



# North Wyke Farm Platform

## Biodiversity Data



## User Guide



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# The North Wyke Farm Platform: Biodiversity Data

**DOI:** <https://doi.org/10.23637/rothamsted.993x2>

**Cite as:** Beaumont, D., Hawkins, J.M.B., and Harris, P. (2025). The North Wyke Farm Platform: Biodiversity Data, *Rothamsted Research, Harpenden, UK*. 32pp.

<https://doi.org/10.23637/rothamsted.993x2>

**Version:** 1.0

**Published by:** Rothamsted Research, Harpenden, UK

**Date:** 11 June 2025

**Description:** The North Wyke Farm Platform (NWFP) was established in 2010 to study and improve grassland livestock production at the farm-scale. The NWFP uses a combination of environmental sensors, routine field and lab-based measurements, and detailed management records to monitor livestock and crop production, emissions to water, emissions to air, soil health, and biodiversity. The rich NWFP datasets help researchers to evaluate the effectiveness of different grassland (and arable) farming systems, which in turn, contributes to the development of sustainable, resilient and net zero land management strategies. This document serves as a user guide to the biodiversity data collections. This document is associated with other dedicated user guides that detail the design, establishment and development of the NWFP, field events, and the quality control process of datasets.

**Site:** North Wyke, Okehampton, Devon, UK. Geographic location: 50.76944, -3.90138; 50°46'10" N, 3°54'05" W.

**Funding:** Rothamsted Research receives strategic funding from the UK Biotechnology and Biological Sciences Research Council (BBSRC). The NWFP has been supported by grants BB/J004308/1, BBS/E/C/000J0100 and is currently supported by grant BBS/E/RH/23NB0008 (2023-28).

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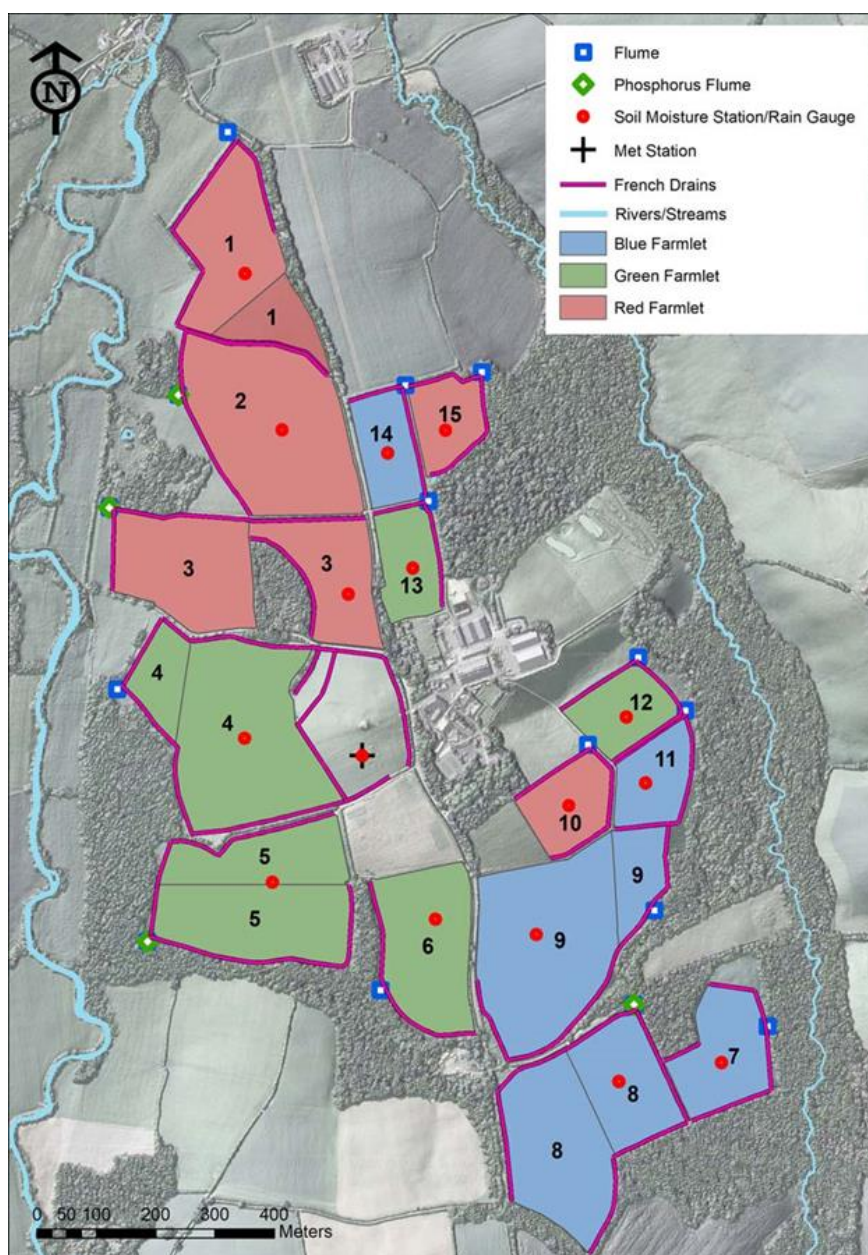
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# 1 Introduction

This document provides a guide to the biodiversity data collections produced on the NWFP (Figure 1). Information on the site characteristics and design and development of the NWFP can be found in the User Guide entitled 'NWFP\_UG\_Design\_Develop.pdf' available at <https://repository.rothamsted.ac.uk/item/98y1x/the-north-wyke-farm-platform-design-establishment-and-development>. Site-wide field surveys for botanical composition can be found in the User Guide entitled 'NWFP\_UG\_FieldSurvey\_Data.pdf', also available on the NWFP website.

Figure 1. Map of NWFP showing systems as of 2015-2019 (first system change period <sup>1</sup>).



<sup>1</sup> Green farmlet = permanent pasture, Blue farmlet = high sugar grass/clover; Red farmlet = high sugar grass, and later converted to arable in autumn 2019 (start of second system change period). In November 2017, phosphorus was measured at catchment or flume 3 in addition to flumes 2, 5, & 8. From autumn 2023 onwards phosphorus will be measured on all catchments. Numbers represent catchment number. Note some catchments consist of multiple fields.

## 2 Acoustic Monitoring

### 2.1 Background

As many taxa vocalise, using passive automated acoustic recorders is an effective way to track biodiversity trends across spatial and temporal scales. Researchers are increasingly using acoustic recorders as they are non-invasive, can be deployed in the field for extended times at multiple sites, and can detect wildlife beyond what can be visually seen either by a surveyor or camera. Recordings are either in the audible range sound (e.g. birds, most mammals, amphibians) or ultrasound range (e.g. bats, bush-crickets).

All British bat species are insectivores and play an important role as a natural control method for pest insects on both crops and livestock. Monitoring of bat species and their population dynamics can act as an important indicator of ecosystem health as they are sensitive to changes in land use, farming practices and climate.

Bats are challenging to monitor because most are nocturnal, wide-ranging and can be difficult to identify. An effective and efficient way of monitoring bats is to record their echolocation calls as each species has distinctive calls and therefore can be used to identify species.

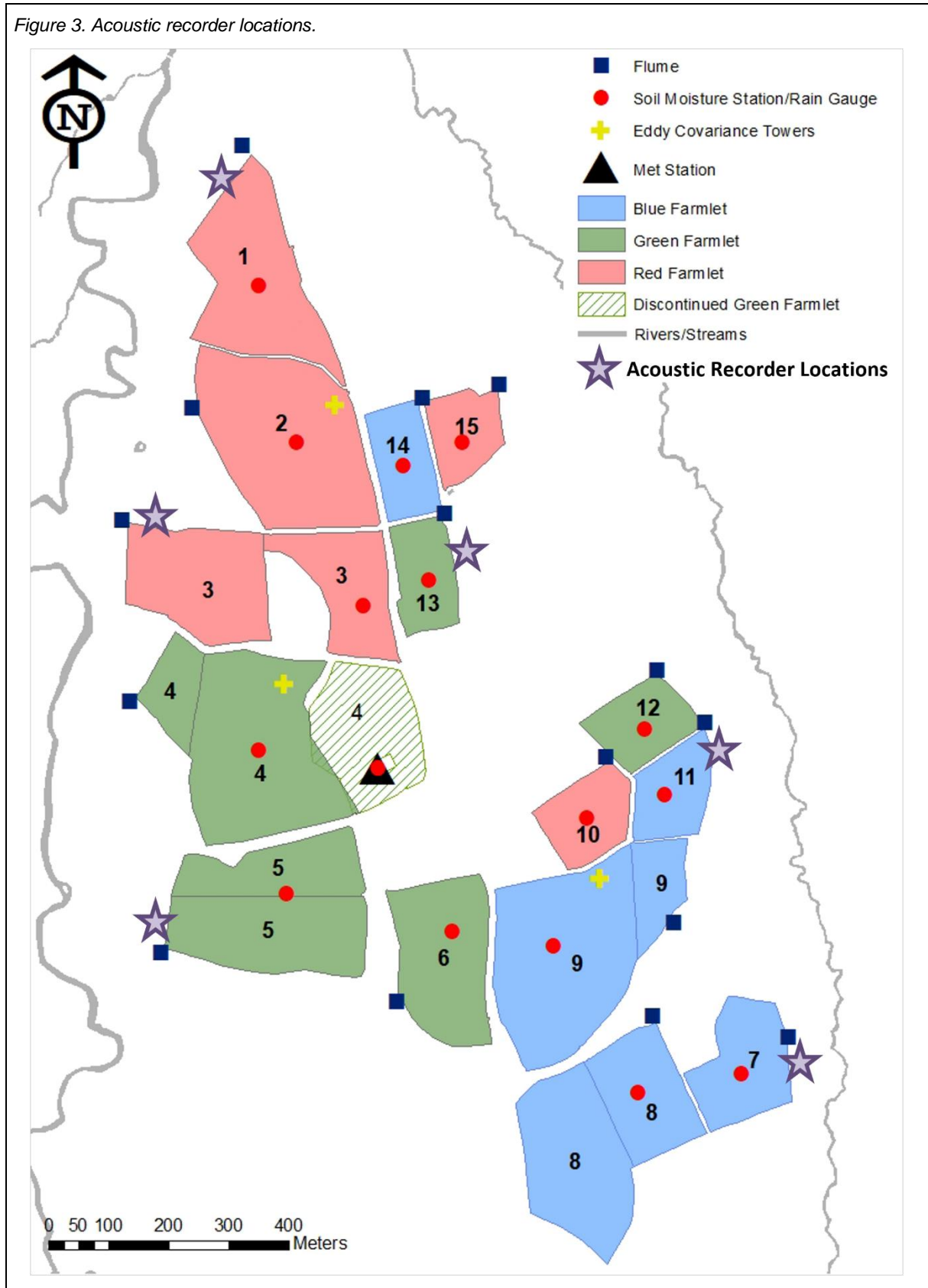
### 2.2 Location and deployment of acoustic recorders

Monitoring commenced in October 2022 for one week each month using six static Song Meter Mini Bat (SMMB) [Wildlife Acoustics, Maynard, MA, USA] recorders (Figure 2) located in the field margins on the NWFP (Figure 3). The recorders are attached to wooden posts at a height of 2m and set to record in the ultrasonic range to monitor bat species presence, and seasonal activity patterns and are rotated around the NWFP field margin sites to prevent recorder bias.

Figure 2. Song Meter Mini Bat acoustic recorders.



Figure 3. Acoustic recorder locations.



## 2.3 Recorder deployment in the field

Monitoring is carried out over a period of 7 nights. The recorders are set to record 30 minutes before sunset on the second Tuesday of each month and recording stopped 30 minutes after sunrise on the third Tuesday of each month. The settings for the recorders are given in [Appendix A](#).

## 2.4 Data collection and storage

All audio recordings (.wav files) are stored so data can be further interrogated to investigate new questions beyond the initial research inquiry and reanalysed as new methods and identification algorithms develop. Audio recordings can be used for estimations of species presence, abundance, community composition and monitoring spatial and temporal changes in behaviour. Alternatively, biodiversity indices can be calculated using the whole recording (“the soundscape”) to quantify aspects of the acoustic environment.

## 2.5 Data processing

The audio recordings are uploaded to the BTO acoustic pipeline [<https://www.bto.org/our-science/projects/bto-acoustic-pipeline>], which applies machine learning algorithms to classify sound events using a random forest classifier. Once processing is complete, .csv files are downloaded from the pipeline, and which contain the information in [Appendix B](#).

Automated audio analysis tools such as the BTO acoustic pipeline have improved in accuracy and efficiency due to innovations in signal processing and machine learning. However, it is best practise to use both standardised methods alongside automated or semi-automated analysis to ensure good quality data. BTO recommend that the pipeline species identifiers with a probability of less than 0.5 i.e. 50%, are discarded from data analysis as advocated by Barre et al. (2019), however these recordings may also be checked depending on the research question. BTO species identifiers need to be verified prior to data analysis to quantify error rate. To check whether the ‘assigned’ species is correct, an experienced bat acoustics analyst needs to manually verify identifications (i.e. standard method) by viewing spectrograms in the raw .wav form files.



### 3 BIOSCAN Malaise Trapping

#### 3.1 Background

The NWFP is participating in the BIOSCAN project [<https://bioscan.tol.sanger.ac.uk>] led by the Wellcome Sanger Institute; a network of malaise traps across the UK to passively collect arthropods. Specimens are analysed by the Sanger Institute using DNA barcoding to provide a baseline characterisation of species diversity over space and time and will provide a resource for DNA-based biomonitoring in the UK. The project is part of the global BIOSCAN [<https://ibol.org/bioscan/>] initiative to develop globally accessible DNA-based systems to establish biodiversity baselines and reveal species interactions. The protocols are similar to the Global Malaise Programme <https://biodiversitygenomics.net/projects/gmp/>.

##### 3.1.1 Location

Two malaise traps, supplied by the Sanger Institute, are deployed on a monthly basis for a 24-hour period on the NWFP. One trap is located in the field drainage margin of Orchard Dean South (currently permanent pasture) and the other on a grassland margin in Poor Field (currently arable) see Figure 4. Each trap is deployed within a few meters of a static acoustic recorder location (see Section 2). Both traps are positioned to intercept flying insects, perpendicular to a flight line along the edge of a treeline.

*Figure 4. Malaise traps sited on grassland and arable field margins.*



##### 3.1.2 Protocol

Trapping started in January 2023 and traps are deployed to coincide with acoustic recording i.e. a suitable 24-hour weather window (low wind speed, no or low rainfall) within the week starting from the second Tuesday of each month. During 2023, each 24-hour trapping period was split in two to coincide with acoustic monitoring timings i.e. the first specimen collection from dusk-dawn and the second from dawn-dusk in order to assess potential prey availability for bats. Each catch bottle contains 50mls of 100% ethanol and on collection samples are stored at room temperature away from light. Individual specimens are placed into 96-well plates, and batches of plates and associated catch tubes are sent quarterly to the Sanger Institute for DNA sequencing. If specimens are too large to fit into a well, a leg or head is placed into the well and the remaining parts placed into the appropriate catch tube for

archiving. At each sampling timepoint, photographs are taken of each catch (Figure 5) and each plate (Figure 6) and metadata recorded.

Figure 5. Catch contents.



Figure 6. Plated specimens.



### 3.1.3 Metadata Protocol

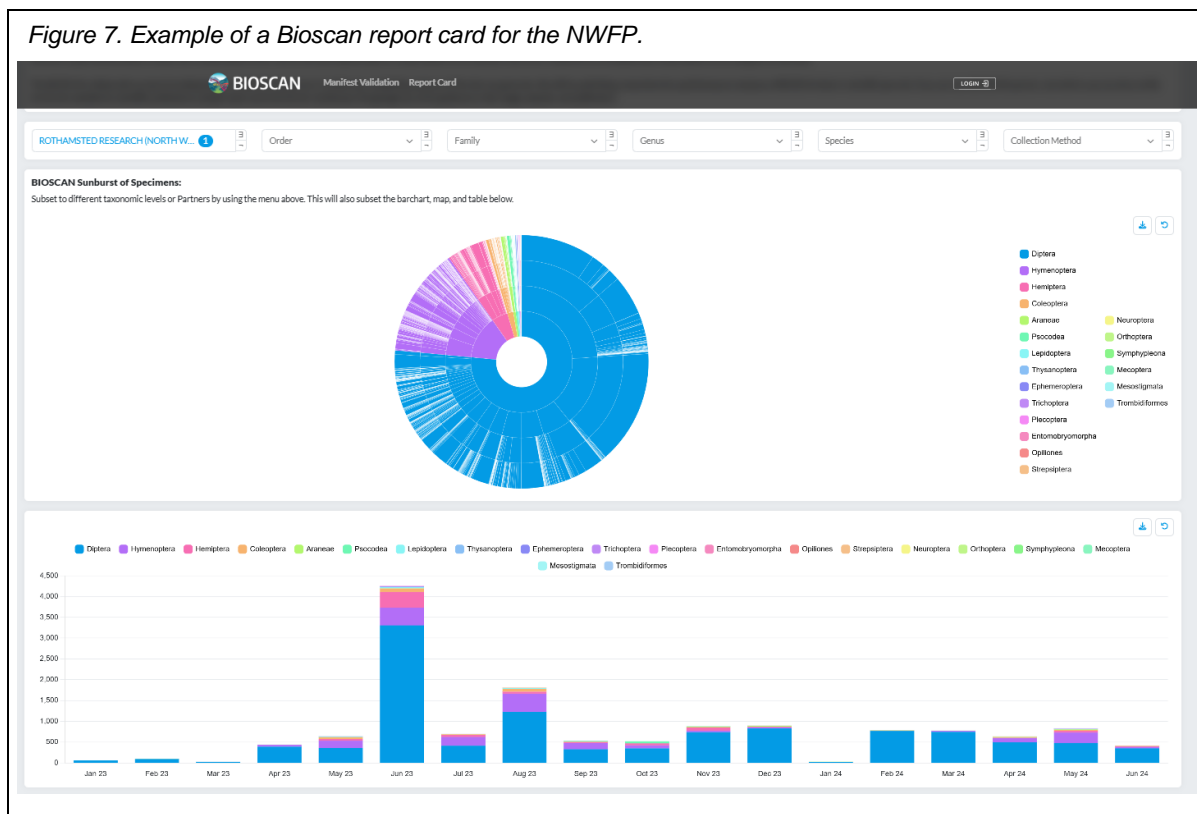
The project has a detailed BIOSCAN Manifest Standard Operating Procedure V3.1 to ensure correct and comprehensive metadata is captured at a single sample level (each plate well). Once a batch of samples is ready to ship, an online [Tree Of Life Onboarding Form](#) is completed, and the associated manifest Excel file is uploaded to the manifest validation portal [\[https://bioscan.tol.sanger.ac.uk/manifest-validation\]](https://bioscan.tol.sanger.ac.uk/manifest-validation).

Once validation is complete, the BIOSCAN team email a sample tracking system (STS) version of the manifest. Once these steps have been completed shipping is then arranged with the Sanger BIOSCAN team. A new manifest Excel file is started for the next sampling period.

### 3.1.4 Data Processing

At Sanger, each plate is imaged, and a small aliquot of DNA is extracted from each specimen. The ~658 base pair of the cytochrome c oxidase subunit I gene (COI) from each insect's mitochondrial genome is used for sequencing. Once data has undergone quality control, each successfully sequenced specimen is added to the Barcode Of Life Data (BOLD) system [\[https://www.boldsystems.org/\]](https://www.boldsystems.org/). BOLD is a cloud based data repository and analysis hub developed at the Centre for Biodiversity Genomics in Canada. Within BOLD, each specimen is allocated a Barcode Index Number (BIN). A BIN indicates the similarity with other specimens in the BOLD database and is used to verify species identifications. As more records are added to BOLD, BINs can change over time. The BIOSCAN project also provides a report card of recorded species [\[https://bioscan.tol.sanger.ac.uk/report-card\]](https://bioscan.tol.sanger.ac.uk/report-card) for each partner site to enable comparisons across space and time (Figure 7).

Figure 7. Example of a Bioscan report card for the NWFP.



As a proportion of specimens will not have a match in the BOLD database, one of the objectives of the BIOSCAN project is to contribute to the reference index for UK arthropods. The BIOSCAN report cards are linked to the BOLD system, and so report cards can be populated with more records as more species identifications become available in the BOLD database.

## 4 Biodiversity Monitoring Aligned to AgZero+ Project

### 4.1 Background

Since June 2023, a variety of species that provide key ecosystem functions have been monitored on the NWFP. The data are supporting a five-year research programme [AgZero+; <https://agzeroplus.org.uk/>] that was initiated in 2022 to support the UK's transition towards home-grown food production that is sustainable, carbon-neutral and enhances biodiversity. The project is jointly funded by the Natural Environment Research Council (NERC) and the Biotechnology and Biological Sciences Research Council (BBSRC) and led by the UK Centre for Ecology and Hydrology (UKCEH) in partnership with Rothamsted Research, British Geological Survey, Plymouth Marine Laboratory, and the National Centre for Earth Observation. AgZero+ is assessing innovative farm managements to help define practical pathways to achieve arable and livestock farming systems that minimise negative trade-offs between agricultural productivity and the environment. Measurements on commercial farms

will be linked with data from long-term experimental platforms to demonstrate the benefits of new farming approaches. Data from the NWFP are helping to contribute to the development of biodiversity baselines and metrics, using single or multiple attributes, to provide an assessment of the biodiversity value in each of the three NWFP management systems.

Within the AgZero+ project, two categories of farmland units are sampled:

1. **Cropped Land Parcel (F):** Parcels (fields) are selected to represent the main crop types (both arable and pasture) on each farm, including within field innovations (e.g. agroforestry), field edge and non-crop habitats within the parcel, such as field margins (e.g. grass strips) and hedgerows.

Several sites are sampled within each cropped land parcel:

- **Field Centre (FC):** either 100 m from field edge or field centre if the field is small.
- **Crop Field edge (FE):** the field edge is within the crop, 1 m in from crop edge.
- **Field Boundary (FB):** typically, hedgerows and/or non-sown vegetation (e.g. nettles, brambles etc.) at the edge of the land parcel and forming a boundary between two fields.

If present:

- **Field Margin (FM):** non-crop field margin, or potentially field corner habitat typically established as part of an agri-environmental scheme that does not include the crop (e.g. low input cereals or grassland) such as wildflower strip, grass margin, beetle bank.
- **In-Field Strip (IF):** features within the field such as agroforestry.

2. **Non-cropped Land Parcel (N):** Representative of major non-cropped habitats on the farm e.g. Woodland Deciduous (WD), Woodland Coniferous (WC), game cover areas (GC).

## 4.2 NWFP Biodiversity Sampling Sites

Transects and various trapping methods are used to monitor a variety of species at field boundaries, field margins, field edges (1m from field edge) and field centres (50m from the field edge) in six NWFP fields, two fields in each management treatment. As far as possible the six fields were selected with a similar surrounding landscape (hedgerows, woodlands). Four non-cropped areas in deciduous woodland adjacent to the monitored fields were selected for sampling sites (Table 1 and Figure 8).



Table 1. NWFP Biodiversity sampling sites aligned to the AgZero+ project.

Field / Wood	Farmlet	Catchment	Sampling Unit	Land Use	AgZero+ Code
Poor Field	Red	3	Cropped Land (F)	Arable	NWP_F1
Ware Park	Red	3	Cropped Land (F)	Arable	NWP_F2
Orchard Dean North	Green	5	Cropped Land (F)	Pasture	NWP_F3
Orchard Dean South	Green	5	Cropped Land (F)	Pasture	NWP_F4
Higher Wyke Moor	Blue	8	Cropped Land (F)	Pasture	NWP_F5
Middle Wyke Moor	Blue	8	Cropped Land (F)	Pasture	NWP_F6
Joseph Carr Wood	n/a	n/a	Non-cropped land (N)	Wood	NWP_N1
Bioenergy Plantation	n/a	n/a	Non-cropped land (N)	Wood	NWP_N2
Taw Wood	n/a	n/a	Non-cropped land (N)	Wood	NWP_N3
Wyke Moor Wood	n/a	n/a	Non-cropped land (N)	Wood	NWP_N4

Figure 8. Biodiversity Sampling Sites.



In each field, sampling locations are on the north boundary, therefore, transects from the field edge to the field centre are orientated north-south and transects at the field boundary or field margin run west-east. Due to the NWFP field units differing from a typical farm, in five of the 6 monitored fields the field boundary (FB) sampling locations and transects i.e. next to hedgerows, are located outside of the field managed for agricultural productivity. Field margins (FM) are located within cropped land units so only the two arable fields have a margin (grass). As Orchard Dean North is narrow running north to south, all 6 field centre (FC) sampling points are located 50m south of each field fence.

## 4.3 Protocols

Using standardised biodiversity sampling/surveying protocols across multiple projects adds value and increases research impact. The AgZero+ project farm surveys are scheduled to be conducted for three years (2023, 2024 and 2025). The 2023 field season was considered a pilot year to develop and test the monitoring protocols, therefore the timing of some protocols is different in 2024 and 2025. Potentially, the NWFP surveys could continue post 2025 to provide long-term data sets.

### 4.3.1 Pitfall Traps

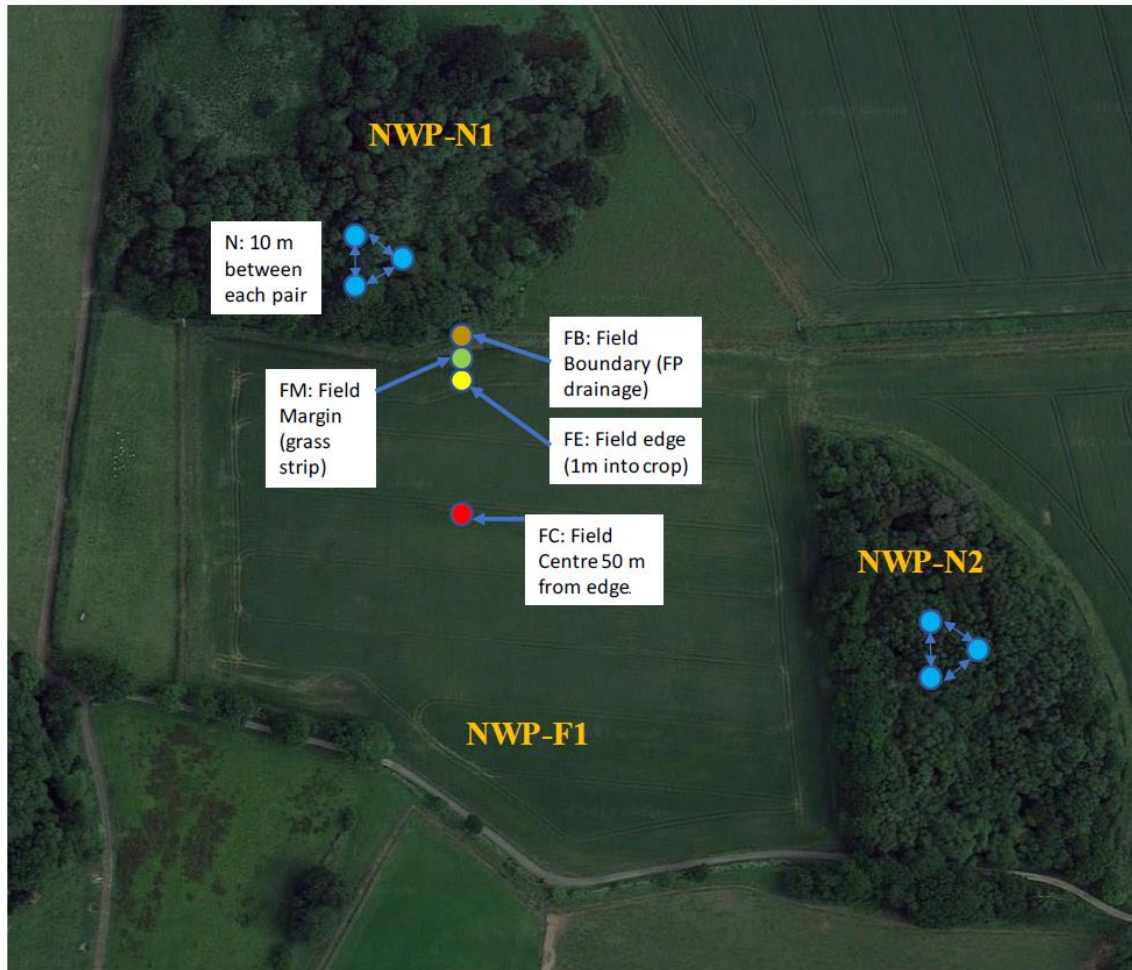
Traps were deployed for two, 2-week trapping periods running consecutively from late June 2023 to late July 2023. From 2024 onwards traps were deployed for 2 weeks in May and 2 weeks in July.

#### 4.3.1.1 Location

- **Cropped sampling points** i.e. field (F): FB, FE, FC and FM and IF, if present. At each sampling point, two pitfall traps deployed 2 m apart.
- **Non-cropped sampling points (N)**: At each location, in the centre of the land parcel there are three sampling points, 10 m apart forming a triangle. At each of the three sampling points deploy a pair of traps 1 m apart.

An example of the locations of pitfall traps for Poor Field (NWP\_F1) and adjacent woodland (NWP\_N1, NWP\_N2) is given in [Figure 9](#).

Figure 9. Trap locations for Poor Field (NWP\_F1) and adjacent woodland (NWP\_N1, NWP\_N2).



#### 4.3.1.2 Methodology

Pitfall traps (PT) consist of a polypropylene cup, 6cm diameter x 7.5cm deep with a lid. Each trap cup is half filled with a 50% solution of Ethylene Glycol (blue) and water and capped. An appropriately sized soil auger is used to make a hole so that when the cup is inserted, the top of the cup is flush with the surrounding ground, and there is no gap between the soil and the cup to ensure that insects can fall into the trap. Once the cup is correctly sited, the lid is removed, and its position marked with a stake (Figure 10).

Figure 10. Pitfall trap.



All the pitfall traps are deployed on the same day and left in place for 14 days. On collection, at each location in the field (F), the catch from both traps is amalgamated into one and capped with a labelled lid. In the case of the non-cropped (N) areas, the catch from all 6 traps is amalgamated into one.

The labelling information for the catch includes date of collection, sampling method (e.g. PT), site code (e.g. NWP), field or non-cropped number (e.g. F1, N1), location (e.g. FB, FE, FM, WD) and number of trap days (e.g. NTD=14).

The capped cups are kept refrigerated until the ethylene glycol solution can be decanted (ideally as soon as possible after collection) via the use of a small sieve to ensure no catch specimens are lost. The catch is then covered with 70% ethanol and capped. Catch samples are sent to Rothamsted Research, Harpenden for identification of the specimens (all ground beetles identified to species, staphylinidae to genera, spiders to main functional groups, and collembola counted).

#### **4.3.2 Pan Trapping**

In 2023, traps were deployed for two, 3-day trapping periods in July and August. From 2024 onwards traps are deployed for 3-day trapping periods in June and July.

##### **4.3.2.1 Location**

- **Cropped sampling points** i.e. field (F): One cluster of 3 pans (yellow, blue and white) placed at FE (1 m into crop or pasture).
- **Non-cropped sampling points** (N): One cluster of 3 pans (yellow, blue, white) placed in centre of non-crop habitat.

##### **4.3.2.2 Methodology**

Pan traps (AKA water traps; WT) are brightly coloured bowls that superficially resemble flowers to attract foraging insects. Different insects are attracted to different colours of flowers so using three traps will capture a larger range of insects than using just one type. Each pan trap consists of a cluster of bowls (white, yellow and blue) that are set in an equidistant triangle and mounted on a metal pole so that the pans are above the surrounding vegetation ([Figure 11](#)). Each bowl is filled with soapy water (a few drops of washing up liquid). All the pan traps are deployed on the same day for a period of 3 days.



Figure 11. Pan traps.



On collection, at each location, the catch from the three pans is amalgamated into one container, after firstly removing the soapy water using a sieve and a small paint brush to gently brush the insects from the sieve into the container. The specimens are covered with 70% ethanol, the container capped with a labelled lid and placed in a fridge.

The labelling information for the catch includes date of collection, sampling method (e.g. WT), site code (e.g. NWP), field or non-cropped number (e.g. F1, N1), location (e.g. FE or WD), number of trap days (e.g. NTD=3).

#### 4.3.3 Artificial slugs

Artificial 'slugs' representing prey are used to make assessments of natural pest control in arable fields. No assessments were made in 2023 but 'slugs' were deployed from 2024 onwards for 3 days in May and 3 days in June.

##### 4.3.3.1 Location

Arable fields only:

- **Cropped sampling points** i.e. field (F): One cluster of 5 artificial slugs placed at FE (1 m into crop) and FC (50 m into crop).

##### 4.3.3.2 Methodology

Artificial 'slugs' are made from ~1.5cm long and 0.5cm diameter pieces of green non-toxic plasticine (e.g., Newplast green non-toxic modelling clay). At each sampling point (FE & FC), five artificial 'slugs' are placed on the soil surface in an 'X', with each 'slug' separated by ~30cm, and each location marked with a cane (Figure 12).

All the 'slugs' are deployed on the same day for a period 3 days. On collection, each 'slug' is individually stored in a labelled microtube (handled carefully so that no bite marks are erased, or extra indentations formed) and associated metadata recorded. A magnifying glass is used to distinguish three types of bites, (noting any bird pecks), and the density of each bite category is recorded (Table 2).

Figure 12. Deployment of Artificial 'slugs'.

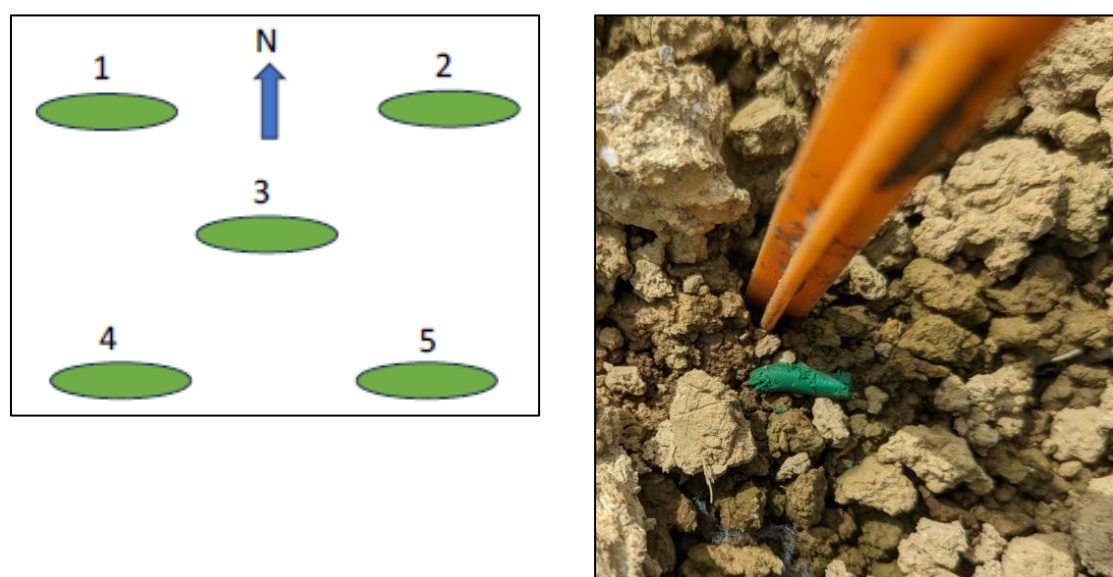


Table 2. Categories and density of bite marks on artificial 'slugs'

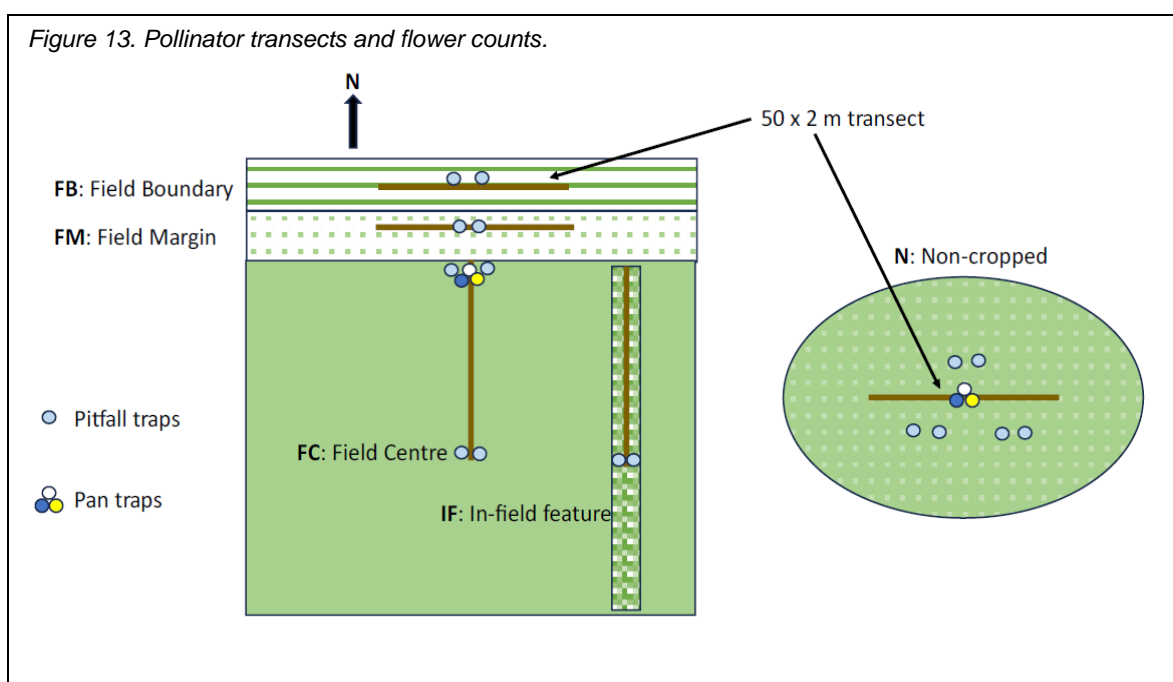
Type of bite	Description	Density of bite numeric categories
Small beetle (SB)	Looks like created by a pin	1 = 1-5 bites/pecks per slug of a given size class 2 = 5-10 bites/pecks per slug 3 = >10bites/pecks per slug
Large beetle (LB)	Looks like created by a scalpel	
Rodent bites (RB)	Evidence of teeth marks and/or large volumes of plasticine been removed	
Bird pecks (BP)	Can often see shape of beak	

#### 4.3.4 Pollinator transects and flower counts

One survey is conducted in June and another in July.

##### 4.3.4.1 Location

- **Cropped areas:** In all sampling fields, one 50m x 2m transect is surveyed along the field boundary (FB) and one 50m x 2m transect going into the field (FC - perpendicular to the edge). If a field margin (FM) or an in-field feature (IF e.g. agroforestry strip) is present, then one 50m x 2m transect is carried out in these areas (Figure 13)
- **Non-cropped areas:** a single 50m x 2m transect surveyed through the centre (Figure 13).



##### 4.3.4.2 Methodology

Pollinator surveys are conducted between 09:30 - 17:00, when shade temperature is above 13°C with at least 60% clear sky (or > 15°C in any sky conditions), no rain and windspeed not exceeding 5 on the Beaufort Scale. Each transect is observed for five minutes by walking slowly along the boundary of each transect to prevent the disturbance of insects. At the start of the survey the date, time, transect location and weather conditions (temperature, windspeed and cloud cover %) are recorded. The total number of insects visiting flowers and flying within the transect area are recorded for each insect category (Table 3).

Table 3. Insect species/families recorded in Pollinator transects.

Insect group	Recorded total number of species / genus / family / order
Butterflies	Identified to species
Honeybee	<i>Apis mellifera</i>
Bumblebees	<i>Bombus lapidaries</i> (red-tailed) <i>Bombus terrestris</i> / <i>lucorum</i> (buff-tailed / white-tailed – grouped as difficult to distinguish) <i>Bombus pascuorum</i> (common carder) <i>Bombus pratorum</i> (early) <i>Bombus hortorum</i> (garden) <i>Bombus hyonorum</i> (tree) <i>Bombus ruderatus</i> (ruderal) <i>Bombus psithrus</i> (cuckoo bumblebees)
Wild bees	<i>Andrena</i> spp (mining) <i>Lasioglossum</i> spp (sweat) <i>Anthophora</i> spp (flower) <i>Solitary other</i> / <i>unknown</i>
Hoverflies	<i>Syrphinae</i> group <i>Eristalis</i> group Other
Other flies	total
Parasitoids	(specifically seen feeding on flowers)

Once a pollinator survey is completed, all dicot species in flower along the transect are recorded using a scale. Each transect is split into five equal sections of 10m x 2m, and within each section, each flowering species is given a score.

The first score, 'frequency of flowers', refers to the number of sections a particular species is in bloom (i.e. if a buttercup is in flower in 3 out of the 5 sections the score is 3). The second score indicates the 'flower cover' for each species:

- 1 = < 10 individual flowers and < 1% cover in the transect area.
- 2 = > 10 individual flowers and < 1% cover in the transect area.
- 3 = 1-5% cover of flowers in the transect area.
- 4 = > 5% cover of flowers in the transect area.

One umbel (e.g. *Heracleum sphondylium*), one head (*Trifolium repens*), one spike (e.g. *Rhinanthus minor*) or one capitulum (e.g. *Leucanthemum vulgare*) is classed a one flower unit.

#### 4.3.5 Plant community assessments

One survey is conducted in July.

##### 4.3.5.1 Location

- **Cropped areas:** In all sampling fields, one 50m x 2m transect surveyed along the field boundary (FB) and one 50m x 2m transect going into the field (FC - perpendicular to the edge). If a field margin (FM) or an infield feature (IF e.g.



agroforestry strip) is present, then one 50m x 2m transect to be undertaken in these areas.

- **Non-cropped areas:** a single 50m x 2m transect will surveyed though the centre.

The same transect areas is used for the pollinator and flower count surveys ([Section 4.3.4](#)).

#### 4.3.5.2 Methodology

The presence (not % cover) of all plant species rooted within 50cm x 50cm quadrats, at 5m intervals along each 50m x 2m transect is recorded along with the transect location and date of survey.

### 4.3.6 Weed seedbank assessments

These were carried out September 2023 during a time window between arable crop harvesting and sowing.

#### 4.3.6.1 Location

- **Cropped areas (only F1-6):** sample collection points at field edge (FE) and field centre (FC).

#### 4.3.6.2 Methodology

In each field, a 5cm diameter corer was used to collect three 0-15cm deep soil cores at the field edge (FE), in the vicinity of the pitfall traps at 1m intervals (west-east). All three FE soil samples were placed into a labelled bag and sealed. The procedure was repeated at the field centre (FC), and the samples bulked into a separate bag. Sampling dates and location were recorded. The samples were stored at <4°C and in dark conditions until they were sent to Rothamsted Research, Harpenden for processing where germinating seedlings from the soil samples were identified.

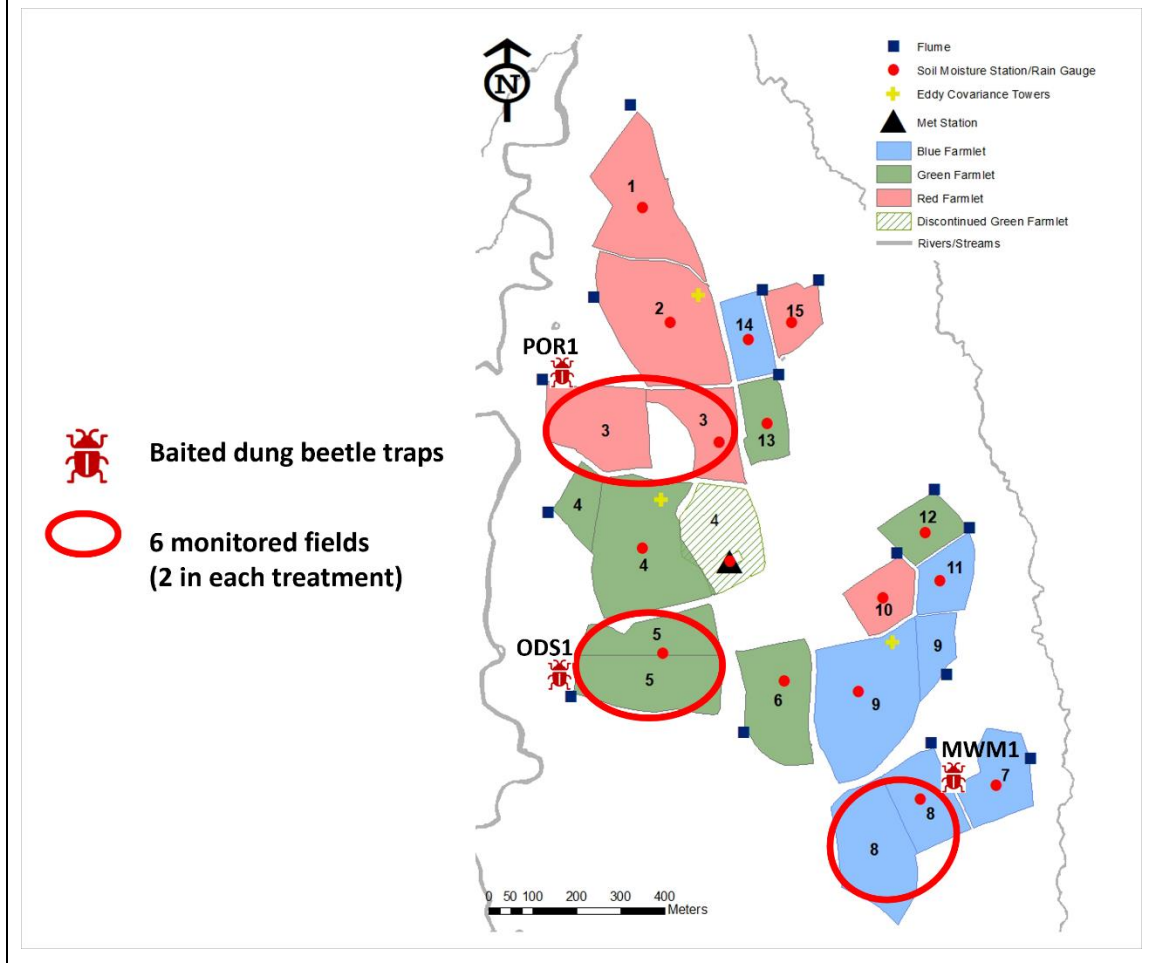
### 4.3.7 Dung beetle sampling

In 2023 baited dung traps were deployed for 7 days in August and hand-sorting conducted once in August. From 2024 onwards, baited traps were deployed twice for 7 days in May and August, dung hand-sorting sampling also biannually in May and August.

#### 4.3.7.1 Location

**Baited dung traps:** One baited trap per farmlet, located in the NWFP drainage areas, to protect from livestock damage ([Figure 14](#)). Two of the traps (Poor Field and Orchard Dean South) are located within 1m of the static acoustic recorder locations ([Section 2.2](#)).

Figure 14. Location of baited dung beetle traps: POR1, ODS1, and MWM1.



**Dung hand-sorting sampling:** In 2023, hand-sorting only occurred in the NWFP fields designated for AgZero+ monitoring if livestock were present in a field on the day of sampling. From 2024 all NWFP fields where livestock are present were sampled.

#### 4.3.7.2 Methodology

**Baited pitfall traps:** A 2.5L container is filled to a depth of 4cm with a 50/50 mix of propylene glycol and water and the container sealed with a lid. The container is inserted into a hole so that the top of the container is level with the soil surface and the lid removed. A mesh is placed over the container and tent pegs used to secure it. A ball of fresh, homogenised dung (~1kg) is put in the centre of the mesh (Figure 15).

Figure 15. Baited dung beetle traps and example of a catch.



In 2023 the traps were baited with the dung collected from the farmlet and livestock type in the vicinity of the trap (ODS1: 'green' cattle dung collected from Orchard Dean South; MWM1: 'blue' sheep dung collected from Middle Wyke Moor). From 2024 onwards only cattle dung is used as bait. Since the 'red' arable farmlet has no livestock, cattle dung is collected from the 'green' farmlet. Tent pegs are used to set a plant pot saucer (large enough to protect the trap from rain) above the dung at a height to allow insects access to the dung. All the traps are deployed on the same day and are collected seven days later. All insects (not just dung beetles), including larvae are collected from the trap and placed in a labelled (date of collection, location, baited dung trap, dung type) specimen tube containing propylene glycol and are stored in fridge. All relevant metadata including where the dung used for each trap was collected from is recorded.

**Dung hand-sorting sampling:** Sampling is carried out in fair (not too hot/dry or wet) weather conditions on one of the days during the same week the dung baited traps are deployed. One sample of ~2kg of dung of differing ages is collected from each NWFP field where livestock are present by sub-sampling across the field in a 'W' pattern. The soil interface under each dung sub-sample is inspected for tunnels and the number recorded. Each dung sample is put in a white tray, broken apart, and sorted through for 15 minutes (to standardise the sampling effort) to collect all invertebrates (including larvae) which are placed in a labelled (date of collection, location, hand-sorting, dung type) specimen tube containing propylene glycol and stored in a fridge until identification.

## 5 Additional Sampling

In addition to the standard AgZero+ protocols previously described, the six monitored NWFP fields (Section 4.2) have two extra measurements as outlined below.

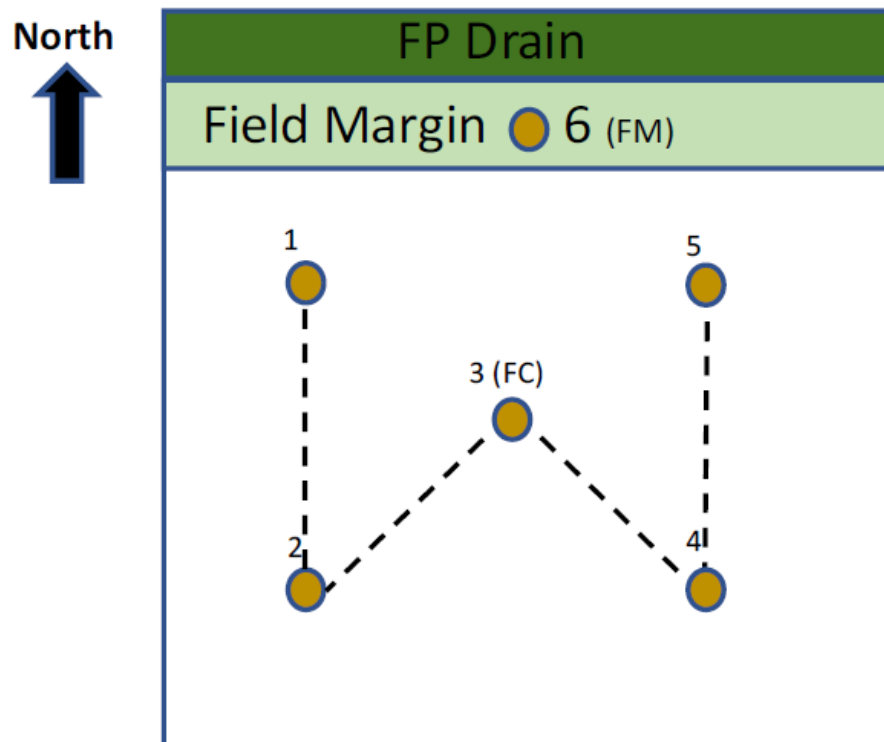
### 5.1 Earthworms

Carried out once a year in September to coincide with pre-cultivation of arable fields (i.e. after harvest and before sowing).

#### 5.1.1 Location

- **Only in cropped areas (F1-6):** Five locations in a 'W' pattern (Figure 16) within each field, one of which is in the vicinity of the field centre (FC). Samples are taken at the field margin (FM) if present.

Figure 16. Sampling in a 'W' pattern.



#### 5.1.2 Methodology

Earthworms are sampled when they are more likely to be active (warm and moderate-high soil moisture levels). In each field, at each sampling location a 20cm x 20cm x 20cm hole is dug and the extracted soil placed on a mat. The soil is hand-sorted for 10 minutes to standardise the sampling effort, and each earthworm put into a labelled plastic pot along with a small amount of soil and stored in a fridge. Within a day of collection, the earthworms are separated into juveniles (no saddle present) and adults (saddle present) for each sample. The number



and biomass (g) only of juveniles is recorded whilst the adult earthworms are separated into three functional groups:

1. Epigeic (litter-dwelling earthworms).
2. Endogeic (topsoil earthworms).
3. Anecic (deep burrowing earthworms).

The number and biomass (g) of each of the three adult categories is recorded along with all relevant metadata (sampling date, location, land management details). Once all the information has been obtained the earthworms are released.

## 5.2 Plant Community Assessment

Carried out once a year in July.

### 5.2.1 Location

All six 'AgZero+' NWFP monitored fields ([Section 4.2](#)).

### 5.2.2 Methodology

Botanical assessments of all the NWFP fields have been done several times on the NWFP 50m sampling grid as described in the NWFP [User Guide to Field Survey Data](#). The same method described in the guide is used to survey the six 'AgZero+' fields annually. Quadrats (50cm x 50cm) are positioned on the ground with the south-west corner directly on the sampling grid point and the western edge aligned in a northerly direction using a compass. The Domin scale ([Table 4](#)) is used to visually assess the estimated percentage cover of each species rooted within the quadrat plus bare ground and is recorded along with relevant metadata (survey date, location, comments).

*Table 4. The Domin scale for estimating the % cover of plant species.*

Cover	Domin Score
91-100%	10
76-90%	9
51-75%	8
34-50%	7
26-33%	6
11-25%	5
4-10%	4
<4% (many individuals)	3
<4% (several individuals)	2
4% (few individuals)	1

## 6 Biodiversity Genomics Europe: Pollinator Communities

### 6.1 Background

The Biodiversity Genomics Europe (BGE) Consortium aims to accelerate the use of genomic science to enhance understanding of biodiversity, monitor biodiversity change, and guide interventions to address its decline. Within the BGE initiative the Pollinator Communities project was established to compare pollinator communities in gardens and agricultural fields (excluding livestock pastures) across Europe using Malaise traps to sample sites. Arthropod bulk samples are analysed using DNA metabarcoding to improve the inventory of pollinators and set a baseline for temporal trends in European garden and agricultural habitats.

#### 6.1.1 Malaise Trapping

##### 6.1.1.1 Location

When not being used for the BIOSCAN project (see [Section 3](#)), the malaise trap in Poor Field ([Section 3.1.1](#)) was set for five continuous weeks in June/July 2024. An additional trap was sited away from the NWFP in a garden environment ([Figure 17](#)).

*Figure 17. Malaise trap in a garden setting.*



##### 6.1.1.2 Methodology

Each collection bottle contained 300mls of ethanol (at least 96%) and samples were collected every 7 days on the same day of the week by swapping the filled bottle with a fresh one. At the end of a 7 day sampling period, it was permissible to interrupt sampling for 24 hours if the traps were required for the BIOSCAN project. Each bottle was labelled with a barcode and all the relevant metadata recorded (location, location code, barcode ID,

week number, start and collection date and time). The samples were stored at room temperature, away from light exposure, whilst ensuring the arthropods were submerged in the ethanol and unopened to avoid contamination. The samples were sent to the Institute of Natural Products and Agrobiology, La Laguna, Tenerife for analysis. Data will be kept externally but access is generated for all project collaborators.

## 7 Data Portal

The NWFP Data Portal (<https://nwfp.rothamsted.ac.uk/>) allows accessibility to the core NWFP datasets to not only Rothamsted Research but also the wider research community. The data are open access and free to download but users are required to register their interest. For the biodiversity data collections, some datasets are openly available through the data portal, while some are openly available via other avenues.

The NWFP website (<https://nw-farmplatform.rothamsted.ac.uk/>) offers a wealth of online, and regularly updated information to complement the data.

## 8 Citing the Data

If you choose to use any of datasets provided by the NWFP in a publication, please cite:

- Orr, R. J., Murray, P. J., Eyles, C. J., Blackwell, M. S. A., Cardenas, L. M., Collins, A. L., Dungait, J. A. J., Goulding, K. W. T., Griffith, B. A., Gurr, S. J., Harris, P., Hawkins, J. M. B., Misselbrook, T. H., Rawlings, C., Shepherd, A., Sint, H., Takahashi, T., Tozer, K. N., Whitmore, A. P., Wu, L. and Lee, M. R. F. (2016). *The North Wyke Farm Platform: effect of temperate grassland farming systems on soil moisture contents, runoff and associated water quality dynamics*. *European Journal of Soil Science*, 67, 4, 374-385. ([doi:10.1111/ejss.12350](https://doi.org/10.1111/ejss.12350)).

In addition, if using data from the baseline period please cite:

- Takahashi, T., Harris, P., Blackwell, M. S. A., Cardenas, L. M., Collins, A. L., Dungait, J. A. J., Hawkins, J. M. B., Misselbrook, T. H., McAuliffe, G. A., McFadzean, J. N., Murray, P. J., Orr, R. J., Rivero, M. J., Wu, L. and Lee, M. R. F. (2018). *Roles of instrumented farm-scale trials in trade-off assessments of pasture-based ruminant production systems*. *Animal*, 12, 8, 1766-1776. ([doi:10.1017/S1751731118000502](https://doi.org/10.1017/S1751731118000502)).
- Orr, R. J., Griffith, B. A., Rivero, M. J. and Lee, M. R. F. (2019). *Livestock Performance for Sheep and Cattle Grazing Lowland Permanent Pasture: Benchmarking Potential of Forage-Based Systems*. 9, 2, 101-118. ([doi:10.3390/agronomy9020101](https://doi.org/10.3390/agronomy9020101)).

For the datasets used, please cite the latest version of the relevant User Guide PDF document(s), listed in the table below, that describe the establishment and development of the NWFP, and the various datasets produced in detail. Note that the User Guide entitled 'NWFP\_UG\_Design\_Develop.pdf' should be cited irrespective of the dataset used.

Table 5. User guides to the NWFP data.

Data used	Main title of User Guide PDF document	DOI
All datasets	NWFP_UG_Design_Develop.pdf	<a href="https://doi.org/10.23637/rothamsted.98y1x">https://doi.org/10.23637/rothamsted.98y1x</a>
15-minute time-series datasets (water, soil moisture, meteorology)	NWFP_UG_Hydrology&WaterQuality_Data.pdf	<a href="https://doi.org/10.23637/rothamsted.98y34">https://doi.org/10.23637/rothamsted.98y34</a>
	NWFP_UG_SMS_Data.pdf	<a href="https://doi.org/10.23637/rothamsted.98y4x">https://doi.org/10.23637/rothamsted.98y4x</a>
	NWFP_UG_MET_Data.pdf	<a href="https://doi.org/10.23637/rothamsted.98y4w">https://doi.org/10.23637/rothamsted.98y4w</a>
Greenhouse gases	NWFP_UG_GHG_Data.pdf	<a href="https://doi.org/10.23637/rothamsted.98y52">https://doi.org/10.23637/rothamsted.98y52</a>
	NWFP_UG_GreenFeed_Data.pdf	<a href="https://doi.org/10.23637/rothamsted.98y53">https://doi.org/10.23637/rothamsted.98y53</a>
Field surveys	NWFP_UG_FieldSurvey_Data.pdf	<a href="https://doi.org/10.23637/rothamsted.98y51">https://doi.org/10.23637/rothamsted.98y51</a>
Livestock	NWFP_UG_Livestock_Data.pdf	<a href="https://doi.org/10.23637/rothamsted.98y50">https://doi.org/10.23637/rothamsted.98y50</a>
Field events	NWFP_UG_FieldEvents_Data.pdf	<a href="https://doi.org/10.23637/rothamsted.98y4z">https://doi.org/10.23637/rothamsted.98y4z</a>
Forage Quantity and Quality	NWFP_UG_Forage_Quantity&Quality_Data.pdf	<a href="https://doi.org/10.23637/rothamsted.992wy">https://doi.org/10.23637/rothamsted.992wy</a>
Biodiversity Data	NWFP_UG_Biodiversity_Data.pdf	<a href="https://doi.org/10.23637/rothamsted.993x2">https://doi.org/10.23637/rothamsted.993x2</a>

Also, please include the following sentences in the acknowledgments section:

*“The North Wyke Farm Platform is a UK National Capability supported by the Biotechnology and Biological Sciences Research Council (BBS/E/RH/23NB0008).”*

*“We acknowledge the interests of the Ecological Continuity Trust (ECT), whose national network of LTEs includes the experiment on which this research was conducted.”*



## 9 References

Barré, K., Le Viol, I., Julliard, R., Pauwels, J., Newson, S. E., Julien, J.-F., Claireau, F., Kerbiriou, C. and Bas, Y. (2019). Accounting for automated identification errors in acoustic surveys. *Methods in Ecology and Evolution*, 10, 1171-1188. <https://doi.org/10.1111/2041-210X.13198>.

## 10 Acknowledgements

Acknowledgement and thanks for the development and provision of the sampling protocols are given to the following:

Rothamsted Research: Hannah Romanowski for the acoustic monitoring described in [Section 2](#).

British Trust for Ornithology (BTO): Dr. Stuart Newson for providing advice on acoustic recorder settings and deployment height.

Wellcome Sanger Institute - BIOSCAN: Dr. Mara Lawniczak & Dr. Lyndall Pereira) for protocols described in [Section 3](#).

AgZero+: UKCEH - Prof. Niall McNamara, Prof. Richard Pywell & Dr. Ben Woodcock; Rothamsted Research - Prof. Jonathan Storkey & Dr. Samantha Cook for the pitfall trap, pan trap, artificial prey, pollinator transect, flower counts, plant community assessment and weed seedbank protocols described in [Section 4](#).

Rothamsted Research: Dr. Kelly Jowett for the dung beetle protocol described in [Section 4.3.7](#).

BIOPOLIS – CIBO: BGE Pollinator Communities: Dr. Laura Nájera Cortazar for the malaise trap protocol described in [Section 6.1.1](#).

## 11 Appendices

*Appendix A. Settings for Song Meter Mini Bat acoustic recorder.*

Setting	Definition	Recommended BTO setting for standardised bat calls
Recording Format	Full spectrum (full acoustic soundscape) creates .wav files. Zero-crossing (only detects strongest frequency of a signal) creates .zc files	Full spectrum
Full spectrum sample rate	Highest audio frequency that can be recorded in full spectrum	384 kHz
Non-triggered recording		OFF
Minimum trigger frequency	Minimum frequency that an ultrasonic sound will trigger recording	15 kHz
Maximum recording length	Maximum length that recording will last once triggered	5 seconds
Trigger window	Silence between ultrasonic triggers	2 seconds
Save noise files	Sets files whether files considered noise will be deleted or will be saved and marked as noise files for further review.	ON
Left channel gain	Adjusts the amplitude of the sample recorded by the ultrasonic microphone	0 db (set low so bats recorded near the recorder are not too loud and overload the device)

*Appendix B. Information supplied from BTO Acoustic Pipeline post-processing.*

Information	Description
Recording file name	Given by pipeline (includes the coordinates entered in the BTO Survey Metadata )
Original file name	Name of original wav file
Latitude	
Longitude	
Scientific name	Scientific name of organism identified
English name	English name of organism identified
Species group	Broad organism group (bats, bird, small mammal, bush cricket)
Probability	Estimated probability of correct classification (i.e., false positive rate). The probability is scaled so that the higher the probability, the lower the false positive rate.
Warnings	Warning message if species identified is unlikely or very rare in the area.
Actual data	Exact date of the recording in actual time
Survey date	Date of the survey that the recording is associated with (e.g. survey date at 03:18 will be the date of the previous evening when the survey began).
Time (of recording)	