



# **Knepp Wildland Project**

**River Adur re-naturalisation:**

**Pre-project ecological surveys.**

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# **River Adur re-naturalisation: pre-project ecological surveys.**

## **1. Introduction**

### **1.1. Background to river restoration.**

A stretch of the River Adur approximately 2km in length, plus stretches of its tributaries, crosses the Knepp Estate. The river has suffered many engineering changes over the years and is now over wide and deep. It still flows through a wide, largely grassland, floodplain.

The re-wilding project that extends across all 3,500ha of the Estate means that restoring the river to a more natural condition will be highly beneficial. There are constraints and issues to this scheme that are to be dealt with more fully in the feasibility study to be produced by the Environment Agency (EA). Suffice it here to quote the aim of the restoration as set out in Janes, Mant and Fellick (2006):

*"To enhance the channel and floodplain habitat diversity by physical manipulation of channel planform, bed levels and flow patterns with a particular emphasis on reconnecting the flood-pain to the river channel."*

### **1.2. Background to ecological monitoring at Knepp.**

The re-wilding project began in 2001, when the first area of land was taken out of arable. Further parcels were taken out in 2005 and in subsequent years – for details see Greenaway (2005, 2006) and Knepp Caste Estate website<sup>1</sup>. The re-wilding project is interesting and thought-provoking. It raises many issues, not least of which is how allowing a more natural landscape to develop largely through the agent of large herbivores will affect biodiversity. In order to monitor these changes it was necessary to carry out a baseline ecological survey. Firstly, a summary of what was already known about the wildlife on the estate was prepared (Greenaway, 2005). Then a prioritised programme of fieldwork was implemented in the summer of 2005, the results of which are to be found in Greenaway 2006. This was intended to provide the basis for ongoing monitoring work. Since 2005, there have been additional baseline surveys and a limited number of repeat surveys. All the survey and monitoring work has been severely limited by the available funding.

Although the baseline surveys range over the whole estate, a considerable proportion of the effort was focussed on the floodplain. However, to date, the results of these particular surveys have not been assessed separately. With the renewed hope that the river restoration may finally commence, this report is aimed at getting together as much of the baseline survey work that has been carried out in the river

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<sup>1</sup> [www.knepp.co.uk](http://www.knepp.co.uk)

itself and on its floodplain. I would be happy to include surveys from other sources in this report, which it is hoped will be a working document that will be useful to identify significant gaps and to contribute to the feasibility study that is likely to be prepared by EA.

## **2. River corridor and floodplain surveys.**

Most of the pre-2005 surveys of the floodplain and the adjacent countryside are listed in Sussex Biodiversity record Centre's Environmental Survey Directory. This list is presented in Greenaway 2005 Appendix 1. Where relevant, these surveys are mentioned in the ensuing text.

Some of the more recent survey results are presented in this report, but for reasons of brevity, the lengthier datasets are omitted. Details of the results of the 2005- 2008 surveys are available either as appendices in Greenaway 2006, EN Research Report 693 downloadable from [www.naturalengland.org.uk/publications/default.htm](http://www.naturalengland.org.uk/publications/default.htm), or as raw data available on request from Theresa Greenaway.

### **2.1. Vegetation structure and vascular plant surveys.**

The river corridor and floodplain of the Adur and Lancing Brook were surveyed in 1991 by Clark and Finch as part of an assessment that led to the designation of the SNCI H18 Knepp Mill Pond, River Adur and Lancing Brook. In 2005, Kate Ryland (Dolphin Ecological Surveys) carried out an extended Phase II survey using NVC where possible across the whole Estate (Greenaway, 2006). In addition, eight belt transects were set up to monitor changes in the vascular plant communities as the re-wilding project progressed. One of these (Transect B2) started in Swallows Furzefield (TQ16067 20643) and extended north across the floodplain to the bank of the river, using 2 x 2m contiguous quadrats.

Ryland also carried out two surveys of aquatic and bankside vascular plants along the River Adur and Lancing Brook, one in August 2005 and the second in May 2007 (Appendix 1). The 2005 survey took place during a hot, dry spell in which the surface of both the river and the brook supported dense rafts of duckweed, mostly fat duckweed *Lemna gibba*, but also common duckweed *Lemna minor*. Both these species are associated with low flow rates and both are characteristic of eutrophic waters. There was far less duckweed in the spring survey of 2007. No species of conservation importance were recorded although great yellow-cress *Rorippa amphibia*, found on the River Adur on the section between Capps Bridge and the A24 is scarce in Sussex. This was recorded in 2005, was still present in 2007 and had spread downstream.

Fran Southgate also commissioned a vegetation survey of approximately 1.5ha of land at grid reference TQ151210, adjacent to the Lancing Brook immediately to the west of Tenchford Bridge. This was carried out by Kate Ryland on 24<sup>th</sup> May 2007 in warm, dry weather conditions. The purpose of the survey was to provide baseline information about the site before plans to create an area of wet woodland were implemented. The baseline survey will allow basic monitoring of vegetation changes to be undertaken in the future as the wet woodland habitat develops.

In addition to the above surveys, a Phase II (NVC) survey was also carried out by Rich Howorth (West Weald Landscape Project Officer, SWT) on the floodplain between Kingsbridge Lane and the A24, in August 2005 (Appendix 2 and Map). 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:

**Table 1. Vegetation communities of River Adur floodplain 2005.**

Community	Description
No NVC	<i>Holcus lanatus</i> dominated/mixed species grassland
MG13	<i>Agrostis stolonifera</i> dominated/mixed species/+ other species grassland
MG7(d)	<i>Lolium perenne</i> improved grassland
MG1	<i>Arrhenatherum elatius</i> – <i>Dactylis glomerata</i> rank grassland.
MG9	<i>Deschampsia caespitosa</i> dominated grassland.
No NVC	Various seeded grassland mixes, largely as arable reversion.
S6	<i>Carex riparia</i> swamp.
S22	<i>Glyceria fluitans</i> swamp.
S28b	<i>Phalaris arundinacea</i> swamp.
No NVC	Wet tall herbs (2 types) with much nettle.
W10(a?)	<i>Quercus robur</i> woodland (fringe).

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 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 was also found in isolated low-lying areas. A small part of W10 woodland occurred 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.

### **Transect survey**

Howorth also intended to record five pairs of transects across the river, using 2 x 2m contiguous quadrats and recording all vascular plants, leaf litter, bare ground and animal dung, but 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' (southern transect point TQ 16174 20631) was sampled over 3 days from 26<sup>th</sup> July to 2<sup>nd</sup> August 2005 (Appendix 3).

A total of 57 quadrats were sampled. Vegetation heights varied between 40-120 cm in the upper tier and 5-30 cm in the lower tier, and lacked an obvious pattern, except for a peak around 36-40m distance where a thistle patch occurred (Appendix 3, Fig. 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 (Appendix 3, Fig. 2).

24 vascular plant species were recorded, with 5 species 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 (Appendix 3, Fig. 3), without any statistical analysis, a few patterns of grass species dominance are apparent along the transect. *Hordeum secalinum* was present at variable frequency along almost the entire transect length, at times peaking at very high frequencies of c. 80%. 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. This was apparently the old river course, with lush vegetation and a different composition, with *Agrostis canina* present up to the riverbank but absent on the north side, where sown *Agrostis capillaris*

dominated. The agricultural grasses *Lolium perenne* and *Phleum pratense* were most prevalent on the north bank of the river.

This transect survey took a lot of time and was done late in the season, when wind and rain had caused the vegetation to lodge. Future surveys should be done in June for better grass cover assessment.

### **Wet woodland surveys**

In 2008, Neil Sanderson was commissioned by Fran Southgate to survey Wet Woodlands in West Sussex. This included Charlwood, an area of ancient woodland that just edged onto of the floodplain. Fran Southgate will hold the details of this survey, the report of which has not yet (July 2008) been received.

## **3. Fauna of River Adur, Lancing Brook and floodplain.**

### **3.1. Invertebrates**

Prior to 2005, there are very few records for invertebrate groups except for dragonflies, damselflies and butterflies. These, plus some additional groups of invertebrates were surveyed in 2005 (Greenaway 2006) and of these the following are relevant to the pre-project baseline information on the river restoration project.

**3.1.1. Odonata:** 20 species on SxBRC database prior to 2004. Dataset goes back to 1968, though not continuously recorded; & most records date from 1993-1995. Five species of conservation interest:

Hairy dragonfly *Brachytron pratense* Nb Sx RSI: Clean, still water bodies such as lakes, old ponds, gravel pits canals & ditches with abundance of vegetation. Benefits from traditionally managed grazing meadows & associated ditches, action of herbivores keeping some areas poached beneficial (Belden *et al.*, 2004).

Variable damselfly *Coenagrion pulchellum* Nb Sx RSI: Fens, water meadows, marshes and shallow ponds; slow-moving water. Favoured habitat in Sussex traditionally managed grazing pastures and associated ditches, with high water level & good range of aquatic and emergent plants (Belden *et al.*, 2004).

Downy emerald *Cordulea aenea* Nb Sx RSI: Prefers nutrient-poor, acidic, tree-lined or woodland (usually deciduous) ponds, lakes & canals. Occasionally slow-flowing rivers and streams with overhanging branches. Larvae live in slowly decomposing vegetation at the bottom of still waterbodies, so dredging is a serious threat. Nutrient enrichment also a threat. Loss of woodland ponds or clearance of their tree-lined fringes has negative effect on adults (Belden *et al.*, 2004).

Ruddy darter *Sympetrum sanguineum* Sx RSI: Well-vegetated ponds, lakes, gravel pits, canals and ditches, occasionally slow-flowing waters. Excessive plant clearance and pond dredging potentially disastrous, as larvae live amongst roots of aquatic plants. Need traditionally grazed water meadows (Belden *et al.*, 2004).

Black-tailed skimmer *Orthetrum cancellatum* Sx RSI: Large, shallow open ponds, lakes, gravel pits & occasionally slow-moving rivers, adjacent ditches and small ponds. Likes bare ground at waterside where males can sun themselves. Needs open water, not allowed to scrub over at the edges (Belden *et al.*, 2004).

Also recorded on River Adur, tributaries and elsewhere on Estate:

Large red damselfly *Pyrrhosoma nymphula*,  
Blue-tailed damselfly *Ischnura elegans*,  
Common blue damselfly *Enallagma cyathigerum*,  
Azure damselfly *Coenagrion puella*,  
Red-eyed damselfly *Erythronia najas*,  
Emerald damselfly *Lestes sponsa*,  
Beautiful demoiselle *Calopteryx virgo*,  
Banded demoiselle *Calopteryx splendens*,  
Brown hawker *Aeshna grandis*,  
Southern hawker *Aeshna cyanea*,  
Migrant hawker *Aeshna mixta*,  
Emperor dragonfly *Anax imperator*,  
Broad-bodied chaser *Libellula depressa*,  
Four-spotted chaser *Libellula quadrimaculata*,  
Common darter *Sympetrum striolatum*.

This indicates that even with intensive arable land-use bordering much of the river, Knepp was of significant interest for a wide range of species of Odonata, each with its particular habitat requirements.

On 2 days in June & July 2005, 14 species of Odonata were recorded; all these had been previously recorded but only 2 species of conservation interest were seen, hairy dragonfly and ruddy darter. Comparing 2 days records with all those between 1968–1995 is unrealistic, nevertheless, 14 species is a good total for such a restricted survey.

#### Interpretation of Odonata data.

Dragonflies present on the Estate have habitat requirements ranging from fast-flowing water (beautiful demoiselle) to still water (hairy dragonfly); open water (common blue damselfly) to shaded, tree-lined

ponds (downy emerald). Many species will benefit from the more natural grazing and browsing of the cattle and pigs.

As a group, Odonata are key indicators of diversity on wetland habitat on Knepp and as such, it is highly recommended that an in-depth Odonata survey should be undertaken in 2009, April – October, to get the full range of species and where they occur.

### **3.1.2. Wetland and aquatic molluscs.**

Martin Willing surveyed this group in October 2005, sampling 5 aquatic sites along the River Adur as it crosses Knepp and 2 terrestrial sites in damp ditches. A total of 23 aquatic and 7 terrestrial species were recorded. Willing stated that the freshwater molluscan community present in this stretch of the River Adur was one of low diversity and common taxa widespread in Sussex and elsewhere in southern England dominated by 5 species – *Lymnaea peregra*, *Physella acuta*, *Bithynia tentacula*, *Sphaerium corneum* and *Pisidium nitidum*. These are all tolerant of a wide range of freshwater habitats including stagnant and slightly polluted ones. The lack of extensive shallow marginal areas, together with a relative lack of macrophyte vegetation, may have reduced molluscan diversity.

Additional survey work in 2009 could be considered advantageous. This group could be predicted to benefit by the floodplain renaturalisation, although migration is likely to be slow if there are no source populations or dispersal agents. Perhaps a more extensive mollusc survey of upstream and downstream Adur might be considered. Certainly mollusc diversity should be monitored post-project.

### **3.1.3. Moths in the River Adur floodplain.**

No moth records were held on SxBRC database prior to 2005. Tim Freed surveyed moths in 2005, including sites in the R. Adur floodplain. His survey report states that 139 species of moths were recorded on the floodplain. Of these 31 (c.22%) were predominantly species of riverbanks, ditches and damp pasture including *Gynnidomorpha alismiana* (Nationally Scarce Nb), small scallop (Local), gothic (Local), southern wainscot (Local), double kidney (Local) and olive (Local), all of particular interest. Other significant moths from this site were 8 woodland species having Local status of which lunar-spotted pinion was of particular note. Interesting grassland species were: clover case-bearer (Local), *Aethes smeathmanniana* (Local), and *Celypha rosaceana* (Local).

Knepp Mill Pond also supports a number of moth species of conservation interest – Freed reports the following in 2005: 42 species



recorded, with 10 of these not recorded at the floodplain site. 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.

The Knepp wetlands thus already have a significant moth diversity, with a number of species of conservation interest. More extensive surveys covering a longer seasonal span could increase this total. Additional moth surveys on the pre-project floodplain are likely to make a significant contribution to the baseline pre-project data, if funding permits.

#### **3.1.4. Wetland and aquatic beetles**

There was virtually nothing known about Knepp Coleoptera prior to 2005. For the baseline ecological survey, Peter Hodge surveyed 4 locations:

Ditch TQ1565 2100 (1<sup>st</sup> June)

R. Adur: south bank TQ1520 (1<sup>st</sup> June and 23<sup>rd</sup> July)

R. Adur: north bank TQ1520 (1<sup>st</sup> June and 23<sup>rd</sup> July)

R. Adur: east bank TQ1521 (1<sup>st</sup> June and 23<sup>rd</sup> July)

Just two days fieldwork resulted in a total of 118 species of Coleoptera, 21 species 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 – a leaf beetle *Longitarsus rutilis*, a weevil *Notaris scirpi*, a weevil *Pelenomus comari*, pollen beetles *Melegethes gagathinus*, *Melegethes ochropus*, a flower beetle *Ishnomera cyanea*, a leaf-hopper bug *Oliarus panzeri*, a soldier fly *Odontomyia tigrina*, a solitary bee *Macropis europaea* and long-winged cone-head *Conocephalus discolor*. Except for the flower beetle and the cone-head, all of these species are dependent on wetlands or specific wetland macrophytes.

Hodge felt that with 118 species of beetles recorded in 2 days, the results of this limited survey were promising, and a more extensive survey of wetland beetles could only be expected to augment these results considerably. He considered that a wider, shallower river allowed to flow in a naturally meandering channel would provide considerably enhanced habitat for aquatic and wetland beetles, and changes in the beetle fauna would be interesting.

In addition, pitfall traps were set up by Professor Paul Buckland, one of which, C4, was sited by Middle Brook, old lagg grassland by River Adur. This resulted in 50 species, 41 of which had not been recorded by Hodge, and which probably included a higher proportion of grassland species<sup>2</sup>. Buckland's Coleoptera records for C4 are available in Excel format.

If resources permit, additional surveys of wetland and aquatic beetle species would be advantageous.

### **3.1.5. Invertebrates not surveyed.**

No survey work has been carried out on the status of other aquatic and freshwater invertebrates. As signal crayfish are known to occur downstream, monitoring this alien might be advisable.

## **3.2. Vertebrates.**

### **3.2.1. Freshwater fish.**

*I have very limited data on fish – this section could best be filled in by EA.*

### **3.2.2. Amphibians and reptiles.**

Pre-2005, great crested newt *Triturus cristatus*, grass snake *Natrix natrix*, adder *Vipera berus*, common lizard *Lacerta vivipara* and slow-worm *Anguis fragilis* had been recorded in various parts of the Estate. It is highly likely that great crested newt, grass snake as well as other amphibians will utilise both the existing floodplain and the post-restoration floodplain to a greater or lesser extent, although a partial survey by Mark Elliott in 2005 only located great crested newt in ponds in Renches Wood.

It is unlikely that further pre-project survey would make a significant contribution to the river restoration project, and additional survey work is therefore not recommended, unless there is funding left over from priority monitoring.

### **3.2.3. Birds.**

SOS has been conducting Wetland Birds Surveys (WeBS) at Knepp Mill Pond annually during the winter months since 1976/77, and some 122 species have been recorded (Chris Blandford Assoc., 2003). Knepp Mill Pond is particularly important for overwintering birds, and the proximity of this pond to the River Adur and Pulborough Marshes provides connectivity at a landscape scale, both for local movements of birds as well as for long-range migratory species (Chris Blandford Assoc., 2003). Many of those recorded are of conservation interest. In addition,

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<sup>2</sup> It is hoped to get more of this material identified in 2008.

the British Trust for Ornithology (BTO) Breeding Birds Survey Scheme 2005 has randomly selected the Grid Square TQ1520 to be surveyed annually by a BTO volunteer. There were initial delays, and the survey has only been carried out for 2007 and 2008. This square includes part of the River Adur and floodplain and just a small section of Lancing Brook where it joins the river. Helen Crabtree of BTO has kindly passed these records on to me, and this dataset will be of increasing interest over time. At this stage, it is not thought a priority to extend bird survey on the river corridor and floodplain.

### **3.2.4. Mammals**

Mammalian records prior to 2005 are largely casual observations rather than the results of *ad hoc* surveys.

#### Water vole, water shrew and otter.

There is an otter record at the junction of Lancing Brook and the River Adur dating 1994. In 2005, Fran Southgate identified evidence of both water vole and water shrew on the river corridor of both the Adur and Lancing Brook.

#### Bat.

A brief bat survey of the deer park area was carried out by Daniel Whitby in 2002. This identified six bat species – common pipistrelle *Pipistrellus pipistrellus*, soprano pipistrelle *Pipistrellus pygmaeus*, brown long-eared bat *Plecotus auritus*, noctule *Nyctalus noctula*, Natterer's bat *Myotis nattereri* and Daubenton's bat *Myotis daubentonii*. In addition, whiskered bat *Myotis mystacinus* and serotine *Eptesicus serotinus* have been recorded from nearby Shipley prior to 2005.

The Knepp Estate as a whole would be expected to have increasing bat use as the re-wilding project proceeds and a more insect-rich habitat mosaic develops. Daniel Whitby carried out a further bat survey in August and September 2005, part of which involved using two automatic bat loggers to detect bat activity along different stretches of the River Adur across Knepp. This produced records of five species, common and soprano pipistrelles, Daubenton's and Natterer's bats and serotine. In other locations across Knepp, bats were trapped so that their sex and breeding status could be ascertained. Six species trapped were either lactating females or juveniles, indicating that their nursery roosts are in or close to the Estate. All bats, especially lactating females, need to drink and the water resource at Knepp is therefore a major contribution to the bat habitat requirements.

On-going work in summer 2008 involving radio-tracking barbastelle bats *Barbastella barbastellus* from The Mens reserve has shown that at least one female flies c. 14km from The Mens to forage in the southern part of Knepp (F.Greenaway, pers. comm.). This Habitat Regs Schedule II

UKBAP Priority species breeds in dense woodland but forages over water meadows and coarse, wet grasslands. The restored floodplain will undoubtedly extend suitable barbastelle foraging habitat. A full report on this will be available later in the year.

The 14 or so bat species likely to be breeding in southern England all have different breeding and foraging habitat requirements. Two species, soprano pipistrelle and Daubenton's bats, habitually forage over water. In general, breeding female bats forage in the best, most insect-productive sites, and the more solitary male bats make do with sub-optimal foraging habitat. Trapping (mist net and harp trap) bats enables the sex to be ascertained, and thus acts as a highly useful indicator of habitat quality.

A full bat survey of the River Adur floodplain and its tributaries prior to river restoration work is therefore highly advisable, and likely to be a requirement of an EIA, especially if there is any tree-work required. Trapping and radio-tagging an individual female bat (under licence) of all species caught in spring would enable nursery roost sites to be located. Post-project bat surveys would also contribute valuable information to river restoration projects.

#### **3.2.6. Monitoring the activity of large herbivores on the floodplain area.**

At the time of first writing this report, July 2008, Charlie Burrell was on the verge of ordering 6 radio collars from BlueSky Telemetry. These collars will allow detailed GPS information to be remotely downloaded and mapped on ArcView. It is as yet undecided who will carry out the mapping. This is likely to be an important source of information on large herbivore activity under the extensive and more-natural grazing regime implemented at Knepp.

### **3.3. Other surveys.**

#### **3.3.1. Fixed-point photographs.**

Fixed point photographs have been taken annually since 2005 along the butterfly transect surveyed by Rich Howorth. Some 10 points lie along the floodplain. These photographs are available on CDROM from Theresa Greenaway.

## **4. Summing up.**

### **4.1. Vegetation.**

The information collected on the ecology of the River Adur floodplain allows a fair assessment of its pre-project status. The vegetation overall displayed a relatively impoverished state of structure and community, with, however, scattered areas of richer, relict vascular plant communities. There are no species of national or regional conservation importance, though a few are of more local Sussex interest.

## **4.2. Fauna.**

Survey work on vertebrates and invertebrates is still somewhat patchy but has nevertheless contributed to a fair baseline inventory. It has also identified the presence of a number of species of conservation interest, some of which are protected under the Wildlife and Countryside Act (1981) and a few of which are UKBAP Priority species, with Species Action Plans in place.

### **4.2.1. Invertebrates.**

Some groups of invertebrates are somewhat depauperate, notably freshwater molluscs; other groups have fared better. The Odonata species have survived river engineering and knock-on effects of intensive agriculture on the water quality, and the species diversity of dragonflies and damselflies is good, with 5 species of conservation interest recorded relatively recently. The presence of three of those not re-recorded in 2005 could well be confirmed with further survey work. There is a good diversity of wetland moths and wetland beetles, with species of conservation importance found in both groups in 2005.

### **4.2.2. Fish**

*Fish – EA to provide comment please.*

### **4.2.3. Mammals**

Water voles, otters and water shrews – *Fran, please could you send me a summing up para.*

Bats. The bat species logged along the River Adur in 2005 indicates a fair diversity, but a better interpretation cannot be carried out until further work that identifies the presence or otherwise of breeding females is undertaken. The occurrence of the foraging female barbastelle over this area in 2008 is of considerable importance, owing to its legal status, that it is a UKBAP species and the fact that it is breeding in a Special Area of Conservation (SAC), The Mens. Bats are likely to be a very good indication of water and wetlands quality. An improved river and floodplain should lead to a higher diversity and biomass of invertebrates, which in turn would be shown by the bat community.

## **4.3. Photography.**

The fixed-point photographs are useful, but aerial photographs before and after river restoration would be desirable.

## **5. Recommendations**

Subject to funding, the following pre-project surveys are strongly recommended. These should be planned and commissioned in winter 2008 / 2009 and carried out where appropriate in 2009, prior to work commencing on the river re-naturalisation in 2010.

- Survey fixed-point belt transects across the floodplain, completing and / or extending work carried out by Rich Howorth and Kate Ryland in 2005.
- Consider repeat Phase II vegetation mapping along floodplain.
- Carry out a full Odonata survey along river corridor / floodplain May – September 2009.
- A wetland / aquatic mollusc survey – also include any mollusc data from upstream and downstream stretches of the river. Extend survey to these areas if funds allow.
- If resources permit, carry out additional surveys of wetland and aquatic beetles.
- Survey and update signal crayfish status in R. Adur.
- *Fish surveys EA please comment.*
- Repeat surveys for water vole, water shrew and otter.
- Full bat survey of the River Adur floodplain and its tributaries on Knepp. Trapping and radio-tagging an individual female bat (under licence) of all species caught in spring to enable nursery roost sites to be located and for importance of restoration area to be evaluated (NB – In the event of an EIA this will almost certainly have to be done as all are protected.)
- Aerial photographs of the floodplain before restoration commences are recommended. Co-ordinates needed so that repeat photographs could be taken post-project.
- Funding needed to cover fieldwork, project management, report etc.
- Other? *Please add.*

## References

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## Appendices

**Appendix 1.** Aquatic and bankside vascular plants, River Adur and Lancing Brook.

**Appendix 2.** Vegetation survey of floodplain and transect crossing R.Adur corridor.

**Appendix 3.** Analysis of River corridor transect.

**Map of floodplain vegetation survey.**