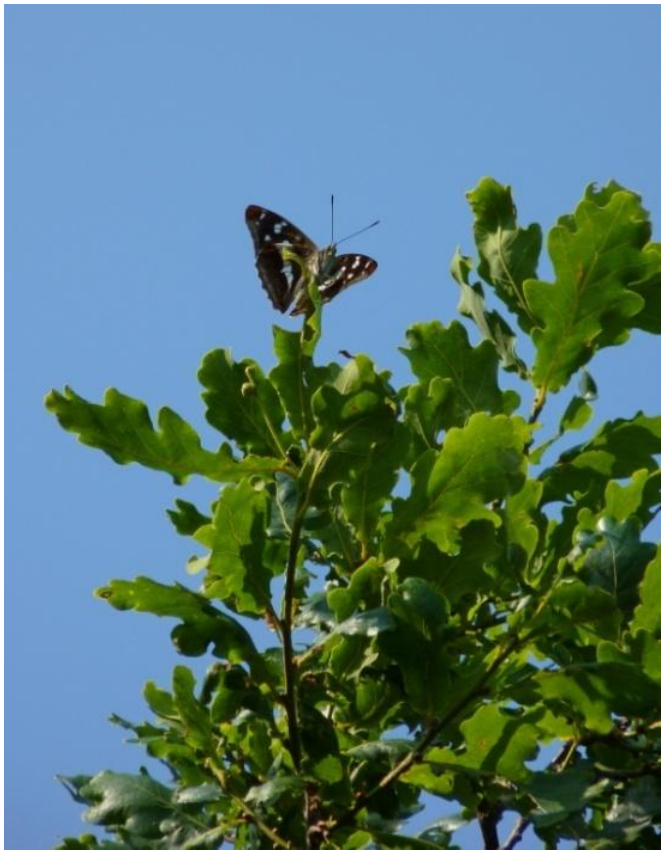
Knepp Wildland Project

Annual biodiversity report and monitoring update 2013



Purple Emperor ***Neil Hulme***

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December 2013

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Contents

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1. Introduction

The Knepp Wildland Project continues to thrive, and despite one of the coldest springs on record, surveillance and monitoring of the flora and fauna benefiting from wildland management is really starting to show positive results. As in previous years, the monitoring of breeding birds, butterflies and ragwort has been repeated, and there have been a number of more casual observations. Perhaps the biggest single event was the recording weekend organised by Penny Green (Manager, Sussex Biodiversity Record Centre), which took place on 1st & 2nd June 2013, when many keen recorders descended on Knepp to make a note of everything that grew, flew or scuttled. This weekend will have made a valuable contribution to the ever-growing Knepp species database. Also in 2013, three MSc students from Imperial College of Science, Medicine and Technology based their theses on different aspects of the Wildland Project, and the report of a fourth student who carried out her fieldwork in 2012 was received. It is very rewarding to see that such students are now able to utilise an increasing amount of the surveillance work that has been slowly accumulating since monitoring began in 2005. Their research is also making a considerable contribution to our knowledge of how the Project is benefiting wildlife and the wider environment.

2. Summary of surveys

Table 1. 2013 fieldwork

Survey/Report	Surveyor	Site	Time
Brown hairstreak eggs	Neil Hulme	Southern Block	January
Butterfly survey	Neil Hulme	N, M & S Blocks	August
Purple Emperor	Neil Hulme & Matthew Oates	Southern Block	July
Earthworms & pig impact	Joseph Cole	Southern block	May-June
Barn owl survey	Barrie Watson	Southern Block	July
Breeding Bird Survey	BTO volunteer	TQ1520	April & June
Breeding Birds	Paul James	E/W N Block, N/S S Block	April-June
Bird track	John & Sheila Maskell	Honeypools & Brookhouse	Various
Re-wilding and birds of Conservation concern	Isobel Donovan	Southern block	April-May
Winter Thrush Survey	Simon carter	Southern block	January & February
Yellowhammers & re-wilding	Tim Saunders	Southern block	June
Reptiles	SARG	2 areas in Southern block	May-September
Ragwort Survey	Patrick Toe	16 fields, S block	July
Edible fodder survey	Amy Nightingale	Southern block	June, Aug, Oct
Bryophytes	Tom Ottley	Across estate	June
Vascular plants	Nick Sturt / SBRS	Across estate	June
Recording Weekend	SxBRC	Across estate	June
Miscellaneous records	various	Across estate	Various

A considerable amount of fieldwork and surveys has been carried out in 2013 (Table 1). Copies of completed reports can be obtained from Knepp Castle Estate. Raw data is either held by Knepp Castle Estate, T. Greenaway or the surveyor and copies of all thesis reports received are also available from the estate. Summaries of the 2013 surveys are presented in S.4 and S.5. Additionally, a summary of the Nightingale survey carried out by Olivia Hicks in 2012 is included. This important survey report was not available in time for the 2012 Annual Update.

3. Recording weekend.

In order to boost the information held on Knepp species diversity, a Recording Weekend was held over 1st and 2nd June, 2013. Organised by Penny Green, some 40 ardent specialists spent an enjoyable two days exploring and recording as much flora and fauna as possible. Some stayed for the whole 2 days, others for either Saturday or Sunday. A range of taxonomic groups was covered: plants, mosses, invertebrates (beetles, moths, dragon-and damselflies, spiders etc), birds, amphibians, reptiles and the occasional mammal. Not all of the reports and species lists have yet been received, many surveyors leaving field work identifications to do over the winter months, but at the time of writing, over 400 species records have been received. Many of these are not only new additions to the Knepp database, but also either new county records for West Sussex or records of species of conservation importance. To date, 10 invertebrate species of conservation importance have been identified, the most significant of which is possibly the beetle *Pyrrhidium sanguineum* recorded by Peter Hodge. This species was only found for the first time in Sussex last year and appears to be colonising quite quickly. Interesting records are also to be expected from Sarah Patton as she heroically delved into deer and crow carcasses!

Groups such as bryophytes and spiders have received little of no attention previously and the bryophyte report (see S.5.4) was of therefore of particular interest. The Sussex Botanical Recording Society's report is also summarised, see S.5.3. When all records have been submitted, it is hoped that a report will be produced assessing the achievements and value of this recording marathon.

4. Fauna

4.1. Breeding bird survey

This survey repeated that of 2005, 2007 to 2011 and 2012. The purpose of this survey is to monitor changes in breeding birds over time as the Estate moves away from intensive arable land use to a more natural grazing system. The survey was undertaken by Paul James (James, 2012), who also carried out the previous years' surveys. Two transects were surveyed from late March – June, one in the area north of the A272 and east of Shipley Road (area A) and another in the area south of Countryman Lane and west of New Barn Farm (area B). Ten visits were made to each transect. The surveys were conducted and the results mapped using the standard Common Birds Census species and activity codes, and digitised by Amy Nightingale (Knepp Castle Estate).

Spring 2013 was the coldest in the UK since 1962, with temperatures for March, April and May below the long-term average for each month. Spells of warm weather through the season were very short-lived, until it finally warmed up in July, achieving mean temperatures of above average. The low spring temperatures may have delayed breeding, but it also delayed the departure of winter visitors such as fieldfare, redwing and woodcock which were still present in early April, resulting in a record total of 66 species for this year's annual survey. Three species new to this survey, green sandpiper, great black-backed gull and fieldfare, were recorded, bringing the total since 2005 to 83. Of the 66 species recorded, 13 were Red List Species of High Conservation Concern and 19 Amber

List Species of Medium Conservation Concern as identified by the latest assessment of the status of all of the UK's 246 regularly occurring birds (Eaton *et al* 2009).

The number of territories for each species shows some interesting trends compared with previous years. For the first year since the surveys commenced, there were no Skylark territories along transect B (Southern Block), continuing the decline from 11 in 2009, nine in 2010, four in 2011 and three in 2012. The explanation undoubtedly lies with habitat change and the encroachment of bramble and willow into formerly arable fields. This may also account for the decrease in Yellowhammer territories from 8 in 2008 to one in 2013. Whitethroat had another poor year with just 5 territories along transect B in 2013 compared with 19 in 2009. Given that Whitethroat shows a preference for low scrub and brambles, it is likely that the reasons for this decline lie elsewhere.

There were a number of notable species, including:

- **Red kite** (Amber list) Single sightings of red kite on both transects plus a number of other reports of up to two birds over the spring and summer raise the likelihood that colonisation of the Estate by this species is imminent.
- **Hobby** (Schedule 1) Alarm calls and territorial behaviour noted on two occasions from Bar Furzefield (Transect A) indicate nesting. A pair of hobbies was also noted at this site in 2011.
- **Peregrine** (Schedule 1) A single adult on a pylon along transect A on 3rd June (following two similar records in 2012) again raises the possibility of future nesting on the Estate.
- **Lapwing** (Red list) A single bird displaying in Brookhouse 8 on 6th April and a pair in Brookhouse 10 on 15th April (both transect B) raised hopes of nesting, but not seen again.
- **Turtle dove** (Red list) Turtle doves were not recorded from transect B until 18th June when 2-3 males were heard 'purring'. Either the birds were late arriving or the cold, late spring had not provided suitable conditions for singing. Turtle dove has become increasingly rare in the UK so its continued presence on the Estate is particularly encouraging.
- **Cuckoo** (Red list) A difficult bird to survey as singing birds may be encountered almost anywhere on the Estate south of Countryman Lane. Probably there was just one territory along transect B in 2013 near Lower Barn where a singing male was noted on several occasions. A fledged juvenile was seen at the northern end of Bull Field on 18th June.
- **Barn owl** (Amber list) A pair was recorded on several dates at Lower Barn (transect B). No attempt was made to inspect the nest box so it is uncertain whether nesting occurred.[1]
- **Woodlark** (Red list) A singing male in Brookhouse 8 on 9th June only. This record conforms to the pattern of previous years with presumably unpaired males singing for a day or two from widely scattered locations across the Estate.
- **Nightingale** (Amber list) Three territories recorded along transect B. An interesting development was the presence of a singing male in scrub in Brookhouse 4. This demonstrates how ecological succession is benefitting this species on the Estate where record numbers were recorded in 2013.

4.2. BTO Breeding Bird Survey (TQ1520)

The BTO Breeding Bird Survey[2] takes place annually over a number of 100m grid squares, one of which (TQ1520) lies within the Wildland Project area. A transect across this square has been recorded by volunteers since 2007, with one survey taking place in April each year and a second in June. The Sussex Branch of the BTO kindly forwards the results. Since 2007, a total of 56 species has been recorded in this square. This year, 28 species were recorded in April and 27 in June. No new species were seen. The June survey resulted in the highest numbers of blackbirds, rooks and house

[1] See S.4.3. report on barn owl monitoring.

[2] http://www.bto.org/bbs/

sparrows. This is encouraging news for house sparrows as populations of this once very common bird are still low and it is now on the Red List of Conservation Concern. The increasing availability of invertebrates may well be benefiting this species, which feeds its young on insects and other invertebrates. The eventual results of the BTO survey will be an interesting assessment of population trends across the UK, and will enable the Knepp results to be evaluated accordingly.

4.3. Barn owl survey

Barrie Watson annually records barn owl breeding in nest boxes positioned in barns and trees across the Estate and rings the chicks. 2013 was a bad year for barn owls, the long cold spring having a considerable impact on breeding. Only one pair attempted to nest. One chick and one adult were ringed, and one adult first ringed in 2007 was observed. The total number ringed since 1996 thus only rose by 2, bringing the number to 139.

4.4. Winter thrush survey

Simon Carter carried out a winter thrush survey on parts of the Southern Block over 3 days in January and February 2013. Blackbirds, Song thrushes, Fieldfares and Redwings were recorded. The aim was to start an assessment of the populations and habitat use of these four species over winter in Knepp. In 2013, the berry crop was poor, and it was thought that resident and migrant thrushes were feeing additionally on terrestrial invertebrates.

4.5. Nightingales and the Wildland Project – a thesis.

The field work for this thesis was carried out in the summer of 2012, but the report was not received until 2013. It is included in this year's report as it represents a significant, and extremely interesting, study. As part of her Master of Research degree at Imperial College, Olivia Hicks presented a thesis entitled "The impacts on bird diversity of re-wilding an intensive farm – a focus on the nightingale *Luscinia megarhynchos*". This study aimed to determine the effects of near-naturalistic grazing on nightingale habitat. The North, Shipley and Southern Blocks of the Knepp estate were surveyed, together with two nearby external farms that functioned as comparisons. Both these farms were managed intensively, similar to the way Knepp was managed prior to the re-wilding project. With a predicted outcome that extensive grazing systems would support significantly higher levels of nightingale habitat than intensive systems, and therefore higher levels of paired nightingales, the study also aimed to investigate possible changes to nightingale conservation policy.

Field work was undertaken in site visits during May 2012. During visits, each site was systematically surveyed for male nightingale territories. Nightingales are extremely territorial birds and territories are rarely closer than 50m, enabling the territories to be mapped without duplication. A total of 43 nightingale territories was found across all sites. There were 34 territories on the Knepp Estate and a further 9 on neighbouring intensive farmland. Paired nightingales were found to be significantly more abundant on extensive farmland than intensive land.

During the late 1990's 2 nightingale territories were noted by Charlie Burrell for 3 years but disappeared before the start of the re-wilding scheme. One nightingale territory was recorded in the Southern Block in 2005 by Paul James (Greenaway 2006). By changing the land management from an intensive system to its current extensive management regime, Knepp has increased nightingale territories to 34 in just over 10 years, with a significantly higher percentage of paired birds than neighbouring intensive farms. This strongly implies that the extensive management system has vastly improved nightingale breeding habitat. The most significant cause for this is hedgerow width.

Nightingale territories were only found in scrub or field margins of 8 metres or more in width. This broad width is needed to enable the central portion of the hedge to establish maturity and provide a portion of open ground beneath the hedge canopy. Nightingales nest close to the ground and

therefore need dense habitat and protection from predation, but also need sheltered open ground for invertebrate foraging. Browsing may have a negative on basal hedge thickness, but the spiny and freely suckering blackthorn *Prunus spinosa* causes increasing width and density of hedgerow faster than other species. Hicks concluded that this study has provided strong evidence that nightingales should be re-categorized as a farmland bird so that changes in conservation effort could be made where appropriate on farmland to increase potential habitat for breeding pairs.

4.6. Re-wilding and Birds of Conservation Concern – a thesis.

Imperial College MSc student Isobel Donovan studied the effects of re-wilding on breeding bird performance. The 2005 baseline survey (Greenaway 2006) recorded 8 Red listed breeding bird species and 14 Amber listed species and the Breeding Bird survey of 2011 (James, 2011) recorded 10 Red listed bird species and 12 Amber listed bird species. Following on from this, and from the nightingale habitat survey of 2012 (Hicks 2012), Donovan based her study on an investigation of the densities of some of these Red and Amber listed species – residents: yellowhammer (*Emberiza citronella)*, linnet (*Carduelis cannabina),* green woodpecker (*Picus viridis)* and song thrush (*Turdus philomelos)*; migrants cuckoo (*Cuculus canorus*), whitethroat (*Sylvia communis*) and nightingale (*Luscinia megarhynchos)*. The aim was also to investigate whether heterospecific attraction (a process by which migrant bird species use resident species for cues to high quality breeding habitats) was augmenting these densities or whether other processes might also be acting to increase these species on Knepp.

The fieldwork was carried out on the Southern block and, for comparison, at Prior's Byne Farm in Partridges Green, West Sussex. The sites were surveyed by means transects visited during April and May 2013. Data was analysed to produce estimated densities. The estimated densities of the birds surveyed at Knepp were found to be higher than estimates of bird densities in high quality European habitat and higher than density estimates at Priors Byne.

Two species, cuckoo and song thrush, that had high densities in the Southern Block were not recorded at Prior's Byne. It is thought that agricultural practices have reduced the foraging resource for song thrushes, the absence of which on Knepp may have helped promote key prey items on which song thrushes depend. The breeding success of cuckoos is considered to be dependent on successful breeding attempts by their host species, but habitat structure may also be important. Females rely on vantage points in order to survey for host nests and the habitat mosaic found in the Southern Block may contribute to the high density of cuckoos in this area.

As a result of her study, Donovan suggested that cuckoo, nightingale and green woodpecker could be used as subjects for focal species modelling, which can be used to develop ecological networks, restoring ecological function and conserving biodiversity. Regarding heterospecific attraction, for six out of seven predicted attractions only one was seen to be significant, and even this was subject to interpretation. Donovan stated that the results of this study must be interpreted with caution due to its observational nature. Constraints include possible observer bias, the limited time available for fieldwork, and the effect the cold spring of 2013 had on the arrival and performance of breeding migrants. Nevertheless, this thesis provides an interesting assessment of aspects of the Wildland project some 10-15 years after its inception.

4.7. Yellowhammers and re-wilding – a thesis

Imperial College MSc student Tim Saunders selected the Red listed Yellowhammer as the subject of his thesis, entitled "The Impact of Landscape Level Arable Reversion on Invertebrate Feedstock for Yellowhammers". This study aimed to determine the key features in an evolving landscape that influenced the level of yellowhammer activity, exploring how the re-wilding project has affected

invertebrate and yellowhammer populations and the relationship between the two. The study was carried out in June 2013 on the Southern Block at Knepp, and Prior's Byne Farm, Partridge Green. Data in the Southern Block was collected from fields re-wilded in consecutive years 2000 - 2006, creating a chrono-sequence used to examine the effect of succession on the provisioning of summer food for yellowhammers. Prior's Byne farm was used as a control site, the fields selected were intensively managed wheat fields with 6m field borders. A total of 61 individual yellowhammers were sighted and 1139 calls recorded across all sites.

This survey indicated some interesting results in terms of yellowhammer habitat preferences. It was found that an increased sward height had a negative effect on yellowhammer call density, with an optimum height being around 21cm, suggesting that sward height is an important component of feeding habitat selection. No significant association was found between yellowhammer call density and the year in which fields were entered into the re-wilding scheme. No significant differences in plant communities between fields of different ages in the Southern Block were observed, except for increases in the mean percentage cover of blackthorn, oak and bramble. In contrast, invertebrate communities were markedly different across the southern block and show a relatively clear response to the number of years since the land was set aside. The highest number of invertebrates caught in any transect at Prior's Byne was lower than the median abundance within all fields sampled in the Southern Block.

The case for ecological trade-offs resulting from landscape level re-wilding is strongly supported by the yellowhammer habitat associations demonstrated in the analysis. Yellowhammers feed their young on invertebrates but as adults rely largely on seeds. The maturation of the re-wilding project may provide increasing supplies of invertebrates during the summer months, but ecological succession to a relatively stable point determined by the near-natural grazing regime could also mean species and structures that have a negative relationship to yellowhammer sightings and call density at field level. The majority of the individual yellowhammers sighted were in or beside the boundary hedges, with very few being sighted within scrubby areas in the middle of fields.

Yellowhammers seem to exhibit flexible rather than narrow foraging strategies, having strong associations with different invertebrate groups depending on availability. Some yellowhammer habitat associations were found to differ between the re-wilded land and the control land (cereal crops with 6m borders and hedgerows). These differences are of great interest when considering species specific conservation strategies, such as the most appropriate strategies for locations in which yellowhammer populations are particularly vulnerable. This study was limited by the time available, and the methodology necessary to meet the time constraint. It has highlighted many areas that would benefit from further survey work.

4.8 Reptile survey

A preliminary reptile survey was undertaken May-September in 2013 by Sussex Amphibians and Reptile Group (SxARG). The aim of this pilot was to ascertain methodological and logistical constraints prior to beginning wider scale surveys in 2014. Two survey areas were established in the Southern Block, Site 1 an area of tussocky grassland and scrub south of Smoke House farm, and Site 2 an area of grass, scrub and trees adjacent to the northern edge of Hammer Pond. Reptile refugia (aluminium tins) measuring 50 x 50 cm were used on both areas.

This preliminary study highlighted the presence of two species of reptile, slow worm and grass snake, within both survey areas although these have been observed in different densities between sites with Site 2 showing higher numbers of both. The pilot programme confirmed that SxARG is able to undertake the required number of checks on refugia and that more than two areas can be surveyed simultaneously. A strategy for the 2014 reptile season will now be devised to cover more areas and to assess reptile species distribution across the estate.

4.9. Butterfly surveys.

4.9.1. Northern & Middle Block

Butterflies have been surveyed annually, usually in July, for nine years (2005-13 inclusive), as part of the overall monitoring programme. These surveys of the Northern and Middle Blocks were initially conducted by Rich Howarth of the Sussex Wildlife Trust, but in 2012 the task of monitoring butterflies over the wider Wildland Project area was taken on by Neil Hulme, Conservation Adviser for the Sussex Branch of Butterfly Conservation.

The standard UKBMS Transect technique previously employed by Howarth has been maintained for the Northern and Middle Blocks, the details of which have been described in earlier reports. The key feature to note is the subdivision of the Transect route into 26 recording 'parcels'. This year the Transect was again walked over two days, 1st and 3rd August, as it is difficult to complete the route within a single day during the hours when butterflies are likely to be on the wing. Twenty-three species were recorded in 2013, the highest number since surveying commenced in 2005. This is a significant increase over the 13 species observed in 2005 and the lowest figure of 12 for 2008. It provides the firmest indication yet that some species are reacting positively to habitat change across the Northern and Middle Blocks. Butterfly abundance has remained remarkably consistent, particularly over the last six years. Given the limitations of a single Transect survey each year and the predominance in July of the ubiquitous Meadow Brown and Gatekeeper (together contributing 58% towards the total count in 2013), this is perhaps unsurprising. Species diversity and trends amongst more specialised butterflies are more likely to reflect improvements in habitat quality, and may ultimately prove to be more sensitive indicators of change.

The Green-veined White again showed an increase in abundance and occurrence across the survey area. This is likely to be due to an increase in the abundance of the crucifers on which the caterpillars feed around hedge bases, ditches and other damper areas. Suitable foodplants include Garlic Mustard (*Alliaria petiolata*), Cuckooflower (*Cardamine pratensis*), Charlock (*Sinapis arvensis*) and Large Bitter-cress (*C. amara*).

The increase in abundance and spread of the Essex Skipper in 2012 was not maintained this year, but the closely related Small Skipper did appear in greater numbers and over a wider area than in previous years. The Small Skipper caterpillar feeds mainly on Yorkshire Fog grass *Holcus lanatus*. When looked as a group, these 'golden skippers' do appear to be doing well across the Northern and Middle Blocks, but it will be necessary to observe a sustained trend over a period of several more years before firmer conclusions can be drawn.

4.9.2. Southern Block Timed Count Surveys

In 2012 it was decided to introduce two additional annual surveys along a fixed route planned to cover a variety of habitats over part of the Southern Block. Following a route determined in 2012, the two surveys in 2013 were carried out in May and July. The aim was to record butterfly species flying over a wider period than previously. The Southern Block surveys are conducted as Timed Counts, with a standardised period of recording being spent (flexibly) within each of the named survey sections (e.g. 'Sallow Fields') along the route. A more generous survey corridor is allowed than in the Transect survey and with no ceiling to the recording cube, it is possible to record arboreal species. There is also no requirement to walk at a steady, rapid pace, so that more interesting habitat patches can be examined more thoroughly, potentially allowing for the sighting of less common butterflies.

The **May survey** aimed to record early flying butterflies. Only 12 individuals of 6 species were seen, a rather low number probably reflecting the prolonged, cold spring weather. The most notable

observed were the Orange Tip and Small Heath, a UK Biodiversity Action Plan (UKBAP) Priority Species (for research only). Both species may prove useful in monitoring habitat changes across the Southern Block.

The **July survey** aimed to record high summer species, and revealed an impressive number and diversity of butterflies, with 1137 individuals and 23 species being recorded across this part of the Southern Block. This is significantly more than the 549 individuals and 16 species recorded in 2012. However, after only two years of data collection it is difficult to interpret the significance of these increases, particularly when considering the influence of weather; 2012 was the worst year on record for butterflies across the UK. Unsurprisingly, the Meadow Brown and Gatekeeper dominated the assemblage, contributing 67% to the total count.

Several widespread and quite common species may prove useful in monitoring habitat changes across the Southern Block, namely Small Skipper, Green-veined White and Marbled White. Although there is no suitable breeding habitat for the species, and none is likely to develop, the Chalkhill Blue provided a welcome addition to the record list. Two male butterflies made the long journey from downland colonies to the south.

The occurrence of Purple Emperor butterflies over 8 survey sections is of particular interest. This is an uncommon and highly elusive species, more usually associated with oak-rich, mixed woodland habitats. There can be little doubt that the Purple Emperor has reacted spectacularly to the development of Sallow (*Salix* spp.) scrub over large areas of the Southern Block, providing the butterfly with very extensive breeding habitat. This species is discussed in greater detail in the Purple Emperor survey report (S.4.6.3).

4.9.3. Purple Emperor survey

Surveys conducted by Purple Emperor expert Matthew Oates (National Trust) at Knepp in 2009 found that this species was just starting to breed in the extensive sallow (*Salix* spp.) scrub developing over former arable land. Prior to then, it probably occurred only intermittently over the Wildland project area, wandering in from woods to the north and south east during good summers and dying out during poor summers. In 2012, a very poor year for almost all butterflies, the Purple Emperor surprisingly appeared during a Timed Count survey of the Southern Block.

In 2013 a survey focussing on the Purple Emperor butterfly was introduced. This species is invariably under-recorded by most standardised survey methods, due to its arboreal lifestyles and highly elusive habits. Neil Hulme and Matthew Oates employed an informal methodology, searching the areas considered most likely to reveal the presence of the butterfly based on detailed knowledge of the species' autecology. A large area within the Southern Block was surveyed on 20th and 21st July 2013 specifically to determine to what extent the Purple Emperor has colonised this area of the Wildland Project. The 84 and 72 individuals recorded consecutively surpassed expectations. A short, follow-up evening survey on 24th July resulted in a further 30 records.

Due to the almost linear habitat (most males collecting on the medium to large oaks (*Quercus robur*) along field margins), and speed of survey, it is considered that significant double counting is highly unlikely and these totals are probably a rather conservative reflection of total population size. To place these figures in context, the Southwater Woods to the north of the A272 are considered to be the species' stronghold in Sussex, providing sightings of about 20 individuals per day in the best seasons.

The Knepp Estate now appears to hold the UK's second strongest population of Purple Emperors. This is especially significant as the butterfly almost invariably occurs at low population level and very few really sizeable colonies are known. Only the Fermyn Woods complex in Northants can better these statistics. The Knepp population has developed remarkably quickly and, as the areas of sallow scrub develop further over the estate, it is considered likely that the population of Purple Emperor will continue to increase. These observations demonstrate quite clearly that the Purple Emperor should not be considered as a species confined to mature, oak-rich woodland habitats. It is clearly able to thrive in much more open countryside, in areas where suitable specimens of its food-plant (*Salix* spp.) grow in profusion.

4.9.4. Brown hairstreak egg survey.

Winter Brown Hairstreak butterfly egg surveys are now included as part of the extended Knepp Castle Estate Wildland monitoring programme, initiated during 2012. The methodology comprises a timed count over areas where suitable blackthorn growth occurs in five areas in the Southern Block. It was conducted on 2 occasions in January and March 2013 by Neil Hulme. A measure of their relative density was achieved by calculating the number of eggs discovered per hour of searching. The search for eggs over five areas within the Southern Block revealed highly variable densities, ranging from zero discoveries per hour, to 23.

The first four areas searched yielded very modest results, ranging from zero to 4 eggs per hour of searching. These results are typical for areas of the wider landscape in which Brown Hairstreak occurs, but which are situated some distance from epicentres of activity, including the assembly trees around which males congregate and breeding occurs. Females are known to disperse over long distances away from these areas, laying eggs at low densities. Evidence of browsing of the food-plant, which can result in the removal of a high percentage of the eggs laid, was noted as being widespread over all these areas. The browsing action of herbivores has probably significantly reduced the number of eggs.

The fifth area examined, running close to the fence-line along the eastern margin of field Brookhouse 5, produced a count of 23 eggs in one hour. Despite the heavily grazed nature of blackthorn suckers in this area, which will undoubtedly have resulted in the removal of a large number of eggs, this represents an unusually high density, reflecting the activity of probably half a dozen or more female butterflies. This is perhaps unsurprising, given the quite close proximity of the area to the Brown Hairstreak master trees (male assembly area) discovered on 22nd August 2012 at the Hooklands Lane/Green lane intersect.

4.10. Earthworm abundance and the impacts of pigs – a thesis

Earthworms are well-known to have a beneficial effect on soil structure. However, pigs predate earthworms, which they locate by pushing their snouts through the soil. Imperial College student Joseph Cole studied the effects of pigs on earthworms for his MSc thesis. The aims were to determine whether pig rooting was having an effect of earthworm abundance and species diversity, and also on soil conditions such as moisture content, temperature, pH and infiltration. The field work was undertaken in May and June 2013. The survey area was the Southern block, across which 93 sites were selected covering areas disturbed by pig activity and undisturbed areas. Impressively, 1,289 earthworms of 19 species were recorded in the samples taken. The survey showed that pig rooting activity did significantly reduce both the abundance and diversity of earthworms. This could indicate that pig numbers ought to be limited to avoid excessive earthworm predation, but Cole suggested that there should be further studies to assess these impacts over greater spatial and

temporal scales. This is the first time such a study has been made within the Wildland Project area and it is well worth reading Cole's full report.

5. Flora

5.1. Ragwort Monitoring

This was the fifth year that ragwort has been monitored. Patrick Toe carried out a visual assessment plus photographs of the 16 fields he first surveyed in 2009 (Toe & Greenaway 2013). Ragwort abundance continues to fluctuate considerably from year to year. Five fields merited a rating of Abundant in 2013, in contrast with only two fields in 2012. Barn Field has the highest ranking over the past five years of the survey, ranking 'A' four times and 'F' once. Oaklands 2 and Broomers have each ranked 'O' for all surveys, making these two fields consistently the best regarding ragwort abundance, so far confirming a trend indicated in the 2012 survey. It was suggested in the 2012 Survey report that perhaps Barn Field should have additional ragwort control. This may still be worthwhile; but it may also be constructive to study the conditions prevalent in Barn Field in comparison with those in Oaklands 2 and Broomers.

5.2. Common fleabane

In August 2013 Charlie Burrell emailed the Knepp Advisory Group members regarding common fleabane *Pulicaria dysenterica*. This herbaceous perennial with yellow, daisy-like flowers has been on the increase in the Southern Block, to the extent that by August, it is taking over hundreds of acres. Charlie's concern was that as it 'swamps out' other palatable plants, it would have an effect on the livestock carrying capacity of this part of the estate. Information was sought regarding any work carried out on this species.

Common fleabane is a native species of lowland England, Wales and southern Scotland. It grows in wet fields, marshes and ditches, spreading by seeds and rhizomes, and flowers in August and September. It gets both its common and Latin name from its reputed efficacy in repelling fleas. Although seemingly unpalatable to livestock, it is not included in *Poisonous Plants and Fungi* (Cooper & Johnson 1988), published by HMSO and which focuses on plants toxic to livestock.

The joint opinion of the members of the Advisory group who responded was that unforeseen events such as the explosion of common fleabane are the outcome of returning to a more traditional, extensive grazing regime after many years of intensive agriculture. The exponential increase in common fleabane over the last 5 years is what ecologists call a transient successional change. The new regime in Knepp has resulted in perfect conditions for the spread of this species, but it is thought probable that this will be a short-lived phase and in time, a grass-dominated vegetation will prevail. It is considered that there is little alternative to waiting it out: any intervention will be hugely costly and probably only lead to some other unexpected outcome. Such outcomes are interesting and informative for ecologists, but can present a dilemma for the owner.

For Knepp, it has implications for planning stocking levels of different grazers and browsers. An assessment of this summer's available forage area in the Southern block was produced (Nightingale, 2013) to evaluate the effects of common fleabane and ragwort on summer grazing. Two surveys were carried out over the summer and one more after the plant died back in October. The survey showed a considerable decline in available fodder between June and August, largely due to the combined increases in fleabane and ragwort. By October, the situation had improved, with palatable vegetation re-growing following fleabane dieback. Nevertheless, if summer grazing is reduced while

common fleabane remains abundant, more cattle will have to be removed from the site in addition to the 50 head already taken off the Southern Block in 2013, for at least part of the year.

5.3. Sussex Botanical Recording Society report

Sussex Botanical Recording Society covered various parts of the estate over the Recording Weekend in June, including the arable reversions south of Hammer Pond, Spring Wood and pond, the north half and south end of Kneppmill Pond, and patches of ancient woodland at the north end of the Estate near Hartsgravel Bridge and Old Keeper's Cottage. A number of different habitats were covered including hedges, woodlands and wet areas, as well as the previously arable fields. A total of 76 species were recorded. These records, as well as contributing to the knowledge of Knepp plant diversity, will also contribute to the new Sussex Plant Atlas which is currently in preparation.

Although vascular plant diversity remains rather low in arable reversions, it is predicted that this will rise with time. The hedges, woodlands and wet areas provided much more diversity and there were some notable finds, one of the best being Adder's tongue *Ophioglossum vulgare*, an indicator of old pasture. The small streams and ponds were of particular interest, as such habitats have declined quite drastically in both quantity and quality in the wider Sussex countryside. On Knepp, they support a good range of aquatics and marginals including several species of water starworts *Callitriche* and in at least one site the scarce Marsh Speedwell *Veronica scutellata*. In addition one ornithologist reported Water-violet *Hottonia palustris* at Lower Barn in a site where he had known it for many years.

A few spikes of Greater Butterfly Orchid *Platanthera chlorantha* and Early-purple Orchid *Orchis mascula* were found in Spring Wood, while its pond provided a good range of aquatic plants including Lesser Water-parsnip *Berula erecta*, a species which seems to be in decline in Sussex as a whole. The patches of ancient woodland at the north end of the Estate near Hartsgravel Bridge and Old Keeper's Cottage produced a good selection of Ancient Woodland Indicator Species, notably plentiful Wych Elm *Ulmus glabra* and some natural as well as planted Crabapple *Malus sylvestris*.

5.4. Bryophyte survey

The bryophyte survey on 2nd June 2013 covered a small part of the Knepp Castle Estate including the lake in Spring Wood, the outflow stream from that lake following down as far as the river, the river banks down as far as the public footpath leading to Charlwood Barn, the dam end of the main lake and the outflow from it, the old ruins, the carr woodland adjoining southern shore of the main lake and the main buildings plus the surrounding woodland.

Although limited in time and scope, an impressive total of 89 bryophyte species were recorded including several rarities. This large number of species reflects the very varied habitat with an abundance of water courses. Epiphytes were thriving with many trees of favoured species such as ash, field maple, elder and willow; a few quite scarce species were consequently found. Some of the man-made structures examined proved of interest, especially as many of these have been undisturbed for a long time. The lake margins were predictably rich in species and it is thought that more remain to be discovered in future surveys. The bryophyte ground floras of the woodlands inspected were rather poor in species. This is partly due to soil chemistry, many woodland mosses preferring more acid conditions, but also due to the excessive disturbance of the ground by livestock. Ungrazed woodlands on the Estate would be expected to have a richer bryophyte flora.

Overall, the rewilding project at Knepp is going to result in some excellent habitat for mosses either being retained or created. Although Sussex is well-worked generally for bryophytes, it would appear the Knepp Estate has been overlooked to a large extent, and the results from this survey indicate

that Knepp may ultimately prove to be one of the richest sites in Sussex. This survey has added no fewer than 24 new records for the 10 km grid square, TQ12, which is remarkable as on the whole bryophytes in Sussex have been well-recorded. At least 7 species were recorded as Scarce or Rare in Sussex.

6. Incidental species records.

Most of the incidental records that have been brought to my attention this year have been birds. The year started with Charlie's observations that thrushes were singing in earnest in February and that there were 5 overwintering green sandpipers. Ted Green spotted ravens successfully nesting at the back of the house. Ted also spotted a Red kite nest with 2 fledglings at Hill House Plantation, and another Red kite seen repeatedly perching in a dead tree near New Barn track in the Southern Block, which could suggest another red kite nesting area (feeding platforms have been installed near these two locations). 'Bird Track' continued to record bird species in selected locations across the estate in February, May and June 2013. David Buckingham carried out a bird survey of eleven fields in the Southern Block on 27th May. He recorded 28 species, of which the most interesting were Skylark, Nightingale, Whitethroat, Woodlark, Spotted flycatcher and Turtle dove. The last two species are on the Red List of Conservation Concern. Paul James also recorded singing Turtle doves and a Woodlark on 9th June. Yet more observations of Turtle dove occurred on the following day, when Shena and John Maskell heard 2 individuals at the marshy end of Honeypools on 10th June, and 2 Nightingales near to the end of Dial Post Road – but more surprisingly, an unknown bird of prey that they subsequently identified as a Red-tailed Hawk. Finally, in October, 15-20 eels were found next to the eel trap at the bottom of Knepp Mill Pond dam wall.

7. Discussion.

There has been a considerable amount of survey effort in 2013. The species database has certainly been augmented by the efforts of the recorders who converged on Knepp for one weekend in June. More structured surveillance was pursued by Neil Hulme, aided by Matthew Oates, and the results of their butterfly surveys are indicating beyond doubt that the Wildland Project is benefiting this group in general – and the iconic Purple Emperor in particular. The butterfly surveys will continue to be an annual event the long-term results of which will make an important contribution to the evaluation of the Wildland project.

One inference in particular can be drawn from the 2013 surveys and research – the value of scrub and hedgerows. The increase in sallow scrub in the Southern Block, in association with mature oaks, has undoubtedly led to the very welcome increase in Purple Emperor butterflies. Young blackthorn scrub benefits brown hairstreak butterflies, but in this case, browsing his having a demonstrably negative impact. Hedgerows are well-known for providing nesting and foraging resources for many species of small birds, and the research carried out by Donovan and Saunders contributes to our knowledge of these benefits especially to species of conservation importance such as the yellowhammer. But perhaps the greatest benefit has been demonstrated by the considerable increase in the number of nightingales recorded in 2012 and 2013 by Hicks and Donovan. The broadly spreading, thorny hedges enclosing areas of bare ground are providing ideal conditions for successful breeding, making Knepp a key site for these iconic birds.

Research is now drawing more and more on the results of surveys made from 2005 onwards. Individually, such surveys would appear to have had little to contribute to an evaluation of the effects of the Wildland project as a whole. But the chief rationale behind these surveys was that they would record both baselines and changes over the years. Such changes sometimes seem slow and

unremarkable, especially for promoting the project to those that may doubt its merit over more intensive land management. Now the value of all this work is beginning to show. However, the potential value of all surveys will only be realised if these continue to be repeated at appropriate intervals, as it is only by doing this that changes will be observed and research can be focussed effectively. It is therefore now time to plan the 10-year repeat in 2015 of all the surveys that were first carried out in the 2005 Baseline ecological Survey (Greenaway, 2006).

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