn will provide an increase food resource for predators such as barn owls, stoats, weasels and foxes. The lack of firm evidence of dormice may or may not be an accurate reflection of the status of this rodent on the Estate and further survey work commenced earlier in the year will help to clarify this. There were no resources available to study rabbit numbers on the Estate. This would be useful information, as the effects of rabbit-grazing need to be considered.

**Recommendations**

- Carry out more comprehensive dormouse survey.
- Endeavour to prepare an estimate of rabbit numbers on the Estate.

## 4.3 Monitoring strategy

The results of the 2005 fieldwork should be used to inform and guide the planning of future research and the monitoring programme. However, the preparation of the monitoring programme is not within the remit of this report. It is recommended that this report and the survey results obtained should be studied and that a forum should be convened to identify monitoring priorities and draft a monitoring strategy framework. The success or otherwise of any such strategy will of course depend on adequate funding over what should be a long timescale.

## 4.4 Conclusions

Grazing as a conservation tool is not a new idea – especially on open habitats such as chalk grassland and heathland. Few would dispute the essential role of sheep in maintaining the open, short sward of the Sussex Downs, but the benefits of grazing woodlands are less clear-cut, and there are many factors that have to be considered. On Knepp there are large areas of grassland, the majority of which were formerly arable, and a number of relatively small areas of woodland. Some of these woods are fenced to exclude animals, others are unfenced. It will be constructive to monitor the development of habitat mosaics across the woodland and grassland.

Near-natural grazing differs from what is generally meant by conservation grazing. One of the most significant differences is the fate of the animals utilised – for instance, cattle employed in conservation grazing may still be part of a farmer's beef production business, and as such will be removed from a site when forage is poor or supplied with supplementary feed. Herbivores that are a part of a 'de-domesticated' near-natural grazing scheme are unlikely to contribute to meat supply for human consumption for a number of legislative reasons, and in order to fulfil their role would be left on site all year. Any site can therefore sustain only the number of animals that can find sufficient food for survival in late winter (Helmer, 2002) or during summer drought. If a fully near-natural system does develop on Knepp, this grazing regime will end up very different from the conservation grazing utilised on some Sussex Wildlife Trust reserves.

There are very few published studies of the impact of cattle on woodlands (Armstrong and others, 2003) and virtually no published work, to date, of near-natural grazing in the UK. A special issue of *Vakblad Natuurbeheer* – 'Grazing and Grazing Animals', published in 2002, drew on the experiences of the first few years of the European National Ecological Network. This publication provides information on a range of issues and also identifies aspects about which little is known. Kirby (2003) examined Vera's hypothesis, and in response to the relatively little quantitative spatial detail modelled a four-phase park-scrub-grove-breakup approach based on spatial and temporal patterning. He also drew attention to a number of issues pertinent to the UK that are not entirely compatible with Vera's hypothesis. Hodder and others (2005) also consulted widely on a variety of issues raised by Vera, exploring his theory as well as discussing palaeoecological evidence and naturalistic grazing and conservation case studies. In spite of this, there are still no firm conclusions and certainly no complete agreement has been reached regarding either the past role of large herbivores in the European or UK wildwood or the relevance or advisability of any attempts to reproduce what is at best a hypothetical option. What is certain is that more research is needed to address the questions raised both in the UK and on continental Europe.

Trials of near-natural grazing are a crucial part of this research. We need to know more about the range of habitats and their dynamics that are likely to develop and also species of plants and animals that such habitats support. Only by evaluating such trials will our understanding of how a pre-human 'natural' landscape might have functioned be improved. How relevant or useful this understanding may be to 21st Century biodiversity conservation also remains to be seen, but it is to be hoped that the changes made to Knepp will at the very least have a part to play in maintaining the rich biodiversity of West Sussex.

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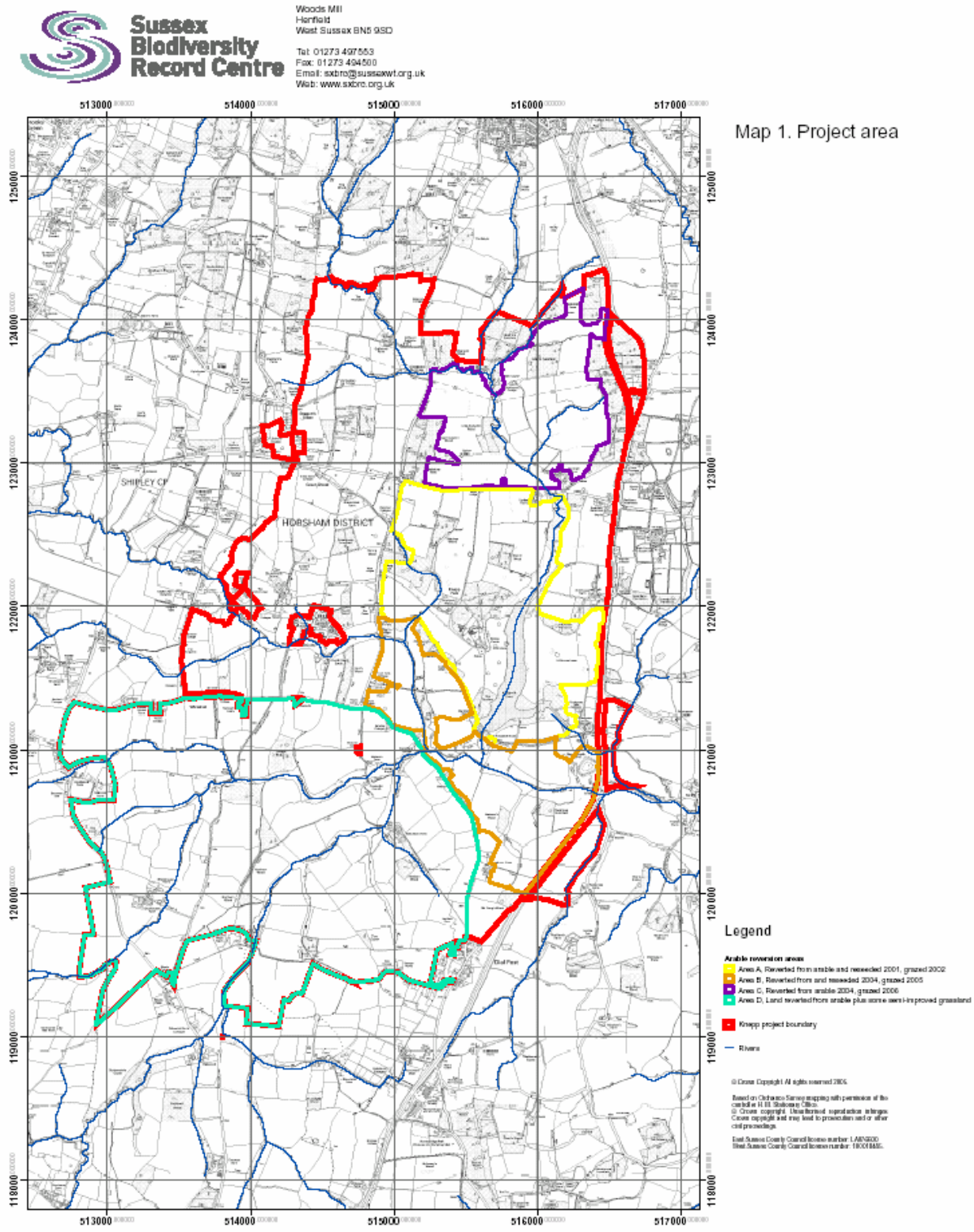
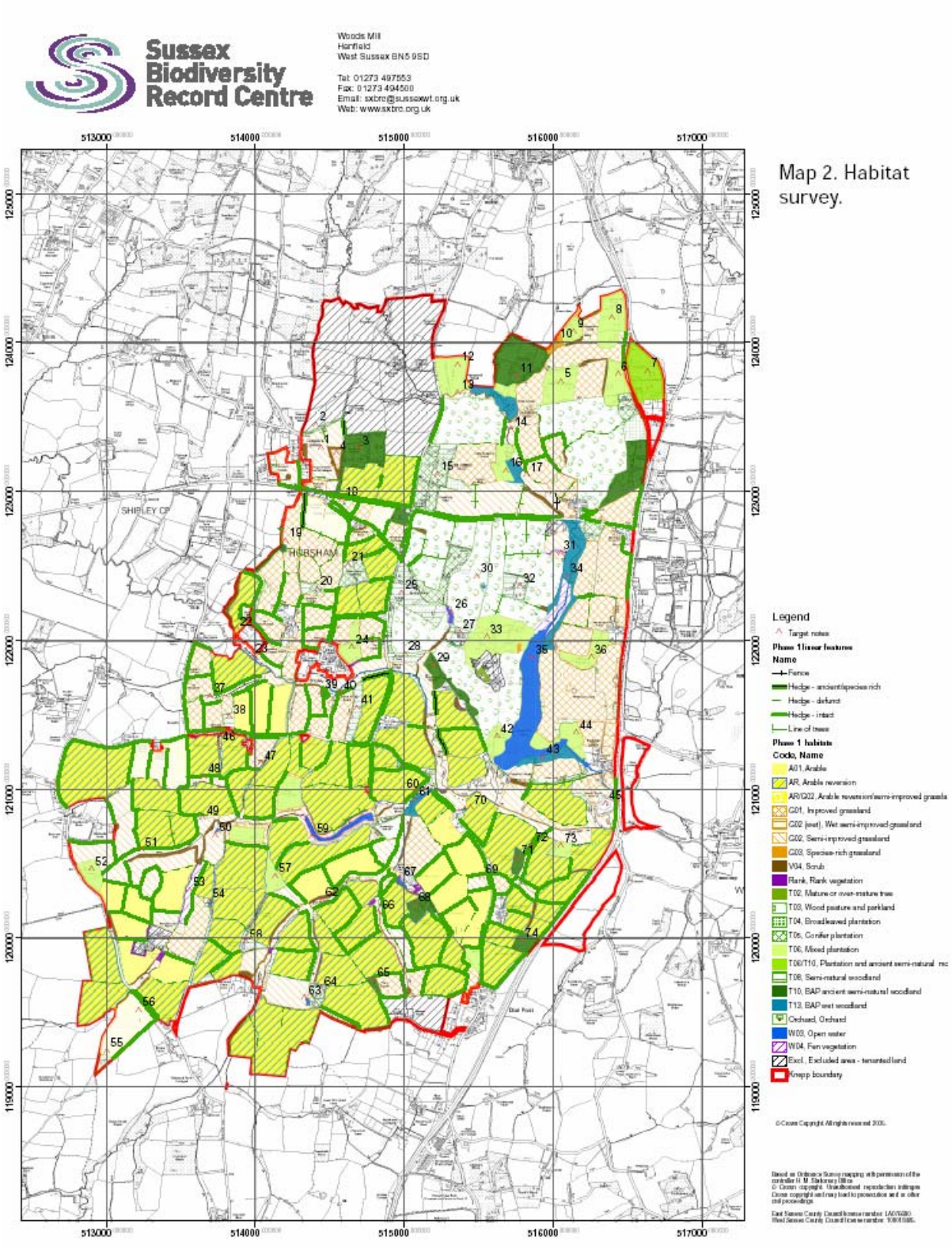
# Maps

# Map 1 Project area



# Map 2 Habitat survey



## Target notes for the habitat map

1. Damp, semi-improved grassland (formerly reversion) with a mixture of common species and tussocky structure. Grassy in places but with creeping cinquefoil, marsh thistle, glaucous sedge, fleabane, grass vetchling, common birds-foot-trefoil etc.
2. Shaw with mixed species including oak, field maple, hawthorn, ash, hornbeam, bluebell etc.
3. **Renches Wood**. Actively coppiced ancient woodland with stands of dense sycamore, occasional horse chestnut and conifers planted, including a block of conifers in the northeast. Otherwise contains hazel, oak, field maple, wild cherry, wild service tree, spindle, hornbeam, midland hawthorn and a species rich ground flora with common spotted-orchid, bush vetch, primrose, violets, wood sedge, wood spurge, pendulous sedge, wood anemone, barren strawberry etc. Occasional bracken, bramble dense in places and garden privet locally frequent.
4. Relict species rich grassland, unmanaged and developing a tussocky, coarse sward that is damp in places. Marsh thistle, hard rush, bugle, common knapweed, red fescue, sedges, square-stemmed St John's wort, fleabane, common sorrel etc. Surrounded by mixed trees and shrubs including oak, willows, bramble, hazel and hawthorn.
5. **Coates Furzefield**. Plantation woodland on an ancient woodland site with old boundary banks, ponds etc. and mown, species rich rides. Sycamore, oak, field maple, holly, hazel, gorse, silver birch are present over a slightly acid ground flora with bluebell, wood spurge, dogs mercury, honeysuckle, bracken, wood sage, wild daffodil, common dog violet, yellow archangel etc. **Dormouse potential and possibly great crested newt potential if pond contains water for long enough.**
6. **Bar Furzefield**. Mosaic of conifer plantation, broadleaved plantation and hazel coppice on ancient woodland site with species rich, damp rides. A species rich area with hazel, oak, holly, horse chestnut, hawthorn, birch, sycamore, wych elm, hornbeam etc. over cowslip, crosswort, marsh thistle, bramble, honeysuckle, dogs mercury, bluebell, primrose, violet, enchanters nightshade etc. Rhododendron is present and should be removed. There is an abrupt transition south of the east-west ride from conifers to broadleaves, then back to conifers further south. The woodland has good, dense scrub margins and contains plenty of deadwood. An especially species rich ride in the north has abundant devils-bit scabious, bugle, violets and sedges. **Dormouse potential.** Coates Wood. A mixture of semi-natural woodland and plantation with old hornbeam coppice and oak standards over dense bluebell. Nice ponds and wet flushes present. Ash and coniferous plantation occur over a bluebell dominated ground flora with occasional areas of hazel coppice and a diverse ground flora that includes primrose, wood spurge, wood sage, wood anemone, violets and early purple orchid. In wetter areas willows, marsh thistle, bugle, meadowsweet, sedges and devils-bit scabious occur. There are patches of gorse and a dense stand of rhododendron, the latter should be removed. A series of small ponds are present and there are some valuable mature oak and beech trees. **Great crested newt potential.**
7. **Bar Cover Furzefield.** Re-planted ancient woodland comprising generally unmanaged hazel, hornbeam and sweet chestnut coppice with oak, ash and Scots pine. The rich ground flora includes bluebell, early purple orchid and violet helleborine. Rides are particularly diverse. **Dormouse potential but isolated by the A24 road.**

8. **Pollardshill Furze.** A mosaic of broadleaf and conifer plantation on an ancient woodland site with a good, shrubby margin. Old banks are present. The very rich ground flora includes devils-bit scabious, bugle, wood spurge, agrimony, primrose, bluebell, wood sage, three-veined sandwort, honeysuckle, betony, violets, heath speedwell, foxglove etc. In the north is dense scrub with gorse, birch, young oak and willows whilst in the north east is young sweet chestnut coppice. Ash and beech plantation areas occur and there are older pine trees along the edges of coniferous plantation in the south. Some mixed broadleaved areas also occur.
9. A mixed copse of ancient origin with hazel and hornbeam coppice and mixed planted species. It has an open structure and sparse shrub layer in places. A large pheasant release pen is present. There is a gill stream along the northern edge and along the southern side an old bank and ditch with dense scrub. Species present include pine, oak, field maple, hawthorn, wych elm, sycamore, ash, hazel, hornbeam, willow, bluebell, bracken, honeysuckle, three-veined sandwort, and early purple orchid. **Moderate dormouse potential.**
10. A structurally diverse and very species rich glade with an unimproved sward that includes betony, devils-bit scabious, field woodrush, common sorrel, common knapweed, yarrow, sweet vernal grass, agrimony, crosswort, bugle, barren strawberry, cowslip etc. The stream to the south is scrub lined with hawthorn, blackthorn, elder and alder buckthorn over bramble, nettle and dogs mercury. The stream to the north is also wooded. A lovely old oak is present at the southern end. Young oaks, bramble and bracken are encroaching into the glade and should be managed. The glade narrows into a ride though the adjoining woodland with scrub and streams on both sides.
11. **Horsham Common.** This is a complex mosaic of ancient woodland and plantation. The northern parts are predominantly hazel and hornbeam coppice with oak, hawthorn, field maple, ash, blackthorn, birch, holly, crab apple, spindle etc. with a species rich ground flora that includes primrose, early purple orchid, wood melick, bluebell, dogs mercury, wood sedge, violets, wood anemone and pendulous sedge. Old, fruiting hazels are frequent in the north. **Dormouse potential.** There are also some dense stands of oak plantation, a gill in the west, areas of pine plantation and some wide rides with wet flushes and a diverse flora. Occasional apple trees have been planted along one ride edge and there is a large, disused pheasant pen in the wood. The southern part of this area has a mixture of poplar plantation and more semi-natural wet woodland that contains willows, alder, nettle, ramsons, bramble, elder, hawthorn, blackthorn, dogs mercury, meadowsweet, water mint, lesser spearwort and hemlock water-dropwort. There is a large overgrown, dry pond in the southern area, called Alder Copse, on the steep banks of which is considerable badger activity.
12. **Hartsgravel Wood.** This woodland is linked to Alder Copse/Horsham Common by a strip of wet woodland and a grassy ride. The wood appears to be ancient in origin with dense bluebell, yellow archangel, stands of bracken and patches of more grassy ground flora. Hazel, hornbeam and sweet chestnut coppice are present with oak, holly and ash. Ramsons occur on the stream banks. There are areas of broadleaved and coniferous plantation as well as large rhododendron thickets, which should be removed.
13. Narrow fields of wet, unmanaged grassland that are a poor semi-improved grassland/tall herb transition habitat. Contain plants such as meadow foxtail, nettle, common cleavers, crosswort, common sorrel, cow parsley, cocks-foot, creeping buttercup, cuckoo flower, germander speedwell, creeping bent, rough meadow-grass, lesser stitchwort, Yorkshire

fog and hemlock water-dropwort. There is a dry bank with scrub and trees to the south of the fields.

14. Wet grassland either side of the stream. The stream has occasional trees and shrubs on the banks including oak, alder, willow, hazel, blackthorn etc and dense nettle on the banks. Emergent vegetation in the stream includes hemlock water-dropwort, branched bur-reed and reed canary-grass whilst water-starwort occurs in the channel. **Water vole potential.**
15. **Great Cockshill Wood.** Probably of ancient origin but much modified by more recent management. Has a central area of conifer plantation and the eastern arm of the woodland is broadleaved plantation. In the north and south are areas of hornbeam and hazel coppice with ash, oak, elm and some rhododendron over bluebell dominated ground flora. There are areas of disturbed ground and piles of debris near the sheds in the south. The ground flora is variable with some species rich areas containing primrose, bluebell, violet etc. but other zones where bramble and nettle predominate. The central, wet ride has a diverse flora. Signs of muntjac presence were seen.
16. **Little Cockshill Wood.** Re-planted ancient woodland. Some hazel and ash coppice with a ground flora dominated by ramsons near the stream and by bluebell in drier parts of the wood. The main ride has a species rich flora. Oak, blackthorn, field maple etc. are present along with planted conifers, horse chestnut, willow and a dense area of young broadleaf plantation in the west. The hazel coppice in the east has been cut recently and rather dense oak and ash standards retained. There is a small area of wet woodland with flushes containing yellow flag and planted willow (probably cricket bat willow) in the south east.
17. Very wet, inundated grassland/marsh with shallow standing water areas and developing stands of rushes and sedges. A small, overgrown pond in the south has marginal branched bur-reed, floating sweet-grass, reed canary-grass, yellow flag, water mint, soft rush etc. and grades into a shallow flush with jointed rush, cuckoo flower etc. A ditch to the north also has abundant emergent vegetation. Access was limited to this area but it has great potential for a variety of wildlife especially wetland birds, amphibians, invertebrates and water voles. **Water vole and great crested newt potential.**
18. Small, open field pond with a fringe of branched bur-reed and abundant duckweed. **Great crested newt potential.**
19. Wooded pond at the northern end of an old sunken track that has a rich ancient woodland flora. The pond is surrounded by oak, field maple, hazel, holly, ash, bluebell, wood anemone, greater stitchwort etc. **Great crested newt potential.**
20. **Jockies Copse.** Partly re-planted, broadleaved ancient woodland site with streams and flushes. Area of hazel coppice has ash and oak standards and a bluebell dominated ground flora. Other species present include field maple, spindle, blackthorn, crack willow, dogs mercury, three-veined sandwort, wood anemone and much regenerating sycamore. There are dense scrubby edges in the west of the woodland and under the power lines. Deadwood is abundant. **Moderate dormouse potential, but isolated.**
21. **Greenstreet Furzefield.** Mixed, scrubby margins surround this conifer plantation, which also has dense areas of sycamore re-growth and coppice. There are relict hazel, field maple and ash coppice stools and mature crab apples, suggesting the broadleaved fringe at least is of ancient origin. The ground flora is patchy with some bluebell dominated areas and other grassy zones. The occasional glades and rides are fairly species rich and contain violets, ground-ivy, bramble, bugle, wood sedge, primrose etc. There are some dense stands of bramble and bracken and good deadwood habitats, including some standing trunks with woodpecker holes.

22. Valuable old oak tree.
23. **River Adur.** The river has an average width of about 2m through the estate and has generally steep banks dominated by a coarse flora including nettle, hemlock water-dropwort, common cleavers, hogweed, cow parsley and tussocky grasses with variable densities of trees and shrubs on the bank top, primarily alder, ash, oak, willows, field maple, hawthorn and blackthorn. The channel and margins in the western part of the estate support a typical wetland flora that includes reed canary-grass, branched bur-reed, meadowsweet, common reedmace, common water-plantain, yellow water-lily, hemlock water-dropwort and reed sweet-grass. The eastern part of the river is highly engineered and has a rather different suite of marginal and aquatic plants that includes reed canary-grass, branched bur-reed, common club-rush, rushes, yellow flag, hemlock water-dropwort, greater pond sedge, yellow water-lily, fringed water-lily and pondweeds. A more thorough botanical survey of the river and especially its aquatic vegetation would yield much more information than was possible during the phase I survey. **Water vole potential.**
24. **Church Wood.** Mixed areas of plantation over relict ancient woodland. Species present include oak, ash, hawthorn, field maple, sycamore, garden privet and snowberry over a ground flora with bluebell, nettle, ground-ivy, greater stitchwort, violets and early purple orchid. There are old banks present, mature oaks and old field maple coppice stools. Honeysuckle is abundant and the wood has a varied structure.
25. **Spring Wood and Matches Wood.** Parts are fenced to exclude grazing animals, whilst other areas are already grazed and are developing a wood pasture structure. The area is a mixture of ancient woodland and more recent plantation of oak and conifers, though the whole area may be of ancient origin. The most semi-natural areas have hornbeam and hazel coppice with oak, hawthorn, Scots pine, beech, field maple, ash, wych elm, blackthorn and holly over a ground flora that is locally quite coarse and enriched but that also includes bluebell, lesser celandine, three-veined sandwort, enchanters nightshade, dogs mercury, early purple orchid, violet, primrose and bugle. Old banks surround the wood and there is a stream in the north with pools and flushes. The area has a diverse structure. Rhododendron is occasional and should be removed.
26. A large pond extending into the woodland with a fringe of soft rush, gipsywort, water mint, hemlock water-dropwort, common water-plantain, redshank, water cress, common reedmace and brooklime. This pond may be stocked with fish and marsh frogs are present. **Water vole potential and limited great crested newt potential, though fish will reduce this.**
27. **Brickyard Wood.** A small copse of hazel and hornbeam coppice that is grazed. Rhododendron is present within the sparse shrub layer and there is an open structure. The ground flora is diverse and a small pond and stream in the south add to the value of this copse.
28. **Knepp Park Wood.** A grazed copse with old banks, hazel coppice, oak, hawthorn, horse chestnut, field maple, ash, elm and occasional conifers and non-native shrubs. The rich ground flora includes bluebell, moschatel, dogs mercury etc. and there is a dense band of nettle along the stream edging the copse.
29. **Charlwood Wood.** This woodland is excluded from the grazed area and contains considerable amounts of badger activity. It is predominantly hazel coppice with oak, hornbeam, field maple, elder, hawthorn, wild cherry, holly and ash over bluebell, bracken

and wood anemone. Steep slopes and wet flushes contribute to its structural and topographical diversity.

30. A small pond that is shaded by a fringe of oak, willow etc. and has limited aquatic or marginal vegetation. **Great crested newt potential.**

31. A wetland area adjoining a stream within the main parkland that is dominated by soft rush, hard rush, sedges and fleabane etc. The adjoining drain supports wetland species such as hemlock water-dropwort, reed canary-grass, creeping bent, jointed rush, silverweed, cuckoo flower and yellow flag.

32. **Merrick Wood.** Fenced to exclude grazing there is a narrow fringe of trees and shrubs outside the fence line. It comprises apparently ancient semi-natural woodland with some re-planted areas of conifers and poplars. The western area has impenetrable scrub and re-growth, elsewhere there is hornbeam and hazel coppice with oak, hawthorn, ash, blackthorn, horse chestnut, sycamore, field maple and conifers over a rich ground flora that includes bracken, bluebell, violet, dogs mercury, male fern, enchanters nightshade, bugle, wood sedge, common spotted-orchid and bramble. A small, shallow pond is present to the south east of the wood in a field with a mature oak tree. **Dormouse potential, but rather isolated. Great crested newt potential in small pond.**

33. **Knepp Castle Woodland.** A very mixed area of grazed woodland with a mosaic of planted broadleaves and conifers, including some native species and many exotics. There are some very old lime and holm oak trees as well as oak, Scots pine, hawthorn, sweet chestnut, field maple, horse chestnut, rhododendron, copper beech, hornbeam, aspen, birch, rowan, sycamore, cherry laurel and willows. The ground flora varies in this area from lush to sparse with areas of nettle and bramble and more diverse areas with primrose, violet, dogs mercury and daffodil. There are some wet, grassy rides that are very species rich and in places equivalent to unimproved grassland sward with plants such as devils-bit scabious, agrimony, field woodrush and sweet vernal grass. There is also some hazel coppice in the north west and occasional wet flushes with rushes and sedges. A pond in the north west has the invasive plant skunk cabbage in it, which should be removed to prevent its spread. There are an old bank and ditch on the western edge of the wood and abundant deadwood within the area. This woodland grades into the semi-natural wet woodland along the millpond edge (see note 34).

34. Mosaic of wet woodland, fen and drier woodland. In the north, near Lodge Farm, the wet woodland is semi-natural but also contains planted poplars with the crack willow, blackthorn, grey willow and alder. It grades into drier woodland to the east that has locally frequent wych elm, including coppiced stools which is unusual, field maple, hawthorn, oak etc. The wet woodland contains extensive flushes and abundant deadwood. The ground flora includes much nettle along with cow parsley, various grasses, reed canary-grass, water mint, brooklime, ground-ivy, hemlock water-dropwort, dogs mercury, yellow flag, ramsons, garlic mustard, redshank, meadowsweet, wild angelica, branched bur-reed, cuckoo flower, gipsywort, yellow loosestrife and red currant. Grazing animals have access to this woodland. To the north east is a drier arm of woodland that is fenced from grazing and comprises mixed, re-planted ancient woodland with relict hazel coppice, bluebell, pendulous sedge, early purple orchid etc. Along the eastern edge of the wood is a dry, wooded bank with hazel, hawthorn, wild service tree, field maple, blackthorn and bluebell. This adjoins a wetter woodland strip on the eastern bank of the millpond. The wet woodland grades into a rich area of fen and developing willow carr, especially on the western side of the millpond. Tall wetland plants such as common

reedmace, reed canary-grass, marsh horsetail and yellow flag typically dominate the fen. **Water vole potential and great crested newt potential.**

35. **Knepp Millpond.** The millpond was not surveyed in detail because there is already recent biological information available. In summary, it has a diverse fringe of emergent vegetation that includes plants such as reed canary-grass, common reedmace, common club-rush, lesser reedmace, greater pond sedge, soft rush, yellow loosestrife and hemlock water-dropwort. **Water vole potential.**
36. **Hillhouse Plantation.** A dense, scrubby area of mixed plantation with much nettle, bramble and pendulous sedge in the ground flora as well as relict ancient woodland plants including bluebell. Elder, hawthorn, blackthorn ash and willows are frequent and there is a small pond in the south east that is surrounded by willows. **Great crested newt potential in the pond.**
37. Species rich wet grassland field bounded by hedges, scrub and a tributary stream. Sward includes cuckoo flower, meadowsweet, common knapweed, common sorrel, bugle, creeping buttercup, reed canary-grass, yellow flag, soft rush and crosswort.
38. Small copse and shaw. The copse is scrubby with much invasive garden privet but also has an area of oak and ash plantation and a semi-natural, probably ancient origin area with oak, field maple, hawthorn and ash over a rich ground flora that includes common spotted-orchid, three-veined sandwort, honeysuckle, bluebell, moschatel, bugle and violets.
39. A farm pond surrounded by willows with emergent hemlock water-dropwort and rushes. The outlet ditch to the river contains common reedmace, hemlock water-dropwort, reed canary-grass, water forget-me-not etc. Marsh frogs are present. **Great crested newt potential and water vole potential in ditch and river especially.**
40. Ancient oak pollard with a hollow trunk and dead branches in its crown.
41. **South Wood.** Some areas of broadleaved plantation and occasional conifers, but essentially an ancient woodland site with hazel and sycamore coppice stools along with oak, field maple, hawthorn, birch etc. over bluebell, greater stitchwort, primrose, nettle, dogs mercury, moschatel, bracken, red campion, three-veined sandwort and wood sage. Straw bales and dung have been dumped in the north eastern corner and along the western ride causing localised enrichment. There is an old bank and ditch along the western edge. The rides are currently narrow and shady but have the potential to be more species rich with appropriate management.
42. **The Rookery.** Mixed plantation woodland that is mainly larch and beech with rhododendron, oak, bramble, elm, ash, holly, dogwood, horse chestnut, hazel and stands of bamboo also present. The ground flora contains species such as bluebell, nettle, red campion, male fern, wood spurge, violet, wood anemone, primrose, three-veined sandwort, honeysuckle, bracken and dogs mercury. The woodland has been extensively modified but the ground flora suggests an ancient origin. The wood grades into willow carr and elm dominated stands towards the millpond edge.
43. Mixed, wet woodland on the millpond edge with fen areas. Ash, oak, field maple, willows, grey poplar, alder, hawthorn, common reed, rushes, common reedmace, cuckoo flower, hemlock water-dropwort, marsh thistle, water mint etc. A very diverse habitat. **Water vole potential and great crested newt potential.**
44. Mixed woodland with much rhododendron and wet areas on the millpond edge.

45. **Castle ruins.** Variable, semi-improved grassland with shallow ditches that contain rushes, cuckoo flower etc. Scattered anthills. Finer sward on the castle mound with red fescue, meadow wood-rush etc.
46. Shaw/gill with oak, nettle, holly, blackthorn, honeysuckle, bramble, hawthorn, bluebell etc. Stream dry, banks steep and large badger sett.
47. **Penbridge Lane.** Old green lane, mostly wooded but with some sections more open and grassy with hedges along the edges. Wet in places with small ponds (see below). Banks and ditches on both sides in places. Wide range of plant species including oak, hazel, blackthorn, nettle, bluebell, cow parsley, greater stitchwort, honeysuckle, elder, willows, crosswort, wood spurge, primrose etc. Valuable corridor habitat. **Great crested newt potential, moderate dormouse potential.**
48. Two small fields with wet, species rich swards. Western field is part mown with benches, caravans, shooting blinds etc. The eastern field is unmown. Sward in both includes meadow foxtail, creeping bent, meadow-grasses, cocks-foot, white clover, yarrow, creeping buttercup, meadow buttercup, cuckoo flower, common knapweed, sweet vernal grass, red clover, sharp-flowered rush, field wood-rush, hairy sedge, cow parsley, common sorrel and silverweed. There is a small, overgrown pond in the western field. **Great crested newt potential.**
49. **"Wildflower Field".** Wet semi-improved grassland and a small adjoining field and area of scrub north of the stream. Grass dominated sward with a typical range of species such as meadow foxtail, creeping buttercup, meadow buttercup, yarrow, common sorrel, crosswort, cocks-foot, red fescue, hairy sedge, common birds-foot-trefoil, cuckoo flower, sedges, reed canary-grass, soft rush and tufted hair-grass. The adjoining scrub and small ponds form the eastern end of Oaklands Lagg. **Great crested newt potential.**
50. **"Wildflower Meadow" and pond.** An area of tussocky, semi-improved grassland with a valuable, graded scrub edge along Penbridge Lane. Contains similar species to the Wildflower Field though has a rather more species rich bank at the northern end where common knapweed, red fescue, yarrow, ribwort plantain, bulbous buttercup, common sorrel etc. occur. The pond is a good habitat with open water, varied aquatic flora and a diverse marginal fringe of wetland species. Plants recorded in and around the pond include rushes, common club-rush, sedges, branched bur-reed, water forget-me-not, water dock, broad-leaved pondweed, gipsywort, false fox-sedge, yellow flag, common marsh-bedstraw, common water plantain, water mint, marsh horsetail, fine-leaved water-dropwort and the uncommon species water-violet. Grass snake and marsh frog were seen around the pond. Combined with the scrub and mature trees this area has high biodiversity potential and varied habitats with diverse structure. **Great crested newt potential and water vole potential.**
51. **Oaklands Lagg.** Tussocky, wet semi-improved grassland with surrounding scrub, bramble banks and hedges. Wetter in the eastern end where hemlock water-dropwort, meadow foxtail and false oat-grass are especially prominent in the sward towards the ponds. The rest of the area has a range of species including meadow vetchling, bugle, creeping thistle, soft rush, meadow foxtail, cocks-foot, common sorrel, sedges, creeping cinquefoil, yarrow, perennial rye-grass, greater stitchwort, common knapweed and sweet vernal grass. **Water vole potential.**
52. **Fox Covert/Loders Gorse.** Areas of conifer plantation, sycamore (including coppice) and old hornbeam coppice that appears to be re-planted ancient woodland. Oak, ash, blackthorn, field maple, hazel, grey willow and bramble also occur and the wood has a

good shrubby margin. Some relict areas of species rich ground flora, especially on the damp, but rather shady rides which have bluebell, primrose, bugle, greater stitchwort, violet, three-veined sandwort and early purple orchid. There are also some quite coarse and enriched areas dominated by nettle. Bracken is locally frequent.

53. Wetland mosaic of fen, wet grassland, developing willow carr with ponds, scrapes and flushes and fragments of drier, unimproved grassland that contain old anthills. Parts of this area are inaccessible. A new area of planted broadleaved trees is present in the south. Plants noted here include hemlock water-dropwort, meadow foxtail, nettle, creeping buttercup, creeping thistle, crosswort, germander speedwell, hard rush, gipsywort, common knapweed, pepper-saxifrage (an indicator of unimproved grassland), water mint, jointed rush, yellow loosestrife, reed canary-grass, Yorkshire fog, cuckoo flower, greater stitchwort, bugle, ground-ivy, bittersweet, common reedmace and branched bur-reed. This is a very valuable habitat complex especially for birds, invertebrates and amphibians. **Great crested newt potential and water vole potential.**
54. Wooded pond on the edge of Penbridge Lane. Oak, hazel, field maple, hawthorn, blackthorn, bramble, ash and grey willow surround this well vegetated pond. There are varied water depths with a shallow area next to the track. Wetland plants around the pond include common reedmace, common water plantain, hard rush, water forget-me-not, false fox-sedge, water mint, great willowherb, common water-starwort, reed canary-grass, soft rush, brooklime and common club-rush. A less welcome plant is the non-native and highly invasive floating pennywort *Hydrocotyle ranunculoides* that was present in the shallow area during the phase I survey, however when a check was made in July this shallow area had dried out and there was no sign of the pennywort. It would be advisable to monitor the pond in case this species re-appears in the spring and if so it should be removed. There is a herb rich bank by the pond where common knapweed, silverweed, crosswort etc. provide a potentially good source of nectar for insects. **Great crested newt potential and water vole potential.**
55. Mixed shaw leading to a small wet copse of coppiced hazel with oak, blackthorn, hawthorn, field maple, grey willow etc. There are planted oaks, dense scrub and flushes in the west and a mixed ground flora that includes bluebell, bracken, primrose, nettle, bramble, honeysuckle, broad buckler-fern, bugle, soft rush, greater stitchwort, remote sedge, common marsh bedstraw, cuckoo flower, lesser spearwort, hemlock water-dropwort and three-veined sandwort.
56. Pond surrounded by scrub of grey willow, hawthorn, nettle, blackthorn, bramble and hemlock. **Great crested newt potential.**
57. **Bentons Gorse.** Newly re-planted mixed plantation with occasional mature Scots pine and oak trees within an intact fringe of mixed trees and shrubs. Dense scrub along the stream forms a useful habitat. Poorly drained soil is indicated by the presence of rushes and marsh thistle. Dense bramble and gorse occur over a coarse ground flora of grasses, common cleavers, docks, nettle and occasional bluebell, foxglove, soft rush, wood sage, common hemp-nettle, red campion and ground-ivy. This area is potentially good reptile habitat.
58. **Northern Wood.** A stream and shaw join this area to Bentons Gorse to the north. The shaw has old hazel, field maple and ash coppice stools as well as oak, hawthorn, crab apple, blackthorn, elder and holly over a ground flora of bluebell, nettle, cow parsley, bracken, lesser celandine, selfheal, ground-ivy, dogs mercury etc. There is a large badger sett on the steepest part of the stream bank. The stream valley is less steep in the south

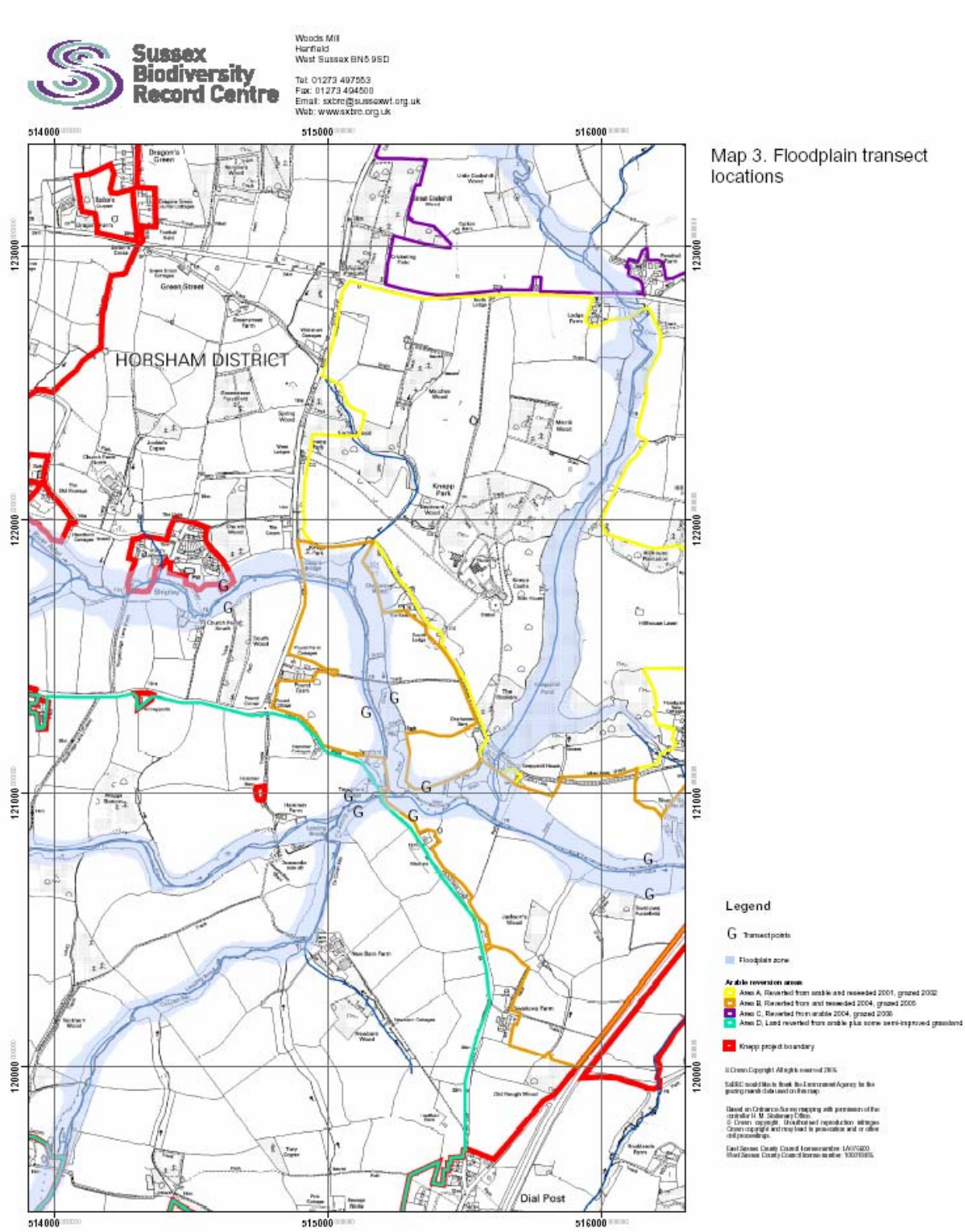
and has a small wooded pond with yellow flag in it at the junction with the main part of the wood. The woodland is recently cut hornbeam coppice with ash and oak standards. Dense elder, bramble and occasional pines are present. The wide wet ride along the western edge has a typically diverse ground flora. **Moderate dormouse potential.**

59. **Hammer Pond.** The wet grassland lagg grades into fen vegetation and developing willow carr at the western end of the Hammer Pond. There are valuable scrub margins on both sides of the pond are with grey willow, blackthorn, hawthorn, oak, gorse etc. There is a grassy, mown path along the northern edge of the pond and a dense band of nettle and hemlock water-dropwort. The pond itself has wide, species rich fen margins with a range of wetland species including reed canary-grass, meadow foxtail, hemlock water-dropwort, nettle, grey willow, white willow, crosswort, common reed, hairy sedge, soft rush, water forget-me-not, silverweed, water mint, floating sweet-grass, common reedmace, cuckoo flower, common club-rush, yellow loosestrife, branched bur-reed and marsh horsetail. The aquatic flora includes broad-leaved pondweed but was not surveyed fully. At the outlet of the Hammer Pond there is an old oak with exposed root system that has potential as a holt site. **Water vole potential.**
60. Small, wet horse grazed fields by the stream have some wet flushes and the stream has a range of marginal plants including common reed.
61. Poplar plantation with hazel, field maple and oak trees on the margins. Has a tall, lush ground flora with much nettle, hogweed, cow parsley, meadow foxtail, hemlock water-dropwort, crosswort, water mint, rough meadow-grass, meadow sweet and common cleavers. Blackthorn and willow scrub are also present. **Water vole potential.**
62. **Pond Field Lagg.** Lancing Brook runs though this area and is lined by mixed wetland species including reed canary-grass, branched bur-reed, hemlock water-dropwort, water mint, common yellow-cress, brooklime, watercress, fools watercress and soft rush. Occasional yellow water-lily is present in the brook and the banks have a mixture of trees, scrub and hedges alongside them. There is much badger activity in the steep wooded bank at the south end of the lagg. On the drier banks at the edges of the lagg the grassland sward is quite species rich with common sorrel, common knapweed, lesser stitchwort, sweet vernal-grass, yarrow, germander speedwell, common birds-foot-trefoil, field woodrush, agrimony, red clover, cuckoo flower etc. The wetter parts of the lagg have a more lush, grass dominated sward. There is a wooded bank along the south western arm of the lagg.
63. Pond in Pond Field. This is an open, grazed pond with a fringe of rushes, common club-rush etc. and some yellow water-lily. **Great crested newt potential.**
64. **Wick Wood.** This is a conifer plantation of old and young trees with a fringe of broadleaved species, including oak, hazel, field maple, elm, hornbeam and birch and some natural regeneration of broadleaved species as well as frequent gorse and bramble under the young trees. Bracken, bluebell and bramble are prominent in the ground layer.
65. **Tory Copse.** A small area of relict ancient woodland containing hazel coppice with ash, oak, blackthorn, elder, hawthorn, midland hawthorn, bluebell, wood millet, field maple etc.
66. **Middle Link Lagg.** This area of grassland has been intensively horse grazed until recently and still has a very short sward, but appears to be only semi-improved. The ditch running through the centre has wetland plants such as hemlock water-dropwort, fools watercress, brooklime and watercress present. The ditch is dry in the north but wetter upstream where a fenced section has a lush fringe of wetland plants. There is a small,

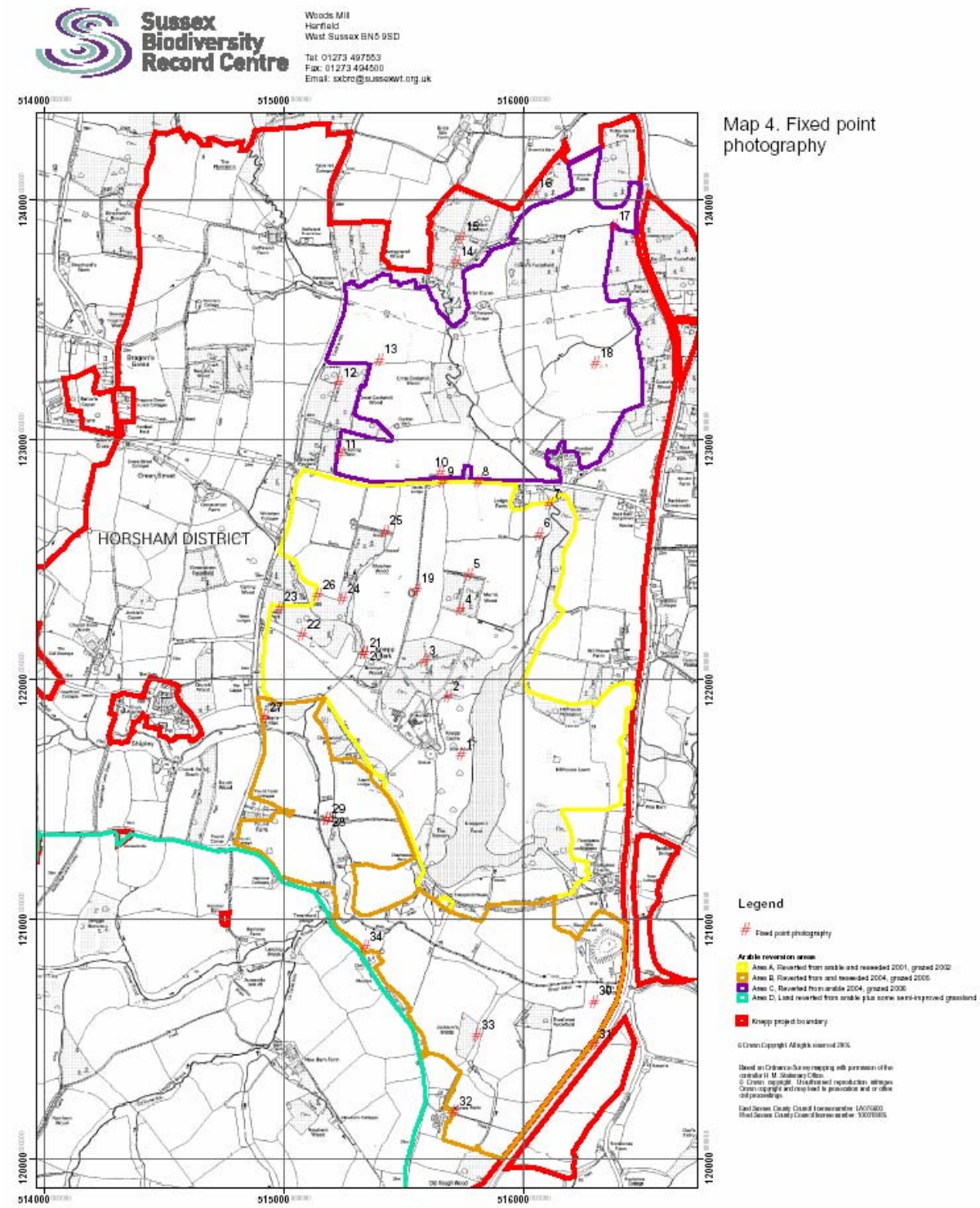
overgrown pond at the upstream extreme that is hidden in grey willow scrub. **Great crested newt potential in the small pond and possibly water vole potential in the well vegetated part of the ditch.**

67. Large open pond adjoining the farmyard which has emergent common reedmace and hemlock water-dropwort as well as marginal willows and a band of scrub and trees to the west. **Great crested newt potential and water vole potential.**
68. **Newbarn Wood.** Ancient woodland with hazel coppice and occasional planted conifers. Also present are oak, field maple, hawthorn, blackthorn, holly, bluebell, wood anemone, bracken, three-veined sandwort, honeysuckle, bramble, ash, spindle and cow parsley. **Moderate dormouse potential but rather isolated.**
69. Small tussocky pasture with a grass dominated sward of perennial rye-grass, cocks-foot, bent-grasses, meadow foxtail, red fescue, Yorkshire fog but also with an abundance of common herbs in places including white clover, common birds-foot-trefoil, yarrow, common sorrel, creeping buttercup, creeping thistle and lesser stitchwort. There is a small, open pond in the east that contains a water-crowfoot, lesser spearwort, common water-plantain, branched bur-reed, floating sweet-grass, water purslane and grey willow. **Great crested newt potential.**
70. Open pond with common reedmace, branched bur-reed, common duckweed, rushes, yellow loosestrife etc. and a flush, bramble and scrub. Varied structure. **Great crested newt potential.**
71. **Jacksons Wood.** Conifer plantation in the north but mostly intact ancient woodland in the remainder with old ash and oak coppice stools, midland hawthorn, field maple, hornbeam, blackthorn, hazel, crab apple and wild service tree over a ground flora that includes bluebell, bramble, grasses, wood anemone, primrose and bracken.
72. A green lane with dense, mixed hedges on both sides, mature oaks and banks of bramble and nettle. Tussocky species-poor semi-improved grassland occupies the central strip. At the southern end is a pond with much emergent common reedmace and areas of wet grassland on both sides of the feeder stream. **Great crested newt potential in pond.**
73. **Swallows Furzefield.** Mixed conifer plantation and sweet chestnut coppice woodland over a ground flora dominated by bluebell. A large badger sett is present.
74. **Old Rough Wood.** A diverse area of ancient woodland hazel coppice with oak, holly, field maple etc. over a bluebell dominated ground flora.

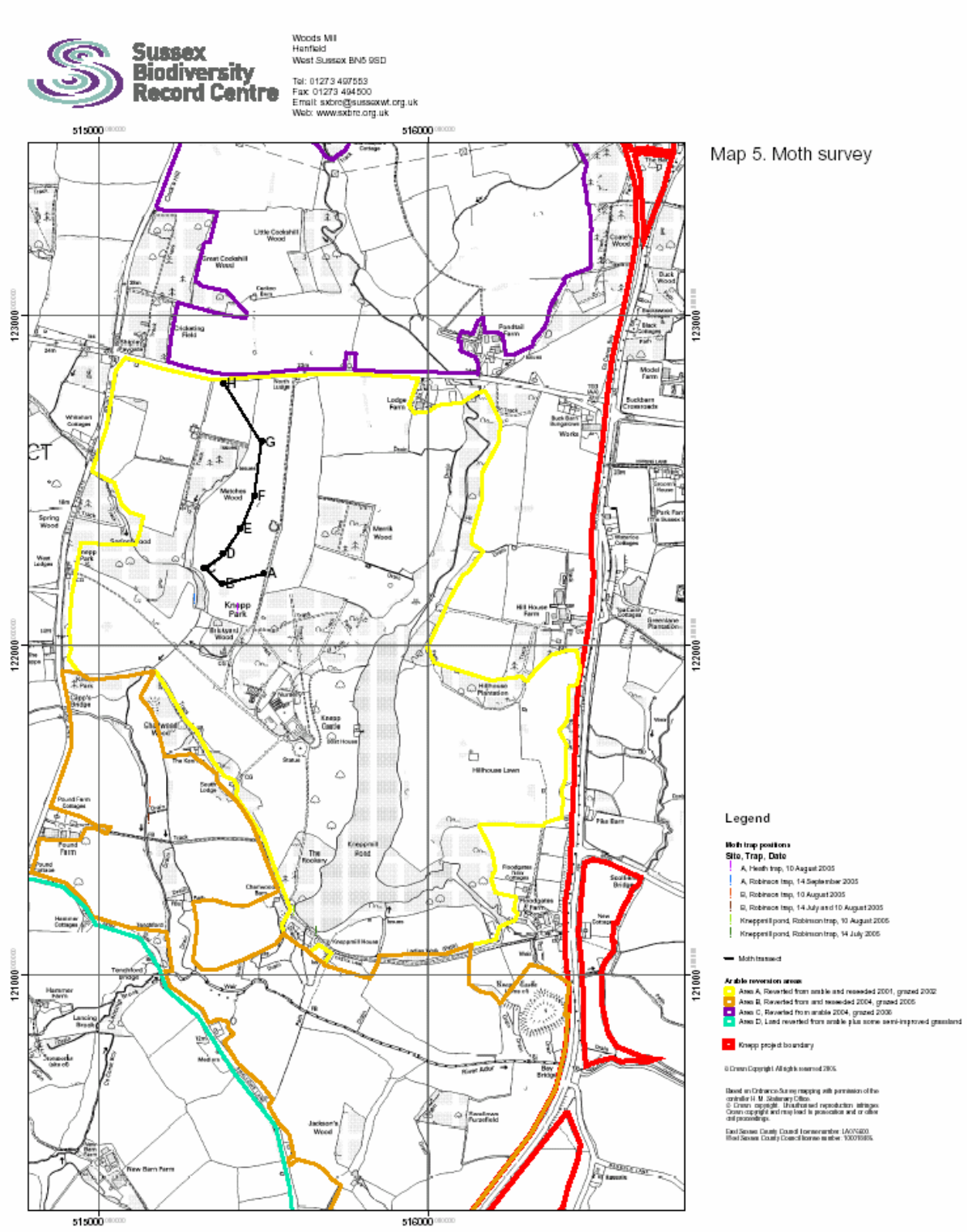
# Map 3 Floodplain transect locations



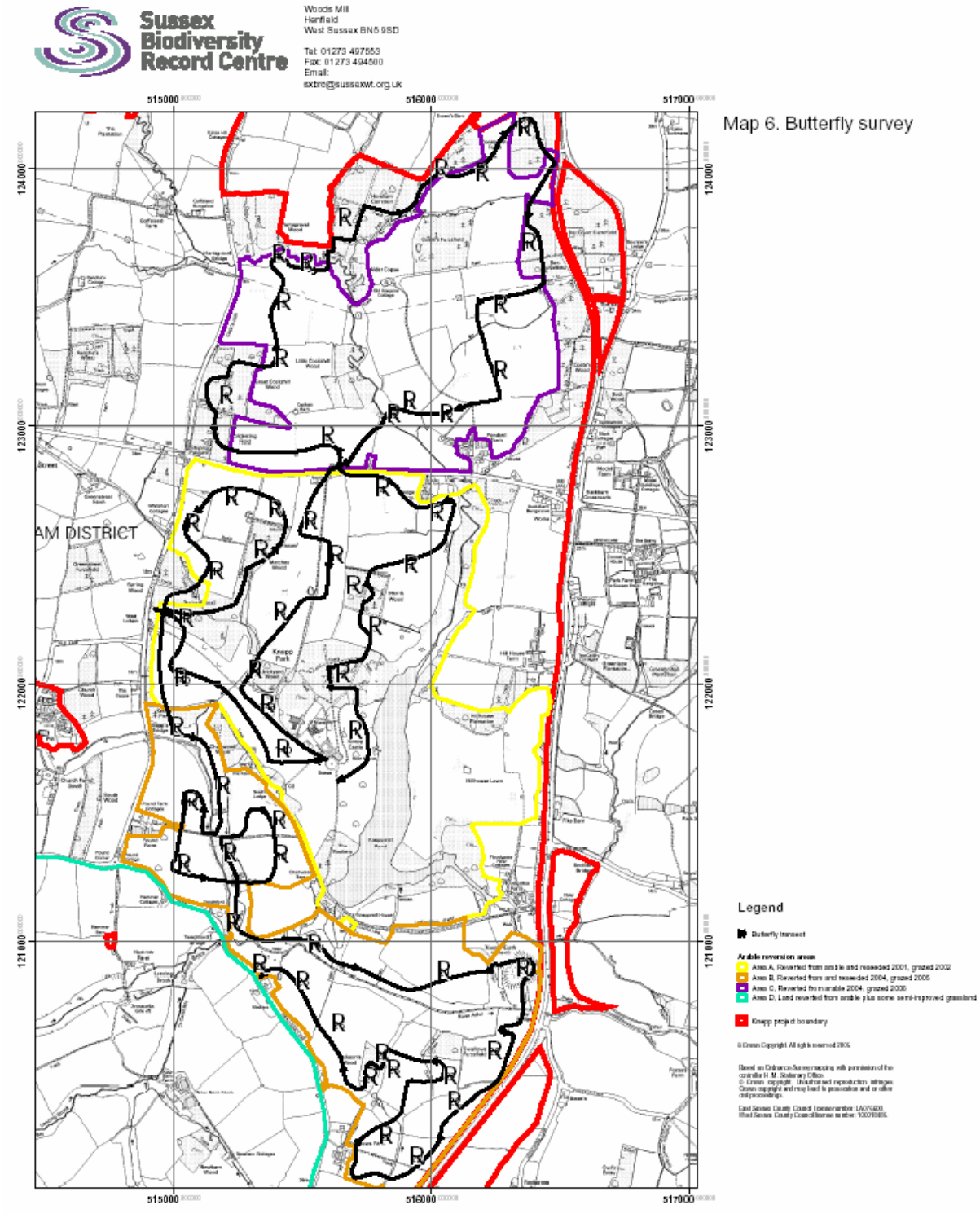
# Map 4 Fixed-point photography



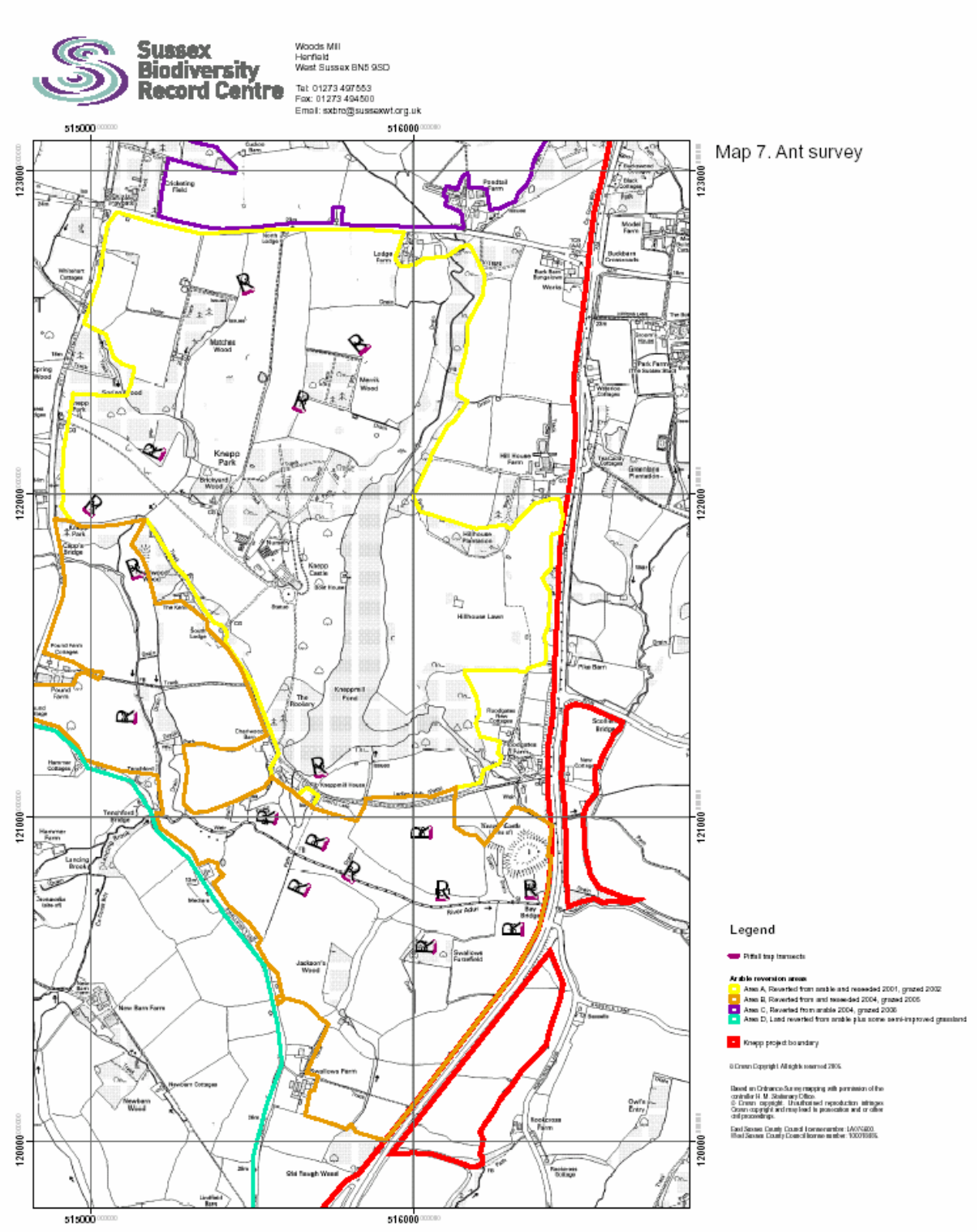
# Map 5 Moth survey



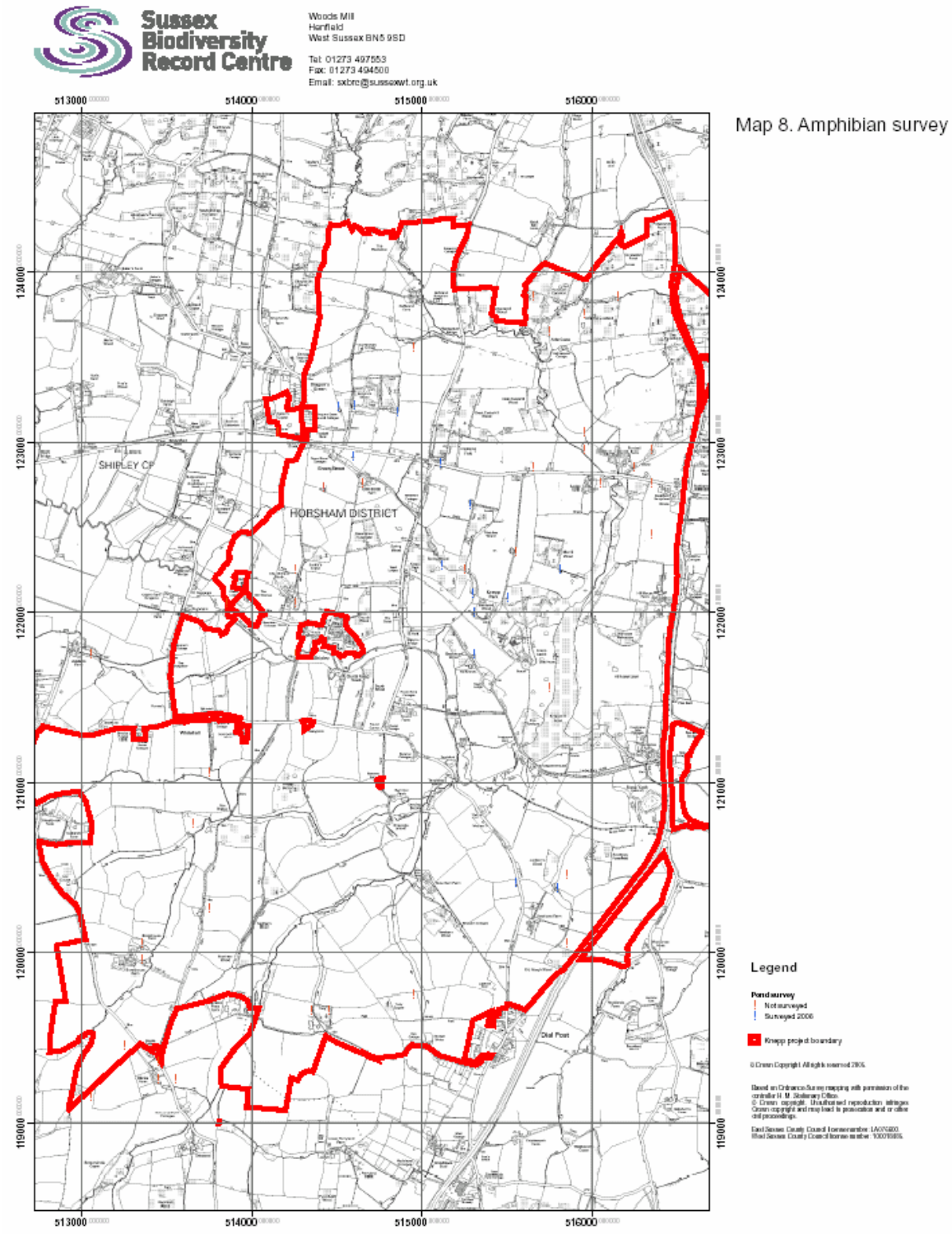
# Map 6 Butterfly survey



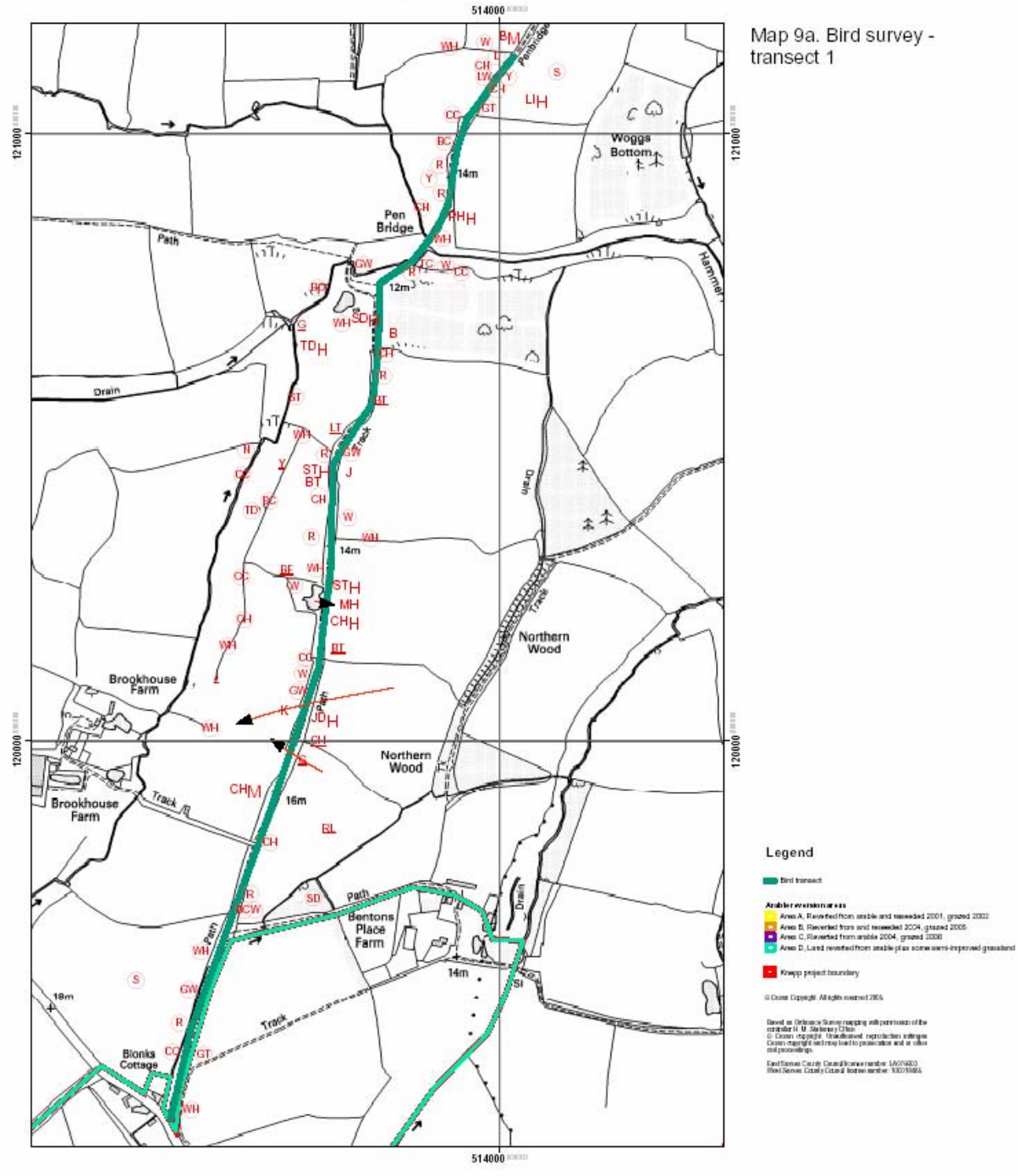
# Map 7 Ant survey

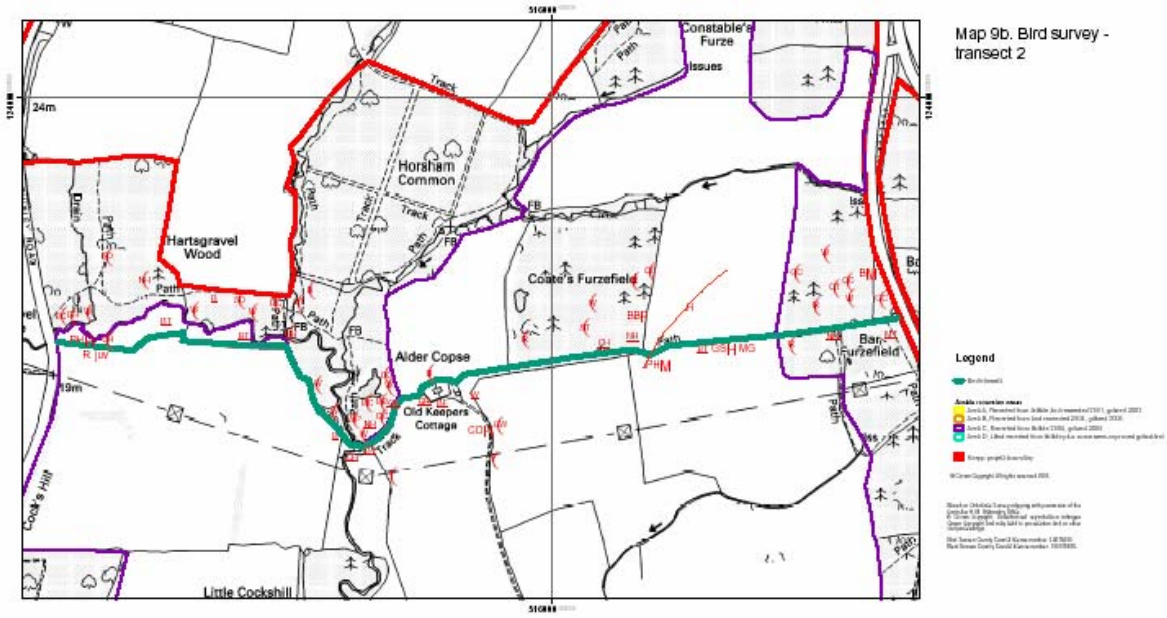


# Map 8 Amphibian survey

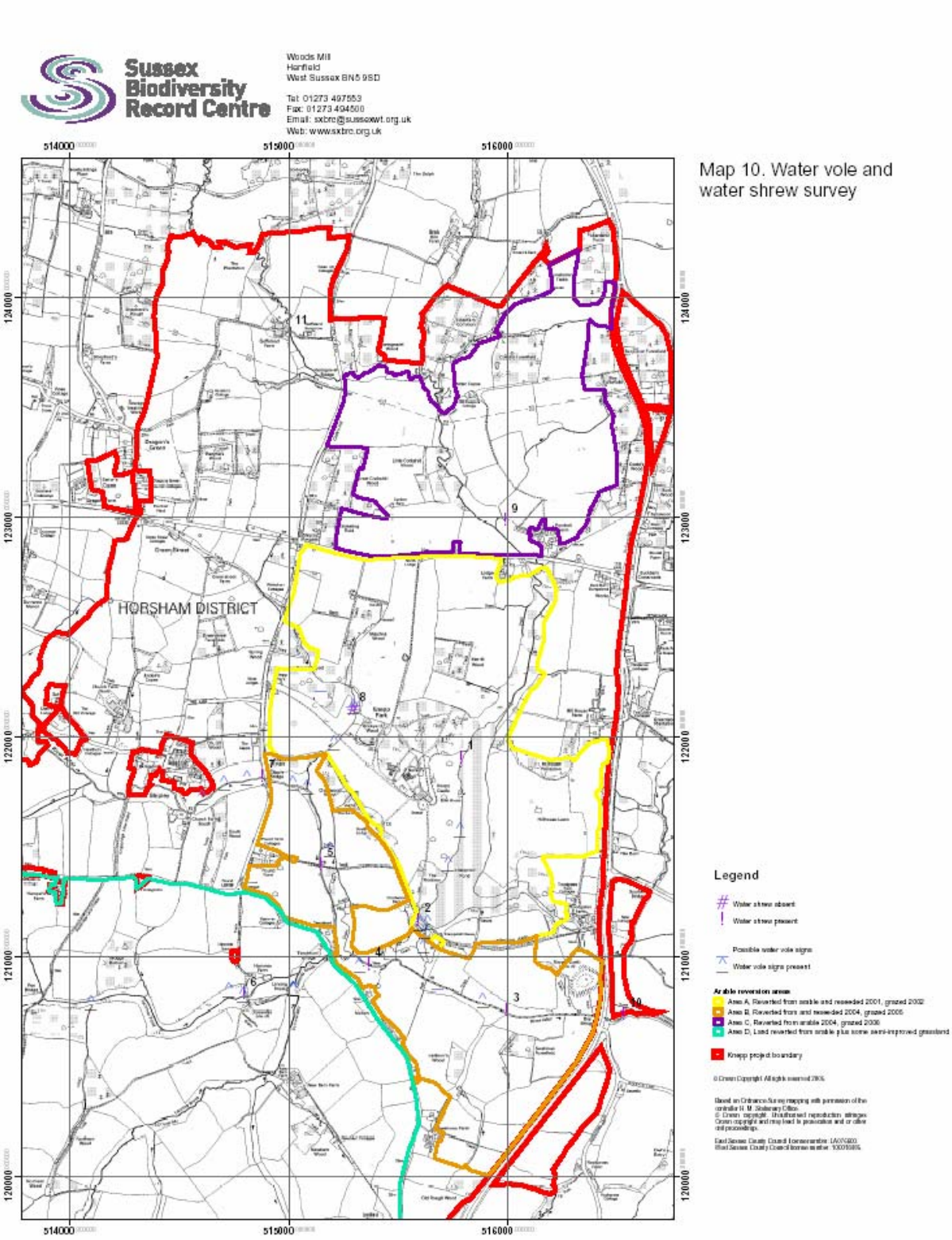


# Map 9 Breeding bird survey

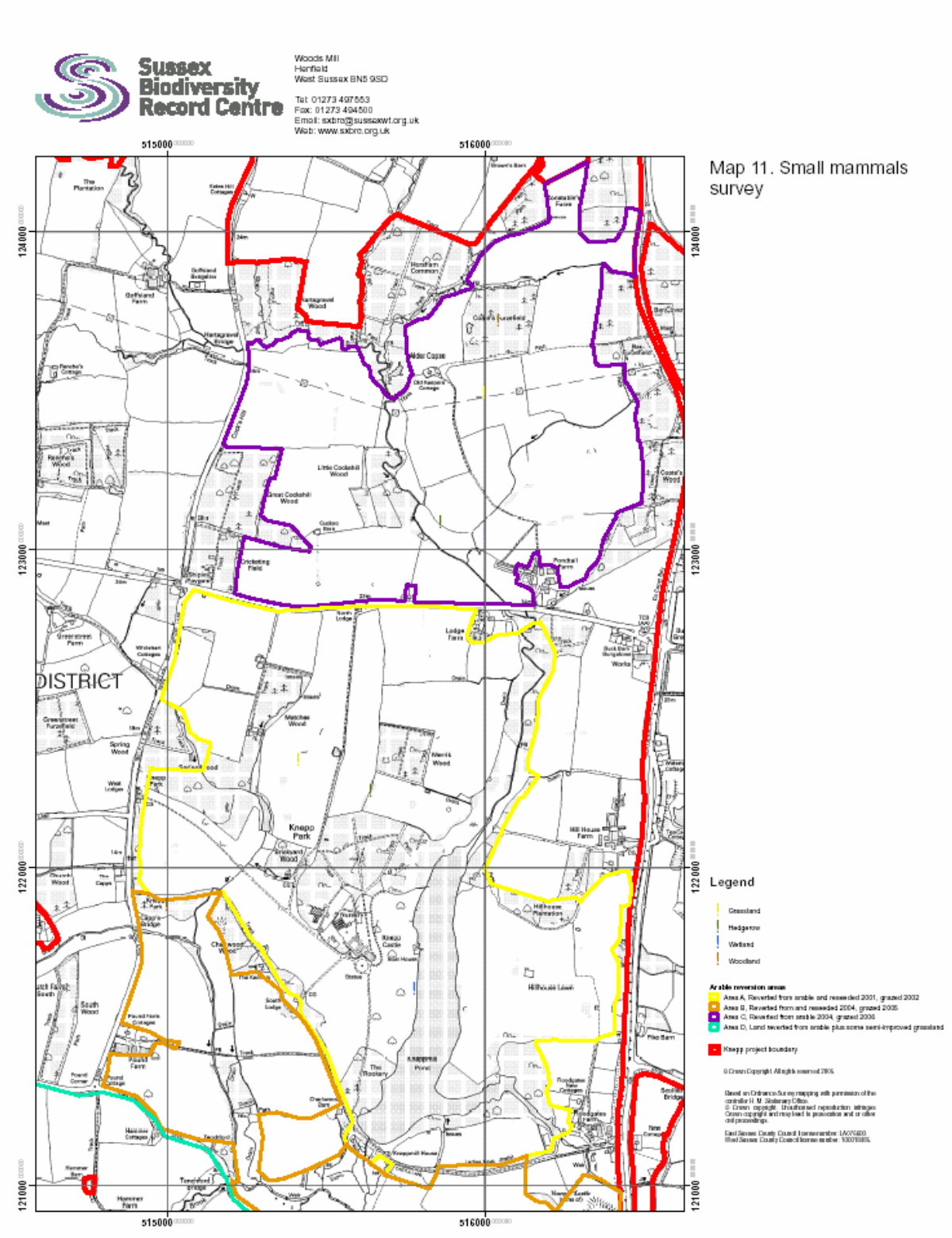



Sussex Biodiversity Record Centre
Woods Hill
Henfield
West Sussex BN5 9SD
Tel: 01273 492153
Fax: 01273 494303
E-mail: sxbrc@sussexwt.org.uk
Web: www.sxbrc.org.uk
Map 9b. Bird survey - transect 2
Legend
Constable's Furze
Issues
Horsham Common
Hartsgravel Wood
Coate's Furzefield
Alder Copse
Old Keepers Cottage
Ban Furzefield
Little Cockshill
Cook's Hill
24m
19m
Track
Path
FB

# Map 10 Water vole and water shrew survey



# Map 11 Small mammals (shrews, voles, mice) survey



# Appendices

# Appendix 1 Project brief

## Baseline study of effects of moving towards a naturalistic grazing regime on the Knepp Estate

### *Rationale*

There is increasing interest in the consequences of moving towards more naturalistic grazing regimes at a landscape scale. The ecological background to this has been reviewed by English Nature during 2004 and an assessment made of some of the issues that are likely to arise in different situations. One of the areas considered during these assessments was the Knepp Estate in Sussex where the owner is interested in taking improved farmland out of productive agriculture. A small scale 'river channel restoration' project is also taking place on the estate.

Sussex Wildlife Trust wishes to understand the landscape scale consequences of such novel management and therefore propose to carry out a baseline survey of the habitats and species currently using the area. This would involve a number of elements but including:

- GIS habitat map to phase 1 standard from existing data and up-to-date aerial photographs.
- Quadrat recording in representative areas to assess broad composition.
- Transects across potential transition areas to measure expected change.
- A grid-based sample of points to help pick up the unexpected changes.
- Collation of species records for the site.
- Identification of potential future recording – eg butterfly transects, breeding birds as being groups likely to be sensitive to changes in habitat mosaics.
- Special requirements for any rare species.

This project is designed to set up this baseline survey in a way that will ensure that it can be carried on using local resources (through the Sussex Wildlife Trust) subsequently.

### *Objective*

A baseline survey of the estate and records that can be used to monitor subsequent changes under the naturalistic grazing regime.

### *Methods*

A broad approach to survey has been identified as follows. The precise numbers and sizes of the transects and plots will be influenced by the results from the Phase 1 survey.

**Collate exiting survey information**

- Collate information held within the Sussex BRC.

- Collate survey information collected by or on behalf of the Knepp estate, not currently held on the BRC.

**Phase 1 habitat survey**

Carry out a detailed phase I survey mapping all habitats to at least a scale of 1:10,000, according to methodology used by English Nature. This will be carried out in two parts:

1. A desk study using recent aerial photograph interpretation, river corridors surveys and other existing information as appropriate to compile an outline phase I survey map. This will then be digitised onto computer. This can be done in winter so work can start before the field season.
2. Ecological survey adding detail to the phase I map. This will refine the map done by desk study and will include plant community descriptions with lists of frequent and notable species.

**Scoping study with BRC Survey Unit (BRCSU)**

A walk around the Knepp estate to assess what methods of monitoring would be appropriate – locations and approaches for transect and quadrat studies, species groups requiring more information or more systematic study. This will include a brief report outlining the survey work recommended for the project. Transects and quadrats will also be positioned for later survey.

**Quadrats**

Permanent quadrats will be recorded in different habitat types in order to maintain records of a sample of vegetation. These will be accurately located so that the same areas can be recorded year after year if required. These should include:

- X quadrats measuring 2m x 2m in grassland areas.
- X quadrats measuring 5m x 5m in woodland areas (ground flora)
- X quadrats measuring 50m x 50m in woodland areas (tree cover)
- X quadrats measuring 2m x 2m in previous arable land.

**Transects**

Permanent transects will be recorded across sample zones of variation in order to follow how these zones move or change with time. This will include the following:

- X belt transects measuring 50m x 5m stretching from woodland centres out into adjacent grazed areas. All trees and shrubs and all major plant communities will be recorded within the belt.
- X belt transects measuring 50m x 2m stretching from the centre of the river Adur and through the adjacent flood plain. All major zones of wetland vegetation will be recorded within the belt. (May change this to 10 2x2m quadrats along the transect line.)

**Fixed point photographs**

Permanent marker points will be established adjacent to quadrats and transects to mark locations for fixed-point photographs. Photographs to be taken in May (to pick up spring vegetation), August (to pick up summer vegetation) and December (to pick up vegetation structure and landform) of each year.

**Wetland survey information**

Links will be made to any work being undertaken as part of the river restoration.

### *Specialist surveys*

The scoping study should aim to identify species groups or particular studies that could be carried out to add to the understanding of the effect of naturalistic grazing. This will be a long list, including more than might be covered by available funding. Studies will be put in priority order to provide a shopping list to guide choices should funding or other opportunities become available. These specialist studies are likely to include:

- Various bird studies (common bird census, breeding bird surveys etc.)
- Butterfly transects
- Rare plant studies.
- Tree age class distributions.
- Fungus surveys
- Bryophyte and lichen surveys.
- Invertebrate surveys (eg dead wood invertebrates).
- Tracking of grazer behaviour (eg radio tracking cows).
- Dead wood distribution survey.
- Freshwater invertebrate surveys.

# Appendix 2 Habitat survey data

**Average vegetation height figures in brackets indicate extremes of height within the quadrat**

| Transect number | Quadrat number | Average vegetataion height (cm) | Comments on vegetation structure |
|---|---|---|---|
| A1 | 1 | 0 | Woodland floor is almost bare apart from tree seedlings. The canopy is uniform with a sparse, spindly shrub layer. The bank and ditch are generally bare with some bramble etc. The field has an even, uniform sward. |
| | 2 | 0 | |
| | 3 | 0 (3m and 10m trees) | |
| | 4 | 0 (10+m tree) | |
| | 5 | 0 | |
| | 6 | 30 (0) | |
| | 7 | 15 | |
| | 8 | 20 | |
| | 9 | 25 | |
| | 10 | 25 | |
| | 11 | 25 | |
| | 12 | 25 | |
| | 13 | 25 | |
| | 14 | 25 | |
| | 15 | 15 | |
| A2 | 1 | 10 (1m and 10m tree) | Limited structural diversity in the woodland itself and an abrupt transition from woodland edge to the field. The woodland canopy is uniform throughout the plantation. The grassland sward is also uniform and this transect has two distinct zones with little transitional habitat. |
| | 2 | 10 | |
| | 3 | 10 | |
| | 4 | 10 | |
| | 5 | 0 (10) | |
| | 6 | 40 | |
| | 7 | 20 | |
| | 8 | 15 | |
| | 9 | 10 | |
| | 10 | 15 | |
| | 11 | 10 | |
| | 12 | 5 | |
| | 13 | 10 | |
| | 14 | 10 | |
| | 15 | 10 | |
| B1 | 1 | 0 | Woodland section was very desiccated, but the ground flora was formerly dominated by bluebell, common cleavers etc. and the woodland has a tall, even canopy and diverse shrub layer. The bank and ditch support dense bramble, nettle etc. adding to the variation in structure. The field had been topped and has a sparse, uniform sward with many bare patches on the dry, cracked ground. |
| | 2 | 0 | |
| | 3 | 5 (30) | |
| | 4 | 10 | |
| | 5 | 10 | |
| | 6 | 0 (5-60) | |
| | 7 | 60 (5) | |
| | 8 | 5 | |
| | 9 | 5 | |
| | 10 | 5 | |
| | 11 | 5 | |
| | 12 | 5 | |
| | 13 | 5 | |
| | 14 | 5 | |
| | 15 | 5 | |

| Transect number | Quadrat number | Average vegetataion height (cm) | Comments on vegetation structure |
|---|---|---|---|
| C1 | 1 | 5 (40) | Transect crosses a woodland ride and bank/ditch on wood edge – these sections show greatest structural variation. The grassland edge was mown but not grazed whilst the final section was both mown and grazed so had a very uniform sward. |
| | 2 | 10 | |
| | 3 | 10 (1) | |
| | 4 | 30 | |
| | 5 | 80 (0) | |
| | 6 | 80 (0) | |
| | 7 | 50 (5) | |
| | 8 | 5 (20) | |
| | 9 | 5 | |
| | 10 | 20 | |
| | 11 | 5 | |
| | 12 | 5 | |
| | 13 | 5 | |
| | 14 | 5 | |
| | 15 | 5 | |
| C2 | 1 | 20 | Has a varied structure in the woodland edge though with a rather abrupt transition to the field. Grassland sward is uniform and was sheep grazed earlier in the year. |
| | 2 | 10 (20) | |
| | 3 | 30 (5-80) | |
| | 4 | 10 (100) | |
| | 5 | 10 | |
| | 6 | 10 | |
| | 7 | 15 | |
| | 8 | 15 | |
| | 9 | 15 | |
| | 10 | 15 | |
| | 11 | 15 | |
| | 12 | 15 | |
| | 13 | 10 | |
| | 14 | 10 | |
| | 15 | 15 | |
| D1 | 1 | 10 | Heavily horse grazed and parched grassland with a very low, even sward until the edge of the ditch where the vegetation is more lush. The ditch contains ungrazed, tall herb species and therefore has a much greater vegetation height. |
| | 2 | 5 | |
| | 3 | 2 | |
| | 4 | 2 | |
| | 5 | 2 | |
| | 6 | 3 | |
| | 7 | 3 | |
| | 8 | 2 (10) | |
| | 9 | 2 | |
| | 10 | 3 | |
| | 11 | 3 | |
| | 12 | 10 | |
| | 13 | 15 | |
| | 14 | 15 (100) | |
| | 15 | 100 | |
| D2 | 1 | 40 | A taller grass dominated sward, but horse grazed and trampled causing a decrease in structural diversity. Occasional tussocks of rushes and tufted hair-grass provide the main variation. |
| | 2 | 30 | |
| | 3 | 15 | |
| | 4 | 20 | |
| | 5 | 20 | |
| | 6 | 20 | |

| Transect number | Quadrat number | Average vegetataion height (cm) | Comments on vegetation structure |
|---|---|---|---|
| | 7 | 30 | |
| | 8 | 25 | |
| | 9 | 40 | |
| | 10 | 30 | |
| | 11 | 30 | |
| | 12 | 30 | |
| | 13 | 40 | |
| | 14 | 40 | |
| | 15 | 40 (80) | |

# Botanical survey of River Adur and Lancing Brook

## Species lists

### Section 1 River Adur, Shipley Windmill to Capps Bridge (TQ144217 to TQ148217)

| | | |
|---|---|---|
| *Acer campestre* | Field maple | O |
| *Achillea millefolium* | Yarrow | O |
| *Agrostis stolonifera* | Creeping bent | A |
| *Alnus glutinosa* | Alder | OLF |
| *Angelica sylvestris* | Wild angelica | O |
| *Anisantha sterilis* | Barren brome | O |
| *Apium nodiflorum* | Fools water-cress | R |
| *Arctium minus* | Lesser burdock | O |
| *Arrhenatherum elatius* | False oat-grass | F |
| *Calystegia sepium* | Hedge bindweed | A |
| *Centaurea nigra* | Common knapweed | O |
| *Cirsium arvense* | Creeping thistle | FLA |
| *Conium maculatum* | Hemlock | R |
| *Cornus sanguinea* | Dogwood | R |
| *Cruciata laevipes* | Crosswort | R |
| *Dactylis glomerata* | Cocks-foot | F |
| *Deschampsia cespitosa* | Tufted hair-grass | O |
| *Dipsacus fullonum* | Teasel | OLF |
| *Epilobium hirsutum* | Great willowherb | F |
| *Filipendula ulmaria* | Meadowsweet | F |
| *Fraxinus excelsior* | Ash | O |
| *Glechoma hederacea* | Ground-ivy | O |
| *Heracleum sphondylium* | Hogweed | O |
| *Holcus lanatus* | Yorkshire fog | F |
| *Juncus effusus* | Soft rush | O |
| *Lathyrus pratensis* | Meadow vetchling | O |
| *Lemna gibba* | Fat duckweed | ALD |
| *Lemna minor* | Common duckweed | LA |
| *Lycopus europaeus* | Gipsywort | F |
| *Lysimachia vulgaris* | Yellow loosestrife | O |
| *Lythrum salicaria* | Purple loosestrife | F |
| *Mentha aquatica* | Water mint | F |
| *Nupha lutea* | Yellow water-lily | OLF |
| *Oenanthe crocata* | Hemlock water-dropwort | F |
| *Phalaris arundinacea* | Reed canary-grass | ALD |
| *Plantago lanceolata* | Ribwort plantain | R |
| *Potentilla reptans* | Creeping cinquefoil | O |
| *Prunus spinosa* | Blackthorn | OLF |
| *Rubus fruticosus* | Bramble | A |
| *Rumex obtusifolius* | Broad-leaved dock | O |
| *Sagittaria sagittifolia* | Arrowhead | O |
| *Salix babylonica* | Weeping willow | R |
| *Sambucus nigra* | Elder | O |
| *Scrophularia auriculata* | Water figwort | F |
| *Scutellaria galericulata* | Common skullcap | R |

| | | |
|---|---|---|
| *Senecio aquaticus* | Marsh ragwort | O |
| *Senecio erucifolius* | Hoary ragwort | R |
| *Senecio jacobaea* | Common ragwort | O |
| *Sison amomum* | Stone parsley | F |
| *Sparganium emersum* | Unbranched bur-reed | R |
| *Sparganium erectum* | Branched bur-reed | ALD |
| *Stachys palustris* | Marsh woundwort | O |
| *Typha latifolia* | Bulrush | OLF |
| *Urtica dioica* | Nettle | A |
| *Vicia cracca* | Tufted vetch | O |

### 5.1.1 Section 2 River Adur, Capps Bridge to A24 (TQ148217 to TQ164207)

| | | |
|---|---|---|
| *Acer campestre* | Field maple | R |
| *Achillea millefolium* | Yarrow | O |
| *Agrostis stolonifera* | Creeping bent | F |
| *Alisma plantago-aquatica* | Common water-plantain | O |
| *Alnus glutinosa* | Alder | OLF |
| *Angelica sylvestris* | Wild angelica | RLO |
| *Apium nodiflorum* | Fools water-cress | O |
| *Arctium minus* | Lesser burdock | R |
| *Barbarea vulgaris* | Wintercress | R |
| *Bidens tripartite* | Trifid bur-marigold | R |
| *Brassica nigra* | Black mustard | R |
| *Bromus hordeaceus* | Soft brome | O |
| *Butomus umbellatus* | Flowering rush | O |
| *Callitriche agg.* | Water-starwort | R |
| *Calystegia sepium* | Hedge bindweed | OLF |
| *Carex pendula* | Pendulous sedge | O |
| *Carex sp.* | Sedge sp. | LF |
| *Centaurea nigra* | Common knapweed | R |
| *Cirsium arvense* | Creeping thistle | OLF |
| *Cirsium vulgare* | Spear thistle | O |
| *Conium maculatum* | Hemlock | O |
| *Corylus avellana* | Hazel | RLO |
| *Cruciata laevipes* | Crosswort | R |
| *Cynosurus cristatus* | Crested dogs-tail | O |
| *Dactylis glomerata* | Cocks-foot | O |
| *Deschampsia cespitosa* | Tufted hair-grass | O |
| *Dipsacus fullonum* | Teasel | RLO |
| *Elytrigia repens* | Common couch | OLF |
| *Epilobium hirsutum* | Great willowherb | O |
| *Equisetum arvense* | Field horsetail | O |
| *Filipendula ulmaria* | Meadowsweet | O |
| *Fraxinus excelsior* | Ash | O |
| *Geranium dissectum* | Cut-leaved cranesbill | R |
| *Glyceria maxima* | Reed sweet-grass | LF |
| *Heracleum sphondylium* | Hogweed | RLO |
| *Holcus lanatus* | Yorkshire fog | O |
| *Hordeum secalinum* | Meadow barley | FLA |
| *Humulus lupulus* | Hop | OLF |
| *Hypochaeris radicata* | Common cats-ear | R |

| | | |
|---|---|---|
| *Iris pseudacorus* | Yellow flag | R |
| *Juncus effusus* | Soft rush | O |
| *Juncus inflexus* | Hard rush | O |
| *Lathyrus pratensis* | Meadow vetchling | O |
| *Lemna gibba* | Fat duckweed | ALD |
| *Lemna minor* | Common duckweed | O |
| *Leontodon autumnalis* | Autumnal hawkbit | O |
| *Lolium perenne* | Perennial rye-grass | F |
| *Lycopus europaeus* | Gipsywort | O |
| *Lythrum salicaria* | Purple loosestrife | OLF |
| *Malva sylvestris* | Common mallow | R |
| *Mentha aquatica* | Water mint | OLF |
| *Myosotis scorpioides* | Water forget-me-not | OLF |
| *Myosoton aquaticum* | Water chickweed | R |
| *Nupha lutea* | Yellow water-lily | F |
| *Nymphoides peltata* | Fringed water-lily | O |
| *Oenanthe crocata* | Hemlock water-dropwort | OLF |
| *Persicaria amphibia* | Amphibious bistort | OLF |
| *Persicaria hydropiper* | Water-pepper | F |
| *Persicaria maculosa* | Redshank | OLF |
| *Phalaris arundinacea* | Reed canary-grass | A |
| *Phleum pratense* | Timothy | OLF |
| *Pimpinella saxifrage* | Burnet saxifrage | R |
| *Poa trivialis* | Rough meadow-grass | O |
| *Potamogeton lucens* | Shining pondweed | FLA |
| *Prunus spinosa* | Blackthorn | OLF |
| *Pteridium aquilinum* | Bracken | O |
| *Pulicaria dysenterica* | Fleabane | O |
| *Quercus robur* | Pedunculate oak | R |
| *Ranunculus repens* | Creeping buttercup | OLF |
| *Ranunculus sceleratus* | Celery-leaved buttercup | R |
| *Rorippa amphibian* | Great yellow-cress | LO |
| *Rubus fruticosus* | Bramble | O |
| *Rumex conglomeratus* | Clustered dock | O |
| *Rumex crispus* | Curled dock | O |
| *Rumex obtusifolius* | Broad-leaved dock | O |
| *Sagittaria sagittifolia* | Arrowhead | OLF |
| *Salix caprea* | Goat willow | R |
| *Salix cinerea* | Grey willow | OLA |
| *Salix viminalis* | Osier | O |
| *Sambucus nigra* | Elder | R |
| *Schoenoplectus lacustris* | Common club-rush | OLF |
| *Scrophularia auriculata* | Water figwort | O |
| *Senecio erucifolius* | Hoary ragwort | O |
| *Senecio jacobaea* | Common ragwort | O |
| *Silaum silaus* | Pepper-saxifrage | R |
| *Sison amomum* | Stone parsley | F |
| *Solanum dulcamara* | Bittersweet | O |
| *Sonchus asper* | Prickly sow-thistle | R |
| *Sparganium emersum* | Unbranched bur-reed | O |
| *Sparganium erectum* | Branched bur-reed | FLA |
| *Stachys palustris* | Marsh woundwort | F |
| *Taraxacum agg.* | Dandelion | O |

| | | |
|---|---|---|
| *Trifolium pratense* | Red clover | R |
| *Trifolium repens* | White clover | LF |
| *Typha latifolia* | Bulrush | OLF |
| *Urtica dioica* | Nettle | FLA |
| *Vicia cracca* | Tufted vetch | O |

### 5.1.2 Section 3 Lancing Brook, Hammer Pond (TQ148208 to TQ144208)

| | | |
|---|---|---|
| *Achillea millefolium* | Yarrow | O |
| *Agrostis stolonifera* | Creeping bent | A |
| *Alisma plantago-aquatica* | Common water-plantain | OLF |
| *Alopecurus geniculatus* | Marsh foxtail | OLA |
| *Alopecurus pratensis* | Meadow foxtail | OLA |
| *Arrhenatherum elatius* | False oat-grass | F |
| *Bidens tripartite* | Trifid bur-marigold | OLF |
| *Calystegia sepium* | Hedge bindweed | FLA |
| *Carex hirta* | Hairy sedge | OLA |
| *Centaurea nigra* | Common knapweed | R |
| *Cirsium arvense* | Creeping thistle | OLF |
| *Cirsium vulgare* | Spear thistle | OLF |
| *Cruciata laevipes* | Crosswort | OLF |
| *Dactylis glomerata* | Cocks-foot | OLF |
| *Dipsacus fullonum* | Teasel | O |
| *Elytrigia repens* | Common couch | LA |
| *Galium aparine* | Common cleavers | OLF |
| *Galium palustre* | Common marsh-bedstraw | OLF |
| *Glyceria fluitans* | Floating sweet-grass | LA |
| *Heracleum sphondylium* | Hogweed | O |
| *Holcus lanatus* | Yorkshire fog | F |
| *Hordeum secalinum* | Meadow barley | O |
| *Juncus effusus* | Soft rush | OLF |
| *Lycopus europaeus* | Gipsywort | F |
| *Lysimachia vulgaris* | Yellow loosestrife | F |
| *Lythrum salicaria* | Purple loosestrife | O |
| *Mentha aquatica* | Water mint | F |
| *Myosotis scorpioides* | Water forget-me-not | OLF |
| *Oenanthe crocata* | Hemlock water-dropwort | F |
| *Persicaria amphibia* | Amphibious bistort | FLA |
| *Persicaria hydropiper* | Water-pepper | OLF |
| *Persicaria maculosa* | Redshank | OLF |
| *Phalaris arundinacea* | Reed canary-grass | ALD |
| *Phleum pratense* | Timothy | OLF |
| *Potentilla anserina* | Silverweed | ALD |
| *Prunus spinosa* | Blackthorn | OLF |
| *Pulicaria dysenterica* | Fleabane | O |
| *Ranunculus repens* | Creeping buttercup | F |
| *Rumex obtusifolius* | Broad-leaved dock | O |
| *Salix alba* | White willow | R |
| *Salix cinerea* | Grey willow | F |

| | | |
|---|---|---|
| *Schoenoplectus lacustris* | Common club-rush | FLA |
| *Scirpus sylvaticus* | Wood club-rush | OLF |
| *Senecio aquaticus* | Marsh ragwort | R |
| *Solanum dulcamara* | Bittersweet | O |
| *Sonchus arvensis* | Perennial sow-thistle | RLO |
| *Sparganium erectum* | Branched bur-reed | OLF |
| *Stachys palustris* | Marsh woundwort | FLA |
| *Trifolium pratense* | Red clover | OLF |
| *Typha latifolia* | Bulrush | FLA |
| *Urtica dioica* | Nettle | FLA |

### 5.1.3 Section 4 Lancing Brook, Hammer Pond to Tenchford Bridge/Adur confluence (TQ148208 to TQ15321)

| | | |
|---|---|---|
| *Acer campestre* | Field maple | R |
| *Achillea millefolium* | Yarrow | R |
| *Agrostis stolonifera* | Creeping bent | F |
| *Alisma plantago-aquatica* | Common water-plantain | O |
| *Angelica sylvestris* | Wild angelica | OLF |
| *Callitriche agg.* | Water-starwort | O |
| *Calystegia sepium* | Hedge bindweed | A |
| *Carex sp.* | Sedge sp. | R |
| *Cirsium arvense* | Creeping thistle | LF |
| *Dactylis glomerata* | Cocks-foot | O |
| *Dryopteris filix-mas* | Male fern | R |
| *Epilobium hirsutum* | Great willowherb | R |
| *Equisetum arvense* | Field horsetail | R |
| *Equisetum fluviatile* | Water horsetail | LF |
| *Filipendula ulmaria* | Meadowsweet | O |
| *Fraxinus excelsior* | Ash | R |
| *Galium aparine* | Common cleavers | F |
| *Glechoma hederacea* | Ground-ivy | LF |
| *Hedera helix* | Ivy | LA |
| *Iris pseudacorus* | Yellow flag | R |
| *Juncus effusus* | Soft rush | O |
| *Lemna minor* | Common duckweed | LA |
| *Lysimachia vulgaris* | Yellow loosestrife | O |
| *Lythrum salicaria* | Purple loosestrife | O |
| *Mentha aquatica* | Water mint | OLF |
| *Myosotis scorpioides* | Water forget-me-not | OLF |
| *Myosoton aquaticum* | Water chickweed | OLF |
| *Nupha lutea* | Yellow water-lily | O |
| *Oenanthe crocata* | Hemlock water-dropwort | OLF |
| *Persicaria maculosa* | Redshank | O |
| *Phalaris arundinacea* | Reed canary-grass | OLF |
| *Phragmites australis* | Common reed | OLA |
| *Prunus spinosa* | Blackthorn | F |
| *Quercus robur* | Pedunculate oak | R |
| *Ranunculus repens* | Creeping buttercup | OLF |

| | | |
|---|---|---|
| *Rosa canina* | Dog rose | O |
| *Rubus fruticosus* | Bramble | OLF |
| *Rumex obtusifolius* | Broad-leaved dock | O |
| *Salix caprea* | Goat willow | R |
| *Salix cinerea* | Grey willow | F |
| *Sambucus nigra* | Elder | R |
| *Scrophularia auriculata* | Water figwort | O |
| *Sison amomum* | Stone parsley | R |
| *Solanum dulcamara* | Bittersweet | R |
| *Sonchus arvensis* | Perennial sow-thistle | R |
| *Sparganium erectum* | Branched bur-reed | OLF |
| *Stachys palustris* | Marsh woundwort | OLF |
| *Urtica dioica* | Nettle | ALD |
| *Vicia cracca* | Tufted vetch | R |

# Appendix 3 River Adur Floodplain data

### Table 1 – Quadrat descriptions

| Community (NVC) | Quadrat/ Strip no. | Date | Slope | Vegetation height (layers) | Description incl. management |
|---|---|---|---|---|---|
| **QUADRATS – 2x2 m** | | | | | |
| Hl- dominated grassland – NVC? | Q4 | 16/8/05 | None | 50 & 15 cm | Grassland dominated by *Holcus lanatus* as the principal component of the main sward here. |
| Hl-mixed spp grassland – NVC? | Q5 | 16/8/05 | None | 70 & 20 cm | Tussocky main mixed grassland sward near river; old vehicle tracks. |
| | Q8 | 16/8/05 | None | 70 & 25 cm | Dense mixed grassland main sward. |
| | Q18 | 23/8/05 | None | 35 cm | Band of dense longer damp tussocky mixed grassland at N field edge (similar to other strip just W of Capps Bridge), grading into *Carex* cf *curta* patch; horse-dunging area, hence longer and less grazed. |
| Agt-dominated grassland - MG13 (?) | Q7 | 16/8/05 | None | 10 cm only | Damp lush *Agrostis stolonifera*-dominated grassland extending partly around inner moat of old castle (plus patch by A24 road); short-grazed & poached by cattle. MG13? |
| | Q10 | 16/8/05 | None | 5 cm only | Very short damp lush *Agrostis stolonifera*-dominated grassland on lower ground of old river course, with limited *Alopecurus geniculatus* hence NVC MG13 community. |
| | Q14 | 17/8/05 | None | 50 & 15 cm | *Agrostis stolonifera*-dominated grassland on lower ground of old river course middle section, with some *Alopecurus geniculatus* hence NVC MG13 community. Patches of *Carex hirta, Deschampsia caespitosa, Juncus inflexus* and docks in other part of former channel. Photo taken. |
| | Q13 | 17/8/05 | Slight undulations | 50 & 15 cm | More mixed & modified *Agrostis stolonifera*-dominated grassland. MG13?? |
| Agt-mixed spp grassland - MG13? | Q23 | 23/8/05 | None | 10 cm only | Short-grazed grassland in narrow low-lying meandering old river bed (?) northern end (connected to S22, Q12, to S) just S of footpath and old bridge structure; preferentially grazed area. Photo taken from distance. |
| Agt-Other mixed grassland - NVC? | Q16 | 17/8/05 | None | 40 & 10 cm | Variable sward structure and composition, with surroundind sward also containing both *Hordeum secalinum* (A-F) and *Lolium perenne* (F). |
| | Q17 | 17/8/05 | None | 70 & 20 cm | Variable tussocky very species-poor sward (with *Holcus lanatus* to E in field). |
| Agt-Lp improved grassland (MG7/13) | Q11 | 16/8/05 | None | 50 & 20 cm | Reseeded dense slightly tussocky grassland band at fringe of vehicle track. |
| Improved grassland - MG7d | Q22 | 23/8/05 | None | 40 & 15 cm | A quite species-rich improved grassland (with much *Lolium perenne* and some *Alopecurus pratensis*, hence 'd' sub-community typical of lowland alluvial locations) with quadrat taken in slightly taller than average patch; horse-grazed. Photo taken. |
| Dc-dominated grassland - MG9 | Q3 | 16/8/05 | None | 60 & 20 cm | Small tussocky slightly lower-lying *Deschampsia caespitosa* wet grassland patch amongst main drier grassland sward. MG9 (sub-community?). |
| | Q21 | 23/8/05 | None | 5-100 cm | Very tussocky species-poor centre of stand, with *Arrhenatherum elatius* in nearby sward, hence classified as MG9b. Grass was 'topped' and cuttings left in-situ. |
| Ae-Dg rank grassland – MG1 | Q2 | 16/8/05 | S ~10 deg | 100 & 25 cm | Rank tussocky grassland beneath bank line along old boundary *c.* 3 m wide. Scant grazing by cattle, anthills present. MG1b. |

| Community (NVC) | Quadrat/ Strip no. | Date | Slope | Vegetation height (layers) | Description incl. management |
|---|---|---|---|---|---|
| | Q19 | 23/8/05 | N ~5-10 deg | 50 & 20 cm | Apparently ungrazed slightly rank grassland, with quadrat taken from higher and drier patch in W of field with more *Festuca rubra* and herbs (including *Lathyurus pratensis*) but less *Holcus lanatus* than main field sward to E below. Photo taken (down valley). MG1a. |
| | Q20 | 23/8/05 | N ~3 deg | 50 cm | Unusual dense wet grassland flush in field linear hollows (similar stand with *Holcus lanatus* at field W margin too) with tussocky patches, weedy composition plus wetland species *Phalaris arundinacea* invading. MG1 (sub-community?). |
| Fr-dominated grassland – seeded (?) | Q1 | 16/8/05 | None | 10 cm only | Very short grassland on raised bank by new fenceline, apparently sown grass seed mix. Evident grazing by deer & cattle. MG7/MG1a? |
| Seeded arable reversion | Q6 | 16/8/05 | None | 30 & 5 cm | Short sward at SE reseeded field corner above floodplain; deer & pony droppings nearby. |
| Seeded arable reversion | Q9 | 16/8/05 | None | 20 cm only | Short sward at in low-lying area near river reseeded. |
| Seeded arable reversion | Q15 | 17/8/05 | E ~5 deg | 10-20 cm only | Short sward sloping towards river; cut and topped with arisings left in-situ. |
| *Glyceria fluitans* 'swamp' wet grassland - S22 | Q12 (4x4m) | 17/8/05 | None | 10 cm only | *Glyceria fluitans* dominating low-lying meandering old river bed (?) southern end fringed by rush (grading into *Agrostis stolonifera*-dominated grassland MG13? Higher up to north of channel, Q23); poached by cattle with bare ground patches. S22 a or c? |
| **STRIPS – 10 m** | | | | | |
| Dc-dominated - MG9a (?) | S1 | 16/8/05 | - | 50+ cm | Wetland vegetation in dry graded-edge ditch *c.* 1 m wide average. Anthill at edge. |
| *Carex riparia* swamp S6 | S2 | 16/8/05 | - | 130 cm | Tall sedge-dominated dry ditch 1.5 – 3 m wide by 1.2 m deep, with steep sides collapsed in places from stock poaching. |
| *Glyceria fluitans* 'swamp' S22 (sub-community?) | S4 | 17/8/05 | - | 70 cm marginal & 15 cm base | *Glyceria fluitans* dominating base of ditch 1.5 m wide & 0.7 m deep, just below vehicle track bridge, with taller marginal vegetation on shallow-shelving sides. Weedy heterogeneous sward with more rush lower down ditch. Photo taken. |
| *Phalaris arundinacea* swamp S28b | S5 | 17/8/05 | - | Up to 150 cm | Tall grass-dominated steep-sided ditch 1.2 m deep, above vehicle track bridge. Photo taken. |
| *Wet tall herbs 1 - NVC?* | S3 | 16/8/05 | - | 120+ cm | Rush and nettle-dominated steep-sided ditch 1.5 m wide by 0.8 m deep at outflow of Kneppmill Pond (eutrophic); anthills at edge. |
| *Wet tall herbs 2 -NVC?* | S6 | 23/8/05 | - | Up to 150 cm | Diverse tall herb-rich restricted vegetation type (c. 20 m length only) in steep-medium sided ditch (eutrophic); poached by stock access, nettles topped also. Photo taken. |
| **STRIP – 30/10 m** | | | | | |
| W10 (a?) woodland fringe | S7 | 23/8/05 | - | ?? | Charlwood edge sampled as if hedgerow (30m woody core & 10m field layer), from bend in fence S from unmarked ditches along deer fence & ditchline, no real field layer within wood and scrub boundary cut back. |

## Table 2 – Species domin values for Phase 2 floodplain survey

| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15 | Q16 | Q17 | Q18 | Q19 | Q20 | Q21 | Q22 | Q23 | S1 | S2 | S3 | S4 | S5 | S6 | S7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **NVC (sub-) community** | MG7/MG1a? | MG1b | MG9 | HI-dom | HI-mixed | Arable reversion | Agt-dom | HI-mixed | Arable reversion | Agt-dom | Agt-Lp | S22 (a/c?) | Agt-dom | Agt-dom | Arable reversion | Agt-Other | Agt-Other | HI-mixed | MG1a | MG1 | MG9 (b) | MG7d | Agt-mixed | MG9a (?) | S6 | Wet tall herbs | S22 | S28b | Wet tall herbs | W10 (a?) |
| **Notes** | Seeded (?) | | | NVC? | NVC? | Seeded | MG13? | NVC? | Seeded | MG13 | MG7/13 | | MG13?? | MG13 | Seeded | NVC? | NVC? | NVC? | | Wet flush! | Ae nearby | | MG13? | | | NVC? | | | NVC? | Wood fringe |
| *Acer campestre* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 5 |
| *Achillea millefolium* | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | |
| *Agrostis canina* | | | 4 | | 4 | | | | | | | | | | | | | | | | | | | | | | | | 1 | |
| *Agrostis capillaris* | 1 | 1 | | 3 | | 5 | | 4 | 5 | | | | | | | | | | | | | 7 | | | 2 | | | | 1 | |
| *Agrostis gigantea* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 |
| *Agrostis sp.* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Agrostis stolonifera* | | | | | | | 9 | | | 10 | 8 | 2 | 10 | 9 | 8 | 9 | 9 | 4 | | | | 4 | 9 | | | | 5 | 4 | 2 | 3 |
| *Alopecurus geniculatus* | | | | | | | | | | 1 | | 2 | | 3 | | | | | | | | | | | | | | | | |
| *Alopecurus myosuroides* | | | | | | 2 | | | 3 | | | | | | | | | | | | | | | | | | | | | |
| *Alopecurus pratensis* | | | | | 6 | | | | | | | | | | | 1 | | | | | | 3 | 2 | | 1 | | 1 | | | |
| *Arrhenatherum elatius* | | 8 | | | | | | | | | | | | | | | | | | 9 | | | | | | | | | | |
| Bare soil | 4 | 1 | | | | 2 | 2 | | 1 | 1 | | 1 | | | 4 | | | | | | | | 3 | 1 | | | | | 2 | |
| *Bromus hordeaceus* | | | | | | 4 | | | | | | | | | 2 | | | | | | | | | | | | | | | |
| *Calystegia sepium* | | | | | | | | | | | | | | | | | | | | 2 | | | | | | | | 2 | 2 | |
| *Cardamine pratensis* | | | | | | | | | | | | | | | | | | | | | | | | 2 | 2 | | | | | |
| *Carex cf curta* | | | | | | | | | | | | | | | | | | 5 | | | | | | | | | | | | |
| *Carex riparia* | | | | | | | | | | | | | | | | | | | | | | | | | 9 | | | | | |
| *Cerastium fontanum* | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | |
| *Chenopodium album* | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | |
| *Cirsium arvense* | 4 | 2 | | | | | | | | | | | | | | 1 | | | | | | | | | | 4 | 3 | | 1 | 4 |
| *Cirsium palustre* | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | |
| *Cirsium sp.* | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | |
| *Cirsium vulgare* | | | | | | | | | | | | | | | 1 | | | | | | | | | | | 1 | 2 | | | |
| *Convolvulus arvensis* | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Crepis capillaris* | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | |
| *Crucifereae1* | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | 2 | | |
| *Cynosurus cristatus* | | | | | | 7 | | | 5 | 4 | | | | | 5 | | | | | | | | | | | | | | | |
| *Dactylis glomerata* | | 7 | | | | 2 | | | | | | | | | 5 | | | | 4 | | | 4 | | | 3 | 3 | | | 1 | 2 |
| *Deschampsia caespitosa* | | | 8 | | | | 5 | | | | | | 2 | 1 | | | | | | | 8 | | 2 | 8 | 1 | 2 | | | | |
| *Elymus repens* | | | | | | | | | | | | | | | | | | 2 | | | | | | | | | 1 | 1 | 1 | |
| *Epilobium hirsutum* | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | |
| *Epilobium parviflorum* | | | | | | 1 | | | 1 | | | | | | 1 | | | | | | | | | | | | | | | |
| *Equisetum fluviatile* | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | | | |
| *Festuca rubra* | 9 | | | | | | | 2 | | | | | | | | | | | 8 | | | 3 | | | | | | | | |
| *Filipendula ulmaria* | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | 1 | 2 |
| *Fraxinus excelsior* | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | 7 |
| *Galium aparine* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| *Galium cf saxatile* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | |
| *Geranium dissectum* | | | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | |
| *Geranium molle* | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Glyceria fluitans* | | | | | | | | | | | | 10 | | | | | | | | | | | 4 | | | | 9 | | | |
| *Glyceria maxima* | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | |
| *Heracleum sphondylium* | | 1 | | | | | | | | | | | | | | | | | 1 | | | | | | | 1 | | | | |
| *Holcus lanatus* | 2 | | 5 | 10 | 8 | | 4 | 8 | | | | | 2 | 4 | | 5 | | 7 | 4 | | 5 | 5 | 3 | 4 | | 4 | 2 | 2 | 1 | 5 |
| *Hordeum secalinum* | | | 4 | 3 | 4 | | | 7 | | | | | 4 | 4 | | | 7 | | | | | 4 | | | 2 | 2 | 2 | | | |
| *Iris pseudacorus* | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | | | |
| *Juncus effusus* | | | | | | | | | | | | 2 | | | | | | | | 2 | | | 4 | 7 | | 7 | 1 | 4 | 1 | |
| *Juncus inflexus* | | | | | | | | | | | | | | | | | | | | | | | 4 | | | | | | | |
| *Kickxia elatine* | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Lathyurus pratensis* | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | | | |
| Leaf litter | 2 | 2 | 2 | 2 | 4 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 3 | 3 | 2 | 2 | 2 | 2 | 4 | 5 | 6 | 2 | 1 | 3 | 4 | 2 | 2 | 1 | 1 | |
| *Leontodon autumnalis* | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Lolium perenne* | 2 | | 3 | 2 | | 3 | | 3 | | 2 | 8 | | 4 | | 3 | | | 6 | | | | 6 | 4 | | | | 3 | | 2 | |

| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15 | Q16 | Q17 | Q18 | Q19 | Q20 | Q21 | Q22 | Q23 | S1 | S2 | S3 | S4 | S5 | S6 | S7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **NVC (sub-) community** | MG7/MG1a? | MG1b | MG9 | HI-dom | HI-mixed | Arable reversion | Agt-dom | HI-mixed | Arable reversion | Agt-dom | Agt-Lp | S22 (a/c?) | Agt-dom | Agt-dom | Arable reversion | Agt-Other | Agt-Other | HI-mixed | MG1a | MG1 | MG9 (b) | MG7d | Agt-mixed | MG9a (?) | S6 | Wet tall herbs | S22 | S28b | Wet tall herbs | W10 (a?) |
| **Notes** | Seeded (?) | | | NVC? | NVC? | Seeded | MG13? | NVC? | Seeded | MG13 | MG7/13 | | MG13?? | MG13 | Seeded | NVC? | NVC? | NVC? | | Wet flush! | Ae nearby | | MG13? | | | NVC? | | | NVC? | Wood fringe |
| *Lotus uliginosus* | | | | | | | | | 1 | | | | | | 2 | | | | | | | | | | | | | | | |
| *Lycopus europaeus* | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 2 | 7 | 3 |
| *Lythrum salicaria* | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | 1 | | |
| *Matricaria perforata* | | | | | | 1 | | | 2 | | | | | | 2 | | | | | | | | | | | | | | | |
| *Mentha aquatica* | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 3 | | 2 | 3 | 3 |
| *Myosotis scorpiodes* | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | 1 | | |
| *Myosoton aquaticum* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | |
| *Oenanthe crocata* | | | | | | | | | | | | | | | | | | | | | | | | | 2 | 3 | | | 2 | |
| *Phalaris arundinacea* | | | | | | | | | | | | | | | | | | | | 4 | | | | | | | | 8 | | |
| *Phleum pratense* | | | | | | 6 | | | 7 | | | | 1 | | 4 | | | | | | | 4 | | | | | 2 | | | |
| *Pimpernella saxifraga* | | | | | | | | | | | | | | | | | | | 2 | | | | | | 3 | 2 | | | | |
| *Plantago major* | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | |
| *Poa annua* | | | | | | 4 | | | 2 | | | | | | 1 | | | | | | | | | | | | | | | |
| *Poa trivialis* | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | |
| *Polygonum aviculare* | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | |
| *Polygonum hydropiper* | | | | | | | | | | | | 2 | | | | | | | | | | | | | | 1 | | 2 | 4 | |
| *Polygonum lapathifolium* | | | | | | | | | | 3 | | | | | | | | | | | | | | | | | | | | |
| *Prunus spinosa* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 |
| *Quercus rober* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 8 |
| *Ranunculus repens* | 1 | | | | | | | | | 3 | | 3 | | 3 | | 1 | | 5 | 1 | | | 2 | 1 | | | | 4 | | 2 | 1 |
| *Rumex acetosa* | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | |
| *Rumex conglomeratus* | | 1 | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | |
| *Rumex obtusifolius* | | 1 | | | | | | | | | | | | | | | | | | 2 | | | | | 1 | 1 | 2 | 2 | 1 | 2 |
| *Salix cinerea* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 5 |
| *Senecio jacobaea* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | |
| *Senecio vulgaris* | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | |
| *Solanum dulcamara* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | |
| *Stachys sylvatica* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | |
| *Stellaria sp.?, Caryophyllaceae* | | | | | | | | | | | | | | | | | | | 3 | | | | | | | | | | | |
| *Stellaria graminea* | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Taraxacum officinale* | 1 | | | | | | | | | | | | | | | | | | | | | 2 | | | | | 1 | | | |
| *Trifolium pratense* | | | | | | 2 | | | 3 | | | | | | 2 | | | | | | | | | | | | | | | |
| *Trifolium repens* | | | | | | | | 1 | 6 | | | | 2 | | | 2 | | 4 | | | | | 3 | | | | 3 | | | |
| *Urtica dioica* | | 3 | | | | | | | | | | | | | | | | | | 3 | | | | | 2 | 8 | 4 | 3 | 8 | 8 |
| *Veronica arvensis* | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Veronica beccabunga* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | |

# Appendix 4 Moth survey data

### Table 1. Moths recorded from Site A - Reseeded grassland

| **Site A**<br>**Moths -** Species and families in taxonomic order | **Status** | **14 July** | **2 August** | **10 August** | **Hostplant** | **Habitat** |
|---|---|---|---|---|---|---|
| ZYGAENIDAE | | | | | | |
| Six-spot burnet | C | | 2 | | *Lotus corniculatus* | Grassland, downland |
| Narrow-bordered five-spot burnet | C | | 2 | | *Lathyrus pratensis*, *Lotus* spp., *Trifolium* spp. | Grassland, downland, fen, marsh, woods |
| OECOPHORIDAE | | | | | | |
| *Batia unitella* | L | 1 | | | Dead wood, fungi | General occurrence |
| GELECHIIDAE | | | | | | |
| ***Dichomeris alacella*** | **Nb** | 1 | | | Lichens on trees | Woods |
| *Helcystogramma rufescens* | L | 1 | | | Poaceae esp. *Poa* spp. | General occurrence |
| TORTRICIDAE | | | | | | |
| *Agapeta hamana* | C | 1 | | | *Carduus* spp. | General occurrence |
| Variegated golden tortrix | C | 2 | | | Polyphagous | Woods, gardens, parks |
| ***Cnephasia pasiuana*** | L | 1 | | | Compositae, *Ranunculus* | Pasture, arable, fen |
| *Celypha lacunana* | C | | | 7 | Polyphagous | General occurrence |
| *Bactra lancealana* | C | 1 | | | *Juncus* spp., *Scripus* ssp. | Grassland, fen, marsh |
| Plum fruit moth | C | 1 | | | *Prunus* spp. | Hedgerows, orchards, scrub |
| *Dichrorampha acuminatana* | C | | 1 | | *Leucanthemum vulgare*, *Tanacetum vulgare* | Dry pasture, downland |
| PYRALIDAE | | | | | | |
| ***Calamotropha paludella*** | **Nb** | 1 | | | *Typha* spp. | Fen, marsh, vegetation in water |
| *Chrysoteuchia culmella* | C | C30 | 14 | | Poaceae | General occurrence in grassy places |
| *Crambus perlella* | C | | 1 | 3 | Poaceae | General occurrence in grassy places |
| *Agriphila selasella* | L | | 3 | 5 | Poaceae | Fen, marsh, hedgerow |
| *Agriphila straminella* | C | C20 | 48 | 11 | Poaceae | General occurrence in grassy places |
| *Agriphila tristella* | C | | 4 | 8 | Poaceae | General occurrence in grassy places |
| *Agriphila inquinatella* | C | | | 1 | Poaceae | Heaths, dry pasture, beaches |
| *Catoptria pinella* | L | 1 | | | Poaceae, *Carex* spp. | Heath, fen, marsh |
| *Catoptria falsella* | L | 1 | | | Mosses | Gardens, parks, orchards |
| Water veneer | C | 1 | | 1 | Polyphagous on aquatic plants | Vegetation in water |
| *Scoparia basistrigalis* | C | 1 | | | Presumed to be mosses | Woods, fen, marsh |
| *Eudonia angustea* | C | 1 | | | Mosses | General occurrence |
| Mother of pearl | C | 8 | | | *Urtica dioica* | General occurrence |
| *Endotricha flammealis* | C | 1 | | | Polyphagous | General occurrence |
| *Phycita roborella* | C | 2 | | | *Quercus* spp. | Woods, gardens |
| DREPANIDAE | | | | | | |
| Oak hook-tip | C | 2 | | | *Quercus* spp, *Betula pendula* | Woods, gardens, parks |
| Buff arches | C | 3 | | | *Rubus fruticosus* | Woods, parks |

| **Site A**<br>**Moths -** Species and families in taxonomic order | **Status** | **14 July** | **2 August** | **10 August** | **Hostplant** | **Habitat** |
|---|---|---|---|---|---|---|
| GEOMETRIDAE | | | | | | |
| Single-dotted wave | C | 1 | | | *Anthriscus*, *Pimpinella* | Woods, damp pasture, riverbank |
| Phoenix | C | 1 | | | *Ribes* spp. | Damp pasture, gardens, woods |
| July highflyer | C | 3 | | | *Salix* spp., *Corylus*, *Vaccinium* | Woods, grasslands, fen, marsh |
| Canary-shouldered thorn | C | | | 1 | Polyphagous esp. *Betula* spp. | General occurrence |
| Peppered moth | C | 1 | | | Polyphagous | General occurrence |
| SPHINGIDAE | | | | | | |
| Pine hawk-moth | L | 1 | | | *Pinus sylvestris* | Woods |
| NOTODONTIDAE | | | | | | |
| Pale prominent | C | 1 | | | *Populus* and *Salix* spp. | General occurrence |
| Buff-tip | C | 10 | | | Polyphagous | Gardens, parks, scrub, woods |
| LYMANTRIIDAE | | | | | | |
| Yellow-tail | C | 8 | | | Polyphagous | General occurrence |
| Black arches | L | 1 | | | *Quercus* spp. decid. trees | Woods |
| ARCTIIDAE | | | | | | |
| Round-winged muslin | L | 1 | | | Lichens , mosses | Fen, marsh, damp pasture |
| Rosy footman | L | 2 | | | Lichens | Woods |
| Dingy footman | C | 1 | | | Lichens | Woods, fen, marsh |
| Common footman | C | 5 | | | Lichens | General occurrence |
| NOCTUIDAE | | | | | | |
| Heart & dart | C | 4 | | | Herbaceous & cultivated plants | General occurrence |
| Flame shoulder | C | 2 | | 1 | Polyphagous | General occurrence |
| Large yellow underwing | CI | 36 | | | Polyphagous | General occurrence |
| Lesser yellow underwing | C | 1 | | | Polyphagous | General occurrence |
| Lesser broad-bordered yellow Underwing | C | | | 2 | Polyphagous | General occurrence |
| Double square-spot | C | 2 | | | Polyphagous. | Woods, lush riverbanks |
| Bright-line brown-eye | C | 1 | | | Polyphagous | Gardens, parks, orchards |
| Smoky wainscot | C | 1 | | | Poaceae | Grassland |
| Common wainscot | C | | | 1 | Poaceae | Grassland |
| Coronet | L | 4 | | | *Fraxinus*, *Alnus* , *Ligustrum* | Woods, downland, fen, marsh |
| Copper underwing | C | 1 | | | Polyphagous esp. *Quercus* | Woods, parks, gardens |
| Dun-bar | C | 2 | | | Polyphagous | General occurrence, woods |
| Dark arches | C | 13 | | | Poaceae | General occurrence |
| Common rustic spp. | C | 6 | | | Poaceae | General occurrence |
| Dusky sallow | C | 4 | | | Poaceae | Dry pasture, grassland, downland |
| Uncertain | C | 11 | 1 | | Herbaceous plants | General occurrence |
| Rustic | C | 13 | | | Herbaceous plants | General occurrence |
| Nut-tree tussock | C | 1 | | | Polyphagous on trees esp. *Corylus* | Woods |
| Silver Y | CI | | 2 | | Polyphagous | General occurrence |
| Straw dot | CI | | | 11 | Poaceae | Fen, marsh, grassland, woods |

## Table 2. Lepidoptera recorded from Site A - Daytime survey 2 August 2005

| **Moths** in taxonomic order | **Transect Line Walks** | | | | | | | | **Hostplant** | **Habitat** |
|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **A** | | |
| Six-spot burnet | | 1 | | | | | | 1* | *Lotus corniculatus* | Grassland, downland |
| Narrow-bordered five-spot Burnet | | | | | | 1 | | 1* | *Lathyrus pratensis*, *Lotus* spp., *Trifolium* spp. | Grassland, downland, fen, marsh, woods |
| *Dichrorampha acuminatana* | 1 | | | | | | | | *Leucanthemum vulgare*, *Tanacetum vulgare* | Dry pasture, downland |
| *Chrysoteuchia culmella* | 3 | 1 | | 4 | 1 | 4 | 1 | | Poaceae | General occurrence in grassy places |
| *Crambus perlella* | | | | | | | | 1 | Poaceae | General occurrence in grassy places |
| *Agriphila selasella* | | | | 3 | | | | | Poaceae | Fen, marsh, hedgerow |
| *Agriphila straminella* | 17 | 15 | | 5 | | 9 | 2 | | Poaceae | General occurrence in grassy places |
| *Agriphila tristella* | 1 | | | 2 | 1 | | | | Poaceae | General occurrence in grassy places |
| Uncertain | | | 1 | | | | | | Herbaceous plants | General occurrence |
| Silver Y | | | | | | 2 | | | Polyphagous | General occurrence |
| **Butterflies** | | | | | | | | | | |
| Small skipper | 2 | 1 | 1 | 1 | | 1 | 1 | | Poaceae esp. *Holcus lanatus*, *Phleum pratense* | Tall grassland |
| Small white | | | | | | 2 | | | Brassicaceae | Arable, grassland, gardens, wasteland |
| Small copper | | | 1 | | | | | | *Rumex* ssp. esp *R. acetosa*, *R. acetosella* | Acid and neutral grassland, wasteland |
| Common blue | | 3 | | | | 1 | | | *Lotus corniculatus* + other Fabaceae | Grassland, wasteland |
| Meadow brown | 4 | 4 | 3 | 1 | 3 | 10 | 1 | | Poaceae esp. *Poa* spp. | Grassland |

***** Five cocoons of zygaenid moths were also found in the vicinity of A.

## Table 3. Moths recorded from Site B - River Adur Floodplain

| **SITE B**<br>**Moths -** Species and Families in taxonomic order | **Status** | **14 July** | **10 August** | | **Hostplant** | **Habitat** |
|---|---|---|---|---|---|---|
| | | | **A Trap** | **B Trap** | | |
| TISCHERIIDAE | | | | | | |
| *Tischeria ekebladella* | C | 1 | | | *Quercus* spp., *Castanea* | Woods |
| ZYGAENIDAE | | | | | | |
| Leopard moth | C | 3 | | | Deciduous trees & shrubs | Woods, orchards, gardens |
| YPONOMEUTIDAE | | | | | | |
| *Argyresthia goedartella* | C | 2 | | | *Betula* spp., *Alnus glutinosa* | General occurrence |
| Apple Ermine | C | 1 | | | *Malus* | Gardens, orchards, parks, woods |
| COLEOPHORIDAE | | | | | | |
| Clover case-bearer | L | | 1 | | *Trifolium repens* | Dry pasture, downland, wasteland |
| *Coleophora saxicolella* | C | | 1 | | *Atriplex*, *Chenopodium* | Dry pasture, arable |
| ELACHISTIDAE | | | | | | |
| *Elachista maculicerusella* | C | 1 | | | *Phalaris, Phragmites*, other Poaceae | Fen, marsh, riverbank |
| OECOPHORIDAE | | | | | | |
| *Batia unitella* | L | 1 | | | Dead wood, fungi | General occurrence |
| Brown house-moth | C | | 1 | 1 | Dry plant or animal matter | General occurrence |
| *Carcina quercana* | C | | | 1 | Polyphagous | General occurrence |
| GELECHIIDAE | | | | | | |
| *Helcystogramma rufescens* | C | 1 | | | Poaceae | General occurrence |
| COSMOPTERIGIDAE | | | | | | |
| *Limnaecia phragmitella* | L | 1 | | | *Typha* spp. | Fen, marsh |
| TORTRICIDAE | | | | | | |
| ***Gynnidomorpha* sp.** [**alismana**/vectisana?] | **Nb** | | | 1 | *Alisma plantago-aquatica* | Vegetation in water |
| *Agapeta hamana* | C | 4 | 1 | | *Carduus* spp. | General occurrence |
| *Aethes smeathmanniana* | L | | 13 | | *Achillea*, *Centaurea*, *Anthemis* | General occurrence |
| Barred fruit-tree tortrix | C | 1 | | | Polyphagous | Woods, gardens, orchards |
| Dark fruit-tree tortrix | C | | | 1 | Polyphagous | General occurrence |
| Red-barred tortrix | C | | | 1 | Polyphagous | General occurrence |
| Grey tortrix | C | 1 | | | Polyphagous | General occurrence |
| *Aleimma loeflingiana* | C | 1 | | | *Quercus*, *Carpinus*, *Acer* | woods |
| *Acleris forsskaleana* | C | 3 | 1 | | *Acer campestre*, *Acer* spp. | Woods, gardens, orchards |
| *Celypha striana* | C | 2 | | | *Taraxacum* | Dry pasture, downland |
| *Celypha rosaceana* | L | 1 | | | *Sonchus*, *Taraxacum* | Dry pasture |
| *Celypha lacunana* | C | 1 | 2 | 4 | Polyphagous | General occurrence |
| Marbled orchard tortrix | C | 1 | | | Polyphagous on trees | General occurrence |
| Bramble shoot moth | C | 2 | | | *Rubus* spp. | General occurrence |
| *Eucosma campoliliana* | C | | | 1 | *Senecio jacobaea* | Dry pasture, downland, wasteland |

| **SITE B**<br>**Moths -** Species and Families in taxonomic order | **Status** | **14 July** | **10 August** | | **Hostplant** | **Habitat** |
|---|---|---|---|---|---|---|
| | | | **A Trap** | **B Trap** | | |
| *Eucosma hohenwartiana* | C | 1 | | 1 | *Centaurea* spp., *Serratula* | Dry pasture, downland |
| Bud moth | C | | | 1 | Polyphagous | General occurrence |
| *Pammene fasciana* | L | | 1 | | *Quercus* spp., *Castanea* | Gardens, orchards, woods |
| PYRALIDAE | | | | | | |
| *Chrysoteuchia culmella* | C | 45 | 5 | 2 | Poaceae | General occurrence |
| *Crambus perlella* | C | 12 | 4 | | Poaceae | General occurrence |
| *Agriphila selasella* | L | | 49 | 11 | Poaceae | Fen, marsh, hedgerow |
| *Agriphila straminella* | C | 39 | 31 | 17 | Poaceae | General occurrence |
| *Agriphila tristella* | C | | 1 | 1 | Poaceae | General occurrence |
| Water veneer | C | 1 | 2 | | Polyphagous on aquatic plants | Vegetation in water |
| *Dipleurina lacustrata* | C | 1 | | | Mosses | General occurrence |
| *Eudonia mercurella* | C | | 3 | 5 | Mosses | General occurrence |
| Brown china-mark | C | 1 | 1 | | *Potamogeton, Hydrocharis, Sparaganium* spp. | Vegetation in water |
| Small china-mark | C | | 2 | 1 | *Lemna* spp. under water | Vegetation in water |
| Small magpie | C | 1 | | | *Urtica*, *Marrabium*, *Stachys*, *Mentha, Ballota* | General occurrence |
| *Phlyctaenia coronata* | C | 1 | | | *Sambucus nigra, Viburnum, Syringa, Ligustrum* | General occurrence |
| Mother of pearl | C | 5 | 11 | 8 | *Urtica dioica* | General occurrence |
| *Endotricha flammealis* | C | 2 | | | Polyphagous | Woods, wasteland |
| *Phycita roborella* | C | 5 | | 1 | *Quercus* spp., *Pyrus*, *Malus* | Woods, gardens, orchards |
| *Euzophera pinguis* | L | | 1 | | Pollarded trees esp. *Fraxinus* | Woods, gardens, orchards |
| PTEROPHORIDAE | | | | | | |
| White plume moth | C | 1 | | | *Convolvulus*, *Calystegia* spp. | Dry pasture, parks, wasteland |
| LASIOCAMPIDAE | | | | | | |
| Drinker | C | 8 | | | Poaceae, Cyperaceae | Woods, grassland, fen, marsh, bog |
| DREPANIDAE | | | | | | |
| Scalloped hook-tip | C | 1 | | | *Betula* spp. | Woods, heath |
| Pebble hook-tip | C | | 1 | | *Betula* spp., *Alnus glutinosa* | Woods, heath |
| GEOMETRIDAE | | | | | | |
| Large emerald | C | 1 | | | *Betula* spp., *Alnus glutinosa* | Woods, heath |
| Common emerald | C | | | | Polyphagous on decid. trees | Woods, gardens, parks, scrub |
| Blood-vein | C | 4 | | 1 | Polygonaceae | General occurrence |
| Single-dotted wave | C | 3 | | | *Anthriscus, Pimpinella* | Woods, damp pasture, river banks, ditches |
| Small scallop | L | 2 | | | *Galium* | Woods, damp pasture, fen, marsh |
| Riband wave | C | | 1 | | Polyphagous | General occurrence |

| **SITE B**<br>**Moths -** Species and Families in taxonomic order | **Status** | **14 July** | **10 August** | | **Hostplant** | **Habitat** |
|---|---|---|---|---|---|---|
| | | | **A Trap** | **B Trap** | | |
| Common carpet | C | | 5 | 1 | *Galium* | General occurrence |
| July highflyer | C | 1 | | | *Salix* spp., *Corylus*, *Calluna, Vaccinium* | Woods, grassland, fen, marsh |
| Slender pug | C | 1 | | | *Salix* spp. | Woods, fen, marsh, ditches |
| Maple pug | L | 1 | | | *Acer campestre* | Woods, hedgerow, downland, parks, gardens |
| Lime-speck pug | C | | 1 | | Polyphagous | General occurrence |
| Green pug | C | 1 | | | *Malus*, *Pyrus*, *Prunus* spp. | Woods, gardens, orchards, scrub |
| Clouded border | C | 3 | | | *Salix* spp., *Populus* spp. | Woods, dry pasture, fen, marsh |
| Latticed heath | CI | 1 | | | *Medicago sativa*, *Trifolium* | Woods, heath, dry pasture etc |
| Brimstone moth | C | 7 | 5 | 3 | Polyphagous | General occurrence |
| Canary-shouldered thorn | C | | | 1 | Polyphagous esp. *Betula* spp. | General occurrence |
| Dusky thorn | C | | 6 | 2 | *Fraxinus* | Woods, gardens, orchards |
| Early thorn | C | 1 | | | Polyphagous | General occurrence |
| Scalloped oak | C | 4 | | 1 | Polyphagous | General occurrence |
| Peppered moth | C | 1 | | | Polyphagous | General occurrence |
| Willow beauty | C | 3 | | 1 | Polyphagous | General occurrence |
| Engrailed | C | 4 | | | Polyphagous | Woods, orchards, scrub |
| SPHINGIDAE | | | | | | |
| Poplar hawk-moth | C | 4 | | | *Populus* spp., *Salix* spp. | General occurrence |
| Elephant hawk-moth | C | 1 | | | *Epilobium* spp., *Galium*, *Fuchsia*, *Menyanthes* | General occurrence |
| NOTODONTIDAE | | | | | | |
| Sallow kitten | C | | | 1 | *Salix*, *Populus tremula* | General occurrence |
| Pebble prominent | C | 3 | 2 | | *Salix* spp., *Populus* spp. | General occurrence |
| Swallow prominent | C | | 3 | 1 | *Populus* spp., *Salix* spp. | General occurrence |
| Coxcomb prominent | C | 1 | | | Polyphagous on decid. trees | General occurrence |
| Pale prominent | C | | | 1 | *Populus* spp., *Salix* spp. | General occurrence |
| Buff-tip | C | 9 | | | Polyphagous | Gardens, parks, woods |
| LYMANTRIIDAE | | | | | | |
| Yellow-tail | C | 17 | | 1 | Polyphagous on decid. trees | General occurrence |
| Black arches | L | 1 | | | *Quercus* spp., decid. trees | Woods |
| ARCTIIDAE | | | | | | |
| Round-winged muslin | L | 2 | | | Lichens, mosses | Fen, marsh, damp pasture |
| Rosy footman | L | 2 | | | Lichens | Woods |
| Dingy footman | C | 5 | | 1 | Lichens | Woods, fen, marsh |

| **SITE B**<br>**Moths -** Species and Families in taxonomic order | **Status** | **14 July** | **10 August** | | **Hostplant** | **Habitat** |
|---|---|---|---|---|---|---|
| | | | **A Trap** | **B Trap** | | |
| Scarce footman | L | 1 | 1 | | Lichens | Woods, heath, downland |
| Buff footman | L | 1 | 1 | | Lichens and algae on trees | Woods, downland, scrub |
| Common footman | C | 7 | | | Lichens on trees etc. | General occurrence |
| Ruby tiger | C | 1 | 12 | 3 | Polyphagous | General occurrence |
| Cinnabar | C | 1 | | | *Senecio* spp. | Dry pasture, downland |
| NOCTUIDAE | | | | | | |
| Heart & dart | C | 3 | | | Herbaceous and cultivated plants | General occurrence |
| Shuttle-shaped dart | C | | 2 | | Polyphagous | General occurrence |
| Flame | C | 1 | | | Polyphagous | General occurrence |
| Flame shoulder | C | 2 | 16 | 6 | Polyphagous | General occurrence |
| Large yellow underwing | C | 29 | 16 | 9 | Polyphagous | General occurrence |
| Lesser yellow underwing | C | 3 | 1 | 1 | Polyphagous | General occurrence |
| Broad-bordered yellow underwing | C | 2 | | | Polyphagous | General occurrence |
| Lesser broad-bordered yellow underwing | C | | 4 | 1 | Polyphagous | General occurrence |
| Small square-spot | C | | | 1 | Polyphagous | General occurrence |
| Setaceous Hebrew character | CI | 1 | 8 | 4 | Polyphagous, esp. *Urtica* | General occurrence |
| Double square-spot | C | 1 | | | Polyphagous | Woods, lush riverbanks |
| Six-striped rustic | C | | 17 | 18 | Polyphagous | Woods, damp pasture, fen, marsh |
| Square-spot rustic | C | | 1 | | Polyphagous | General occurrence |
| Gothic | L | 1 | | | Polyphagous | Riverbanks, ditches, marsh |
| Bright-line brown-eye | C | 3 | | | Polyphagous | Gardens, parks, orchards |
| Clay | C | 1 | | | Poaceae | General occurrence |
| White-point | CI | | 5 | 1 | Poaceae | Maritime, grassland |
| Southern wainscot | L | 1 | | | *Phragmites*, *Phalaris* | Fen, marsh, riverbanks |
| Smoky wainscot | C | 17 | | | Poaceae | Grasslands |
| Common wainscot | C | 2 | 33 | 35 | Poaceae | Grasslands |
| Shoulder-striped wainscot | C | 1 | | | Poaceae | General occurrence |
| Minor shoulder-knot | C | 2 | | | *Salix* spp. | Woods, scrub, fen, marsh |
| Poplar grey | C | 2 | | | *Populus* spp., *Salix* spp. | Woods, gardens, scrub |
| Knot grass | C | 1 | | 1 | Polyphagous | General occurrence |
| Coronet | L | 1 | | | *Fraxinus*, *Alnus*, *Ligustrum* | Woods, downland, fen, marsh |
| Copper underwing | C | 1 | 2 | | Polyphagous esp. *Quercus* | Woods, parks, gardens |
| Double kidney | L | 2 | | | *Salix* spp. esp. *S.cinerea* | Woods, fen, marsh, riverbanks |
| Olive | L | 2 | | | *Populus* spp. | Woods, scrub, fen, marsh, garden |
| Dun-bar | C | 7 | | | Polyphagous | General occurrence, woods |
| Lunar-spotted pinion | L | 1 | | | *Ulmus* spp. and others | Woods, gardens, hedgerow |

| **SITE B**<br>**Moths -** Species and Families in taxonomic order | **Status** | **14 July** | **10 August** | | **Hostplant** | **Habitat** |
|---|---|---|---|---|---|---|
| | | | **A Trap** | **B Trap** | | |
| Dark arches | C | 37 | | 2 | Poaceae | General occurrence |
| Light arches | C | 3 | | | Poaceae | Dry pasture |
| Double lobed | C | 8 | 1 | | *Phalaris arundinacea, Glyceria maxima* | Fen, marsh, river banks, woods, gardens |
| Marbled minor | C | 1 | | | Poaceae | General occurrence |
| Rosy minor | C | 1 | | | Poaceae | Dry pasture, scrub, fen, marsh |
| Common rustic spp. | C | 13 | 18 | 15 | Poaceae | General occurrence |
| Small dotted buff | C | 4 | | | *Deschampsia cespitosa* | Damp pasture, fen, marsh, woods |
| Dusky sallow | C | 2 | | | Poaceae | Grassland, downland |
| Rosy rustic | C | | 6 | 1 | Polyphagous | General occurrence |
| Uncertain | C | 39 | | | Herbaceous plants | General occurrence |
| Rustic | C | 18 | 1 | 1 | Herbaceous plants | General occurrence |
| Vine's rustic | CI | | 2 | 2 | Polyphagous | Gardens, wasteland, heath |
| Marbled white spot | C | 1 | | | *Molinia caerulea* and others | Acid grassland, heath, woods |
| Burnished brass | C | 4 | | | *Urtica* spp. and others | Acid grassland, fen, marsh |
| Gold spot | C | | 1 | | Polyphagous on marshland plants | Fen, marsh, river bank, acid grassland, woods |
| Spectacle | C | 1 | | | *Urtica dioica* | Garden, grassland, fen, marsh |
| Straw dot | CI | 1 | 22 | 15 | Poaceae | Fen, marsh, grassland, woods |
| Snout | C | 1 | | | *Urtica dioica* | General occurrence |
| Fan-foot | C | 1 | | | Withered leaves | Hedgerows, gardens, scrub |

## Table 4. Moths recorded from Kneppmill Pond

| **Moths** - Species and Families in taxonomic order | **Status** | **23 August** | | **9 September** | **Hostplant** | **Habitat** |
|---|---|---|---|---|---|---|
| | | **A Trap** | **B Trap** | | | |
| TORTRICIDAE | | | | | | |
| Chequered fruit-tree tortrix | C | | 1 | | Polyphagous | Hedgerows, gardens, orchards |
| *Celypha lacunana* | C | | 2 | | Polyphagous | General occurrence |
| *Pammene fasciana* | L | | | 1 | *Quercus* spp., *Castanea* | Gardens, orchards, woods |
| Garden rose tortrix | C | | | 1 | Polyphagous on Rosaceae | General occurrence |
| PYRALIDAE | | | | | | |
| *Chrysoteuchia culmella* | C | 1 | | | Poaceae | General occurrence |
| *Agriphila selasella* | L | | 1 | | Poaceae | Fen, marsh, hedgerow |
| *Agriphila tristella* | C | 2 | | | Poaceae | General occurrence |
| *Eudonia pallida* | L | | | 2 | Mosses, lichens | Marsh, fen, bog |
| *Eudonia mercurella* | | 1 | | | Mosses | General occurrence |
| Brown China-mark | C | 2 | | | *Potamogeton, Hydrocharis, Sparaganium* spp. | Vegetation in water |
| Mother of pearl | C | | 3 | 2 | *Urtica dioica* | General occurrence |
| *Cryptoblabes bistriga* | L | | | 1 | *Quercus* + other decid. trees | Woods |
| *Trachycera advenella* | L | 1 | 1 | | *Crataegus* spp., *Sorbus* | Hedgerows |
| *Phycita roborella* | C | 2 | | | *Quercus* spp., *Pyrus*, *Malus* | Woods, gardens, orchards |
| DREPANIDAE | | | | | | |
| Oak Hook-tip | C | | | 2 | *Quercus* spp, *Betula pendula* | Woods, gardens, parks |
| GEOMETRIDAE | | | | | | |
| Brimstone moth | C | | 2 | | Polyphagous | General occurrence |
| Dusky thorn | C | | 1 | 1 | *Fraxinus* | Woods, gardens, orchards |
| Willow beauty | C | 1 | | | Polyphagous | General occurrence |
| Common white wave | C | | | 1 | Polyphagous on trees, *Betula* | Woods, heath, scrub |
| Light emerald | C | | 1 | 1 | Polyphagous on decid. trees | Woods, gardens |
| ARCTIIDAE | | | | | | |
| Dingy footman | C | | 1 | | Lichens | Woods, fen, marsh |
| **Hoary Footman** | **NbI** | | | 1 | Lichens, Fabaceae | Mainly maritime |
| NOCTUIDAE | | | | | | |
| Flame shoulder | C | 3 | 2 | | Polyphagous | General occurrence |
| Large yellow underwing | CI | 2 | 3 | 12 | Polyphagous | General occurrence |
| Broad-bordered yellow underwing | C | 1 | | | Polyphagous | General occurrence |
| Lesser broad-bordered yellow underwing | C | 2 | 1 | | Polyphagous | General occurrence |
| Small square-spot | C | | | 2 | Polyphagous | General occurrence |
| Setaceous Hebrew character | CI | 2 | 4 | 6 | Polyphagous esp. *Urtica* | General occurrence |

| **Moths** - Species and Families in taxonomic order | **Status** | **23 August** | | **9 September** | **Hostplant** | **Habitat** |
|---|---|---|---|---|---|---|
| | | **A Trap** | **B Trap** | | | |
| Six-striped rustic | C | 11 | 6 | | Polyphagous | Woods, damp pasture, fen, marsh |
| Square-spot rustic | C | 4 | 12 | 40+ | Polyphagous | General occurrence |
| White-point | CI | 2 | 5 | 3 | Poaceae | Maritime, grassland |
| Common wainscot | C | 5 | 9 | 5 | Poaceae | Grasslands |
| Coronet | L | | 1 | | *Fraxinus*, *Alnus*, *Ligustrum* | Woods, downland, fen, marsh |
| Common rustic spp. | C | | 3 | | Poaceae | General occurrence |
| **Webb's wainscot** | **Nb** | 1 | | | *Typha* spp., *Iris pseudocorus*, *Sparangium erectum* | Ponds, ditches, fen, vegetation in water |
| **Rush wainscot** | **R D B 3** | | 1 | | *Typha* spp., *Schoenoplectus lacustris*, *Iris pseudocorus* | Ponds, fens, vegetation in water |
| Uncertain | C | 1 | | | Herbaceous plants | General occurrence |
| Vine's rustic | CI | 1 | 1 | | Polyphagous | Gardens, wasteland, heath |
| Burnished brass | C | | | 1 | *Urtica* spp. and others | Acid grassland, fen, marsh |
| Spectacle | C | | 1 | | *Urtica dioica* | General occurrence |
| Straw dot | CI | 2 | 4 | | Poaceae | Fen, marsh, grassland, woods |
| Snout | C | | 1 | | *Urtica dioica* | General occurrence |

**Table 5. Common and Scientific Names of Lepidoptera recorded in this survey**
listed alphabetically. NEN = no English name

| | |
|---|---|
| Spectacle | *Abrostola tripartia* |
| Water veneer | *Acentria ephemerella* |
| NEN | *Acleris forsskaleana* |
| Garden rose tortrix | *Acleris variegana* |
| Poplar grey | *Acronicta megacephala* |
| Knot grass | *Acronicta rumicis* |
| NEN | *Aethes smeathmanniana* |
| NEN | *Agapeta hamana* |
| NEN | *Agriphila inquinatella* |
| NEN | *Agriphila selasella* |
| NEN | *Agriphila straminella* |
| NEN | *Agriphila tristella* |
| Heart & dart | *Agrotis exclamationis* |
| Shuttle-shaped dart | *Agrotis puta* |
| NEN | *Aleimma loeflingiana* |
| Copper underwing | *Amphipyra pyramidea* |
| Light arches | *Apamea lithoxylaea* |
| Dark arches | *Apamea monoglypha* |
| Double lobed | *Apamea ophiogramma* |
| Rush wainscot | *Archanara algae* |
| Webb's wainscot | *Archanara sparganii* |
| Variegated golden tortrix | *Archips xylosteana* |
| NEN | *Argyresthia goedartella* |
| Silver Y | *Autographa gamma* |
| Flame | *Axylia putris* |
| NEN | *Bactra lancealana* |
| NEN | *Batia unitella* |
| Peppered moth | *Biston betularia* |
| Minor shoulder-knot | *Brachylomia viminalis* |
| Common white wave | *Cabera pusaria* |
| NEN | *Calamotropha paludella* |
| Light emerald | *Campaea margaritata* |
| NEN | *Carcina quercana* |
| Small china-mark | *Cataclysta lemnata* |
| NEN | *Catoptria falsella* |
| NEN | *Catoptria pinella* |
| NEN | *Celypha lacunana* |
| NEN | *Celypha rosaceana* |
| NEN | *Celypha striana* |
| Latticed heath | *Chiasmia clathrata* |
| NEN | *Chrysoteuchia culmella* |
| NEN | *Cnephasia pasiuana* |
| Grey tortrix | *Cnephasia stephensiana* |
| Clover case-bearer | *Coleophora frischella* |
| NEN | *Coleophora saxicolella* |
| Nut-tree tussock | *Colocasia coryli* |
| Lunar-spotted pinion | *Cosmia pyralina* |
| Dun-bar | *Cosmia trapezina* |
| NEN | *Crambus perlella* |
| Coronet | *Craniophora ligustri* |
| Scalloped oak | *Crocallis elinguaria* |
| NEN | *Cryptoblabes bistriga* |
| Elephant hawk-moth | *Deilephila elpenor* |
| Burnished brass | *Diarchrysia chrysitis* |
| Small square-spot | *Diarsia rubi* |
| NEN | *Dichomeris alacella* |
| NEN | *Dichrorampha acuminatana* |
| NEN | *Dipleurina lacustrata* |
| Red-barred tortrix | *Ditula angustiorana* |
| Pebble hook-tip | *Drepana falcataria* |
| Engrailed | *Ectropis bistortata* |
| Hoary footman | *Eilema caniola* |
| Scarce footman | *Eilema complana* |
| Buff footman | *Eilema depressa* |
| Dingy footman | *Eilema griseola* |
| Common footman | *Eilema lurideola* |
| NEN | *Elachista maculicerusella* |
| Brown china-mark | *Elophila nymphaeata* |
| NEN | *Endotricha flammealis* |
| Canary-shouldered thorn | *Ennomos alinaria* |
| Dusky thorn | *Ennomos fuscantaria* |
| Bramble shoot moth | *Epiblema uddmanniana* |
| Common carpet | *Epirrhoe alternata* |
| Dusky sallow | *Eremobia ochroleuca* |
| NEN | *Eucosma campoliliana* |
| NEN | *Eucosma hohenwartiana* |
| NEN | *Eudonia angustea* |
| NEN | *Eudonia mercurella* |
| NEN | *Eudonia pallida* |
| Phoenix | *Eulithis prunata* |
| Lime-speck pug | *Eupithecia centaureata* |
| Maple pug | *Eupithecia inturbata* |
| Slender pug | *Eupithecia tenuiata* |
| Yellow-tail | *Euproctis similis* |
| Small magpie | *Eurrhypara hortulata* |
| Drinker | *Euthrix potatoria* |
| NEN | *Euzophera pinguis* |
| Scalloped hook-tip | *Falcaria lacertinaria* |
| Sallow kitten | *Furcula furcula* |
| Large emerald | *Geometra papilionaria* |
| Plum fruit moth | *Grapholita funebrana* |
| NEN | *Gynnidomorpha alismana/vectisana*? |
| Buff arches | *Habrosyne pyritoides* |
| Marbled orchard tortrix | *Hedya nubiferana* |
| NEN | *Helcystogramma rufescens* |
| Common emerald | *Hemithea aestivaria* |
| Brown house-moth | *Hofmannophila pseudospretella* |
| Uncertain | *Hoplodrina alsines* |
| Vine's rustic | *Hoplodrina ambigua* |
| Rustic | *Hoplodrina blanda* |

| | |
|---|---|
| Rosy rustic | *Hydraecia micacea* |
| July highflyer | *Hydriomena furcata* |
| Pine hawk-moth | *Hyloicus pinastri* |
| Snout | *Hypena proboscidalis* |
| Riband wave | *Idaea aversata* |
| Single-dotted wave | *Idaea dimidiata* |
| Small scallop | *Idaea emarginata* |
| Double kidney | *Ipimorpha retusa* |
| Olive | *Ipimorpha subtusa* |
| Bright-line brown-eye | *Laconobia oleracea* |
| Poplar hawk-moth | *Laothoe populi* |
| NEN | *Limnaecia phragmitella* |
| Clouded border | *Lomaspilis marginata* |
| Small copper | *Lycaena phlaeas* |
| Black arches | *Lymantria monacha* |
| Meadow brown | *Maniola jurtina* |
| Common/lesser common rustic spp. | *Mesapamea* spp. |
| Rosy minor | *Mesoligia literosa* |
| Rosy footman | *Miltochrista miniata* |
| White-point | *Mythimna albipuncta* |
| Shoulder-striped wainscot | *Mythimna comma* |
| Clay | *Mythimna ferrago* |
| Smoky wainscot | *Mythimna impura* |
| Common wainscot | *Mythimna pallens* |
| Southern wainscot | *Mythimna straminea* |
| Gothic | *Naenia typica* |
| Lesser yellow underwing | *Noctua comes* |
| Broad-bordered yellow underwing | *Noctua fimbriata* |
| Lesser broad-bordered yellow underwing | *Noctua janthe* |
| Large yellow underwing | *Noctua pronuba* |
| Pebble prominent | *Notodonta ziczac* |
| Flame shoulder | *Ochropleura plecta* |
| Marbled minor | *Oligia strigilis* |
| Brimstone moth | *Opisthograptis luteolata* |
| nen | *Pammene fasciana* |
| Barred fruit-tree tortrix | *Pandemis cerasana* |
| Chequered fruit-tree tortrix | *Pandemis corylana* |
| Dark fruit-tree tortrix | *Pandemis heparana* |
| Green pug | *Pasiphila rectangulata* |
| Willow beauty | *Peribatodes rhomboidaria* |
| Buff-tip | *Phalera bucephala* |
| Swallow prominent | *Pheosia tremula* |
| nen | *Phlyctaenia coronata* |
| Small dotted buff | *Photedes minima* |
| Ruby tiger | *Phragmatobia fuliginosa* |
| NEN | *Phycita roborella* |
| Small white | *Pieris rapae* |
| Mother of pearl | *Pleuroptya ruralis* |
| Gold spot | *Plusia festucae* |
| Common blue | *Polyommatus icarus* |
| Marbled white spot | *Protodeltote pygarga* |
| White plume moth | *Pterophorus pentadactyla* |
| Pale prominent | *Pterostoma palpina* |
| Coxcomb prominent | *Ptilodon capucina* |
| Straw dot | *Rivula sericealis* |
| NEN | *Scoparia basistrigalis* |
| Early thorn | *Selenia dentaria* |
| Bud moth | *Spilonota ocellana* |
| Brown hairstreak | *Thecla betulae* |
| Round-winged muslin | *Thumatha senex* |
| Small skipper | *Thymelicus sylvestris* |
| Blood-vein | *Timandra comae* |
| NEN | *Tischeria ekebladella* |
| NEN | *Trachycera advenella* |
| Cinnabar | *Tyria jacobaeae* |
| Oak hook-tip | *Watsonalla binaria* |
| Setaceous Hebrew character | *Xestia c-nigrum* |
| Six-striped rustic | *Xestia sexstrigata* |
| Double square-spot | *Xestia triangulum* |
| Square-spot rustic | *Xestia xanthographa* |
| Apple ermine | *Yponomeuta malinellus* |
| Fan-foot | *Zanclognatha tarsipennalis* |
| Leopard moth | *Zeuzera pyrina* |
| Six-spot burnet | *Zygaena filipendulae* |
| Narrow-bordered five-spot burnet | *Zygaena lonicerae* |

# Appendix 5 Butterfly survey

## Table 1.

| BUTTERFLY SITE RECORDING FORM (adapted from Butterfly Conservation) - Knepp Estate, TQ51, West Sussex | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Surveyed by Rich Howorth, Sussex Wildlife Trust** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Recording Date:** | | | | **19/07/05** | | | | | | | | | | | | | | | | | | | | | | | | | | **20/07/05** | |
| **General weather conditions** | | | | **Max T - 20 deg C, Wind W-NW, 3-4 (med-strong), sunshine patchy** | | | | | | | | | | | | | | | | | | | | | | | | | | **Max T - 22 deg C, Wind W, 3-4 (med-strong), sunshine lots, some cloud** | |
| **Parcel no. (see map)** | | | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14A** | **14B** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | **26** | |
| **Habitat (Grassland, Woodland, Arable Fallow)** | | | | **G** | **W** | **W** | **G** | **G** | **W** | **G** (rank) | **W** | **G** | **W** | **W** | **G** | **G** | **G** | **G** | **W** | **G** | **G** | **G** (cut) | **G** | **G** | **G** | **G** | **AF** | **W** (& lane) | **G** | **G** (long) | |
| **Start time** | | | | 11.17 | 11.44 | 12.04 | 12.12 | | 13.45 | 14.24 | 14.46 | | | 15.52 | 16.15 | 16.40 | 17.05 | 10.38 | 11.00 | 11.41 | 12.49 | 13.25 | 14.41 | 15.07 | 15.14 | 15.34 | 16.20 | 16.33 | 16.43 | 16.59 | |
| **Finish time** | | | | 11.36 | 11.57 | 12.10 | 12.57 | | 14.01 | 14.44 | 15.30 | | | 16.03 | 16.34 | 17.02 | 17.14 | 10.51 | 11.35 | 11.54 | 13.20 | 13.44 | 15.04 | 15.12 | 15.27 | 16.20 | 16.24 | 16.40 | 16.54 | 17.03 | |
| **Length of visit (mins):** | | | | 19 | 13 | 6 | 45 | 25 | 16 | 20 | 44 | 18 | 10 | 9 | 19 | 22 | 9 | 13 | 35 | 13 | 31 | 19 | 23 | 5 | 13 | 46 | 4 | 7 | 11 | 4 | **499** |
| **Weather conditions (Poor/ Moderate/ Ideal):** | | | | P-M | M | M | M | M-I | M | M | M | M | M | M | M | M | M | P-M | M | P-M | M | P-M | M | M | M | M | M | M | M | M | |
| **SPECIES** | **BC rec.** | **Recorded Jul 05** | **Further records (RH)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | **Total indivs** |
| **Small Skipper** | Y | Y | | | | | 23 | | | 9 | | | | | | 1 | | | | | | | | 1 | | | | | 1 | **35** |
| **Essex Skipper** | Y | Y | | | | | | | | | | | | | | | | | | | | | | | | 3 | | | | **3** |
| **Large Skipper** | Y | Y | | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | **2** |
| **Brimstone** | Y | Y | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | **2** |
| **Large White** | Y | Y | | 1 | | | | | | 1 | 2 | | 1 | | | | | | | | | | | | 2 | 1 | | 1 | | **9** |
| **Small White** | Y | Y | | 2 | 1 | | | 1 | | | 5 | | | | | | | | 3 | | 2 | | | | | | | | 1 | **15** |
| **Green-veined White** | Y | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | **0** |
| **Orange-tip** | Y | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | **0** |
| **Green Hairstreak** | Y | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | **0** |
| **Brown Hairstreak** | Y | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | **0** |
| **Purple Hairstreak** | Y | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | **0** |
| **Small Copper** | Y | | Y | | | | | | | | | | | | | | | | | | | | | | | | | | | | **0** |
| **Brown Argus** | Y | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | **0** |
| **Common Blue** | Y | | Y | | | | | | | | | | | | | | | | | | | | | | | | | | | | **0** |
| **Holly Blue** | Y | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | **0** |
| **White Admiral** | Y | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | **0** |
| **Red Admiral** | Y | | Y | | | | | | | | | | | | | | | | | | | | | | | | | | | | **0** |
| **Painted Lady** | Y | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | **0** |
| **Small Tortoiseshell** | Y | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | **0** |
| **Peacock** | Y | Y | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | **1** |
| **Comma** | Y | Y | | | | | | | 1 | | | | | | | | | | | | | | 1 | | | | | | | | **2** |
| **Silver-washed Fritillary** | Y | Y | | | | | | | | | 6 | | | 3 | | | | | 4 | | | | | | | | | | | | **13** |
| **Speckled Wood** | Y | Y | | | | | | | 2 | | 1 | | | | | | | | 2 | | | | | | | | | | | | **5** |
| **Marbled White** | | | Y | | | | | | | | | | | | | | | | | | | | | | | | | | | | **0** |
| **Gatekeeper** | Y | Y | | 3 | 2 | 4 | 14 | 6 | 2 | 35 | 13 | | 10 | 9 | 3 | 1 | | 4 | 21 | 4 | 21 | 1 | 9 | | 6 | 1 | 17 | 9 | 3 | | **198** |
| **Meadow Brown** | Y | Y | | 24 | 3 | | 51 | 54 | 14 | 20 | 37 | 10 | 2 | 16 | 24 | 31 | 7 | 15 | 21 | 10 | 71 | 41 | 34 | 10 | 5 | 11 | 40 | 37 | 1 | 22 | **611** |

| **Ringlet** | Y | Y | | | | | | | | 5 | | | | | | | | | | | | | | | | | | | | **5** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total no. of individual butterflies** | | | | **30** | **6** | **4** | **90** | **61** | **19** | **70** | **64** | **10** | **13** | **28** | **27** | **33** | **7** | **19** | **51** | **14** | **95** | **42** | **44** | **10** | **12** | **14** | **61** | **48** | **5** | **24** | **901** |
| **No of indivs /min survey (relative density)** | | | | **1.58** | **0.46** | **0.67** | **2.00** | **2.44** | **1.19** | **3.50** | **1.45** | **0.56** | **1.30** | **3.11** | **1.42** | **1.50** | **0.78** | **1.46** | **1.46** | **1.08** | **3.06** | **2.21** | **1.91** | **2.00** | **0.92** | **0.30** | **15.25** | **6.86** | **0.45** | **6.00** | **1.81** |
| Rel abund GK | | | | 0.16 | 0.15 | 0.67 | 0.31 | 0.24 | 0.13 | 1.75 | 0.30 | 0.00 | 1.00 | 1.00 | 0.16 | 0.05 | 0.00 | 0.31 | 0.60 | 0.31 | 0.68 | 0.05 | 0.39 | 0.00 | 0.46 | 0.02 | 4.25 | 1.29 | 0.27 | 0.00 | |
| Rel abund MB | | | | 1.26 | 0.23 | 0.00 | 1.13 | 2.16 | 0.88 | 1.00 | 0.84 | 0.56 | 0.20 | 1.78 | 1.26 | 1.41 | 0.78 | 1.15 | 0.60 | 0.77 | 2.29 | 2.16 | 1.48 | 2.00 | 0.38 | 0.24 | 10.00 | 5.29 | 0.09 | 5.50 | |
| **No. of species** | | | | **4** | **3** | **1** | **4** | **3** | **4** | **5** | **6** | **1** | **3** | **3** | **2** | **3** | **1** | **2** | **5** | **2** | **4** | **2** | **3** | **1** | **3** | **3** | **4** | **3** | **3** | **3** | |

# Appendix 6 Wetland beetle data



## 1. Species recorded on 1 June 2005, 1 June 2005

### a. Ditch, TQ15652100, 1 June 2005

COLEOPTERA (beetles)
CHRYSOMELIDAE (leaf beetles)
*Psylliodes chrysocephala*
CURCULIONIDAE (weevils)
*Thryogenes festucae*
STAPHYLINIDAE (rove beetles)
*Stenus cicindeloides*

### b. R. Adur: south bank, TQ1520, 1 June 2005

COLEOPTERA (beetles)
APIONIDAE (weevils)
*Apion frumentarium* (= *A. miniatum*)
*Eutrichapion ervi*
*Perapion curtirostre*
*Perapion hydrolapathi*
BRUCHIDAE (pPea-weevils)
*Bruchus rufimanus*
CANTHARIDAE (soldier beetles)
*Cantharis figurata*
*Cantharis lateralis*
*Cantharis nigra*
*Cantharis nigricans*
*Cantharis rufa*
*Rhagonycha limbata*
CHRYSOMELIDAE (leaf beetles)
*Cassida rubiginosa*
*Chalcoides aurata*
*Chalcoides aurea*
*Chalcoides plutus* on crack willow, TQ15792083
*Donacia simplex*
*Galerucella calmariensis*
*Gastrophysa viridula*
*Lema cyanella*
*Longitarsus suturellus*
*Phaedon tumidulus*
*Plateumaris sericea*
*Phyllotreta ochripes*
*Phyllotreta undulata*
*Psylliodes chrysocephala*
COCCINELLIDAE (ladybirds)
*Calvia quattuorodecimguttata*
*Coccidula rufa*
*Coccidula scutellata*
*Propylea quattuordecimpunctata*

*Rhyzobius litura*
*Tytthaspis sedecimpunctata*
CURCULIONIDAE (weevils)
*Ceutorhynchus obstrictus* (=*C. assimilis*)
*Hypera pollux*
*Nedyus quadrimaculatus*
*Pelenomus comari* 2 on purple loosestrife, TQ154209
*Phyllobius pyri*
*Rhinoncus pericarpius*
*Sitona lineatus*
*Trichosirocalus troglodytes*
ELATERIDAE (click beetles)
*Agriotes acuminatus*
*Agriotes obscurus*
*Agriotes pallidulus*
MELYRIDAE
*Malachius bipustulatus*
NITIDULIDAE (pollen beetles, etc)
*Meligethes aeneus*
OEDEMERIDAE
*Oedemera nobilis*
PHALACRIDAE
*Phalacrus fimetarius*
RHYNCHITIDAE (weevils)
*Rhynchites caeruleus*
SCRAPTIIDAE
*Anaspis humeralis*
*Anaspis maculata*
STAPHYLINIDAE (rove beetles)
*Tachyporus hypnorum*

DIPTERA (flies)
EMPIDIDAE (dance flies)
*Empis livida*
*Empis tessellata*
SCIOMYZIDAE (snail-killing flies)
*Pherbina coryleti*
STRATIOMYIDAE (soldier flies)
*Chloromyia formosa*
SYRPHIDAE (hover-flies)
*Anasimyia lineata*

HEMIPTERA-HETEROPTERA (bugs)
MIRIDAE (capsid bugs)
*Dryophilocoris flavoquadrimaculatus*
*Stenodema laevigatum*
TINGIDAE (lace bugs)
*Tingis ampliata*
HEMIPTERA-HOMOPTERA (bugs)
CERCOPIDAE
*Cercopis vulnerata*

HYMENOPTERA (bees, wasps, ants, etc)
APIDAE (bees)
*Andrena chrysosceles*

**c. R. Adur: north bank, TQ1520, 1 June 2005**

COLEOPTERA (beetles)
APIONIDAE (weevils)
*Protapion fulvipes*
CANTHARIDAE (soldier beetles)
*Cantharis lateralis*
*Cantharis pallida*
CHRYSOMELIDAE (leaf beetles)
*Chalcoides aurata*
*Donacia simplex*
*Gastrophysa viridula*
*Oulema lichenis*
*Phaedon cochleariae*
*Phyllotreta nigripes*
*Phyllotreta ochripes*
*Psylliodes chrysocephala*
COCCINELLIDAE (ladybirds)
*Coccinella septempunctata*
*Propylea quattuordecimpunctata*
*Tytthaspis sedecimpunctata*
CURCULIONIDAE (weevils)
*Anthonomus rubi*
*Barypeithes pellucidus*
*Ceutorhynchus obstrictus* (=*C. assimilis*)
*Ceutorhynchus pallidactylus*
*Nedyus quadrimaculatus*
*Phyllobius pomaceus*
*Sitona lineatus*
ELATERIDAE (click beetles)
*Agriotes sputator*
MELYRIDAE
*Malachius bipustulatus*
NITIDULIDAE (pollen beetles, etc)
*Meligethes aeneus*
OEDEMERIDAE
*Oedemera lurida*
*Oedemera nobilis*
PHALACRIDAE
*Phalacrus fimetarius*
STAPHYLINIDAE (rove beetles)
*Tachyporus hypnorum*

DIPTERA (flies)
EMPIDIDAE (dance flies)
*Empis livida*
SCIOMYZIDAE (snail-killing flies)
*Sepedon spinipes*
STRATIOMYIDAE (soldier flies)
*Odontomyia tigrina* — male on *Sparganium erectum*, TQ15552095; female swept, TQ15602089

HEMIPTERA-HETEROPTERA (bugs)
MIRIDAE (capsid bugs)
*Capsus ater*

HEMIPTERA-HOMOPTERA (bugs)
CERCOPIDAE
*Aphrophora alni*

**d. R. Adur: east bank, TQ1521, 1 June 2005**
COLEOPTERA (beetles)
APIONIDAE (weevils)
*Acanephodus onopordi*
*Apion frumentarium (= A. miniatum)*
*Perapion hydrolapathi*
CANTHARIDAE (soldier beetles)
*Cantharis figurata*
*Cantharis lateralis*
*Cantharis pallida*
*Cantharis pellucida*
*Cantharis rufa*
*Malthodes minimus*
*Rhagonycha limbata*
*Rhagonycha testacea*
CARABIDAE (ground beetles)
*Pterostichus cupreus*
CHRYSOMELIDAE (leaf beetles)
*Altica lythri*
*Chrysolina polita*
*Epitrix pubescens*
*Galerucella calmariensis*
*Galerucella sagittariae*
*Gastrophysa polygoni*
*Hypera pollux*
*Lema cyanella*
*Longitarsus dorsalis* on *Senecio jacobaea*, TQ15112170
*Phaedon cochleariae*
*Phaedon tumidulus*
*Phyllotreta diademata*
*Phyllotreta undulata*
*Prasocuris phellandrii* TQ15202151
COCCINELLIDAE (ladybirds)
*Adalia bipunctata*
*Propylea quattuordecimpunctata*
*Tytthaspis sedecimpunctata*
CURCULIONIDAE (weevils)
*Anthonomus rubi*
*Ceutorhynchus floralis*
*Ceutorhynchus obstrictus* (=*C. assimilis*)
*Cionus alauda*
*Cionus hortulanus*
*Hadroplontus litura*
*Hypera rumicis* on *Rumex*, TQ15202151
*Liophloeus tessulatus*
*Nedyus quadrimaculatus*
*Phyllobius pomaceus*
*Poophagus sisymbrii*
*Rhinoncus pericarpius*

ELATERIDAE (click beetles)
*Agriotes pallidulus*
*Agriotes sputator*
HISTERIDAE
*Saprinus semistriatus* — under dead crow, TQ15152166
MELYRIDAE
*Malachius bipustulatus*
OEDEMERIDAE
*Ischnomera cyanea* — female on riverside vegetation, TQ15082177
RHYNCHITIDAE
*Deporaus betulae*
SCRAPTIIDAE
*Anaspis humeralis*
*Anaspis maculata*
SILPHIDAE
*Nicrophorus vespillo* — 2 under dead crow, TQ15152166
*Thanatophilus sinuatus* — under dead crow, TQ15152166
STAPHYLINIDAE (rove beetles)
*Aleochara curtula* — under dead crow, TQ15152166
*Aleochara lata* — under dead crow, TQ15152166
*Paederus littoralis*
*Tachyporus obtusus*

DIPTERA (flies)
EMPIDIDAE (dance flies)
*Empis livida*
STRATIOMYIDAE (soldier flies)
*Beris vallata*
*Chloromyia formosa*
SYRPHIDAE (hover-flies)
*Helophilus pendulus*
*Platycheirus rosarum*
*Syritta pipiens*

HEMIPTERA-HETEROPTERA (bugs)
MIRIDAE (capsid bugs)
*Calocoris norvegicus*
*Liocoris tripustulatus*
PENTATOMIDAE (shield bugs)
*Eurydema oleracea*

HEMIPTERA-HOMOPTERA (bugs)
CERCOPIDAE
*Cercopis vulnerata*

ORTHOPTERA (grasshoppers & crickets)
TETTIGONIIDAE (bush-crickets)
*Leptophyes punctatissima* (speckled bush-cricket)
*Pholidoptera griseoaptera* (dark bush-cricket)
TETRIGIDAE (groundhoppers)
*Tetrix subulata* (slender ground-hopper)

**2. Species recorded on 23 July 2005**

**a. R. Adur: south bank, TQ1520, 23 July 2005**

COLEOPTERA (beetles)
APIONIDAE (weevils)
*Ceratapion gibbirostre*
*Eutrichapion ervi*
*Perapion violaceum*
CANTHARIDAE (soldier beetles)
*Cantharis lateralis*
*Rhagonycha fulva*
CARABIDAE (ground beetles)
*Demetrias atricapillus*
CHRYSOMELIDAE (leaf beetles)
*Aphthona euphorbiae*
*Cassida viridis*
*Crepidodera ferruginea*
*Gastrophysa viridula*
*Lema cyanella*
*Longitarsus suturellus*
*Oulema lichenis*
*Psylliodes chrysocephala*
*Psylliodes picina*
*Phyllotreta nigripes*
*Phyllotreta undulata*
COCCINELLIDAE (ladybirds)
*Adalia decempunctata*
*Coccinella septempunctata*
*Propylea quattuordecimpunctata*
*Rhyzobius litura*
*Tytthaspis sedecimpunctata*
CURCULIONIDAE (weevils)
*Ceutorhynchus obstrictus* (=*C. assimilis*)
*Nedyus quadrimaculatus*
*Notaris scirpi*
HALIPLIDAE (water beetles)
*Haliplus fluviatilis*
NITIDULIDAE (pollen beetles, etc)
*Meligethes aeneus*
*Meligethes ochropus*
OEDEMERIDAE
*Oedemera nobilis*
SCIRTIDAE
*Cyphon coarctatus*
STAPHYLINIDAE (rove beetles)
*Tachyporus obtusus*

DERMAPTERA (earwigs)
FORFICULIDAE
*Forficula auricularia* (common earwig)

DIPTERA (flies)
ASILIDAE (robber flies)
*Leptogaster cylindrica*
STRATIOMYIDAE (soldier flies)
*Chloromyia Formosa*

HEMIPTERA-HETEROPTERA (bugs)
COREIDAE (squash bugs)
*Coreus marginatus*
LYGAEIDAE (ground bugs)
*Cymus melanocephalus*
*Heterogaster urticae*
MIRIDAE (capsid bugs)
*Calocoris norvegicus*
*Deraeocoris ruber*
*Liocoris tripustulatus*
*Lopus decolor*
*Miridius quadrivirgatus*
*Pithanus maerkeli*
*Plagiognathus arbustorum*
*Stenodema laevigatum*
*Stenotus binotatus*
TINGIDAE (Lace bugs)
*Tingis cardui*

HEMIPTERA-HOMOPTERA (bugs)
CERCOPIDAE
*Neophilaenus lineatus*
*Philaenus spumarius*
CIXIIDAE (leaf-hoppers)
*Oliarus panzeri*

LEPIDOPTERA (butterflies)
HESPERIIDAE
*Thymelicus sylvestris* (small skipper)
NYMPHALIDAE
*Aglais urticae* (small tortoiseshell)
*Polygonia c-album* (comma)
PIERIDAE
*Pieris brassicae* (large white)
*Pieris napi* (green-veined white)
SATYRIDAE
*Maniola jurtina* (meadow brown)
*Pararge aegeria* (speckled wood)
*Pyronia tithonus* (the gatekeeper)

NEUROPTERA (lacewings)
HEMEROBIIDAE (brown lacewings)
*Micromus variegatus*

ODONATA (dragonflies)
COENAGRIIDAE
*Ischneura elegans* (blue-tailed damselfly)

ORTHOPTERA (grasshoppers & crickets)
ACRIDIDAE (grasshoppers)
*Chorthippus parallelus* (meadow grasshopper)
TETTIGONIIDAE (bush-crickets)
*Leptophyes punctatissima* (speckled bush-cricket)
*Pholidoptera griseoaptera* (dark bush-cricket)

**b. R. Adur: north bank, TQ1520, 23 July 2005**

COLEOPTERA (beetles)
APIONIDAE (weevils)
*Malvapion malvae*
*Nanophyes marmoratus*
*Pseudapion rufirostre*
CANTHARIDAE (soldier beetles)
*Cantharis lateralis*
*Rhagonycha fulva*
CHRYSOMELIDAE (leaf beetles)
*Cassida viridis*
*Galerucella calmariensis*
*Gastrophysa viridula*
*Phyllotreta nigripes*
*Phyllotreta undulata*
COCCINELLIDAE (ladybirds)
*Adalia bipunctata*
*Coccinella septempunctata*
*Propylea quattuordecimpunctata*
*Tytthaspis sedecimpunctata*
CURCULIONIDAE (weevils)
*Ceutorhynchus obstrictus* (=*C. assimilis*)
*Ceutorhynchus pallidactylus*
NITIDULIDAE (pollen beetles, etc)
*Meligethes aeneus*

DIPTERA (flies)
SYRPHIDAE (hover-flies)
*Cheilosia illustrata*
*Episyrphus balteatus*
TACHINIDAE (parasitic flies)
*Eriothrix rufomaculata*

HEMIPTERA-HETEROPTERA (bugs)
LYGAEIDAE (ground bugs)
*Kleidocerys resedae*
MIRIDAE (capsid bugs)
*Calocoris norvegicus*
*Dicyphus epilobii*
*Heterotoma meriopterum*
*Notostira elongata*
*Stenotus binotatus*

HEMIPTERA-HOMOPTERA (bugs)
CERCOPIDAE
*Philaenus spumarius*
CICADELLIDAE
*Evacanthus interruptus*
DELPHACIDAE
*Conomelus anceps*

HYMENOPTERA (bees, wasps, ants, etc)
APIDAE (bees)
*Bombus pascuorum*
CHRYSIDIDAE (ruby-tailed wasps)
*Omalus aeneus*
TIPHIIDAE (solitary wasps)
*Myrmosa atra*

LEPIDOPTERA (butterflies)
HESPERIIDAE
*Thymelicus lineola* (Essex skipper)
NYMPHALIDAE
*Aglais urticae* (small tortoiseshell)
PIERIDAE
*Pieris napi* (green-veined white)
SATYRIDAE
*Maniola jurtina* (meadow brown)
*Pyronia tithonus* (the gatekeeper)

LEPIDOPTERA (moths)
ARCTIIDAE
*Tyria jacobaeae* (the cinnabar)

ORTHOPTERA (grasshoppers & crickets)
ACRIDIDAE (grasshoppers)
*Chorthippus parallelus* (meadow grasshopper)
TETTIGONIIDAE (bush-crickets)
*Conocephalus discolor* (long-winged cone-head)

**c. R. Adur: east bank, TQ1521, 23 July 2005**
COLEOPTERA (bBeetles)
APIONIDAE (weevils)
*Apion frumentarium* (= *A. miniatum*)
*Ceratapion gibbirostre*
*Nanophyes marmoratus*
*Protapion nigritarse*
CANTHARIDAE (soldier beetles)
*Cantharis lateralis*
*Rhagonycha fulva*
CHRYSOMELIDAE (leaf beetles)
*Altica lythri*
*Cassida rubiginosa*
*Cassida viridis*
*Crepidodera ferruginea*
*Crepidodera transversa*
*Donacia simplex*
*Galerucella calmariensis*
*Galerucella pusilla*
*Gastrophysa viridula*
*Longitarsus rutilus*
*Oulema lichenis*
*Prasocuris phellandrii*
*Psylliodes picina*
*Sphaeroderma testaceum*

COCCINELLIDAE (ladybirds)
*Coccidula rufa*
*Coccinella septempunctata*
*Propylea quattuordecimpunctata*
*Rhyzobius litura*
*Tytthaspis sedecimpunctata*

CURCULIONIDAE (weevils)
*Ceutorhynchus obstrictus* (=*C. assimilis*)
*Cionus alauda*
*Cionus hortulanus*
*Datonychus melanostictus*
*Hypera pollux*
*Nedyus quadrimaculatus*
*Pelenomus comari*
MELYRIDAE
*Axinotarsus ruficollis*
NITIDULIDAE (pollen beetles, etc)
*Meligethes aeneus*
*Meligethes gagathinus*
OEDEMERIDAE
*Oedemera nobilis*
SCIRTIDAE
*Scirtes hemisphaerica*
STAPHYLINIDAE (rove beetles)
*Stenus cicindeloides*
*Tachyporus obtusus*

DIPTERA (Flies)
STRATIOMYIDAE (soldier flies)
*Beris vallata*
TEPHRITIDAE (picture-winged flies)
*Urophora cardui*

HEMIPTERA-HETEROPTERA (bugs)
COREIDAE (squash bugs)
*Coreus marginatus*
MIRIDAE (capsid bugs)
*Calocoris norvegicus*
*Deraeocoris ruber*
*Dicyphus epilobii*
*Liocoris tripustulatus*
*Lopus decolor*
*Plagiognathus arbustorum*
*Stenodema laevigatum*
*Stenotus binotatus*
PENTATOMIDAE (shield bugs)
*Eurydema oleracea*
RHOPALIDAE
*Rhopalus subrufus*

HEMIPTERA-HOMOPTERA (bugs)
CERCOPIDAE
*Philaenus spumarius*
CICADELLIDAE
*Evacanthus interruptus*
DELPHACIDAE
*Conomelus anceps*

HYMENOPTERA (bees, wasps, ants, etc)
APIDAE (bees)
*Bombus pascuorum*
*Macropis europaea*

LEPIDOPTERA (butterflies)
PIERIDAE
*Pieris brassicae* (large white)
*Pieris napi* (green-veined white)
SATYRIDAE
*Maniola jurtina* (meadow brown)
*Pyronia tithonus* (the gatekeeper)

LEPIDOPTERA (moths)
GEOMETRIDAE
*Timandra griseata* (Blood Vein)

ODONATA (dragonflies)
COENAGRIIDAE
*Ischneura elegans* (blue-tailed damselfly)

ORTHOPTERA (grasshoppers & crickets)
ACRIDIDAE (grasshoppers)
*Chorthippus parallelus* (meadow grasshopper)
TETTIGONIIDAE (bush-crickets)
*Leptophyes punctatissima* (speckled bush-cricket)

## 3. Red Data Book and Nationally Scarce species recorded

COLEOPTERA (beetles)

CHRYSOMELIDAE (leaf beetles)

**Na** *Longitarsus rutilus*

Widely distributed but very local in southern England. Phytophagous. Found near ponds or streams and in damp woodland, appearing to prefer partial shade. Associated with Water Figwort *Scrophularia aquatica* and Balm-leaved Figwort *S. scorodonia*. The larvae probably develop at the roots of the foodplant. Listed as **RDB2** in Shirt (1987); the status has now been revised to **Na** (Hyman, 1992).

CURCULIONIDAE (weevils)

**Nb** *Notaris scirpi*

Widespread but local in England and Wales and not recorded from South-west England. Associated with Lesser Pond Sedge *Carex acutiformis* and Reedmace *Typha latifolia*.

**Nb** *Pelenomus comari*

Widely distributed in England, Wales and south-west Scotland. Found in wetland habitats. Phytophagous. Associated with Marsh Cinquefoil *Potentilla palustris* and sometimes with Purple Loosestrife *Lythrum salicaria*. The larvae feed externally on the leaves.

NITIDULIDAE (pollen beetles, etc)

**N** *Meligethes gagathinus*

Very local in southern England and also recorded from North-east England. Found in wetlands beside ponds and ditches. Associated with flowers of Water Mint *Mentha aquatica*.

**N** *Meligethes ochropus*

Very local with a scattered distribution in England. The larvae develop in the flowers of marsh woundwort *Stachys palustris*.

OEDEMERIDAE

**Nb** *Ischnomera cyanea*

Two species (*I. caerulea* and *I. cyanea*) were previously confused in Britain under the name *I. Caerulea*. *I. cyanea* is by far the most frequent and is widely distributed though local in England and Wales. Found mainly in ancient broad-leaved woodland, pasture-woodland and old hedgerows. Adults frequently visit flowers, including hawthorn and Hogweed. The larvae develop in dead wood of a variety of tree species.

HEMIPTERA-HOMOPTERA (bugs)

CIXIIDAE (leaf-hoppers)

**N** *Oliarus panzeri*

A very local species which is confined to South-east England. The ecology is poorly understood but it may prefer areas that are periodically waterlogged but which dry out and crack in summer. The foodplants are unknown but the nymphs are thought to be root feeders.

DIPTERA (flies)

STRATIOMYIDAE (soldier flies)

**N** *Odontomyia tigrina*

Widespread but local, mostly in the southern half of England and Wales. Associated with wetland, especially ancient fens and grazing marshes. The aquatic larvae have been found in shallow water at the margins of both freshwater and slightly brackish ponds and ditches.

HYMENOPTERA (bees, wasps, ants, etc)

APIDAE (bees)

**Na** *Macropis europaea*

Restricted to Southern England. Closely associated with Yellow Loosestrife *Lysimachia vulgaris*, in fens and beside ponds and rivers. Nests are excavated in the ground and are generally well concealed by overhanging vegetation. It is not so rare as once thought and has recently been recorded from a number of new sites. Its status has been revised from **RDB3 (Rare)** in Shirt (1987) to **Nationally Scarce Category A (Na)** in Falk (1991).

ORTHOPTERA (grasshoppers & crickets)

TETTIGONIIDAE (bush-crickets)

**Na** *Conocephalus discolor* (long-winged cone-head)

Formerly very local near the coast of Sussex, Hampshire, Isle of Wight and Dorset, this species has been slowly extending its range and now occurs in many inland localities in south-east England. Found in areas of long grass, reeds or rushes.

# Appendix 7 Breeding bird survey

**Table 1 – List of species recorded on the Knepp Castle Estate, Spring 2005**

| Species | Species code | Green listed | Amber listed | Red listed |
|---|---|---|---|---|
| Grey heron | H | * | | |
| Mute swan | MS | | * | |
| Mallard | MA | * | | |
| Tufted duck | TU | * | | |
| Red kite | KT | | * | |
| Common buzzard | BZ | * | | |
| Kestrel | K | | * | |
| Red-legged partridge | RL | * | | |
| Pheasant | PH | * | | |
| Moorhen | MO | * | | |
| Lapwing | L | | * | |
| Stock dove | SD | | * | |
| Woodpigeon | WP | * | | |
| Collared dove | CD | * | | |
| Turtle dove | TD | | | * |
| Cuckoo | CU | | * | |
| Barn owl | BO | | * | |
| Little owl | LO | | | |
| Green woodpecker | G | | * | |
| Great spotted woodpecker | GS | * | | |
| Skylark | S | | | * |
| Meadow pipit | MP | | * | |
| Pied wagtail | PW | * | | |
| Wren | WR | * | | |
| Dunnock | D | | * | |
| Robin | R | * | | |
| Nightingale | N | | * | |
| Blackbird | B | * | | |
| Song thrush | ST | | * | |
| Reed warbler | RW | * | | |
| Lesser whitethroat | LW | * | | |
| Whitethroat | WH | * | | |
| Garden warbler | GW | * | | |
| Blackcap | BC | * | | |
| Chiffchaff | CC | * | | |
| Willow warbler | WW | | * | |
| Goldcrest | GC | | * | |
| Long-tailed tit | LT | * | | |
| Marsh tit | MT | | | * |
| Coal tit | CT | * | | |
| Blue tit | BT | * | | |
| Great tit | GT | * | | |
| Nuthatch | NH | * | | |
| Treecreeper | TC | * | | |
| Jay | J | * | | |
| Magpie | MG | * | | |
| Jackdaw | JD | * | | |
| Rook | RO | * | | |
| Carrion crow | C | * | | |
| House sparrow | HS | | | * |
| Chaffinch | CH | * | | |
| Greenfinch | GR | * | | |
| Goldfinch | GO | * | | |
| Linnet | LI | | | * |
| Bullfinch | BF | | | * |
| Yellowhammer | Y | | | * |
| Reed bunting | RB | | | * |

## Table 2. Number of species registrations along each transect

| Species | Species code | Area A | Area B |
|---|---|---|---|
| Grey heron | H | 1 | |
| Mute swan | MS | | |
| Mallard | MA | | |
| Tufted duck | TU | | |
| Red kite | KT | | |
| Common buzzard | BZ | | |
| Kestrel | K | | 1 |
| Red-legged partridge | RL | | 1 |
| Pheasant | PH | 2 | 1 |
| Moorhen | MO | | 1 |
| Lapwing | L | | |
| Stock dove | SD | 2 | 2 |
| Woodpigeon | WP | 1 | 2 |
| Collared dove | CD | 1 | |
| Turtle dove | TD | | |
| Cuckoo | CU | | |
| Barn owl | BO | | |
| Little owl | LO | | |
| Green woodpecker | G | | 2 |
| Great Spotted Woodpecker | GS | 1 | |
| Skylark | S | | 2 |
| Meadow pipit | MP | | |
| Pied wagtail | PW | 1 | |
| Wren | WR | 11 | 6 |
| Dunnock | D | 1 | 1 |
| Robin | R | 6 | 8 |
| Nightingale | N | | 1 |
| Blackbird | B | 5 | 2 |
| Song thrush | ST | 1 | 3 |
| Reed warbler | RW | | |
| Lesser whitethroat | LW | | 1 |
| Whitethroat | WH | | 10 |
| Garden warbler | GW | 1 | 4 |
| Blackcap | BC | 3 | 4 |
| Chiffchaff | CC | 4 | 6 |
| Willow warbler | WW | | |
| Goldcrest | GC | 2 | |
| Long-tailed tit | LT | | 1 |
| Marsh tit | MT | 1 | |
| Coal tit | CT | 1 | |
| Blue tit | BT | 5 | 3 |
| Great tit | GT | 2 | 2 |
| Nuthatch | NH | 4 | |
| Treecreeper | TC | | 1 |
| Jay | J | | 2 |
| Magpie | MG | 1 | |
| Jackdaw | JD | | 1 |
| Rook | RO | | |
| Carrion crow | C | | |
| House sparrow | HS | | |
| Chaffinch | CH | 6 | 10 |
| Greenfinch | GR | 1 | |
| Goldfinch | GO | | |
| Linnet | LI | | 1 |
| Bullfinch | BF | 1 | 1 |
| Yellowhammer | Y | 2 | 3 |
| Reed bunting | RB | | |

# Appendix 8 Small mammal survey (shrews, voles, mice) data

**Small mammal trapping data sheets**
**Woodland 2**

| | Date | Time | Trap | Spp. | ID | Age | Sex | B. cond. | HB | Tail | H.Foot | Wt (g) | Bag wt | Actual wt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 15.8.05 | 19.00pm | 10 | Tripped | | | | | | | | | | 0 |
| **2** | 16.8.05 | 10.04 | 1 | Tripped | | | | | | | | | | 0 |
| **3** | | | 10 | Bank vole | E | J | M | | 94 | 36 | 16 | 67 | 50 | 17 |
| **4** | 16.8.05 | 20.41 | 1 | Bank vole | | J | F | | 73.9 | 30.6 | 17.2 | 44 | 30 | 14 |
| **5** | | | 3 | Bank vole | | A | M | | 93.8 | 44 | 16 | 50 | 33 | 17 |
| **6** | 17.8.05 | 18.35 | 3 | Bank vole | A | A | F | Pregnant | 72.5 | 31.1 | 16.3 | 72 | 50 | 22 |
| **7** | 18.8.05 | 09.40am | 5 | Bank vole | A | A | M | TS | 89.1 | 33.1 | 15.8 | 57 | 39 | |
| **8** | | | 10 | recap bank vole | E | A | M | TS | | | | | | |
| **9** | | 19.25 | 3 | Tripped | | | | | | | | | | |
| **10** | | | 4 | Tripped | | | | | | | | | | |
| **11** | | | 5 | Tripped | | | | | | | | | | |
| **12** | | | 6 | Tripped | | | | | | | | | | |
| **13** | | | 10 | recap bank vole | A | | F | | | | | | | |
| **14** | | | | | | | | | | | | | | |

| Water 2 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Date** | **Time** | **Trap** | **Spp.** | **ID** | **Age** | **Sex** | **B. cond.** | **HB** | **Tail** | **H.Foot** | **Wt (g)** | **Bag wt** | **Actual wt** |
| | 16.8.05 | 9.00am | 2 | Common shrew | C | A | ? F | Perf | 64.6 | 35.4 | 9.7 | | | 7 |
| | | | 9 | Woodmouse | | A | M | TS | 94 | 89 | 22 | 63 | 38 | 25 |
| | | 20.07 | 5 | Field vole | B | A | M | TS | 123.7 | 31.6 | 17.9 | 80 | 33 | |
| **1** | 17.8.05 | 9.10am | 2 | Tripped | | | | | | | | | | 0 |
| **2** | | | 6 | Recap - field vole | B | | | | | | | | | 0 |
| **3** | | | 9 | Woodmouse | A | A | F | Nip halos | 82.4 | 71.1 | 20.6 | 57 | 36 | 21 |
| **4** | | 18.00pm | 4 | Field vole | D | A | M | TS | 84.1 | 27.3 | 14.9 | 81 | 55 | 26 |
| **5** | | | 5 | Bank vole | | J/SA | M | TA/TM | 72.5 | 37.6 | 12.6 | 47 | 32 | 15 |
| **6** | | | 6 | Recap - field vole | B | A | M | TS | | | | | | 0 |
| **7** | 18.8.05 | 8.50am | 2 | Recap - field vole | B | BIG! | M | TS | | | | | | 0 |
| **8** | | | 5 | Field vole | E | A | F | Nip halos | 91.9 | 25.6 | 18 | 68 | 39 | 29 |
| **9** | | | 9 | Woodmouse | F | SA | F | | 87.4 | 84.5 | 20.2 | 70 | 49 | 21 |
| **10** | | 18.45 | 2 | Recap - field vole | D | | M | | | | | | | 0 |
| **11** | | | 4 | Recap - field vole | B | | M | | | | | | | 0 |
| **12** | | | 8 | Recap - field vole | C | | F | Nip halos | | | | | | 0 |
| **13** | 19.8.05 | 8.45 | 4 | Recap - field vole | D | A | M | | | | | | | 0 |
| **14** | | | 5 | Woodmouse | | J/SA | ?M | | 62.2 | 66 | | 67 | 55 | 12 |
| **15** | | | 7 | Recap - ?field vole | | A | M | TS | | | | | | 0 |
| | | | 8 | Recap - ? field vole | E | | F | | | | | | | 0 |
| | | | 9 | Tripped | | | | | | | | | | |

| | Hedge 2 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Date** | **Time** | **Trap** | **Spp.** | **ID** | **Age** | **Sex** | **B. cond.** | **HB** | **Tail** | **H.Foot** | **Wt (g)** | **Bag wt** | **Actual wt** |
| **1** | 23.8.05 | 10.45 | 1 | Bank vole | A | ?A | F | Nipples | 88.6 | 37.3 | 15.4 | 64 | 43 | 21 |
| **2** | | | 2 | Tripped | | | | | | | | | | 0 |
| **3** | | | 5 | Woodmouse | A | SA | M | TM | 72 | 71 | 17.1 | 52 | 37 | 15 |
| **4** | 24.8.05 | 8.45 | 1 | Recap - bank vole | A | ?A | F | Nipples | | | | | | 0 |
| **5** | | | 2 | Tripped | | | | | | | | | | |
| **6** | | | 5 | Woodmouse | | A | M | TS | 94 | 78.8 | 17 | 54 | 30 | 24 |
| **7** | | | 9 | Tripped | | | | | | | | | | 0 |
| **8** | | | 10 | Tripped | | | | | | | | | | 0 |
| **9** | 25.8.05 | 9.20am | 1 | Recap - bank vole | A | | | | | | | | | 0 |
| **10** | | | 5 | Recap - woodmouse | | A | M | TS | 92 | 79 | 17 | 64 | 40 | 24 |
| **11** | | | 7 | Recap - woodmouse | A | SA | M | TM | | | | | | 0 |
| **12** | | | 9 | Woodmouse | C | SA/A | M | TM | 76.2 | 74.7 | 20 | 55 | 40 | 15 |
| **13** | 27.8.05 | 9.30am | | Bank vole | | | | | | | | | | 0 |
| **14** | | | | Woodmouse | A | | F | | | | | | | |
| **15** | | | | Woodmouse | A | | M | | | | | | | |
| **16** | | | | Field vole | B | | M | TS | | | | | | |
| **17** | | | | Field vole | D | | M | | | | | | | |
| **18** | | | | Field vole | E | | F | | | | | | | |

| Grass 2 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Date** | **Time** | **Trap** | **Spp.** | **ID** | **Age** | **Sex** | **B. cond.** | **HB** | **Tail** | **H.Foot** | **Wt (g)** | **Bag wt** | **Actual wt** |
| **1** | | | | | | | | | | | | | | |
| **2** | | | | | | | | | | | | | | |
| **3** | | | | | | | | | | | | | | |
| **4** | | | | | | | | | | | | | | |
| **5** | | | | | | | | | | | | | | |
| **6** | 27.8.05 | 8.30am | | Woodmouse | A | M | | | | | | | | |
| **7** | | | | Woodmouse | A | M | | | | | | | | |
| **8** | | | | | | | | | | | | | | |
| **9** | | | | | | | | | | | | | | |
| **10** | | | | | | | | | | | | | | |
| **11** | | | | | | | | | | | | | | |
| **12** | | | | | | | | | | | | | | |
| **13** | | | | | | | | | | | | | | |
| **14** | | | | | | | | | | | | | | |
| **15** | | | | | | | | | | | | | | |

| Woodland 3 - hornbeam etc + pendulous sedge | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Date** | **Time** | **Trap** | **Spp.** | **ID** | **Age** | **Sex** | **B. cond.** | **HB** | **Tail** | **H.Foot** | **Wt (g)** | **Bag wt** | **Actual wt** |
| **1** | 23.8.05 | 6.55 | 1 | Woodmouse | A | A | M | TM | 87.8 | 73.7 | 21.7 | 62 | 44 | 18 |
| **2** | | | 3 | Woodmouse | A | A | F | Perf | 90 | 87.6 | 19.2 | 74 | 51 | 23 |
| **3** | | | 4 | Woodmouse | B | A | M | TS | 97.2 | 47.2 (broken) | 21.1 | 73 | 44 | 29 |
| **4** | | | 6 | Woodmouse | C | A | M | TS | 90 | 83.7 | 18.8 | 77 | 52 | 25 |
| **5** | | | 7 | Woodmouse | EC | SA | M | | 86.8 | 76.2 | | 75 | 58 | 17 |
| **6** | | | 8 | Woodmouse | D | A | M | TS | 101 | 72.6 | 19.5 | 72 | 43 | 29 |
| **7** | 24.8.05 | 6.45 | 1 | Woodmouse | DF | SA | M | TM | 78 | 82.2 | 19 | 60 | 37 | 23 |
| **8** | | | 3 | trap moved | | | | | | | | | | 0 |
| **9** | | | 4 | Woodmouse | A | | | | | | | | | 0 |
| **10** | | | 6 | Woodmouse | B | | | | | | | | | 0 |
| **11** | | | 8 | Recap - escaped - wood mouse | | | | | | | | | | 0 |
| **12** | | | 10 | Recap - wood mouse | C | A | M | TS | | | | | | 0 |
| **13** | 25.8.05 | 6.30am | 1 | Recap - wood mouse | A | A | F | Nipple halos | | | | | | 0 |
| **14** | | | 3 | Recap - wood mouse | C | A | M | TS | | | | | | 0 |
| **15** | | | 4 | Recap - wood mouse | Escaped | | | | | | | | | 0 |
| **16** | | | 6 | Woodmouse | F | A | M | TS | 92 | 84.9 | 20.4 | 545 | 522 | 23 |
| **17** | | | 7 | Woodmouse | BE | A | M | TS | 84.1 | 75.4 | 21.6 | 546 | 525 | 21 |
| **18** | | | 9 | Woodmouse | B | A | M | TM | 88 | 76.9 | 18.7 | 552 | 529 | 23 |
| **19** | 26.8.05 | 7am | 1 | Recap - wood mouse | DF | | | | | | | | | 0 |
| **20** | | | 4 | Recap - wood mouse | A | A | F | Nipple halos | | | | | | 0 |
| **21** | | | 6 | Recap - wood mouse | B | Escaped | | | | | | | | 0 |
| **22** | | | 7 | Recap - wood mouse | B | A | M | TA | | broken | | | | 0 |
| **23** | | | 9 | Woodmouse | | A | M | TS | 90.9 | 93.5 | 19.7 | 62 | 38 | 24 |
| **24** | | | 10 | Tripped | | | | | | | | | | 0 |
| **25** | 27.8.05 | 7am | | Bank vole | CB | M | | | | | | | | 0 |
| **26** | | | | Bank vole | AB | F | | | | | | | | 0 |
| **27** | | | | Bank vole | A | F | | | | | | | | |
| **28** | | | | Bank vole | F | F | | | | | | | | |
| **29** | | | | Common shrew | | | | | | | | | | |
| **30** | | | | Woodmouse | B | M | | | | | | | | |
| **31** | | | | Woodmouse | C | M | | | | | | | | |
| **32** | | | | Woodmouse | B | F | | | | | | | | |
| **33** | | | | Pigmy shrew | A | | | | | | | | | |

| Water 3 - Low lying wet flush/shallow ditch with abundant wetland vegetation. | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Date** | **Time** | **Trap** | **Spp.** | **ID** | **Age** | **Sex** | **B. cond.** | **HB** | **Tail** | **H.Foot** | **Wt (g)** | **Bag wt** | **Actual wt** |
| **1** | 23.8.05 | 8.05 | 2 | Bank vole | A | SA | F | | 94 | 35.5 | 16.5 | 61 | 47 | 14 |
| **2** | | | 5 | Water shrew | A | A | F? | | 83.4 | 44.6 | 16.4 | 45 | 34 | 11 |
| **3** | | | 8 | Bank vole | B | SA/A | M | TM | 92.8 | 35.6 | 17.4 | 60 | 40 | 20 |
| **4** | | | 9 | Tripped | | | | | | | | | | 0 |
| **5** | | | 10 | Woodmouse | A | SA? | F | | 85 | 68.5 | 20 | 56 | 40 | 16 |
| **6** | | 18.10 | 8 | Field vole | C | SA? | F | | 94.1 | 21.4 | 16.9 | 55 | 36 | 19 |
| **7** | | | 9 | Common shrew | | | | | 68.5 | 27.8 | 12.3 | 50 | 44 | 6 |
| **8** | | | 10 | Bank Vole | D | SA | M | | 83.4 | 37.8 | 14.6 | 45 | 31 | 14 |
| **9** | 24.8.05 | 7.30 | 1 | Tripped | | | | | | | | | | 0 |
| **10** | | | 2 | Common shrew | | | M | TS | 69.8 | 33.5 | 12.5 | | | 0 |
| | | | 8 | Bank vole | E | A | M | TM | 87 | 34.2 | 15 | 65 | 35 | |
| **11** | | | 9 | Field vole | F | A | M | TS | 101.2 | 27.2 | 16.9 | 60 | 33 | 27 |
| **12** | | | 10 | Bank vole | Bald head | J | F | | 78 | 36.1 | 12.8 | 46 | ? | #VALUE! |
| **13** | | 18.00 | 7 | Bank vole | A | | F | | | | | | | 0 |
| **14** | | | 8 | Recap - B vole | E | | | | | | | | | 0 |
| **15** | | | 9 | Common shrew | | | | | | | | | | 0 |
| **16** | 25.7.05 | 7.55 | 1 | Woodmouse | B | SA | F | | 80 | 76.1 | 18.3 | 50 | 35 | 15 |
| **17** | | | 2 | Woodmouse | C | A | M | TS | 86 | 70 | 19.2 | 50 | 34 | 16 |
| **18** | | | 5 | Recap - water shrew | A | | | | | | | | | 0 |
| **19** | | | 6 | Recap - B vole | E | | | | | | | | | 0 |
| **20** | | | 7 | Recap - B vole | B | | | | | | | | | 0 |
| **21** | | | 8 | Field vole | A | SA | F | | 80.8 | 19 | 15 | 54 | 37 | 17 |
| **22** | | | 9 | Recap - woodmouse | A | | | | | | | | | 0 |
| **23** | | 18.1 | 5 | Recap - B vole | E | | | | | | | | | 0 |
| **24** | | | 6 | Field vole | B | A | M | TM | 94 | 27.4 | 16 | 67 | 43 | 24 |
| **25** | | | 7 | Tripped | | | | | | | | | | 0 |
| **26** | | | 8 | Recap - water shrew | A | | | | | | | | | 0 |
| **27** | | | 10 | Tripped | | | | | | | | | | |
| **28** | 26.8.05 | 7.5 | 1 | Recap - woodmouse | C | A | M | TS | | | | | | |
| **29** | | | 2 | Recap - woodmouse | B | SA | F | | | | | | | |
| **30** | | | 5 | Recap - B vole | E | | | | | | | | | |
| **31** | 27.8.05 | 9am | | Bank vole | | | | | | | | | | |
| **32** | | | | Common shrew | C | | | | | | | | | |

| Water 3 - Low lying wet flush/shallow ditch with abundant wetland vegetation. | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Date** | **Time** | **Trap** | **Spp.** | **ID** | **Age** | **Sex** | **B. cond.** | **HB** | **Tail** | **H.Foot** | **Wt (g)** | **Bag wt** | **Actual wt** |
| **33** | | | | Recap -woodmouse | A | | F | | | | | | | |
| **34** | | | | Recap - water shrew | A | | | | | | | | | |
| **35** | | | | Recap - field vole | A | | F | | | | | | | |
| **36** | | | | Recap - field vole | B | | F | | | | | | | |
| **37** | | | | Recap - field vole | A | | M | | | | | | | |
| **38** | | | | Recap - field vole | E | | M | | | | | | | |
| | | | | Yellow neck | B | | M | | | | | | | |

| Hedge 3 - some ancient trees (oaks), sparse srhubs, understorey; linked to woodland at one end, water 3 at other. | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Date** | **Time** | **Trap** | **Spp.** | **ID** | **Age** | **Sex** | **B. cond.** | **HB** | **Tail** | **H.Foot** | **Wt (g)** | **Bag wt** | **Actual wt** |
| **1** | 23.8.05 | 9.05 | 1 | Wood mouse | A | SA | F | | 62.3 | 67.6 | 15.8 | 63 | 50 | 13 |
| **2** | | | 4 | Bank vole | A | A | F | Perf | 78.1 | 37.9 | 13.6 | 62 | 47 | 15 |
| **3** | | | 5 | Wood mouse | A - r eye closed | A | M | TS | 84 | 74.1 | 16.8 | 57 | 36 | 21 |
| **4** | | | 6 | Wood mouse | B - part of tail hairless | J | F | | 78.2 | 65.8 | 17.8 | 46 | 31 | 15 |
| **5** | | | 7 | Wood mouse | C | A | M | TS | 95.3 | 79.7 | 18.8 | 63 | 41 | 22 |
| **6** | | | 8 | Wood mouse | CC | J | F | | 76.4 | 72.9 | 20.5 | 57 | 41 | 16 |
| **7** | | | 10 | Wood mouse | D | A | M | TS | 94.6 | 75.8 | 18.8 | 62 | 40 | 22 |
| **8** | | 18.45 | 8 | Common shrew | | | | | 66.5 | 37.1 | 11.7 | 45 | 38 | 7 |
| **9** | | | 9 | Bank vole | B | SA | F | | 78.8 | 20.6 | 16.1 | 48 | 34 | 14 |
| **10** | 24.8.05 | 7.45 | 1 | Recap - woodmouse | A | SA | F | | | | | | | 0 |
| **11** | | | 8 | Recap - bank vole | B | | | | | | | | | 0 |
| **12** | | | 9 | Wood mouse | E | SA/A | F | | 75.6 | 70.4 | 20.9 | 46 | 30 | 16 |
| **13** | | | 10 | Recap - woodmouse | C | A | M | TS | | | | | | 0 |
| **14** | | 18.30pm | 9 | Bank vole | F | A | M | TM | 81.4 | 42.1 | 16.2 | 85 | 65 | 20 |
| **15** | 25.8.05 | 8.40am | 1 | Recap-woodmouse | A | SA | F | | | | | | | 0 |
| **16** | | | 2 | Tripped | | | | | | | | | | 0 |
| **17** | | | 4 | Recap - bank vole | A | A | F | Nipple halos | | | | | | 0 |
| **18** | | | 8 | Common shrew | | | | | 53.9 | 34.8 | 15.9 | 42 | 35 | 7 |
| **19** | | | 9 | Bank vole | C | A | M | TM | 88.9 | 38.2 | 15.1 | 60 | 39 | 21 |
| **20** | | | 10 | Recap - woodmouse | B | | | | | | | | | 0 |
| **21** | | 18.40pm | 8 | Recap - bank vole | F | | | | | | | | | 0 |
| **22** | | | 10 | Recap - bank vole | B | | | | | | | | | 0 |
| **23** | 26.8.05 | 8.35 | 1 | Recap - woodmouse | A | J | F | | | | | | | 0 |
| **24** | | | 3 | Recap - woodmouse | C | A | M | TS | | | | | | 0 |
| **25** | | | 4 | Recap - bank vole | A | | | | | | | | | 0 |
| **26** | | | 8 | Tripped | | | | | | | | | | 0 |
| **27** | | | 9 | Recap - bank vole | C | A | M | TM | | | | | | 0 |
| **28** | | | 10 | Wood mouse | | A | m | TS | 91.9 | 73.6 | 17.8 | 69 | 50 | 19 |
| **29** | 27.8.05 | 10 | | Bank vole | E | M | | | | | | | | 0 |
| **30** | | | | Bank vole | A | F | | | | | | | | 0 |
| | | | | Bank vole | A | M | | | | | | | | |

| Grass 3. | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Date** | **Time** | **Trap** | **Spp.** | **ID** | **Age** | **Sex** | **B. cond.** | **HB** | **Tail** | **H.Foot** | **Wt (g)** | **Bag wt** | **Actual wt** |
| **1** | 25.8.05 | 9.am | 7 | Bank vole | A | F | | | | | | | | 0 |
| **2** | | | 9 | Woodmouse | C | | | | | | | | | 0 |
| **3** | | 19.03 | 5 | Tripped | | | | | | | | | | 0 |
| **4** | 26.8.05 | 9.15 | 1 | Recap - bank vole | A | A | F | nip halos | | | | | | 0 |
| **5** | | | 3 | Woodmouse | | J/SA | F | | 69.5 | 68.3 | 18.2 | 45 | 27 | 18 |
| **6** | | | 9 | Recap - woodmouse | C | | | | | | | | | 0 |
| **7** | 27.8.05 | | | Bank vole | B | | F | | | | | | | 0 |
| **8** | | | | Woodmouse | | | | | | | | | | 0 |
| **9** | | | | | | | | | | | | | | 0 |
| **10** | | | | | | | | | | | | | | 0 |
| **11** | | | | | | | | | | | | | | 0 |
| **12** | | | | | | | | | | | | | | 0 |

ENGLISH NATURE

# Research Information Note

*English Nature Research Reports*, No. 693

**Knepp Castle Estate baseline ecological survey**

Report Author: Theresa E. Greenaway, 2006

Keywords: Grazing animals, naturalistic grazing, Vera, Sussex, Knepp

# Introduction

Knepp Castle estate covers an area of 1 416 hectares, in the Low Weald Natural Area, south of Horsham, West Sussex. It originated as a royal hunting park in the Middle Ages. The owner, Charlie Burrell, wishes to recreate the landscape designed by Humphrey Repton, but as plans developed, he took on a more ambitious scheme to create a landscape-scale park in which a variety of large herbivores would roam freely, currently covering about 322 hectares.

This comes at a time when Vera's ideas on grazing and forest history (Vera 2000) are being widely discussed, raising much interest, and discussion on the practicalities and constraints of modern landscape uses. Hodder and Bullock (2005) provide a useful discussion of the difference between "near natural" grazing and "conservation" grazing, and the system set up at Knepp falls somewhere between the two.

The aim is to record and evaluate changes in biodiversity and vegetation structure following the reversion of land under intensive arable management to a more natural grazing regime.

# What was done

In 2001, 202 hectares were taken out of arable and commercial grassland and planted with a native seed mix. 28 hectares were planted with a wild flower seed mix.

In 2002, Fallow deer were introduced, followed by long horn cattle and Exmoor ponies in 2003. In 2005, 2 Tamworth sows and 8 piglets were introduced. In 2005, the density of animals was estimated to be 550, comprising 500 deer, 6-10 ponies, 16 cattle with 13 calves and 10 sows.

This project records the results of the baseline ecological recordings, develops a monitoring strategy, identifies the areas of research and gives the results of the phase 1 study.

The following surveys have been undertaken:

| | |
|---|---|
| Extended Phase I habitat | Diptera |
| Belt transects | Wetland beetles |
| Aquatic vascular plants | Grassland beetles |
| Lichens | Hymenoptera |
| Soils & vegetation analysis* | Ants |
| Pond condition survey | Amphibians |
| NVC Floodplain | Reptiles |
| Fixed point photography | Breeding birds |
| Wetland Mollusca | Barn owls |
| Spiders* | Bats |
| Collembola | Water voles & otters |
| Odonata | Dormouse |
| Lepidoptera – moths | Small mammals |
| Lepidoptera - butterflies | Pigs & patch dynamics* |

*These survey reports have not yet been received and are not included in this report

**Continued……**

# Results and conclusions

This report covers a great deal of survey work which gives a snapshot assessment of the Estate near to the beginning of the grazing regime.. The results are available in the report. Over 900 species have been recorded in the 2005 field survey, including 71 species of conservation interest.

The habitat survey showed that 60% of the project area is grassland, 21% woodland or wood pasture, and just 1.1 % is covered by scrub. This latter area is expected to increase.

There are no conclusions to be drawn from the research carried out at this stage because it is a baseline survey, but it is hoped that research will continue at Knepp and this data can later be used in comparison.

# English Nature's viewpoint

English Nature is interested in the concept of naturalistic grazing, and has produced a discussion document about it (Kirby 2003) as well as looking at modern naturalistic grazing systems (Hodder and others, 2005). The next logical step is to see how it works in practise.

English Nature fully support the Knepp project, and eagerly await results of forthcoming research into the future as the project develops. The naturalistic approach to grazing must be based on sound ecological and animal management principles, as the Knepp project is. The steering group to take the project forward involves a large number of participants from different organisations, which highlights the interest in the approach. English Nature anticipates that unforeseen issues that may arise will be embraced by the steering group.

# Selected references

HODDER, K.H., and others. 2005. Large herbivores in the wildwood and modern naturalistic grazing systems. *English Nature Research Reports*, No. 648.

KIRBY, K.J. 2003. What might a British forest-landscape driven by large herbivores look like? *English Nature Research Reports*, No. 530.

VERA, F.W.M. 2000. *Grazing ecology and forest history*. CABI Publishing.

WHITBREAD, A. & JENMAN, W. 1995. A natural method of conserving biodiversity in Britain. *British Wildlife,* 6, 2, 84-93.

## Further information

*English Nature Research Reports* and their *Research Information Notes* are available to download from our website: www.english-nature.org.uk

For a printed copy of the full report, or for information on other publications on this subject, please contact the Enquiry Service on 01733 455100/101/102 or e-mail enquiries@english-nature.org.uk

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Front cover photographs:
Top left: Using a home-made moth trap.
Peter Wakely/English Nature 17,396
Middle left: $Co_2$ experiment at Roudsea Wood and Mosses NNR, Lancashire.
Peter Wakely/English Nature 21,792
Bottom left: Radio tracking a hare on Pawlett Hams, Somerset.
Paul Glendell/English Nature 23,020
Main: Identifying moths caught in a moth trap at Ham Wall NNR, Somerset.
Paul Glendell/English Nature 24,888