Biological Recording Company

Sapperton Wilder

Baseline Earthworm Survey Report

Keiron Derek Brown

Version 1

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Funded by and produced for

sapperton wilder

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Earthworm Surveys

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Katie Ling
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Contents

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Introduction

The Sapperton Wilder is a regenerative farming experiment to test improving biodiversity and socioeconomic returns from marginal Cotswold land. The site was previously intensively farmed arable land.

The site is divided intro 3 blocks, which are further divided into a total of 19 fields (see Figure 1). A further 3 fields are used as control sites at other farms within Gloucestershire.

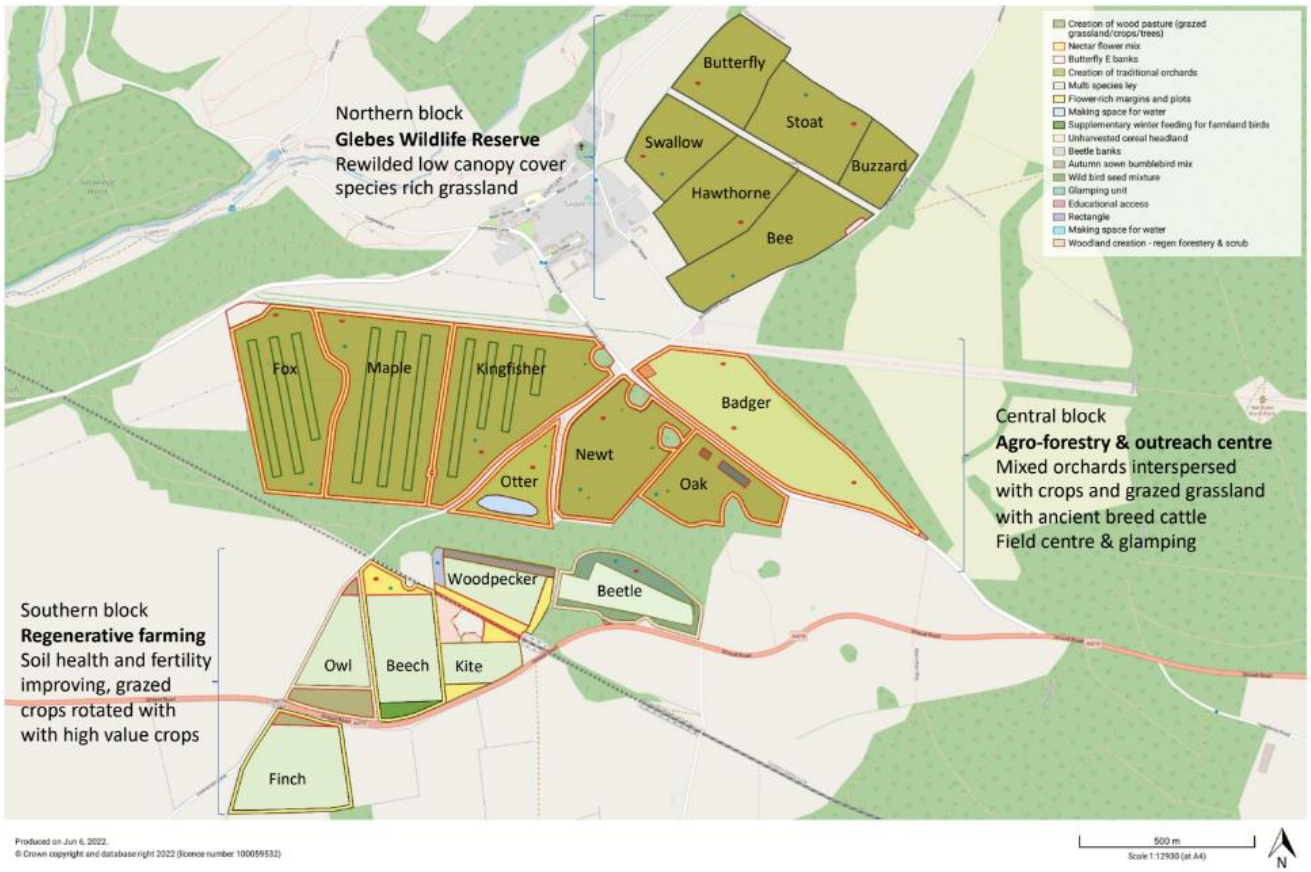

Figure 1: Land use map illustrating the location of the 3 blocks and 19 fields contained within the Sapperton Wilder experiment.

The Biological Recording Company was commissioned in April 2023 to assist in undertaking a baseline survey of the sites involved in the Sapperton Wilder experiment in Gloucestershire prior to the beginning of experimental treatments across the study site.

Earthworms are widely regarded to be of great ecological importance, with different ecological categories of earthworm contributing to soil processes and resulting in a number of ecosystem services (see Figure 2) (Keith & Robinson, 2012).

Understanding earthworm populations across the experiment site and how they are impacted post-treatment will be important for measuring the impact of the various treatments being applied.

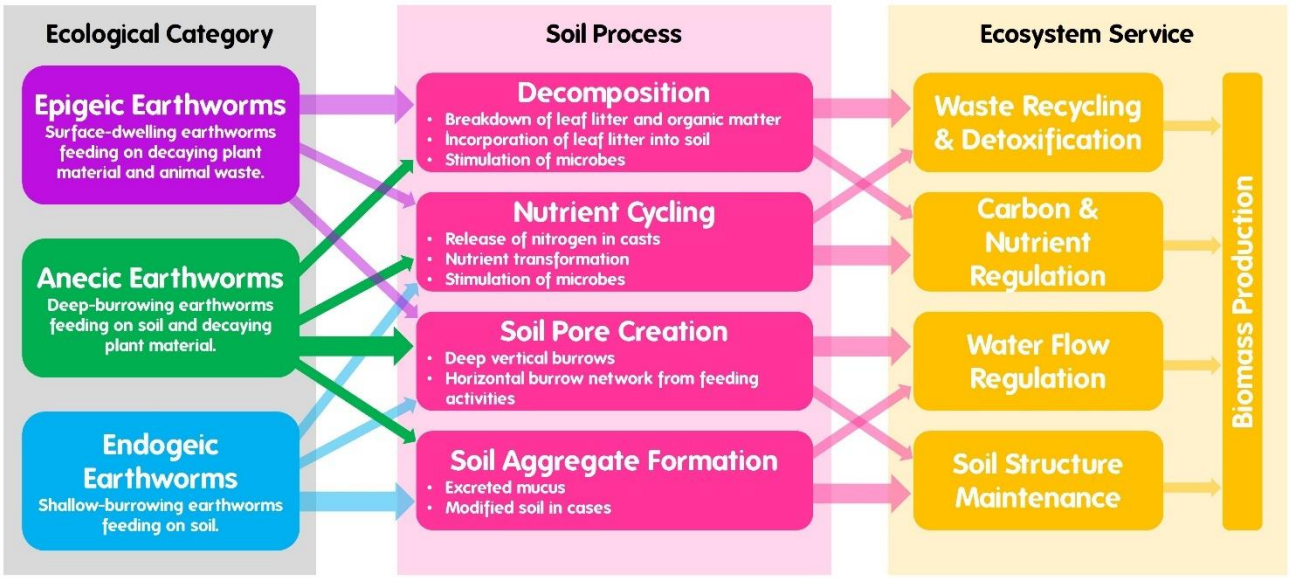

Figure 2: Earthworm ecosystem services adapted from (Keith & Robinson, 2012).

Earthworm Survey Methodology

The survey involved undertaking small-scale soil pit surveys within each of the 19 fields involved in the experiment and at 3 control sites, totalling 22 soil pit survey locations. At each sample site a random point was selected within the target field and 5 soil pits were excavated, following the National Earthworm Recording Scheme guidance on soil pit sampling and the 'NERS 5 pit protocol' (Brown, Earthworm Recorders Handbook [Version 8], 2019).

For each soil pit:

1. A soil pit measuring approximately 25cm by 25cm was excavated to a depth of around 10cm was excavated. Always check the empty pit to make sure no earthworms are in the bottom or sides!
2. The soil excavated from the pit was placed on a sorting tray and the pit was checked for any earthworms.
3. Any adult earthworms that were found in the soil were removed and collected into a labelled sample tube.
4. Any juvenile earthworms that were found were returned to the soil pit and the total number of earthworms returned to the soil were recorded.
5. The soil was returned to the pit once the contents has been sorted and compacted down to avoid leaving a hole or uneven surface that people could trip over.

For each site:

1. 5 replicate soil pit excavations were completed, all within the same 100 m OS grid square.
2. A Soil Pit Survey Form was completed, recording the sampling date, name of the field and location (e.g., Beetle Field, Sapperton Wilder), name of the lead surveyor (recorder name), 6-figure OS grid reference, habitat, number of soil pits sampled and any other notes regarding the sampling site.
3. All earthworm specimens were examined and identified where possible using a microscope the Key to the Earthworms of the UK & Ireland (2nd Edition). Where specimens were not originally identified by Keiron Brown, they were checked and species determination verified by Keiron Brown.
4. The total number of unidentified earthworms was calculated by adding the number of unidentifiable specimens from the sample tubes to the number of specimens returned to the soil in the field.
5. The data for each site was submitted to the National earthworm Recording Scheme via the Soil Pit Survey form on iRecord. All records have since been accepted to the National Earthworm Recording Scheme and have passed the National Earthworm Recording Scheme verification protocol (Brown, Verification, 2022).

Limitations of the survey methodology

1. Soil conditions can vary greatly within a single site and are known to have a significant influence on earthworm populations. It is therefore recommended that more than 5 sample points per site are surveyed to gather robust data to inform any conclusions regarding earthworm abundance and diversity at any given location. The budget and capacity for this baseline survey were limited so it was decided to opt for a lower number of replicates per field in order to gather data on each of the 19 Sapperton Wilder fields and 3 control fields.

2. Weather can be another important factor as it has a direct impact on soil conditions, particularly soil moisture. These surveys were undertaken after an unusually dry spring and the soil was noticeably dry. Repeating the survey during a period following wet weather is likely to result in greater abundance and possibly greater species diversity results.

3. Soil pit surveying is effective for extracting soil-dwelling species, particularly endogeic species from the top layers of soil and can easily be standardised and used to gain good qualitative data for research. However, as a sampling method it is biased towards soil-dwelling species (particularly endogeic species) and less effective than mustard sampling for extracting deep-burrowing anecic species.

Survey Results

A total of 887 individual earthworms were recorded across the 22 sample sites (744 from the 19 Sapperton Wilder sites). Of these specimens, 219 were identifiable to species level.

A detailed breakdown of the survey results by sample site can be found in Table 1. The total number of earthworms recorded at a single site ranged from 15 (Stoat field, Northern block) to 76 (Newt field, Central block). The total number of earthworms recorded from the control sites varied even more greatly, from 8 control 2 :) to 98 (Regen ag control) The number of identifiable adults was greatest in (Regen ag control) and Newt field (24) and two of the Southern block fields: Woodpecker (1) and Owl (2). Lower Hampen and Newt showed the highest species diversity, each with 5 species of earthworm recorded. The lowest species diversity recorded was a single species present at a site, and this was the case across 8 different sites (with representatives in all blocks and two out of three of the control sites). The proportion of adults also varied greatly between sites, ranging from 2% (Woodpecker) and 48% (Buzzard, Northern block).

A total of 6 different earthworm species were recorded across the sites out of a total of 30 species known to occur in the UK. All of the species detected at the control sites were also detected at multiple sites within the experiment. 5 of the 6 species recorded are classed as very common or common and 1 species is regarded as uncommon (see Table 2). All of the species recorded have a low habitat specificity and widespread UK distributions.

Allolobophora chlorotica was by far the most recorded species across both the experiment and control sites, accounting for 76.3% of all adult earthworms. This endogeic (shallow-burrowing and feeding on soil) species is the most common species of earthworm within the UK and accounts for 10.7% of all earthworm records submitted to the National Earthworm Recording Scheme. It is known to be disturbance tolerant and commonly recorded in large numbers in agricultural soils.

UK Earthworm Provision Conservation Status Assessment Report

Table 1: Numbers of earthworms sampled at each sample site by species

		Species						Totals		
		Allolobophora chlorotica	*Aporrectodea caliginosa*	*Aporrectodea longa*	*Aporrectodea rosea*	*Lumbricus castaneus*	*Satchellius mammalis*	Adults	Unidentified	**Total Earthworms**
Northern Block	Butterfly	2			1			3	21	**24**
	Stoat	2	1		1			4	11	**15**
	Buzzard	12			1			13	14	**27**
	Swallow	8					1	9	29	**38**
	Hawthorne	6						6	29	**35**
	Bee	14						14	17	**31**
Central Block	Fox	9			5	1	3	18	31	**49**
	Maple	7						7	29	**36**
	Kingfisher	4	2	1	1			8	38	**46**
	Otter	7	4	1				12	19	**31**
	Newt	19	1	2		1	1	24	52	**76**
	Oak	6			2			8	44	**52**
	Badger	7			1		1	9	17	**26**
Southern Block	Finch	10	1					11	31	**42**
	Owl	2						2	52	**54**
	Beech	5						5	34	**39**
	Kite	3	1					4	51	**55**
	Woodpecker	1						1	41	**42**
	Beetle	5	2					7	19	**26**
Control Sites	Regen Ag Control	24	7	1	6		2	40	58	**98**
	Conventional Control 1	11						11	26	**37**
	Conventional Control 2	3						3	5	**8**
	TOTAL	**167**	**19**	**5**	**18**	**2**	**8**	**219**	**668**	**887**

Table 2: Summary of distribution, habitat and rarity statuses. Taken from UK Earthworm Provisional Conservation Status Assessment Report (in prep).

Species	Distribution	Habitat	Rarity
Allolobophora chlorotica	Widespread	Low	Very common
Aporrectodea caliginosa	Widespread	Low	Very common
Aporrectodea longa	Widespread	Low	Common
Aporrectodea rosea	Widespread	Low	Common
Lumbricus castaneus	Widespread	Low	Common
Satchellius mammalis	Moderately widespread	Low	Uncommon

Aporrectodea caliginosa is an endogeic species and was the second most recorded species and accounted for 8.7%. Like *A. chlorotica*, it is often abundant at sites where it occurs and classed as very common. It is also known to be disturbance tolerant and often recorded in large numbers from agricultural soils.

Aporrectodea longa is an anecic (deep-burrowing and feeding on soil and above ground decaying plant material) species and the only anecic species recorded on site. Although it was only detected at 4 sites, it is likely that it is widespread across the site as juvenile anecic earthworms were noted in many of the samples but could not be identified as they were juvenile or damaged. It is regarded as a common species and found in a wide range of habitats (including agricultural soils).

Aporrectodea rosea is another endogeic species and is considered common. It is also considered disturbance tolerant and found in a wide range of habitats, including agricultural soils.

Lumbricus castaneus is commonly found in both the soil and above-ground microhabitats, making it difficult to categorise within any of the ecological categories. It is regarded as a common species and found in a wide range of habitats (including agricultural soils).

Satchellius mammalis is another species that is found in both the soil and above-ground microhabitats 9though it is often classed as epigeic based on its colour and size). It is regarded as uncommon due to the known distribution being more patchy than common species.

Conclusions

Both abundance and species diversity were highly variable across the experiment area and the control sites, making it difficult to make any conclusions regarding the current health of individual sample sites based on earthworm populations.

The species diversity across the whole site was relatively low as just 6 species were recorded, and all of the species were recorded are known to have a low habitat specificity and 5 of the 6 species are regarded as widespread and either very common or common (with just a single species regarded as uncommon and moderately widespread within the UK). This may be a result of the preceding weather and dry soil conditions experienced during sampling or could be a reflection of the historical intensive agricultural use.

It is recommended that further sampling is conducted in autumn/winter 2023 following a sustained period of wet weather to provide a more comprehensive baseline survey.

In order to detect changes over time, surveys should be conducted at a minimum of once per year at the same time each year. Sampling in both spring and autumn/winter will help reduce the impact of anomalous results due to weather conditions and help reduce the impact of natural seasonal variation in earthworm populations.

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