Appendix A: Methodology for field survey and agreement holder interview

A1 Field survey

Option code	Option definition
HB11	Management of hedgerows of very high environmental value (both sides)
HB12	Management of hedgerows of very high environmental value (one side)
HC10	Creation of woodland outside the LFA
HC12	Maintenance of wood pasture and parkland
HC13	Restoration of wood pasture and parkland
HC14	Creation of wood pasture
HC15	Maintenance of successional areas and scrub
HC16	Restoration of successional areas and scrub
HC18	Maintenance of high value traditional orchards
HC19	Maintenance of traditional orchards in production
HC20	Restoration of traditional orchards
HC21	Creation of traditional orchards
HC5	Ancient trees in arable fields
HC6	Ancient trees in intensively managed grass fields
HC7	Maintenance of woodland
HC8	Restoration of woodland
HC9	Creation of woodland in the LFA
HD10	Maintenance of traditional water meadows
HD6	Crop establishment by direct drilling (non-rotational)
HD7	Arable reversion by natural regeneration
HD9	Maintenance of designed/engineered water bodies
HE10	Floristically enhanced grass margin
HF12	Enhanced wild bird seed mix plots (rotational or non-rotational)
HF13	Fallow plots for ground nesting birds
HF14	Unharvested, fertiliser-free conservation headland
HG6	Fodder crop management to retain or re-create an arable mosaic (rotational)
HG7	Low input spring cereal to retain or re-create an arable mosaic
HJ3	Arable reversion to unfertilised grassland to prevent erosion or run-off
HJ4	Arable reversion to grassland with low fertiliser input to prevent erosion and run-off
HJ5	In-field grass areas to prevent erosion or run-off
HK10	Maintenance of wet grassland for wintering waders and wildfowl
HK11	Restoration of wet grassland for breeding by waders
HK12	Restoration of wet grassland for wintering waders and wildfowl

Table A1. HLS option codes and descriptions for those options identified by Natural England as priorities for resurvey. Continued below.

Option code	Option definition
HK13	Creation of wet grassland for breeding waders
HK14	Creation of wet grassland for wintering waders and wildfowl
HK15	Maintenance of semi-improved or rough grassland for target species
HK16	Restoration of semi-improved or rough grassland for target species
HK17	Creation of semi-improved or rough grassland for target species
HK6	Maintenance of species rich semi-natural grassland
HK7	Restoration of species rich semi natural grassland
HK8	Creation of species rich semi natural grassland
HK9	Maintenance of wet grassland for breeding waders
HL10	Restoration of moorland
HL11	Creation of upland heathland
HL7	Maintenance of rough grazing for birds
HL8	Restoration of rough grazing for birds
HL9	Maintenance of moorland
HN2	Permissive open access
HN3	Permissive footpaths
HN4	Permissive bridleway/cycle path access
HN7	Upgrading CRoW access for cyclists/horses
HN8	Educational access base payment
HN9	Educational access payment per visit
HO1	Maintenance of lowland heathland
HO2	Restoration of lowland heathland on neglected sites
HO3	Restoration of forestry areas to lowland heathland
HO4	Creation of lowland heathland from arable or improved grassland
HP2	Restoration of sand dunes
HP5	Maintenance of coastal saltmarsh
HP8	Creation of inter-tidal and saline habitat on grassland
HQ1	Maintenance of ponds of high wildlife value <100 sq m
HQ10	Restoration of lowland raised bog
HQ2	Maintenance of ponds of high wildlife value >100 sq m
HQ3	Maintenance of reedbeds
HQ4	Restoration of reedbeds
HQ5	Creation of reedbeds
HQ6	Maintenance of fen
HQ7	Restoration of fen
HQ8	Creation of fen
HQ9	Maintenance of lowland raised bog

Table A1 continued. HLS option codes and descriptions for those options identified by Natural England as priorities for resurvey.

Dear Sir/ Madam

Higher Level Stewardship (HLS) Monitoring Programme 2015

Monitoring is an important part of the HLS scheme, enabling Natural England to establish whether the scheme is delivering its intended environmental benefits. Between 2009 and 2011, Natural England undertook a programme to create a national baseline for monitoring HLS agreements and yours was surveyed as part of the sample. Now, five or six years on from the baseline survey, we would like to resurvey your agreement to record and review progress against scheme objectives and I am writing to request your consent to surveyors having access to your agreement land to carry out this work.

This year's survey will mainly take place between May and September, with work on a few agreements where bird options are important undertaken into the winter. It will be undertaken by specialist surveyors from the Centre for Ecology and Hydrology (CEH), who also conducted the baseline. Each agreement will be visited by a team of field surveyors (usually two and typically taking 2-3 days). They will use the habitat maps made previously to target fieldwork, looking at the condition of the main environmental features and any capital works that have been put in place. We will use the environmental data collected to evaluate progress within each agreement via indicators of success and this will contribute to an overall assessment of HLS. As well as the field survey, we are keen to capture your experience of the agreement, what's gone well, what hasn't etc., and so we hope to arrange a separate visit at a time of your convenience to undertake a short questionnaire with each agreement holder.

The survey is intended to provide Natural England with important feedback on the environmental benefits provided by HLS, and its component options and objectives. It is not designed as an audit or inspection and I can assure you that the information collected will be used solely to develop and refine the schemes. Although we aim to produce a public report with the findings of the project, they will not be reported in such a way that individual agreements or agreement holders are identifiable, unless you give specific permission otherwise (e.g. as case studies).

If you have any queries or would like to know more about the survey, please do not hesitate to contact me or alternatively your scheme adviser. Otherwise if you are content there is no need to reply to this letter; the CEH team will as before contact you in advance by telephone to arrange suitable access arrangements. It wouldn't be necessary to accompany the surveyors during their survey.

I hope you will be able to help us with the survey and would like to express my thanks, in advance, for your help.

Yours Sincerely

Andrew Cooke
Senior Monitoring Advisor
Natural England

Rock slope	**Upland calcareous grassland**			**Grass moorland**
Alchemilla alpina	Agrostis capillaris	Euphrasia officinalis agg.	Plantago maritima	Agrostis capillaris/ vinealis
Arenaria serpyllifolia	Alchemilla alpina	Filipendula ulmaria	Potentilla erecta	Carex spp.
Asplenium adiantum-nigrum	Alchemilla glabra	Filipendula vulgaris	Primula farinosa	Erica cinerea
Asplenium ruta-muraria	Angelica sylvestris	Galium saxatile	Ranunculus repens	Erica tetralix
Asplenium trichomanes	Antennaria dioica	Galium sterneri	Sanguisorba minor	Festuca spp.
Asplenium viride	Anthoxanthum odoratum	Galium verum	Saxifraga aizoides	Molinia caerulea
Carex capillaris	Armeria maritima	Gentiana verna	Saxifraga hypnoides	Nardus stricta
Carex pulicaris	Asperula cynanchica	Gentianella spp.	Scabiosa columbaria	Non-crustose lichens
Ceterach officinarum	Bellis perennis	Geum rivale	Selaginella selaginoides	Potentilla erecta
Cystopteris fragilis	Briza media	Helianthemum nummularium	Sesleria caerulea	Sphagnum spp.
Dryas octopetala	Campanula rotundifolia	Helianthemum oelandicum	Stachys officinalis	Trichophorum cespitosum
Helianthemum nummularium	Carex capillaris	Hippocrepis comosa	Succisa pratensis	Vaccinium myrtillus
Hieracium spp.	Carex caryophyllea	Juniperus communis	Thymus polytrichus	
Koeleria macrantha	Carex flacca	Kobresia simpliciuscula	Veronica officinalis	
Persicaria vivipara	Carex panicea	Koeleria macrantha		
Polystichum aculeatum	Carex pulicaris	Lathyrus linifolius		
Polystichum lonchitis	Carlina vulgaris	Leontodon hispidus		
Polystichum setiferum	Cerastium fontanum	Linum catharticum		
Saxifraga aizoides	Cetraria islandica	Lotus corniculatus		
Saxifraga oppositifolia	Cochlearia alpina	Myosotis alpestris		
Sedum acre	Coelocaulon aculeatum	Nardus stricta		
Selaginella selaginoides	Danthonia decumbens	Parnassia palustris		
Silene acaulis	Draba incana	Persicaria vivipara		
Thalictrum alpinum	Dryas octopetala	Pilosella officinarum		
Thymus polytrichus	Dwarf shrubs	Pinguicula vulgaris		

Table A.2 Species and taxa recorded for upland unenclosed parcels, by protocol used. Species names above are those used since the start of the baseline survey in 2009, but there have been changes to the taxonomy (*Sanguisorba minor* to *Poterium sanguisorba*, *Ceterach officinarum* to *Asplenium ceterach*, *Stachys officinalis* to *Betonica officinalis* and *Trichophorum cespitosum* to *T. germanicum;* (Stace, 2010).

Dry heath	**Dry / wet heath**	**Mires**		**Mires/ wet heath**	**Wet heath**
Arctostaphylos uva-ursi	Agrostis curtisii	Andromeda polifolia	Rhynchospora alba	Calluna vulgaris	Agrostis curtisii
Betula nana	Andromeda polifolia	Arctostaphylos uva-ursi	Rubus chamaemorus	Carex echinata	Andromeda polifolia
Calluna vulgaris	Arctostaphylos uva-ursi	Betula nana	Sphagnum spp.	Carex flacca/nigra/panicea	Arctostaphylos uva-ursi
Deschampsia flexuosa	Betula nana	Calluna vulgaris	Trichophorum cespitosum	Carex rostrata	Betula nana
Empetrum nigrum s.l.	Calluna vulgaris	Carex bigelowii	Vaccinium myrtillus	Carex viridula	Calluna vulgaris
Erica cinerea	Carex spp.	Carex echinata	Vaccinium spp.	Drosera spp.	Carex spp.
Erica tetralix	Drosera spp.	Carex flacca/nigra/panicea	Viola palustris	Empetrum nigrum	Drosera spp.
Genista anglica	Empetrum nigrum	Carex rostrata		Erica cinerea	Empetrum nigrum s.l.
Myrica gale	Erica cinerea	Carex viridula		Erica tetralix	Erica cinerea
Other grasses	Erica tetralix	Cornus suecica		Eriophorum angustifolium	Erica tetralix
Racomitrium lanuginosum	Eriophorum angustifolium	Drosera spp.		Eriophorum vaginatum	Eriophorum angustifolium
Salix repens	Molinia caerulea	Empetrum nigrum		Menyanthes trifoliata	Molinia caerulea
Ulex europaeus	Myrica gale	Erica cinerea		Molinia caerulea	Myrica gale
Ulex gallii	Narthecium ossifragum	Erica tetralix		Myrica gale	Narthecium ossifragum
Vaccinium myrtillus	Non-crustose lichens	Eriophorum angustifolium		Narthecium ossifragum	Non-crustose lichens
Vaccinium vitis-idaea	Pleurocarpous moss	Eriophorum vaginatum		Non-crustose lichens	Pleurocarpous moss
	Potentilla erecta	Menyanthes trifoliata		Pinguicula spp.	Potentilla erecta
	Racomitrium lanuginosum	Molinia caerulea		Pleurocarpous moss	Racomitrium lanuginosum
	Rhynchospora alba	Myrica gale		Potentilla palustris	Rhynchospora alba
	Rubus chamaemorus	Narthecium ossifragum		Rhynchospora alba	Rubus chamaemorus
	Salix repens	Non-crustose lichens		Rubus chamaemorus	Salix repens
	Sphagnum spp.	Pinguicula spp.		Sphagnum spp.	Sphagnum spp.
	Trichophorum cespitosum	Pleurocarpous moss		Trichophorum cespitosum	Trichophorum cespitosum
	Vaccinium myrtillus	Potentilla palustris		Vaccinium myrtillus	Vaccinium myrtillus
	Vaccinium spp.	Racomitrium lanuginosum		Viola palustris	Vaccinium spp.

Table A.2 continued. Species and taxa recorded for upland unenclosed parcels, by habitat protocol used. Species names above are those used by HLS recorders since the baseline survey started in 2009, but there have been changes to the taxonomy (e.g. *Potentilla palustris* is now *Comarum palustre* (Stace, 2010)).

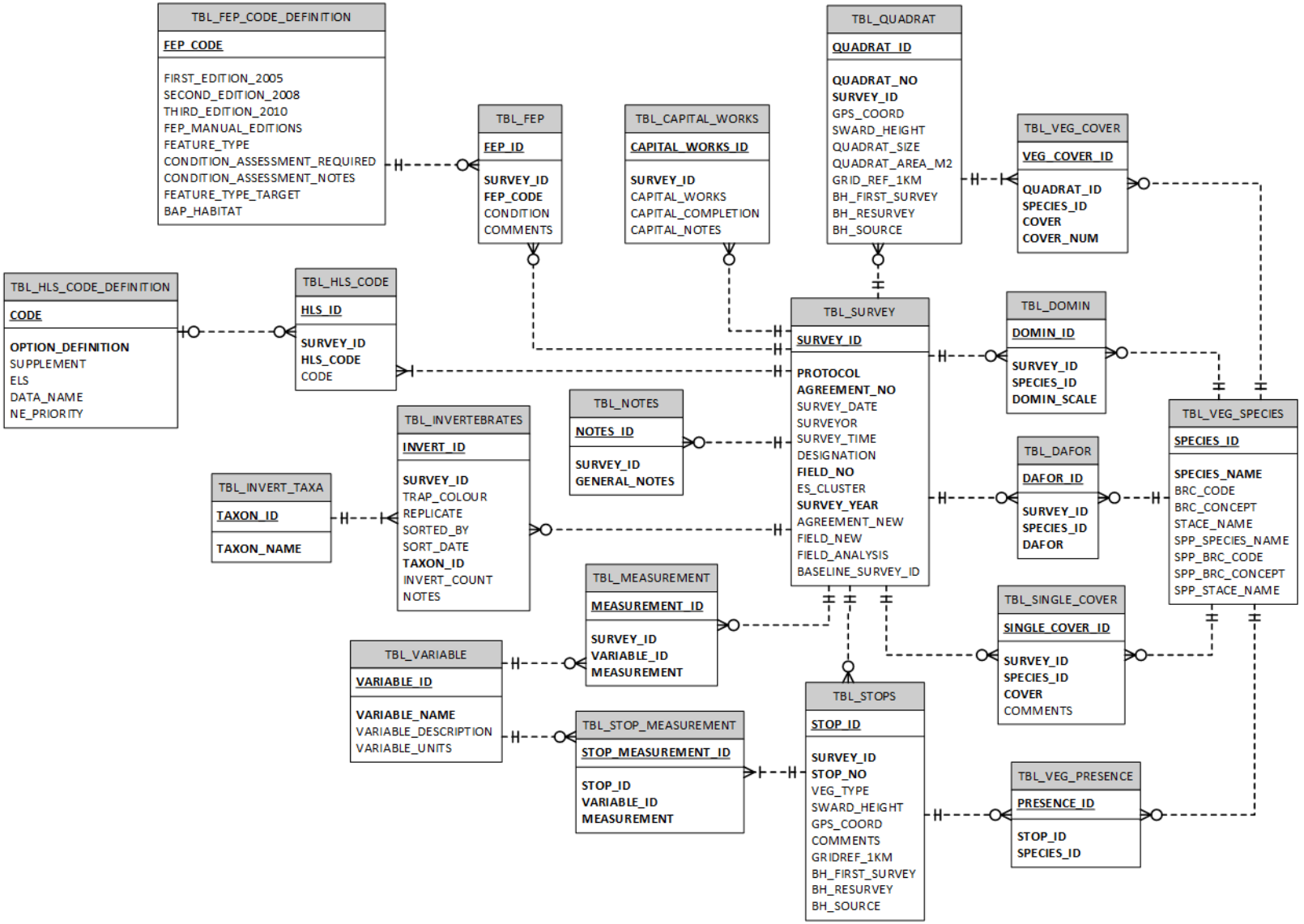


Figure A1. Relational diagram for the main tables of the HLS baseline and resurvey database, excluding indicator of success and the winter bird survey which are shown in Figures A2 – A3 below.

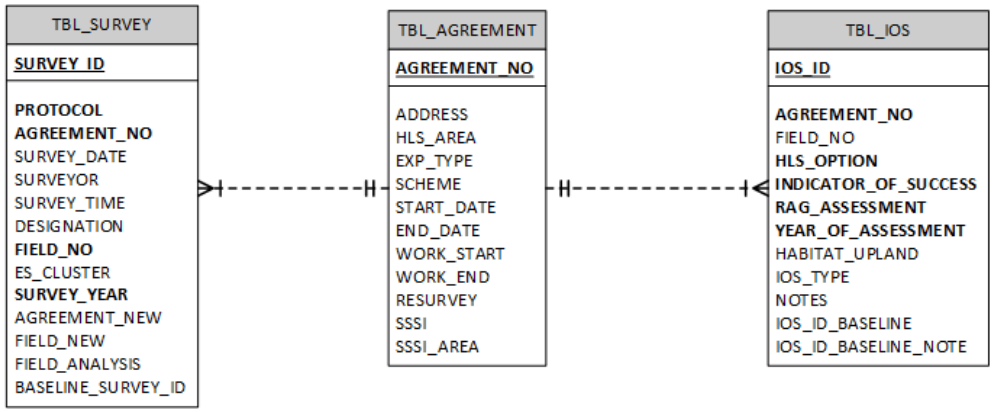


Figure A2. Relational diagram for the HLS resurvey indicators of success data and baseline survey RAG assessment, within the HLS database. Main database tables are shown in Figure A1.

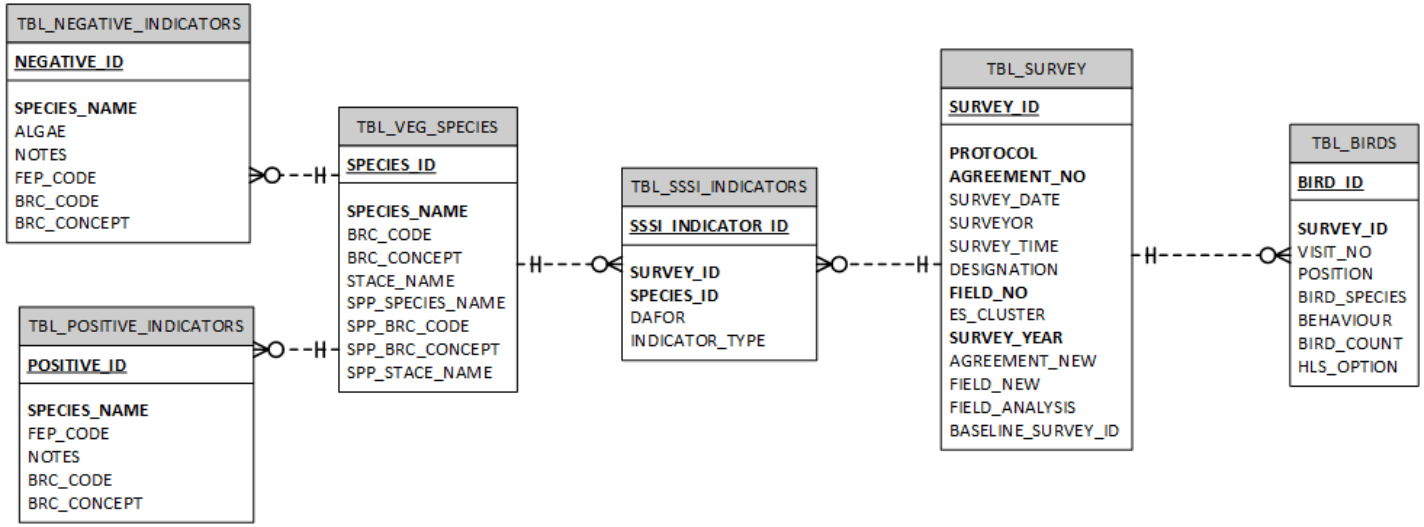


Figure A3. Relational diagram for the HLS winter bird survey, within the HLS resurvey database. Main database tables are shown in Figure A1.

A2 Survey of agreement holders

Part 1: Business Profile

1. **What is the total area of land you manage (as shown on the map)?** …….. hectares / acres

2. **How much of this is …**

	Hectares	**Acres**
Owned by you/the business you work for		
Rented by you/the business you work for		
Common land		
Other (please tell us what)		

3. **Can you tell us approximately what area of land is under each of the following categories?**

	Hectares	**Acres**
Arable land		
In grass for >5 years		
Temporary grass		
Rough grazing		
Woodland		
Other (please tell us)		

4. **Is any of the land registered organic or under organic conversion?**

◯ **Yes** ◯ **No**

5. **Which *one* of the following best characterises your farm / land / organisation?**

	Tick		**Tick**
Dairy		Arable	
Cattle/sheep, lowland		Horticulture	
Cattle/sheep, LFA		Mixed	
Pigs		Nature reserve	
Poultry		Other (please tell us)	

6. *(Where applicable)* **In terms of the value of sales, what is your most important enterprise?**

Part 2: Respondent Profile

7. **What is your role in the business / organisation?**

	Tick	**Comments**
Sole proprietor		

Partner with family member(s)
Partner with non-relative
Director/manager
Other (please specify)

8. Please tell us your age ……

9. How long have you been managing this land? ……

10. What is your highest level of formal education? (tick one box)

	Tick
School education; left before 16	
O-levels/CSEs/GCSEs	
A Levels	
Technical qualification (OND, BTEC or HND)	
Undergraduate degree	
Postgraduate degree	
Other (please specify)	
Prefer not to disclose	

11. Is your highest level of education related to agriculture or land management?

◯ **Yes** ◯ **No**

Part 3: Previous engagement with independent environmental practices

12. Have you previously carried out any specific environmental work / practices on this land, independent of an agri-environment scheme? (If yes, go to Q14)

◯ **Yes** ◯ **No**

13. If no, why was this the case? (go to Q16)

14. [SHOW CARD A] If yes, which of the following environmental work/practices have you previously undertaken, independent of an agri-environment scheme?

		Tick
1	Boundary restoration & management (e.g. hedgerows, stonewalls)	
2	Creation of new and/or management of existing water features	
3	Create or maintain wildlife meadows, heathland, parkland or common land	
4	Maintaining field margins for wildlife (inc. headlands & beetle banks)	
5	Manage and/or establish woodlands for conservation	
6	Scrub clearance	
7	Soil management plan	
8	Organic farming	
9	Other (Please tell us)	

15. [SHOW CARD B] Please tell us <u>up to 3 sources</u> of information that you used to inform these independent environmental management practices

		Tick
1	Neighbour/friend/relative	
2	Farming or scientific literature	
3	Courses/conferences/workshops/discussion groups	
4	Farming websites	
5	Online forums	
6	Agronomist or other agricultural adviser	
7	Defra documentation/communication	
8	Natural England/English Nature adviser	
9	Conservation organisation (e.g. Wildlife trust; RSPB; FWAG)	
10	Gamekeeper, GWCT and shooting friends	
11	Other (please specify)	

Part 4: Previous engagement with environmental schemes

16. Prior to your current HLS agreement, have you (the agreement holder, rather than the farm/institution) participated in any other agri-environment scheme(s) (here or anywhere else)?
(If yes, go to Q18; If no, go to Q17)

◯ **Yes** ◯ **No**

17. If no, why was this the case? (Now go to Q25)

18. If yes, what schemes were these and when did they begin?

Scheme	**Start date (year)**

19. [SHOW CARD C] What was your main motivation in applying for <u>previous</u> schemes? (Tick one)

		Tick
1	Financial support offered	
2	Conducive with farm system/features already on farm	
3	Personal interest in wildlife and/or the environment	
4	Shooting/hunting/fishing interests	
5	Anticipated benefits to overall farming system i.e. improved soil	
6	Fulfil cross compliance or other regulatory requirements	
7	Next step from previous scheme	
8	Benefits for others (public/community)	
9	Other (Please specify)	

20. [SHOW CARD D] Which of the following statements best describes your opinion about the impact of <u>previous</u> environmental schemes?

		Tick
1	I saw no environmental benefit	
2	I saw little environmental benefit	
3	I saw a slight environmental benefit	
4	I saw significant environmental benefit	
5	I am not really sure (please tell us why you are not sure)	

21. Please explain your answer.

22. Now thinking about formal agri-environmental schemes (e.g. Environmental Stewardship, ESAs) <u>in general</u>, what do you believe are the main aims of these schemes?

Part 5: Your HLS application

23. Were you approached by a Natural England adviser (or other third party) about submitting an application for HLS?

◯ Yes, Natural England (or another third party) approached us

◯ No, we approached Natural England

24. Thinking back to when you first found out about HLS, which of the following best describes your attitude at the time?

◯ HLS was something we definitely wanted to do

◯ HLS was something we felt indifferent about

◯ HLS was something that we did not want to do

25. Why did you decide to join HLS?

26. Other than the Natural England advisor, who was involved in making your application?

	Tick	Who?
I made the application independently		n/a
I applied myself, but sought advice from others outside the business		
Someone else within the business made the application (if so, go to Q28)		
An agent or another 3rd party designed & submitted the application on my behalf (if so, go to Q28)		
Other (if so, go to Q28)		

27. [SHOW CARD E] In choosing your HLS options, please indicate how much you referred to each of the following:

		Not at all	Somewhat	A lot
1	Environmental Information Map			
2	Farm Environment Plan (FEP)			
3	Target statements			
4	HLS Handbook			
5	Technical guidance notes			
6	Other sources (please state)			

28. [SHOW CARD F] Why did you choose the options for your agreement? (tick one or more)

		Tick
1	The features were already in place	
2	The management was already in place	
3	The options would enable us to increase the wildlife	
4	The options would enable us to protect historic features	
5	The options would enable us to improve shooting	
6	The options would enable us to protect the landscape features	
7	The options would enable us to reduce pollution and soil erosion	

8	The options would enable us to fulfil other requirements (e.g. cross compliance)
9	The options would allow increased gross margins from poor yielding areas
10	The options would allow easier crop management (e.g. reduced spread of weeds)
11	Chosen features were identified in the FEP
12	Chosen features were identified in the Natural Character Area (NCA) targeting statement
13	Other reasons (please specify)

29. How much control do you feel you had in shaping your eventual agreement?

◯ **Complete control** ◯ **Considerable** ◯ **Some control** ◯ **Not much control**

30. Please elaborate on how in control you felt and why …

Part 6: Your HLS agreement

31. ~~What proportion (%) of your farm/land (as in Q1) is covered by HLS options?~~ ~~.....~~

32. What year did your HLS agreement begin? .....

33. Thinking specifically about the options you have chosen, what do you believe are the main environmental objectives of your HLS agreement?

34. Do you feel that the management prescriptions are right for your land?

◯ **Yes** ◯ **Partly** ◯ **No**

35. Please explain your answer

36. 'Indicators of Success' are a yard stick by which to judge whether the management practices are working, and to see whether adjustments are needed. How often do you refer to the Indicators of Success for your agreement?

◯ **Regularly** (go to Q37) ◯ **Occasionally** (go to Q37) ◯ **Not at all** (go to Q38)

37. If yes, in what way (if at all) does this influence your management of the agreement?

Capital works

38. Have you had a capital works plan in your HLS agreement? (If no, go to Q43)

◯ **Yes** ◯ **No**

39. [SHOW CARD G] If yes, why did you choose the capital items? (tick one or more options)

		Tick
1	Necessary to deliver the objectives of the option	
2	Benefits farm management	
3	Was going to conduct work anyway	
4	Attractive payment rate	
5	Other reasons (please specify)	

40. Did you complete all the capital works as planned? (If yes, go to Q42)

◯ **Yes** ◯ **No**

41. If not, what changed?

42. In your opinion, how important were the capital works to the success of the options they were associated with?

◯ **Essential** ◯ **Important** ◯ **Not very important** ◯ **Not at all important** ◯ **Unsure**

Specific options

Remind participants that this is a tick box exercise and that they will get the chance to elaborate in the next section …

43. [SHOW CARD H] How confident are you that you will achieve your Indicators of Success for the following options in your HLS agreement? (on a scale of 1-5, 1 being not at all confident, 5 being certain)

Pre-populate …	**1 (not at all)**	**2**	**3**	**4**	**5 (certain)**
Option 1					
Option 2					
Option 3					
Option 4					
Option 5					
Option 6					
Option 7					
Option 8					
Option 9					
Option 10					
Option 11					
Option 12					
Option 13					

44. [SHOW CARD I] How easy or difficult have you found it to carry out the management prescription for each of these options? (on a scale of 1-5, 1 very difficult, 5 being very easy)

Pre-populate …	**1 (very difficult)**	**2**	**3**	**4**	**5 (very easy)**
Option 1					
Option 2					
Option 3					
Option 4					
Option 5					
Option 6					
Option 7					
Option 8					
Option 9					
Option 10					
Option 11					
Option 12					
Option 13					

Option 1 …… *Pre-populate*

45. Why was this option chosen?

[Option 1]

46. How did you decide where to locate it (if applicable)?

[Option 1]

47. You told me earlier that you are …… confident about achieving the Indicators of Success for this option. Please could you explain why?

[Option 1]

48. You told me earlier that you found it …… to carry out the management prescriptions for this option. Please could you explain why?

[Option 1]

49. If applicable, what has been done to address any management difficulties associated with this option?

[Option 1]

Option 2 ……. *Pre-populate*

50. Why was this option chosen?

[Option 2]

51. How did you decide where to locate it (if applicable)?

[Option 2]

52. You told me earlier that you are …….. confident about achieving the Indicators of Success for this option. Please could you explain why?

[Option 2]

53. You told me earlier that you found it …….. to carry out the management prescriptions for this option. Please could you explain why?

[Option 2]

54. If applicable, what has been done to address any management difficulties associated with this option?

[Option 2]

Outcome of your agreement

55. [SHOW CARD J] Now thinking about your HLS agreement as a whole, to what degree do you think your HLS agreement has improved / maintained / enhanced each of the following? (on a scale of 1-5, 1 being not at all, 5 being a lot)

		1 Not at all	2	3	4	5 A lot	n/a
1	Water quality (through the reduction of soil erosion)						
2	Wildlife						
3	Landscape character						
4	Historic environment						
5	Flood risk management						
6	Access for farm work						
7	Access for public						

56. Overall, how successful do you feel the HLS agreement has been at meeting its environmental objectives? (on a scale of 1-5, 1 being not at all, 5 being a lot)

◯ **Very successful** ◯ **Successful** ◯ **Neither successful nor unsuccessful** ◯ **Unsuccessful** ◯ **Very unsuccessful**

57. (Using agreement map …) **Please indicate on the map the area of the farm where you have seen most environmental improvement as a result of your HLS agreement? Please tell us about it (i.e. what changes you have observed?)**

58. (Using agreement map …) **Which aspects have you enjoyed the most?**

59. How often have you received advice and/or feedback or support about your HLS management from Natural England (or other conservation) advisor since the beginning of your agreement? (i.e. excluding the initial application process)

◯	◯	◯	◯
None	**1 -2 times**	**3-5 times**	**More frequently**

60. Do you feel you need more support in managing your agreement?

◯	◯
Yes	**No**

61. <u>If yes</u>, what support would you find useful?

Part 7: The future

62. Do you have any suggestions for improvements to the design or delivery of agri-environment schemes in general?

63. How likely is it that you would enter into a similar scheme in the future?

○ **Definitely** ○ **Quite likely** ○ **Unsure** ○ **Not likely** ○ **Definitely not**

64. Please explain your answer

65. How likely is it that you would continue to do environmental management work <u>in the absence of such scheme in the future</u>?

○ **Definitely** ○ **Quite likely** ○ **Unsure** ○ **Not likely** ○ **Definitely not**

66. Please explain your answer

67. Do you have any other comments about the subjects we have been discussing?

<Business Name>>
<<Address1>>
<<Address2>>
<<Address3>>
<<Address4>>
<<Postcode>>

<<Date>>

Dear <<Name>>

Higher Level Stewardship (HLS) Monitoring Programme 2015: Agreement Holder Survey

I am writing to invite you to take part in a survey as part of our research, funded by Natural England (NE), into the environmental benefits provided by the HLS scheme.

Monitoring is an important part of the HLS scheme, enabling NE to establish whether it is delivering its intended environmental benefits. Between 2009 and 2011, NE undertook baseline monitoring of HLS agreements and you kindly allowed your agreement to be included in that survey. We are reviewing progress against scheme objectives. In addition to the ecological survey, carried out by the Centre for Ecology & Hydrology, we are inviting agreement holders to participate in a face-to-face interview. Farmers and land managers are central to the outcome of HLS and by conducting the survey we hope to understand this relationship further.

The survey aims to capture your experience of the agreement, including what has gone well and what has not. It also seeks to understand a bit more about you, your previous environmental management experiences and motivations for participating in HLS. By conducting the survey we aim to provide NE with important feedback on the role of the HLS agreement holder, the survey is not designed as an audit or inspection and we wish to assure you that the information collected will be used solely to develop and refine agri-environmental schemes. We will produce a publically available report on the findings of the project, but we would like to stress that neither individual agreements nor agreement holders will be identifiable. Please see the attached information sheet for further details about the survey and how we will use and protect the information you provide, if you agree to take part.

We will be phoning you to ask you to take part and arrange a convenient time to visit to undertake an interview. The interview should take no more than 60 minutes. Participation is entirely voluntary but I do hope that you will agree to take part so that we can build a better understanding of the role of agreement holders in the outcomes of HLS.

If you have any questions about the survey please contact Professor Matt Lobley, M.Lobley@exeter.ac.uk or 01392 724539. If you are happy for us to contact you, there is no need to reply; the CRPR team (or our colleagues from the University of Newcastle) will contact you in advance. If you have any concerns that you wish to address to Natural England please contact Andrew Cooke (Andrew.I.Cooke@naturalengland.org.uk).

With many thanks in advance for your time and cooperation.

Yours sincerely,

Associate Professor Matt Lobley, University of Exeter, Co-director Centre for Rural Policy Research and Principle Investigator HLS Monitoring Programme 2015

Appendix B: Changes to mapped habitats between baseline and resurvey of HLS agreements

This appendix contains graphs that are not included in the main report, which show changes to mapped habitats between baseline (2009 – 2011) and resurvey (2015 - 2016) of HLS agreements. Habitats for which no change in extent was recorded between the baseline and resurvey are not included in these graphs (see y axes of Figures 3.1 – 3.3 in main report for all broad habitats >10ha and all priority and FEP habitats > 5ha that were surveyed, regardless of change).

A1 Changes in broad and priority habitat categories, grouped by option type

Transitions between broad habitats under HK (grassland) and HL (moorland and rough grazing for birds) option groups are given in Section 3.3 of the main report, as more than 2500 ha of each of these option groups was surveyed (Figure 3.8 main report). Transitions between broad and priority habitats between baseline survey and resurvey, for HC, HO and HQ option groups, are below (Figures B1 and B2). The HC option group is dominated by options HC7 and HC8 (maintenance and restoration of woodland respectively), the HO group consists of land under lowland heathland options, and the HQ options relate mainly to fen (HQ6, HQ7, HQ8: maintenance, restoration and creation of fen respectively) and restoration of lowland wet bog (HQ10).

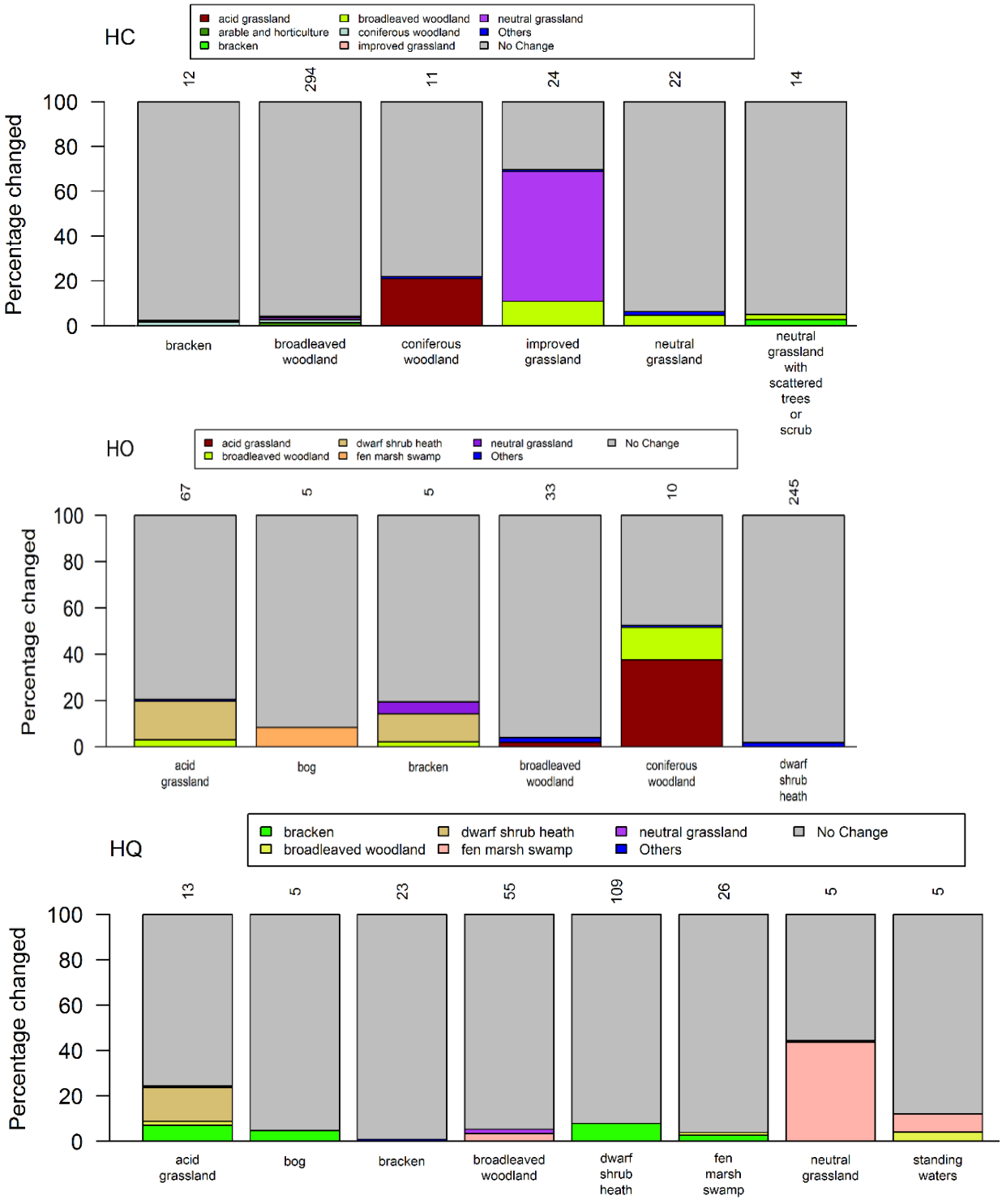


Figure B1. Transitions between broad habitats within HC (woodland), HO (lowland heathland) and HQ (fen and lowland wet bog) option groups, between baseline survey (2009-2011) and resurvey (2015-2016) of land under Higher Level Stewardship management. Broad habitats listed along x axis are baseline habitats, those in box above are resurvey broad habitats. Area surveyed in hectares given above each bar.

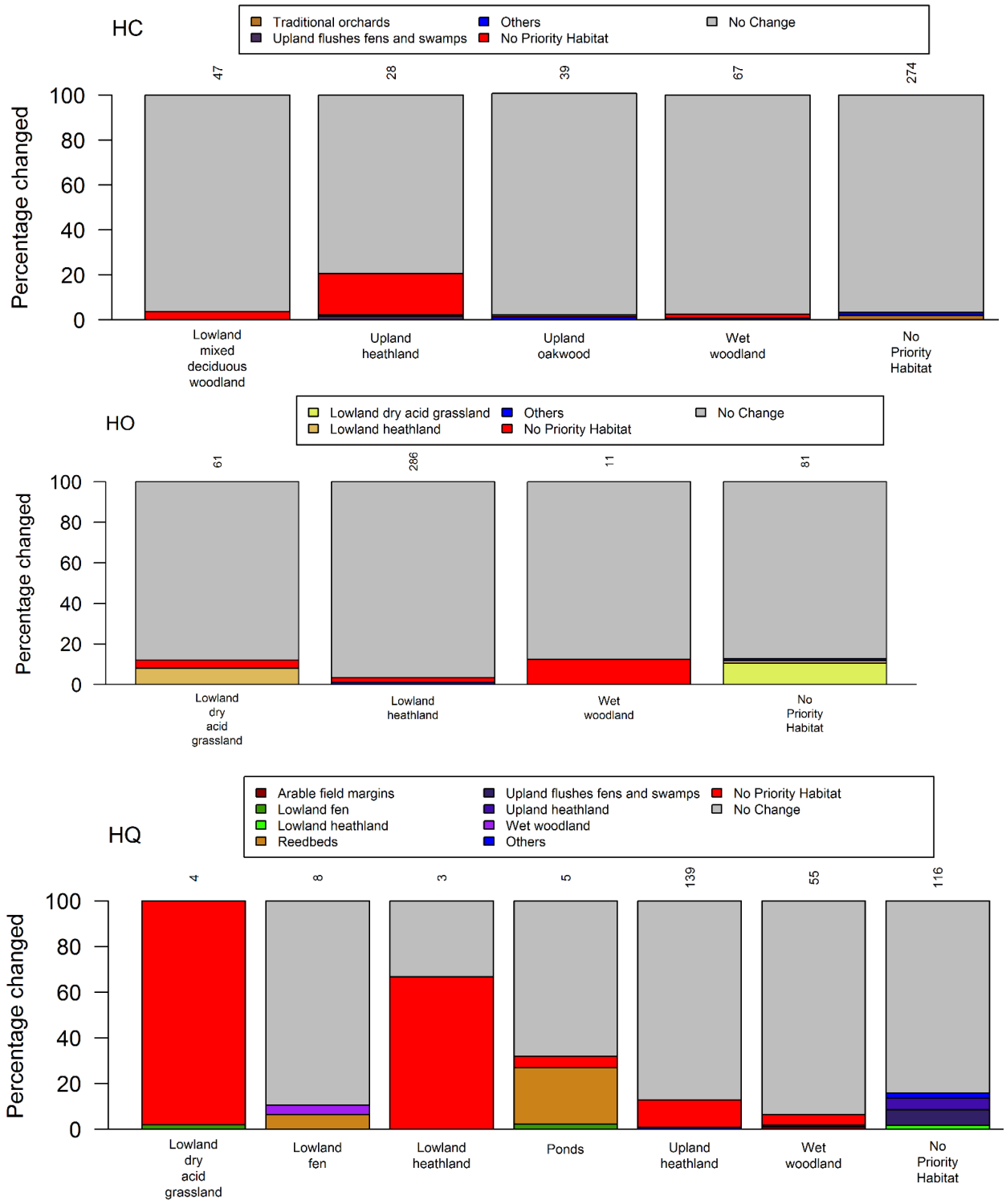


Figure B2. Transitions between priority habitats within HC (woodland), HO (lowland heathland) and HQ (fen and lowland wet bog) option groups, between baseline survey (2009-2011) and resurvey (2015-2016) of land under Higher Level Stewardship management. Priority habitats listed along x axis are baseline habitats, those in box above are resurvey priority habitats. Area surveyed in hectares are above each bar.

A2 Changes in Farm Environment Plan feature habitats between HLS baseline survey and resurvey

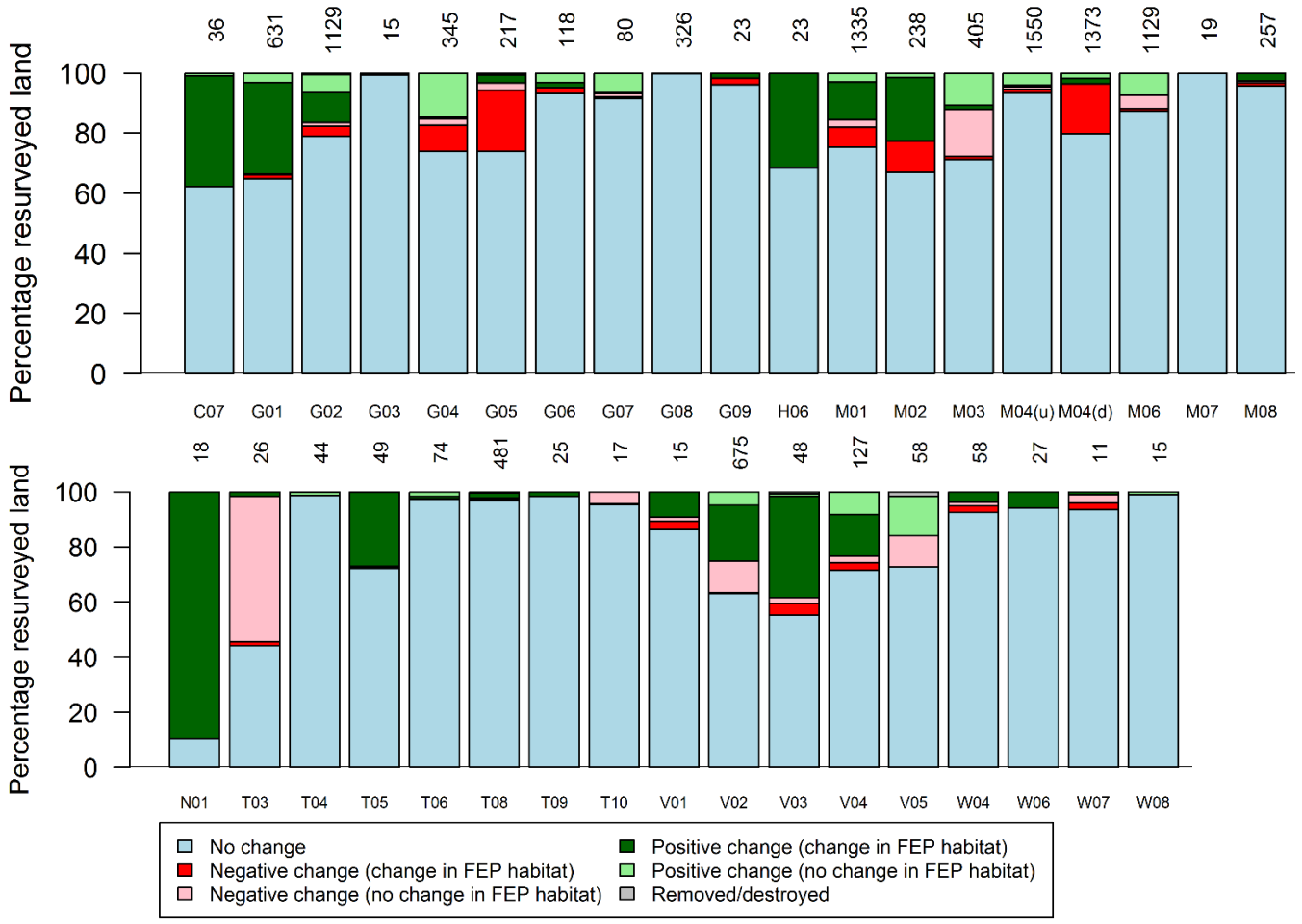


Figure B3. Changes in extent and condition of habitat features as defined by Farm Environment Plan categories, between baseline survey (2009-2011) and resurvey (2015-2016) of land under Higher Level Stewardship management. See Table 3.1 in main report for descriptions of FEP feature codes. Blue = no change, pink = negative change in condition but not extent of habitat, red = negative change in condition and extent, pale green = positive change to condition but not extent, dark green = positive change to condition and extent of habitat. M04 (d) = dry upland heath, M04 (u) = undefined upland heath. Area surveyed in hectares given above each bar.

Changes to FEP habitat features largely underscore those discussed above in relation to broad (Section 3.1 main report) and priority (Section 3.2 main report) habitats. For example, the negative changes in habitat extent in G05 (Figure B3) relates to the change in the priority lowland dry acid grassland habitat discussed in Section 3.2. There is a large decline in condition of T03, wood pasture and parkland, though a relatively small area is affected as only twenty-six hectares were surveyed in this category. As for priority habitats, across the range of FEP habitat features more changes were positive than negative. FEP habitat features showing substantial (>25% surveyed area) positive change include C07 (saline lagoons) which relate to the creation of reedbeds, H06 (historic water meadows) for which the positive changes relate to a transition of semi-improved or mosaic improved/unimproved grasslands towards semi-natural grasslands and N01 (land at risk of generating diffuse pollution) which relates to the recovery of bare

ground on heathland. All three of these features cover relatively small areas (<36 ha), for which small changes in extent can give rise to big percentage differences.

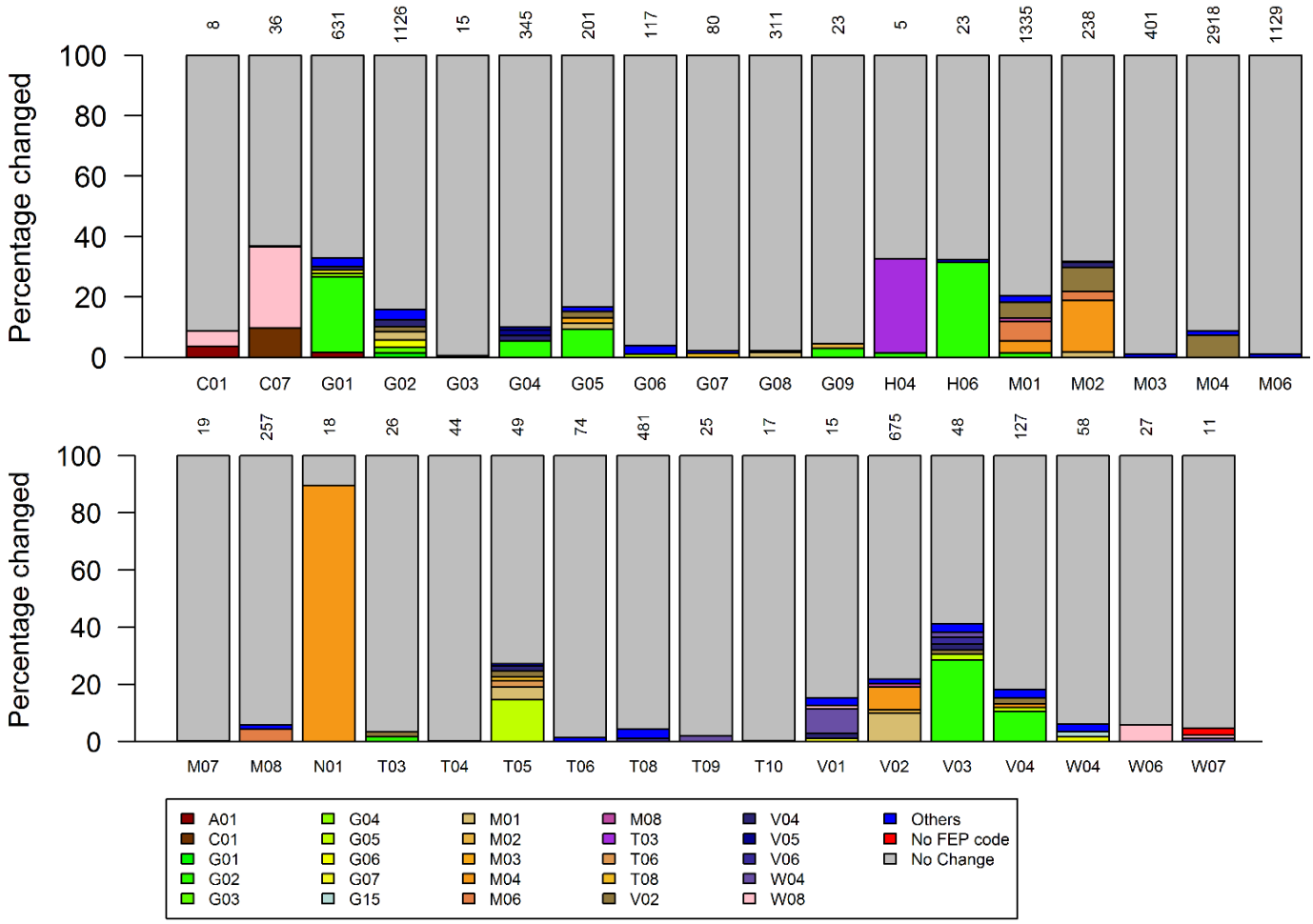


Figure B4. Transitions between habitat features as defined by Farm Environment Plan categories, between baseline survey (2009-2011) and resurvey (2015-2016) of land under Higher Level Stewardship management. See Table 3.1 in main report for descriptions of FEP feature codes. FEP habitats features listed along x axis are baseline habitats, features in box are resurvey FEP habitats. Area surveyed in hectares given above each bar.

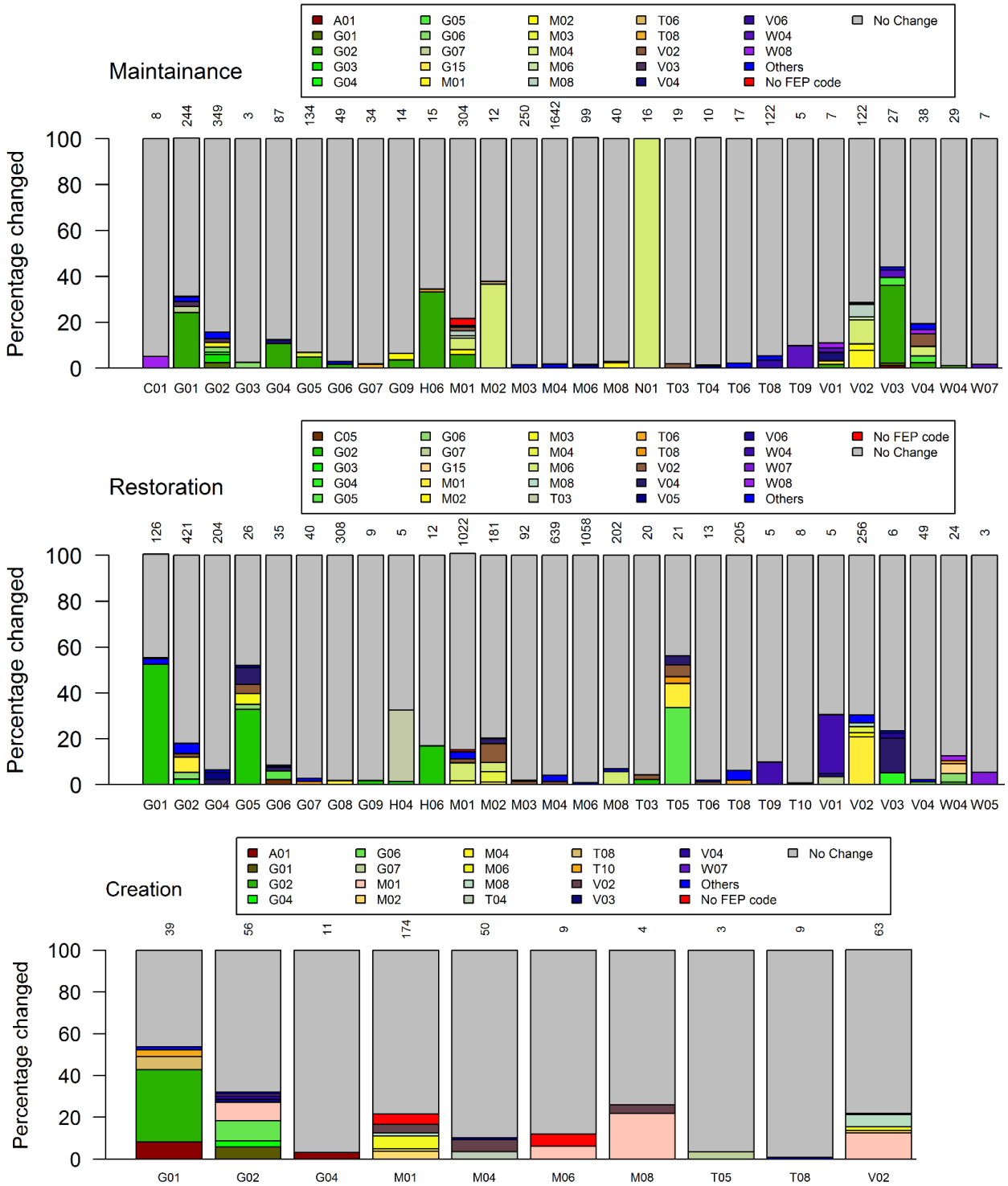


Figure B5. Transitions between habitat features defined by Farm Environment Plan categories, between baseline survey (2009-2011) and resurvey (2015-2016) of land under Higher Level Stewardship management. FEP habitat categories are grouped according to option type (maintenance vs. restoration vs. creation). See Table 3.1 in main report for descriptions of FEP feature codes. FEP habitats features listed along x axis are baseline habitats, features in box are resurvey FEP habitats. Area surveyed in hectares given above each bar.

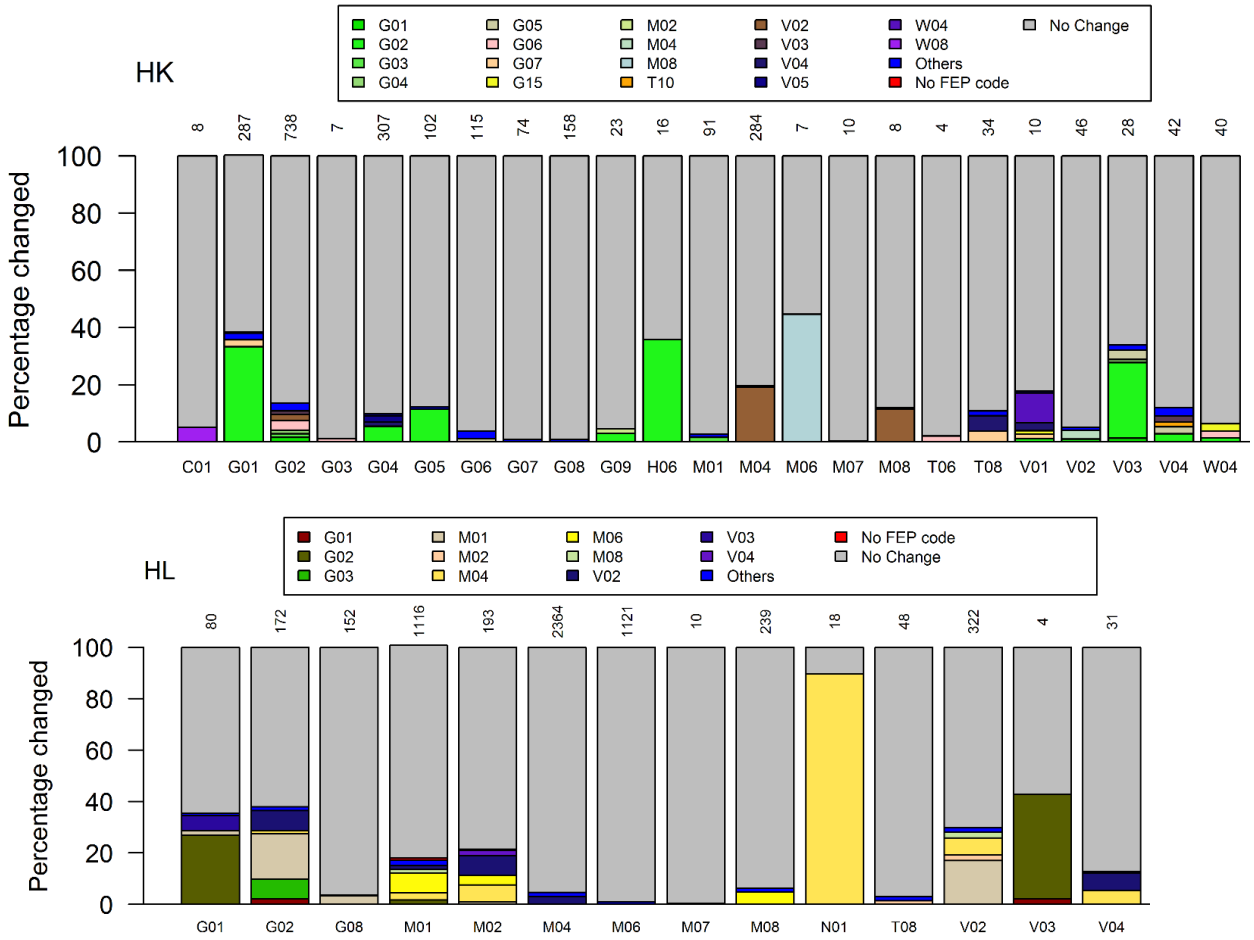


Figure B6. Transitions between habitat features defined by Farm Environment Plan categories, between baseline survey (2009-2011) and resurvey (2015-2016) of land under Higher Level Stewardship management. FEP habitat categories graphs are presented in option groups. See Table 3.1 in main report for descriptions of FEP feature codes. FEP habitats features listed along x axis are baseline habitats, features in box are resurvey FEP habitats. Area surveyed in hectares given above each bar.

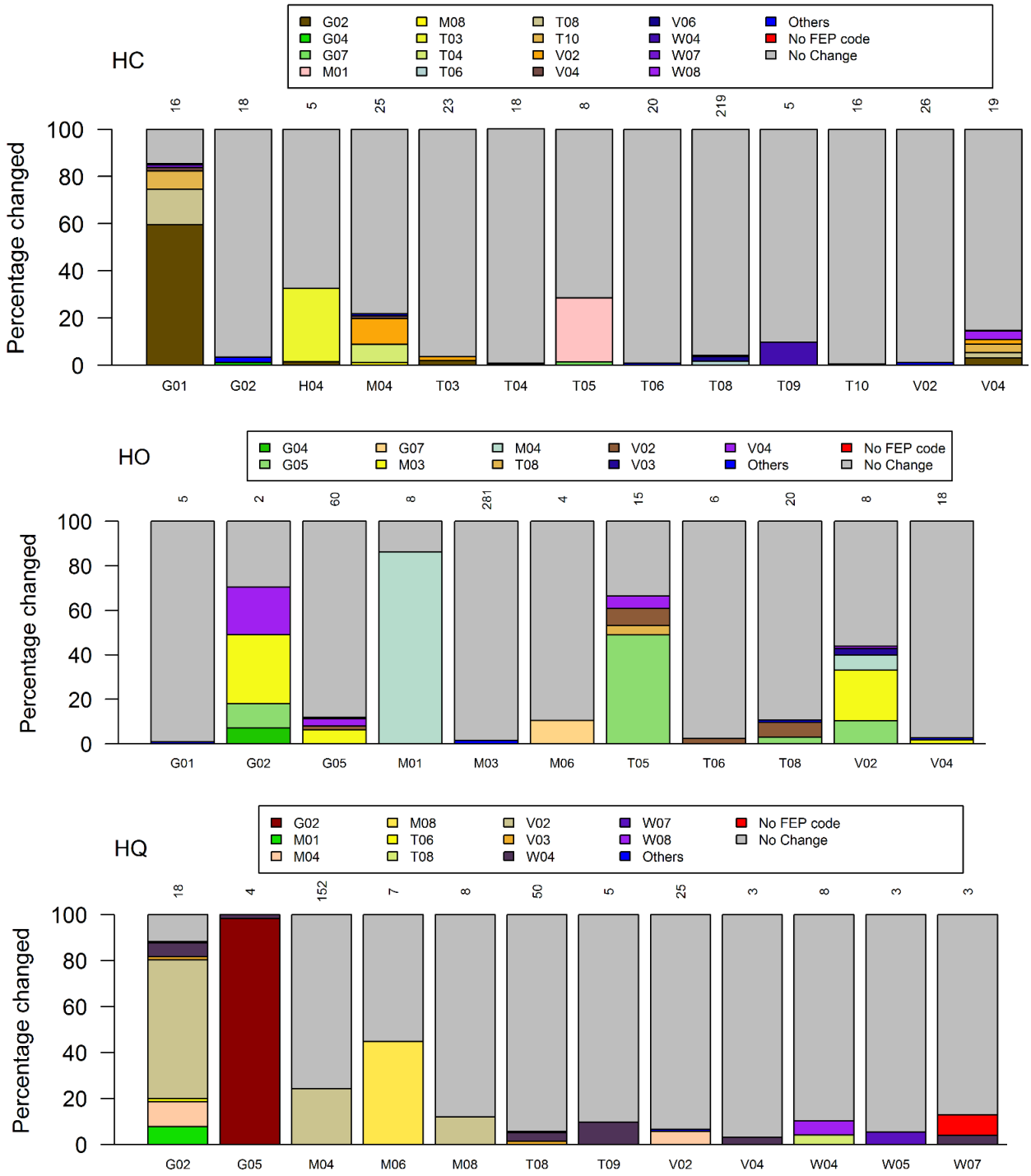


Figure B7. Transitions between habitat features defined by Farm Environment Plan categories, between baseline survey (2009-2011) and resurvey (2015-2016) of land under Higher Level Stewardship management. FEP habitat categories graphs are presented in option groups. See Table 3.1 in main report for descriptions of FEP feature codes. FEP habitats features listed along x axis are baseline habitats, features in box are resurvey FEP habitats. Area surveyed in hectares given above each bar.

Appendix C: Multivariate results for lowland options with low replication

ii. Creation: lowland heath

Not a sensible analysis: there are very few sites, and no overlap between the baseline and the resurvey phases in the ordination (Fig. C1). There were only two resurvey quadrats, and these were not of heathy vegetation, hence the length of DCA axis 1 (the resurvey site was an earth bank adjacent to woodland, Leigh Woods, North Somerset, parcel 8131, agreement AG00270304).

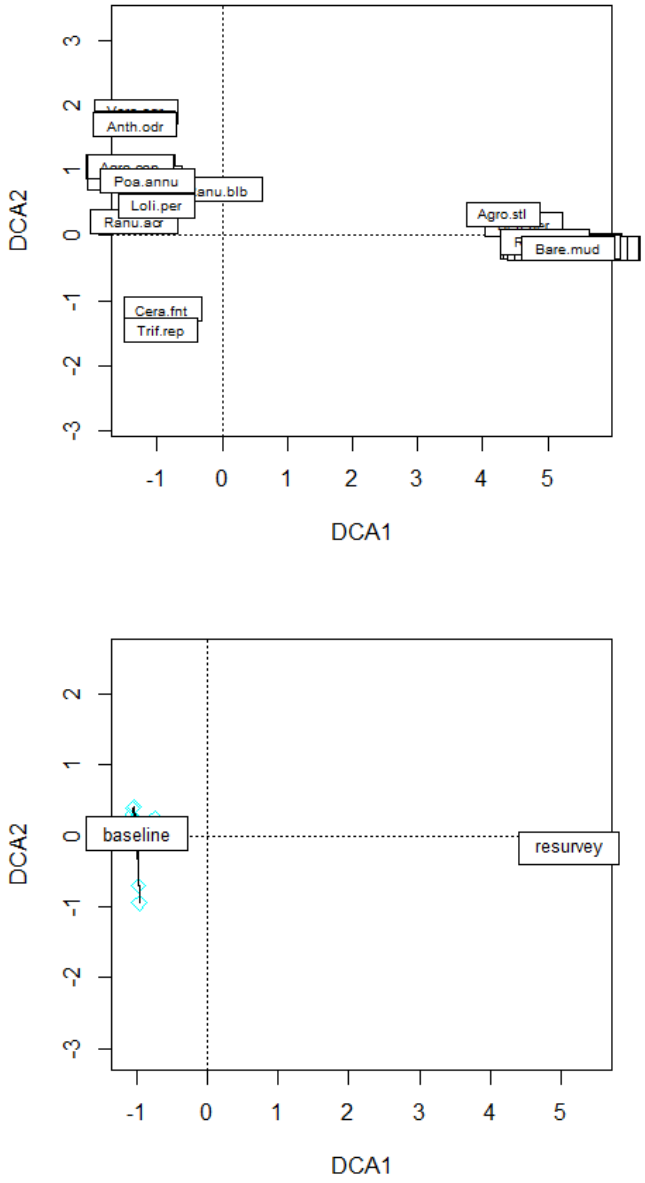


Figure C1. Creation: lowland heath. The top ordination shows species; only the most abundant species are shown, and these are layered in order of relative diversity using the inverse Simpson index. The bottom ordination shows sites, grouped by survey phase; phase text indicates the centroid of the group.

iii. Creation: fen

There was only site, but this was resurveyed. No tests indicated a significant difference, but this may be due to low power (Fig. C2). The ordination may indicate a scrubbing up of the site

(DCA axis 2), although this interpretation should be carefully verified against the raw data and other available evidence.

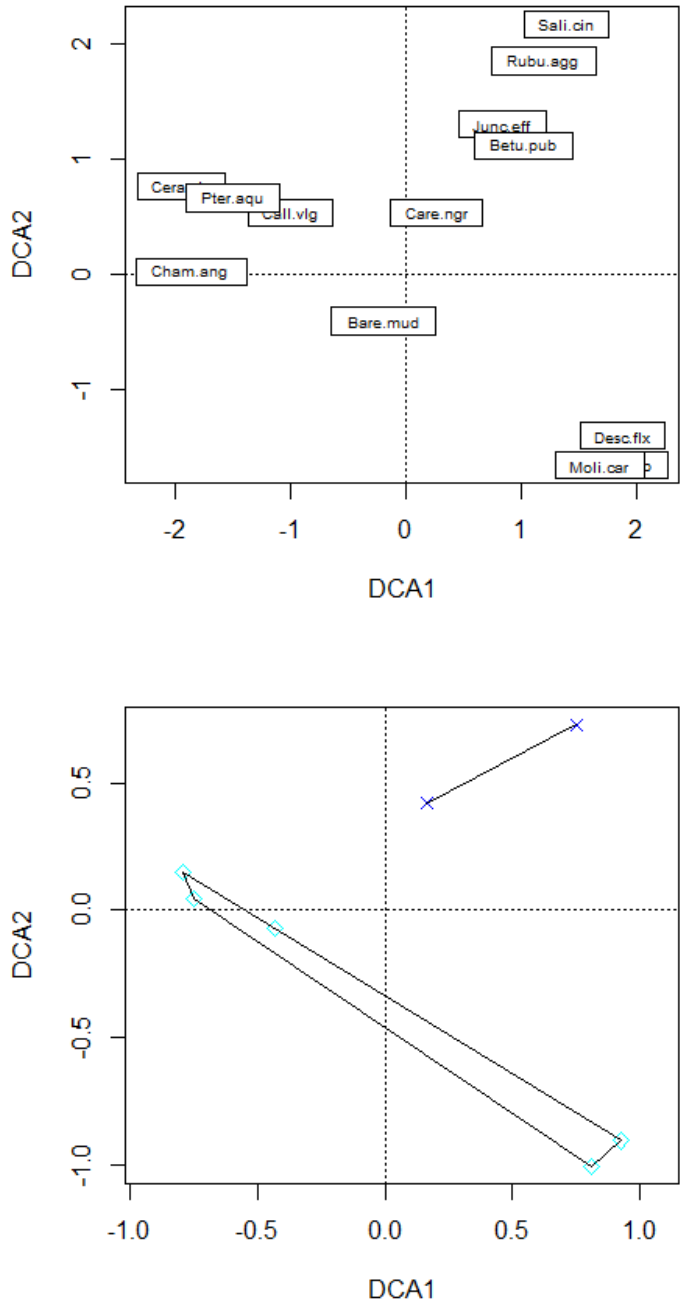


Figure C2. Creation: fen. The top ordination shows species; only the most abundant species are shown, and these are layered in order of relative diversity using the inverse Simpson index. The bottom ordination shows sites, grouped by survey phase: aqua diamonds = baseline; blue crosses = resurvey.

iv. Creation: woodland

One single resurveyed quadrat (within parcel 7188, agreement AG00301968). Analysis not sensible.

vii. Restoration: sand dunes

No difference between phase locations was found (PerMANOVA; $P = 0.65$; Fig. C3), nor for multivariate dispersion ($P = 0.62$), but power is likely to be low with only two parcels surveyed.

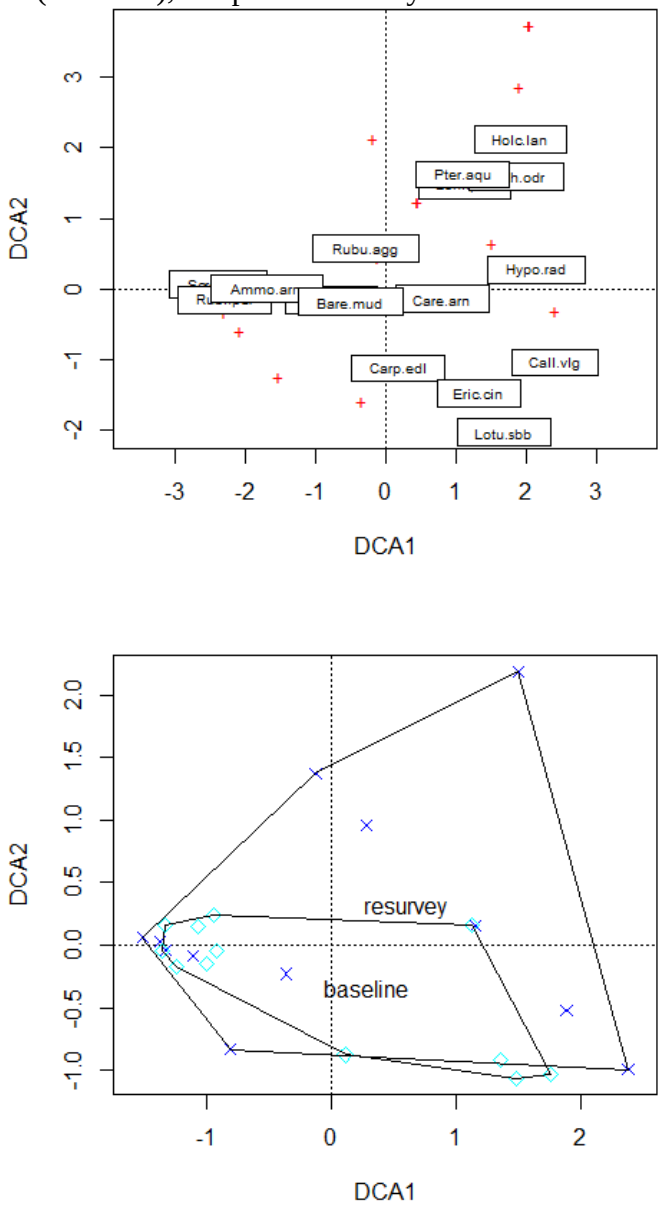


Figure C3. Restoration: sand dunes. The top ordination show species; only the most abundant species are labelled, and these are layered in order of relative diversity (using the inverse Simpson index); red pluses indicated unlabelled species. The bottom ordination shows sites grouped by survey phase.

xiii. Maintenance: lowland raised bog

This ordination provides possible evidence for drying out, although the sample size is small (Fig. C4). Such as the data are, an increase in *Rubus*, *Rhododendron*, and *Deschampsia flexuosa* may be indicated (Fig. C5). However, all statistical tests were marginal (PerMANOVA: $P = 0.17$; dispersion test: $P = 0.238$; multiple linear models: $P = 0.317$).

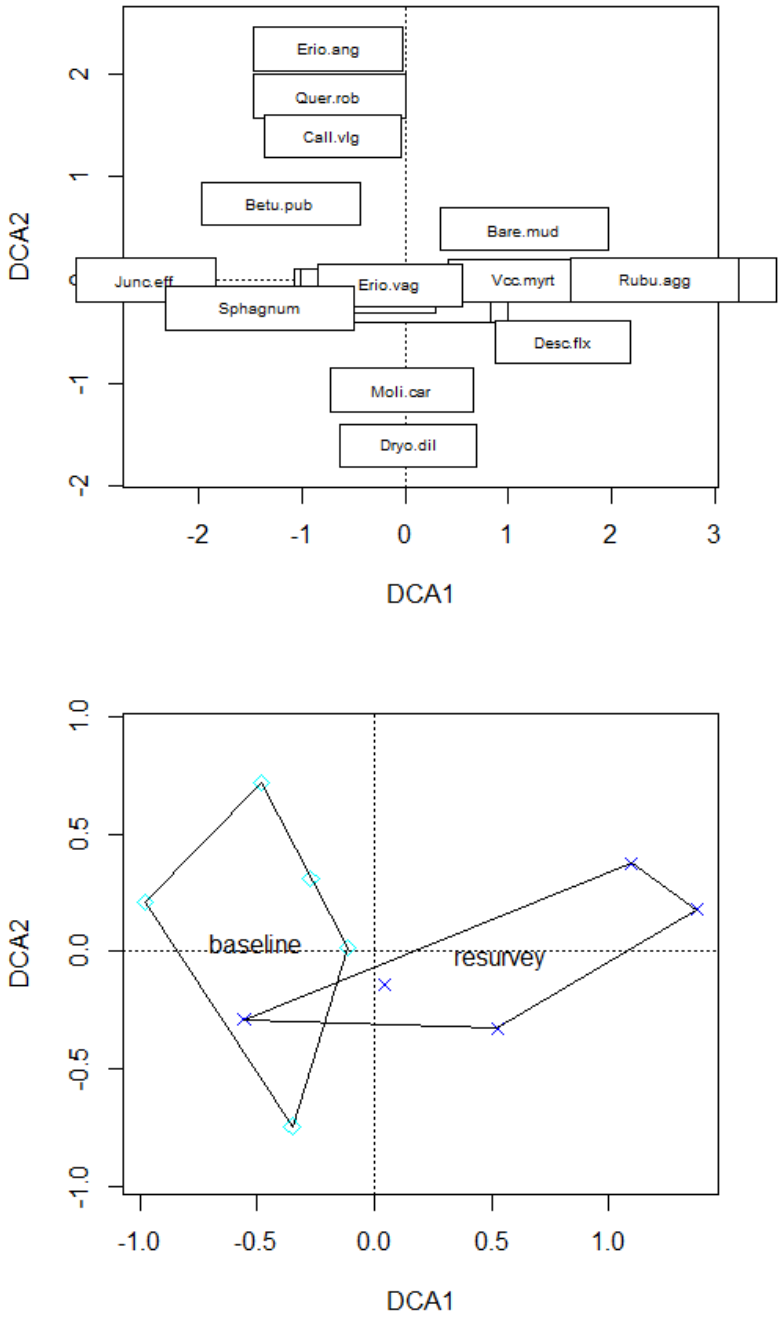
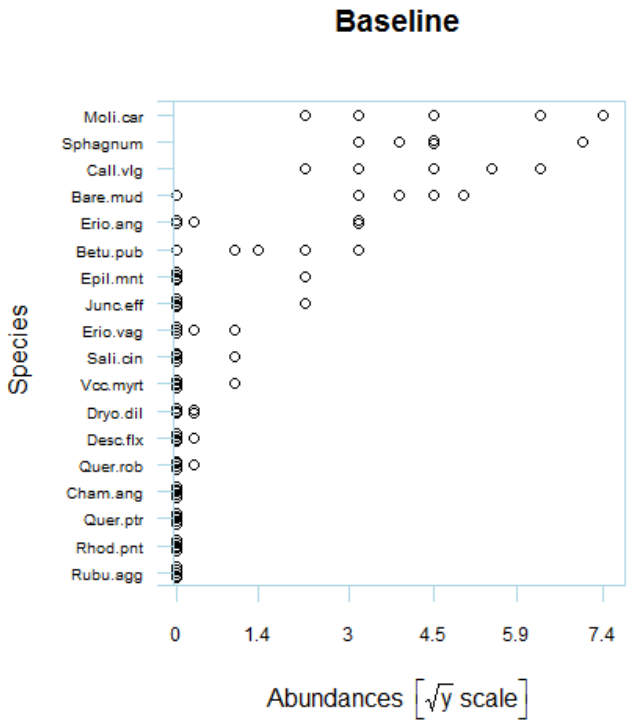


Figure C4. Restoration: lowland raised bog. The top ordination show species; only the most abundant species are labelled, and these are layered in order of relative diversity (using the inverse Simpson index). The bottom ordination shows sites, grouped by survey phase.



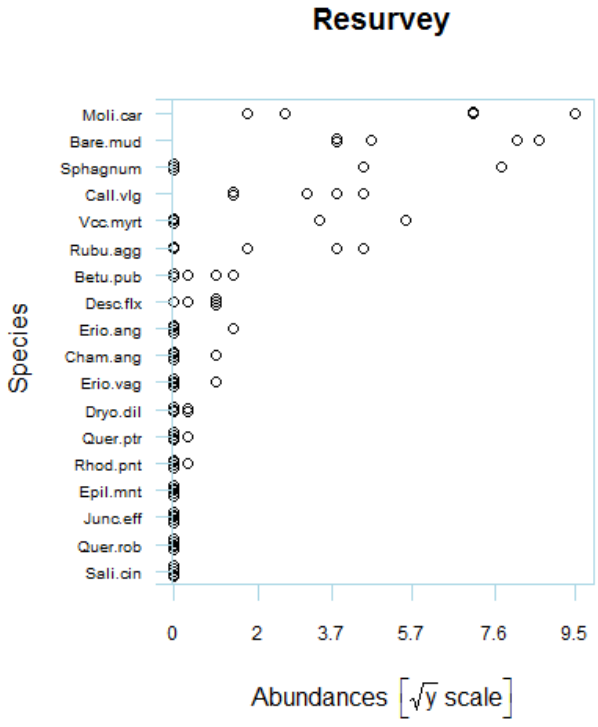


Figure C5. Restoration: lowland raised bog. The twenty most abundant species by survey phase.

Appendix D: Data summaries and statistical models for analyses at option scale

D1 Condition assessments for habitats at HLS baseline and resurvey

D1.1 HK7 – restoration of species rich semi-natural grassland

D1.1.1 Criteria on which condition assessment were failed for HK7

Although not a mandatory field within the survey, surveyors often noted which criteria a feature had failed on when carrying out assessments. The tables below shows counts of comments (where made) for individual condition assessment criteria per habitat feature under management option HK7. Note that not all conditions were accompanied by notes, so it is possible that some criteria may be underrepresented in the tables below. A condition of C is attributed where two or more criteria are failed, and condition of B attributed where one criteria is failed.

Condition criteria G02 feature	Baseline	Resurvey	Same in both baseline and resurvey
Cover of undesirables <5%		4	
Cover of wildflowers >10%	5	8	3
Cover of bare ground <10%	1	1	1
Cover of invasive trees <5% & signs of waterlogging <30%	1	6	1
Total number of parcels with comments	6	16	6

Table D1 Number of surveyor comments relating to the criteria on which condition assessments were failed (graded B or C) for habitat feature G02 (semi-improved grassland) under HK7 management option.

Condition criteria G03 feature	Baseline	Resurvey	Same in both baseline and resurvey
Cover of undesirables <5%	2	2	2
Cover of wildflowers >10%	5	7	5
Cover of bare ground <10%			
Cover of invasive trees <5% & signs of waterlogging <30%			
Feature not present		2	
Total number of parcels with comments	6	10	6

Table D2 Number of surveyor comments relating to the criteria on which condition assessments were failed (graded B or C) for habitat feature G03 (species-rich grassland) under HK7 management option.

Condition criteria G04 feature	Baseline	Resurvey	Same in both baseline and resurvey
Cover of undesirables <5%			
Cover of wildflowers and sedges >30%	2	3	
Cover of bare ground <10%			
Cover of invasive trees and shrubs <5%	2	4	2
At least two indicator species frequent	2	4	2
Feature not present		1	
Total number of parcels with comments	6	14	6

Table D3 Number of surveyor comments relating to the criteria on which condition assessments were failed (graded B or C) for habitat feature G04 (lowland calcareous grassland) under HK7 management option.

Condition criteria G05 feature	Baseline	Resurvey	Same in both baseline and resurvey
Cover of undesirable species <5%	1		
Cover of bare ground <10%			
Cover of bracken <20% & cover of scrub & bramble <5%			
Cover of coarse grass species <20%	1	1	1
At least one indicator species frequent	1	3	1
Feature not present		2	
Total number of parcels with comments	3	5	

Table D4 Number of surveyor comments relating to the criteria on which condition assessments were failed (graded B or C) for habitat feature G05 (lowland dry acid grassland) under HK7 management option.

Condition criteria G06 feature	Baseline	Resurvey	Same in both baseline and resurvey
Cover of undesirable species <5%	2	1	
Cover of wildflowers & sedges > 30%	8	6	4
Cover of bare ground <10%			
Cover of invasive trees and shrubs <5%		2	
At least two indicator species frequent & two occasional	11	10	6
Feature not present			
Total number of parcels with comments	13	13	7

Table D5 Number of surveyor comments relating to the criteria on which condition assessments were failed (graded B or C) for habitat feature G06 (lowland meadows) under HK7 management option.

Condition criteria G07 feature	Baseline	Resurvey	Same in both baseline and resurvey
Cover of undesirable species <10%		1	
Cover large sedges <30%, large grasses <20%			
Cover invasive trees <5%	1	9	
Cover non-jointed rushes <50%	1	1	
At least two indicator species frequent & two occasional	5	5	3
Feature not present	1 (G02)	2 (G02)	1
Total number of parcels with comments	5	15	3

Table D6 Number of surveyor comments relating to the criteria on which condition assessments were failed (graded B or C) for habitat feature G06 (lowland meadows) under HK7 management option.

Comments for two different parcels for G07 list that the criteria for presence of at least two indicator species frequent and two occasional within the condition assessment are only just met. For both examples the change from baseline to resurvey shows an improvement B-A. Decline in condition from A at baseline survey to B at resurvey are all associated with an increase in scrub cover.

G08: only two parcels were assessed, both failed on occurrence of indicator species, with one assessed at condition C also failing on cover of wild flowers and sedges.

G09: In the baseline the parcel that was given an A was only narrowly passed, however in resurvey it failed on the number of indicator species. Those given a B in resurvey were failed only on wildflower cover (one was cited as almost being a B in the baseline survey but failing on number of frequent indicator species).

D1.1.2 Analytical model output for condition for HK7

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	1.6484	0.7025	2.346	0.01896	*
area	-0.8156	1.2942	-0.63	0.52859	
slope	-0.5275	0.2747	-1.921	0.05478	.
cond. base. A	-0.6599	0.5796	-1.138	0.25494	
cond. base. B	0.705	0.5285	1.334	0.18223	
feature G04	-2.1032	0.7902	-2.662	0.00777	**
feature G06	-3.8722	0.8917	-4.343	1.41E-05	***
feature G07	-2.0969	0.7368	-2.846	0.00443	**
feature other	-1.4993	0.6361	-2.357	0.01842	*

Odds ratios	
(Intercept)	5.19869
area	0.44239
slope	0.59005
cond. base. A	0.51693
cond. base. B	2.02378
feature G04	0.12206
feature G06	0.02081
feature G07	0.12284
feature other	0.22329

95% CI (profile likelihood)		
	2.50%	97.50%
(Intercept)	1.35594	22.4734
area	0.02111	5.30332
slope	0.33585	0.996
cond. base. A	0.16097	1.5877
cond. base. B	0.72	5.80677
feature G04	0.02395	0.54977
feature G06	0.00302	0.10448
feature G07	0.02614	0.48942
feature other	0.05808	0.73115

Table D7 Output of final generalised linear mixed model output for odds ratio analysis of change in condition assessment for option HK7, adjusted for covariates selected though multi-model comparison approach. cond. base. A = baseline condition of A, cond. base. B = baseline condition of C. Reference feature for analyses (compared to listed features) was G02 (semi-improved grassland), reference baseline condition was C. See Table 2.3 for further details of covariates.

D1.2 HK6 – maintenance of species rich semi-natural grassland

D1.2.1 Criteria on which condition assessment were failed for HK6

D1.2.1.1 Habitat feature G06, lowland meadows

Surveyor's comments for failed condition assessment describe the areas as not being correctly attributed to habitat feature (not actually being G06). The other frequent reason cited in the comments for failure is based on frequency of positive indicators.

D1.2.1.2 Habitat G07, purple moor-grass and rush pasture

Reasons given for failure of condition assessment are cover of trees and shrubs and also indicator species.

D1.2.1.3 Other habitats including G03, G04, G05, G08 and G09

The most frequent reasons stated for not attributing a favourable condition assessment relate to a lack of positive indicator species and the cover of wildflowers.

D1.2.2 Analytical model output for condition assessment for HK6

	Estimate	Std. error	z value	Pr(>|z|)	
(Intercept)	3.44868	2.09656	1.645	0.1	.
area	9.00753	7.33482	1.228	0.2194	
supplement? (Y)	1.47075	0.62495	2.353	0.0186	*
cond. base. A	-0.091	0.69165	-0.132	0.8954	
cond. base. B	0.897	0.73205	1.225	0.2205	
feature G06	-2.0517	1.00984	-2.032	0.0422	*
feature other	-1.1622	0.91044	-1.277	0.2018	

Odds ratios		95% CI (profile likelihood)	2.50%	97.50%
(Intercept)	31.4588	(Intercept)	1.34052	3.73E+03
area	8164.34	area	0.4987	2.52E+11
supplement? (Y)	4.35249	supplement? (Y)	1.34499	1.60E+01
cond. base. A	0.91305	cond. base. A	0.22746	3.54E+00
cond. base. B	2.45224	cond. base. B	0.592	1.09E+01
feature G06	0.12852	feature G06	0.01369	8.02E-01
feature other	0.3128	feature other	0.03924	1.59E+00

Table D8 Output of final generalised linear model output for odds ratio analysis of change in condition assessment for option HK6, adjusted for covariates selected though multi-model comparison approach. cond. base. A = baseline condition of A, cond. base. B = baseline condition of C. Reference feature for analyses (compared to listed features) was G02 (semi-improved grassland), reference baseline condition was C, reference was no supplement. See Table 2.3 for further details of covariates.

D1.3 HK15 / 16 – maintenance / restoration of semi-improved or rough grassland for target species

D1.3.1 Criteria on which condition failed for HK15 / 16

Condition assessment criteria G02 & G03 feature	Baseline	Resurvey	Same in both baseline and resurvey
Cover of undesirables <5% Cover of wildflowers & sedges >10% Cover of bare ground <10 ** Cover of invasive trees and shrubs <5% and indicators of waterlogging <30%	13 15 1 3	8 18 1 11	3 10 0 2
Total number of parcels with comments	19	30	13

** Additional condition assessment required for G02.

Table D9 Number of surveyor comments relating to the criteria on which condition was failed (graded B or C) for habitat features G02 (semi-improved grassland) and G03 (species-rich grassland) under HK15 and HK16 management options.

On BAP priority grassland the most frequent criteria under which habitat features failed condition assessment were a greater than required cover of undesirables and too much scrub.

D1.3.2 Analytical model output for change in condition for HK15 / HK16

	Estimate	Std. error	z value	Pr(>|z|)	
(Intercept)	-0.901	1.016	-0.886	0.376	
area	-2.847	1.345	-2.118	0.034	*
pres. score 3	-1.694	0.860	-1.971	0.049	*
pres. score 4	-0.156	1.074	-0.146	0.884	
env. zone 2	1.233	0.850	1.451	0.147	
env. zone 3	-0.242	1.013	-0.239	0.811	
man. ease 4	1.642	0.892	1.840	0.066	.
man. ease 5	2.723	0.931	2.925	0.003	**
cond. base. A	0.153	0.859	0.178	0.859	
cond. base. B	-0.356	0.671	-0.530	0.596	
feature G15	-0.191	0.995	-0.192	0.848	
feature other	-0.725	0.700	-1.034	0.301	
option HK16	1.879	0.999	1.881	0.060	.

Odds ratios	
(Intercept)	0.406
area	0.058
pres. score 3	0.184
pres. score 4	0.855
env. zone 2	3.431
env. zone 3	0.785
man. ease 4	5.166
man. ease 5	15.226
cond. base. A	1.165
cond. base. B	0.701
feature G15	0.826
feature other	0.485
option HK16	6.546

	95% CI (profile likelihood)	
	2.50%	97.50%
(Intercept)	0.049	2.906
area	0.003	0.630
pres. score 3	0.029	0.883
pres. score 4	0.102	7.560
env. zone 2	0.686	20.405
env. zone 3	0.102	5.999
man. ease 4	0.972	34.265
man. ease 5	2.840	114.726
cond. base. A	0.219	6.775
cond. base. B	0.184	2.644
feature G15	0.127	7.269
feature other	0.117	1.881
option HK16	1.029	54.471

Table D10 Output of final generalised linear model output for odds ratio analysis of change in condition for options HK15 & HK16, adjusted for covariates selected though multi-model comparison approach. Area = area of parcel under option; pres. score = baseline panel score of how appropriate management prescriptions were for option; env. zone = environment zone; man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; cond. base. A = baseline condition of A, cond. base. B = baseline condition of C. References for analyses (compared to listed categories): pres. score = score of 1 or 2; env. zone = 1; man. ease = score of 1, 2 or 3; baseline condition = C; feature = G02 (semi-improved grassland); HLS option = HK15. See Table 2.3 for further details of covariates.

D1.4 HL9 / HL10 – maintenance / restoration of moorland

D1.4.1 Criteria on which condition was failed for options HL9 and HL10

D1.4.1.1 FEP habitat M04, upland moorland heath.

Condition criteria include a cover of dwarf shrub heath of at least 50% for dry heath and between 20 and 75% for wet heath with at least two shrub species present, condition also requires a diverse age structure of heather present. The majority of surveyor comments relating to parcels being given a condition of C cite failure to comply with dwarf shrub heath cover and appropriate age structure as reasons for failing.

D1.4.1.2 Habitat feature M06, blanket bog BAP habitat

Failure to comply with cover of sphagnum and dwarf shrub heath are the most frequent reasons stated for not meeting condition criteria.

D1.4.1.3 Habitat feature M08, upland flushes, fens and swamps BAP habitat

The most frequent criteria under which condition criteria were not met were too great a cover of amount of soft and sharp flowered rushes and bog-mosses not being at least frequent.

D1.4.2 Analytical model output for change in condition for HL9 / HL10

	Estimate	Std. error	z value	Pr(>|z|)	
(Intercept)	1.4187	1.3552	1.047	0.29514	
altitude	-0.8463	0.5871	-1.442	0.14942	
pres. score 3	-2.2588	0.9152	-2.468	0.01358	*
pres. score 4	-0.4689	1.3001	-0.361	0.71836	
supplement? (Y)	-0.9033	0.7583	-1.191	0.23359	
cond. base. A	2.6298	1.0408	2.527	0.01151	*
cond. base. B	2.7973	0.7915	3.534	0.00041	***
feature M06	1.0993	1.0732	1.024	0.30569	
feature other	0.6312	0.821	0.769	0.44201	
option HL9	0.9571	1.1498	0.832	0.4052	

Odds ratios	
(Intercept)	4.13184
altitude	0.42898
pres. score 3	0.10447
pres. score 4	0.62571
supplement? (Y)	0.40524
cond. base. A	13.8707
cond. base. B	16.4003
feature M06	3.00198
feature other	1.87987
option HL9	2.60401

95% CI (profile likelihood)		
	2.50%	97.50%
(Intercept)	0.29462	67.0007
altitude	0.12027	1.28479
pres. score 3	0.01388	0.54447
pres. score 4	0.04508	7.95477
supplement? (Y)	0.08412	1.72003
cond. base. A	2.0846	134.3
cond. base. B	3.89043	92.7995
feature M06	0.38922	28.6379
feature other	0.381	10.2074
option HL9	0.30551	30.2245

Table D11 Output of final generalised linear model output for odds ratio analysis of change in condition for options HL9 and HL10, adjusted for covariates selected though multi-model comparison approach. Altitude = altitude of HLS agreement; pres. score = baseline panel score of how appropriate management prescriptions were for option; supplement ? (Y) = supplementary option applied; cond. base. A = baseline condition of A, cond. base. B = baseline condition of C; feature M06 = blanket bog (BAP habitat). References for analyses (compared to listed categories): pres. score = score of 1 or 2; no supplementary option applied; baseline condition = C; feature = M04 (upland heath); HLS option = HL8. See Table 2.3 for further details of covariates.

D1.5 HL7 / HL8 – maintenance / restoration of rough grazing for birds

	Estimate	Std. error	z value	Pr(>|z|)	
(Intercept)	0.09799	0.67186	0.146	0.884	
cond. base. A	0.49663	0.95504	0.52	0.6031	
cond. base. B	0.39664	0.85135	0.466	0.6413	
Option HL8	1.57183	0.88224	1.782	0.0748	.
Feature other	0.06321	0.78317	0.081	0.9357	

Odds ratios	
(Intercept)	5.010447
cond. base. A	0.577899
cond. base. B	1.628006
Option HL8	0.578375
Feature other	2.351617

95% CI (profile likelihood)		
	2.50%	97.50%
(Intercept)	0.798707	48.58753
cond. base. A	0.061337	4.029319
cond. base. B	0.192122	10.60473
Option HL8	0.115246	2.478797
Feature other	0.481204	17.89779

Table D12 Output of final generalised linear model output for odds ratio analysis of change in condition for options HL7 and HL8, adjusted for covariates selected though multi-model comparison approach. cond. base. A = baseline condition of A, cond. base. B = baseline condition of C. References for analyses (compared to listed categories): condition = C; feature = G02 (semi-improved grassland); HLS option = HL7.

D1.6 HC7 / HC8 – maintenance / restoration of woodland

D1.6.1 Criteria on which condition criteria were failed for HC7 / HC8

Condition criteria FEP habitat feature T08	Baseline	Resurvey	Same in both baseline and resurvey
Native species dominant. Non-natives <10% vegetation		4	
Diverse age and height structure	8	16	7
Free from damage	1	4	
Standing and fallen dead trees <20cm diameter are present	1	8	
Area is protected from agricultural and other adjacent operations	5	1	
Total number of parcels with comments	12	25	7

Table D13 Number of surveyor comments relating to the criteria on which condition assessments were failed (graded B or C) for woodland feature T08 (native semi-natural woodland) under HC7 and HC8 management options.

D1.6.2 Analytical model output for change in condition for HC7 / HC8

	Estimate	Std. error	z value	Pr(>|z|)
(Intercept)	1.6115	1.0172	1.584	0.113
cond. base. A	-0.5484	1.0318	-0.531	0.595
cond. base. B	0.4874	0.9793	0.498	0.619
Option HC8	-0.5475	0.7667	-0.714	0.475
Feature other	0.8551	0.8844	0.967	0.334

Odds ratios	
(Intercept)	5.010447
cond. base. A	0.577899
cond. base. B	1.628006
Option HC8	0.578375
Feature other	2.351617

	95% CI (profile likelihood)	
	2.50%	97.50%
(Intercept)	0.798707	48.58753
cond. base. A	0.061337	4.029319
cond. base. B	0.192122	10.60473
Option HC8	0.115246	2.478797
Feature other	0.481204	17.89779

Table D14 Output of final generalised linear model output for odds ratio analysis of change in condition for options HC7 and HC8, adjusted for covariates selected though multi-model comparison approach. cond. base. A = baseline condition of A, cond. base. B = baseline condition of C. References for analyses (compared to listed categories): condition = C; feature = T08 (native semi-natural woodland); HLS option = HC7.

D1.7 Condition assessment results for management options not replicated sufficiently for statistical analysis at the option(s) scale

D1.7.1 HO2 – restoration of lowland heathland on neglected sites

	M03	Resurvey				
		A	B	C	N/A	Total
Baseline	A	1				1
	B		3		1	4
	C	1	2	7		10
	Total	2	5	7	1	15

Table D15 Condition results at baseline and resurvey for option HO2. All parcels were classed as habitat feature M03, lowland heath BAP habitat.

D1.7.2 HK9– maintenance of wet grassland for breeding waders

HK9	A		B		C		N/A
	BL	RS	BL	RS	BL	RS	RS
G02			2	4	6		4
G06	2		1	3	1	1	
G12	3		9	4	1	4	5
G13	3	3	1	3	2		
G15	1	1					
W04	1	1					
Total	10	5	13	14	10	5	9

Table D16 Condition at baseline and resurvey for 33 habitat features under management option HK9. Further details of change in condition for each features in Tables D14 – C17 below.

	G12	Resurvey				
		A	B	C	N/A	Total
Baseline	A				3	3
	B		4	3	2	9
	C			1		1
	Total		4	4	5	13

Table D17 Condition results at baseline resurvey for option HK9, for habitat feature G12, habitat for breeding waders.

	G13	Resurvey				
		A	B	C	N/A	Total
Baseline	A	1	2			3
	B		1			1
	C	2				2
	Total	3	3			6

Table D18 Condition results at baseline survey and resurvey for option HK9, for habitat feature G13, habitat for wintering waders and wildfowl.

	Other	Resurvey				
		A	B	C	N/A	Total
Baseline	A	2	2			4
	B		3			3
	C		2	1	4	7
	Total	2	7	1	4	14

Table D19 Condition results at baseline and resurvey for option HK9 (maintenance of wet grassland for breeding waders), for remaining habitat features not covered in tables C13 and C14 above. Habitat features include G02 (semi-improved grassland), G06 (lowland meadows), G15 (coastal and flood plain grazing marsh, BAP habitat) and W04 (fens).

G02, G12 & G15		Resurvey				
		A	B	C	N/A	Total
Baseline	A	5		1		6
	B		2			2
	C		1	1		2
	N/A					
	Total	5	3	2		10

Table D20 Condition results at baseline and resurvey for option HK11 (restoration of wet grassland for breeding waders), for habitat features G02 (semi-improved grassland), G12 (habitat for breeding waders) and G15 (coastal and flood plain grazing marsh, BAP habitat).

D1.7.3 HK10 – maintenance of wet grassland for wintering waders and wildfowl

G02, G13 & G15		Resurvey A	B	C	N/A	Total
Baseline	A	2				2
	B		3			3
	C	1	1		1	3
	N/A					
	Total	3	4			8

Table D21 Condition results at baseline and resurvey for HK10 (maintenance of wet grassland for wintering waders and wildfowl), for habitat features G02 (semi-improved grassland), G13 (habitat for wintering waders and wildfowl) and G15 (coastal and flood plain grazing marsh, BAP habitat).

D 1.7.4 HQ3 and HQ4 – maintenance and restoration of reedbeds

W08		Resurvey A	B	C	Total
Baseline	A	5			5
	B	1	3		4
	C		1	2	3
	Total	6	4	2	12

Table D22 Condition results at baseline and resurvey for options HQ3 and HQ4, for habitat feature W08 (reedbeds, BAP priority habitat).

D1.7.5 HQ6 and HQ7 – maintenance and restoration of fen

W04		Resurvey A	B	C	N/A	Total
Baseline	A	3	1			4
	B	2	3			5
	C	1	1	5	1	8
	Total	6	5	5	1	17

Table D23 Condition results at baseline and resurvey for options HQ6 and HQ7, for habitat feature W04 (fens, BAP priority habitat).

Other		Resurvey A	B	C	N/A	Total
Baseline	A	1				1
	B	1			2	3
	C		4			4
	Total	2	4	0	2	8

able D24 Condition results at baseline and resurvey for options HQ6 and HQ7, for habitat features not covered in Table C18 above (G15 - coastal and flood plain grazing marsh, BAP habitat, M03 - lowland heath BAP habitat, W05 - lowland raised bog, BAP habitat, and W07 – ponds, BAP habitat).

D1.7.6 HB11 and HB12 - maintenance of hedgerows of very high environmental value (one side or both sides)

	F02	Resurvey				
		A	B	C	N/A	Total
Baseline	A	10	2	2		14
	B	5	1			6
	C	1	1		1	3
	N/A		1			
	Total	16	5	2	1	24

Table D25 Condition results at baseline and resurvey for options HB11 and HB12, for habitat feature F02 (defined as ancient and/or species rich hedgerow, BAP habitat in edition 1 of FEP handbook, and as high environmental value boundary in edition 3 of FEP handbook (England, 2010)).

Comments on reasons for failing condition under options HB11 and HB12 cover a range of aspects including gappiness, no interesting ground flora, width and height. Surveyors commented that there had been "recent hedgerow management and hedge not fully recovered" for the hedges where no condition assessment could be attributed ("N/A" in table above).

D1.7.7 HC19, HC20, HC21 – maintenance, restoration and creation of traditional orchards

	T15	Resurvey				
		A	B	C	N/A	Total
Baseline	A	3				3
	B	2	1	1		4
	C			1		1
	N/A		1			1
	Total	5	2	2		9

Table D26 Number of surveyor comments relating to the criteria on which condition were failed (graded B or C) for habitat feature T15 (traditional orchards) under management options HC19, HC20 and HC21.

D1.7.8 HC15 and HC16 – maintenance and restoration of successional areas and scrub

	V05	Resurvey				
		A	B	C	N/A	Total
Baseline	A			2	1	3
	B		1	2		3
	C		3	2		5
	Total		4	6	1	11

Table D27 Condition results at baseline and resurvey for options HC15 and HC16, for habitat feature V05 (scrub of high environmental value).

Condition criteria V05 feature	Baseline	Resurvey	Same in both baseline and resurvey
At least three woody species, not one species dominant >75%	4	5	3
Good age range – mixture of seedlings, samplings, young and mature shrubs		6	0
Pernicious weeds and invasive species <5% ground cover			
Well-developed edge with ungrazed tall herbs	3	3	3
Clearing and glades within scrub	1	1	0
Total number of parcels with comments	5	9	3

Table D28 Number of surveyor comments relating to the criteria on which condition assessments were failed (graded B or C) for habitat feature V05 (semi-improved grassland) under options HC15 and HC16.

Many areas of scrub (V05) were dominated by a single species with many also not having a good age range or diversity in age of scrub. Many scrub areas surveyed were too small to have clearings or glades and did not have well developed edges.

D2 Vegetation response variables assessed at baseline and resurvey

D2.1 HK7 - restoration of species rich semi-natural grassland

Species richness:

Fixed effects:				95% CI (profile likelihood):		
	Estimate	Std. Error	t value		2.50%	97.50%
(Intercept)	2.329	2.312	1.007	.sig01	1.840	6.320
altitude	-0.837	0.807	-1.037	.sigma	4.781	6.641
pres. score 3	-0.812	2.117	-0.383	(Intercept)	-1.804	6.925
pres. score 4	-0.015	2.091	-0.007	altitude	-2.280	0.666
quad. difference	2.002	0.559	3.580	pres. score 3	-4.659	2.989
supplement? (Y)	4.972	1.660	2.995	pres. score 4	-3.823	3.730
feature G02	-2.250	1.496	-1.504	quad. difference	0.786	3.005
feature G04	1.735	2.397	0.724	supplement? (Y)	1.612	7.944
feature G06	-2.030	1.915	-1.060	feature G02	-5.235	0.462
feature G07	0.070	2.169	0.032	feature G04	-2.756	6.105
feature other	-0.277	1.392	-0.199	feature G06	-5.793	1.407
site mean	1.119	0.720	1.553	feature G07	-3.844	4.535
				feature other	-2.957	2.318
				site mean	-0.296	2.433

Table D29 Output of final generalised linear mixed model analysis of change in higher plant species richness derived from quadrat data for option HK7. Covariates were selected though multi-model comparison approach. Habitat features: G02 = semi-improved grassland; G04 = lowland calcareous grassland; G06 = lowland meadows; G07 = purple moor grass and rush pasture. Quad. difference = difference in the number of quadrats assessed at baseline survey and resurvey where applicable (most frequently the same number were assessed); supplement? (Y) = supplementary option applied in addition to HK7; pres. score = baseline panel score of how appropriate management prescriptions were for option; altitude = average altitude for parcel; slope = average slope for quadrat locations; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): supplement? = no supplementary option; pres. score = 2.

Ellenberg fertility (N)

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	-0.033	0.112	-0.294
feature G02	-0.089	0.100	-0.896
feature G04	-0.190	0.143	-1.327
feature G06	-0.032	0.121	-0.264
feature G07	0.059	0.157	0.377
feature other	0.069	0.096	0.724
site mean	0.026	0.050	0.534

95% CI (profile likelihood):

	2.50%	97.50%
.sig01	0.000	0.290
.sigma	0.402	0.525
(Intercept)	-0.251	0.180
feature G02	-0.283	0.100
feature G04	-0.462	0.086
feature G06	-0.261	0.199
feature G07	-0.239	0.363
feature other	-0.113	0.263
site mean	-0.069	0.121

Table D30 Output of final generalised linear mixed model analysis of change in Ellenberg fertility indicator score, derived from quadrat data for option HK7. Covariates were selected though multi-model comparison approach. Habitat features see Table D29 legend above; site mean = average site value at baseline survey and resurvey.

Ellenberg reaction (R):

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	0.115	0.123	0.933
day difference	0.039	0.047	0.833
env. zone 2	-0.190	0.120	-1.585
env. zone 3	-0.180	0.134	-1.344
feature G02	0.036	0.084	0.429
feature G04	-0.150	0.140	-1.073
feature G06	0.066	0.105	0.634
feature G07	-0.096	0.142	-0.677
feature other	0.079	0.081	0.975
site mean	0.041	0.050	0.812

95% CI (profile likelihood):

	2.50%	97.50%
.sig01	0.097	0.287
.sigma	0.300	0.397
(Intercept)	-0.121	0.342
day difference	-0.052	0.125
env. zone 2	-0.412	0.032
env. zone 3	-0.427	0.071
feature G02	-0.125	0.194
feature G04	-0.408	0.120
feature G06	-0.129	0.264
feature G07	-0.361	0.178
feature other	-0.070	0.248
site mean	-0.052	0.137

Table D31 Output of final generalised linear mixed model analysis of change in Ellenberg reaction indicator score, derived from quadrat data for option HK7. Covariates were selected though multi-model comparison approach. Habitat features see Table D29 legend; env. zone = environment zone; day difference = difference in the number of days from start of the year to survey date (resurvey – baseline); site mean = average site value at baseline survey and resurvey. Reference for analysis (compared to listed categories): env. zone = 1.

Ellenberg moisture (F):

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	0.056	0.071	0.792
feature G02	-0.018	0.064	-0.281
feature G04	-0.091	0.095	-0.962
feature G06	0.028	0.076	0.373
feature G07	-0.142	0.096	-1.485
feature other	-0.031	0.060	-0.509
site mean	0.012	0.037	0.320

95% CI (profile likelihood):

	2.50%	97.50%
.sig01	0.000	0.175
.sigma	0.255	0.332
(Intercept)	-0.078	0.192
feature G02	-0.141	0.104
feature G04	-0.273	0.089
feature G06	-0.116	0.177
feature G07	-0.336	0.040
feature other	-0.146	0.084
site mean	-0.059	0.085

Table D32 Output of final generalised linear mixed model analysis of change in Ellenberg moisture indicator score, derived from quadrat data for option HK7. Covariates were selected though multi-model comparison approach. For habitat features see Table D29 legend above.

Competitiveness score (CSR C):

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	0.144	0.249	0.578
area	0.056	0.027	2.051
env. zone 2	-0.146	0.108	-1.351
env. zone 3	-0.031	0.113	-0.271
man. ease 2	-0.249	0.245	-1.018
man. ease 3	0.033	0.224	0.148
man. ease 4	-0.003	0.226	-0.014
man. ease 5	-0.035	0.240	-0.145
slope	0.083	0.039	2.146
feature G02	0.024	0.073	0.333
feature G04	-0.367	0.139	-2.637
feature G06	0.020	0.091	0.224
feature G07	-0.023	0.112	-0.202
feature other	-0.057	0.069	-0.833
site mean	-0.007	0.038	-0.178

95% CI (profile likelihood):

	2.50%	97.50%
.sig01	0.033	0.205
.sigma	0.194	0.271
(Intercept)	-0.261	0.553
area	0.004	0.105
env. zone 2	-0.319	0.055
env. zone 3	-0.217	0.163
man. ease 2	-0.653	0.144
man. ease 3	-0.335	0.388
man. ease 4	-0.376	0.354
man. ease 5	-0.427	0.349
slope	0.009	0.149
feature G02	-0.127	0.146
feature G04	-0.608	-0.124
feature G06	-0.152	0.170
feature G07	-0.228	0.185
feature other	-0.173	0.082
site mean	-0.100	0.051

Table D33 Output of final generalised linear mixed model analysis of change in Grime competitiveness score, derived from quadrat data for option HK7. Covariates were selected though multi-model comparison approach. For habitat features see Table D29 legend above. Env. zone = environment zone; man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; area = area of parcel under option HK7; slope = average slope for quadrat locations; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; man. ease = 1.

Ruderality score (CSR R):

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	-0.204	0.122	-1.678
altitude	-0.067	0.038	-1.756
area	-0.081	0.030	-2.715
pres. score 3	0.215	0.094	2.289
pres. score 4	0.173	0.093	1.868
supplement? (Y)	0.073	0.080	0.914
feature G02	0.031	0.079	0.392
feature G04	0.042	0.119	0.356
feature G06	-0.055	0.095	-0.581
feature G07	0.072	0.117	0.614
feature other	0.081	0.070	1.164
site mean	0.031	0.040	0.769

95% CI (profile likelihood):

	2.50%	97.50%
.sig01	0.052	0.237
.sigma	0.222	0.304
(Intercept)	-0.426	0.024
altitude	-0.135	0.004
area	-0.135	-0.020
pres. score 3	0.044	0.382
pres. score 4	0.008	0.342
supplement? (Y)	-0.074	0.218
feature G02	-0.117	0.181
feature G04	-0.186	0.253
feature G06	-0.234	0.117
feature G07	-0.149	0.291
feature other	-0.049	0.214
site mean	-0.047	0.102

Table D34 Output of final generalised linear mixed model analysis of change in Grime ruderality score, derived from quadrat data for option HK7. Covariates were selected though multi-model comparison approach. For habitat features see Table D29 legend above. Supplement? (Y) = supplementary option applied in addition to HK7; pres. score = baseline panel score of how appropriate management prescriptions were for option; area = area of parcel under option HK7; altitude = average altitude for parcel; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): supplement? = no supplementary option; pres. score = 2.

Stress tolerator score (CSR S):

Fixed effects:

	Estimate	Std. error	t value
(Intercept)	-0.066	0.124	-0.529
slope	-0.002	0.040	-0.050
supplement? (Y)	0.018	0.083	0.217
feature G02	0.054	0.094	0.572
feature G04	0.169	0.136	1.248
feature G06	-0.017	0.105	-0.161
feature G07	0.093	0.128	0.727
feature other	-0.033	0.082	-0.398
site mean	-0.016	0.040	-0.405

95% CI (profile likelihood):

	2.50%	97.50%
.sig01	0.000	0.188
.sigma	0.320	0.420
(Intercept)	-0.313	0.160
slope	-0.075	0.076
supplement? (Y)	-0.133	0.182
feature G02	-0.118	0.242
feature G04	-0.080	0.425
feature G06	-0.213	0.177
feature G07	-0.141	0.354
feature other	-0.189	0.120
site mean	-0.095	0.056

Table D35 Output of final generalised linear mixed model analysis of change in Grime stress-tolerator score, derived from quadrat data for option HK7. Covariates were selected though multi-model comparison approach. For habitat features see Table D29 legend above. Supplement? (Y) = supplementary option applied in addition to HK7; slope = average slope for quadrat locations; site mean = average site value at baseline survey and resurvey.

Grass to forb ratio (log):

Fixed effects:				95% CI (profile likelihood):		
	Estimate	Std. Error	t value		2.50%	97.50%
(Intercept)	-0.657	0.457	-1.436	.sig01	0.712	1.414
agri. class 4	-0.510	0.484	-1.054	.sigma	0.881	1.200
agri. class5	-0.753	0.602	-1.252	(Intercept)	-1.504	0.194
agri. class non	-0.079	0.680	-0.116	agri. class 4	-1.399	0.383
day difference	-0.062	0.180	-0.344	agri. class5	-1.854	0.371
feature G02	-0.015	0.293	-0.051	agri. class non	-1.335	1.167
feature G04	0.483	0.544	0.889	day difference	-0.409	0.268
feature G06	0.557	0.394	1.415	feature G02	-0.574	0.541
feature G07	0.867	0.440	1.968	feature G04	-0.556	1.479
feature other	0.123	0.278	0.442	feature G06	-0.175	1.304
site mean	-0.192	0.149	-1.290	feature G07	-0.025	1.676
				feature other	-0.397	0.670
				site mean	-0.482	0.085

Tables D36 Output of final generalised linear mixed model analysis of change in grass to forb ratio, derived from quadrat data for option HK7. Covariates were selected though multi-model comparison approach. For habitat features see Table D29 legend above. Agri. class = agricultural land classification; day difference = difference in number of days since start of the year to survey date (resurvey – baseline). References for analysis (compared to listed categories): agri. class = 2 or 3 (combined due to low frequencies).

Woody plant cover:

Fixed effects:				95% CI (profile likelihood):		
	Estimate	Std. Error	t value		2.50%	97.50%
(Intercept)	0.046	0.031	1.479	.sig01	0.000	0.055
area	0.011	0.008	1.428	.sigma	0.065	0.088
pres. score 3	-0.071	0.023	-3.079	(Intercept)	-0.011	0.105
pres. score 4	-0.046	0.023	-1.974	area	-0.004	0.026
supplement? (Y)	0.064	0.020	3.251	pres. score 3	-0.113	-0.028
feature G02	-0.005	0.021	-0.213	pres. score 4	-0.087	-0.003
feature G04	-0.104	0.029	-3.541	supplement? (Y)	0.027	0.100
feature G06	-0.001	0.025	-0.043	feature G02	-0.046	0.034
feature G07	-0.018	0.030	-0.601	feature G04	-0.158	-0.044
feature other	-0.014	0.019	-0.743	feature G06	-0.048	0.044
site mean	0.114	0.010	11.375	feature G07	-0.073	0.038
				feature other	-0.051	0.020
				site mean	0.095	0.132

Tables D37 Output of final generalised linear mixed model analysis of change in percentage cover of woody and semi-woody species, derived from quadrat data for option HK7. Covariates were selected though multi-model comparison approach. For habitat features see Table D29 legend above. Pres. score = baseline panel score of how appropriate management prescriptions were for option; area = area of parcel under option HK7; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): supplement? = no supplementary option; pres. score = 2.

Negative indicator species cover:

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	0.014	0.011	1.214
area	0.005	0.004	1.316
env. zone 2	0.011	0.010	1.071
env. zone 3	0.020	0.010	2.010
feature G02	-0.014	0.009	-1.599
feature G04	0.008	0.013	0.603
feature G06	-0.018	0.010	-1.729
feature G07	-0.017	0.013	-1.357
feature other	-0.016	0.008	-1.984
site mean	0.017	0.003	4.767

95% CI (profile likelihood):

	2.50%	97.50%
.sig01	0.000	0.010
.sigma	0.034	0.043
(Intercept)	-0.008	0.035
area	-0.002	0.012
env. zone 2	-0.008	0.029
env. zone 3	0.001	0.038
feature G02	-0.032	0.003
feature G04	-0.017	0.032
feature G06	-0.038	0.002
feature G07	-0.042	0.007
feature other	-0.032	-0.001
site mean	0.010	0.023

Tables D38 Output of final generalised linear mixed model analysis of change in percentage cover of negative indicator species, derived from quadrat data for option HK7. Covariates were selected though multi-model comparison approach. For habitat features see Table D29 legend above. Env. zone = environment zone; area = area of parcel under option HK7; site mean = average site value at baseline survey and resurvey. Reference for analysis (compared to listed categories): env. zone = 1.

Pollinator plant species cover:

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	-0.112	0.170	-0.657
area	-0.043	0.024	-1.794
man. ease 2	0.008	0.187	0.042
man. ease 3	0.144	0.161	0.893
man. ease 4	0.178	0.161	1.105
man. ease 5	0.426	0.175	2.432
feature G02	0.003	0.065	0.054
feature G04	-0.104	0.099	-1.052
feature G06	-0.005	0.078	-0.066
feature G07	0.128	0.098	1.311
feature other	0.020	0.062	0.316
site mean	0.005	0.028	0.180

95% CI (profile likelihood):

	2.50%	97.50%
.sig01	0.000	0.158
.sigma	0.185	0.256
(Intercept)	-0.402	0.183
area	-0.087	0.003
man. ease 2	-0.313	0.330
man. ease 3	-0.130	0.418
man. ease 4	-0.096	0.452
man. ease 5	0.129	0.728
feature G02	-0.117	0.123
feature G04	-0.287	0.067
feature G06	-0.161	0.128
feature G07	-0.055	0.307
feature other	-0.105	0.129
site mean	-0.046	0.056

Tables D39 Output of final generalised linear mixed model analysis of change in percentage cover of pollinator plant species, derived from quadrat data for option HK7. Covariates were selected though multi-model comparison approach. For habitat features see Table D29 legend above. Area = area of parcel under option HK7; man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; site mean = average site value at baseline survey and resurvey. Reference for analysis (compared to listed categories): man. ease = 1.

Grazing score:

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	2.345	6.305	0.372
pres. score 3	22.598	5.617	4.023
pres. score 4	5.846	5.609	1.042
slope	-2.914	2.236	-1.303
feature G02	-6.185	5.065	-1.221
feature G04	3.326	7.423	0.448
feature G06	-15.477	6.072	-2.549
feature G07	-15.030	7.117	-2.112
feature other	-1.356	4.565	-0.297
site mean	3.447	2.255	1.529

95% CI (profile likelihood):

	2.50%	97.50%
.sig01	0.640	13.154
.sigma	15.934	21.228
(Intercept)	-9.332	14.233
pres. score 3	12.332	33.032
pres. score 4	-4.441	16.191
slope	-7.041	1.307
feature G02	-15.677	3.446
feature G04	-10.383	17.151
feature G06	-26.938	-4.287
feature G07	-28.058	-0.831
feature other	-10.301	7.037
site mean	-1.049	7.563

Tables D40 Output of final generalised linear mixed model analysis of change in 'grazing suited' score, derived from quadrat data for option HK7. Covariates were selected though multi-model comparison approach. For habitat features see Table D29 legend above. Pres. score = baseline panel score of how appropriate management prescriptions were for option; slope = average slope for quadrat locations; site mean = average site value at baseline survey and resurvey. Reference for analysis (compared to listed categories): pres. score = 2.

Sward height:

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	9.409	3.913	2.404
agri. class 4	-2.762	3.566	-0.774
agri. class 5	1.683	4.404	0.382
agri. class non	-1.912	5.101	-0.375
day difference	2.026	1.465	1.383
feature G02	-1.786	2.943	-0.607
feature G04	-2.008	4.533	-0.443
feature G06	-3.774	3.595	-1.050
feature G07	-6.517	4.250	-1.534
feature other	-0.500	3.039	-0.164
site mean	11.800	1.518	7.771

95% CI (profile likelihood):

	2.50%	97.50%
.sig01	0.000	5.735
.sigma	11.193	14.320
(Intercept)	2.241	16.658
agri. class 4	-9.473	3.455
agri. class 5	-6.420	9.650
agri. class non	-11.880	6.481
day difference	-0.697	4.663
feature G02	-7.433	3.546
feature G04	-10.586	5.996
feature G06	-10.382	2.909
feature G07	-14.238	1.395
feature other	-5.782	5.507
site mean	9.056	14.489

Tables D41 Output of final generalised linear mixed model analysis of change in sward height, derived from quadrat data for option HK7. Covariates were selected though multi-model comparison approach. For habitat features see Table D29 legend above. Day difference = difference in number of days since start of the year to survey date (resurvey – baseline); agri. class = agricultural land class. Reference for analysis (compared to listed categories): agri. class = 2 or 3 (combined due to low frequencies).

D2.2 HK6 - maintenance of species rich semi-natural grassland

Species richness:

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. error	t value	Pr(>|t|)			2.5%	97.5%
(Intercept)	2.787	5.694	0.489	0.627		(Intercept)	-8.649	14.223
agri. class 4-5	-6.115	2.461	-2.485	0.016	*	agri. class 4-5	-11.057	-1.172
agri. class non	6.562	5.026	1.306	0.198		agri. class non	-3.532	16.657
day difference	2.810	1.144	2.455	0.018	*	day difference	0.511	5.109
pres. score 3 - 4	2.363	2.200	1.074	0.288		pres. score 3 - 4	-2.056	6.782
quad. difference	1.286	1.459	0.882	0.382		quad. difference	-1.644	4.216
feature G02	-1.412	2.798	-0.505	0.616		feature G02	-7.031	4.208
feature G06	7.559	3.178	2.378	0.021	*	feature G06	1.175	13.943
feature other	3.461	3.977	0.870	0.388		feature other	-4.527	11.449
site mean	0.380	1.124	0.338	0.737		site mean	-1.878	2.638

Table D42 Output of final generalised linear model analyses of change in species richness derived from quadrat data for option HK6. Covariates were selected though multi-model comparison approach. Habitat features: G02 = semi-improved grassland; G06 = lowland meadows. Quad. difference = difference in the number of quadrats assessed at baseline survey and resurvey where applicable (most frequently the same number were assessed); agri. class = agricultural land class; pres. score = baseline panel score of how appropriate management prescriptions were for option; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): agri. class = 2 or 3 (combined due to low frequencies); pres. score = 2.

Ellenberg fertility (N):

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. error	t value	Pr(>|t|)			2.5%	97.5%
(Intercept)	0.139	0.273	0.508	0.614		(Intercept)	-0.409	0.686
area	0.109	0.080	1.360	0.179		area	-0.051	0.269
env. zone 2	-0.175	0.201	-0.868	0.389		env. zone 2	-0.578	0.228
env. zone 3	0.300	0.184	1.632	0.108		env. zone 3	-0.068	0.669
feature G02	-0.100	0.183	-0.548	0.586		feature G02	-0.466	0.266
feature G06	0.048	0.201	0.241	0.811		feature G06	-0.353	0.450
feature other	-0.414	0.202	-2.052	0.045	*	feature other	-0.819	-0.010
site mean	0.012	0.096	0.126	0.900		site mean	-0.181	0.205

Table D43 Output of final generalised linear model analyses of change in Ellenberg fertility score derived from quadrat data for option HK6. Covariates were selected though multi-model comparison approach. Habitat features: G02 = semi-improved grassland; G06 = lowland meadows. Env. zone = environment zone. Reference for analysis (compared to listed categories): env. zone = 1.

Ellenberg reaction (R):

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. error	t value	Pr(>|t|)			2.5%	97.5%
(Intercept)	-0.016	0.200	-0.081	0.936		(Intercept)	-0.414	0.382
env. zone 2	-0.274	0.146	-1.873	0.065	.	env. zone 2	-0.566	0.018
env. zone 3	0.400	0.151	2.646	0.010	*	env. zone 3	0.098	0.701
feature G02	-0.021	0.132	-0.160	0.873		feature G02	-0.284	0.241
feature G06	0.042	0.142	0.296	0.769		feature G06	-0.242	0.326
feature other	-0.128	0.155	-0.827	0.411		feature other	-0.438	0.181
site mean	0.127	0.064	1.997	0.050	*	site mean	0.000	0.254

Table D44 Output of final generalised linear model analyses of change in Ellenberg reaction score derived from quadrat data for option HK6. Covariates were selected though multi-model comparison approach. Habitat features: G02 = semi-improved grassland; G06 = lowland meadows. Env. zone = environment zone. Reference for analysis (compared to listed categories): env. zone = 1.

Ellenberg moisture (F):

	Fixed effects:				95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)		2.50%	97.50%
(Intercept)	0.163	0.167	0.979	0.331	(Intercept)	-0.170	0.496
env. zone 2	0.137	0.136	1.013	0.315	env. zone 2	-0.133	0.408
env. zone 3	-0.117	0.114	-1.025	0.309	env. zone 3	-0.344	0.111
feature G02	0.039	0.110	0.354	0.724	feature G02	-0.181	0.259
feature G06	-0.181	0.123	-1.465	0.147	feature G06	-0.427	0.065
feature other	-0.041	0.130	-0.317	0.752	feature other	-0.300	0.218
site mean	0.070	0.051	1.368	0.176	site mean	-0.032	0.173

Table D45 Output of final generalised linear model analyses of change in Ellenberg moisture score derived from quadrat data for option HK6. Covariates were selected though multi-model comparison approach. Habitat features: G02 = semi-improved grassland; G06 = lowland meadows. Env. zone = environment zone. Reference for analysis (compared to listed categories): env. zone = 1.

Competitiveness score (CSR C):

Fixed effects:						95% CI (profile likelihood):		
	Estimate	Std. error	t value	Pr(>|t|)			2.5%	97.5%
(Intercept)	-0.043	0.115	-0.375	0.709		(Intercept)	-0.274	0.187
day difference	-0.084	0.041	-2.045	0.045	*	day difference	-0.166	-0.002
feature G02	0.142	0.090	1.581	0.119		feature G02	-0.038	0.322
feature G06	-0.030	0.100	-0.297	0.768		feature G06	-0.231	0.171
feature other	-0.033	0.106	-0.315	0.754		feature other	-0.245	0.178
site mean	-0.021	0.047	-0.454	0.651		site mean	-0.115	0.072

Table D46 Output of final generalised linear model analyses of change in Grime competitiveness score derived from quadrat data for option HK6. Covariates were selected though multi-model comparison approach. Habitat features: G02 = semi-improved grassland; G06 = lowland meadows. Day difference = difference in number of days since start of the year to survey date (resurvey – baseline).

Ruderality score (CSR R):

Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. error	t value	Pr(>|t|)		2.5%	97.5%
(Intercept)	0.096	0.141	0.679	0.500	(Intercept)	-0.186	0.377
area	0.015	0.047	0.330	0.742	area	-0.078	0.109
supplement? (Y)	0.000	0.099	0.003	0.997	supplement? (Y)	-0.197	0.198
feature G02	-0.086	0.110	-0.778	0.440	feature G02	-0.306	0.135
feature G06	-0.010	0.114	-0.089	0.929	feature G06	-0.238	0.218
feature other	-0.090	0.122	-0.739	0.463	feature other	-0.335	0.154
site mean	0.008	0.048	0.162	0.872	site mean	-0.089	0.105

Table D47 Output of final generalised linear model analyses of change in Grime ruderality score derived from quadrat data for option HK6. Covariates were selected though multi-model comparison approach. Habitat features: G02 = semi-improved grassland; G06 = lowland meadows. Supplement? (Y) = supplementary option applied in addition to HK6; area = area of parcel under option HK6.

Stress tolerator score (CSR S):

Fixed effects:

	Estimate	Std. error	t value	Pr(>|t|)	
(Intercept)	-0.233	0.182	-1.284	0.204	
area	0.013	0.053	0.250	0.804	
env. zone 2	0.232	0.134	1.730	0.089	.
env. zone 3	-0.032	0.122	-0.261	0.795	
feature G02	0.073	0.119	0.612	0.543	
feature G06	0.034	0.133	0.257	0.798	
feature other	0.254	0.134	1.897	0.063	.
site mean	0.007	0.054	0.137	0.892	

95% CI (profile likelihood):

	2.5%	97.5%
(Intercept)	-0.598	0.131
area	-0.093	0.119
env. zone 2	-0.037	0.502
env. zone 3	-0.276	0.213
feature G02	-0.166	0.311
feature G06	-0.233	0.302
feature other	-0.014	0.523
site mean	-0.101	0.116

Table D48 Output of final generalised linear model analyses of change in Grime stress-tolerator score derived from quadrat data for option HK6. Covariates were selected though multi-model comparison approach. Habitat features: G02 = semi-improved grassland; G06 = lowland meadows. Env. zone = environment zone; area = area of parcel under option HK6; site mean = average site value at baseline survey and resurvey. Reference for analysis (compared to listed categories): env. zone = 1.

Grass to forb ratio (log):

Fixed effects:

	Estimate	Std. error	t value	Pr(>|t|)	
(Intercept)	0.677	0.772	0.877	0.385	
pres. score 3 - 4	-0.716	0.410	-1.749	0.086	.
slope	0.464	0.223	2.081	0.043	*
feature G02	-0.417	0.475	-0.877	0.385	
feature G06	0.211	0.514	0.411	0.683	
feature other	-0.988	0.650	-1.521	0.135	
site mean	-1.031	0.230	-4.486	0.000	***

95% CI (profile likelihood):

	2.5%	97.5%
(Intercept)	-0.873	2.227
pres. score 3 - 4	-1.539	0.106
slope	0.016	0.912
feature G02	-1.371	0.538
feature G06	-0.821	1.244
feature other	-2.293	0.317
site mean	-1.492	-0.569

Table D49 Output of final generalised linear model analyses of change in grass to forb ratio for option HK6. Covariates were selected though multi-model comparison approach. Habitat features: G02 = semi-improved grassland; G06 = lowland meadows. Pres. score = baseline panel score of how appropriate management prescriptions were for option, area = area of parcel under option HK6; site mean = average site value at baseline survey and resurvey. Reference for analysis (compared to listed category): pres. score = 2.

Negative indicator species cover:

Fixed effects:						95% CI (profile likelihood):		
	Estimate	Std. error	t value	Pr(>|t|)			2.5%	97.5%
(Intercept)	-0.021	0.017	-1.219	0.229		(Intercept)	-0.056	0.014
area	0.012	0.005	2.410	0.020	*	area	0.002	0.021
pres. score 3 - 4	-0.004	0.008	-0.526	0.601		pres. score 3 - 4	-0.020	0.012
env. zone 2	0.000	0.011	0.044	0.965		env. zone 2	-0.022	0.023
env. zone 3	-0.006	0.010	-0.603	0.550		env. zone 3	-0.027	0.014
slope	-0.006	0.004	-1.399	0.168		slope	-0.014	0.002
feature G02	0.009	0.009	1.049	0.300		feature G02	-0.009	0.028
feature G06	-0.021	0.011	-1.961	0.056	.	feature G06	-0.043	0.001
feature other	-0.003	0.013	-0.210	0.835		feature other	-0.028	0.023
site mean	-0.131	0.004	-34.298	<2e-16	***	site mean	-0.139	-0.123

Table D50 Output of final generalised linear model analyses of change in percentage cover of negative indicator species for option HK6. Covariates were selected though multi-model comparison approach. Habitat features: G02 = semi-improved grassland; G06 = lowland meadows. Env. zone = environment zone; pres. score = baseline panel score of how appropriate management prescriptions were for option; area = area of parcel under option HK6; slope = average slope for quadrat locations; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; pres. score = 2.

Woody plant cover:

Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. error	t value	Pr(>|t|)		2.5%	97.5%
(Intercept)	-0.011	0.018	-0.616	0.540	(Intercept)	-0.048	0.025
day difference	-0.003	0.006	-0.442	0.660	day difference	-0.015	0.010
feature G02	0.009	0.014	0.608	0.546	feature G02	-0.020	0.037
feature G06	0.001	0.016	0.041	0.968	feature G06	-0.031	0.032
feature other	0.010	0.017	0.598	0.552	feature other	-0.024	0.044
site mean	0.008	0.007	1.105	0.274	site mean	-0.006	0.021

Table D51 Output of final generalised linear model analyses of change in percentage cover of woody and semi-woody species for option HK6. Covariates were selected though multi-model comparison approach. Habitat features: G02 = semi-improved grassland; G06 = lowland meadows. Day difference = difference in number of days since start of the year and survey date (resurvey – baseline); site mean = average site value at baseline survey and resurvey.

Grazing score:

Fixed effects:						95% CI (profile likelihood):		
	Estimate	Std. error	t value	Pr(>|t|)			2.5%	97.5%
(Intercept)	49.349	18.467	2.672	0.010	*	(Intercept)	12.257	86.442
env. zone 2	-5.479	11.326	-0.484	0.631		env. zone 2	-28.228	17.271
env. zone 3	-7.084	9.084	-0.780	0.439		env. zone 3	-25.330	11.162
man. ease 4	-23.369	9.660	-2.419	0.019	*	man. ease 4	-42.772	-3.966
man. ease 5	-8.440	10.576	-0.798	0.429		man. ease 5	-29.681	12.802
supplement? (Y)	9.056	8.841	1.024	0.311		supplement? (Y)	-8.703	26.814
feature G02	-17.244	9.558	-1.804	0.077	.	feature G02	-36.441	1.953
feature G06	-29.161	12.224	-2.386	0.021	*	feature G06	-53.715	-4.608
feature other	-22.445	13.533	-1.659	0.104		feature other	-49.627	4.737
site mean	3.400	4.186	0.812	0.421		site mean	-5.008	11.808

Table D52 Output of final generalised linear model analyses of change in grazing score for option HK6. Covariates were selected though multi-model comparison approach. Habitat features: G02 = semi-improved grassland; G06 = lowland meadows. Env. zone = environment zone; supplement? (Y) = supplementary option applied in addition to HK6; man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; supplement? = no supplementary option; man. ease = 1, 2 or 3 (combined due to low frequencies).

Sward height:

Fixed effects:						95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	-9.974	10.507	-0.949	0.347		(Intercept)	-31.123	11.175
agri. class 4-5	-5.319	5.795	-0.918	0.363		agri. class 4-5	-16.983	6.345
agri. class non	6.443	8.174	0.788	0.435		agri. class non	-10.011	22.897
env. zone 2	5.513	5.665	0.973	0.336		env. zone 2	-5.889	16.915
env. zone 3	10.686	6.226	1.716	0.093	.	env. zone 3	-1.846	23.218
man. ease 4	-3.141	4.946	-0.635	0.529		man. ease 4	-13.097	6.816
man. ease 5	3.270	4.858	0.673	0.504		man. ease 5	-6.509	13.050
feature G02	3.807	4.476	0.851	0.399		feature G02	-5.202	12.816
feature G06	4.854	6.314	0.769	0.446		feature G06	-7.856	17.564
feature other	7.667	7.105	1.079	0.286		feature other	-6.636	21.969
site mean	0.213	2.218	0.096	0.924		site mean	-4.252	4.678

Table D53 Output of final generalised linear model analyses of change in sward height for option HK6. Covariates were selected though multi-model comparison approach. Habitat features: G02 = semi-improved grassland; G06 = lowland meadows. Agri. class = agricultural land class; env. zone = environment zone; man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; agri. class = 2 or 3 (combined due to low frequencies); man. ease = 1, 2 or 3 (combined due to low frequencies).

Pollinator plant species cover:

Fixed effects:						95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.5%	97.5%
(Intercept)	-0.140	0.126	-1.114	0.269		(Intercept)	-0.392	0.111
pres. score 3 - 4	0.188	0.065	2.877	0.005	**	pres. score 3 - 4	0.058	0.319
feature G02	-0.021	0.083	-0.250	0.803		feature G02	-0.186	0.145
feature G06	-0.028	0.086	-0.332	0.741		feature G06	-0.200	0.143
feature other	0.108	0.107	1.009	0.317		feature other	-0.106	0.321
site mean	-0.027	0.034	-0.795	0.430		site mean	-0.096	0.041

Table D54 Output of final generalised linear model analyses of change in percentage cover of pollinator plant species for option HK6. Covariates were selected though multi-model comparison approach. Habitat features: G02 = semi-improved grassland; G06 = lowland meadows. Pres. score = baseline panel score of how appropriate management prescriptions were for option; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): pres. score = 2.

D2.3 HK15 / 16 – maintenance / restoration of semi-improved or rough grassland for target species

Species richness:

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	-2.490	2.136	-1.166	0.246		(Intercept)	-6.724	1.745
day difference	1.798	0.665	2.704	0.008	**	day difference	0.479	3.116
env. zone 2	3.416	1.482	2.304	0.023	*	env. zone 2	0.477	6.355
env. zone 3	-3.005	2.054	-1.463	0.146		env. zone 3	-7.077	1.067
feature G02	2.880	1.615	1.784	0.077	.	feature G02	-0.322	6.081
feature G15	-0.971	2.003	-0.485	0.629		feature G15	-4.943	3.001
feature other	3.314	1.486	2.230	0.028	*	feature other	0.368	6.259
HK16	-0.366	1.568	-0.233	0.816		HK16	-3.475	2.743
site mean	0.496	0.668	0.743	0.459		site mean	-0.829	1.821

Table D55 Output of final generalised linear model analyses of change in species richness derived from quadrat data for options HK15 and HK16. Covariates were selected though multi-model comparison approach. Habitat features: G02 = semi-improved grassland; G15 = Coastal and flood plain grazing marsh (BAP habitat). Day difference = difference in number of days since start of the year (resurvey – baseline); env. zone = environment zone; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; HLS options = HK15.

Ellenberg fertility (N)

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	0.065	0.155	0.423	0.673		(Intercept)	-0.241	0.372
env. zone 2	-0.238	0.105	-2.262	0.026	*	env. zone 2	-0.447	-0.030
env. zone 3	-0.127	0.149	-0.852	0.396		env. zone 3	-0.422	0.168
feature G02	0.001	0.117	0.006	0.996		feature G02	-0.232	0.233
feature G15	-0.280	0.126	-2.230	0.028	*	feature G15	-0.530	-0.031
feature other	0.133	0.109	1.220	0.225		feature other	-0.083	0.349
HK16	0.068	0.108	0.626	0.533		HK16	-0.146	0.282
site mean	0.003	0.050	0.060	0.953		site mean	-0.096	0.102

Table D56 Output of final generalised linear model analyses of change in Ellenberg fertility score derived from quadrat data for options HK15 and HK16. For habitat features see Table D55 legend above. Env. zone = environment zone; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; HLS options = HK15.

Ellenberg reaction (R):

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	-0.079	0.148	-0.537	0.592		(Intercept)	-0.372	0.213
env. zone 2	-0.263	0.107	-2.452	0.016	*	env. zone 2	-0.475	-0.050
env. zone 3	-0.248	0.143	-1.730	0.086	.	env. zone 3	-0.532	0.036
feature G02	0.130	0.111	1.173	0.243		feature G02	-0.090	0.351
feature G15	0.053	0.119	0.442	0.660		feature G15	-0.183	0.289
feature other	0.198	0.104	1.911	0.059	.	feature other	-0.007	0.404
HK16	0.144	0.105	1.375	0.172		HK16	-0.063	0.351
site mean	-0.057	0.049	-1.153	0.251		site mean	-0.154	0.041

Table D57 Output of final generalised linear model analyses of change in Ellenberg reaction score derived from quadrat data for options HK15 and HK16. For habitat features see Table D55 legend above. Env. zone = environment zone; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; HLS options = HK15.

Ellenberg moisture (F):

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	0.157	0.128	1.231	0.222		(Intercept)	-0.097	0.412
area	-0.092	0.044	-2.108	0.038	*	area	-0.179	-0.005
day difference	0.119	0.045	2.615	0.010	*	day difference	0.029	0.209
feature G02	-0.007	0.113	-0.059	0.953		feature G02	-0.231	0.218
feature G15	0.315	0.129	2.432	0.017	*	feature G15	0.058	0.571
feature other	-0.150	0.100	-1.491	0.139		feature other	-0.349	0.050
HK16	-0.206	0.107	-1.930	0.057	.	HK16	-0.418	0.006
site mean	0.015	0.046	0.324	0.746		site mean	-0.077	0.106

Table D58 Output of final generalised linear model analyses of change in Ellenberg moisture score derived from quadrat data for options HK15 and HK16. For habitat features see Table D55 legend above. Day difference = difference in number of days since start of the year (resurvey – baseline); area = area of parcel under HLS management option site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): HLS option = HK15.

Competitiveness score (CSR C):

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	-0.036	0.137	-0.263	0.793		(Intercept)	-0.309	0.237
day difference	-0.112	0.036	-3.106	0.003	**	day difference	-0.184	-0.040
pres. score 3	-0.014	0.081	-0.173	0.863		pres. score 3	-0.176	0.148
pres. score 4	0.242	0.101	2.404	0.019	*	pres. score 4	0.041	0.443
env. zone 2	-0.131	0.087	-1.513	0.135		env. zone 2	-0.304	0.042
env. zone 3	0.163	0.124	1.316	0.193		env. zone 3	-0.084	0.410
man. ease 4	-0.188	0.092	-2.037	0.046	*	man. ease 4	-0.372	-0.004
man. ease 5	0.005	0.090	0.052	0.959		man. ease 5	-0.176	0.185
slope	0.089	0.041	2.163	0.034	*	slope	0.007	0.171
feature G02	0.051	0.094	0.547	0.587		feature G02	-0.136	0.238
feature G15	0.252	0.129	1.956	0.055	.	feature G15	-0.005	0.509
feature other	0.037	0.085	0.432	0.667		feature other	-0.133	0.206
HK16	-0.064	0.089	-0.721	0.474		HK16	-0.241	0.113
site mean	0.027	0.032	0.856	0.395		site mean	-0.036	0.091

Table D59 Output of final generalised linear model analyses of change in Grime competitiveness score for options HK15 and HK16. For habitat features see Table D55 legend above. Day difference = difference in number of days since start of the year (resurvey – baseline); env. zone = environment zone; pres. score = baseline panel score of how appropriate management prescriptions were for option; man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; slope = average slope for quadrat locations; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; pres. score = 2; man. ease = 1, 2 or 3 (combined due to low frequencies), HLS options = HK15.

Ruderality score (CSR R):

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	0.021	0.124	0.169	0.866		(Intercept)	-0.226	0.268
agri. class 4-5	0.158	0.080	1.982	0.051	.	agri. class 4-5	-0.001	0.317
area	0.043	0.029	1.467	0.147		area	-0.015	0.101
pres. score 3	-0.035	0.076	-0.456	0.650		pres. score 3	-0.186	0.117
pres. score 4	-0.265	0.088	-3.029	0.003	**	pres. score 4	-0.440	-0.091
man. ease 4	0.070	0.085	0.827	0.411		man. ease 4	-0.099	0.239
man. ease 5	-0.119	0.081	-1.464	0.148		man. ease 5	-0.282	0.043
feature G02	0.027	0.101	0.270	0.788		feature G02	-0.174	0.229
feature G15	-0.276	0.113	-2.453	0.017	*	feature G15	-0.501	-0.052
feature other	0.016	0.084	0.187	0.852		feature other	-0.153	0.184
HK16	0.057	0.084	0.679	0.499		HK16	-0.110	0.223
site mean	0.018	0.037	0.478	0.634		site mean	-0.056	0.092

Table D60 Output of final generalised linear model analyses of change in Grime ruderality score for options HK15 and HK16. For habitat features see Table D55 legend above. Pres. score = baseline panel score of how appropriate management prescriptions were for option; man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; area = area of parcel under HLS management option; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): agri. class = 2 or 3 (combined due to low frequencies); pres. score = 2; man. ease = 1, 2 or 3 (combined due to low frequencies); HLS option = HK15.

Stress tolerator score (CSR S):

Fixed effects:						95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	-0.375	0.165	-2.271	0.026	*	(Intercept)	-0.704	-0.046
pres. score 3	-0.018	0.099	-0.185	0.854		pres. score 3	-0.215	0.179
pres. score 4	-0.149	0.111	-1.342	0.184		pres. score 4	-0.371	0.072
env. zone 2	0.220	0.101	2.175	0.033	*	env. zone 2	0.018	0.421
env. zone 3	0.105	0.137	0.769	0.445		env. zone 3	-0.168	0.379
man. ease 4	0.219	0.104	2.101	0.039	*	man. ease 4	0.011	0.427
man. ease 5	0.053	0.100	0.533	0.596		man. ease 5	-0.146	0.252
slope	-0.073	0.051	-1.435	0.156		slope	-0.175	0.029
supplement? (Y)	-0.061	0.090	-0.677	0.501		supplement? (Y)	-0.240	0.119
feature G02	0.269	0.117	2.294	0.025	*	feature G02	0.035	0.503
feature G15	0.174	0.129	1.349	0.182		feature G15	-0.083	0.430
feature other	0.061	0.103	0.590	0.557		feature other	-0.145	0.266
HK16	0.125	0.117	1.071	0.288		HK16	-0.108	0.358
site mean	0.055	0.046	1.184	0.240		site mean	-0.038	0.148

Table D61 Output of final generalised linear model analyses of change in Grime stress tolerator score, derived from quadrat data for options HK15 and HK16. For habitat features see Table D55 legend above. Env. zone = environment zone; supplement? (Y) = supplementary option applied in addition to HK15 or HK16; pres. score = baseline panel score of how appropriate management prescriptions were for option; man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; slope = average slope for quadrat locations; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; supplement? = no supplementary option; pres. score = 2; man. ease = 1, 2 or 3 (combined due to low frequencies), HLS option = HK15.

Grass to forb ratio (log):

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	-0.412	0.571	-0.722	0.472		(Intercept)	-1.548	0.724
altitude	0.535	0.192	2.788	0.007	**	altitude	0.153	0.916
day difference	-0.228	0.181	-1.257	0.212		day difference	-0.587	0.132
man. ease 4	0.188	0.390	0.483	0.630		man. ease 4	-0.587	0.964
man. ease 5	-0.423	0.432	-0.981	0.329		man. ease 5	-1.282	0.435
feature G02	0.378	0.451	0.837	0.405		feature G02	-0.520	1.276
feature G15	1.527	0.674	2.266	0.026	*	feature G15	0.187	2.868
feature other	-0.305	0.409	-0.746	0.458		feature other	-1.118	0.508
HK16	0.575	0.372	1.546	0.126		HK16	-0.165	1.314
site mean	0.163	0.176	0.929	0.356		site mean	-0.187	0.513

Table D62 Output of final generalised linear model analyses of change in grass to forb ratio for options HK15 and HK16. For habitat features see Table D55 legend above. Day difference = difference in number of days since start of the year (resurvey – baseline); man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; altitude = average altitude for parcel; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): man. ease = 1, 2 or 3 (combined due to low frequencies), HLS option = HK15.

Pollinator plant species cover:

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	-0.122	0.086	-1.409	0.162		(Intercept)	-0.293	0.050
day difference	-0.108	0.031	-3.487	0.001	***	day difference	-0.169	-0.047
feature G02	0.116	0.073	1.581	0.117		feature G02	-0.029	0.260
feature G15	-0.036	0.084	-0.433	0.666		feature G15	-0.203	0.130
feature other	0.106	0.068	1.562	0.121		feature other	-0.028	0.240
HK16	0.087	0.068	1.275	0.205		HK16	-0.048	0.221
site mean	-0.022	0.029	-0.730	0.467		site mean	-0.080	0.037

Table D63 Output of final generalised linear model analyses of change in percentage cover of pollinator plant species for options HK15 and HK16. For habitat features see Table D55 legend above. Day difference = difference in number of days since start of the year (resurvey – baseline). Reference for analysis (compared to listed category): HLS option = HK15.

Woody plant cover:

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	-0.254	0.093	-2.726	0.008	**	(Intercept)	-0.441	-0.068
agri. class 4-5	-0.127	0.063	-2.006	0.049	*	agri. class 4-5	-0.252	-0.001
altitude	-0.080	0.035	-2.254	0.028	*	altitude	-0.150	-0.009
area	0.024	0.020	1.160	0.250		area	-0.017	0.064
day difference	-0.036	0.024	-1.492	0.140		day difference	-0.085	0.012
env. zone 2	0.210	0.057	3.663	0.000	***	env. zone 2	0.095	0.324
env. zone 3	0.370	0.099	3.760	0.000	***	env. zone 3	0.174	0.567
man. ease 4	-0.004	0.056	-0.079	0.937		man. ease 4	-0.115	0.106
man. ease 5	0.160	0.062	2.558	0.013	*	man. ease 5	0.035	0.284
feature G02	0.008	0.065	0.127	0.900		feature G02	-0.121	0.138
feature G15	0.041	0.089	0.456	0.650		feature G15	-0.138	0.219
feature other	0.134	0.061	2.199	0.031	*	feature other	0.012	0.256
HK16	0.023	0.061	0.377	0.707		HK16	-0.099	0.146
site mean	-0.074	0.027	-2.727	0.008	**	site mean	-0.127	-0.020

Table D64 Output of final generalised linear model analyses of change in percentage cover of woody and semi-woody species for options HK15 and HK16. For habitat features see Table D55 legend above. Day difference = difference in number of days since start of the year (resurvey – baseline); env. zone = environment zone; man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; area = area of parcel under HLS management option; altitude = average altitude for parcel; site mean = average site value at baseline survey and resurvey. References for analyses (compared to listed categories): env. zone = 1; man. ease = 1, 2 or 3 (combined due to low frequencies); HLS option = HK15.

Grazing score:

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	4.675	7.054	0.663	0.509		(Intercept)	-9.309	18.658
agri. class 4-5	10.355	4.820	2.148	0.034	*	agri. class 4-5	0.800	19.910
agri. class non	-11.813	12.860	-0.919	0.360		agri. class non	-37.307	13.680
pres. score 3	1.523	5.130	0.297	0.767		pres. score 3	-8.647	11.692
pres. score 4	-17.139	5.866	-2.921	0.004	**	pres. score 4	-28.768	-5.509
feature G02	-5.775	5.857	-0.986	0.326		feature G02	-17.387	5.837
feature G15	-11.089	6.271	-1.768	0.080	.	feature G15	-23.520	1.343
feature other	3.170	5.470	0.579	0.564		feature other	-7.674	14.014
HK16	-9.205	5.450	-1.689	0.094	.	HK16	-20.008	1.599
site mean	4.576	2.260	2.025	0.045	*	site mean	0.096	9.056

Table D65 Output of final generalised linear model analyses of change in score for grazing, for options HK15 and HK16. For habitat features see Table D55 legend above. Pres. score = baseline panel score of how appropriate management prescriptions were for option; agri. class = agricultural land classification; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): agri. class = 2 or 3 (combined due to low frequencies); pres. score = 2; HLS option = HK15.

Sward height:

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	-1.234	4.265	-0.289	0.773		(Intercept)	-9.694	7.226
feature G02	6.576	3.616	1.819	0.072	.	feature G02	-0.596	13.748
feature G15	3.376	4.208	0.802	0.424		feature G15	-4.971	11.723
feature other	5.318	3.395	1.567	0.120		feature other	-1.416	12.052
HK16	-6.041	3.157	-1.914	0.059	.	HK16	-12.302	0.221
site mean	6.873	1.345	5.112	0.000	***	site mean	4.207	9.540

Table D66 Output of final generalised linear model analyses of change in sward height for options HK15 and HK16. For habitat features see Table D55 legend above. Site mean = average site value at baseline survey and resurvey. Reference for analysis (compared to listed category): HLS option = HK15.

D2.4 HC7 / HC8 – maintenance / restoration of woodland

Species richness:

Fixed effects:						95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	16.636	5.061	3.287	0.002	**	(Intercept)	6.340	26.931
area	-6.347	2.196	-2.890	0.007	**	area	-10.816	-1.879
day difference	3.608	1.917	1.881	0.069	.	day difference	-0.293	7.509
pres. score 4	-11.195	5.437	-2.059	0.047	*	pres. score 4	-22.257	-0.133
env. zone 2	-15.305	4.773	-3.207	0.003	**	env. zone 2	-25.015	-5.594
env. zone 3	-14.822	5.894	-2.515	0.017	*	env. zone 3	-26.813	-2.832
quads. difference	6.351	2.098	3.028	0.005	**	quads. difference	2.084	10.619
slope	-3.952	2.260	-1.749	0.090	.	slope	-8.550	0.645
supplement? (Y)	16.247	5.591	2.906	0.006	**	supplement? (Y)	4.872	27.621
feature T08	1.071	3.986	0.269	0.790		feature T08	-7.038	9.180
HC8	0.874	5.404	0.162	0.872		HC8	-10.120	11.869
site mean	1.125	1.974	0.570	0.573		site mean	-2.891	5.140

Table D67 Output of final generalised linear model analyses of change in species richness derived from quadrat data for options HC7 and HC8. Covariates were selected though multi-model comparison approach. Habitat feature: T08 = Native semi-natural woodland. Day difference = difference in number of days since start of the year (resurvey – baseline); quads. difference = difference in the number of quadrats assessed at baseline survey and resurvey where applicable (most frequently the same number were assessed); env. zone = environment zone; supplement? (Y) = supplementary option applied in addition to HK15 or HK16; pres. score = baseline panel score of how appropriate management prescriptions were for option; area = area of parcel under HLS management option; slope = average slope for quadrat locations; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; supplement? = no supplementary option; pres. score = 1, 2 or 3 (combined due to low frequencies); HLS option = HC7.

Ellenberg fertility (N)

Fixed effects:						95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	0.316	0.147	2.154	0.037	*	(Intercept)	0.019	0.613
agri. class 4	-0.320	0.146	-2.202	0.034	*	agri. class 4	-0.615	-0.026
agri. class 5	0.049	0.193	0.252	0.802		agri. class 5	-0.342	0.439
agri. class non	0.282	0.327	0.862	0.394		agri. class non	-0.380	0.944
altitude	0.090	0.080	1.133	0.264		altitude	-0.071	0.252
day difference	0.074	0.050	1.478	0.147		day difference	-0.027	0.176
env. zone 2	-0.090	0.119	-0.756	0.454		env. zone 2	-0.330	0.150
env. zone 3	0.265	0.174	1.521	0.136		env. zone 3	-0.087	0.617
slope	-0.228	0.054	-4.195	0.000	***	slope	-0.338	-0.118
feature T08	-0.115	0.114	-1.009	0.319		feature T08	-0.344	0.115
HC8	-0.326	0.112	-2.917	0.006	**	HC8	-0.552	-0.100
site mean	-0.129	0.066	-1.951	0.058	.	site mean	-0.262	0.005

Table D68 Output of final generalised linear model analyses of change in Ellenberg fertility indicator for options HC7 and HC8. Covariates were selected though multi-model comparison approach. Habitat feature: T08 = Native semi-natural woodland. Day difference = difference in number of days since start of the year (resurvey – baseline); env. zone = environment zone; agri. class = agricultural land class; altitude = average altitude for parcel; slope = average slope for quadrat locations; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; agri. class = 2 or 3 (combined due to low frequencies); HLS option = HC7.

Ellenberg reaction (R):

Fixed effects:						95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	-0.080	0.192	-0.419	0.678		(Intercept)	-0.468	0.308
pres. score 4	0.357	0.181	1.971	0.056	.	pres. score 4	-0.010	0.723
env. zone 2	0.064	0.175	0.367	0.716		env. zone 2	-0.290	0.418
env. zone 3	0.594	0.211	2.818	0.008	**	env. zone 3	0.167	1.021
slope	-0.236	0.077	-3.071	0.004	**	slope	-0.392	-0.080
feature T08	-0.217	0.142	-1.529	0.135		feature T08	-0.503	0.070
HC8	-0.119	0.157	-0.760	0.452		HC8	-0.437	0.199
site mean	0.093	0.076	1.212	0.233		site mean	-0.062	0.247

Table D69 Output of final generalised linear model analyses of change in Ellenberg reaction indicator for options HC7 and HC8. Habitat feature: T08 = Native semi-natural woodland. Env. zone = environment zone; pres. score = baseline panel score of how appropriate management prescriptions were for option; slope = average slope for quadrat locations; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; HLS option = HC7.

Ellenberg moisture (F):

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	-0.204	0.180	-1.137	0.261		(Intercept)	-0.566	0.157
agri. class 4	0.153	0.125	1.218	0.229		agri. class 4	-0.100	0.405
agri. class 5	0.141	0.153	0.918	0.364		agri. class 5	-0.168	0.449
agri. class non	-0.179	0.257	-0.697	0.489		agri. class non	-0.696	0.338
altitude	-0.198	0.072	-2.748	0.009	**	altitude	-0.342	-0.053
env. zone 2	-0.138	0.137	-1.006	0.320		env. zone 2	-0.415	0.138
env. zone 3	0.103	0.206	0.498	0.621		env. zone 3	-0.312	0.518
man. ease 4 - 5	0.298	0.113	2.635	0.011	*	man. ease 4 - 5	0.070	0.525
feature T08	-0.014	0.123	-0.111	0.912		feature T08	-0.261	0.234
HC8	0.037	0.110	0.335	0.739		HC8	-0.184	0.257
site mean	0.008	0.061	0.131	0.897		site mean	-0.115	0.130

Table D70 Output of final generalised linear model analyses of change in Ellenberg moisture indicator data for options HC7 and HC8. Covariates were selected though multi-model comparison approach. Habitat feature: T08 = Native semi-natural woodland. Env. zone = environment zone; agri-class = agricultural land class; man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; altitude = average altitude for parcel; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; agri. class = 2 or 3 (combined due to low frequencies); man. ease = 1, 2 or 3 (combined due to low frequencies), HLS option = HC7.

Competitiveness score (CSR C):

	Fixed effects:				95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)		2.50%	97.50%
(Intercept)	0.010	0.136	0.076	0.940	(Intercept)	-0.261	0.282
env. zone 2	-0.086	0.120	-0.714	0.478	env. zone 2	-0.325	0.154
env. zone 3	0.180	0.138	1.302	0.198	env. zone 3	-0.096	0.457
feature T08	0.031	0.115	0.269	0.789	feature T08	-0.199	0.261
HC8	-0.056	0.111	-0.510	0.612	HC8	-0.278	0.165
site mean	-0.053	0.052	-1.013	0.315	site mean	-0.157	0.051

Table D71 Output of final generalised linear model analyses of change in Grime competitiveness score for options HC7 and HC8. Covariates were selected though multi-model comparison approach. Habitat feature: T08 = Native semi-natural woodland. Env. zone = environment zone; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; HLS option = HC7.

Ruderality score (CSR R):

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	0.067	0.093	0.722	0.473		(Intercept)	-0.119	0.254
feature T08	-0.130	0.089	-1.468	0.147		feature T08	-0.307	0.047
HC8	-0.020	0.078	-0.259	0.797		HC8	-0.177	0.136
site mean	-0.111	0.039	-2.855	0.006	**	site mean	-0.188	-0.033

Table D72 Output of final generalised linear model analyses of change in Grime ruderality score derived from quadrat data for options HC7 and HC8. Covariates were selected though multi-model comparison approach. Habitat feature: T08 = Native semi-natural woodland; site mean = average site value at baseline survey and resurvey. Reference for analysis (compared to listed category): HLS option = HC7.

Stress tolerator score (CSR S):

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	0.139	0.128	1.087	0.281		(Intercept)	-0.117	0.395
altitude	0.061	0.066	0.917	0.363		altitude	-0.072	0.193
env. zone 2	-0.132	0.109	-1.209	0.231		env. zone 2	-0.349	0.086
env. zone 3	-0.401	0.167	-2.399	0.019	*	env. zone 3	-0.734	-0.067
feature T08	-0.025	0.102	-0.245	0.807		feature T08	-0.229	0.179
HC8	0.023	0.100	0.226	0.822		HC8	-0.177	0.222
site mean	-0.050	0.047	-1.073	0.288		site mean	-0.143	0.043

Table D73 Output of final generalised linear model analyses of change in Grime stress-tolerator score for options HC7 and HC8. Covariates were selected though multi-model comparison approach. Habitat feature: T08 = Native semi-natural woodland. Env. zone = environment zone; altitude = average altitude for parcel; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; HLS option = HC7.

Grass to forb ratio (log):

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	1.764	1.314	1.343	0.192		(Intercept)	-0.947	4.476
agri. class 4	-2.268	1.253	-1.810	0.083	.	agri. class 4	-4.855	0.319
agri. class 5	-3.427	1.480	-2.316	0.029	*	agri. class 5	-6.481	-0.373
agri. class non	-2.324	1.854	-1.253	0.222		agri. class non	-6.151	1.503
altitude	-0.086	0.683	-0.126	0.901		altitude	-1.496	1.324
day difference	0.360	0.415	0.867	0.395		day difference	-0.497	1.217
env. zone 2	1.926	1.422	1.355	0.188		env. zone 2	-1.008	4.860
env. zone 3	3.029	1.820	1.665	0.109		env. zone 3	-0.727	6.785
man. ease 4 - 5	-0.644	1.043	-0.618	0.542		man. ease 4 - 5	-2.797	1.508
supplement? (Y)	0.324	0.860	0.376	0.710		supplement? (Y)	-1.451	2.098
feature T08	0.619	0.881	0.703	0.489		feature T08	-1.200	2.438
HC8	-1.496	0.981	-1.525	0.140		HC8	-3.520	0.528
site mean	-1.258	0.569	-2.212	0.037	*	site mean	-2.432	-0.084

Table D74 Output of final generalised linear model analyses of change in grass to forb ratio for options HC7 and HC8. Habitat feature: T08 = Native semi-natural woodland. Day difference = difference in number of days since start of the year (resurvey – baseline); agri. class = agricultural land class; env. zone = environment zone; supplement? (Y) = supplementary option applied in addition to HK15 or HK16; man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; altitude = average altitude for parcel; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; agri. class = 2 or 3 (combined due to low frequencies); supplement? = no supplementary option; man. ease = 1, 2 or 3 (combined due to low frequencies), HLS option = HC7.

Woody plant cover:

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	0.284	0.146	1.945	0.056	.	(Intercept)	-0.008	0.576
day difference	-0.078	0.062	-1.242	0.219		day difference	-0.202	0.047
feature T08	-0.105	0.137	-0.763	0.448		feature T08	-0.378	0.169
HC8	0.010	0.127	0.081	0.936		HC8	-0.244	0.265
site mean	-0.008	0.065	-0.122	0.904		site mean	-0.138	0.122

Table D75 Output of final generalised linear model analyses of change in percentage cover of woody and semi-woody species for options HC7 and HC8. Habitat feature: T08 = Native semi-natural woodland. Site mean = average site value at baseline survey and resurvey. Reference for analysis (compared to listed categories): HLS option = HC7.

Positive indicator species cover:

Fixed effects:						95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	-0.052	0.075	-0.685	0.496		(Intercept)	-0.203	0.099
pres. score 4	0.044	0.063	0.708	0.482		pres. score 4	-0.081	0.170
env. zone 2	0.077	0.070	1.098	0.277		env. zone 2	-0.064	0.218
env. zone 3	-0.015	0.077	-0.196	0.845		env. zone 3	-0.169	0.139
supplement? (Y)	-0.034	0.068	-0.491	0.625		supplement? (Y)	-0.171	0.103
feature T08	-0.010	0.065	-0.159	0.874		feature T08	-0.141	0.121
HC8	-0.020	0.065	-0.314	0.755		HC8	-0.150	0.109
site mean	-0.052	0.029	-1.772	0.082	.	site mean	-0.110	0.007

Table D76 Output of final generalised linear model analyses of change in percentage cover of positive indicator species for HC7 and HC8. Habitat feature: T08 = Native semi-natural woodland. Env. zone = environment zone; supplement? (Y) = supplementary option applied in addition to HK15 or HK16; pres. score = baseline panel score of how appropriate management prescriptions were for option; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; supplement? = no supplementary option; pres. score = 2; HLS option = HC7.

Pollinator plant species cover:

Fixed effects:						95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	0.451	0.167	2.704	0.009	**	(Intercept)	0.118	0.784
feature T08	-0.368	0.155	-2.369	0.021	*	feature T08	-0.679	-0.058
HC8	-0.032	0.147	-0.214	0.831		HC8	-0.326	0.263
site mean	0.034	0.073	0.474	0.637		site mean	-0.111	0.179

Table D77 Output of final generalised linear model analyses of change in pollinator plant species for options HC7 and HC8. Habitat feature: T08 = Native semi-natural woodland. Site mean = average site value at baseline survey and resurvey. Reference for analysis (compared to listed categories): HLS option = HC7.

Grazing score:

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	-23.674	17.853	-1.326	0.196		(Intercept)	-60.371	13.024
agri. class 4	-27.371	15.954	-1.716	0.098	.	agri. class 4	-60.165	5.423
agri. class 5	-57.616	22.228	-2.592	0.015	*	agri. class 5	-103.306	-11.925
agri. class non	-420.181	97.202	-4.323	0.000	***	agri. class non	-619.983	-220.378
area	70.425	15.566	4.524	0.000	***	area	38.430	102.421
day difference	11.535	5.990	1.926	0.065	.	day difference	-0.777	23.846
pres. score 4	-20.396	15.201	-1.342	0.191		pres. score 4	-51.641	10.849
env. zone 2	73.407	22.468	3.267	0.003	**	env. zone 2	27.224	119.590
env. zone 3	26.349	25.210	1.045	0.306		env. zone 3	-25.470	78.168
man. ease 4 - 5	-24.955	17.149	-1.455	0.158		man. ease 4 - 5	-60.204	10.295
slope	11.473	7.631	1.503	0.145		slope	-4.213	27.160
feature T08	32.300	13.143	2.458	0.021	*	feature T08	5.284	59.316
HC8	-7.160	14.806	-0.484	0.633		HC8	-37.594	23.273
site mean	16.661	9.027	1.846	0.076	.	site mean	-1.893	35.216

Table D78 Output of final generalised linear model analyses of change in grazing score for options HC7 and HC8. Habitat feature: T08 = Native semi-natural woodland. Day difference = difference in number of days since start of the year (resurvey – baseline); agri. class = agricultural land class; env. zone = environment zone; pres. score = baseline panel score of how appropriate management prescriptions were for option; man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; area = area of parcel under HLS management option; slope = average slope for quadrat locations; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): env. zone = 1; agri. class = 2 or 3 (combined due to low frequencies); pres. score = 2; man. ease = 1, 2 or 3 (combined due to low frequencies), HLS option = HC7.

D2.5 HL9 / HL10 – maintenance and restoration of moorland

Ellenberg fertility (N): Fixed effects

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	0.923	0.818	1.128	0.288	
altitude	-0.322	0.173	-1.864	0.095	.
pres. score 3	-0.170	0.449	-0.379	0.713	
pres. score 4	-1.556	0.703	-2.215	0.054	.
man. ease 4	-1.084	0.437	-2.479	0.035	*
man. ease 5	-1.041	0.509	-2.046	0.071	.
slope	-0.208	0.108	-1.919	0.087	.
supplement? (Y)	0.285	0.289	0.987	0.349	
feature M04	-0.142	0.391	-0.364	0.724	
feature M06	-0.069	0.234	-0.297	0.773	
feature other	0.145	0.251	0.578	0.578	
HL9	0.619	0.505	1.227	0.251	
site mean	0.002	0.118	0.015	0.988	

95% CI (profile likelihood):

	2.5%	97.5%
(Intercept)	-0.927	2.773
altitude	-0.713	0.069
pres. score 3	-1.185	0.845
pres. score 4	-3.146	0.033
man. ease 4	-2.072	-0.095
man. ease 5	-2.192	0.110
slope	-0.454	0.037
supplement? (Y)	-0.368	0.939
feature M04	-1.026	0.742
feature M06	-0.598	0.459
feature other	-0.422	0.712
HL9	-0.522	1.761
site mean	-0.265	0.268

Table D79 Output of final generalised linear model analyses of change in Ellenberg fertility indicator for options HL9 and HL10. Covariates were selected though multi-model comparison approach. Habitat feature: M04 = upland heath (BAP habitat); M06 = blanket bog (BAP habitat). Altitude = average altitude for parcel; pres. score = baseline panel score of how appropriate management prescriptions were for option; man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; slope = average slope for quadrat locations; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): pres. score = 2; man. ease = 2 or 3 (combined due to low frequencies); HLS option = HL8.

Ellenberg reaction (R): Fixed effects

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	0.401	0.290	1.380	0.182	
day difference	0.372	0.090	4.120	0.000	***
pres. score 3	-0.160	0.204	-0.782	0.443	
pres. score 4	0.077	0.196	0.391	0.699	
man. ease 4	-0.574	0.179	-3.210	0.004	**
man. ease 5	-0.357	0.228	-1.570	0.131	
feature M04	0.260	0.193	1.343	0.193	
feature M06	-0.169	0.128	-1.315	0.203	
feature other	-0.692	0.143	-4.827	0.000	***
HL9	0.245	0.178	1.379	0.182	
site mean	0.323	0.077	4.169	0.000	***

95% CI (profile likelihood):

	2.50%	97.5%
(Intercept)	-0.203	1.005
day difference	0.184	0.560
pres. score 3	-0.584	0.265
pres. score 4	-0.331	0.484
man. ease 4	-0.946	-0.202
man. ease 5	-0.831	0.116
feature M04	-0.142	0.662
feature M06	-0.435	0.098
feature other	-0.990	-0.394
HL9	-0.125	0.615
site mean	0.162	0.484

Table D80 Output of final generalised linear model analyses of change in Ellenberg reaction indicator for options HL9 and HL10. Covariates were selected though multi-model comparison approach. Habitat feature: M04 = upland heath (BAP habitat); M06 = blanket bog (BAP habitat). Day difference = difference in number of days since start of the year (resurvey – baseline); pres. score = baseline panel score of how appropriate management prescriptions were for option; man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): pres. score = 2; man. ease = 2 or 3 (combined due to low frequencies); HLS option = HL8.

Ellenberg moisture (F): Fixed effects

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	0.484	0.473	1.022	0.333	
area	0.321	0.122	2.638	0.027	*
pres. score 3	-0.432	0.293	-1.471	0.175	
pres. score 4	0.097	0.523	0.185	0.857	
man. ease 4	0.591	0.302	1.954	0.082	.
man. ease 5	0.240	0.332	0.723	0.488	
slope	0.107	0.082	1.305	0.224	
supplement? (Y)	-0.761	0.229	-3.320	0.009	**
feature M04	-0.215	0.279	-0.770	0.461	
feature M06	-0.112	0.154	-0.726	0.487	
feature other	0.022	0.181	0.123	0.905	
HL9	-0.705	0.368	-1.917	0.087	.
site mean	-0.127	0.085	-1.490	0.170	

95% CI (profile likelihood):

	2.5%	97.5%
(Intercept)	-0.587	1.555
area	0.046	0.596
pres. score 3	-1.096	0.232
pres. score 4	-1.087	1.280
man. ease 4	-0.093	1.275
man. ease 5	-0.511	0.992
slope	-0.078	0.291
supplement? (Y)	-1.280	-0.243
feature M04	-0.846	0.416
feature M06	-0.460	0.237
feature other	-0.386	0.430
HL9	-1.538	0.127
site mean	-0.320	0.066

Table D81 Output of final generalised linear model analyses of change in Ellenberg moisture indicator for options HL9 and HL10. Covariates were selected though multi-model comparison approach. Habitat feature: M04 = upland heath (BAP habitat); M06 = blanket bog (BAP habitat). Area = area of parcel under HLS management option; pres. score = baseline panel score of how appropriate management prescriptions were for option; man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; slope = average slope for quadrat locations; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): pres. score = 2; man. ease = 2 or 3 (combined due to low frequencies); HLS option = HL8.

Competitiveness score (CSR C): Fixed effects

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	0.146	0.227	0.645	0.532	
area	-0.079	0.074	-1.059	0.312	
day difference	-0.119	0.100	-1.186	0.261	
man. ease 4	-0.161	0.235	-0.685	0.508	
man. ease 5	-0.557	0.306	-1.818	0.096	.
slope	-0.231	0.061	-3.782	0.003	**
feature M04	0.100	0.162	0.618	0.549	
feature M06	-0.334	0.170	-1.962	0.076	.
feature other	0.897	0.153	5.876	0.000	***
HL9	-0.154	0.240	-0.641	0.534	
site mean	0.392	0.080	4.924	0.000	***

95% CI (profile likelihood):

	2.5%	97.5%
(Intercept)	-0.353	0.645
area	-0.243	0.085
day difference	-0.339	0.102
man. ease 4	-0.677	0.356
man. ease 5	-1.230	0.117
slope	-0.366	-0.097
feature M04	-0.256	0.456
feature M06	-0.708	0.041
feature other	0.561	1.233
HL9	-0.682	0.374
site mean	0.217	0.567

Table D82 Output of final generalised linear model analyses of change in Grime competitiveness score for options HL9 and HL10. Covariates were selected though multi-model comparison approach. Habitat feature: M04 = upland heath (BAP habitat); M06 = blanket bog (BAP habitat). Area = area of parcel under HLS management option; day difference = difference in number of days since start of the year (resurvey – baseline); man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): man. ease = 2 or 3 (combined due to low frequencies); HLS option = HL8.

Stress tolerator score (CSR S): Fixed effects

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	0.004	0.246	0.015	0.988	
day difference	0.143	0.112	1.283	0.224	
man. ease 4	-0.064	0.251	-0.255	0.803	
man. ease 5	0.308	0.322	0.958	0.357	
slope	0.205	0.070	2.927	0.013	*
feature M04	-0.025	0.185	-0.137	0.894	
feature M06	0.340	0.200	1.700	0.115	
feature other	-0.754	0.170	-4.438	0.001	***
HL9	0.172	0.253	0.681	0.509	
site mean	0.399	0.089	4.507	0.001	***

95% CI (profile likelihood):

	2.5%	97.5%
(Intercept)	-0.533	0.540
day difference	-0.100	0.386
man. ease 4	-0.610	0.483
man. ease 5	-0.393	1.009
slope	0.052	0.357
feature M04	-0.430	0.379
feature M06	-0.096	0.776
feature other	-1.124	-0.384
HL9	-0.378	0.722
site mean	0.206	0.592

Table D83 Output of final generalised linear model analyses of change in Grime competitiveness score for options HL9 and HL10. Covariates were selected though multi-model comparison approach. Habitat feature: M04 = upland heath (BAP habitat); M06 = blanket bog (BAP habitat). Day difference = difference in number of days since start of the year (resurvey – baseline); man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; ?"; slope = average slope for quadrat locations; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): man. ease = 2 or 3 (combined due to low frequencies); HLS option = HL8.

Ruderality score (CSR R):

Fixed effects:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	0.433	0.226	1.915	0.085	.
area	-0.113	0.082	-1.379	0.198	
day difference	0.231	0.101	2.282	0.046	*
man. ease 4	-0.690	0.232	-2.974	0.014	*
man. ease 5	-0.694	0.302	-2.300	0.044	*
slope	-0.146	0.067	-2.172	0.055	.
supplement? (Y)	0.354	0.118	2.994	0.014	*
feature M04	0.133	0.181	0.731	0.482	
feature M06	-0.394	0.155	-2.538	0.030	*
feature other	-0.272	0.200	-1.361	0.204	
HL9	0.088	0.219	0.403	0.696	
site mean	-0.040	0.074	-0.547	0.597	

95% CI (profile likelihood):

	2.5%	97.5%
(Intercept)	-0.071	0.936
area	-0.296	0.070
day difference	0.005	0.456
man. ease 4	-1.208	-0.173
man. ease 5	-1.365	-0.022
slope	-0.296	0.004
supplement? (Y)	0.090	0.617
feature M04	-0.271	0.536
feature M06	-0.740	-0.048
feature other	-0.717	0.173
HL9	-0.400	0.577
site mean	-0.205	0.124

Table D84 Output of final generalised linear model analyses of change in Grime ruderality score for options HL9 and HL10. Covariates were selected though multi-model comparison approach. Habitat feature: M04 = upland heath (BAP habitat); M06 = blanket bog (BAP habitat). Day difference = difference in number of days since start of the year (resurvey – baseline); man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; ?"; slope = average slope for quadrat locations; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): man. ease = 2 or 3 (combined due to low frequencies); HLS option = HL8.

Negative indicator species cover:

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.5%	97.5%
(Intercept)	-0.006	0.020	-0.278	0.784		(Intercept)	-0.048	0.036
day difference	-0.002	0.009	-0.285	0.778		day difference	-0.020	0.015
man. ease 4	0.000	0.016	0.031	0.976		man. ease 4	-0.032	0.033
man. ease 5	0.021	0.021	0.980	0.337		man. ease 5	-0.023	0.065
feature M04	-0.007	0.013	-0.540	0.594		feature M04	-0.035	0.020
feature M06	0.029	0.012	2.356	0.027	*	feature M06	0.004	0.054
feature other	-0.005	0.012	-0.426	0.674		feature other	-0.029	0.019
HL9	0.003	0.017	0.156	0.878		HL9	-0.033	0.038
site mean	0.011	0.008	1.323	0.199		site mean	-0.006	0.028

Table D85 Output of final generalised linear model analyses of change in negative indicator species cover for options HL9 and HL10. Covariates were selected though multi-model comparison approach. Habitat feature: M04 = upland heath (BAP habitat); M06 = blanket bog (BAP habitat). Day difference = difference in number of days since start of the year (resurvey – baseline); man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"; ?"; site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): man. ease = 2 or 3 (combined due to low frequencies); HLS option = HL8.

Dwarf shrub cover:

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.5%	97.5%
(Intercept)	0.026	0.060	0.428	0.672		(Intercept)	-0.098	0.149
feature M04	-0.042	0.067	-0.623	0.538		feature M04	-0.179	0.096
feature M06	0.073	0.041	1.789	0.085	.	feature M06	-0.011	0.156
feature other	-0.075	0.042	-1.788	0.085	.	feature other	-0.161	0.011
HL9	-0.068	0.044	-1.530	0.138		HL9	-0.159	0.023
site mean	0.013	0.028	0.450	0.657		site mean	-0.046	0.071

Table D86 Output of final generalised linear model analyses of change in dwarf shrub cover for options HL9 and HL10. Covariates were selected though multi-model comparison approach. Habitat features: M04 = upland heath (BAP habitat); M06 = blanket bog (BAP habitat). Site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): HLS option = HL8.

Sward height:

	Fixed effects:					95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.5%	97.5%
(Intercept)	-3.023	4.681	-0.646	0.524		(Intercept)	-12.646	6.599
feature M04	2.224	4.719	0.471	0.641		feature M04	-7.476	11.923
feature M06	-6.368	3.766	-1.691	0.103		feature M06	-14.109	1.373
feature other	-4.139	3.442	-1.203	0.240		feature other	-11.214	2.936
HL9	3.045	4.173	0.730	0.472		HL9	-5.532	11.622
site mean	-5.155	1.901	-2.711	0.012	*	site mean	-9.063	-1.247

Table D87 Output of final generalised linear model analyses of change in sward height for options HL9 and HL10. Covariates were selected though multi-model comparison approach. Habitat features: M04 = upland heath (BAP habitat); M06 = blanket bog (BAP habitat). Site mean = average site value at baseline survey and resurvey. References for analysis (compared to listed categories): HLS option = HL8.

D3 Vegetation response variables assessed at HLS resurvey only

D3.1 HF12 - Enhanced wild bird seed mix plots (rotational or non-rotational)

Species richness

Fixed effects:						95% CI (profile likelihood):		
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	-2.611	0.141	-18.479	<2e-16	***	(Intercept)	-2.902	-2.347
man ease 4-5	-4.757	0.192	-24.724	<2e-16	***	man ease 4-5	-5.124	-4.367
area	-1.090	0.105	-10.392	<2e-16	***	area	-1.293	-0.882
pres. score 4	-0.051	0.137	-0.374	0.708		pres. score 4	-0.322	0.215

Table D88 Output of final generalised linear model analyses of species richness in summer at resurvey derived from quadrat data for option HF12. Covariates were selected though multi-model comparison approach. Area = area of bird seed plot, pres. score = baseline panel score of how appropriate management prescriptions were for option; man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"

Winter seed provision

Fixed effects:								
	Estimate	Std. Error	t value	Pr(>|t|)			2.50%	97.50%
(Intercept)	1.299	0.651	1.995	0.046	*	(Intercept)	0.135	2.786
man ease 4-5	-1.145	0.857	-1.337	0.181		man ease 4-5	-2.951	0.484

Table D89 Output of final generalised linear model analyses of winter bird seed provision for option HF12. Covariates were selected though multi-model comparison approach. Man. ease = farmer survey response to "How easy or difficult have you found it to carry out the management prescription for these options?"

D4 Condition for historic features at baseline and resurvey

D4.1 H01 - above-ground historic feature

	H01	Resurvey				
		A	B	C	N/A	Total
Baseline	A	1				1
	B	5	2	2	1	10
	C	1				1
	Total	7	2	2	1	12

D4.2 H03 - historic routeway

	H03	Resurvey				
		A	B	C	N/A	Total
Baseline	A	1				1
	B					
	C		1			1
	N/A				2	2
	Total	1	1		2	4

D4.3 H04 - large-scale archeological feature

	H04	Resurvey				
		A	B	C	N/A	Total
Baseline	A		2			2
	B				1	1
	C				2	2
	Total		2		3	5

D4.4 H05 - relict boundary of historic importance

	H05	Resurvey				
		A	B	C	N/A	Total
Baseline	A	3	2			5
	B	1			1	2
	C		1			1
	Total	4	3		1	8

D4.5 H06 - historic water meadow

	H06	Resurvey				
		A	B	C	N/A	Total
Baseline	A					
	B	1				1
	C	1	9		1	11
	Total	2	9		1	12

D4.6 Condition of historic features which were only surveyed in a single parcel

Historic feature		Condition	
Code	Description	Baseline	Resurvey
H02	Below-ground historic feature	B	B
H08	Building - military	C	C
H09	Building - industrial	C	C
H11	Structure – other of historic or landscape importance	B	A
H12	Build water feature	B	C
H14	Designed landscape	B	A

Appendix E: Data summaries and statistical models for analyses across all HLS agreements surveyed

E1 Condition assessments at HLS baseline survey and resurvey

FEP habitat feature	FEP feature group	FEP feature group 1 code	FEP feature group 2 code
C02	Other	O	O
C05	Other	O	O
F01	Boundary - Hedge	B	O
F02	Boundary - Hedge	B	O
G02	Grassland - plants	GP	GP
G03	Grassland - plants	GP	GP
G04	BAP Grassland - plants	BGP	BGP
G05	BAP Grassland - plants	BGP	BGP
G06	BAP Grassland - plants	BGP	BGP
G07	BAP Grassland - plants	BGP	BGP
G08	BAP Grassland - plants	BGP	BGP
G09	BAP Grassland - plants	BGP	BGP
G10	BAP Grassland - plants	BGP	BGP
G11	Grassland - other	GO	O
G12	Grassland - other	GO	O
G13	Grassland - other	GO	O
G14	Grassland - other	GO	O
G15	Grassland - other	GO	O
L01	Other	O	O
M03	Heathland/moorland	B	O
M04	Heathland/moorland	HM	O
M06	Heathland/moorland	B	O
M07	Heathland/moorland	HM	O
M08	Heathland/moorland	B	O
T01	Trees, wood pasture, parkland, woodland and orchards	T	O
T02	Trees, wood pasture, parkland, woodland and orchards	T	O
T03	Trees, wood pasture, parkland, woodland and orchards	T	O
T04	Trees, wood pasture, parkland, woodland and orchards	T	O
T05	Trees, wood pasture, parkland, woodland and orchards	T	O
T06	Trees, wood pasture, parkland, woodland and orchards	T	O
T07	Trees, wood pasture, parkland, woodland and orchards	T	O
T08	Trees, wood pasture, parkland, woodland and orchards	T	O
T15	Trees, wood pasture, parkland, woodland and orchards	T	O
V05	Other	O	O
W04	Wetland	W	O
W05	Wetland	W	O
W07	Wetland	W	O
W08	Wetland	W	O

Table E1. FEP habitat feature groupings used for analyses of change in condition assessments.

E1.1 Output from multi-model selection process

Models with delta BIC < 5

Global model call: glmer(formula = mgt_met ~ cond_base + fep_group2 + ah_type + consult + sssi + alt_cs + area_cs + perc_succ + c_paf + agri_class + (1 | agree), data = cond_ass2, family = binomial, na.action = "na.fail")

Model selection table

	(Int)	ah_typ	cnd_bas	fep_gr2	df	logLik	BIC	delta	weight
65	0.5003		+	+	6	-259.778	556.2	0	0.601
1	0.05554		+		4	-266.975	558.4	2.17	0.203
67	0.5625	+	+	+	7	-258.218	559.2	2.99	0.134
3	0.1586	+	+		5	-265.12	560.8	4.57	0.061

Models ranked by BIC(x)
Random terms (all models): '1 | agree'

E1.2 GLMM Summary (Adjusted) - 1st best fitting model: estimates are log odds ratios

Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) [glmerMod]
Family: binomial (logit)
Formula: mgt_met ~ fep_group2 + cond_base + (1 | agree)
Data: cond_ass

AIC	BIC	logLik	deviance	df.resid
788.4	815.5	-388.2	776.4	665

Scaled residuals:

Min	1Q	Median	3Q	Max
-2.7475	-0.927	0.4239	0.6619	1.6232

Random effects:

Groups	Name	Variance	Std.Dev.
agree	(Intercept)	0.227	0.4764

Number of obs: 671, groups: agree, 153

Fixed effects:	Estimate	Std. error	z value	Pr(>|z|)	
(Intercept)	0.4484	0.2311	1.94	0.0524	.
fep_group2BGP	-1.1286	0.264	-4.276	1.91E-05	***
fep_group2Other	-0.1036	0.2338	-0.443	0.6575	
cond_baseA	0.4864	0.227	2.143	0.0321	*
cond_baseB	1.3321	0.2211	6.026	1.68E-09	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Correlation of Fixed Effects:

	(Intr)	f_2BGP	fp_g2O	cnd_bA
fep_grp2BGP	-0.642			
fp_grp2Othr	-0.666	0.604		
cond_baseA	-0.448	0.067	-0.036	
cond_baseB	-0.427	-0.02	-0.025	0.459

95% CI (profile likelihood):

	2.50%	97.50%
sd_(Intercept)|agree	0	0.832098
(Intercept)	0.0014667	0.916027
fep_group2BGP	-1.6607492	-0.61847
fep_group2Other	-0.5695885	0.352788
cond_baseA	0.0399389	0.933764
cond_baseB	0.9047818	1.775528

Fitted values:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0.2607	0.5752	0.6876	0.6715	0.8268	0.8933

E1.3 GLMM Summary (Adjusted) - 2nd best fitting model: estimates are log odds ratios

Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) [glmerMod]
Family: binomial (logit)
Formula: mgt_met ~ cond_base + (1 | agree)
Data: cond_ass

AIC	BIC	logLik	deviance	df.resid
810.1	828.1	-401.1	802.1	667

Scaled residuals:

Min	1Q	Median	3Q	Max
-2.6127	-0.9555	0.4569	0.6533	1.3299

Random effects:

Groups	Name	Variance	Std.Dev.
agree	(Intercept)	0.3389	0.5822

Number of obs: 671, groups: agree, 153

Fixed effects:	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	0.03518	0.15976	0.22	0.8257	
cond_baseA	0.62312	0.22534	2.765	0.00569	**
cond_baseB	1.41412	0.22154	6.383	1.74E-10	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Correlation of Fixed Effects:

	(Intr)	cnd_bA
cond_baseA	-0.632	
cond_baseB	-0.643	0.466

95% CI (profile likelihood):

	2.50%	97.50%
sd_(Intercept)|agree	0.1806806	0.921829
(Intercept)	-0.2782971	0.353867
cond_baseA	0.1821255	1.069643
cond_baseB	0.9869072	1.860466

Fitted values:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0.3612	0.5536	0.7008	0.6728	0.8	0.8896

E1.4 GLMM Summary (Adjusted) - 3rd best fitting model: estimates are log odds ratios

Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) [glmerMod]
Family: binomial (logit)
Formula: mgt_met ~ ah_type + fep_group2 + cond_base + (1 | agree)
Data: cond_ass

AIC	BIC	logLik	deviance	df.resid
666.5	696.8	-326.3	652.5	547

Scaled residuals:

Min	1Q	Median	3Q	Max
-2.6053	-0.9679	0.434	0.6933	1.5739

Random effects:

Groups	Name	Variance	Std.Dev.
agree	(Intercept)	0.1659	0.4073

Number of obs: 554, groups: agree, 121

Fixed effects:	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	0.38099	0.24803	1.536	0.124522	
ah_type2	-0.26512	0.26001	-1.02	0.307881	
fep_group2BGP	-1.01017	0.27928	-3.617	0.000298	***
fep_group2Other	-0.01644	0.25066	-0.066	0.947719	
cond_baseA	0.49929	0.24427	2.044	0.040954	*
cond_baseB	1.27862	0.23607	5.416	6.09E-08	***

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Correlation of Fixed Effects:

	(Intr)	ah_ty2	f_2BGP	fp_g2O	cnd_bA
ah_type2	-0.17				
fep_grp2BGP	-0.619	-0.054			
fp_grp2Othr	-0.643	-0.046	0.605		
cond_baseA	-0.435	-0.057	0.056	-0.026	
cond_baseB	-0.419	-0.007	-0.023	-0.044	0.458

95% CI (profile likelihood):

	2.50%	97.50%
sd_(Intercept)|agree	0	0.796324
(Intercept)	-0.0991064	0.883547
ah_type2	-0.787331	0.253299
fep_group2BGP	-1.5718877	-0.4687
fep_group2Other	-0.5148881	0.473983
cond_baseA	0.0184582	0.980281
cond_baseB	0.8210153	1.750438

Fitted values:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0.2489	0.5632	0.67	0.6563	0.8145	0.8802

E1.5 GLMM Summary (Adjusted) - 4th best fitting model: estimates are log odds ratios

Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) [glmerMod]
Family: binomial (logit)
Formula: mgt_met ~ ah_type + cond_base + (1 | agree)
Data: cond_ass

AIC	BIC	logLik	deviance	df.resid
682.7	704.3	-336.4	672.7	549

Scaled residuals:

Min	1Q	Median	3Q	Max
-2.4723	-0.9754	0.4822	0.6868	1.2567

Random effects:

Groups	Name	Variance	Std.Dev.
agree	(Intercept)	0.2681	0.5178

Number of obs: 554, groups: agree, 121

Fixed effects:	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	0.05676	0.17899	0.317	0.7512	
ah_type2	-0.32309	0.27014	-1.196	0.2317	
cond_baseA	0.60874	0.24306	2.504	0.0123	*
cond_baseB	1.35168	0.236	5.727	1.02E-08	***

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Correlation of Fixed Effects:

	(Intr)	ah_ty2	cnd_bA
ah_type2	-0.304		
cond_baseA	-0.584	-0.059	
cond_baseB	-0.619	-0.005	0.463

95% CI (profile likelihood):

	2.50%	97.50%
sd_(Intercept)|agree	0	0.88478
(Intercept)	-0.2937331	0.416095
ah_type2	-0.865891	0.214713
cond_baseA	0.1330658	1.090161
cond_baseB	0.8953421	1.825065

Fitted values:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0.3301	0.5342	0.6733	0.6575	0.7906	0.8751

E2 Indicators of success at HLS resurvey

E2.1 Output from multi-model selection process

Models with delta BIC < 5

Global model call: glmer(formula = response ~ c_paf + sssi + ah_type + alt_cs + area_cs + consult + hls_group2 + env_zone + (1 | agree),
data = alldata3, family = "binomial", na.action = "na.fail")

Model selection table

	(Int)	ah_typ	c_paf	sssi	df	logLik	BIC	delta	weight
1	0.5825				2	-1140.76	2295	0	0.487
9	1.211		+		4	-1134.24	2295.4	0.41	0.397
129	0.3731			+	3	-1139.26	2298.7	3.73	0.075
2	0.5189	+			3	-1139.89	2300	5	0.04

Models ranked by BIC(x)
Random terms (all models): '1 | agree'

E2.2 GLMM Summary (Adjusted) - 1st best fitting model: estimates are log odds ratios

Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']
Family: binomial (logit)
Formula: response ~ (1 | agree)
Data: alldata

AIC	BIC	logLik	deviance	df.resid
3199.7	3209.8	-1597.8	3195.7	1171

Scaled residuals:

Min	1Q	Median	3Q	Max
-4.3078	-0.8727	0.0744	0.7566	2.7725

Random effects:

Groups	Name	Variance	Std.Dev.
agree	(Intercept)	0.7404	0.8604

Number of obs: 1173, groups: agree, 170

Fixed effects:

Estimate	Std. error	z	value	Pr(>|z|)	
(Intercept)	0.52718	0.07637	6.903	5.10E-12	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

95% CI (profile likelihood):

	2.50%	97.50%
sd_(Intercept)|agree	0.7407386	1.002244
(Intercept)	0.3772154	0.67907

Fitted values:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0.1993	0.4914	0.6171	0.6118	0.7494	0.9027

E2.3 GLMM Summary (Adjusted) - 2nd best fitting model: estimates are log odds ratios

Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']
Family: binomial (logit)
Formula: response ~ c_paf + (1 | agree)
Data: alldata

AIC	BIC	logLik	deviance	df.resid
3108.5	3128.6	-1550.2	3100.5	1133

Scaled residuals:

Min	1Q	Median	3Q	Max
-4.3233	-0.8652	0.0697	0.7415	2.6903

Random effects:

Groups	Name	Variance	Std.Dev.
agree	(Intercept)	0.6734	0.8206

Number of obs: 1137, groups: agree, 165

Fixed effects:

	Estimate	Std. error	z value	Pr(>|z|)	
(Intercept)	0.80288	0.21594	3.718	0.000201	***
c_paf1+2	-0.52774	0.24233	-2.178	0.029425	*
c_paf3	-0.08275	0.24475	-0.338	0.735286	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Correlation of Fixed Effects:

	(Intr)	c_p1+2
c_paf1+2	-0.891	
c_paf3	-0.882	0.786

95% CI (profile likelihood):

	2.50%	97.50%
sd_(Intercept)|agree	0.7020496	0.961132
(Intercept)	0.3780814	1.232003
c_paf1+2	-1.008601	-0.05046
c_paf3	-0.567575	0.400312

Fitted values:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0.1941	0.4966	0.6236	0.6121	0.7387	0.9033

E2.4 GLMM Summary (Adjusted) - 3rd best fitting model: estimates are log odds ratios

Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']
Family: binomial (logit)
Formula: response ~ sssi + (1 | agree)
Data: alldata

AIC	BIC	logLik	deviance	df.resid
3192.5	3207.7	-1593.3	3186.5	1169

Scaled residuals:

Min	1Q	Median	3Q	Max
-4.3339	-0.8614	0.0759	0.7626	2.8092

Random effects:

Groups	Name	Variance	Std.Dev.
agree	(Intercept)	0.7137	0.8448

Number of obs: 1172, groups: agree, 169

Fixed effects:

	Estimate	Std. error	z value	Pr(>|z|)	
(Intercept)	0.3275	0.1205	2.717	0.00658	**
sssiYES	0.3296	0.1545	2.133	0.03292	*

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Correlation of Fixed Effects:

	(Intr)
sssiYES	-0.779

95% CI (profile likelihood):

	2.50%	97.50%
sd_(Intercept)|agree	0.7252026	0.986417
(Intercept)	0.0905548	0.566819
sssiYES	0.0241878	0.634412

Fitted values:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max
0.1909	0.4976	0.6212	0.6112	0.7448	0.9038

E2.5 GLMM Summary (Adjusted) - 4th best fitting model: estimates are log odds ratios

Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']
Family: binomial (logit)
Formula: response ~ ah_type + (1 | agree)
Data: alldata

AIC	BIC	logLik	deviance	df.resid
2490.3	2504.8	-1242.2	2484.3	921

Scaled residuals:

Min	1Q	Median	3Q	Max
-4.2979	-0.8883	0.117	0.7428	2.7472

Random effects:

Groups	Name	Variance	Std.Dev.
agree	(Intercept)	0.7102	0.8428

Number of obs: 924, groups: agree, 134

Fixed effects:

	Estimate	Std. error	z value	Pr(>|z|)	
(Intercept)	0.57041	0.09574	5.958	2.55E-09	***
ah_type2	0.15093	0.20576	0.734	0.463	

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Correlation of Fixed Effects:

	(Intr)
ah_type2	-0.464

95% CI (profile likelihood):

	2.50%	97.50%
sd_(Intercept)|agree	0.71057	1.003133
(Intercept)	0.382172	0.76137
ah_type2	-0.255133	0.559858

Fitted values:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0.2071	0.5075	0.6421	0.625	0.7623	0.9023

E3 Species richness at HLS baseline survey and resurvey, quadrat data only

E3.1 Broad habitat × survey (baseline vs. resurvey) GLMM summary

Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']
Family: poisson (log)
Formula: species_richness ~ survey * broad_habitat + (1 | agree)
Data: quad2

AIC	BIC	logLik	deviance	df.resid
29795	29932.5	-14876.5	29753	5133

Scaled residuals:

Min	1Q	Median	3Q	Max
-3.6758	-0.8486	-0.1374	0.647	9.4547

Random effects:

Groups	Name	Variance	Std.Dev.
agree	(Intercept)	0.08829	0.2971

Number of obs: 5154, groups: agree, 111

Fixed effects:	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	2.235	0.030	75.080	< 2e-16	***
surveyresurvey	0.228	0.013	18.070	< 2e-16	***
broad_habitatbroad_wood	0.228	0.036	6.390	1.64E-10	***
broad_habitatds_heath	-0.339	0.056	-6.020	1.69E-09	***
broad_habitatfen_ms	-0.177	0.034	-5.250	1.50E-07	***
broad_habitatbog	-0.436	0.083	-5.280	1.27E-07	***
broad_habitatarable	0.171	0.129	1.320	0.1854	
broad_habitatimp_grass	0.004	0.042	0.090	0.9319	
broad_habitatcalc_grass	0.297	0.036	8.200	2.38E-16	***
broad_habitatacid_grass	-0.078	0.029	-2.720	0.0065	**
broad_habitatnot done	0.022	0.083	0.270	0.7879	
surveyresurvey:broad_habitatbroad_wood	0.053	0.041	1.310	0.1901	
surveyresurvey:broad_habitatds_heath	0.363	0.060	6.010	1.85E-09	***
surveyresurvey:broad_habitatfen_ms	0.237	0.041	5.760	8.64E-09	***
surveyresurvey:broad_habitatbog	0.059	0.128	0.460	0.6452	
surveyresurvey:broad_habitatarable	-0.491	0.134	-3.660	0.0002	***
surveyresurvey:broad_habitatimp_grass	-0.043	0.045	-0.960	0.3376	
surveyresurvey:broad_habitatcalc_grass	-0.185	0.042	-4.380	1.20E-05	***
surveyresurvey:broad_habitatacid_grass	0.013	0.034	0.400	0.6918	
surveyresurvey:broad_habitatnot done	-0.050	0.084	-0.600	0.5495	

convergence code: 0
Model failed to converge with max|grad| = 0.00168713 (tol = 0.001, component 1)

Fitted values:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
3.976	8.152	10.36	10.73	12.7	32.7

Response values in dataset :

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0	7	10	10.73	14	53

95% CI (Wald)

	2.50%	97.50%
sd_(Intercept)|agree	NA	NA
(Intercept)	2.176	2.293
surveyresurvey	0.203	0.253
broad_habitatbroad_wood	0.158	0.298
broad_habitatds_heath	-0.449	-0.229
broad_habitatfen_ms	-0.243	-0.111
broad_habitatbog	-0.598	-0.274
broad_habitatarable	-0.082	0.425
broad_habitatimp_grass	-0.078	0.085
broad_habitatcalc_grass	0.226	0.368
broad_habitatacid_grass	-0.135	-0.022
broad_habitatnot done	-0.140	0.184
surveyresurvey:broad_habitatbroad_wood	-0.026	0.133
surveyresurvey:broad_habitatds_heath	0.245	0.481
surveyresurvey:broad_habitatfen_ms	0.157	0.318
surveyresurvey:broad_habitatbog	-0.192	0.310
surveyresurvey:broad_habitatarable	-0.754	-0.228
surveyresurvey:broad_habitatimp_grass	-0.132	0.045
surveyresurvey:broad_habitatcalc_grass	-0.268	-0.102
surveyresurvey:broad_habitatacid_grass	-0.053	0.080
surveyresurvey:broad_habitatnot done	-0.215	0.115

E3.2 GLMM Summary (Adjusted) - Best fitting model from multi-model comparison: estimates are log odds ratios

Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']
Family: poisson (log)
Formula: species_richness ~ alt_cs + broad_habitat + hls_class + survey + (1 | agree)
Data: quad2

AIC	BIC	logLik	deviance	df.resid
29855.8	29960.6	-14911.9	29823.8	5138

Scaled residuals:

Min	1Q	Median	3Q	Max
-3.6421	-0.8545	-0.1451	0.6562	9.4619

Random effects:

Groups	Name	Variance	Std.Dev.
agree	(Intercept)	0.0761	0.2759

Number of obs: 5154, groups: agree, 111

Fixed effects:

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	2.221	0.029	76.730	< 2e-16	***
alt_cs	0.092	0.025	3.630	0.0003	***
broad_habitatbroad_wood	0.261	0.021	12.340	< 2e-16	***
broad_habitatds_heath	-0.096	0.038	-2.540	0.0112	*
broad_habitatfen_ms	-0.044	0.024	-1.840	0.0663	.
broad_habitatbog	-0.420	0.065	-6.460	1.04E-10	***
broad_habitatarable	-0.212	0.043	-4.920	8.67E-07	***
broad_habitatimp_grass	-0.033	0.021	-1.580	0.1136	
broad_habitatcalc_grass	0.147	0.025	5.990	2.04E-09	***
broad_habitatacid_grass	-0.073	0.020	-3.600	0.0003	***
broad_habitatnot done	-0.020	0.019	-1.080	0.2818	
hls_classA	-0.128	0.033	-3.900	9.79E-05	***
hls_classC	-0.113	0.030	-3.720	0.0002	***
hls_classR	0.015	0.014	1.080	0.2801	
surveyresurvey	0.244	0.010	25.180	< 2e-16	***

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

95% CI (profile likelihood):	2.50%	97.50%
sd_(Intercept)|agree	0.241	0.319
(Intercept)	2.164	2.278
alt_cs	0.042	0.141
broad_habitatbroad_wood	0.219	0.302
broad_habitatds_heath	-0.171	-0.022
broad_habitatfen_ms	-0.090	0.003
broad_habitatbog	-0.549	-0.294
broad_habitatarable	-0.297	-0.128
broad_habitatimp_grass	-0.075	0.008
broad_habitatcalc_grass	0.099	0.195
broad_habitatacid_grass	-0.113	-0.033
broad_habitatnot done	-0.057	0.017
hls_classA	-0.192	-0.064
hls_classC	-0.173	-0.054
hls_classR	-0.012	0.041
surveyresurvey	0.225	0.263

Fitted values:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
4.16	8.192	10.31	10.73	12.63	31.63

E4 Ellenberg fertility at HLS baseline survey and resurvey, quadrat data only

E4.1 Broad habitat × survey (baseline vs. resurvey) GLMM summary

Linear mixed model fit by REML ['lmerMod']
Formula: fert_wt ~ survey * broad_habitat + (1 | agree)
Data: quad2

REML criterion at convergence: 12946.8

Scaled residuals:

Min	1Q	Median	3Q	Max
-3.8118	-0.5982	0.0204	0.6201	3.7631

Random effects:

Groups	Name	Variance	Std.Dev.
agree	(Intercept)	0.7363	0.8581
Residual		0.6648	0.8153

Number of obs: 5146, groups: agree, 111

Fixed effects:	Estimate	Std. Error	t value
(Intercept)	4.888	0.085	57.40
surveyresurvey	-0.090	0.035	-2.60
broad_habitatbroad_wood	0.425	0.098	4.33
broad_habitatds_heath	-1.413	0.134	-10.57
broad_habitatfen_ms	-0.032	0.078	-0.42
broad_habitatbog	-2.658	0.192	-13.87
broad_habitatarable	0.849	0.286	2.97
broad_habitatimp_grass	0.307	0.104	2.95
broad_habitatcalc_grass	-1.120	0.112	-10.01
broad_habitatacid_grass	-0.983	0.074	-13.27
broad_habitatnot done	-0.741	0.193	-3.84
surveyresurvey:broad_habitatbroad_wood	-0.198	0.117	-1.69
surveyresurvey:broad_habitatds_heath	0.083	0.157	0.53
surveyresurvey:broad_habitatfen_ms	-0.373	0.102	-3.66
surveyresurvey:broad_habitatbog	0.849	0.292	2.90
surveyresurvey:broad_habitatarable	-0.089	0.296	-0.30
surveyresurvey:broad_habitatimp_grass	-0.137	0.116	-1.18
surveyresurvey:broad_habitatcalc_grass	0.314	0.131	2.40
surveyresurvey:broad_habitatacid_grass	0.316	0.090	3.53
surveyresurvey:broad_habitatnot done	1.012	0.198	5.10

95% CI (profile likelihood):	2.50%	97.50%
sd_(Intercept)|agree	0.746	0.987
sigma	0.798	0.830
(Intercept)	4.720	5.055
surveyresurvey	-0.158	-0.022
broad_habitatbroad_wood	0.233	0.617
broad_habitatds_heath	-1.676	-1.152
broad_habitatfen_ms	-0.185	0.120
broad_habitatbog	-3.033	-2.283
broad_habitatarable	0.290	1.407
broad_habitatimp_grass	0.103	0.511
broad_habitatcalc_grass	-1.339	-0.901
broad_habitatacid_grass	-1.128	-0.838
broad_habitatnot done	-1.118	-0.363
surveyresurvey:broad_habitatbroad_wood	-0.426	0.031
surveyresurvey:broad_habitatds_heath	-0.224	0.391
surveyresurvey:broad_habitatfen_ms	-0.572	-0.173
surveyresurvey:broad_habitatbog	0.276	1.421
surveyresurvey:broad_habitatarable	-0.669	0.491
surveyresurvey:broad_habitatimp_grass	-0.363	0.090

surveyresurvey:broad_habitatcalc_grass	0.058	0.570
surveyresurvey:broad_habitatacid_grass	0.141	0.491
surveyresurvey:broad_habitatnot done	0.623	1.400

Fitted values:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
0.9321	4.31	4.859	4.776	5.543	7.454

Response values in dataset :

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
1	4	4.9	4.776	5.7	8

E4.2 LMM Summary (Adjusted) - Best fitting model from multi-model comparison: estimates are per unit increase

Linear mixed model fit by REML ['lmerMod']
Formula: fert_wt ~ area_cs + broad_habitat + concern + hls_class + (1 | agree)
Data: quad2

REML criterion at convergence: 12731.9

Scaled residuals:

Min	1Q	Median	3Q	Max
-3.8877	-0.5907	0.0144	0.6062	3.8027

Random effects:

Groups	Name	Variance	Std.Dev.
agree	(Intercept)	0.583	0.7635
Residual		0.6402	0.8001

Number of obs: 5146, groups: agree, 111

Fixed effects:	Estimate	Std. Error	t value
(Intercept)	4.825	0.149	32.39
area_cs	-0.083	0.088	-0.95
broad_habitatbroad_wood	0.224	0.060	3.76
broad_habitatds_heath	-1.462	0.101	-14.44
broad_habitatfen_ms	-0.232	0.058	-3.97
broad_habitatbog	-2.430	0.148	-16.41
broad_habitatarable	-0.020	0.098	-0.21
broad_habitatimp_grass	0.133	0.052	2.55
broad_habitatcalc_grass	-0.842	0.075	-11.17
broad_habitatacid_grass	-0.873	0.052	-16.75
broad_habitatnot done	-0.079	0.046	-1.7
concern1	0.250	0.201	1.24
concern3	0.189	0.203	0.93
concern4	-0.262	0.239	-1.1
hls_classA	1.186	0.081	14.71
hls_classC	0.389	0.073	5.32
hls_classR	-0.208	0.036	-5.75
95% CI (profile likelihood):	2.50%	97.50%	
sd_(Intercept)|agree	0.648	0.861	
sigma	0.784	0.815	
(Intercept)	4.538	5.113	
area_cs	-0.252	0.086	
broad_habitatbroad_wood	0.107	0.340	
broad_habitatds_heath	-1.663	-1.266	
broad_habitatfen_ms	-0.347	-0.118	
broad_habitatbog	-2.722	-2.142	
broad_habitatarable	-0.212	0.170	
broad_habitatimp_grass	0.031	0.235	
broad_habitatcalc_grass	-0.991	-0.695	
broad_habitatacid_grass	-0.976	-0.772	
broad_habitatnot done	-0.170	0.012	
concern1	-0.139	0.638	
concern3	-0.202	0.579	
concern4	-0.724	0.199	
hls_classA	1.029	1.344	
hls_classC	0.247	0.534	
hls_classR	-0.280	-0.138	

Fitted values:	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
	0.4468	4.294	4.806	4.776	5.504	7.781

E5 Ellenberg reaction at HLS baseline survey and resurvey, quadrat data only

E5.1 Broad habitat × survey (baseline vs. resurvey) GLMM summary

Linear mixed model fit by REML ['lmerMod']
Formula: ph_wt ~ survey * broad_habitat + (1 | agree)
Data: quad2

REML criterion at convergence: 11006.4

Scaled residuals:

Min	1Q	Median	3Q	Max
-4.7718	-0.4983	0.0455	0.6051	4.6416

Random effects:

Groups	Name	Variance	Std.Dev.
agree	(Intercept)	0.6418	0.8011
Residual		0.453	0.673

Number of obs: 5146, groups: agree, 111

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	5.619	0.079	71.31
surveyresurvey	0.014	0.029	0.5
broad_habitatbroad_wood	0.153	0.081	1.88
broad_habitatds_heath	-1.548	0.111	-14
broad_habitatfen_ms	-0.026	0.064	-0.4
broad_habitatbog	-2.506	0.158	-15.83
broad_habitatarable	0.566	0.236	2.4
broad_habitatimp_grass	0.163	0.086	1.89
broad_habitatcalc_grass	0.055	0.093	0.59
broad_habitatacid_grass	-0.795	0.061	-12.98
broad_habitatnot done	-0.366	0.159	-2.3
surveyresurvey:broad_habitatbroad_wood	-0.172	0.097	-1.78
surveyresurvey:broad_habitatds_heath	-0.134	0.130	-1.03
surveyresurvey:broad_habitatfen_ms	-0.319	0.084	-3.79
surveyresurvey:broad_habitatbog	0.817	0.241	3.38
surveyresurvey:broad_habitatarable	-0.126	0.245	-0.51
surveyresurvey:broad_habitatimp_grass	-0.126	0.095	-1.32
surveyresurvey:broad_habitatcalc_grass	0.104	0.108	0.96
surveyresurvey:broad_habitatacid_grass	0.251	0.074	3.4
surveyresurvey:broad_habitatnot done	0.493	0.164	3.01

95% CI (profile likelihood):	2.50%	97.50%

sd_(Intercept)|agree	0.698	0.920
sigma	0.659	0.685
(Intercept)	5.464	5.774
surveyresurvey	-0.042	0.071
broad_habitatbroad_wood	-0.006	0.312
broad_habitatds_heath	-1.765	-1.332
broad_habitatfen_ms	-0.152	0.100
broad_habitatbog	-2.816	-2.196
broad_habitatarable	0.104	1.027
broad_habitatimp_grass	-0.006	0.331
broad_habitatcalc_grass	-0.126	0.236
broad_habitatacid_grass	-0.915	-0.675
broad_habitatnot done	-0.678	-0.054
surveyresurvey:broad_habitatbroad_wood	-0.361	0.017
surveyresurvey:broad_habitatds_heath	-0.387	0.120
surveyresurvey:broad_habitatfen_ms	-0.483	-0.154
surveyresurvey:broad_habitatbog	0.344	1.289
surveyresurvey:broad_habitatarable	-0.604	0.354
surveyresurvey:broad_habitatimp_grass	-0.313	0.061
surveyresurvey:broad_habitatcalc_grass	-0.108	0.315
surveyresurvey:broad_habitatacid_grass	0.107	0.396
surveyresurvey:broad_habitatnot done	0.173	0.814

E5.2 LMM Summary (Adjusted) - Best fitting model from multi-model comparison: estimates are per unit increase

Linear mixed model fit by REML ['lmerMod']
Formula: ph_wt ~ ah_type + area_cs + broad_habitat + hls_class + (1 | agree)
Data: quad2

REML criterion at convergence: 10911.3

Scaled residuals:

Min	1Q	Median	3Q	Max
-4.7078	-0.4999	0.0419	0.6185	4.8410

Random effects:	Groups	Name	Variance	Std.Dev.
	agree	(Intercept)	0.5419	0.7361
	Residual		0.4464	0.6682

Number of obs: 5146, groups: agree, 111

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	5.557	0.084	66.02
ah_type2	0.277	0.169	1.64
area_cs	-0.034	0.083	-0.41
broad_habitatbroad_wood	0.026	0.050	0.53
broad_habitatds_heath	-1.662	0.085	-19.57
broad_habitatfen_ms	-0.172	0.049	-3.53
broad_habitatbog	-2.224	0.124	-17.97
broad_habitatarable	0.030	0.082	0.37
broad_habitatimp_grass	0.058	0.044	1.33
broad_habitatcalc_grass	0.209	0.063	3.3
broad_habitatacid_grass	-0.664	0.044	-15.22
broad_habitatnot done	-0.022	0.039	-0.56
hls_classA	0.709	0.067	10.51
hls_classC	0.400	0.061	6.51
hls_classR	-0.082	0.030	-2.7

95% CI (profile likelihood):

	2.50%	97.50%
sd_(Intercept)|agree	0.633	0.838
sigma	0.655	0.681
(Intercept)	5.393	5.721
ah_type2	-0.052	0.606
area_cs	-0.196	0.128
broad_habitatbroad_wood	-0.072	0.123
broad_habitatds_heath	-1.829	-1.496
broad_habitatfen_ms	-0.269	-0.077
broad_habitatbog	-2.467	-1.982
broad_habitatarable	-0.130	0.189
broad_habitatimp_grass	-0.027	0.143
broad_habitatcalc_grass	0.085	0.333
broad_habitatacid_grass	-0.750	-0.579
broad_habitatnot done	-0.098	0.054
hls_classA	0.578	0.842
hls_classC	0.280	0.521
hls_classR	-0.141	-0.023

Fitted values:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
1.233	5.119	5.723	5.564	6.248	7.389

E6 Ellenberg moisture at HLS baseline survey and resurvey, quadrat data only

E6.1 Broad habitat × survey (baseline vs. resurvey) GLMM summary

Linear mixed model fit by REML ['lmerMod']
Formula: wet_wt ~ survey * broad_habitat + (1 | agree)
Data: quad2

REML criterion at convergence: 10328.3

Scaled residuals:

Min	1Q	Median	3Q	Max
-4.4049	-0.5523	-0.0928	0.459	6.5935

Random effects:

Groups	Name	Variance	Std.Dev.
agree	(Intercept)	0.282	0.5311
Residual		0.4026	0.6345

Number of obs: 5146, groups: agree, 111

Fixed effects:	Estimate	Std. Error	t value
(Intercept)	5.704	0.054	105.84
surveyresurvey	0.031	0.027	1.14
broad_habitatbroad_wood	0.123	0.076	1.61
broad_habitatds_heath	0.682	0.104	6.59
broad_habitatfen_ms	1.476	0.060	24.41
broad_habitatbog	1.459	0.149	9.79
broad_habitatarable	-0.065	0.222	-0.29
broad_habitatimp_grass	0.133	0.081	1.65
broad_habitatcalc_grass	-0.309	0.087	-3.56
broad_habitatacid_grass	0.244	0.058	4.24
broad_habitatnot done	-0.015	0.150	-0.1
surveyresurvey:broad_habitatbroad_wood	0.230	0.091	2.53
surveyresurvey:broad_habitatds_heath	-0.163	0.122	-1.34
surveyresurvey:broad_habitatfen_ms	-0.518	0.079	-6.55
surveyresurvey:broad_habitatbog	-0.237	0.228	-1.04
surveyresurvey:broad_habitatarable	-0.302	0.230	-1.31
surveyresurvey:broad_habitatimp_grass	-0.159	0.090	-1.77
surveyresurvey:broad_habitatcalc_grass	-0.152	0.102	-1.5
surveyresurvey:broad_habitatacid_grass	-0.210	0.070	-3.01
surveyresurvey:broad_habitatnot done	0.110	0.154	0.72

	2.50%	97.50%

95% CI (profile likelihood):		
sd_(Intercept)|agree	0.461	0.611
sigma	0.621	0.646
(Intercept)	5.598	5.810
surveyresurvey	-0.022	0.084
broad_habitatbroad_wood	-0.026	0.272
broad_habitatds_heath	0.479	0.885
broad_habitatfen_ms	1.357	1.595
broad_habitatbog	1.168	1.751
broad_habitatarable	-0.499	0.369
broad_habitatimp_grass	-0.025	0.292
broad_habitatcalc_grass	-0.478	-0.139
broad_habitatacid_grass	0.131	0.356
broad_habitatnot done	-0.309	0.279
surveyresurvey:broad_habitatbroad_wood	0.052	0.408
surveyresurvey:broad_habitatds_heath	-0.402	0.076
surveyresurvey:broad_habitatfen_ms	-0.673	-0.363
surveyresurvey:broad_habitatbog	-0.682	0.209
surveyresurvey:broad_habitatarable	-0.753	0.148
surveyresurvey:broad_habitatimp_grass	-0.335	0.016
surveyresurvey:broad_habitatcalc_grass	-0.351	0.047
surveyresurvey:broad_habitatacid_grass	-0.346	-0.073
surveyresurvey:broad_habitatnot done	-0.192	0.412

Fitted values:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
4.283	5.286	5.68	5.799	6.178	8.785

Response values in dataset :

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
3.1	5.2	5.5	5.799	6.2	10

E6.2 LMM Summary (Adjusted) - Best fitting model from multi-model comparison: estimates are per unit increase

Linear mixed model fit by REML
['lmerMod']
Formula: wet_wt ~ agri_class + area_cs + broad_habitat + env_zone + hls_class + (1 | agree)
Data: quad2

REML criterion at convergence: 10256.3

Scaled residuals:

Min	1Q	Median	3Q	Max
-4.0067	-0.5634	-0.0875	0.4624	6.5276

Random effects:

Groups	Name	Variance	Std.Dev.
agree	(Intercept)	0.1961	0.4429
Residual		0.3996	0.6322

Number of obs: 5146, groups: agree, 111

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	5.448	0.085	63.76
agri_class4	0.297	0.122	2.44
agri_class5	0.379	0.147	2.57
agri_classNON	0.000	0.177	0
area_cs	-0.084	0.053	-1.58
broad_habitatbroad_wood	0.273	0.047	5.83
broad_habitatds_heath	0.592	0.079	7.46
broad_habitatfen_ms	1.194	0.046	26.05
broad_habitatbog	1.375	0.117	11.76
broad_habitatarable	0.018	0.077	0.24
broad_habitatimp_grass	0.026	0.041	0.64
broad_habitatcalc_grass	-0.462	0.059	-7.81
broad_habitatacid_grass	0.116	0.041	2.83
broad_habitatnot done	0.217	0.036	5.96
env_zone2	0.352	0.116	3.03
env_zone3	-0.039	0.153	-0.26
hls_classA	-0.616	0.063	-9.74
hls_classC	-0.344	0.057	-6.01
hls_classR	-0.004	0.028	-0.14

95% CI (profile likelihood):

	2.50%	97.50%
sd_(Intercept)|agree	0.3710412	0.494837
sigma	0.6193125	0.643983
(Intercept)	5.2849239	5.611312
agri_class4	0.0642058	0.530111
agri_class5	0.0979538	0.660677
agri_classNON	-0.337869	0.338281
area_cs	-0.186072	0.017395
broad_habitatbroad_wood	0.182519	0.366024
broad_habitatds_heath	0.438339	0.748893
broad_habitatfen_ms	1.1067703	1.287858
broad_habitatbog	1.1473626	1.605259
broad_habitatarable	-0.13149	0.169169
broad_habitatimp_grass	-0.053732	0.106915
broad_habitatcalc_grass	-0.578825	-0.34714
broad_habitatacid_grass	0.0368273	0.197736
broad_habitatnot done	0.1462222	0.288847
env_zone2	0.1301621	0.573663
env_zone3	-0.332524	0.252882
hls_classA	-0.739548	-0.49205
hls_classC	-0.455514	-0.23175
hls_classR	-0.059075	0.051361

Fitted values:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
4.069	5.323	5.682	5.799	6.197	8.515

Appendix F - Assembly and analysis of a counterfactual dataset for HLS resurvey: Analysis of temporal change across CS (2007) and NPMS (2015/16) plots

F1 Data selection

The main issues influencing selection of a counterfactual sample of vegetation quadrats are as follows:

- Equivalent temporal intervals between HLS surveys (baselines in 2009, '10, '11 and the repeats in 2015,'16) and the counterfactual surveys (CS in 2007 and NPMS in 2015, '16).
- Equivalent plot sizes.
- Sampling of equivalent habitats.
- Sampling equivalent regions and landscape contexts.
- Controlling for differences in taxonomic coverage.
- Controlling for management under higher level AES options.

Ensuring equivalence of plot sizes

The only plot size common to HLS, CS and NPMS is the 10x10m area used in woodlands. In HLS quadrat sizes of 1x1m and 4x4m are deployed according to habitat type. In NPMS most quadrats are 5x5m in size and equivalence can be achieved with CS X plot data by selecting only species recorded up to the 5x5m nest size. No linear plot sizes are common to any of the three surveys and so a meaningful counterfactual analysis is, at this stage, only possible for habitats that are not sampled solely by linear plots (Table 9.1).

Ensuring equivalence of habitat type

Ideally analysis of a counterfactual time series alongside analysis of the HLS data (from baseline and resurvey) need only be based on equivalence in habitat type among the baseline plots in both datasets. If necessary, any plots where vegetation change shifted sufficiently to register a change in habitat type could be analysed separately from the stable cohort (see for example (Smart et al., 2003). While this can be done for the HLS plots with reference to the common polygon or field that defines a temporal set of repeats, the CS and NPMS plots were recorded in different places so there is no sense in which the vegetation of a CS plot in 2007 can be directly matched to an NPMS plot in 2015. Some degree of like-with-like comparison therefore needs to be applied to the CS and NPMS plots, to increase confidence that unbiased measures of condition were made between the different plots in 2007 and again in 2015 in similar habitats. Clearly though, the definition of the habitat used to group CS and NPMS plots cannot be too narrow otherwise this mitigates against detecting vegetation change. In the comparison of the HLS baseline *vs* CS plots (Mountford et al., 2013) the broad habitat was selected as a compromise, and was used in the current agreement scale analyses of change in quadrat data between baseline and the HLS resurvey (Section 8). These coarse units have also been used repeatedly in analyses of CS data (Norton et al., 2012; Smart et al., 2003) and so we adopt broad habitat again here. This means that the comparison is unable to detect any larger magnitude shifts between vegetation types, for example where calcareous or acid grassland has become dominated by bracken (e.g. (Stevens et al., 2016).

Ensuring equivalence at the broad habitat level may also serve to mask differences in vegetation type and species composition that may emerge in the analysis of differences between CS and NPMS. For instance, a broad range of vegetation referable to fen, marsh & swamp are sampled within CS while in NPMS particular attention is paid to flushes, which are typically associated with lateral movement of soil and groundwater. As a result, base cation availability and pH are often elevated which would be expected to favour species of slightly higher fertility and soil reaction despite them being essentially oligotrophic or mesotrophic features.

Ensuring equivalence of landscape context

The NPMS dataset is intentionally biased toward 1km squares with a greater probability of encountering larger areas of nationally rare LCM semi-natural habitat types. This is measured by a score calculated for each UK monad and these scores were used to randomly order NPMS squares for adoption by volunteers. CS squares with equivalent profiles of weights can therefore be selected so that quadrats grouped by broad habitat also have similar distributions of monad scores. This would mean reducing sample sizes to ensure equivalence. Inspection of broad habitat datasets from CS, NPMS and HLS, showed that distributions of monad scores were reasonably similar within each habitat and so no further filtering was carried out.

Ensuring equivalence of exposure to AES management

To qualify as counterfactual neither CS nor NPMS quadrats should have been subject to higher-level AES management. The ubiquity of the ELS scheme and difficulty of acquiring spatial data on scheme uptake with sufficient resolution to identify plots in and out of scheme led us to focus on excluding land in or formerly in higher level schemes only i.e. ESA, Countryside Stewardship and HLS. Using high resolution data on option uptake available from Defra for HLS and data made available to CEH for the Countryside Survey Integrated Assessment project (Smart et al., 2010), plots that had been in scheme for at least 5 years prior to recording were identified and coded as in-scheme. So that sample sizes were kept as large as possible these plots were retained but only included in tests of between survey (i.e. 2007 CS to 2015/16 NPMS) differences if there were no significant effects of scheme status (i.e. HLS management) including a test of interaction terms between scheme status and broad habitat.

Ensuring equivalence of species coverage

The NPMS allows volunteers to record plant species at three levels of recording effort; Inventory level requires all species to be recorded, Indicator level allows recording of species from a pre-determined list focussing on species indicative of habitat condition, Wildflower level provides a point of entry for the weakest botanists and requires recording of a smaller number of more easily identifiable flowering plants. Graphical exploration of the NPMS and CS data indicated that NPMS Indicator-level plots were consistently poorer in NPMS indicator species than CS and NPMS Inventory-level plots. Indicator-level plots were therefore excluded from the analysis. This was expected given that Indicator-level recording attracts volunteers less able to confidently census all species and hence, likely to record fewer indicators on average than those present in inventory-level plots where a full census is recorded. So as to

maintain consistency of recording across the CS and NPSM datasets, all response variables were calculated based on presence of NPMS indicator species only.

F2 Counterfactual analytical methods

Treatment of the data broadly followed the guidance in (Zuur et al., 2010). The distributions of response variables were graphically explored using box and whisker plots and violin plots. The lmer function for generalized linear mixed modelling (GLMM) in the R package 'lme4' (Bates et al., 2015) was used to initially assess over-dispersion in the indicator richness data and to generate initial parameter estimates for subsequent Bayesian modelling. The monads, within which CS and NPMS plots were nested, were also included as a random effect in both the GLM and Bayesian models. The outlierTest function in the mass package was used to identify outlying data points; however, none were detected. Because of substantial skewness, monad weight was natural log transformed to achieve the normality assumed in the Bayesian model. Initial modelling showed considerable overdispersion in the indicator richness data. This coupled with small and unbalanced sample sizes, suggested a Bayesian approach would offer the most robust basis for inference. It was also thought that the absence of indices of recorder effort for NPMS data but their existence for CS plots could be handled flexibly as missing data; this turned out not to be the case because the absence of recorder effort indices was completely confounded with survey type leading to an unidentifiable model. Model code (F6.2) was written in OpenBUGS ver 3.2.2 rev 1063 (Lunn et al., 2013).

Response variables were indicator richness, mean Ellenberg values for N (fertility), R (soil reaction) and F (wetness), and mean Grime C, S and R scores. No cover weightings were applied since CS species presence data extracted from the 5x5m nest of the $200m^2$ X plots do not have cover values.

Two models of the following form were fitted to each response variable. Model 1 was fitted first so that data for any response variables and broad habitats showing scheme effects could be excluded before fitting model 2:

Model 1
Response variable = intercept + (**beta1** × monad weight) + (**beta2**$_{1..n}$ × broad habitat$_{1..n}$) + (**beta3** × In/Out of scheme) + (**beta5** × In/Out of scheme * broad habitat)

Model 2
Response variable = intercept + (**beta1** × monad weight) + (**beta2**$_{1..n}$ × broad habitat$_{1..n}$) + (**beta4** × survey) + (**beta6** × survey × broad habitat$_{1...n}$),

where 1..n denotes a regression coefficient estimated for n-1 = 6 broad habitats. Broadleaf woodland was arbitrarily assigned as the reference level, such that significant survey*broad habitat interaction terms indicate a difference between survey within each broad habitat that was not the same as the difference between CS and NPMS plots in broadleaf woodland.

A 'significant' effect can be inferred when the 95% credible interval of the stable distribution of estimates for each regression coefficient (beta) does not include zero. In Bayesian analysis,

the parameters to be estimated are treated as random variables with distributions that are usually a function of combining a so-called uninformative prior distribution, representing an open-mind about the mean and variance of the parameter, and the data, which contribute information upon which inference to the wider population can be based. In order to derive a stable distribution of the estimated regression coefficients, each model was run with three MCMC chains taking initial values for all parameters that were guided by the data and by initial GLMMs. After a burn-in of 10,000 iterations, estimation of 95% credible intervals and mean parameter values was based on a further 20,000 iterations. The questions addressed by each regression coefficient are as follows:

Beta 1 : Does the mean value of the response variable differ systematically with the extent to which 1km sample squares contain larger areas of rarer LCM habitat types?

Beta 2 : Does the mean value of the response variable differ between broad habitats. This is of lesser interest but is included so that the overall differences between habitats are accounted for before testing any remaining differences that arise between habitats, between surveys.

Beta 3 : Does the mean value of the response variable differ between plots that were in a higher level scheme for at least 5 years prior to recording versus those plots not in higher level AES?

Beta 4 : Does the mean value of the response variable differ between surveys and therefore between 2007 and 2015/’16?

Beta 5 : Does the mean value of the response variable differ between plots in versus out of higher level AES within each broad habitat?

Beta 6 : Does the mean value of the response variable differ between surveys within each broad habitat?

F3 Counterfactual results

Data assembly

NPMS quadrats recorded in 2015 and 2016 in England were selected with their monad weights and associated broad habitat (Figure F1; Table F1). The results show expected patterns: Rare and localised habitats are under-represented in CS X plots including montane, calcareous grassland and coastal habitats whereas common habitats such as conifer woodland, urban and improved grassland that are not associated with priority habitats, are not sampled by NPMS (Table F1). Habitats sampled in the HLS baseline and resurvey that are sampled in NPMS but not sufficiently covered by CS X plots include supra-littoral sediment and rivers & streams. Habitats sampled in the HLS baseline and resurvey but not sufficiently in NPMS are bracken and improved grassland. Both NPMS and CS have more quadrats that could contribute to habitat coverage but differences in quadrat size rule out their joint analysis. Seven broad habitats had enough quadrats distributed between CS and NPMS surveys for an analysis to be attempted (Table F1). The biggest imbalances between surveys were for arable land (more in CS), dwarf shrub heath (more in CS) and acid grassland (more in CS).

Survey	Broad habitat code	Broad habitat	Out of scheme	In scheme
NPMS	1	Broadleaved woodland	115	14
CS	1	Broadleaved woodland	98	10
NPMS	4	Arable	50	6
CS	4	Arable	199	55
NPMS	6	Neutral grassland	99	25
CS	6	Neutral grassland	142	41
NPMS	8	Acid grassland	8	7
CS	8	Acid grassland	33	38
NPMS	10	Dwarf shrub heath	7	16
CS	10	Dwarf shrub heath	32	36
NPMS	11	Fen, marsh & swamp	10	4
CS	11	Fen, marsh & swamp	8	6
NPMS	12	Bog	2	6
CS	12	Bog	9	12
Total			812	276

Table F1 Total numbers of quadrats used for counterfactual analysis. Iv only for NPMS. All plots located in England. See Figure F2 for maps.

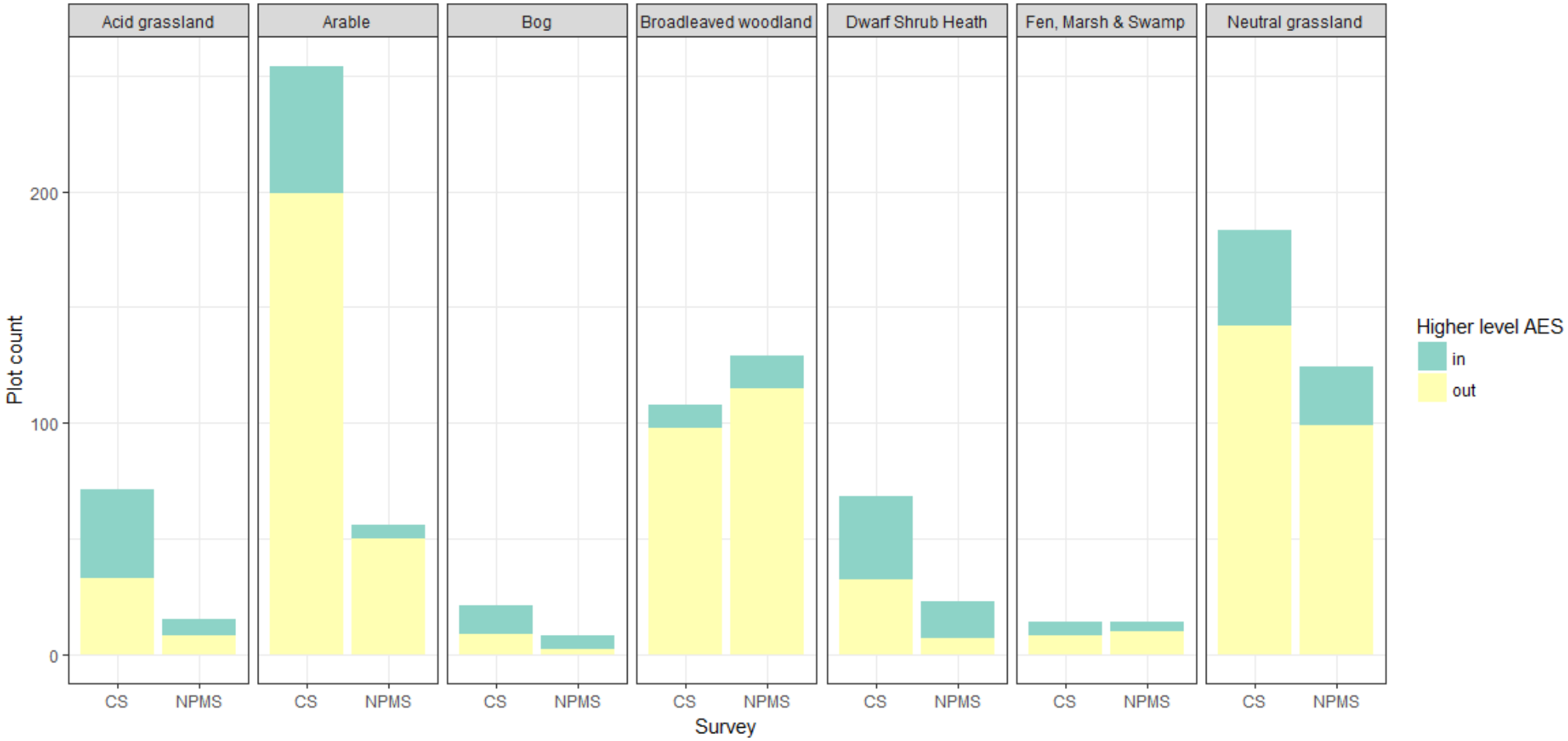
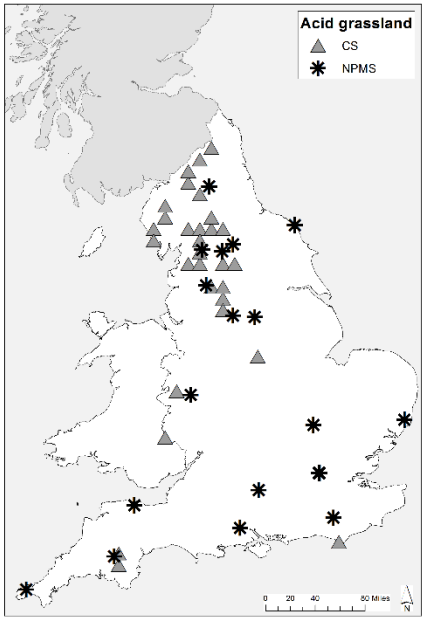
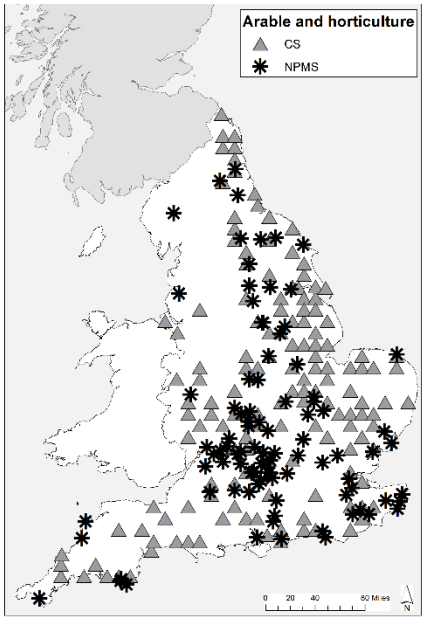
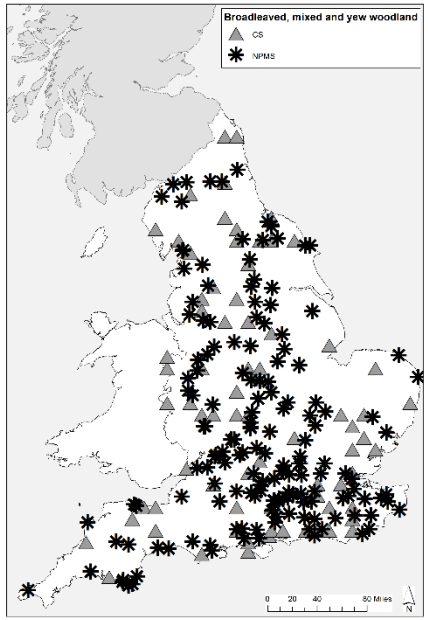
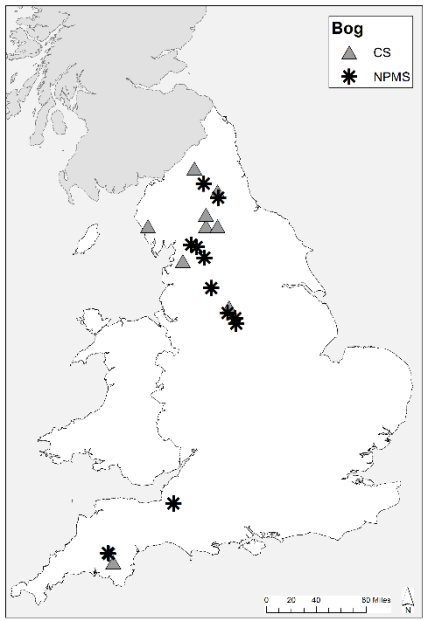


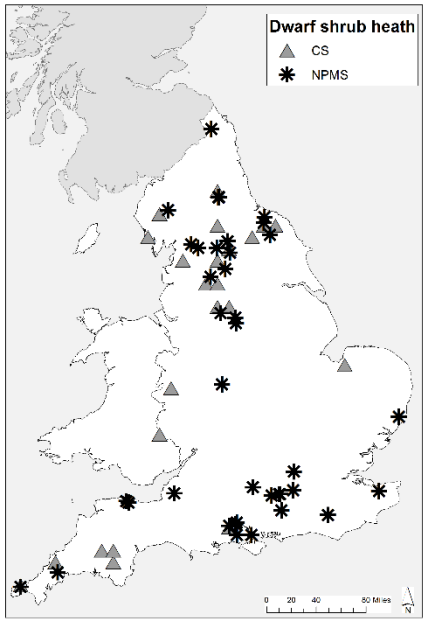
Figure F1 Numbers of plots in CS and NPMS that were used for counterfactual analysis.

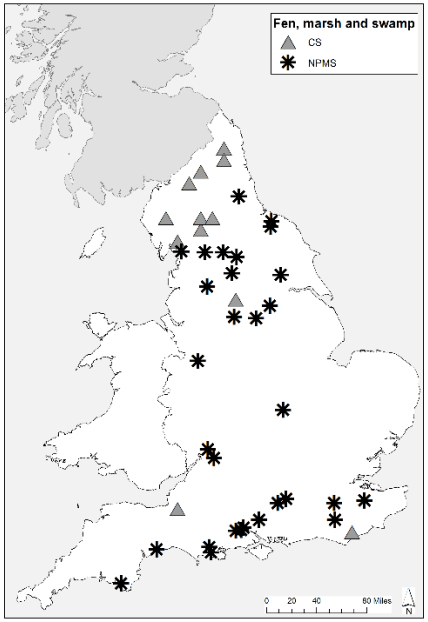












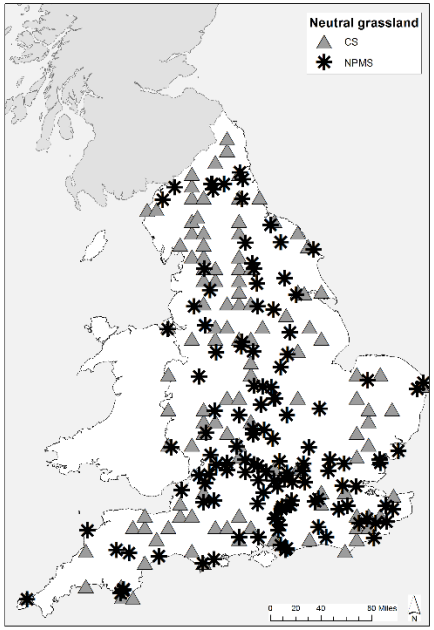


Figure F2 Locations of Countryside Survey and NPMS monads @ 10 x 10km resolution

Differences between response variables

Were any differences linked to scheme status?

Only one difference was discovered: Grime competitor score was 13% lower in arable plots in scheme than out of HLS-type schemes were detected for any of the seven broad habitats. Consequently, all plots were used in further modelling of the difference between surveys (i.e. between the 2007 CS and the 2015/16 NPMS).

Were there any differences between surveys and did these differ between broad habitats?

The overall main effect of survey was significant for indicator richness, Grime S, Ellenberg R and Ellenberg N (Table F2 for results summary; see Table F3 for all parameter estimates and credible intervals). Because different directions of change within different broad habitats can average out leading to no overall significant effect, interest attaches to the survey x habitat interaction terms. These test whether, within each broad habitat, there was a difference between surveys that was not the same as the difference within the reference habitat broadleaved woodland. Note that if most habitats showed enough change in the same direction then the interaction terms would be less likely to differ from zero but the main effect of survey would be more likely significant.

Significant interaction terms arose for all response variables apart from Ellenberg F (wetness) (Figure F3; Table F2). Only the difference in arable plots was significant for Grime C score having excluded plots in higher level AES because of the significant scheme status x habitat interaction. Neutral grassland was the broad habitat least likely to exhibit a significant difference between surveys.

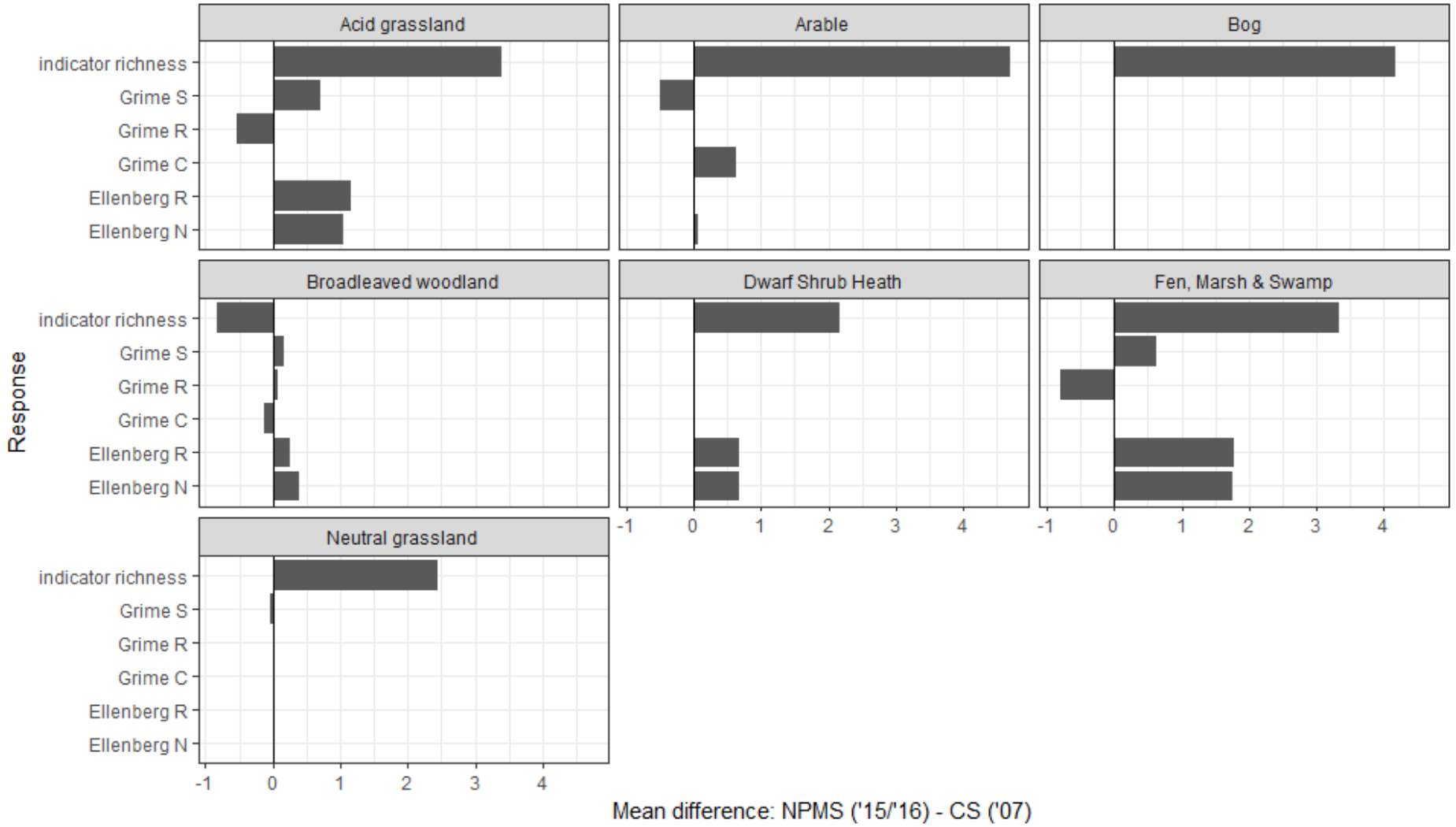


Figure F3 Model estimates of mean differences between CS and NPMS for response variables derived from the indicator species recorded in each plot. See Table F3 for credible intervals and Section F7 for model code. Only statistically significant differences are shown.

Response	Broad habitats with significant survey interaction terms	Monad weight significant?	Survey term significant?	Scheme term significant?	Difference between CS2007 and HLS baseline[1]
Ellenberg N	Acid grassland	NO	YES	NO	CS lower
	Arable				CS higher
	Dwarf shrub heath				
	Fen, marsh & swamp				CS lower
Ellenberg R	Acid grassland	YES	YES	NO	CS lower
	Dwarf shrub heath				CS lower
	Fen, marsh & swamp				CS lower
Grime C	Arable	YES	NO	Scheme*hab interaction	CS lower
Grime R	Acid grassland	NO	NO	NO	CS lower
	Fen, marsh & swamp				
Grime S	Acid grassland	NO	YES	NO	CS higher
	Arable				CS lower
	Fen, marsh & swamp				
	Neutral grassland				CS lower
indicator richness	Acid grassland	YES	NO	Not testable	
	Arable				CS lower
	Bog				
	Dwarf shrub heath				
	Fen, marsh & swamp				
	Neutral grassland				CS lower

Table F2 Summary results from statistical analysis of the CS and NPMS datasets. [1]From Appendix 3D in (Mountford et al., 2013) report to NE on HLS baseline monitoring.

Directions of change were consistently in the same direction for Ellenberg R, (soil reaction), N (fertility) and indicator richness with higher estimated means for each response variable seen across habitats in the NPMS plots (Figure F3). Hence, indicator richness was significantly higher in 2015/16 NPMS plots than 2007 CS plots in neutral grassland, fen, marsh & swamp, dwarf shrub heath, bog, arable and acid grassland relative to broadleaf. Plots in broadleaved woodland were less rich in indicators in 2015/16 NPMS plots than in 2007 CS plots (Figure F3).

What was the effect of monad weight on the vegetation data?

Monad weight was significant for Ellenberg F, Grime C and indicator richness. The direction of the effect indicates that species favouring wetter conditions increased, highly competitive species decreased and number of indicators per plot increased as monads tended to have greater areas of rarer habitats. Solving the regression model for arbitrary values of monad weight gives an estimate of a 17% reduction in indicator species richness moving from the highest value to the lowest value in the dataset.

Table F3 Parameter estimates from BUGS modelling of the CS and NPMS dataset (continued below).

Response	Parameter name	Type	2.5%tile	median	97.5%tile
indicator richness	Arable	main effect	-0.2758	-0.1446	-0.01455
indicator richness	Neutral grassland	main effect	0.04861	0.1475	0.2473
indicator richness	Acid grassland	main effect	-0.07792	0.1551	0.3944
indicator richness	Dwarf Shrub Heath	main effect	-0.3834	-0.16	0.05873
indicator richness	Fen, Marsh & Swamp	main effect	0.04593	0.2405	0.4316
indicator richness	Bog	main effect	-0.27	0.08541	0.4444
indicator richness	**monad weight**	**main effect**	**2.19E-05**	**0.04447**	**0.08932**
indicator richness	reference level	intercept	1.827	2.027	2.213
indicator richness	**Arable**	**survey * habitat interaction**	**-1.153**	**-0.9822**	**-0.8075**
indicator richness	**Neutral grassland**	**survey * habitat interaction**	**-0.4915**	**-0.3495**	**-0.2044**
indicator richness	**Acid grassland**	**survey * habitat interaction**	**-0.7481**	**-0.4678**	**-0.1886**
indicator richness	**Dwarf Shrub Heath**	**survey * habitat interaction**	**-0.6944**	**-0.4134**	**-0.129**
indicator richness	**Fen, Marsh & Swamp**	**survey * habitat interaction**	**-0.7286**	**-0.422**	**-0.1247**
indicator richness	**Bog**	**survey * habitat interaction**	**-1.073**	**-0.6239**	**-0.1905**
indicator richness	survey	main effect	-0.05077	0.08749	0.2231
Ellenberg R	Arable	main effect	0.05888	0.1036	0.1483
Ellenberg R	Neutral grassland	main effect	-0.02655	0.009576	0.04535
Ellenberg R	Acid grassland	main effect	-0.331	-0.2495	-0.167
Ellenberg R	Dwarf Shrub Heath	main effect	-0.6183	-0.5472	-0.4765
Ellenberg R	Fen, Marsh & Swamp	main effect	-0.07679	-0.00208	0.07448
Ellenberg R	Bog	main effect	-0.751	-0.6378	-0.5211
Ellenberg R	monad weight	main effect	-0.0165	-0.00485	0.006437
Ellenberg R	reference level	intercept	1.753	1.806	1.857
Ellenberg R	**Arable**	**survey * habitat interaction**	**-0.05434**	**0.001413**	**0.05732**
Ellenberg R	Neutral grassland	survey * habitat interaction	-0.06315	-0.01211	0.0371
Ellenberg R	Acid grassland	survey * habitat interaction	-0.3455	-0.2462	-0.1514
Ellenberg R	**Dwarf Shrub Heath**	**survey * habitat interaction**	**-0.2685**	**-0.1811**	**-0.09352**
Ellenberg R	**Fen, Marsh & Swamp**	**survey * habitat interaction**	**-0.4206**	**-0.311**	**-0.2028**
Ellenberg R	Bog	survey * habitat interaction	-0.2233	-0.09039	0.04016
Ellenberg R	survey	main effect	-0.085	-0.04263	0.001819
Ellenberg F (wetness)	Arable	main effect	-0.1655	-0.0698	0.02601

Ellenberg F (wetness)	Neutral grassland	main effect	-0.07525	-0.00202	0.07273
Ellenberg F (wetness)	Acid grassland	main effect	-0.1798	-0.01999	0.1387
Ellenberg F (wetness)	Dwarf Shrub Heath	main effect	-0.07408	0.05976	0.1934
Ellenberg F (wetness)	Fen, Marsh & Swamp	main effect	0.03331	0.1949	0.3578
Ellenberg F (wetness)	Bog	main effect	-0.02698	0.1871	0.3999
Ellenberg F (wetness)	monad weight	main effect	0.007231	0.02459	0.04213
Ellenberg F (wetness)	reference level	intercept	1.562	1.643	1.715
Ellenberg F (wetness)	Arable	survey * habitat interaction	-0.07339	0.0437	0.1669
Ellenberg F (wetness)	Neutral grassland	survey * habitat interaction	-0.1206	-0.01587	0.08741
Ellenberg F (wetness)	Acid grassland	survey * habitat interaction	-0.08618	0.09875	0.2842
Ellenberg F (wetness)	Dwarf Shrub Heath	survey * habitat interaction	-0.1282	0.03547	0.2028
Ellenberg F (wetness)	Fen, Marsh & Swamp	survey * habitat interaction	-0.2851	-0.05558	0.1766
Ellenberg F (wetness)	Bog	survey * habitat interaction	-0.2583	-0.00211	0.2547
Ellenberg F (wetness)	survey	main effect	-0.06288	0.01545	0.09707
Ellenberg N	Arable	main effect	0.00623	0.06283	0.1209
Ellenberg N	Neutral grassland	main effect	-0.1838	-0.1367	-0.0912
Ellenberg N	Acid grassland	main effect	-0.4869	-0.3864	-0.2858
Ellenberg N	Dwarf Shrub Heath	main effect	-0.7447	-0.6532	-0.5645
Ellenberg N	Fen, Marsh & Swamp	main effect	-0.2255	-0.1295	-0.03118
Ellenberg N	Bog	main effect	-1.014	-0.8711	-0.7329
Ellenberg N	monad weight	main effect	-0.02518	-0.01024	0.003155
Ellenberg N	reference level	intercept	1.733	1.794	1.864
Ellenberg N	**Arable**	**survey * habitat interaction**	**-0.01602**	**0.05576**	**0.1275**
Ellenberg N	Neutral grassland	survey * habitat interaction	-0.02377	0.03975	0.104
Ellenberg N	Acid grassland	survey * habitat interaction	-0.3612	-0.2444	-0.1263
Ellenberg N	**Dwarf Shrub Heath**	**survey * habitat interaction**	**-0.3008**	**-0.1911**	**-0.07811**
Ellenberg N	**Fen, Marsh & Swamp**	**survey * habitat interaction**	**-0.4968**	**-0.3578**	**-0.2225**
Ellenberg N	Bog	survey * habitat interaction	-0.3004	-0.1357	0.03057
Ellenberg N	**survey**	**main effect**	**-0.1233**	**-0.06812**	**-0.01492**
Grime C	Arable	main effect	-0.1261	-0.04557	0.03513
Grime C	Neutral grassland	main effect	-0.04241	0.02168	0.08615
Grime C	Acid grassland	main effect	-0.2727	-0.1367	0.003236
Grime C	Dwarf Shrub Heath	main effect	-0.209	-0.09062	0.02733
Grime C	Fen, Marsh & Swamp	main effect	-0.0707	0.06791	0.2054

Grime C	Bog	main effect	-0.4045	-0.2104	-0.0181
Grime C	**monad weight**	**main effect**	**-0.03688**	**-0.01883**	**-0.00164**
Grime C	reference level	intercept	1.022	1.102	1.182
Grime C	**Arable**	**survey * habitat interaction**	**-0.4162**	**-0.3165**	**-0.2189**
Grime C	Neutral grassland	survey * habitat interaction	-0.155	-0.06449	0.02237
Grime C	Acid grassland	survey * habitat interaction	-0.2717	-0.1053	0.05482
Grime C	Dwarf Shrub Heath	survey * habitat interaction	-0.2065	-0.05973	0.08793
Grime C	Fen, Marsh & Swamp	survey * habitat interaction	-0.3225	-0.1235	0.0764
Grime C	Bog	survey * habitat interaction	-0.1499	0.081	0.3124
Grime C	survey	main effect	-0.02523	0.04255	0.1171
Grime S	Arable	main effect	0.3088	0.3926	0.476
Grime S	Neutral grassland	main effect	0.2582	0.325	0.3921
Grime S	Acid grassland	main effect	-0.02724	0.1252	0.271
Grime S	Dwarf Shrub Heath	main effect	-0.4408	-0.3125	-0.1826
Grime S	Fen, Marsh & Swamp	main effect	0.02685	0.1742	0.3208
Grime S	Bog	main effect	-0.6106	-0.4104	-0.2112
Grime S	monad weight	main effect	-0.01414	0.005248	0.02432
Grime S	reference level	intercept	0.5869	0.6702	0.7563
Grime S	**Arable**	**survey * habitat interaction**	**0.1396**	**0.2431**	**0.3487**
Grime S	**Neutral grassland**	**survey * habitat interaction**	**0.0018**	**0.09638**	**0.1896**
Grime S	**Acid grassland**	**survey * habitat interaction**	**-0.464**	**-0.2926**	**-0.116**
Grime S	Dwarf Shrub Heath	survey * habitat interaction	-0.2494	-0.08786	0.07063
Grime S	**Fen, Marsh & Swamp**	**survey * habitat interaction**	**-0.4269**	**-0.2163**	**-0.00609**
Grime S	Bog	survey * habitat interaction	-0.3061	-0.06992	0.172
Grime S	**survey**	**main effect**	**-0.1607**	**-0.08548**	**-0.01251**
Grime R	Arable	main effect	-0.6445	-0.5714	-0.4991
Grime R	Neutral grassland	main effect	-0.2204	-0.161	-0.1024
Grime R	Acid grassland	main effect	-0.00755	0.118	0.247
Grime R	Dwarf Shrub Heath	main effect	0.08391	0.197	0.3096
Grime R	Fen, Marsh & Swamp	main effect	-0.4167	-0.2929	-0.1679
Grime R	Bog	main effect	0.1643	0.3471	0.5261
Grime R	monad weight	main effect	-1.79E-04	0.01865	0.03816
Grime R	reference level	intercept	0.746	0.8316	0.9134
Grime R	Arable	survey * habitat interaction	-0.1607	-0.07021	0.02182
Grime R	Neutral grassland	survey * habitat interaction	-0.00339	0.07703	0.1585
Grime R	**Acid grassland**	**survey * habitat interaction**	**0.04497**	**0.1996**	**0.3481**
Grime R	Dwarf Shrub Heath	survey * habitat interaction	-0.02403	0.114	0.2546
Grime R	**Fen, Marsh & Swamp**	**survey * habitat interaction**	**0.2255**	**0.4034**	**0.5827**
Grime R	Bog	survey * habitat interaction	-0.2663	-0.04929	0.167
Grime R	survey	main effect	-0.09167	-0.0262	0.04037

Table F3 Parameter estimates from BUGS modelling of the CS and NPMS dataset (continued above).

F4 Comparing contemporary GMEP and NPMS quadrats by broad habitat; a validation study using Welsh monitoring data

Here we compare vegetation quadrat data from the Glastir Environmental Monitoring Programme (GMEP) and NPMS for Wales where these quadrat datasets were recorded within a three-year window, some being recorded in the same year. Thus, GMEP quadrats for all broad habitats sampled in 2014 and 2016 were compared with NPMS quadrats recorded in the same broad habitats but in 2015/'16. Comparing quadrat data for exactly the same years was only possible for broadleaved woodlands in 2016 because fully nested X plots were not recorded in GMEP in 2015.

Species lists for NPMS inventory-level quadrats and GMEP quadrats were all filtered to include NPMS indicator species only. Preliminary data exploration was carried out by simply box-plotting the response variables by broad habitat, by survey type and, for NPMS quadrats, by indicator and inventory status. Where the notches around the median in each box overlap between data subsets this can be used as an approximate indicator of no significant difference between them. However these results should be interpreted with caution because they may not supported when analysed using methods that fully take account of the nested structure and distributional properties of the data.

F4.1 Validation study results

A preliminary graphical exploration indicated significant effects of NPMS survey level. Quadrats that were fully censussed (Iv) tended to be somewhat higher in indicator-species richness than GMEP quadrats (G) except in broadleaved woodland (Figure F4). These differences might however not be significant if statistically modelled. Indicator species richness in indicator level quadrats (Id) was notably lower than GMEP and NPMS Iv quadrats in all broad habitat groups apart from Dwarf Shrub Heath and Arable (Figure F4). Mean Ellenberg fertility was also higher in most broad habitats in NPMS Iv plots (Figure F5). Given the strong positive correlation between Ellenberg N and R values, it was not surprising that the same pattern applied to mean Ellenberg soil reaction (Figure F6). Mean Ellenberg soil moisture was no different between GMEP and NPMS Iv quadrats except in Acid grassland where median score was lower in NPMS Iv quadrats (Figure F7).

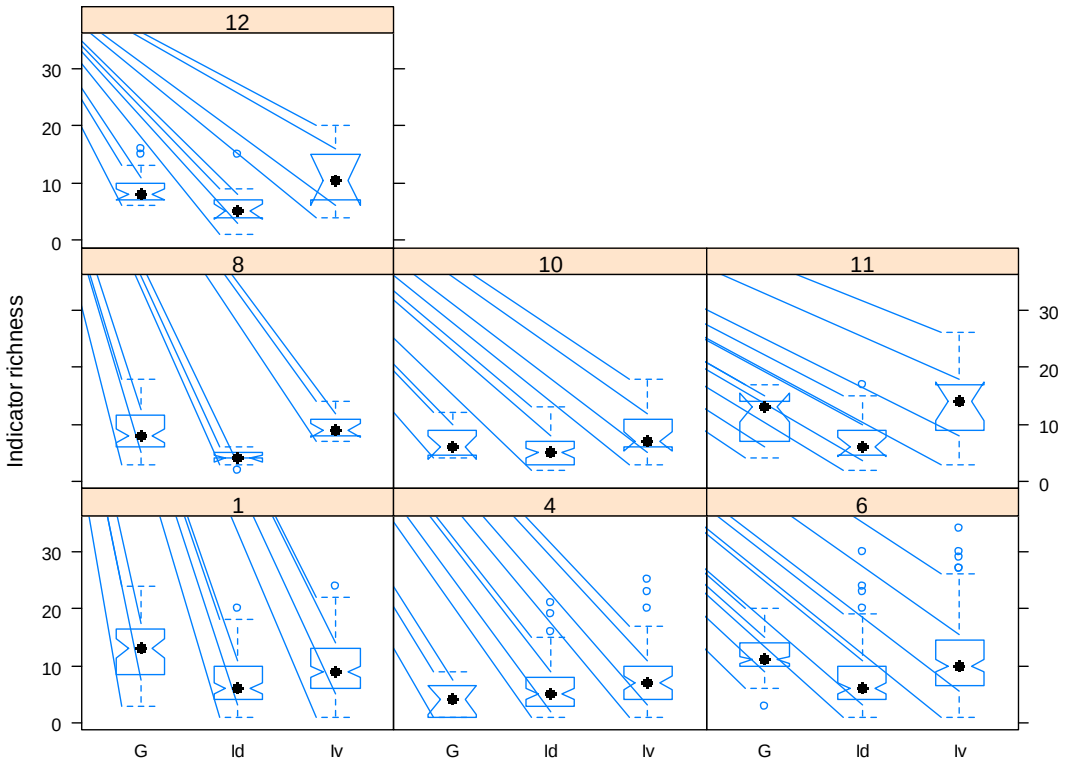


Figure F4 GMEP 2014/'16 quadrats compared with NPMS 2015/'16. Wales only. Numbers above figure panels relate to broad habitats, see Table 1 for descriptions and code numbers. Each box and whisker summarises the distribution of the values of each response variable in each of four datasets coded as follows; G=GMEP quadrat data from Wales, Id=NPMS quadrats in which only selected indicator species were recorded, Iv=NPMS quadrats in which all vascular plant species were recorded. Note however that the variables shown in all plots below irrespective of their survey origins are based solely on presence of indicator species listed by NPMS. Such a constraint ensures that all records in all quadrats were drawn from the same list of plant species although the effort applied in searching for these species may have differed between quadrats. The upper and lower limits of the 'box' indicate the interquartile range while the dashed ends of the 'whiskers' indicate the range of the data with outlying values indicated as circles. The black dot denotes the median value (middle) value among all the data points.

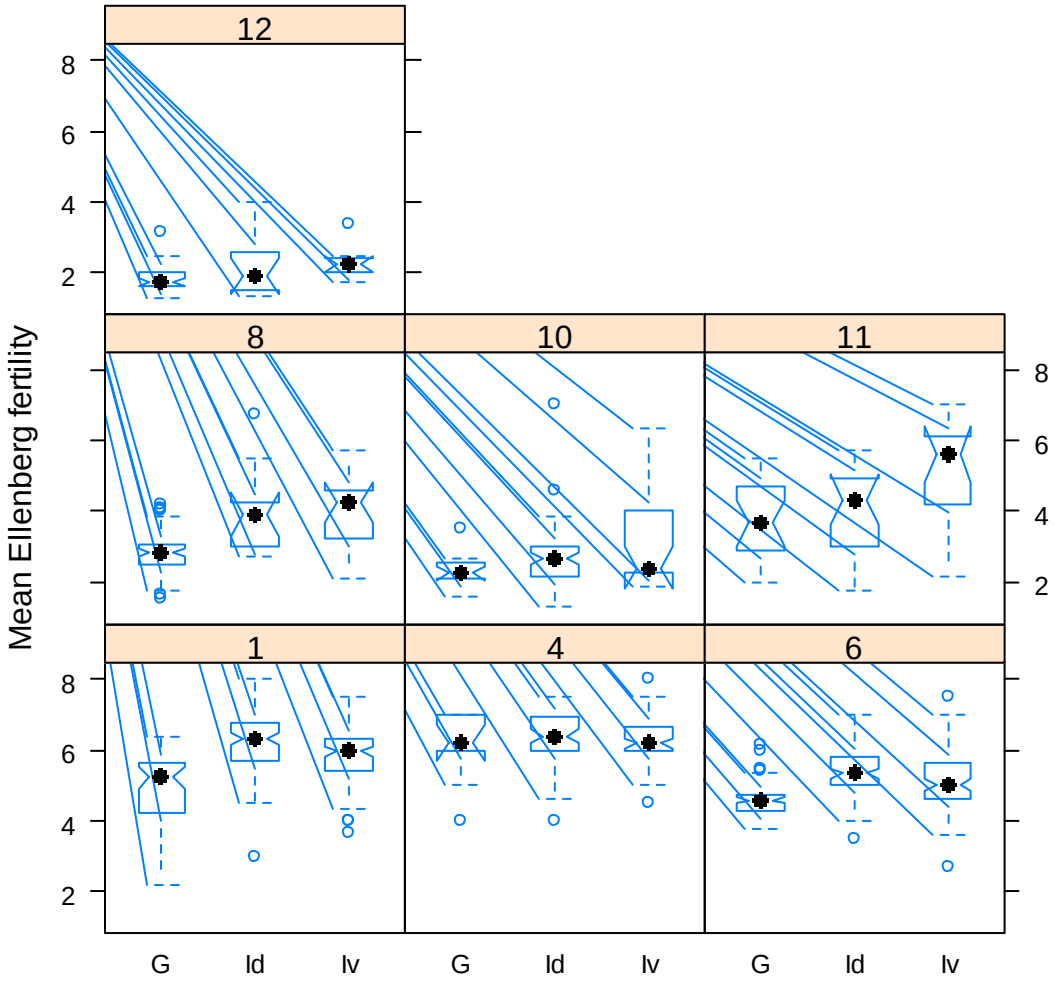


Figure F5 GMEP 2014/'16 quadrats compared with NPMS 2015/'16. Wales only.

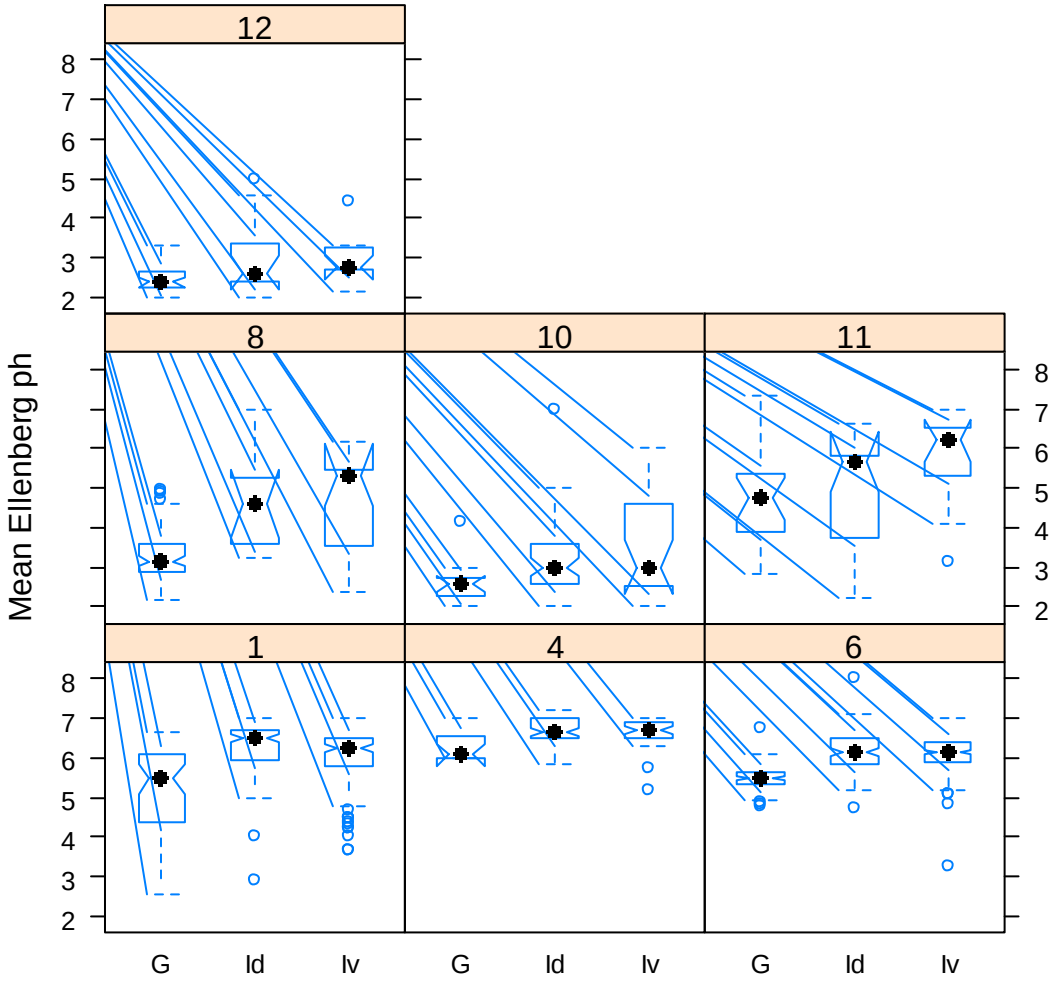


Figure F6 GMEP 2014/'16 quadrats compared with NPMS 2015/'16. Wales only.

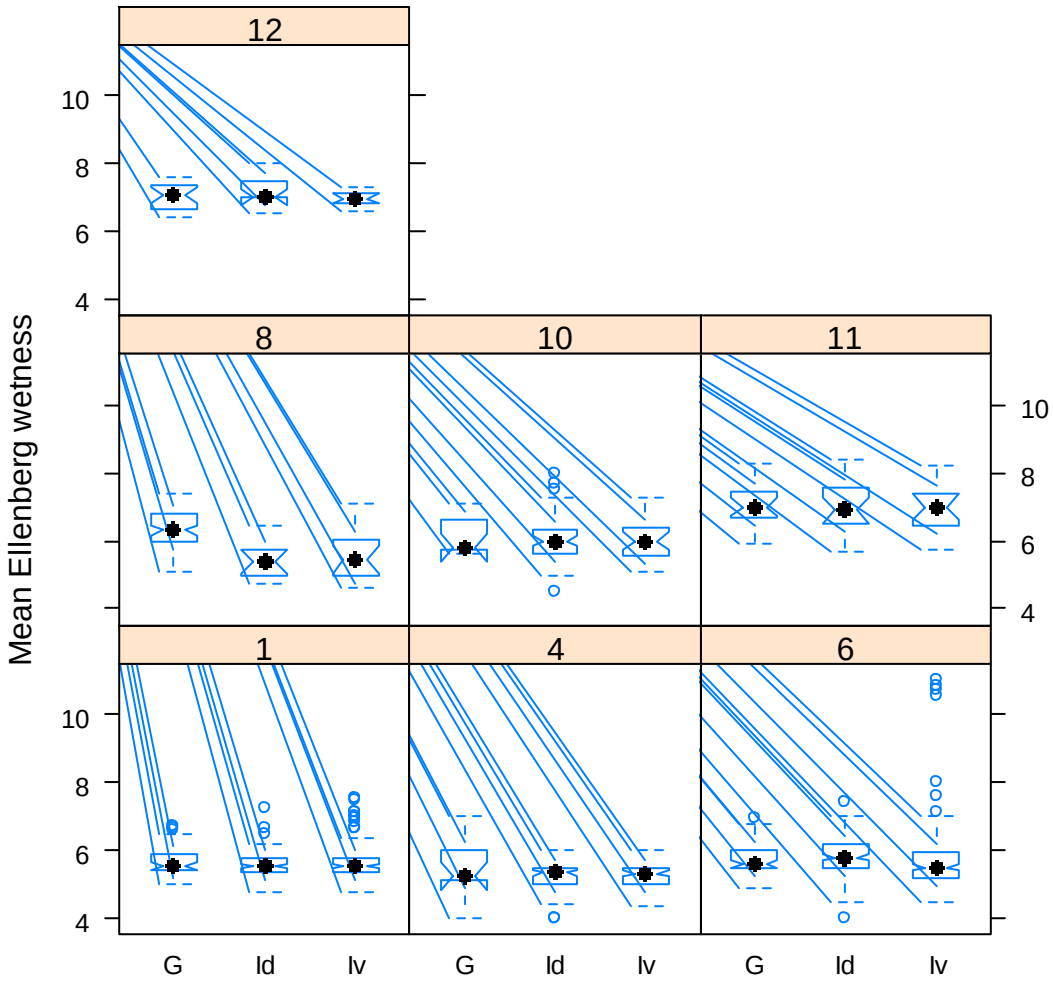


Figure F7 GMEP 2014/'16 quadrats compared with NPMS 2015/'16. Wales only.

F5 Discussion of counterfactual results

The plausibility of the differences between the 2007 CS and the 2015/16 NPMS surveys being attributable to real vegetation change, methodological differences or recording effort, can be assessed in a number of ways. The higher indicator richness in NPMS is not likely to be due to under-recording or biased recording in CS2007. Three lines of evidence support this contention:

1. If quadrat data from the same plot sizes in the same broad habitats but *within the same year or only a year apart* are compared from the NPMS and Glastir Monitoring and Evaluation Program (GMEP) in Wales then similar patterns are seen (Section F4). Despite being near contemporary in their recording year, GMEP recorded somewhat lower indicator richness in bog, dwarf shrub heath, acid grassland, fen, marsh & swamp and arable habitats, and higher richness in broadleaved woodland, the same pattern as seen in the English analysis. Moreover, the same tendency for mean Ellenberg values for N and R to be higher in NPMS and lower in GMEP plots was also clearly apparent (Section F4). These differences are however based on graphical exploration only.
2. The CS v HLS baseline comparison showed no evidence that CS2007 plots were consistently less species rich than the HLS baseline (Section F3; Table F2) which ought to have been the case if CS deviated significantly from another survey of the same habitat types carried out within 3-4 years of CS. CS2007 plots did however have significantly lower mean Ellenberg R and N scores for a number of broad habitats compared to baseline HLS plots (Section F3; Table F2).
3. The QA analysis for CS2007 initially appeared to indicate that there had been an increase in the proportion of over-looked species in the survey and these were more likely to be sedges and then grasses. However, two exhaustive statistical analyses of the QA and CS replicate plot data concluded that "Once cryptogams are removed statistical modelling shows no significant differences\ in the level of under-recording across surveys (Scott et al 2008 http://www.countrysidesurvey.org.uk/sites/www.countrysidesurvey.org.uk/files/QA_PLOTS_3.pdf)."

Higher fertility, pH and richness may reflect the intentional bias within NPMS for sampling flushes and generally higher quality priority habitat patches. It may also reflect geographic and ecological biases in the locations of sampled monads in CS versus NPMS. Certainly NPMS fen, marsh & swamp, dwarf shrub heath and acid grassland plots are represented by monads dispersed across the south and east of England to a greater extent than CS monads (Figure F2). Monads appear more equally dispersed for broadleaved woodland and neutral grassland, and while there is reasonable overlap for monads containing arable plots, it is possible that a higher proportion of NPMS plots are located in the chalk and limestone areas of Wiltshire, Oxfordshire and Gloucestershire (Figure F2).

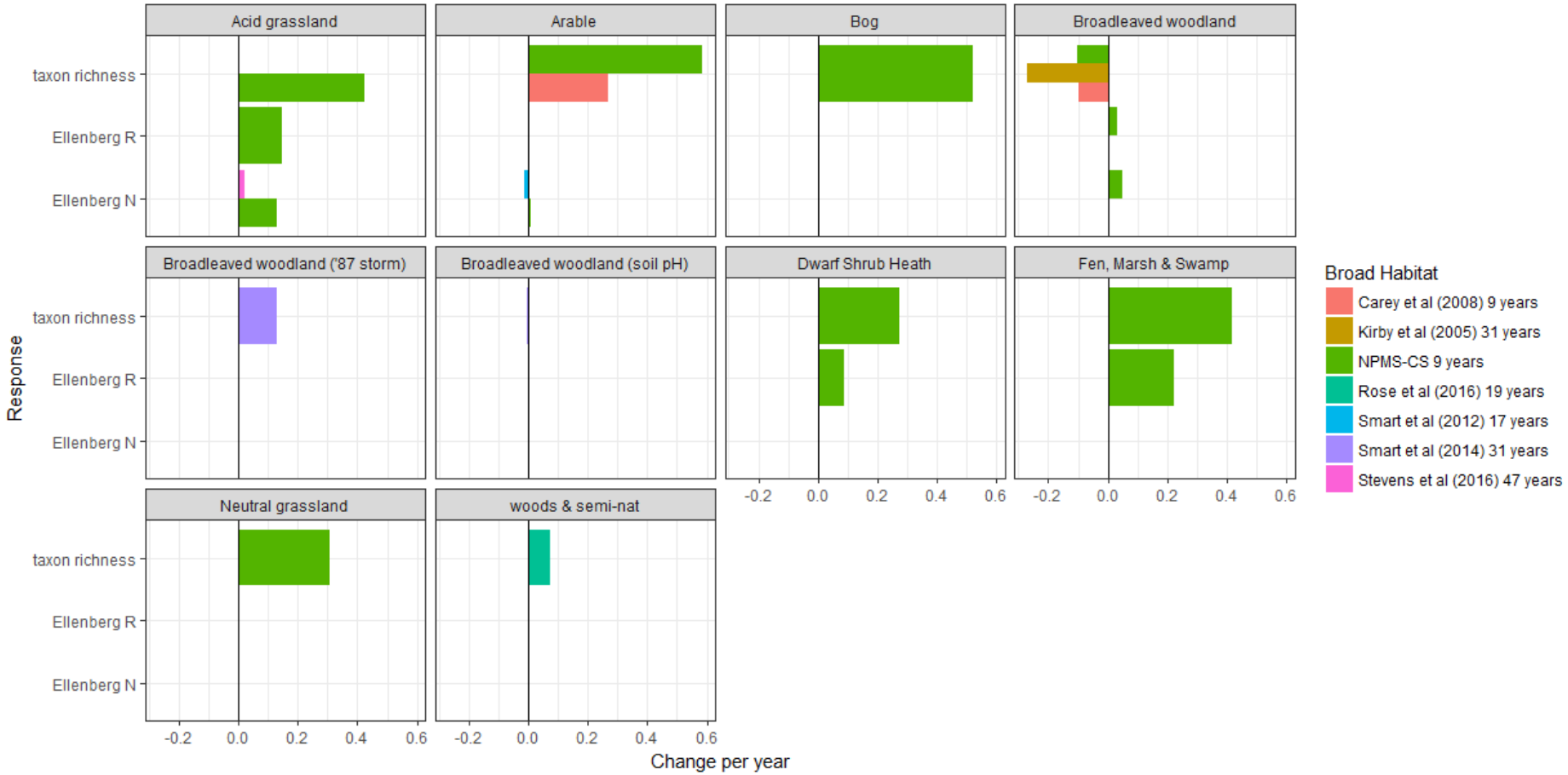


Figure F8 Plots of the statistically significant modelled mean differences in three response variables between CS and NPMS expressed as change per year alongside other recent findings for change in related broad habitats. Only Rose et al (2016) actually overlaps in terms on the years covered by CS and NPMS. Their analysis quantified change from 1993-2012. The absence of a bar indicates no significant change detected e.g. for Stevens et al (2016) who repeated plots in 2012 in English acid grassland first surveyed in 1965. Also note that 'taxon richness' included only NPMS vascular plant indicator species for the NPMS-CS comparison but all vascular plants and scheme-specific lists of bryophytes in the other studies.

If we further assume that CS to NPMS between survey differences are representative of real vegetation change then we might expect the size of the differences in response variables to be similar to other temporal analyses of vegetation surveillance data from the same broad habitats over previous or contemporary time intervals. When compared to recent findings the differences reported here, expressed in common units of the rate of change in a response variable per year, are unusually large suggesting that methodological differences are possibly a more likely explanation than real vegetation change (Figure F8). The two habitats where effect sizes are approaching comparability are arable and broadleaved woodland. These are also the two habitats where we see much more geographical overlap in the distribution of survey monads. Thus, particularly in broadleaf woodland it could be that the comparison between CS and NPMS is less affected by survey differences so that the detected reduction in indicator richness may be picking up ongoing effects of drivers that have been associated with reduction in understorey species richness in many broadleaved woodlands in Britain probably since the end of WWII (Kirby et al., 2005; Smart et al., 2014). Very low proportions of CS and NPMS plots were in higher level AES in broadleaved woodland, hence these results do not offer a reliable assessment of scheme impacts on the habitat type (Figure 9.1). It should also be noted that the locations of the samples in each of the studies differ as does the extent to which they represent each habitat type (Figure 9.1).

F5 Conclusions

The analyses of HLS survey data across all HLS agreements showed that in five of the nine broad habitats assessed (neutral grassland, improved grassland, acid grassland, broadleaved woodland, bog), species richness increased between the baseline survey and resurvey. The lack of a corresponding result for in scheme squares from the counterfactual analysis implies that differences between the CS and NPMS survey methodologies may be obscuring any signal of HLS management in the counterfactual dataset, and illustrates the importance of structured ecological resurveys of the same locations using consistent methods, in order to assess change over time. Indicator species richness was greater in the NPMS than CS datasets for six broad habitats, but as discussed above this may be due to methodological differences rather than real vegetation change, with the possible exception of arable and broadleaved woodland habitats. A comparison of change in species richness between the HLS surveys and this counterfactual is not possible due to the low numbers of arable parcels surveyed in the HLS baseline survey (Section 8.4.1). The decrease in broadleaved woodland species richness found in this counterfactual analysis, to a similar extent as found in other studies, does suggest that woodland management under HLS is successfully increasing the species-richness of the woodland ground flora relative to the trend apparent across the wider countryside.

F7 BUGS code for counterfactual analysis

Author: S.Smart
Date: 06/01/2017

Objective: Random effects model to determine difference between CS2007 and NPMS2015/'16 counterfactual plots to compare with analysis of HLS.

#MODEL 1: Ellenbergs & indicator richness

```
model {

# Likelihoods

        for (i in 1:rs) {

#y[i,2] ~ dpois(mu2[i])                                          # Indicator
richness

#y[i,3] ~ dlnorm(mu3[i], tau3)                                   # EbN.
y[i,4] ~ dlnorm(mu3[i], tau3)                                    # EbR
#y[i,5] ~ dlnorm(mu3[i], tau3)                                   # EbW

yy[i,7]<-log(y[i,7])                                            # Log
monad score

mu3[i] <-  alpha[y[i,1]] + m_score*yy[i,7]  + survey*y[i,6] + hab[y[i,8]]  + s_hab_int[y[i,8]]
* y[i,6]

#mu2[i] <-  alpha[y[i,1]] + m_score*yy[i,7]  + scheme*y[i,10] + hab[y[i,8]]  +
s_hab_int[y[i,8]] * #y[i,10]

                }

# Uninformative priors for each monad; random effect

for (i in 1:380) {

alpha[i] ~ dnorm(mu.int, tauM)

}
```

 # Habitat categories: fixed effects.

```
hab[1]<-0                       #Broadleaf
hab[2] ~dnorm(0, 0.001)         # Arable
hab[3] ~dnorm(0, 0.001)         # Neutral grassland
hab[4] ~dnorm(0, 0.001)         # Acid grassland
hab[5] ~dnorm(0, 0.001)         # DSH
hab[6] ~dnorm(0, 0.001)         # FMS
hab[7] ~dnorm(0, 0.001)         # Bog
```

 # Interaction between habitats and survey (CS v NPMS)

```
s_hab_int[1]<-0                 #Broadleaf
s_hab_int[2] ~dnorm(0, 0.001)   # Arable
s_hab_int[3] ~dnorm(0, 0.001)   # Neutral grassland
s_hab_int[4] ~dnorm(0, 0.001)   # Acid grassland
s_hab_int[5] ~dnorm(0, 0.001)   # DSH
s_hab_int[6] ~dnorm(0, 0.001)   # FMS
s_hab_int[7] ~dnorm(0, 0.001)   # Bog


mu.int ~ dnorm(0, 1.0E-2)

tauM <- 1/pow(sigmaM,2)
sigmaM ~ dunif(0, 100)

tau3 <- 1/ pow(sigma3,2)    # Residual precision
sigma3 ~ dunif(0, 100)      # Residual SD
```

 # regression coefficients

```
reffort ~ dnorm(0, 1.0E-6)
m_score  ~ dnorm(0, 1.0E-6)
survey  ~ dnorm(0, 0.001)
scheme ~ dnorm(0, 0.001)
```

 # Bayes p-values

```
p.reffort <-step(reffort)
p.m_score <-step(m_score)
p.survey <-step(survey)
p.scheme<-step(scheme)

p.arable <-step(hab[2])
p.NG <-step(hab[3])
p.AG <-step(hab[4])
p.DSH <-step(hab[5])
p.FMS <-step(hab[6])
p.Bog <-step(hab[7])
```

```
p.arable_S <-step(s_hab_int[2])
p.NG_S <-step(s_hab_int[3])
p.AG_S <-step(s_hab_int[4])
p.DSH_S <-step(s_hab_int[5])
p.FMS_S <-step(s_hab_int[6])
p.Bog_S<-step(s_hab_int[7])

}
```

References for appendices

Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015) Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software*, **67**, 1-48.

Kirby, K.J., Smart, S.M., Black, H.I.J., Bunce, R.G.H., Corney, P.M., & Smithers, R.J. (2005). *Long-term ecological changes in British broadleaved woodland 1971-2002*, English Nature Research Report 653, part 1, Peterborough, UK.

Lunn, D., Jackson, C., Best, N., Thomas, A., & Spiegelhalter, D. (2013) *The BUGS book: A practical introduction to Bayesian analysis* CRC Press, Taylor & Francis Group, Florida, USA.

Mountford, J.O., Cooke, A.I., Amy, S.R., Baker, A., Carey, P.D., Dean, H.J., Kirby, V.G., Nisbet, A., Peyton, J.M., Pywell, R.F., Redhead, J.W., & Smart, S.M. (2013). *Monitoring the outcomes of Higher Level Stewardship: Results of a 3-year agreement monitoring programme.* Natural England Commissioned Reports 114

Natural England (2010). *Higher Level Stewardship (HLS) Farm Environment Plan (FEP) Manual; Technical guidance on the completion of the FEP and identification, condition assessment and recording of HLS FEP features*, Natural England.

Norton, L.R., Maskell, L.C., Smart, S.S., Dunbar, M.J., Emmett, B.A., Carey, P.D., Williams, P., Crowe, A., Chandler, K., Scott, W.A., & Wood, C.M. (2012) Measuring stock and change in the GB countryside for policy: key findings and developments from the Countryside Survey 2007 field survey. *Journal of Environmental Management*, **113**, 117-127.

Smart, S., M., Ellison, A.M., Bunce, R.G.H., Marrs, R.H., Kirby, K.J., Kimberley, A., Scott, A.W., & Foster, D.R. (2014) Quantifying the impact of an extreme climate event on species diversity in fragmented temperate forests: the effect of the October 1987 storm on British broadleaved woodlands. *Journal of Ecology*, **201**, 1273 - 1287.

Smart, S., Maskell, L., Dunbar, M., Emmett, B., Marks, S., Norton, L., Rose, P., & Simpson, I. (2010). *An Integrated Assessment of Countryside Survey data to investigate Ecosystem Services in Great Britain*, NERC Centre for Ecology and Hydrology, Lancaster, UK.

Smart, S.M., Clarke, R., Van De Poll, H., Robertson, E., Shield, E., Bunce, R., & Maskell, L. (2003) National-scale vegetation change across Britain; an analysis of sample-based surveillance data from the Countryside Surveys of 1990 and 1998. *Journal of Environmental Management*, **67**, 239-254.

Stace, C.A. (2010) *New Flora of the British Isles*, Third edition, Cambridge University Press, Cambridge, UK.

Stevens, C.J., Ceulemans, T., Hodgson, J.G., Jarvis, S., Grime, J.P., & Smart, S.M. (2016) Drivers of vegetation change in grasslands of the Sheffield region, Northern England between 1965 and 2012/3. *Applied Vegetation Science*, **19**, 187-195.

Zuur, A.F., Ieno, E.N., & Elphick, C.S. (2010) A protocol for data exploration to avoid common statistical problems. *Methods in Ecology and Evolution*, **1**, 3-14.