St Edmund Hall Biodiversity Audit Results

NOVEMBER 2023

Contents

Background

Data collection for the 2023 St. Edmund Hall Biodiversity audit was completed in June and July of 2023. Data collection methodologies were a replicate of the original Conference of Colleges 2021 Biodiversity Audit, and further details of audit methodologies can be found in the supplement of this document. This report details the data collected in 2023 compared with the 2021 baseline data for insects, birds, and earthworms, representing the first datapoint for St Edmund Hall to establish biodiversity trends and assess progress towards biodiversity restoration goals. Due to a lack of change in land and tree cover in the college from 2021-2023 these portions of the biodiversity audit were not repeated in 2023. The results of the original land cover and carbon audits from 2021 are reported after the updated sections of the audit.

Acknowledgements

Many thanks to Professor Mark Williams for coordinating data collection and equipment. Thank you to Professor Henrike Lähnemann for taking part in the bird audit at the Queen's Lane site. Kieran E. Storer was responsible for the remaining data collection, analysis, and reporting of audit results. Thank you to Dr Jonathan Green and Professor Tim Barraclough of the Department of Zoology for producing resources and developing methodologies of the original 2021 audit. Thank you to Joel Footring, Katey Fisher, Amelia Jeffery, Abigail Barker and Tom Badenhorst from NatCap Research Ltd for producing and analysing the land cover data in 2021.

Overview

Table 1 below shows the St. Edmund Hall biodiversity dashboard for the groups measured in 2021 and 2023, birds, earthworms, and insects. The overall trends in this data are an increase in bird species and earthworms detected during the audit, and a decline in the number of insects. Detailed accounts of these changes can be found in each group's dedicated section below.

St Edmund Hall Biodiversity Assets Dashboard: 2021 and 2023

Birds	2021	2023	Unit
Species richness	17	25	No. of species
RSPB Birds of Conservation Concern: Red	3	3	No. of species
RSPB Birds of Conservation Concern: Amber	5	5	No. of species
RSPB Birds of Conservation Concern: Green	9	17	No. of species
Earthworms	**2021**	**2023**	**Unit**
Soil-feeding	1	7	No. of worms
Deep-living	0	4	No. of worms
Surface-feeding	0	5	No. of worms
Insects	**2021**	**2023**	**Unit**
Total abundance	500	244	Count
Flies - Diptera	332	108	Count
Beetles (including ladybirds and weevils) - Coleoptera	28	34	Count
Hymenoptera (including ants, bees and wasps) - Hymenoptera	126	102	Count

Table 1: St Edmund Hall biodiversity dashboard for the groups sampled in both 2021 and 2023. Trends show increases in birds and earthworms and decreases in insects between the two sampling periods.

Insects

The 2023 audit took place at the same what3words locations as the 2021 audit (shown in table 2). Blue and yellow pan traps were deployed at three locations on the main college site and two locations offsite, totaling 10 traps across the grounds (5 blue, 5 yellow).

Table 2: What3words Locations of Insect Trapping

Main-site	Offsite
lawn.divisions.frozen	pushy.dates.digit
fairly.native.fend	mile.cheese.mile
yard.organ.double	

Results

In 2023 there were 244 insects trapped in total, approximately half as many as in 2021 (486 insects). This decline in insect abundance in the survey is in part due an emptying of the yellow trap at yard.organ.double during the data collection period. The differences in insect abundance between 2021 and 2023 and may also be due to weather differences in the sampling years, and in the year in between. Particularly, the extreme heat and drought in 2022 likely contributed to changes in insect populations. Despite these declines, a statistical comparison between the two years showed no significant difference in insect abundance due to the high variability of insect data within groups. Continued data collection will shed light on longer term trends within these groups.

Table 3: Abundance and categories of insects obtained from the insect traps on the St Edmund Hall sites.

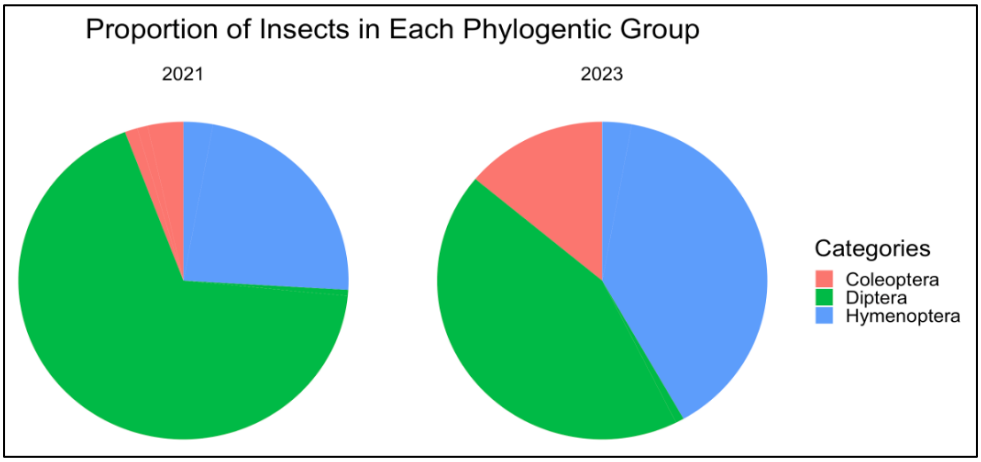
Phylogenetic Family	Phylogenetic Sub-Groups	Year	
		2021	2023
Coleoptera (Beetles)	Ladybirds	6	0
	Weevils	5	0
	Other beetles	17	34
Diptera (Flies)	Hoverflies	3	2
	Other flies	329	106
Hymenoptera (bees, wasps)	Pollinating bees and wasps	14	7
	Parasitoid wasps	112	95
	Total	**486**	**244**

Similar to the 2021 audit the insect groups that were most prevalent in the 2023 audit were parasitoid wasps and flies as shown in Fig., 1. A. Compared to 2021 however, there were proportionally more parasitic wasps, and 'other' beetles (non-ladybirds or weevils) in 2023 (Fig.1., B). This is a positive indicator that the college likely has a diversity of other insects and spiders that

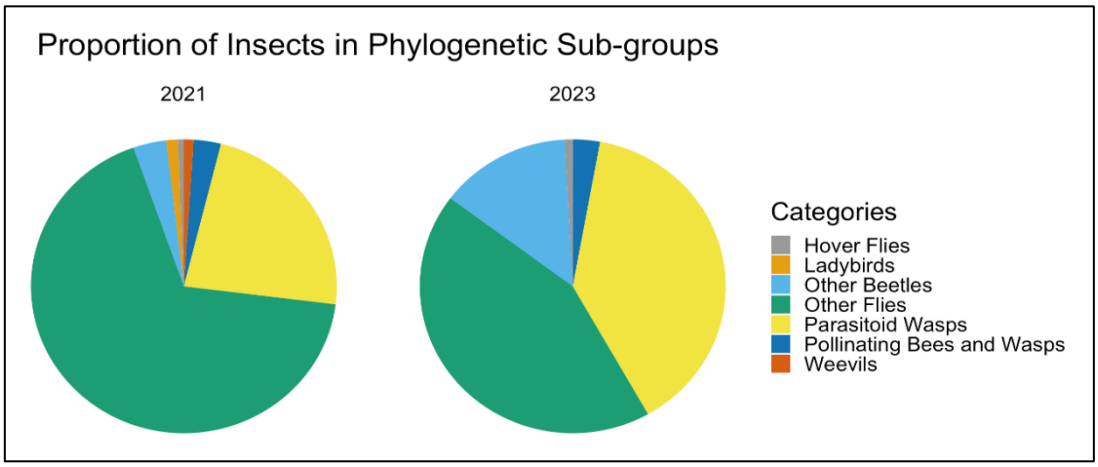
parasitic wasps use as hosts, and that the college is supporting important nutrient cyclers. In terms of the overall insect abundance decline, most of the insect abundance lost between 2021 and 2023 was a decline in dipterans (flies). The number of insects at the main site traps was approximately the same as in the off-site traps, though the main-site traps captured more coleopterans than the off-site locations.

Figure 1: Prevalent Insect Groups and Sub-Groups

a)



b)



Figures 1 a) and b) show breakdowns of the proportion of insects captured in each year falling into phylogenetic groups. Figure 1 a) shows the proportion of insects trapped from each of the three main phylogenetic groups found: coleopterans (beetles), dipterans (flies), and hymenopterans (wasps and bees). Figure 1 b) shows the breakdown of insect phylogenetic sub groups, which shows increases in the proportion of parasitoid wasps (yellow) and other beetles (not ladybirds or weevils, in blue) relative to the total number of insects trapped.

Birds

Bird species were identified by sight and by sound using the Merlin phone application. Records were then compiled and categorised by RSPB Birds of Conservation Concern status (green, amber, red).

Bird species were audited at three locations on the main site St Edmund Hall and at three offsite locations in Norham Gardens. Two of the main site locations were excluded from the data collection due to the high level of background noise interfering with audio species detection and due to lack of activity. Additionally, one of the days of data collection was poor due to heavy rain, a consideration for future data comparison. Fig. 3, shows the trends of bird species in 2021 and 2023, with approximately double the number of green listed bird species in 2023 compared to 2021, an even number of amber listed species across both years, and one less red listed species in 2023 compared with 2021.

Figure 3: Birds of Conservation Concern Categorisation of Species found in St Edmund Hall

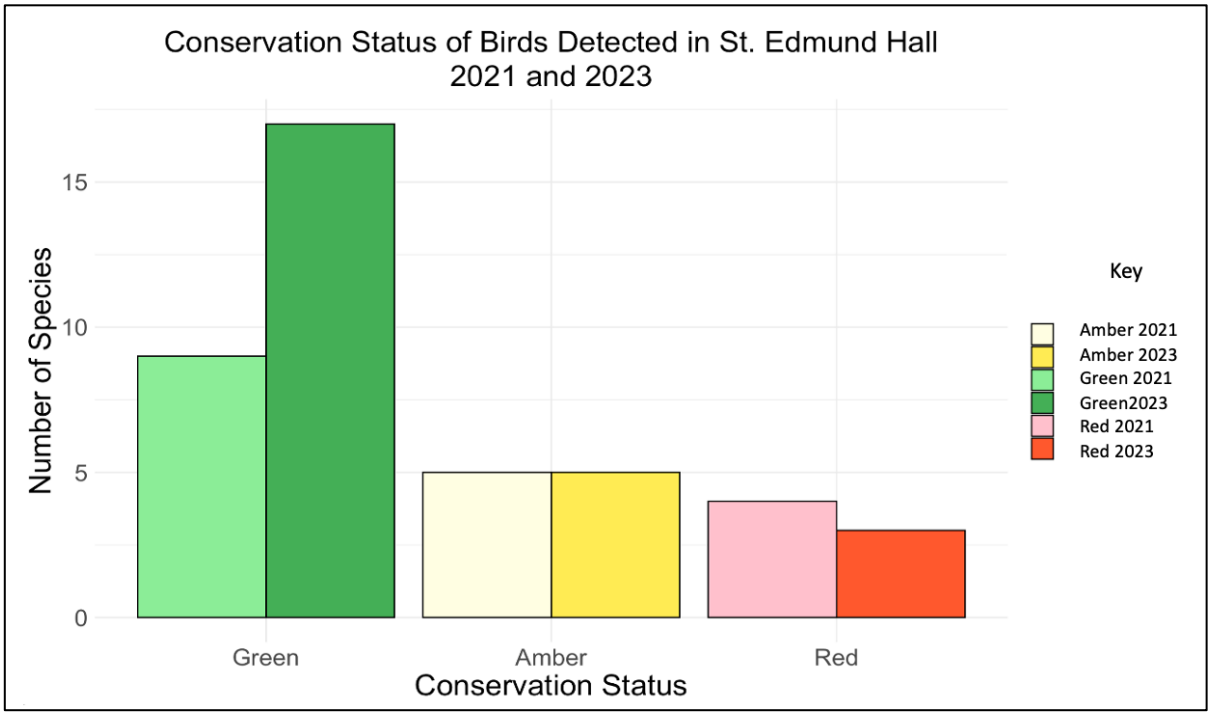


Figure 3 shows a bar chart of the number of bird species in the different conservation categories according to the RSPB Birds of Conservation Concern list (green, amber, and red). The paler columns show records from 2021 and the saturated columns show the results from 2023.

The complete list of bird species detected in each year can be found in Table 4. This table shows that almost all the green listed species that were detected in 2021 were detected again in 2023. Of the amber listed species only wood pigeons and wrens were detected across both years, and of the red listed species, only swifts were detected in both years. These results show that for rarer classes of birds, St Edmund Hall appears to be a transient space rather than a long-term refuge, a consideration for future biodiversity goal setting.

Table 4: Bird Audit Species Lists, 2021 and 2023

Green Listed Bird Species		
Species	2021	2023
Blue Tit	x	x
Carrion Crow	x	x
Chaffinch		x
Coal Tit		x
Collared Dove		x
Blackbird	x	x
Eurasian Jay		x
Goldcrest		x
Goldfinch		x
Great Spotted Woodpecker	x	x
Great Tit	x	x
Jackdaw	x	x
Long Tailed Tit		x
Magpie		x
Robin	x	x
Rook	x	x
Swallow		x
Tree Creeper	x	
Total	9	17

Amber Listed Bird Species		
Species	2021	2023
Black Headed Gull	x	
Bullfinch		x
Common Gull		x
Common Whitethroat	x	
Song Thrush		x
Stock Dove	x	
Wood Pigeon	x	x
Wren	x	x
Total	5	5

Red Listed Bird Species		
Species	2021	2023
House Sparrow		x
Marsh Tit	x	
Mistle Thrush		x
Spotted Flycatcher	x	
Swift	x	x
Yellow Wagtail	x	
Total	4	3

Table 4 shows the species of birds present in the biodiversity audit of St Edmund Hall in 2021 and 2023, along with their RSPB Birds of Conservation Concern classification of green, yellow, or red.

Earthworms

In 2021 and 2023 Earthworms were sampled at the St Edmund Hall what3words locations expect.showed.plug and defeat.limbs.shark, both located off the main college site. In 2021 there was only one earthworm detected across the two sampling locations. In 2023 there were 16 earthworms counted during sampling, with surface feeding, soil feeding, and deep living worms all detected. The abundance of functional groups of earthworms can be seen in Table 4.

Table 5: Earthworm counts by year for each type of earthworm

Earthworm Type	Year	
	2021	2023
Surface Feeding	0	5
Soil Feeding	1	7
Deep Living	0	4

These results show a positive trend for these essential nutrient cyclers. Earthworms are important for maintaining soil quality and fertility and facilitating carbon storage by incorporating organic material into soils. Each group of earthworms has a specific role:

- **Soil feeding (*endogeic*) earthworms** – Live and feed in the top 20cm of soil, rarely coming to the surface. They make horizontal burrows as they feed on the soil, which help mix air into the soil and improve drainage. There are eight species in the UK.
- **Deep living (*anecic*) earthworms** – This type of earthworm makes deep vertical burrows into which they pull leaves to eat during the night, locking carbon into the soil. Their feeding activity modifies the soil structure through the creation of their vertical burrows and increases macro-porosities, aeration, and water infiltration into the deeper soil. There are only three species of deep-living earthworms in the UK.
- **Surface feeding (epigeic) earthworms** – These do not make burrows but live on or near the surface of the soil and eat dead leaves, breaking them down into compost. This decomposition of organic material at the soil surface increases nutrient transformation and helps to stimulate activity of microorganisms. This is the largest group of earthworms in the UK, with 12 species.

Drawing from data across colleges from the baseline surveys in 2021, soil feeding worms were the most common (65% of worms), followed by surface feeding worms (21%) and deep living worms (14%). The 2023 audit shows that in St. Edmund Hall soil feeding worms were the most common as well, but that they also had an elevated proportion of deep living worms. The support of deep living worms is essential for drawing carbon down into soils and shows a positive trend for the college's land management strategies. Similar to the insect data, it is difficult to tell how much of variation is due to changes in weather or natural population variability, but these results show a positive trend for earthworms.

Land Cover, Carbon Storage and Sequestration

These results are a reprint of the data collected and analysed by Nat Cap Research Ltd in 2021.

Land Cover

The majority of landcover on the St Edmund Hall sites is composed of mowed lawn and trees, with relatively few areas of meadow and uncut grass.

Table 6. Asset register of estimated land cover types

Landcover	Area (ha)
Trees	0.27
Mowed lawn	0.29
Wetlands and water meadows	0.00
Herbaceous borders and flower beds	0.14
Meadow and uncut grass	0.03
Water	<0.01
Other	0.98
Total	1.71

Figure 4: Main Site Land Cover Map, Queen's Lane

Figure 4. Land cover map for St Edmund Hall – Queen's Lane site

Figure 5: Off-site Land Cover Map: Crick Road

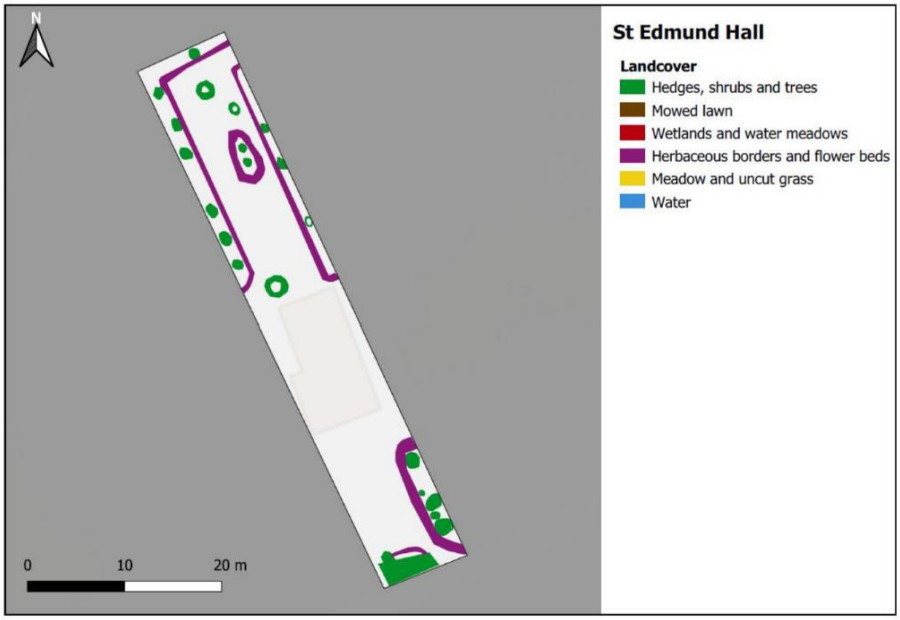


Figure 5. Land cover map for St Edmund Hall – Crick Road site

Figure 6: Off-site Land Cover Map: 24-26 Norham Gardens

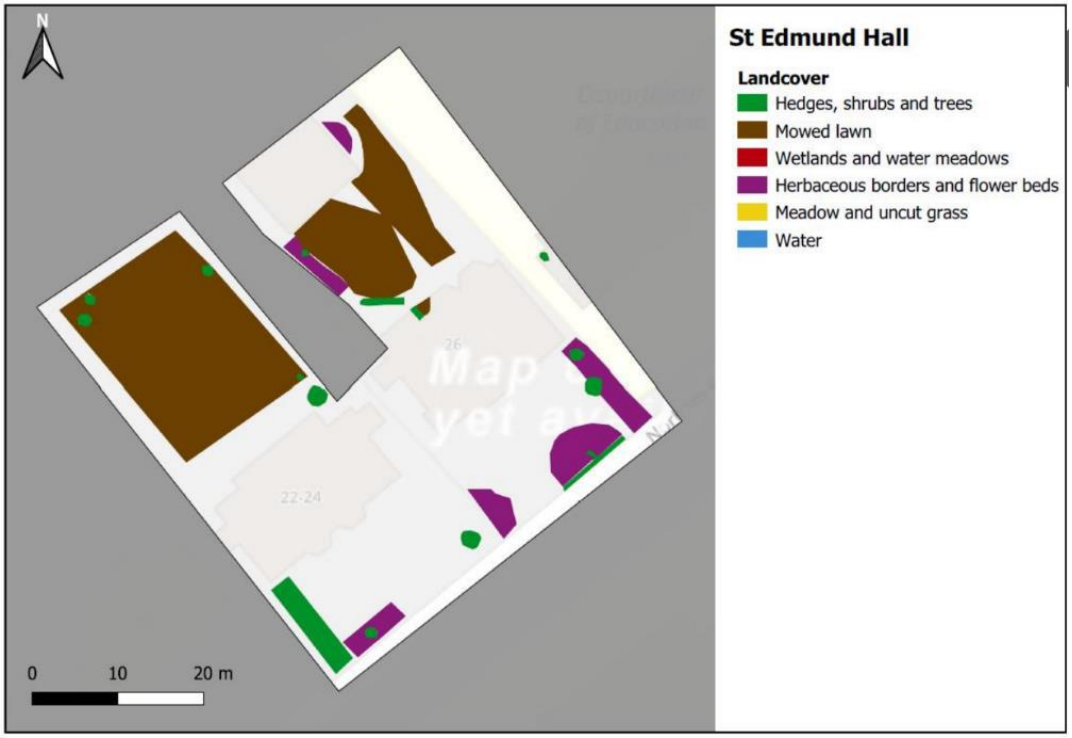


Figure 6 Land cover map - 24-26 Norham Gardens site

Figure 7: Off-site Land Cover; Norham Gardens

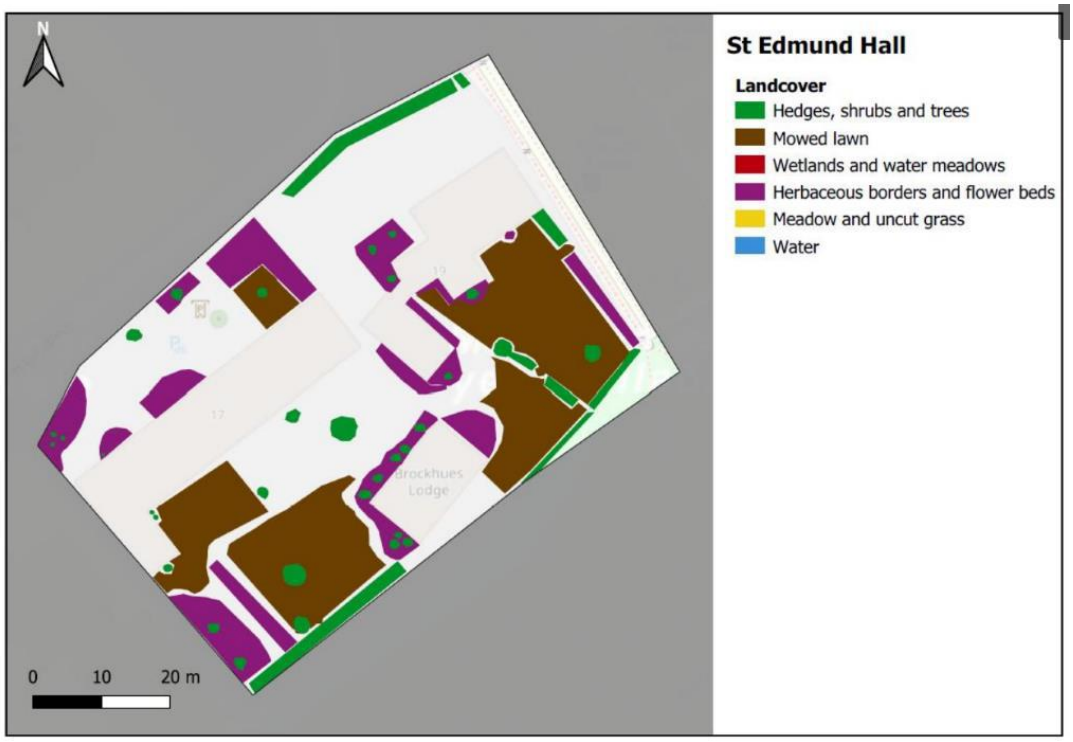


Figure 7. Land cover map for St Edmund Hall – Norham Gardens

Carbon storage

The estimated amount of accumulated carbon (tonnes) that is stored in the different landcover types on the St Edmund Hall site is detailed in Table 7. These results indicate that the trees on the site currently store the greatest amount of carbon (in trunk, branches, leaves, and roots).

Table 7

	Carbon Stocks		
Landcover	Area (ha)	Total (tonnes of carbon)	% of total
Trees[2]	0.27	24.59	97.60
Mowed lawn	0.29	0.29	1.14
Wetlands and water meadows	0.00	-	-
Herbaceous borders and flower beds	0.14	0.29	1.14
Meadow and uncut grass	0.03	0.03	0.12
Water	<0.01	0.00	0.00
Total	0.73	25.20	

Table 7: Register of carbon stored in vegetation – St Edmund Hall

Figure 8: Main Site Carbon – Queen's Lane

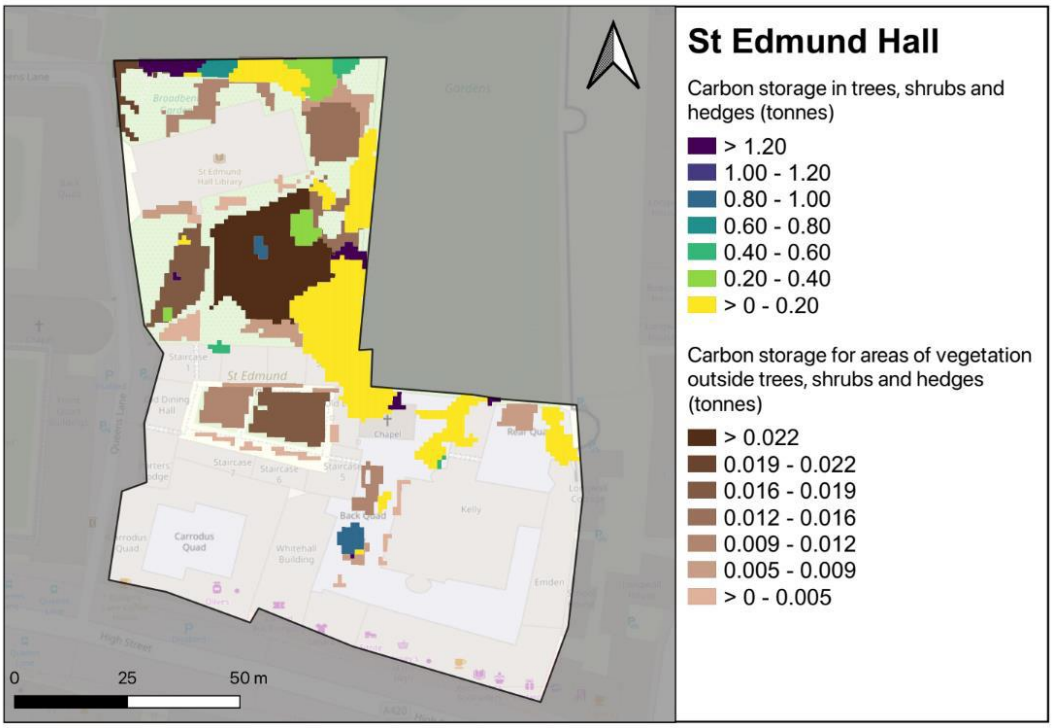


Figure 8: Map indicating the spatial distribution of carbon stored by the different landcover types across the St Edmund Hall main site.

Figure 9: Carbon Storage – Off-Site

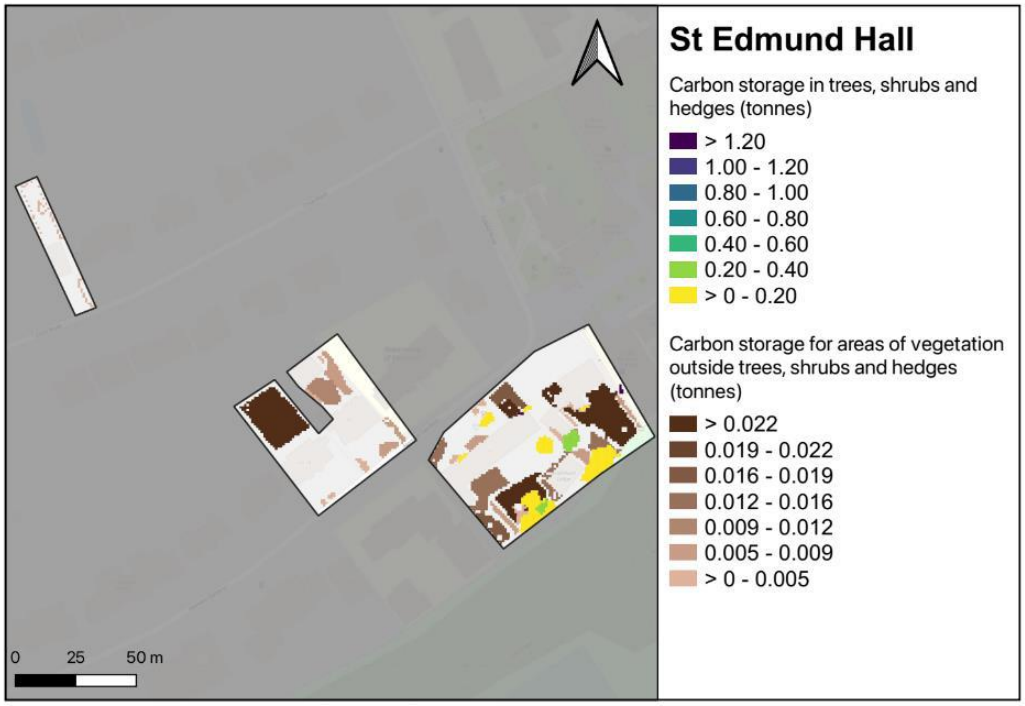


Figure 9: Map indicating the spatial distribution of carbon stored by the different landcover types across the St Edmund Hall annex sites.

Carbon sequestration

The estimated amount of carbon (tC/yr) being drawn down from the atmosphere by the vegetation each year and stored as woody biomass at the St Edmund Hall site is detailed in Figs., 10-11. As with carbon storage, the greatest drawn-down each year is from the trees on the college site.

Figure 10: Carbon Sequestration Main Site

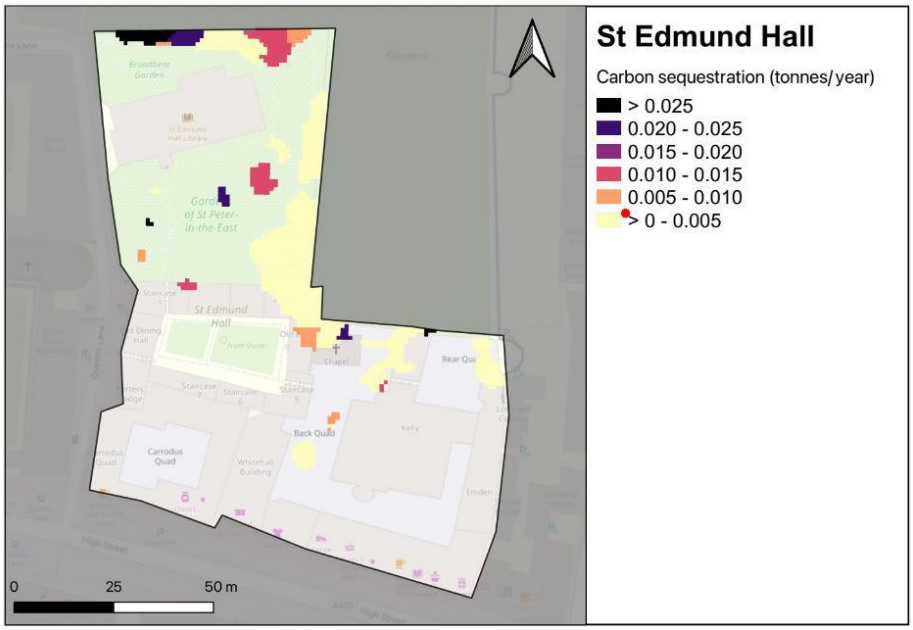


Figure 10. Map indicating the spatial distribution of carbon sequestered (tC/yr) by the different landcover types across the St Edmund Hall main site.

Figure 11: Carbon Sequestration Off-site

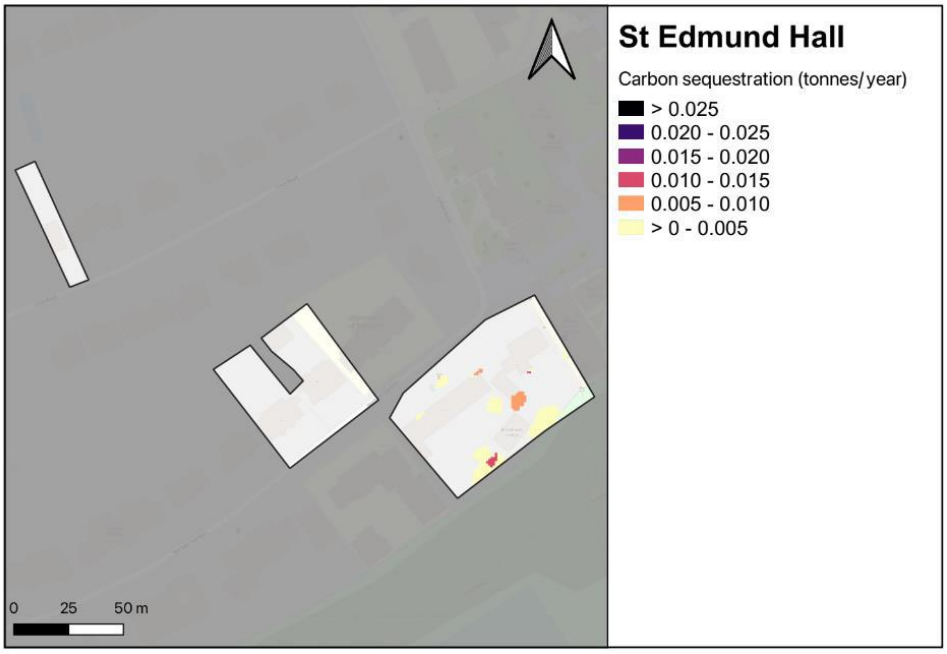


Figure 11. Map indicating the spatial distribution of carbon sequestered by the different landcover types across the St Edmund Hall annex sites.

Supplementary Material

Methodologies

Estimating carbon storage and sequestration

Colleges were provided with a set of landcover maps for their sites. Colleges identified six different categories of land cover (water; mowed lawn; meadow and uncut grass; wetlands and water meadows; herbaceous borders and flowerbeds; hedges, shrubs, and trees) which were recorded directly onto the maps using a simple colour code.

Trees

Tree species and circumference were measured as part of the survey conducted by members of the college community. Tree diameter was then calculated from tree circumference. Tree height was obtained for each measured tree using the National Tree Map. This data was then processed in i-Tree Eco, software that uses allometric equations from the scientific literature to predict carbon storage and sequestration. These values were then assigned to each respective tree to produce the final map outputs. Additional carbon stock values for non-woody vegetation were taken from 'Carbon Storage and Sequestration by Habitat 2021 (NERR094)'. The landcovers retrieved were modified grassland for mowed lawn, wetlands, nursey and horticulture for herbaceous borders and flower beds, lowland meadows for meadows and uncut grass, and standing open water and canals. The tonnes of carbon per hectare and the landcover areas were used to calculate the tonnes of carbon for each landcover using QGIS.

Bird counts

Each college was provided with a map of random sample locations across their site, generated by ArcGIS based on the size of the site. Each college chose random sample locations to complete bird surveys at over three mornings in early summer (June/July). Locations of the survey were recorded using the what3words app. Participants used the BirdNET app to identify birds from their song and the Merlin Bird ID app to help identify species that were visible but not calling.

Insect counts

Sampling took place in June-July at multiple sites in each college using coloured pan traps (ideally yellow, blue, and white to attract a diversity of insects). The selected sites encompassed a range of habitats, including flower beds, meadows, allotments, and sports grounds. The pan traps that were used specifically target insects that visit flowers: some may visit flowers for nectar, while others may eat other parts of the plant (e.g. leaves, pollen).

References and further reading

Many of the methods that were followed have been used for academic research elsewhere. You can read further details in the following publications and websites:

Birds
BirdNET: A deep learning solution for avian diversity monitoring. Kahl *et al.,* 2021

Drivers of avian species richness and community structure in urban courtyard gardens, Biroli *et al.,* 2020. This is existing data on birds in Oxford colleges from an undergraduate project.

Earthworms
Soil health pilot study in England: Outcomes from an on-farm earthworm survey, Stroud, 2019

Earthworm Watch is a collaboration between Earthwatch Institute (Europe) and the Natural History Museum in London. Further information about the research behind their survey is available on the
Earthworm Watch website.

Insects
Optimising coloured pan traps to survey flower visiting insects. Vrdoljak & Samways, 2012.

Measuring bee diversity in different European habitats and biogeographical regions, Westphal *et al.* 2008

Trees
i-Tree Tools for assessing and managing forests and community trees: Resources and Overview
Camden i-Tree Inventory Report