

Knepp Vegetation Monitoring 2017
The Rainbow and 27 Acre Fields Transect
Dolphin Ecological Surveys



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1.0 Background

Rainbow Field and 27 Acre Field in the southern block of the Knepp Wildlands were taken out of arable production in sections over several years from 1998 to 2004.

In summer 2006, as part of the Knepp Estate vegetation monitoring programme, it was decided to install a 140m long belt transect across the different vegetation zones of Rainbow and 27 Acre Fields. The intention was to observe how the vegetation in this part of the Estate developed over time.

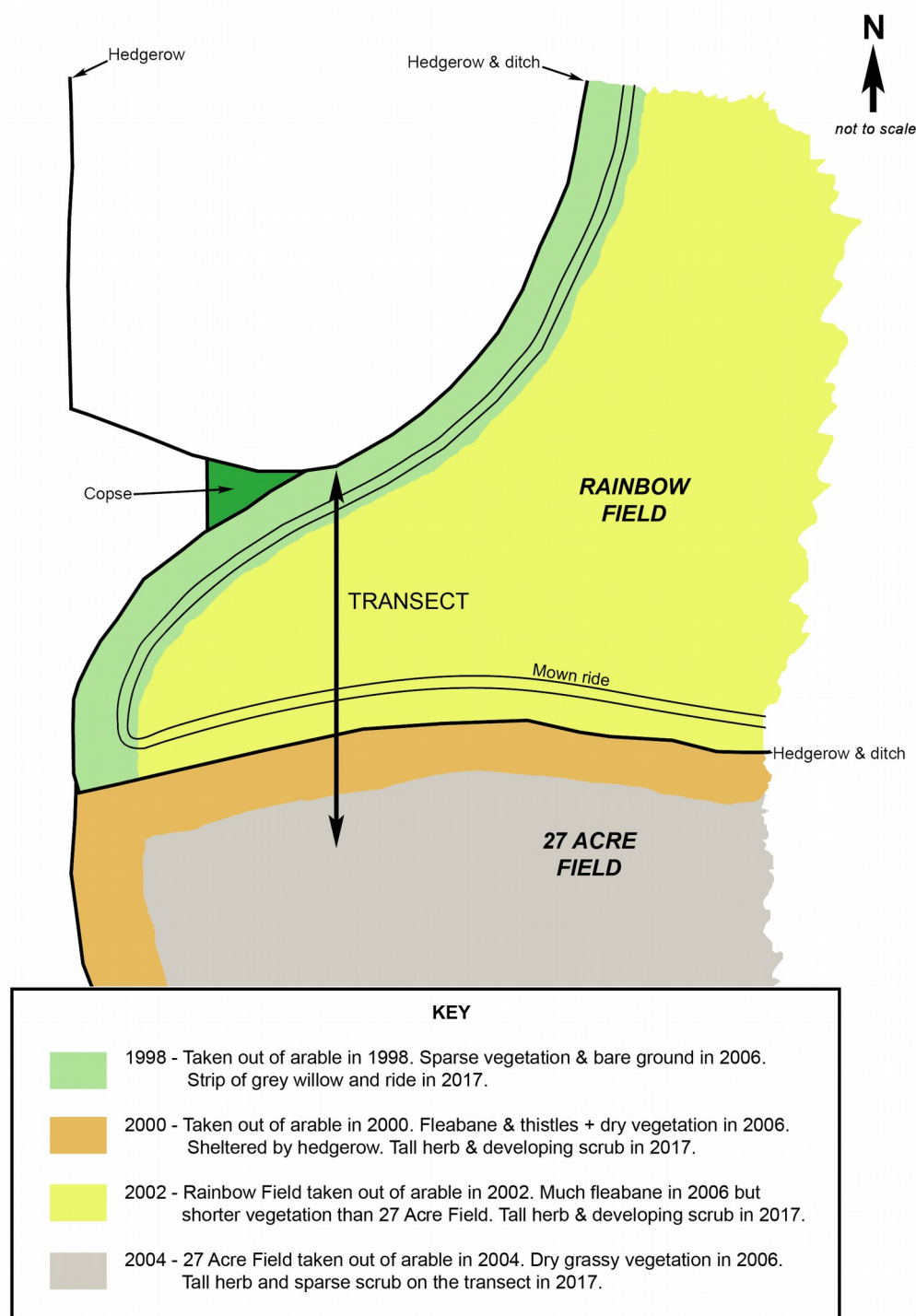
However, setting up and recording vegetation in quadrats along the transect was delayed until June 2007 due to the very hot, dry conditions in 2006.

The original survey assessment notes from 2006 and a summary of the 2007 survey results are included as appendices to this report.

In 2017 the vegetation survey along this 140m long transect was repeated and the results are given below.

Figure 1.

Sketch of Transect Location & Vegetation Zones



2.0 Survey Method & Constraints

2.1 Survey Method

In 2005/6 several shorter transects had been set up at Knepp by Kate Ryland of Dolphin Ecological Surveys as part of the vegetation monitoring programme. During these surveys it was found that installing permanent transect marker posts was largely unsuccessful, mainly because cattle and other livestock tended to knock the posts over.

For this reason in 2007 the locations of the first and last quadrats of the Rainbow Field/27 Acre Field transect were recorded using a handheld GPS and its location was described relative to fixed features but fixed marker posts were not installed.

The 2017 transect vegetation survey took place over three days in August 2017 (18th 22nd and 24th) in warm, dry weather conditions following the same methodology as in the original survey 10 years earlier.

Vegetation in 70 contiguous 2m x 2m quadrats was recorded along the 140m transect by Kate Ryland assisted by Penny Green, the Knepp Ecologist. Vascular plant species present in each quadrat were recorded with their abundance estimated using the Domin scale.

Domin Scale:

- 1 = <4% cover with few individuals
- 2 = <4% cover with several individuals
- 3 = <4% cover with many individuals
- 4 = 4 -10% cover
- 5 = 11 – 25% cover
- 6 = 26 – 33% cover
- 7 = 34 – 50% cover
- 8 = 51 – 75% cover
- 9 = 76 – 90% cover
- 10 = 91 – 100% cover

The average vegetation height (and sometimes the extremes of vegetation height where appropriate) was recorded in each quadrat. The amount of bare ground and moss was also recorded in 2017. Unfortunately the amount of bare ground in each quadrat had not been recorded during the 2007 survey so a comparison of this aspect of the transect over the first decade of monitoring was not possible.

2.2 Constraints

In 2017 the transect was set up as closely as possible to its original route but on a transect of this length that does not have permanent beginning and end point markers, some slight variation in the exact path taken was inevitable.

Using several flexible 30m tape measures to mark the transect line and a rope 2m x 2m quadrat frame was considered the most practical means of carrying out this survey in the terrain at Knepp. However this method also introduces inherent inaccuracies to the exact placement of each quadrat within the structurally complex vegetation.

In 2017 ground level photographs were taken along the transect and of selected quadrats to enhance the accuracy of future monitoring and any vegetation analysis. In addition an aerial video of the transect route was filmed using a UAV operated by Penny Green.

The original survey was carried out in June 2007 whilst the repeat survey took place in August 2017. The 2 month seasonal difference may have affected the plant species that were recorded along the transect but since both surveys were undertaken during the summer months by the same surveyor this should have had a relatively minor impact on the results.

3.0 Survey Results

3.1 Quadrat Data

The 2017 survey results are presented in a separate spreadsheet which contains:

- ◆ The vegetation data for each of the 70 quadrats recorded along the transect in 2017 (species recorded and their abundance)
- ◆ A comparison of the recorded average vegetation height of each quadrat in 2007 and in 2017
- ◆ A full list of the plants recorded along the transect in 2007 compared with 2017
- ◆ An indication of which taxa were recorded at an abundance of 4% or above in any of the quadrats in both 2007 and 2017 i.e. the most constant of the more abundant species

Some comments on the survey results are made below but a more in-depth analysis of the data is outside the scope of this report.

The data contained in the paper quadrat recording sheets from the 2007 survey was not entered into a spreadsheet at that time, instead the record sheets were simply scanned as a pdf document. Putting the 2007 data into a comparable format to the 2017 results would make a direct comparison of the species information much easier in future when time and resources allow.

3.2 Sward Height

In the 2007 report summary the comments made about vegetation structure along the transect were:

- ◆ The field margins tend to have a lower, closed, rabbit-grazed sward whilst the main parts of the field have a generally tall sward with localised patches of bare ground or low vegetation particularly where rabbit grazing is focused.
- ◆ Quadrats 48 and 49 fall on the wide, trampled path on the field margin between Rainbow Field and 27 Acre Field, which is part of a horse-riding route.
- ◆ Quadrats 50 and 51 cover the area between the path and the base of the hedgerow whilst quadrat 52 lies within the hedge and includes a large oak tree as well as blackthorn shrubs.
- ◆ Quadrats 53 and 54 cover the ditch on the south side of the hedge and the ditch margin, which have a tall, coarse flora.
- ◆ From the ditch margin and into the main part of 27 Acre Field the sward is at first patchy with many gaps but has an increasingly closed, tall sward characterised by a similar suite of species to Rainbow Field.
- ◆ The final 6 quadrats (65 to 70) have an almost uniformly closed, grass dominated sward with much thatch and reduced amounts of herbaceous species.

By 2017 the vegetation structure along the transect had become much more complex and the effects of rabbit grazing were much less evident. Tall herb vegetation and scrub had increased markedly in extent whilst signs of livestock grazing, browsing and trampling could be seen in places.

The increased variety in vegetation structure made it much harder to allocate an accurate value for

the average sward height in some 2m x 2m quadrats. To clarify the situation qualifying comments were used far more often in the 2017 field notes and extreme values of height in structurally complex quadrats were also recorded more often by the surveyors.

A summary of comments made about the vegetation structure along the transect in 2017 is:

- ◆ Overall there is much more scrub in all parts of the transect.
- ◆ The starting point of the transect in the ditch was much more shaded than in 2007 and ran through a wide band of willow scrub along the field margin (the area that came out of arable in 1998).
- ◆ A muddy ride/track with low vegetation height runs through this shaded, damp edge zone of Rainbow Field.
- ◆ Large expanses of fleabane were present in both fields. In places this species formed a closed canopy with few other species present.
- ◆ Evidence of the impact of grazing animals is present throughout the transect with well-used tracks, hoof prints, areas of browsed scrub and a worn crossing point through the hedgerow between the two fields.

Figure 2.

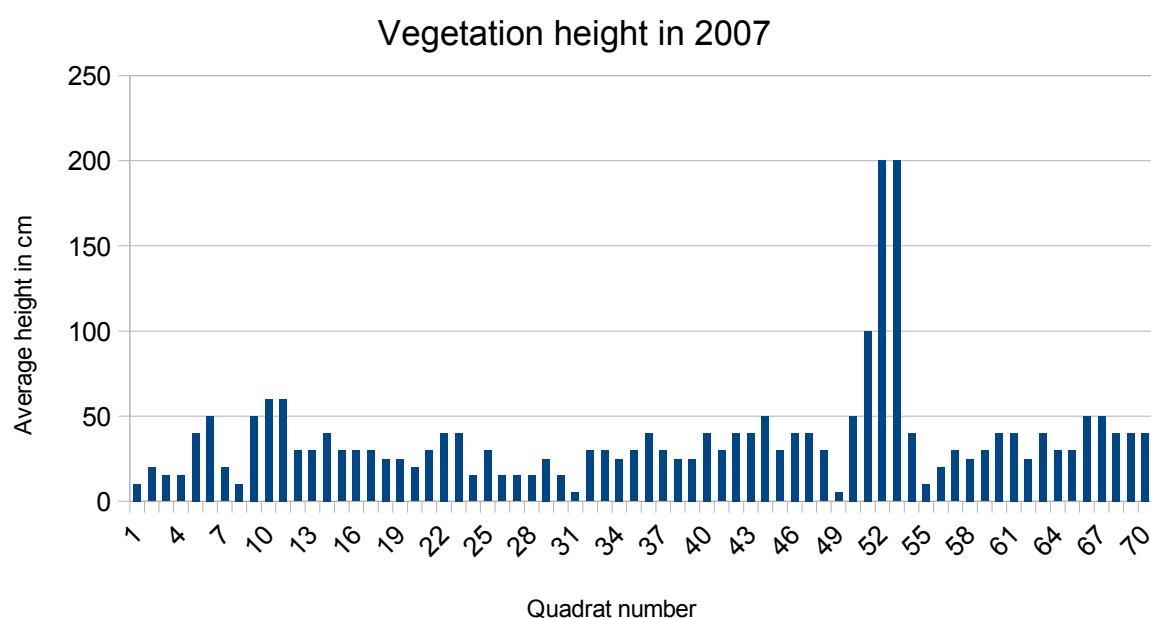


Figure 3.

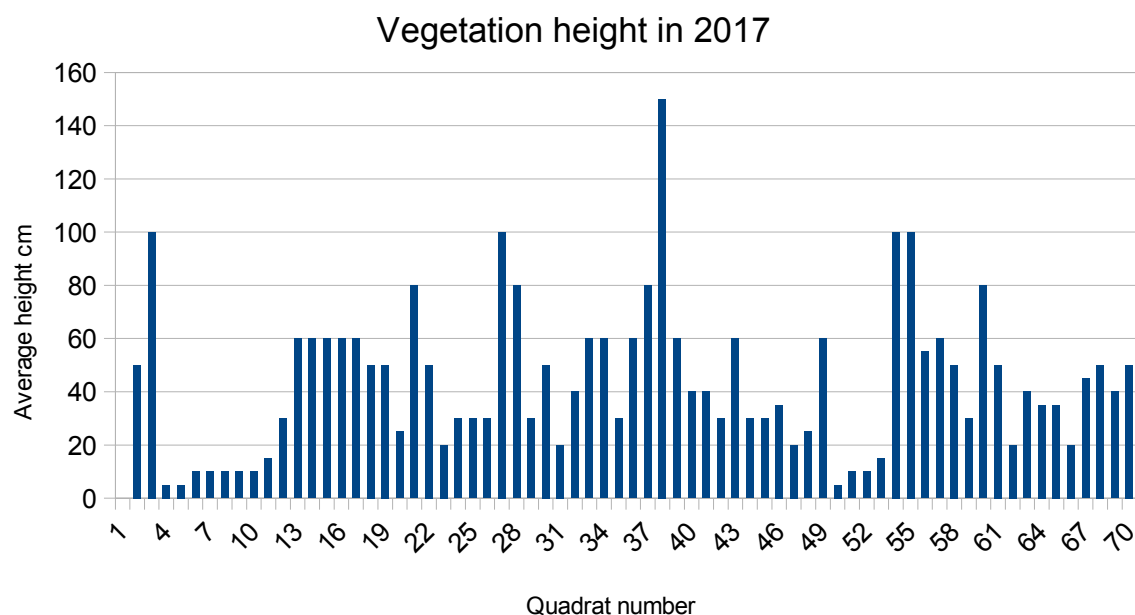
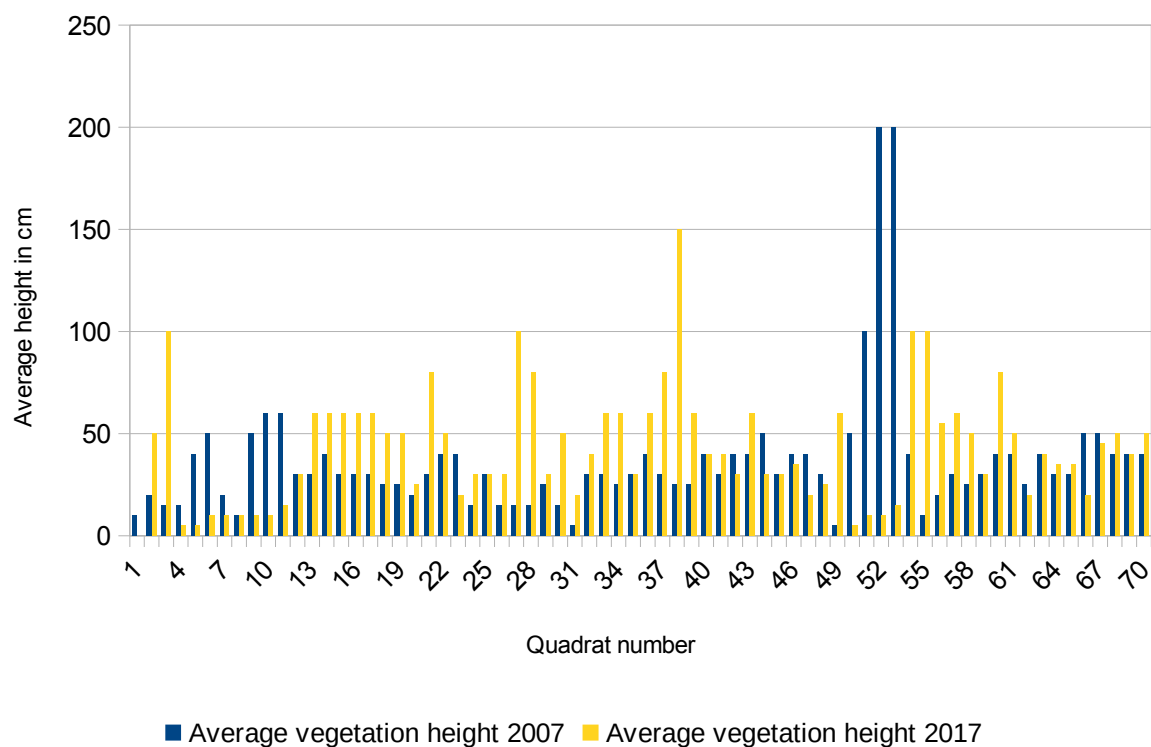


Figure 4. Comparison of Vegetation Height in 2007 vs 2017



Assessing the average vegetation height data confirms that the location of the quadrats along the transect migrated slightly in 2017 compared with 2007. The quadrat numbers covering the hedgerow between the two fields do not coincide exactly because the oak tree in the hedgerow fell in Q52 in 2007 but in Q53 in 2017.



The hedgerow between the two fields showing an animal track on the transect where it passes between two oak trees



View of the ride and willow scrub at the start of the transect in Rainbow Field. This strip came out of arable cultivation in 1998



The start of the transect in Rainbow Field under an oak tree in a ditch with much more scrub than in 2007



The start of the transect in Rainbow Field crossing the ride and entering willow scrub on land taken out of arable in 1998

3.3 Species Present in the Transect

There were differences in the species recorded and in the total number of taxa recorded along the transect from 2007 to 2017. The number of taxa recorded in each survey is summarised in the Figure 5 below, which includes some records made only to genus not species level. Data was extracted from the 2017 survey spreadsheet and from the 2007 the scanned survey sheets.

Roughly half the total number of plant species in both surveys were found to occur at very low abundance in each quadrat (measured as 1 to 3 on the Domin scale) which equates to one or more individual plants but less than 4% cover in total.

To provide some indication of how many plants found along the transect in each survey were present at greater cover, the number of taxa that scored 4 or more on the Domin scale (i.e. 4-10% cover) in at least one quadrat is also included in Figure 5.

Figure 5. Comparison of the Number of Taxa Recorded in 2007 and 2017

	2007 Survey	2017 Survey
Total number of taxa recorded	67	72
Number of taxa that scored at least 4 on the Domin scale in at least one 2m x 2m quadrat	35	30

There were 17 species which were recorded at an abundance of at least 4% cover in at least one quadrat in both surveys. These are described here as the constant, most abundant species.

Grasses

Bent-grasses (*Agrostis spp.*), false oat-grass (*Arrhenatherum elatius*), Yorkshire fog (*Holcus lanatus*) and perennial rye-grass (*Lolium perenne*)

Herbaceous plants

Creeping thistle (*Cirsium arvense*), greater plantain (*Plantago major*), selfheal (*Prunella vulgaris*), fleabane (*Pulicaria dysenterica*), creeping buttercup (*Ranunculus repens*), curled dock (*Rumex crispus*), common ragwort (*Senecio jacobaea*) and white clover (*Trifolium repens*)

Woody species

Blackthorn (*Prunus spinosa*), bracken (*Pteridium aquilinum*), pedunculate oak (*Quercus robur*), bramble (*Rubus fruticosus*) and grey willow (*Salix cinerea*)

Figure 6 below illustrates how these 17 species changed in the number of times they occurred in quadrats along the transect over the decade between the two surveys.

Figure 6. Comparison of the Frequency of the Constant Most Abundant Taxa

In this table the frequency of the 17 constant most abundant taxa is the number of times each of the species was recorded at any abundance in one of the 70 quadrats along the transect in each survey year.

Taxa	Frequency in Quadrats in 2007	Frequency in Quadrats in 2017	Change in Frequency from 2007 to 2017	% change from 2007 to 2017
<i>Agrostis spp.</i>	63	69	+6	8.6% increase
<i>Arrhenatherum elatius</i>	8	2	-6	8.6% decrease
<i>Holcus lanatus</i>	66	63	-3	4.3% decrease
<i>Lolium perenne</i>	5	7	+2	2.9% increase
<i>Cirsium arvense</i>	50	27	-23	32.9% decrease
<i>Plantago major</i>	29	14	-15	21.4% decrease
<i>Prunella vulgaris</i>	3	40	+37	52.8% increase
<i>Prunus spinosa</i>	14	15	+1	1.4% increase
<i>Pteridium aquilinum</i>	2	3	+1	1.4% increase
<i>Pulicaria dysenterica</i>	62	64	+2	2.9% increase
<i>Quercus robur</i>	13	13	0	No change
<i>Ranunculus repens</i>	43	47	+4	5.7% increase
<i>Rubus fruticosus</i>	9	30	+21	30% increase
<i>Rumex crispus</i>	33	42	+9	12.9% increase
<i>Salix cinerea</i>	22	33	+11	15.7% increase
<i>Senecio jacobaea</i>	50	45	-5	7.1% decrease
<i>Trifolium repens</i>	17	36	+19	27.1% increase

In future, when resources allow, the species data from the 2007 and the 2017 surveys could be analysed further to illustrate in more detail how individual taxa have changed in abundance and spatial distribution along the transect over time.

4.0 Discussion

The broad changes in the composition and structure of the vegetation along the transect that spans parts of Rainbow Field and 27 Acre Field are very much as would be predicted over a period of 10 years under the Knepp Wildlands extensive grazing management regime.

The number of species recorded was slightly higher in 2017 than in 2007 but this may be due to recorder bias rather than an actual increase in species-richness over time. However, there is evidence of increased dominance of a few species in 2017 compared with 2007.

The vegetation has changed from the rabbit grazed, typically grassy ex-arable assemblage of 2007 which had a high proportion of annuals, relicts of cultivation and a flush of coarse, weeds such as thistles and ragwort towards tall herb vegetation dominated by perennial species with developing woody scrub. By 2017 much of the transect was a sea of fleabane, though dock, ragwort and thistle remained frequent, along with patches of bramble, willow and rose.



Typical vegetation along the transect in Rainbow Field

The *number of quadrats* in which the most commonly occurring plants were found (see Figure 6) showed some interesting changes from 2007 to 2017. Note that this does not reflect the overall abundance of each species along the transect, which would require further analysis of the quadrat data to clarify.

The greatest increases in recording frequency were seen in selfheal (in 52.8% more quadrats), bramble (in 30% more quadrats), white clover (in 27.1% more quadrats), grey willow (in 15.7% more quadrats) and curled dock (in 12.9% more quadrats).

In contrast the greatest decreases in recording frequency were creeping thistle (in 32.9% fewer quadrats) and greater plantain (in 21.4% fewer quadrats). Other changes in the frequency in quadrats of the most commonly found species in both surveys were all of less than 10%.



Bramble clump and willow along the transect in Rainbow Field

Many species in both surveys were only recorded as a few individuals within the quadrats. Some of these will have been seedlings that failed to develop to maturity whilst others will simply be persisting at low frequency by taking advantage of small niches such as hoof prints or along animal tracks or under the shade of taller plants.

Some of the low-growing annual plants present in 2007, such as hop trefoil and soft brome, are likely to have disappeared through being unable to compete successfully with the robust tall herbs that now dominate the vegetation.

The common spotted-orchid (*Dactylorhiza fuchsii*) that was present in 2007 was not seen again in 2017 but the diminutive grass vetchling (*Lathyrus nissolia*) was re-found in quadrats in 27 Acre Field.

Interesting new finds along the transect in 2017 include sharp-leaved and round-leaved fluellen (*Kickxia elatine* and *K. spuria*) which are relicts of cultivation and have been spotted in several ex-arable fields at Knepp.

Trailing St John's-wort (*Hypericum humifusum*) is associated with moderately acid soils and habitats such as woodland rides or glades but was found in a patch of open, trampled vegetation in 27 Acre Field.

Perennial herbs including ox-eye daisy (*Leucanthemum vulgare*), gipsywort (*Lycopus europaeus*), water mint (*Mentha aquatica*) and corn mint (*M. arvensis*) were also recorded for the first time in the transect in 2017.

The most visually striking change from 2007 to 2017 is the increased structural complexity of the vegetation due to natural succession. In 2007 most of the vegetation in both fields had a fairly low sward with some quite open patches. By 2017 the average sward height had become much more diverse due to increasing levels of willow and bramble scrub.

In 2017 there was a less obvious disparity in the height of the vegetation between the fields than there was in 2007, largely through the overwhelming dominance of fleabane in most areas along the transect.



Fleabane dominating the sward in 27 Acre Field

There is a small grazing enclosure in Rainbow Field near the transect within which there is very dense willow growth. This gives an interesting comparison with the surrounding vegetation that is accessible to various herbivores where scrub is much less frequent and fleabane dominates the sward.



Grazing enclosure full of willow scrub near the transect route

The mown ride which runs around the edge of Rainbow Field also provides a contrast in vegetation height to the rest of the arable reversion vegetation. The short, grassy vegetation of the ride, which is not typical of the naturally regenerating areas, added to the number of plants recorded in the 2017 survey.



The mown, grassy ride on the edge of Rainbow Field looking west

The changes in vegetation observed along the 140m transect across Rainbow Field and 27 Acre Field between 2007 and 2017 and reported here illustrate how reversion of the arable land in the southern block at Knepp Estate under the rewilding management regime is progressing but is only the beginning of the story.

A major difference between the southern block and other parts of the Estate was the longer time lag between cessation of arable production and introduction of various herbivores.

The contrast between the very obvious structural and vegetation changes along this transect and the sometimes less clear changes along the shorter transects recorded in other parts of the Estate, where herbivores were introduced to ex-arable land more quickly, is particularly striking.

Appendix 1

Notes from 2006 by Kate Ryland & Theresa Greenaway

Assessment of Survey requirement of Rainbow and 27 Acres fields, Knepp castle Estate.

A botanical survey of two fields on Knepp Estate taking the form of a belt transect sampled by contiguous quadrats was requested to give baseline information of this area of land, parts of which were taken out of arable 2, 4, 6 and 8 years ago but not grazed.

Kate Ryland (Dolphin Ecological Surveys) and Theresa Greenaway (Record Centre Survey Unit) visited Rainbow and 27 Acres Fields on 25th July 2006 in order to assess whether it would be appropriate to carry out this survey in July / August 2006, whether such a survey would provide useful information, or whether it would be advisable to carry it out earlier in the year.

The summer of 2006 has been extremely dry, and much of July has been officially declared as a 'heatwave', with temperatures frequently above 30 degrees Centigrade.

The following observations are the result of the site assessment:-

- A strip of game cover near the south-east border of 27 Acres would affect any natural vegetational changes along this side of the field by interrupting natural succession of the affected strip through ploughing, creating a physical barrier to vegetative colonisation away from the hedgerow and effectively isolating the central part of the field from the adjoining hedgerow.
- We walked north-west across 27 Acres, land taken out of arable 2 years ago, and observed an extensive straw of annual grasses and self-sown wheat, with scattered young plants of scrub species (wild rose, willow), thistles, docks and fleabane. Much of the grass had lodged, and any small herbaceous species were either non-existent, burnt off or buried beneath straw.
- The strip of 27 Acres along the north-west border of this field has been out of arable for 6 years, has considerable fleabane, thistle, other drought-resistant species and burnt-off plants, and is much influenced by the shelter of the adjacent hedge.
- Crossing into Rainbow Field, the vegetation was shorter after four years since arable cultivation than that left only for 2 years in 27 Acres, but was extremely droughted (parched, desiccated?), with abundant fleabane still green and in flower.
- The strip along the western boundary of Rainbow, out of arable for 8 years, had a fairly sparse covering of drought-affected vegetation, with a surprisingly high percentage of bare ground. It was noted that there were (first year?) oak seedlings in this strip.

- We are of the opinion that it would not be a good use of time or funds to attempt a botanical survey with species identification and abundance estimations, as much of the vegetation that undoubtedly would have been present 6-8 weeks ago has died. If such a survey were to take place within the next few weeks, it could not serve as a scientifically robust baseline against which future surveys could be compared, unless each such survey were always carried out in July/August.
- When is it the intention to graze this land, and will the game cover strip remain in the position it is now, or will it be moved on a rotational basis?

Recommendation

- We recommend that the transect be surveyed in the first two weeks of June 2007. This will
 - Enable a more accurate estimation of plant diversity across these two fields
 - Enable a good estimation of tree seedling recruitment in the absence of any grazing except that of rabbits and roe deer

Appendix 2

Summary Results of the 2007 Rainbow and 27 Acre Field Transect Survey

This additional transect was 140m long and was recorded using the same methodology as in 2005 when a series of transects were recorded across the Knepp Castle Estate. The purpose was to give baseline information on land taken out of arable production 2, 4, 6 and 8 years ago and not grazed.

Location of transect (NE corner of first and last quadrats)	Direction of Transect	Description of Location
TQ 14413 21140 to TQ 14427 21007	N - S	<p>From the western edge of Rainbow Field, near a small copse that adjoins the hedgerow, the transect runs southwards through the southern hedge into 27 Acre Field.</p> <p>The northern end of the transect starts at the foot of an oak tree, which has two larger oaks close together to its east, crosses the hedgerow through a gap between two moderate aged, closely spaced oaks that lie to the east of a larger oak with a barn owl nesting box in it.</p>

On 28th and 29th June 2007 a total of 70 contiguous 2m x 2m quadrats were recorded from the western edge of Rainbow Field through a hedgerow to 27 Acre Field. Unlike the previous transects a permanent marker was not installed, but accurate grid references were taken for the start and end points of the transect using a hand-held GPS unit. A description of the starting point and route of the transect is given above and also shown on a site map.

Vascular plants recorded in each quadrat are shown on the separate recording sheets with a measure of abundance on the DOMIN scale.

On the recording sheets bent-grasses *Agrostis spp.* are usually grouped together due to impracticality of separating the species where both occur within quadrats in the time available.

The vegetation recorded contains few surprises and comprises a mixture of relicts of cultivation, such as black grass *Alopecurus myosuroides* and annual species including scarlet pimpernel *Anagallis arvensis* in the more open, patchy, rabbit-grazed areas along with the developing coarse sward of opportunistic and largely wind-dispersed species. The average vegetation heights of each quadrat, as shown below, indicate how variable the sward height is across the fields.

Grasses were generally abundant across the transect with Yorkshire fog *Holcus lanatus* and bent-grasses most prominent. At the southern end of the transect the vegetation was almost entirely dominated by Yorkshire fog. Tall, coarse herbs, especially fleabane *Pulicaria dysenterica*, creeping thistle *Cirsium arvense*, ragwort *Senecio jacobaea*, curled dock *Rumex crispus* and sow-thistles *Sonchus spp.* occur across the whole transect, though in varied proportions in the different aged reversion swards. Smooth tare *Vicia tetrasperma* is an almost constant component of the vegetation across the transect.

There are some signs of woody species becoming established in the fields with seedlings and

young plants of oak *Quercus robur*, blackthorn *Prunus spinosa*, hawthorn *Crataegus monogyna*, bramble *Rubus fruticosus* and rose *Rosa sp.* found especially near the hedgerows.

Two more notable species that were recorded were grass vetchling *Lathyrus nissolia* and the more surprising occurrence of two individual common spotted orchids *Dactylorhiza fuchsii* (in quadrats 22 and 40). These are both species of grassland rather than arable habitats, as is the common knapweed *Centaurea nigra* recorded in the 6 year old margin of 27 Acre Field.

In the table below the average vegetation height figures in brackets indicate extremes of height within the quadrat.

Quadrat No.	Average Vegetation Height (cm)	Comments on Vegetation Structure
1	10 (60)	
2	20	
3	15 (2)	
4	15 (2)	
5	40	
6	50	
7	20 (50)	
8	10 (50)	
9	50 (10)	
10	60	
11	60 (10)	
12	30	
13	30	
14	40	
15	30	
16	30	
17	30 (2)	
18	25 (2)	
19	25 (2)	
20	20	
21	30	
22	40	
23	40	
24	15	
25	30 (2)	
26	15	
27	15 (25)	
28	15 (25)	
29	25 (2)	
30	15	
31	5 (25)	
32	30	
33	30	
34	25	
35	30 (5)	
36	40	
37	30	
38	25 (10 + 40)	

Quadrat No.	Average Vegetation Height (cm)	Comments on Vegetation Structure
39	25 (10)	
40	40 (2)	
41	30 (10)	
42	40	
43	40	
44	50	
45	30 (5)	
46	40 (5)	
47	40 (5)	
48	30 (5)	
49	5 (20)	
50	50 (20)	
51	100 (0)	
52	200 (10m +0)	
53	200 (0)	
54	40 (0)	
55	10 (0 + 30)	
56	20 (2 + 40)	
57	30 (5)	
58	25	
59	30 (5)	
60	40	
61	40 (2)	
62	25 (2)	
63	40	
64	30	
65	30	
66	50	
67	50	
68	40	
69	40	
70	40	