

**Title:** Delivering biodiversity and pollination services on farmland: a comparison of three wildlife-friendly farming schemes

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**Description:** Data on the species and abundances of bees, butterflies, hoverflies, birds and plants found on farms together with data on the pollination services and species and densities of flowers, from twelve farms in the south of England. Triplets of farms were selected from four regions. All farms in each triplet were in the Government's Entry Level Stewardship scheme, one from each triplet was organic and one from each triplet was in the Conservation Grade scheme. For the four organic and four Conservation Grade farms, three were also in the Government's Higher Level Stewardship scheme. A representative sample of all habitats on each farm was surveyed. The pollinator groups recorded were bees, butterflies and hoverflies. Bees and butterflies were recorded to species level as far as possible in all years and hoverflies were counted in 2012 and 2013 and recorded to species level as far as possible in 2014. Data from pollinator transects are from 2012, 2013 and 2014 and data from pan traps are from 2012 and 2013. The pollinator survey data have associated habitat and weather data. Pollination service data are from Californian poppy phytometer plants placed on farms in 2013. Flower and bird data are from 2013 and 2014.

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**Organisation:** University of Reading

**Datasets accompanying the thesis:** "Delivering biodiversity and pollination services on farmland: a comparison of three wildlife-friendly farming schemes" by Chloe Hardman, Centre for Agri-Environmental Research, School of Agriculture, Policy and Development, University of Reading, Reading RG6 6AR, UK. An overview of survey methods can be found in Chapter 2 of this thesis and further details can be found in individual chapters. These data were also used in the publications:

Hardman, C.J., Harrison, D.P.G., Shaw, P.J., Nevard, T.D., Hughes, B., Potts, S.G., Norris, K. (2016) Supporting local diversity of habitats and species on farmland: a comparison of three wildlife-friendly schemes. *Journal of Applied Ecology*, 53: 171-180. doi: 10.1111/1365-2664.12557

Hardman, C.J., Norris, K., Nevard, T. D., Hughes, B., Potts, S. G. (2016), Delivery of floral resources and pollination services on farmland under three different wildlife-friendly schemes. *Agriculture, Ecosystems and Environment*, 220: 142-151. doi:10.1016/j.agee.2016.01.015

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**Filename:** 1\_Farm\_codes\_CJH.txt

This file describes the four farm triplets where all data were collected. Farms are coded using their regions and AES types. Grid references of the central points on each of the twelve farms are given. Further details on the farms and the site selection process are given in Chapter 2 of the thesis.

Column number	Variable name	Description
1	Region	Region (National Character Area)  LW = Low Weald  HD = Hampshire Downs  CN = Chilterns North  CS = Chilterns South
2	AES type	Agri-environment scheme type  Org= Organic Entry Level Stewardship  ELS= Entry Level Stewardship  CG = Conservation Grade (+ELS)
3	Code	Combination of region and AES type to identify farm
4	X	Six figure easting coordinate of central point on farm
5	Y	Six figure northing coordinate of central point on farm

**Filename:** 2\_Sampling\_point\_locations\_CJH.txt

This file gives the grid references and habitats of all sampling point locations.

Column number	Variable name	Description
1	X	Six figure easting coordinate of centre of sampling point or transect
2	Y	Six figure northing coordinate of centre of sampling point or transect
3	Year	Year of survey at this sampling point
4	Survey	Type of survey: Poll = pollinator survey, Bird = bird survey, Floral = floral survey, Floral&Poll = floral and pollinator surveys, Poll&Plant = pollinator and plant surveys
5	Point	Sampling point ID
6	Farm	Farm coded by region and AES type
7	Habitat	Habitat in which sampling point or transect was located, with habitat codes which are described in Appendix 2 of thesis

**Filename:** 3\_Plant\_species\_data\_12\_CJH.txt

This file contains the percentage cover of each plant species recorded in 1m<sup>2</sup> quadrats in 2012. These data were used in Chapter 3 and the publication Hardman et al. (2016) in the Journal of Applied Ecology.

Column number	Variable name	Description
1	Farm	Farm coded by region and AES type
2	Transect	Transect number
3	Quadrat	Quadrat letter (a, b or c)
4	Date	Date of survey (dd/mm/yyyy)
5-183	Plant species names	Scientific plant name

**Filename:** 4\_Pan\_trap\_species\_data\_1213\_CJH.txt

These data contain details of specimens of bees, butterflies and hoverflies that were collected from pan traps in 2012 and 2013. These data were used in Chapter 3 and the publication Hardman et al. (2016) in the Journal of Applied Ecology and in Chapter 4 and the publication Hardman et al. (2016) in Agriculture, Ecosystems and Environment.

Column number	Variable	Description
1	Year	Year of pan trapping survey
2	Specimen number	A unique identifier for each specimen
3	Farm	Farm coded by region and AES type
4	Pan collection date	Date on which pan traps were collected and specimens were frozen (dd/mm/yyyy)
5	Point number	Sampling point number
6	Round	Sampling round number (1,2 or 3)
7	Status	Empty = no specimens of target groups were caught, Full = a specimen from target group was caught, Missing = specimens lost, NA = status unknown, Void = pan traps disturbed.
8	Order	Order of specimen (Diptera, Lepidoptera or Hymenoptera)
9	Family	Family of specimen
10	Genus	Genus of specimen (for bees and butterflies)
11	Species	Species of specimen (for bees and butterflies)
12	Sex	Sex of specimen: f = female, m = male, q = queen, w = worker
13	Determiner	CJH = Chloe Joy Hardman, EDM = Ellen Dorothea Moss, SPMR = Stuart Paul Mason Roberts
14	Selected for barcoding	Shows whether the specimen was selected for metabarcoding (Yes, No or Not sent because specimen was missing). The metabarcoding results are described in the publication: Tang et al. (2015) High-throughput monitoring of wild bee diversity and abundance via mitogenomics. Methods in Ecology and Evolution. 6(9) 1034-1043.
15	Pinned	Yes or No to show whether specimen was recovered from freezer, pinned and stored in wooden boxes, or not.
16	Notes	Notes relating to specimens or pan trapping.

**Filename:** 5\_Pan\_trap\_env\_data\_12\_CJH.txt

This file contains the environmental variables collected during pan trapping in 2012. These data were used in Chapter 3 and the publication Hardman et al. (2016) in the Journal of Applied Ecology.

Column number	Variable	Description
1	Farm	Farm coded by region and AES type
2	Round	Sampling round number (1,2 or 3)
3	Date	Date when environmental variables were recorded (dd/mm/yyyy)
4	Observer	AB = Amandine Beugnet, CH = Chloe Hardman, KW = Kerri Watson, EE = Emily Edhouse, NA = not available.
5	Point number	Sampling point number
6	Hours out	Number of hours pan traps left out for
7	Max temp	Maximum temperature during the pan trapping period (degrees Celsius)
8	Cloud	Cloud score (1=0-33%, 2=33-66%, 3=66-100%)
9	Wind	Wind score (1=calm, 2=light, 3=breezy)
10	Rain	Rain score (1=none, 2=drizzle, 3=showers)
11	Visibility	Visibility score (1=good, 2=moderate, 3=poor)

**Filename:** 6\_Pan\_trap\_env\_data\_13\_CJH.txt

This file contains the environmental variables collected during pan trapping in 2013. These data were used in Chapter 3 and the publication Hardman et al. (2016) in the Journal of Applied Ecology and in Chapter 4 and the publication Hardman et al. (2016) in Agriculture, Ecosystems and Environment.

Column number	Variable	Description
1	Farm	Farm coded by region and AES type
2	Setting out date	Date pan traps set out (dd/mm/yyyy)
3	Round	Sampling round (1,2 or 3)
4	Point number	Sampling point
5	SO time	Time when pan traps set out (hours:minutes:seconds)
6	SO wind speed knots	Wind speed when pan traps set out (knots)
7	SO cloud cover 8ths	Cloud cover when pan traps set out (oktas)
8	SO Temp C	Temperature when pan traps set out (degrees Celsius)
9	CI time	Time when pan traps collected in (hours:minutes:seconds)
10	CI wind speed knots	Wind speed when pan traps collected in (knots)
11	CI cloud cover 8ths	Cloud cover when pan traps collected in (oktas)
12	CI Temp C	Temperature when pan traps collected in (degrees Celsius)
13	Hours pans left out	Number of hours pan traps left out for
14	Notes	Notes and comments on pan trapping process

**Filename:** 7\_Poll\_transect\_species\_data\_1213\_CJH.txt

This file contains data on the pollinating insects observed on transects in 2012 and 2013, including the plants visited and a short description of habitats written in the field. These data were used in Chapter 3 and the publication Hardman et al. (2016) in the Journal of Applied Ecology and in Chapter 4 and the publication Hardman et al. (2016) in Agriculture, Ecosystems and Environment.

Column number	Variable	Description
1	Year	Year of pollinator transect survey
2	Farm	Farm coded by region and AES type
3	Date	Date of pollinator transect survey (dd/mm/yyyy)
4	Point number	Sampling point number
5	Round	Sampling round (1,2 or 3)
6	Order	Order of insect observed on transect (Diptera, Hymenoptera, Lepidoptera)
7	Family	Family of insect observed on transect
8	Genus	Genus of insect observed on transect
9	Species	Species of insect observed on transect
10	Plant_visited	Scientific name of plant which insect was observed visiting on transect
11	Time	Time of survey
12	Temp	Temperature during transect survey (degrees Celsius)
13	Wind	Wind speed (knots)
14	Cloud	Cloud (oktas)
15	Habitat_description	Short description of habitat focusing on vegetation structure
16	Notes	Notes on unusual conditions

**Filename:** 8\_Floral\_data\_13\_CJH.txt

This file gives data on floral resources that were collected in 2013. These data were used in Chapter 4 and the publication Hardman et al. (2016) Agriculture, Ecosystems and Environment.

Column number	Variable	Description
1	Farm	Farm coded by region and AES type
2	Point	Sampling point
3	Habitat	Habitat in which sampling took place
4	Observer	Observer who carried out floral survey in the field: CH = Chloe Hardman, CD = Cassie-Ann Dodson, CR = Chris Reilly
5	Date	Date of floral survey (dd/mm/yyyy)
6	Point	Sampling point for floral survey 2013
7	Quadrat or transect	Whether records are from a 1 m <sup>2</sup> quadrat or a 49 m x 1 m transect
8	Survey area (m <sup>2</sup> )	Survey area (m <sup>2</sup> ) of quadrat or transect
9	Plant species name	Scientific name of plant species
10	# Floral units	Number of floral units recorded
11	Average flowers per floral unit	Mean number of open flowers per floral unit from three representative specimens

**Filename:** 9\_Phytometer\_data\_13\_CJH.txt

This file contains data from the experiment which used potted plants to measure pollination services. These data were used in Chapter 4 and the publication Hardman et al. (2016) Agriculture, Ecosystems and Environment.

Column number	Variable	Description
1	Farm	Farm coded by region and AES type
2	Point number	Phytometer sampling point number
3	Point letter	Phytometer plant letter (A, B, C)
4	Developed pods	Number of seed pods which fully developed
5	Undeveloped pods	Number of seed pods which did not fully develop
6	Arrangement	Whether the phytometer plants were arranged in a triangle as planned or whether this had to be changed to a line due to practical constraints
7	Vigour score	Visual score describing the vigour of the phytometer plant (1 = very healthy (lots of green leaves), 2 = average, 3 = below average (some brown leaves))
8	Drought	1 = evidence of drought, 0 = no evidence of drought
9	Disturbed	1 = evidence of disturbance, 0 = no evidence of disturbance
10	Dead	1 = phytometer plant died, 0 = phytometer plant survived
11	Date out	Date phytometer set out on farm (dd/mm/yyyy)
12	Date in	Date phytometer collected in from farm (dd/mm/yyyy)

**Filename:** 10\_Bird\_species\_data\_1314\_CJH.txt

This file contains data from the bird surveys carried out in 2013 and 2014 by local voluntary ornithologists using distance sampling methods similar to that used in the British Breeding Bird Survey. These data were used in Chapter 3 and the publication Hardman et al. (2016) in the Journal of Applied Ecology. Note: there were no surveys at farm CS\_Org in 2014.

Column number	Variable	Description
1	Year	Year of survey
2	Farm	Farm coded by region and AES type
3	Round	Sampling round (1 to 5)
4	Transect number	Transect identification number (1 to 10)

5	Bird species	Common name of bird species
6	Total	Number of bird species
7	Distance category	1 = Within 25 metres either side of the transect line, 2 = Between 25 and 100 metres either side of the line, 3 = More than 100 metres either side of the line, F = Birds in flight only, at any distance
9	Left/Right	L = left side of transect, R = right side of transect
8	Seen/heard	S = seen  H = heard only
10	Observer	Two initials identifying the observer (see acknowledgements for full names)
11	Notes	

**Filename:** 11\_Bird\_transects\_1314\_CJH

This file contains weather and other environmental data collected as part of the bird surveys carried out in 2013 and 2014. Note: there were no surveys at farm CS\_Org in 2014.

Column number	Variable	Description
1	Year	Year of survey
2	Farm	Farm coded by region and AES type
3	Transect number	Identification number of bird transect
4	Date	Date of survey (dd/mm/yyyy)
5	Cloud	Cloud: 1=0-33%, 2=33-66%, 3=66-100%
6	Rain	Rain: 1= None, 2= Drizzle, 3= Showers
7	Wind	Wind: 1= Calm, 2= Light, 3=Breezy
8	Visibility	Visibility: 1=Good, 2= Moderate, 3= Poor
9	Visibility left	O=open, R=restricted
10	Visibility right	O=open, R=restricted
11	Start time	Time at which transect started to be surveyed
12	End time	Time at which transect finished being surveyed

**Filename:** 12\_Flower\_density\_14\_CJH.txt

These data on floral resources were collected in 2014 and used in Chapter 5 of the PhD thesis.

Column number	Variable	Description
1	Farm	Farm coded by region and AES type
2	Date	Date of survey (dd/mm/yyyy)
3	Round	Sampling round (1 to 4)
4	Point	Sampling point code/number with L indicating hedgerow transect

5	QA, QB or T	QA = quadrat A, QB = quadrat B, T = transect
6	Habitat	Habitat in which survey was carried out
7	Survey area (m <sup>2</sup> )	The area of quadrat or transect surveyed
8	Plant name	Scientific name of plant species
9	#FU	Number of floral units in the quadrat or transect
10	Flowers per FU	Mean number of open flowers per floral unit from five specimens

**Filename:** 13\_Poll\_transect\_species\_data\_14\_CJH.txt

This file gives pollinator data collected in 2014 on transects and used in Chapter 5 of the PhD thesis.

Column number	Variable	Description
1	Farm	Farm coded by region and AES type
2	Date	Date of survey (dd/mm/yyyy)
3	Point	Sampling point code/number with L indicating hedgerow transect
4	Round	Sampling round (1 to 4)
5	Observer	Initials of observers doing surveys
6	Time	Time hr hr :min min 24 hour format
7	Temp (Celsius)	Temperature recorded during transect survey in degrees Celsius
8	Wind speed max (m/s)	Wind speed recorded using anemometer (metres per second)
9	Cloud	Cloud cover (oktas)
10	Habitat	Habitat name or code
11	Habitat description	Description of the habitat
12	Order	Order of pollinating insect
13	Genus	Genus of pollinating insect
14	Species	Species of pollinating insect
15	Sex	F = female, M = male, Q = queen, W = worker
16	Specimen ref	A unique identification number for the specimens which were pinned for identification
17	Flower visited scientific name	Scientific name of plant which pollinator was observed visiting the flower of, during the transect
18	Number of flower visits	Number of times pollinator visited flowers, having to fly between each visit
19	Caught?	Whether the pollinator specimen was caught using a hand net, Y = yes, N = no
20	Notes	Any additional observations