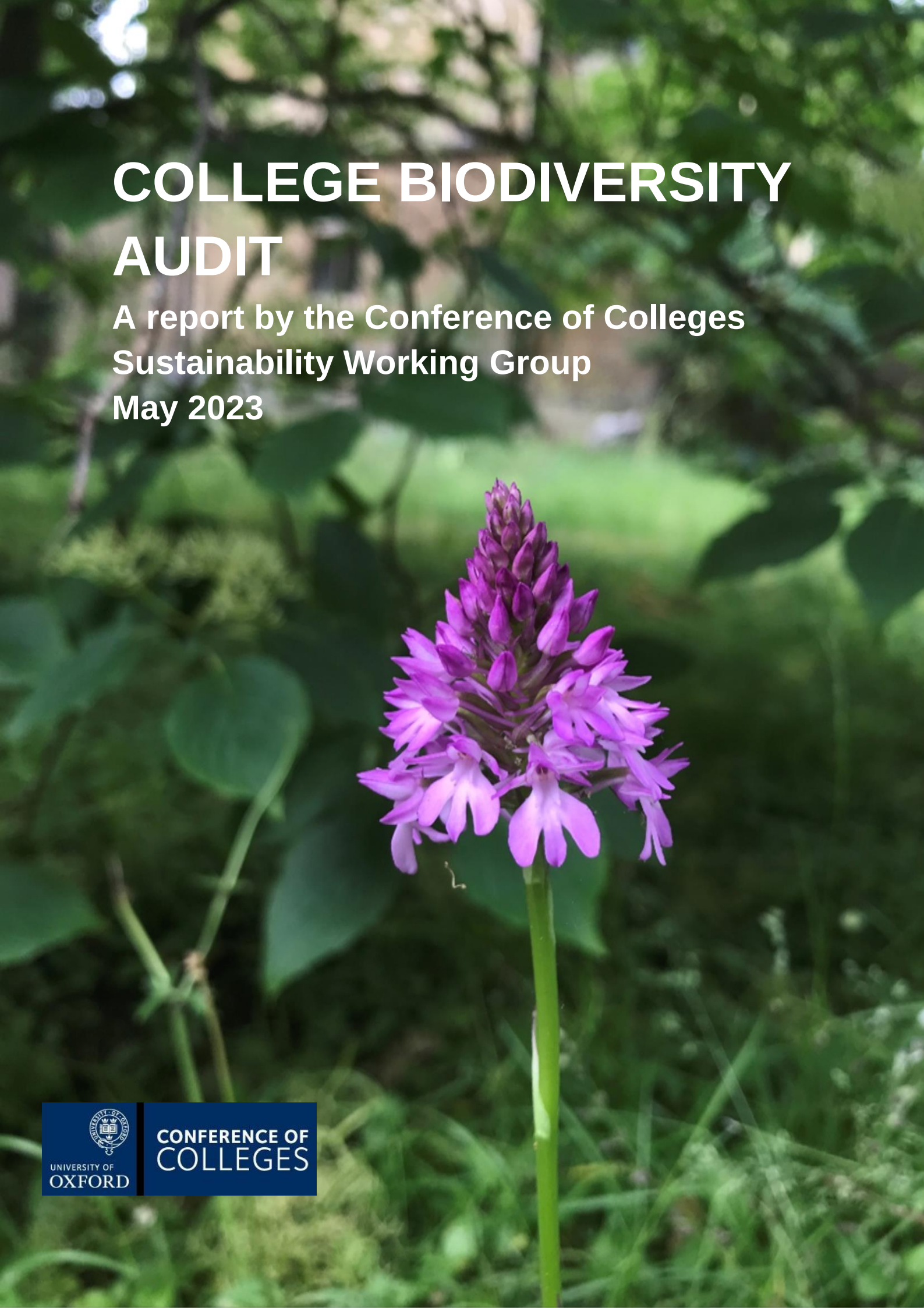
COLLEGE BIODIVERSITY AUDIT

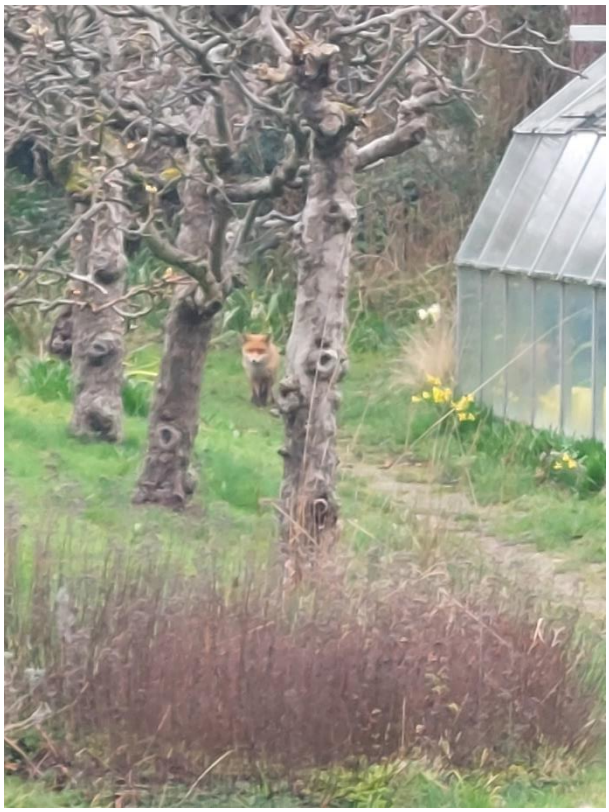
A report by the Conference of Colleges Sustainability Working Group

May 2023



UNIVERSITY OF OXFORD

CONFERENCE OF COLLEGES



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Introduction to College Biodiversity Audit

In 2021, the Conference of Colleges Sustainability Working Group created a report on Existing College Sustainability Initiatives. This report (available here) sought to fill a knowledge gap on the sustainability work that the forty-four colleges and permanent private halls (PPHs) have been doing independently. The 2021 report showcased projects which were already completed or underway, and shared examples of good practice to inspire positive change within the collegiate community. The second phase of the Working Group's project was to establish a comprehensive picture of the current environmental footprint of the collegiate community through an audit exercise examining energy usage, production of waste (plastic, paper, food, other) and biodiversity assets in each college and PPH. This report covers the biodiversity element of that audit. The ultimate ambition must be for the colleges, PPHs, University and City Council to align and share in their actions and ambitions to make Oxford be a truly environmentally sustainable city.

The University has set a target of quantifiable biodiversity net gain by 2035. The University aims to achieve biodiversity net gain through avoidance and reduction of the negative impact of their operations and supply chain (Refrain and Reduce), biodiversity enhancements on and off the estate (Restore and Renew), and biodiversity offsetting (Renew). Rather than suggesting that restoring biodiversity should be done using a homogenous "one size fits all" approach matching the University's, this report seeks to highlight the importance of making individual changes that best suit each college, according to their resources and unique grounds and ecosystems. This report includes examples of good practice, which can offer colleagues inspiration for their own biodiversity projects, and foster collaboration between colleges working within similar environments. A cohesive approach to biodiversity, which recognises and celebrates the differences between colleges, positions the colleges' biodiversity restoration efforts alongside the University's and City's in a productive and positive way.

The biodiversity audits, which were carried out at participating colleges in 2021 and 2022, provide a baseline for tracking biodiversity. The methodologies found at the end of this report give colleagues the tools and resources to independently analyse biodiversity at their college in order to monitor and respond to changes over time. If each college has a comprehensive understanding of their sites' biodiversity, this can facilitate a sharing of knowledge and resources, and collaboration between colleges. Whether big or small, this report celebrates the positive contributions that colleges have made to restore and encourage biodiversity, and offers ideas for future projects.

Background to College Biodiversity Audit

The UK is home to an estimated 70,000 species of animals, plants, fungi, and microorganisms (UK Royal Society, 2022). In the 2022 UK Biodiversity Indicator Report however, just over a third of species were of favourable conservation status, and only 8% of habitats had this status (DEFRA, 2022). Drivers of this biodiversity loss include land cover change, pollution, climate change, invasive species, and habitat fragmentation (DEFRA, 2022, Dearborn and Kark, 2010). As a result of biodiversity and habitat declines, policy changes and land management efforts have emerged to improve the use of urban/built-up areas for nature through practices such as increasing the size of urban green spaces (Aronson et al., 2017), utilising vertical spaces for vegetation (Chen et al., 2020), and creating biodiversity friendly spaces through feeders, nest boxes, and habitat creation (Ronchi and Salata, 2022).

To establish how the University of Oxford colleges are utilised by nature, biodiversity audits were conducted in the summer of 2021 and the summer of 2022. The results of this data collection show college land cover and the species detected in them, including hundreds of insect and tree species, threatened bird species, and species providing essential ecosystem services such as pollination and nutrient cycling. Summaries of this data collection is separated into the audited groups of, land cover, trees, birds, insects, and earthworms. Colleges electing to participate in the different parts of the audit are listed in the chart below.

2021					
College	Land Cover	Trees	Birds	Insects	Worms
Balliol	X	X	X	X	X
Exeter				X	
Lincoln	X	X	X		
Lady Margaret Hall	X	X		X	
Keble	X	X	X	X	X
Kellogg	X	X	X	X	X
Magdalen				X	X
Mansfield	X	X	X	X	X
Merton	X	X		X	X
New College	X	X	X		X
Somerville	X	X	X	X	
St Anthony's	X	X	X		
St Catherine's	X	X	X	X	X
St Edmund Hall	X	X	X	X	X
St Hilda's	X	X	X	X	X
St Hugh's	X	X	X	X	X
St John's	X	X	X	X	X
Trinity	X	X	X	X	X
University	X	X	X	X	X
Wolfson	X	X	X	X	

2022					
College	Land Cover	Trees	Birds	Insects	Worms
Brasenose	X	X	X	X	X
Lady Margaret Hall	X		X	X	
Pembroke	X	X	X	X	X
Somerville	X	X	X	X	X
St Hilda's	X	X	X	X	X
Trinity	X	X	X		X
Wadham	X	X	X	X	X
Wolfson	X		X	X	X

Purpose of Biodiversity Census

Biodiversity baselines are critical for biodiversity goal setting for colleges and the Conference of Colleges, providing information on how colleges support biodiversity across different groups, and opportunities for comparison with future audits. For future audits, data is likely to be seasonally variable and time-sensitive, therefore future sampling should be completed at a consistent time of year for the same length of time to minimise variation. Uncontrollable variations in sampling conditions, such as weather, should be used to contextualise results, and future data collection is encouraged to capture these variations. In the case of the heat and drought during the 2022 census, the results gave insight into how audited groups were coping with this extreme weather and utilising spaces in colleges that provided food, water, and thermal regulation opportunities. This report shows how results can be analysed despite the significant variation in weather between 2021 and 2022.

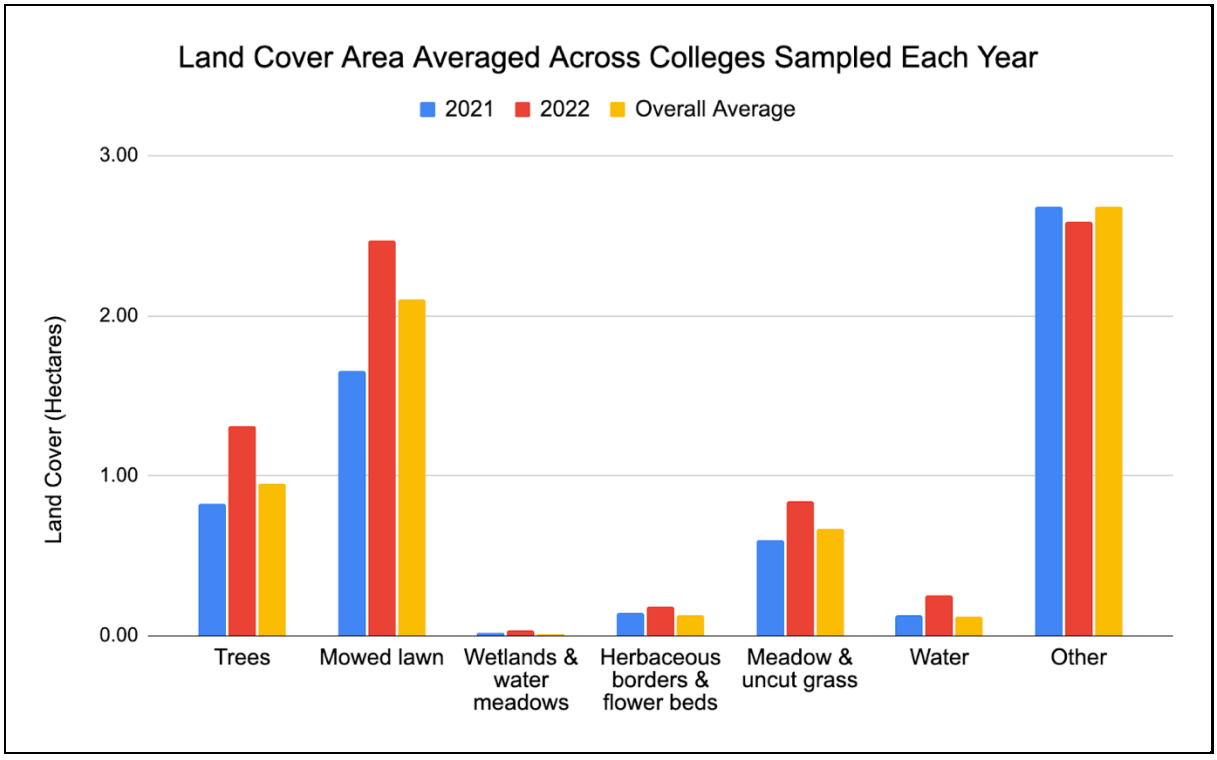
Results are most informative when considering associations between different audited groups and land cover types. For instance, trends across the data indicate that reducing pesticides and fertiliser, and increasing tree coverage and meadow, support biodiversity across multiple groups. Colleges should assess where improvements to biodiversity practices can be made and monitor the effects of this through future biodiversity audits every few years. It is important to note that these biodiversity audits are snapshots in time and are incredibly valuable in evaluating long-term trends in biodiversity. The audit methodologies are detailed at the end of this report for reference.

Biodiversity Analysis Kits

Land cover

Participation: 19 colleges in 2021, 8 colleges in 2022

Land cover was assessed by Nat Cap Research Ltd of colleges which elected to participate each year. Land cover was categorised into trees, mowed lawn, wetlands & water meadows, herbaceous borders & flower beds, meadow & uncut grass, water, and 'other' representing grey areas, such as buildings and pavement. Of the five colleges which completed land cover surveys in both years, none showed significant changes in land cover types apart from Trinity College due to the inclusion of their sports ground in the 2022 survey. The graph below shows the 2021 and 2022 results of each land cover type, averaged across the participating colleges in each year, along with the results of the unique colleges that participated across the two years.



Land Cover Suggestions

The top three land cover types were the 'other' area, mowed lawn, and trees. To improve the diversity of green spaces in colleges, mowed lawn areas could be converted to meadows or trees/shrubs, which support more species of birds and insects and require less maintenance (Norton et al., 2019). Another alternative to mowed lawns is the implementation of wildflower and forb lawns, which maintain the visual effect of mowed lawns but increase plant diversity, providing habitat and food resources throughout the year (Smith and Fellowes, 2014). Grass-free lawns have yet to be implemented on a large scale and represent an opportunity for colleges to reduce their mowed lawn coverage, simultaneously providing a unique type of

urban land cover. Guides to creating and maintaining grass-free lawns can be found at the National History Museum and Royal Horticultural Society websites.

The least common land cover types were blue land cover (water, wetlands, water meadows) and herbaceous borders. Increasing uncommon land cover types is an effective way to increase biodiversity by supplying habitat that is typically limited and providing the broad range of resources necessary for a variety of species (Han et al., 2021). For instance, even marginal increases in herbaceous borders increase foraging opportunities for pollinators and provide winter habitat and hunting grounds for insectivorous mammals and birds (Baldock et al., 2015). Additionally, adding small water bodies to colleges would provide habitat for predatory insects, such as dragonflies, which keep pest species in check, and provide a water source for birds and mammals (Pille and Säumel, 2021). A guide to creating a pond can be found on the Wildlife Trust Website.

Land Cover Examples of Good Practice

Lincoln has recently established a small wildlife pond in their Fellows' Garden. This was a low-cost project, and makes a positive biodiversity contribution in a small, enclosed space.

Lincoln Wildlife Pond

Wildflower meadows are a popular installation at colleges, used to increase biodiversity. These patches of lawn were turned into bulb or wildflower patches, and are fantastic for pollinators (and visually appealing!).

Lincoln Flower Meadow

LMH Flower Meadow

Somerville Flower Meadow

Trinity Flower Meadow

Wolfson's, Lady Margaret Hall's (LMH), and St Catherine's grounds are bordered by the River Cherwell and they host diverse species of aquatic birds and animals, including kingfisher, grey heron, deer and otter. The river floods regularly encouraging the growth of meadowsweet, purple loosestrife and watermint along the margins.

Wolfson harbour

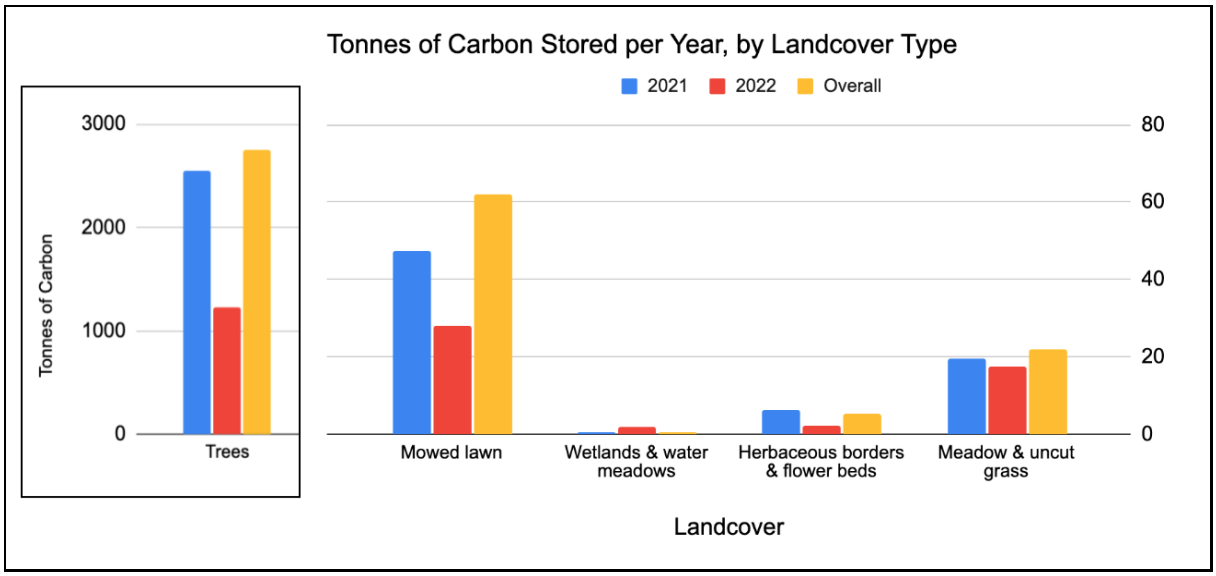
Many of the participating colleges audited their grounds off the main site, including meadows and sports grounds. Pembroke has an ongoing biodiversity project on some of their land, where the students who undertook gathering the audit data have an open-air lab. They are doing mammal footprinting and mist netting for birds, and are planning to start collecting data on interventions.

Biodiversity monitoring is a crucial part of planning future building projects. St Edmund's Hall is planning a new accommodation project, where the landscape and ecology strategy is designed to improve and enhance biodiversity, with an 80% net gain over the site. Thinking of the global impact of a college's operation on biodiversity is also important. LMH participated in a study on how organisations can reduce biodiversity impacts from their food consumption.

Carbon storage and sequestration

Participation: 19 colleges in 2021, 8 colleges in 2022

Land cover reports were used to calculate carbon storage and sequestration, using estimations of carbon capture based on land cover type. Carbon storage refers to the short-term accumulation of carbon, through yearly vegetation growth such as tree leaves, mowed lawns, meadows, and herbaceous borders. Carbon sequestration refers to long-term carbon lock-up, which in the case of colleges, was provisioned solely by trees.



Carbon Storage Suggestions

Transitioning the lower carbon value green spaces to those that store carbon better, such as trees and shrubs, will allow colleges to improve their land cover efficiency for carbon sequestration. It is important to address the other effects of certain green spaces, such as management costs and provisioning habitat. To increase carbon storage and sequestration, colleges can increase land cover types that capture carbon the best, particularly trees, which sequester carbon over the short and long term. Supporting earthworms, which have been shown to improve above-ground biomass by ~20%, is another way to improve carbon sequestration and storage outcomes (Van Groenigen et al., 2014). Advice for earthworm support is in a dedicated section below.

Carbon Storage Examples of Good Practice

Neighbouring Wolfson and LMH have natural meadows and wetlands. LMH has created a more natural meadow by leaving areas of lawn to grow and then cutting them later in the summer (as you would a hay meadow, using an allen scythe). Wolfson is planning a similar project on their marshland.

Scrubland at LMH

Marshland (background) at Wolfson

Newly established Woodland Borders at Trinity

We have made big changes in the garden in the past two years, much of it with an ecological focus, adding new and more diverse plantings. Library Quad has transformed from a paved space to a garden area, with a 20 x 12m bed, half of which is planted with bulbs and herbaceous perennials. This garden focuses in particular on providing blooming species much earlier in the year than a traditional garden to feed pollinators from January onward. It is also designed to not need watering, with plants that will withstand periods of summer drought.

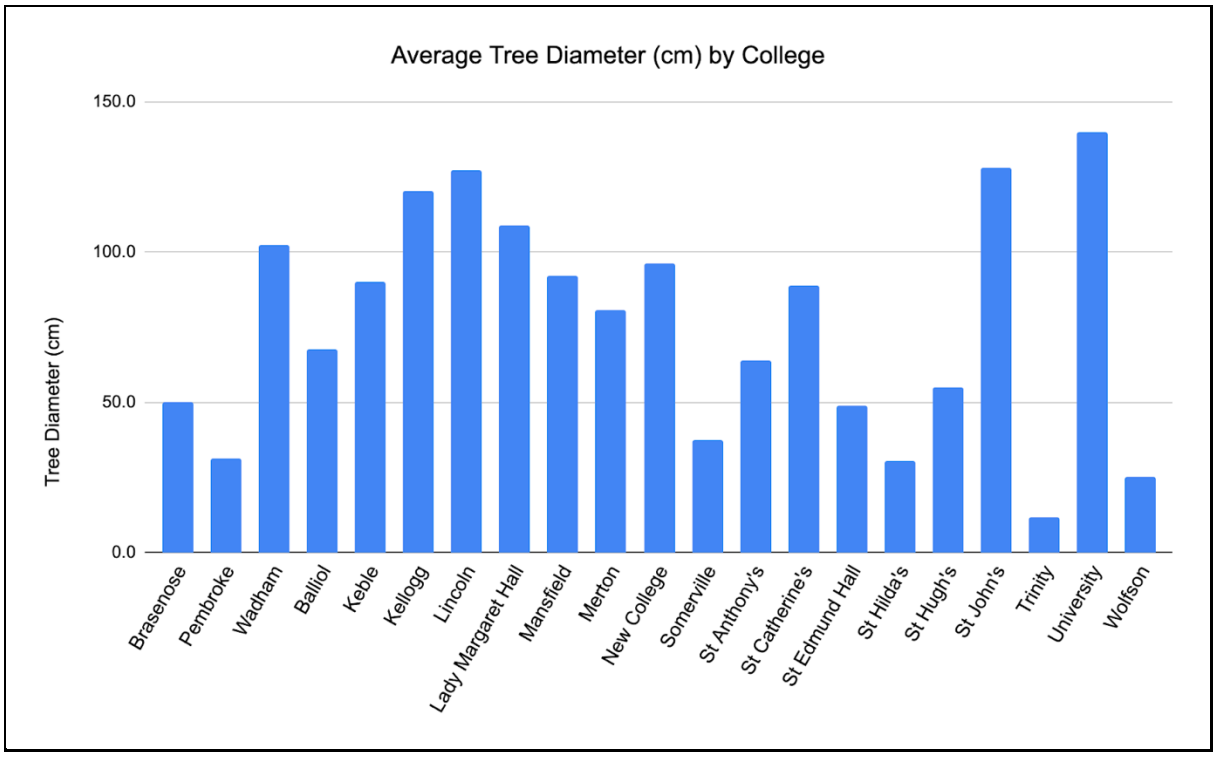
Across the garden, we have focused on extending the season, putting in larger numbers of plants which bloom in Winter and early Spring to provide food for pollinators through the year. We also have a sequence in our gardens, with Library Quad focused on early Spring, the Woodland on Winter and Late Spring, The President's Garden in early Summer and the South Border on Summer through to Autumn. This means we have areas rich in flowers for pollinators through the year. It also increases the impact the gardens have on residents of college from a wellbeing perspective.

– Head Gardener at Trinity (Kate Burtonwood)

Trees

Participation 19 colleges in 2021, 6 colleges in 2022

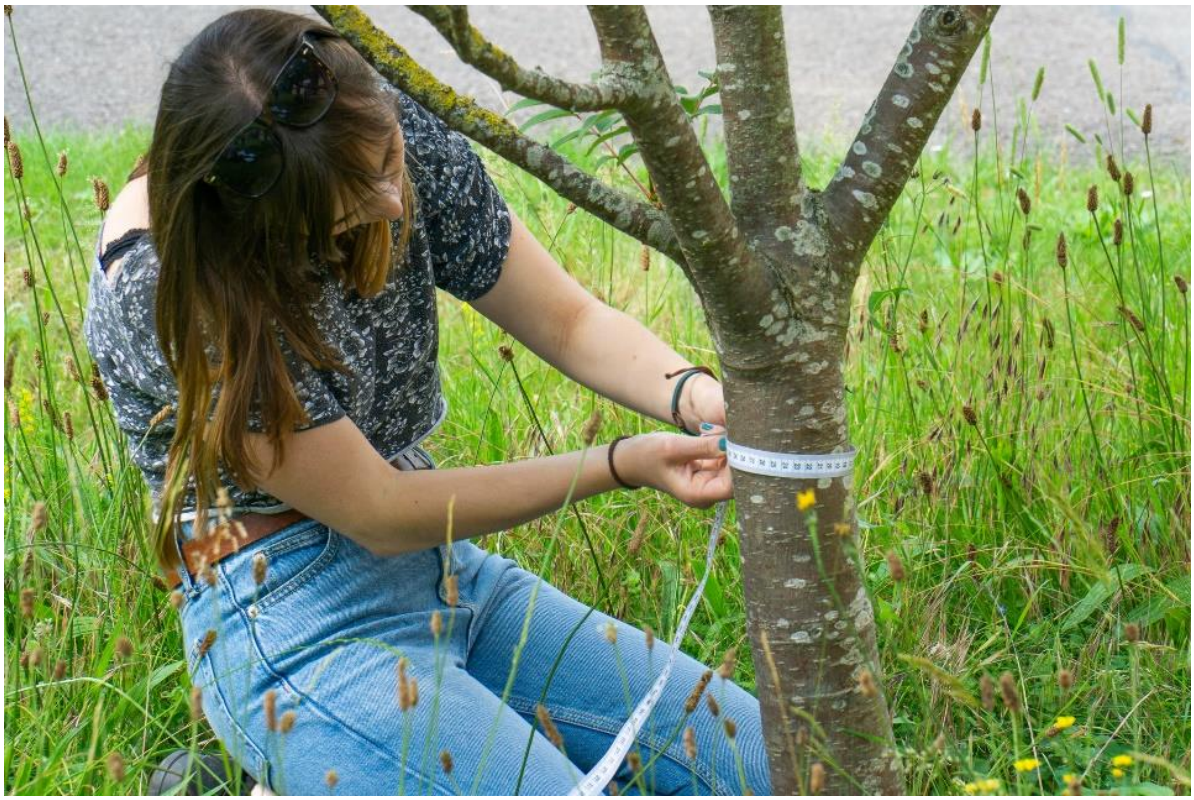
Trees are essential components of ecosystems as habitats for birds, mammals, and insects and provide services of carbon storage and sequestration. Due to the long lives of trees and the rate at which they grow, it is important to invest in the long-term returns of these benefits (Faruqi et al., 2018). Tree coverage was one of the largest land cover types in the colleges, totaling ~15% of a college's grounds on average. Tree surveys involved counting trees, species identification, and taking tree diameter measurements. Over the two years, ~4,500 trees were surveyed across just over 1,000 species. A chart of tree diameter measurements, a proxy for age, is shown below, showing the variation in average tree age between colleges.



Trees Suggestions

Colleges can improve the resilience of their tree populations to pests and diseases by assessing tree health regularly. A guide for checking tree health has been created by Kew gardens, which can be accessed here. Tree health can also be maintained by removing dead branches to limit susceptibility to pests and disease. To keep consistent tree coverage in the coming years, planting new trees and diversifying species in collections will allow colleges to maintain the benefits of noise/air pollution reduction (Selmi et al., 2015, Maleki & Hosseini, 2011), habitat provisioning for associated species (Lerman et al., 2014), and consistent coverage and carbon sequestration in the coming decades.

The risk of pests and disease to some tree species should be considered when selecting species to plant (Tubby and Webber, 2010). Particularly, colleges should be wary of planting ash trees, due to the manifold of diseases that affect them including ash dieback, and potential threats of invasive species, such as emerald ash borer, which has decimated ash populations around the world. Colleges should carefully monitor their tree health and adopt strategies to limit disease, such as buying UK-grown saplings. Additional information about species selection and pest & disease management can be found on the Woodland Trust website.



Trees Examples of Good Practice

Mansfield planted crab apple trees near the Chapel last autumn. These trees offer multi-seasonal interest, and are a food source for birds.

Wadham's grounds are considered to have the third most unusual tree collections in Oxford after the Botanical Gardens and the University Parks. The trees include native and exotic, and include rare 'fossil' trees such as the Monkey Puzzle and Ginkgo, as well as three varieties of Cedar trees. The oldest tree in Wadham is the American Tulip Tree, which was planted in 1701.

I monitor the trees on a regular basis. I do a careful visual check to see how much dead wood there is in the crown of the tree, and do a monthly survey and make a record of any problems or concerns I might have.

Wadham have a professional survey done by a trained arboriculturist about every 5 or 6 years and roughly about twice a year our regular tree surgeon comes and gives me advice on any trees I might be concerned about.

At the moment, I am checking the trees to see if there are any dieback or dead branches as a result of the dry summer in 2022, but luckily most trees seem to be coming into leaf as usual.

– Head Gardener at Wadham (Andrew Little)

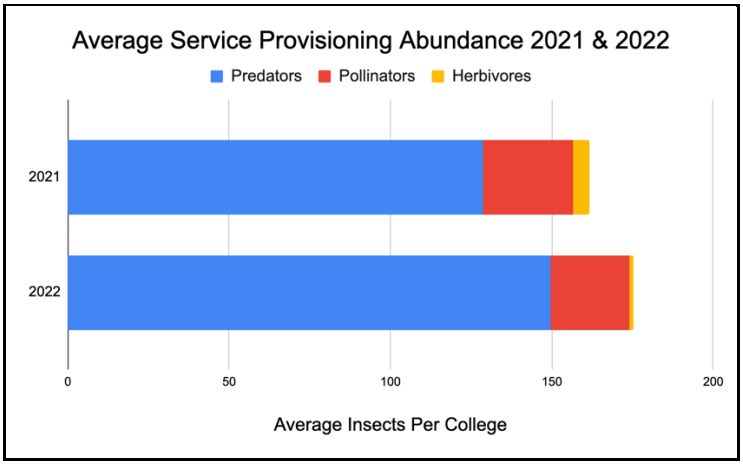
New trees at Mansfield

American Tulip Tree at Wadham

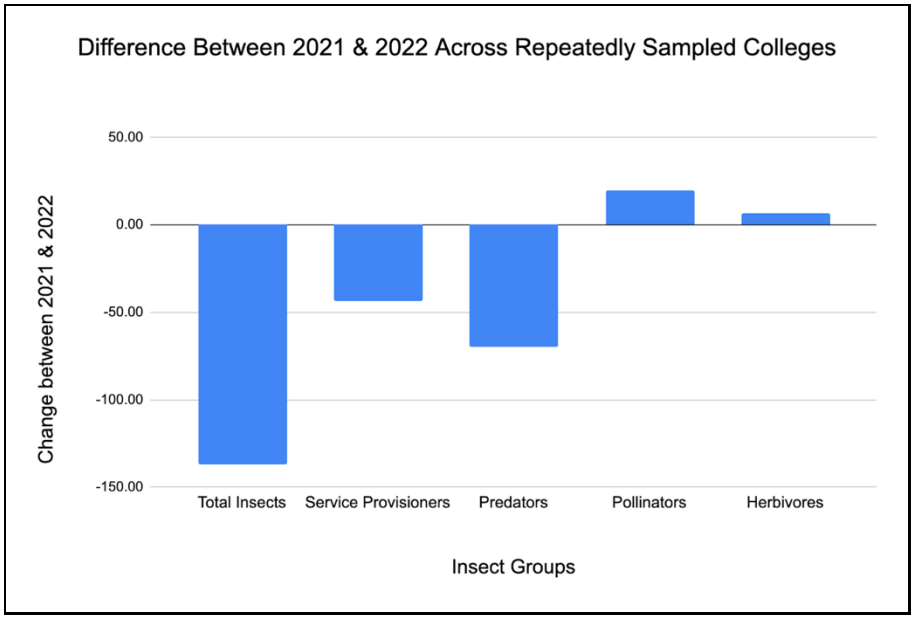
Insects

Participation: 20 colleges in 2021, 9 colleges in 2022.

Insects are critical for ecosystem functions within colleges including nutrient cycling, control of pest species, and pollination of plants (Weisser & Siemann, 2008). Insect audits were carried out with multiple coloured pan traps set up around college sites, used to attract a variety of aerial insect species. In 2021 each college trapped an average of 900 insects across 338 species. This dropped slightly in 2022 to an average of 867 insects trapped. Species counts were not completed in 2022 due to time constraints. Insects were separated into functional groups of predators, pollinators, and herbivores to assess how the colleges are supporting these groups. Predators and pollinators benefit people by reducing pest species and providing important services, such as pollination. Herbivores also play a role in breaking down vegetation and returning nutrients to the soil, though some may be considered pests to gardeners.



The most numerous functional groups in both years were predatory insects, followed by pollinators and herbivores. The average pollinator counts decreased between 2021 and 2022, potentially due to the extended drought and hot temperatures in 2022. The chart below summarises the year-to-year differences between the colleges which participated in both sampling years, showing this difference more clearly. These results show that there were fewer insects overall, and a net loss of service provisioners, and support the theory that declines may be due to the widespread weather stress, which has also been documented in the literature (Kiritani, 2013).



Insects Suggestions

Insect populations and diversity were positively associated with colleges that had more trees, herbaceous borders, and meadows. This suggests that these land cover types are essential for supporting invertebrate biodiversity, and should be prioritised by colleges, to benefit insects and interacting species. Reducing the application of pesticides as much as possible, and eliminating application on herbaceous borders and meadows, will help to protect beneficial insect populations, such as pollinators. Even with a targeted application, pesticides often remain in soils and the environment for longer than anticipated and can affect non-target species (Weber, 2018).

Transitioning to land cover types that require less intensive management and supporting natural predator populations of birds and bats, and introducing biocontrol species, such as parasitic wasps, are ways to reduce the need for pesticide application. Leaving wood and plant material to rot and implementing bee hotels are ways to support insect communities within college grounds. Guides for making and deploying bee hotels can be found on the Wildlife Trust website. Finally, a list of planting pollinator-friendly species for pollen and nectar throughout the year can be found in the Royal Horticultural Society guide to Garden Plants for Pollinators and Wildflowers for Pollinators. Plants introduced to colleges, particularly species designed to attract pollinators, mustn't be pre-treated with pesticides. Ideally, pollinator-friendly plants should be grown from seed, or purchased from a pesticide-free grower.

Insects Examples of Good Practice

Many colleges utilise herbaceous borders and flower beds, planted with perennials and pollinator-friendly plants. Trinity has a natural woodpile near their established a woodland-style bed, which provides shelter for insects and animals. St Hilda's has its own Instagram account #hildabugs, which features photos of their local wildlife including insects and birds. Mansfield students took the initiative to build a bug hotel.

Somerville Herbaceous Border

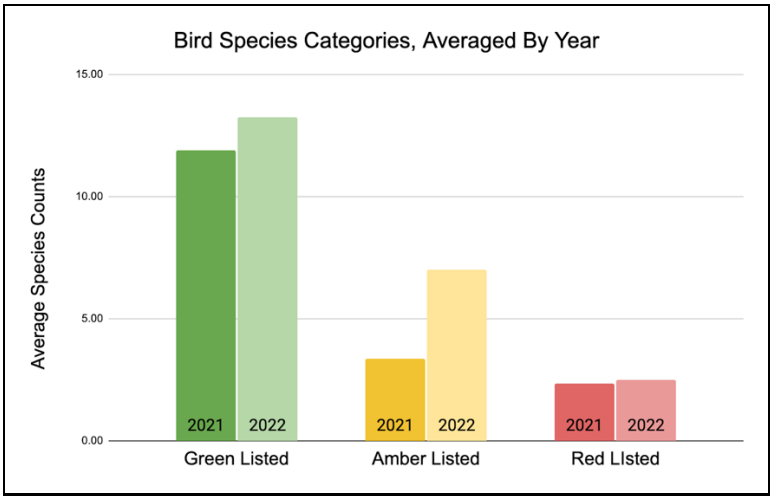
Trinity Wood Pile

Mansfield Bug Hotel

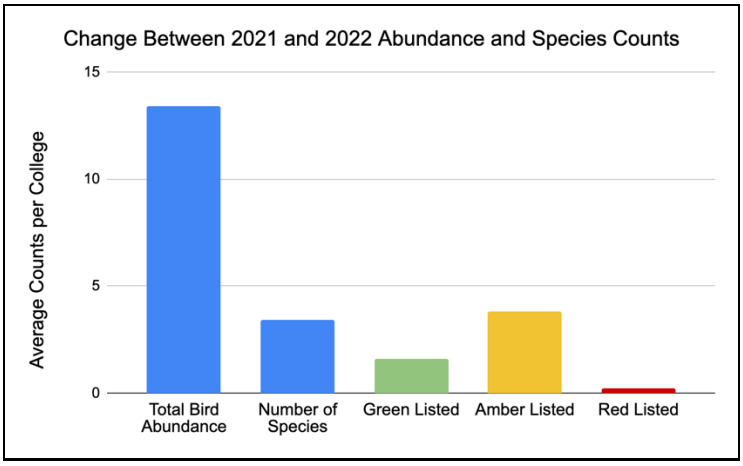
Birds

Participation: 17 in 2021, 8 colleges in 2022

Birds function in ecosystems by controlling pests, dispersing seeds, and moving nutrients through systems (Whelan et al., 2018). Bird abundance counts and species identification was completed by volunteers from each of the colleges. Using the UK Birds of Conservation Concern list, bird species were categorised as green, amber, and red-listed. Between the two years, the number of birds sighted per college increased from an average of 85 individuals to 94. Between 2021 and 2022 there was also an increase in the average number of green and amber-listed species in each college, though the number of red-listed species remained approximately the same.



Of the colleges which participated in the bird census both years, there were on average 67 more birds and 17 more species per college in 2022 compared to 2021. The increase of birds seen in 2022 is likely due to the need for birds to find food and water sources during the persistent heat and drought seen over the summer of 2022. The maintenance of college land during this period ensured foraging habitat and food source provisioning compared to unmanaged areas. The increase of amber-listed species in these sites also shows how college land can be important for supporting threatened wildlife.



Birds Suggestions

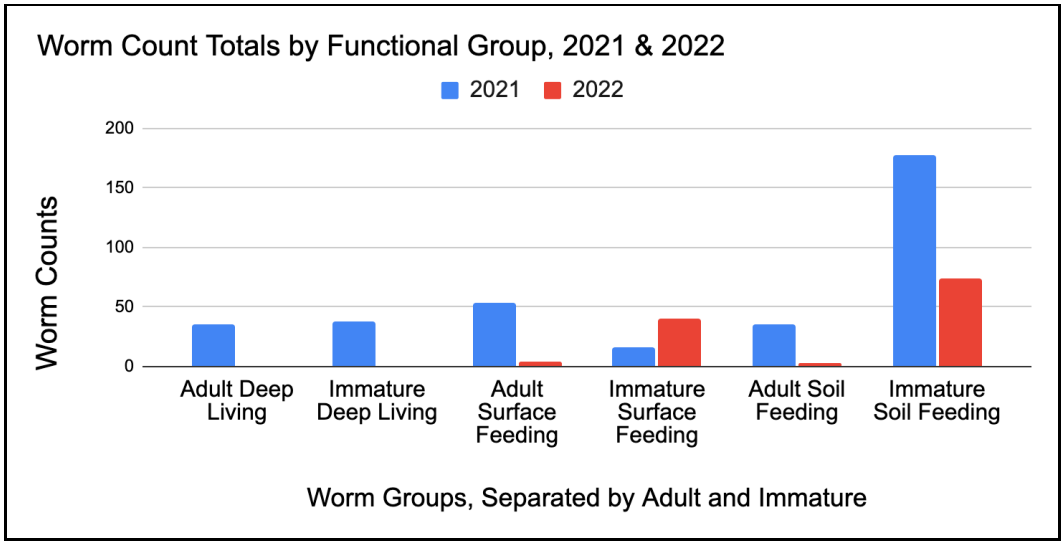
The colleges which support the most birds tended to have larger areas of green space and water presence within the college. Making water available within colleges by adding water features or allowing pools of water to form is one of the simple ways to increase the resources available to birds (Wong et al., 2019). Provisioning food with feeders and nesting opportunities with nest boxes are other ways to support urban birds (James Reynolds et al., 2019). Colleges must be working to maintain the cleanliness of these resources to minimise disease transfer. A guide for maintaining bird feeders and bird boxes can be found on the British Trust for Ornithology's website. Other natural forms of habitat and resource provisioning, such as leaving wood to rot (Marzluff et al., 2008), minimising disturbances, such as tree trimming and grass cutting, during the reproductive season, and limiting the use of pesticides (Brain & Anderson, 2019) are all other forms of land management that can support bird populations and diversity.

Somerville Bird Feeders

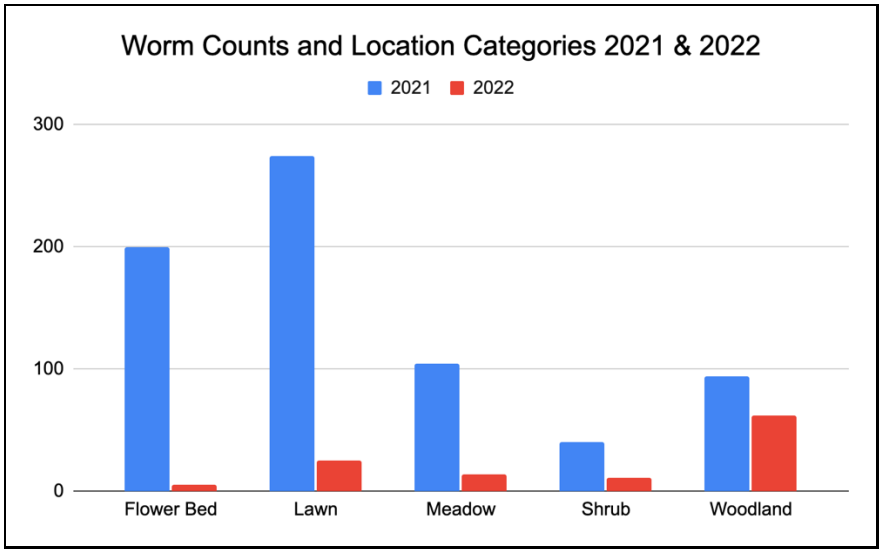
Earthworms

Participation: 14 colleges in 2021, 7 colleges in 2022

Earthworms are critical cyclers of nutrients in ecosystems, breaking down decaying matter into nutrients available for plants and aerating soil, and are a food source for some predatory birds and mammals (Blouin et al., 2013). The three types of worms surveyed were deep living, surface feeding, and soil feeding, each providing different effects on soils and moving nutrients through ecosystems. In addition to earthworm counts, soil pH was recorded along with particle composition, land cover, and fertiliser application at sampling sites. Survey results showed that soil-feeding earthworms were the most abundant across the colleges sampled, followed by surface feeders, and deep feeders. The results are summarised below.



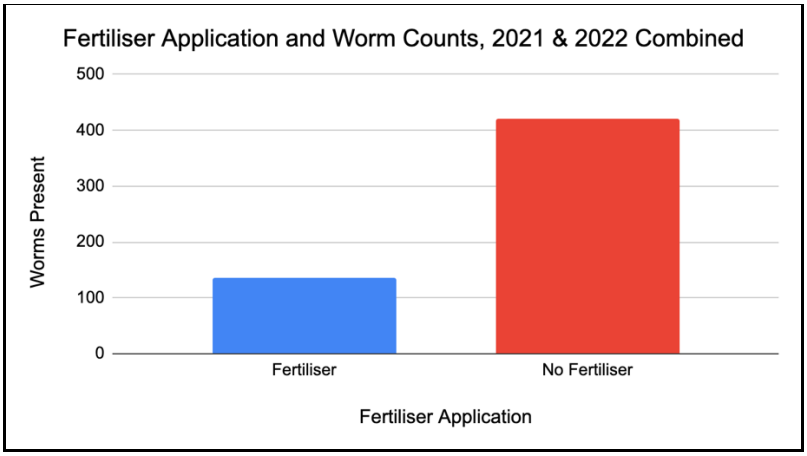
Overall earthworms were most common below mowed lawns, flower beds, and trees. Immature soil-feeding worms were most abundant in lawns, but adults were more evenly distributed between mowed lawns, woodland, flower beds, and shrubs. This result shows how different life stages of earthworms require different nutrients and rely on different land cover types, showing the importance of diverse land cover types within colleges.



Earthworms Suggestions

The 2022 data showed that whilst there were immature earthworms present in colleges, there was on average less than 1 adult earthworm found in each college. This variation may be the result of the drought in 2022 and is supported by most earthworms in 2022 being found in wooded areas of colleges, which provide shade and moisture compared to exposed ground. The shift from a wide number of land cover types to supporting many worms, to only woodland in 2022 suggests that tree cover is critical for providing refuge during extreme heat events/drought. Increased tree coverage should be considered for protecting the nutrient cycling processes within soils through events such as this. Covering the ground with nutrient-rich materials and increasing tall vegetation cover can also help earthworms by regulating soil temperatures and providing digestible materials. Reducing tilling of soil and adding organic compost or mulch can also support earthworms.

2021 data showed that earthworms slightly preferred areas that did not have fertiliser added (whether organic or inorganic), further shown in the 2022 data, where only 4% of worms were in areas where fertilisers were applied. These results are summarised here:



Preference for soils without fertilisers applied may be due to the inaccessible nutrients provided by liquid fertilisers. This finding indicates that colleges should consider limiting/eliminating the application of liquid fertiliser to help support the natural decomposition and nutrient cycling processes provided by earthworms. Instead, maintaining soil fertility by using compost and non-liquid fertilisers, and always using organic fertilisers, will help to support earthworms by providing digestible materials.

Challenges and Conclusions

This report is the culmination of thousands of species counts and records within colleges across the two sampling years. The big takeaways from this data analysis are that colleges should move to less intensively managed land cover practices and implement biodiversity support measures outlined in the sections above. Results are most informative when considering location and associations between different factors, such as any similarities in results between birds, insects, and earthworms, and consistent associations with land cover types. Colleges are encouraged to review their audit reports and assess where land cover and management practices can be improved and expanded.

Some of the challenges colleagues across colleges have noted with respect to their biodiversity work include:

- Climate change and temperature extremes can make gardens and grounds care unpredictable.
- Financial constraints
- Staffing and resources constraints
- Differing views on biodiversity and sustainability priorities within the college community.
- Balance of biodiversity with space for college life and social activities (e.g. lawn space for marques).

Carrying out a periodic census of biodiversity will allow colleges to evaluate the effect of biodiversity improvement practices and give details about when practices support different groups, and in what circumstances. Furthermore, it is encouraged that colleges engage with student interest groups to implement biodiversity support measures to help support their success and support the educational impact of these changes. Guides for creating bee, bird, and bat houses and feeders can be found on the Wildlife Trust website on taking action for wildlife, or be bought easily from most garden centres or online.

Special thank you to Kieran Storer (MBiol) for her work as research assistant on this report, and to the Colleges who offered to provide tours and be featured as examples of good practice.

Trinity Library Quad

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Audit Methodologies

Land Cover Audit Methodology

Understanding the different types of land cover is essential for determining the extent and diversity of different habitats for biodiversity. It is also important for providing a baseline understanding of the natural carbon storage and sequestration provided by these habitats. Once colleges understand the current extent and different types of land cover across their sites, targets can be set with improving biodiversity and carbon storage in mind. For example, some colleges may aim to increase areas of wildflower meadows in some parts of the college to improve feeding and nesting habitats for small creatures and consider additional planting of trees.

Essential equipment

Set of Land Cover maps for your site – *these have been emailed to your college point of contact and you will need to print copies.* Google Earth images are also provided to help with location of boundaries of different land cover types
Colouring pencils: you will need to provide **blue, yellow, red, pink, green** and **brown**

Figure 1- Example land cover map of Wolfson College

Instructions

1. Print a copy of your landcover map

2. Using your land cover map, walk around your site.

3. Based on your observations, record the following landcover types directly onto your map by colouring the relevant sections of your map with the colouring pencils provided. The six colours correspond with the following categories (also included in the key on your map)

CATEGORY	COLOUR
Water	Blue
Mowed lawn	Brown
Meadow and uncut grass	Yellow
Wetlands and water meadows	Red
Herbaceous borders and flowerbeds	Pink
Hedges, shrubs, and trees	Green

Tree Audit Methodology

Trees are vital. As the biggest plants on the planet, they help to combat global warming by absorbing carbon dioxide, removing, and storing carbon while releasing oxygen back into the air. They stabilize the soil, help to improve air quality, and provide a habitat and canopy for many species of wildlife, from birds and insects, to bats and squirrels. It is therefore critical that woodlands and trees in urban areas are protected and sustainably managed.

Essential equipment

Smartphone with the free Flora Incognita and/or the Woodland Trust app British Trees downloaded (available on iOS and Android)
Large soft tape measure – *(e.g. https://www.ebay.co.uk/itm/172493024259)*
Tree Map – this was emailed to the point of contact
Pen and printed results table on which to record your findings

About Tree Maps

National Tree Map is a tool that provides location, height, and canopy extents for all individual trees over three metres in height covering England and Wales. Each college will be provided with maps locating the individual tree data for their sites from Bluesky maps.

Instructions

1. Using your tree map, visit each tree on your site(s) in turn. The trees will be numbered on your map to correspond with your results table.

2. At each tree, identify and record the species by using the Flora Incognita or the Woodland Trust British Trees app. Record this on your results table.

3. Wrap the tape measure all the way around the tree trunk at roughly chest height and record this measurement (the stem basal diameter – also referred to as Diameter Breast Height or DBH) on your results table. If the tree has multiple stems at chest height, please measure and record the diameter of all of these on your results table. You may find it useful to watch this short video demonstrating how to take the measurements: https://www.youtube.com/watch?v=I3qD54zLSn0&ab_channel=Organo-LawnofBoulder

Insect Audit Methodology

Insects are vitally important to the health and function of ecosystems, by pollinating crops and plants, and providing food source for much wildlife. Research indicates that insect populations are in global decline, with their habitats becoming increasingly scarce due to agricultural land use and urban development.

Through this survey colleges can identify and understand the abundance of different groups of insects across their sites. The protocol uses a series of pan-traps to measure species richness and abundance. Pan-traps are brightly coloured trays filled with soapy water, which are placed in various locations across your site. Several colours are used to attract a range of insects – we suggest using blue, yellow, and white. The colours attract insects who fall into the water and are trapped by the low surface tension.

Essential equipment

A4 size coloured plastic trays (**blue, yellow,** and **white**). You will need two of each colour, per site. Examples of the style of tray are linked below: Blue Tray x 2 (link); yellow tray x 2 (link); white tray x2 (link)
Washing up liquid
Water to fill the trays to 1cm depth
Smartphone with what3words app downloaded to determine exact location of sample point (available free on iOS and Android)

Instructions

1. Select two random locations across your college site where you will set up the trays for the insect survey. We suggest recording the exact location on your results table using the what3words app so that you can carry out the audit in the same location in future years for the purpose of direct comparison.

2. Ideally during 9th week (week commencing 20 June 2022), place your plastic trays at the specified locations on your site. The trays need to be on a flat surface in groups of three (one of each colour).

3. Pour 1cm of water into each tray and mix in several drops of washing up liquid.

4. Put up a sign to say that the trays as they are part of an audit exercise. The trays should be left undisturbed throughout the survey. We suggest letting gardeners, scouts and porters know.

5. Record the time and date that you placed out your trays. We suggest recording the exact location of the pan traps using the free what3words app so that you can carry out the audit in the same location in future years for the purpose of direct comparison.

6. After 3 days, members of the Zoology department will come and collect the insect samples that have been collected in the trays.

Bird Audit Methodology

Birds play an important role in our ecosystem through maintaining sustainable population levels of their prey and predator species and assisting plant reproduction as pollinators or seed dispersers. Collecting data on birds helps to understand the diversity of species, habitat locations and, when repeated in future years, will show the patterns in bird diversity.

Most birds are diurnally active and hence use the same sensory modalities as we do. Hence there are two main ways to detect birds – aurally and visually. Visual detection is greatly helped with optical aids – a pair of binoculars – if you can borrow them.

Birdsong is at its best during the 'dawn chorus', as many species sing around sunrise, and typically wind-associated noise is least around dawn. Ideally this survey therefore needs to be carried out for a 30-minute period between 4.00-5.30am when birdsong can be heard best.

Essential equipment

Smartphone with free Merlin Bird ID app downloaded (available on iOS and Android). We recommend watching this explanatory video about the app before you begin: https://www.youtube.com/watch?v=xmSUOLxyatY&t=171s&ab_channel=CornellLabofOrnithology
Pen and printed results table on which to record your findings
what3words app to determine exact location of sample point (available on iOS and Android)
Binoculars

Merlin Bird ID is a research platform from The Cornell Lab of Ornithology that identifies birds by their song and through visual identification. It is a citizen science platform and analysis software for extremely large collections of bird audio recordings.

Instructions

1. Download the Merlin Bird ID app and download the **'bird-pack for Europe: Britain and Ireland' (see figure below).** When you first open the Merlin Bird ID app it will guide you through this process.

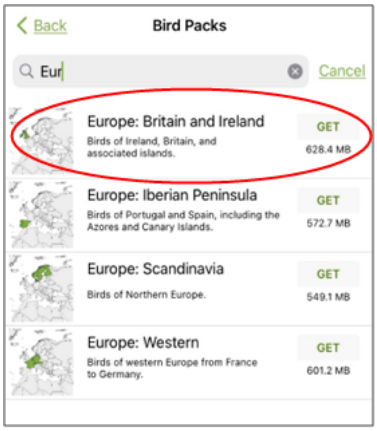

Figure 1 - select the UK bird pack when first using the Merlin app

2. Print out the results tables so that you can record your findings.

3. Select a random sample location from your random sample map where you will stand to complete the bird survey (please choose a different location each time you complete the survey). We suggest recording the precise location using the free what3words app so that you can carry out the audit in the same location in future years for the purpose of direct comparison.

4. At your chosen time between 4.00-5.30am on three mornings stand at your chosen location on your college site.

5. **To identify birds by sight:** open the app, ensure that it has location services switched on, and choose “Start Bird ID”. You will be guided through a short series of five questions that, together with location and date information will enable you to (hopefully) identify the birds that you can see. Count and identify the birds that are on the ground, swimming or in trees & bushes, and visible flying over your sample location and record them using the results tables below.

Figure 2 - Screenshot of recording birdsong

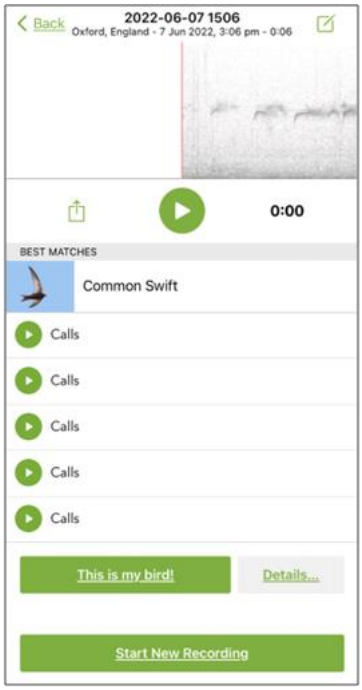

Figure 3 – Real time suggestions of the type of bird will appear at the bottom of the screen

6. **To identify birds by their song:** open the app and when you hear a bird song, press the ‘Sound ID’ button, then tap ‘record’. As the bird song is recorded by your phone, you will see a visualization of the sound on your screen in the form of a spectrogram. As the app analyses the bird call, it will make real-time suggestions of ‘best matches’ at the bottom of the screen. Once you have captured a good segment of the sound (usually around 20 seconds), press the ‘stop’ icon. You can then compare the song that you have recorded with Merlin’s best matches to identify which bird was singing. You can then select ‘This is my bird!’ at the bottom of the screen or ‘Details’ to read more about the species. Record your findings on the results tables below.

7. At the end of the 30-minute session review all the sound observations captured during your session by pressing the ‘my sound recordings tab’ (this can be found under the icon (three lines) on the top left-hand corner of the screen). This lists all the sound

identifications captured (with a date and time stamp) during your session and provides a useful cross-check with your record sheet.

Depending on the number of volunteers who are prepared to get up at 4.30am and the size of your college site, you might want to do several sample locations across the college site.

Earthworm Audit Methodology

Healthy soils are of vital importance for supporting life on Earth and globally store roughly 80% of terrestrial carbon. Earthworms keep soils healthy, increasing soil fertility and carbon storage ability by mixing in dead plant material, air, and water. It is therefore essential that we gain a better understanding of how soil carbon stocks (as well as the other benefits provided by earthworms) are affected by our management of soils.

The methodology of the survey you will undertake is that used for the **'Earthworm Watch'** from the **Natural History Museum** and **Earthwatch Institute**: this aims to better understand the health of soils, including how much carbon they store. This will involve digging two small soil pits measuring 20cmx20cm to a depth of 10cm, and then counting and categorising the soil type and earthworms.

About Earthworm Watch

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.

Essential equipment

Spade or trowel
2 x containers for storing the earthworms
2 x 500ml bottles of mustard water (make this by adding 15g or a heaped tablespoon of powdered mustard to 500ml of tap water).
15ml vinegar
Clean water to wash the earthworms
Large plastic bag
Clock or watch
Pen and printed results table on which to record your findings
Instruction booklet https://www.earthwormwatch.org/sites/default/files/EarthwormWatchInstructionBooklet_2.pdf
Earthworm and soil chart https://www.earthwormwatch.org/sites/default/files/EarthwormandSoilChart.pdf

Instructions

1. Print off copies of the instruction booklet (which sets out the detailed instructions) and the earthworm and soil chart.

2. Select two random sample locations across your college site where you will dig a 20x20cm square pit to 10cm deep, then count and record earthworms. We suggest recording the exact location using the free what3words app so that you can carry out the audit in the same location in future years for the purpose of direct comparison. Following the guidance in the instruction booklet note that you will need to choose at least **two** habitats or management types.

3. Make up the 2 bottles or jars of mustard water, as instructed, and ensure that you have all the necessary equipment.

First soil pit (Section B of instruction booklet): start in one of the habitats or management types present at your chosen site. Follow the instructions to dig your first soil

pit and gather information about the soil and earthworms in that area, using the earthworm and soil chart. Once you have finished your data collection, fill in the first soil pit, placing the earthworms back in the hole (avoiding areas with mustard water still standing) and putting the soil back into the hole.

Second soil pit (Section C of instruction booklet): this soil pit will be in the second habitat or management type present at your chosen site. Follow the instructions to dig your second soil pit and gather information about the soil and earthworm in that area, using the earthworm and soil chart. Once you have completed the data collection, fill in the second soil pit as above.

> [*Disregard Section D of the instruction booklet: data collection for the Earthworm Watch survey has now closed*.]