Solar Habitat 2026:

Ecological trends on solar farms in the UK

Solar Energy UK

Solar Energy UK

is an established trade association working for and representing the entire solar and energy storage value chain. Solar Energy UK represents a thriving member-led community of more than 430 businesses and associates, including installers, manufacturers, distributors, large-scale developers, investors and law firms. Our underlying ethos has remained the same since our foundation in 1978 – to be a powerful voice for our members by catalysing their collective strengths to build a clean energy system for everyone's benefit. Our mission is to empower the UK's solar transformation.

Clarkson & Woods

provide a full range of ecological survey and consultancy services in respect to planning and land management. We are a leading consultancy in the survey, assessment and design of proposed and existing photovoltaic solar developments of all scales, from community owned to nationally significant projects.

We provide a range of services including survey and ecological assessment of solar and battery projects, development of bespoke management plans for solar farms and ecological monitoring of operational solar farms. We have a particular interest in furthering our understanding of the interactions between solar farms and ecology and have co-developed guidance in this area as well as embarking on pioneering research and collaboration with academic institutions.

Lancaster University

is a leading centre of research excellence in the north of England, internationally recognised for its world-class research and training provision. The Lancaster Environment Centre, ranked in the top 100 globally in the QS world university rankings, brings together a vibrant community of students, environmental researchers, government scientists, and industry partners working collaboratively to address some of today's most pressing environmental challenges. Within Lancaster Environment Centre, the Energy–Environment Interactions team contributes to national and international debates on how energy infrastructure can support both decarbonisation and ecological restoration, helping to inform policy and practice.

Front cover photo: Bird's-foot trefoil, Hollie Blaydes, Lancaster University

Wychwood Biodiversity

works with renewable asset owners and managers to increase the biodiversity value of their land. Our team of ecologists is passionate about biodiversity and our core strengths lie in the planning, creation, management and monitoring of bespoke wildlife habitats.

We've developed a range of services to support organisations at all stages of the project cycle, from pre-planning through to the long-term management of solar farms. We provide technical services to support planning applications, development of site management plans and ecological monitoring. We offer tried and tested means to achieve biodiversity gains for single sites or entire portfolios. We've worked with our project partners to produce guidance on biodiversity management for the entire solar industry.

Contents

Foreword

Beccy Speight, CEO, The RSPB

The importance of tackling climate change to help save our declining natural world cannot be overstated – climate change is one of the key drivers of that decline. The RSPB supports the rapid rollout of renewable energy, where it is developed in harmony with nature, and solar is a critical part of this effort to drive forward our transition away from fossil fuels.

But like all infrastructure and development, solar must be developed in the right places and in the right ways so that it works with nature, to the benefit of all. To do otherwise would risk exacerbating other drivers of the nature crisis. The RSPB therefore works to influence the UK's governments and businesses to help guide the energy transition to take place in this way.

Through the RSPB's scientific research, policy advocacy work and our partnerships with businesses, we know that well-sited, well-designed and well-managed solar can be significantly advantageous for biodiversity. This is not only possible but already happening; for example, our studies have shown that solar farms created with biodiversity-boosting features can help some of our iconic farmland bird species whose populations have been in decline, species like Corn Bunting, Linnet and Yellowhammer.

Strong evidence and scientific research underpin everything we do at the RSPB, which is why I welcome this fourth annual *Solar Habitat* report from Solar Energy UK. It is encouraging to see a real commitment to further strengthening the evidence base for biodiversity on solar farms, to inform future management interventions and enable developers to meet both planning obligations and contribute to nature's recovery.

Solar energy and protecting and restoring nature can go hand in hand when wildlife considerations are included in the design and implementation of solar projects. The research and case studies within this report highlight the importance of active engagement between solar developers, local communities and farmers in biodiversity-focused management and monitoring to drive positive change.

It is vital that we continue to build this evidence base in order to better understand how different interventions can perform across various sites and situations. In this way, solar developers can then make informed decisions about how to design and manage solar farms that work for climate and nature.

At the RSPB, we know the possibilities firsthand. We work with businesses to enhance their wildlife-friendly practices, including partnering with solar developers to help them go above and beyond the legal requirements to support and restore nature. Through leveraging our expertise in birds, nature and nature-based climate solutions, these partnerships integrate biodiversity and best practices into the development and management of solar farms, to help recover some of our most iconic species and ensure positive outcomes for nature. We hope these approaches will inspire other solar developers to follow suit.

At this pivotal moment in the energy transition, it is time for the UK's governments and businesses to make sure it happens in a way that cuts carbon emissions, delivers secure energy and also delivers for nature. By making nature positive solar a key part of the transition, we can help ensure a brighter future for people, climate and wildlife.

Lapwing, H. Blaydes, Lancaster University

Summary and highlighted findings

The 2026 *Solar Habitat* report reinforces our growing understanding that well managed solar farms can deliver positive outcomes for biodiversity, while continuing to support renewable energy production. Findings highlight the importance of consistent ecological monitoring and demonstrate how data can be used to identify patterns and trends across large numbers of solar farms.

Data from ecological monitoring across 75 solar farms during 2025 were included in this year's report, representing around 6% of operational sites in the UK. Most sites were new to the *Solar Habitat* database, but the sample was broadly representative of solar farms across the UK in terms of location, age, area and capacity. This is a decrease in the number of sites surveyed in 2024 (124) however, this isn't unexpected as regular annual survey year on year is not common, so there is some natural fluctuation in the number of sites surveyed annually.

As in previous years, data were collected using the Standardised Approach to Monitoring Biodiversity[1], enabling comparable insights across solar farms. Surveys focused on key biodiversity groups including plants, invertebrates and birds, supported by additional case studies and new peer-reviewed research.

Botany

- More than 1,000 quadrats were used to assess grassland habitats across 75 solar farms.
- A total of 259 plant species were recorded across all solar farms, with an average of 28 species per site.
- Most species recorded had favourable conservation status, but several threatened and near threatened species were also observed.
- Greater numbers of plant species were recorded where efforts were made to enhance biodiversity within the solar farm.

Invertebrates

- Ecologists recorded invertebrates along more than 400 transects across 37 solar farms.
- More than 2,500 individual bumblebees and butterflies were counted, comprising 24 different species.
- Butterflies were twelve times more abundant than bumblebees, with four species of conservation interest recorded during structured surveys and incidental observations.
- More individuals and species were recorded at solar farms with more biodiversity-focused management.

Birds

- Around 2,800 individual birds were counted during surveys undertaken at 29 solar farms, including a total of 77 different species.
- Of the species recorded, 25% were Amber Listed species and 22% were Red Listed species.
- A greater number of individual birds and bird species were recorded at solar farms managed with more biodiversity focus.

Mammals

- Although targeted mammal surveys were not undertaken, incidental observations were made at 25 solar farms.
- Eight species of mammal were observed, including two deer species, fox, badger, squirrel, rabbit, common shrew, with the most frequently sighted being the brown hare.

Glossary

Amber Listed (birds) – bird species with an unfavourable conservation status in Europe, whose population/range has declined moderately in recent times or has a historically declining population but has made a recent substantial recovery, rare breeders and species for which the UK holds internationally important populations, as categorised by the British Trust for Ornithology[2].

Archaeophytes – non-native species that were introduced by humans (intentionally or unintentionally) that became naturalised between the start of the Neolithic period and AD1500.

Arisings – vegetation cuttings often left in situ after management.

Biodiversity Net Gain (BNG) – an approach to development that aims to deliver measurable improvements for biodiversity by creating or enhancing habitats.

Birds of Conservation Concern – British Trust for Ornithology Amber or Red Listed species[2].

Botany – relating to plants.

Broadleaf – a group of plants with relatively broad, flat leaves.

Brown soil – well drained, fertile soil with a brown colour that is formed under temperate climates at lower elevations and commonly in agricultural use.

BTO – British Trust for Ornithology.

Caterpillar food plant – plant species on which a caterpillar (the larva of a butterfly or moth) feeds and matures.

Climber - a group of plants that use twining stems, tendrils or sticky pads to cling to surfaces.

Endangered (butterflies) - butterfly species with a high risk of extinction in the wild as categorised by Butterfly Conservation[3].

Endangered (plants) - plant species with high risk of extinction in the wild as categorised by the Botanical Society of Britain and Ireland[4].

Ferns - a group of plants that reproduce using spores and do not have seeds or flowers.

Graminoid – grass, sedge or rush.

Green Listed (birds) – bird species that are of least conservation concern, whose population is stable or increasing, as categorised by the British Trust for Ornithology[2].

Incidental (observations) - biodiversity sightings outside of structured surveys.

Least Concern (butterflies) – butterfly species that are widespread and abundant, as categorised by Butterfly Conservation[3].

Least Concern (plants) – plant species that do not qualify as threatened or near threatened as categorised by the Botanical Society of Britain and Ireland[4].

Near Threatened (butterflies) – butterfly species nearing threatened status, as categorised by Butterfly Conservation[3].

Near Threatened (plants) – plant species close to qualifying for a threatened category in the future as determined by the Botanical Society of Britain and Ireland[4].

Pelosol soil – heavy, clay-rich soil that shrinks and cracks when dry and becomes sticky and poorly drained when wet, associated more with grassland rather than cropland.

Quadrat – a square plot of land marked out for botanical assessment.

Red Listed (birds) – bird species that are globally threatened, whose population/range has declined rapidly in recent times or that have declined historically and not shown recovery, as categorised by the British Trust for Ornithology[2].

Strings (of panels) – a row of panels that are wired together.

Sward – a grassland area.

Taxonomic – the scientific process of naming, defining, and classifying groups of biological organisms based on shared characteristics and evolutionary relationships.

Transect – a walked line through a habitat used to make measurements or observations.

UK Habitat Classification System (UKHab) – a system for classifying vegetation in the UK, required for Biodiversity Net Gain.

Vulnerable (butterflies) – butterfly species considered to be facing a risk of extinction in the wild, as categorised by Butterfly Conservation[3].

Vulnerable (plants) – as categorised by the Botanical Society of Britain and Ireland[4].

Woody plants – a group of plants whose stems/roots are reinforced with wood (typically trees and shrubs).

Marbled white butterflies and a six-spot burnet moth, H Blaydes, Lancaster University

Introduction

The dual crises of climate change and biodiversity loss demand rapid, innovative land management strategies across the United Kingdom. As the country accelerates it's transition toward a clean energy grid, the solar energy sector has emerged not only as a critical provider of renewable power but as a partner in ecological restoration. Well-managed solar farms present a unique opportunity to establish stable habitats that support native species and deliver critical ecosystem services.

Solar Energy UK, alongside Clarkson & Woods, Lancaster University, and Wychwood Biodiversity, are pleased to present the fourth annual *Solar Habitat* report. Since its inception in 2023, this annual publication has synthesised high-level ecological data to track ecological trends, measure the impact of site management strategies, and map the evolving relationship between solar infrastructure and the natural environment.

The data underpinning the *Solar Habitat* series are captured by ecological consultancies during routine compliance and monitoring surveys. These data are submitted to the *Solar Habitat* team for integration, mapping, and macro-level statistical analysis. Crucially, all contributing partners utilise the *Standardised Approach to Monitoring Biodiversity on Solar Farms*[1]. This allows independent site data to be pooled together, transforming localised observations into nationwide insights to build a growing evidence base.

To provide a comprehensive view of solar farm ecosystems, *Solar Habitat 2026* evaluates data collected across 75 operational UK solar farms during the 2025 monitoring season. The report structures its analysis around three core taxonomic pillars: botany, invertebrates and birds. Where available, the report also incorporates incidental data on other wildlife groups, such as mammals.

Additionally, *Solar Habitat 2026* features a selection of operational case studies designed to showcase real-world land management success stories, alongside groundbreaking, peer-reviewed statistical modelling using the monitoring data of 86 sites submitted in 2023. This analysis, led by Lancaster University, demonstrates the value of the monitoring data *Solar Habitat* is based on by isolating the more precise drivers of solar biodiversity. Insights from this research have been included through this report.

Small skipper, A Remazeilles, Clarkson & Woods

Monitoring ecology

Monitoring ecology on solar farms

Monitoring biodiversity on solar farms helps to ascertain their ecological state, assess effectiveness of management interventions, identify any issues and ensure planning obligations are met. Ecological monitoring also facilitates the collection of valuable data that can help to understand the impacts of solar farms on the local environment and how biodiversity responds to these developments and their management.

Solar Habitat uses the data collected during the past ecological monitoring season, combines it into a single dataset, and reports on biodiversity recorded on solar farms. It seeks to identify any patterns that might explain variation in biodiversity across different sites. The *Solar Habitat* report's focus on analysing the impacts of site management actions (including grassland management, habitat creation, herbicide use etc.) and relationships between biodiversity groups. This helps to better understand how solar farms can support biodiversity and to guide solar farm management in the future.

Solar Habitat data

Each *Solar Habitat* report provides a snapshot of biodiversity on solar farms in the year that data were collected. Across the four reports to date, most of the monitored sites have been unique, although a small proportion of solar farms have been surveyed more than once. This reflects standard practice, as most solar farms are not monitored annually but instead are surveyed periodically depending on the management plan to meet compliance requirements.

Peer reviewed publication based on Solar Habitat 2024 data

Whilst *Solar Habitat* reports present high-level results from ecological monitoring at solar farms each year, the database has potential to explore drivers of biodiversity more deeply. As such, data from 86 sites, collected in 2023 and submitted to *Solar Habitat* 2024 were integrated in combination with other data on operational solar farms collected using a Geographic Information System (GIS) and the UK Government's Renewable Energy Planning Database and analysed. The result is a peer-reviewed scientific paper, led by Lancaster University, published in the journal *Environmental Research: Ecology*[6].

The study is based on ecological monitoring data collected at 86 of the solar farms in England and Wales which submitted to *Solar Habitat* 2024. A host of other data were collected using GIS-based techniques to derive additional information about solar farm characteristics and their surrounding landscapes. The aim of the study was to determine the drivers of biodiversity within solar farms, considering a wide range of factors (Table 1). Using statistical modelling techniques, the paper quantified how much variation in biodiversity was associated with each of these factors, focusing on vegetation, butterflies and birds.

The findings showed that overall, a combination of solar farm characteristics, site management, landscape context and survey methods played a role in explaining differences in biodiversity across solar farms. Specific drivers differed depending on the biodiversity group and key findings are presented in more detail across the Botany, Invertebrates and Birds sections of this report.

	Driver	Plants	Butterflies	Birds
Survey methods	Survey month			
	Quadrat size			
	Number of quadrats surveyed			
	Number of transects walked			
Solar farm characteristics	Geographic location			
	Aspect			
	Elevation			
	Slope			
	Annual temperature			
	Age			
	Soil type			
	Previous land use			
Management	Site management			
Landscape characteristics	Landscape composition			
	Landscape diversity			
	Woody linear feature density			
Biodiversity	Plant species richness			
	Invertebrate abundance			
	Invertebrate species richness			

Table 1. A summary of potential drivers of solar farm biodiversity that were considered in the scientific paper. Boxes shaded in blue indicate where there was a significant association (which could be positive or negative) with plants, butterflies or bird biodiversity. Boxes shaded in yellow indicate where the association was not significant and those in grey indicate where an association was not investigated.

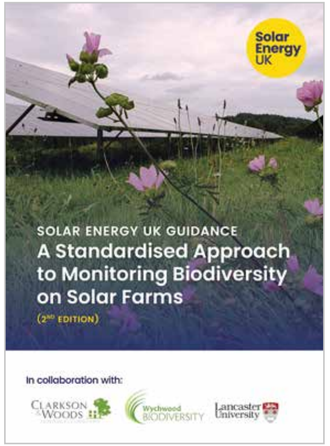
Standardised Approach to Monitoring Biodiversity on Solar Farms

The *Standardised Approach to Monitoring Biodiversity on Solar Farms* is the framework for the data in this and all past *Solar Habitat* reports.

The second edition refines the 2022 framework using practitioner feedback and UK-wide monitoring data collected between 2022 and 2024. This updated edition aligns with mandatory Biodiversity Net Gain (BNG) monitoring requirements, new industry standard guidelines, and growing interest in natural capital benefits. It aims to strengthen data consistency across the expanding solar sector, ensuring relevance amidst changing environmental policies.

The framework categorises monitoring into "Key Components" and "Additional Components." Key components focus on grassland botany and general site management and should be measured during every visit. Additional components are site-specific, depending on planning requirements and asset owners' interests. The methodology includes estimated survey durations and seasonal timings, though it must be scaled up appropriately for larger sites.

Where monitoring is taking place on a solar farm the Standardised Approach to Monitoring Biodiversity on Solar Farms can serve as a guide to ensure consistent monitoring based on existing ecological methodologies, additionally the data collected can be added to the *Solar Habitat* report. Visit the Solar Energy UK website to see details of how to contribute as well as supporting tools such as the Nectar Production calculation tool and an excel form for submitting data to the *Solar Habitat* report.



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Case Study

The Standardised Approach *In Practice*

Despite growing interest in biodiversity enhancement on solar farms, post-construction ecological monitoring remains inconsistent, with many sites remaining unmonitored. A recent poll at the Chartered Institute of Ecology and Environmental Management (CIEEM) autumn conference in 2025 revealed that only 7% of workshop participants had heard of the standardised methodology. Consequently, it was felt that a mechanism was required in order to publicise the methodology more widely.

An article, written as a collaboration between Clarkson & Woods, Wychwood Biodiversity, Lancaster University and University of Santiago de Compostela, was published in the CIEEM publication, *In Practice* in March 2026. The aim of the article was to introduce the standardised approach to monitoring biodiversity on solar farms to a wider audience. The magazine is highly regarded and is read by many ecological consultants, with wider discussions occurring on social media.

The article gives a background on the evolution of the standardised methodology and the necessity of such an approach. An overview of the Key Components and Additional Components is set out within the article, along with best practice principles to follow when designing a monitoring strategy.

The article highlights how the standardised data is improving our understanding of solar farm biodiversity, informing Biodiversity Net Gain assessments, supporting site management decisions and contributing to scientific research. The standardised approach has also facilitated collaboration between industry and academia and is now helping to inform similar monitoring initiatives internationally.

It is hoped that the article will facilitate discussion and adoption of the standardised methodology. Ultimately, the value of the data collected under the methodology will increase as it is applied on more sites and we can gain a more thorough understanding of how renewable energy infrastructure can contribute to nature recovery alongside the transition to net zero.

Overview of solar farms

In 2025, data collected at 75 solar farms were submitted for inclusion in this year's *Solar Habitat* report. Only 20 sites (27%) had been included in previous reports, with most (55 sites; 73%) being new to *Solar Habitat*. The sample represents around 6% of operational solar farms in the UK, and a range of data were collected from sample sites between May and September 2025, focusing on botany, invertebrates and birds.

Solar farm characteristics

Most solar farms in the sample were in England (71 sites; 95%), with the majority in the South West (30 sites; 40%), the South East (13 sites; 17%) and the East Midlands (11 sites; 15%) as shown in Figure 1. This mirrors both the national distribution and distributions observed in previous *Solar Habitat* reports. Around 4% of solar farms in the sample were in Wales (three sites) and one site was in Northern Ireland. No monitoring data were submitted to this report for any solar farms in Scotland.

Solar farms in the sample varied in terms of their age, area and capacity. On average, they were slightly larger (in terms of both area and capacity) compared to sites across the UK (Table 2).

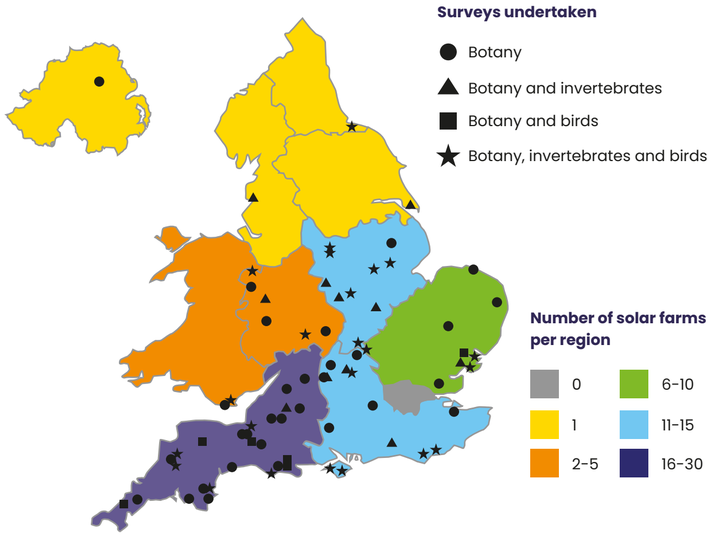


Figure 1: Locations of solar farms that submitted monitoring data to Solar Habitat in 2025. Shapes represents the surveys undertaken at the solar farm, where circles represent sites where only botanical surveys were undertaken, triangles for botanical and invertebrate surveys, squares for botanical and bird surveys and stars for botanical, invertebrate and bird surveys. Regions are shaded according to the number of solar farms that submitted monitoring data to *Solar Habitat* in 2025.

	Solar farms in *Solar Habitat* sample	All solar farms in the UK
Age	10 years	10 years
Area	16 hectares	14 hectares
Capacity	9 MW	8 MW

Table 2. Characteristics of solar farms in the Solar Habitat sample compared to solar farms across the UK. Values in the table are the mean, across solar farms that submitted data to this year's report and across all solar farms in the UK. National level data were calculated using the Renewable Energy Planning Database[6] and a spatial solar farm dataset created by Lancaster University[7].

1	Optimal management for biodiversity with conservation cutting/grazing and no herbicide use. Arisings are removed from the site. A range of habitats (e.g. meadows, tussocky grassland, woodland planting, hedgerow planting) are present.
2	Conservation cutting or grazing takes place on site. Arisings are left on site with signs of thatch in places. A range of habitats are present. Herbicide may be used, but spot treatment only.
3	Site is cut or grazed throughout the year leading to a short sward in the summer months. Some other habitats are present, such as tussocky margins or planted hedgerows/ woodland. Use of herbicides are apparent (e.g. blanket spraying beneath the solar panels).
4	Site is cut or grazed throughout the year leading to a short sward in the summer months. No other habitats (e.g. tussocky margins, new hedgerows or woodland) are present. Use of herbicide is apparent (e.g. blanket spraying fields or beneath the solar panels).
5	Site is unmanaged or 'other'.

Table 3. Site management categories. Categories defined as in the *Standardised Approach to Monitoring Biodiversity on Solar Farms*[1].

Solar farm management

All solar farms monitored in 2025 were assessed in terms of how habitats on site were managed and were assigned an overall management category based on the focus on biodiversity, with Category 1 having the greatest focus on biodiversity and Category 4 having the least (Category 5 is 'other'; Table 3).

Over half of solar farms were placed in Category 3 (53%, 40 sites), but a large proportion were also assigned to Category 2 (32%, 24 sites), indicating some consideration of biodiversity. A smaller number of solar farms (9%, seven sites) were placed into Category 4. In contrast, two solar farms were assigned to Category 1 (3% of sites), where management for biodiversity is considered to be optimal and the remaining solar farms (3%, two sites) were assigned to Category 5.

General observations of grassland management around solar arrays were also made at the majority of solar farms (89%, 67 sites), which were grouped into 'grazed', 'mown' or 'both'. Most solar farms were mown (60%, 40 sites), with many grazed (27%, 18 sites) and a smaller number were both mown and grazed (13%, nine sites).

Botany

Within solar farms, botanical surveys primarily targeted grassland habitats, as these represent the largest habitats within a site. Grassland habitats are valuable due to their ability to support a diverse range of wild plant species, which underpin biodiversity more broadly. In addition, grasslands provide several key ecosystem services, ranging from water regulation to soil preservation, which benefit both wildlife and humans.

Grasslands in the UK are under significant threat, with widespread losses largely driven by a range of factors. However, solar farms offer opportunities for grassland restoration, where lower intensity management regimes can allow more diverse plant communities to establish and persist without the need for intensive intervention. Grassland within solar farms can also be grazed, and when stocking levels are lower or conservation-focused approaches are adopted (e.g. avoiding grazing during the summer months), this can contribute to maintaining and enhancing species-rich grasslands.

Other important habitats within solar farms include hedgerows. Previous *Solar Habitat* reports and published research have demonstrated the value of these habitats to biodiversity within the solar context, but this year there was insufficient data submitted to explore this in depth.

Botanical quadrats

At all 75 solar farms, botanical quadrats were used to assess grassland habitats. A total of 1,332 were surveyed and every quadrat was 1 m x 1 m in size. Quadrats were used to survey grassland in different areas of the solar farm, including directly underneath solar panels ("under"; a total of 414 quadrats), between the rows of solar panels ("between"; a total of 416) and in areas away from the solar array that may be inside or outside of the security fencing (including field margins and open areas; "outside"; a total of 423). A further 79 quadrats were surveyed in areas that had been specifically enhanced for biodiversity, which included wildflower-rich grasslands ("enhanced").

Within many solar farms, five quadrats were assessed under the solar panels, five were assessed between the rows and five were assessed in field margins or other habitats, with enhanced areas being surveyed if they were present. The average number of quadrats surveyed at each site was 18, but this ranged from 13 to 31. More quadrats tended to be surveyed at larger solar farms or those with more variation in habitat types.

Botanical species richness

In all quadrats, the number of plant species were counted and the percentage of the quadrat they occupied were recorded. A total of 259 plant species were recorded across all solar farms surveyed, including broadleaf plants (172 species), graminoids (58 species) and a variety of other species including woody plants, climbers, ferns and agricultural species (29 species).

Yorkshire fog (*Holcus lanatus*) was the most frequently recorded graminoid, present in 67% of all quadrats, followed by creeping bent (*Agrostis stolonifera*) in 42% of quadrats and red fescue (*Festuca rubra*), recorded in 29%, mirroring results presented in previous *Solar Habitat* reports. This is interesting as most of the grassland in the UK is dominated by perennial ryegrass (*Lolium perenne*), a cultivar agricultural grass species. This suggests that grasslands within solar farms could be reverting to native grass communities over time.

The most frequently recorded broadleaf species were also broadly similar to those described in previous *Solar Habitat* reports. Creeping buttercup (*Ranunculus repens*) was present in 14% of quadrats, followed by ribwort plantain (*Plantago lanceolata*) in 13% of quadrats and creeping thistle (*Cirsium arvense*) recorded in 11%. Creeping buttercup is usually found within nutrient rich communities and many of the solar farms included in the 2025 surveys will still be affected by past applications of fertilisers which can take many years to diminish. However, ribwort plantain forms part of more natural and diverse grassland communities; it is a characteristic herb of Other Neutral Grassland within the UK Habitat Classification System (UKHab). Creeping thistle is an injurious weed and can be especially problematic under panels where cutting is difficult.

Botanical species of conservation interest

The majority of plant species recorded inside quadrats were classified as Least Concern (65%) or were species which were not assessed for the Red List4 (30%), which only includes data for 1,720 native and archaeophyte vascular plant species. But there were five species recorded within solar farms classified as Near Threatened, five species classified as Vulnerable and two species classified as Endangered.

Near Threatened species included sheep's sorrel (*Rumex acetosella*) recorded in nine quadrats across four solar farms, bell heather (*Erica cinerea*) recorded in four quadrats at one solar farm and flea sedge (*Carex pulicaris*), spring sedge (*Carex caryophyllea*) and yellow mignonettes (Reseda lutea) which were all observed in one quadrat (Figure 2). Vulnerable species included bladder campion (*Silene vulgaris*) recorded in two quadrats at one solar farm and hare's foot clover (*Trifolium arvense*), orange foxtail (*Alopecurus aequalis*), quaking grass (*Briza media*) and spring vetch (*Vicia lathyroides*) all recorded at one solar farm (Figure 2). Lastly, chamomile (*Chamaemelum nobile*) and common wormwood (*Artemisia absinthium*) were recorded at one solar farm, which are classified as Endangered (Figure 2).

Wild Carrot, H Montag, Clarkson & Woods

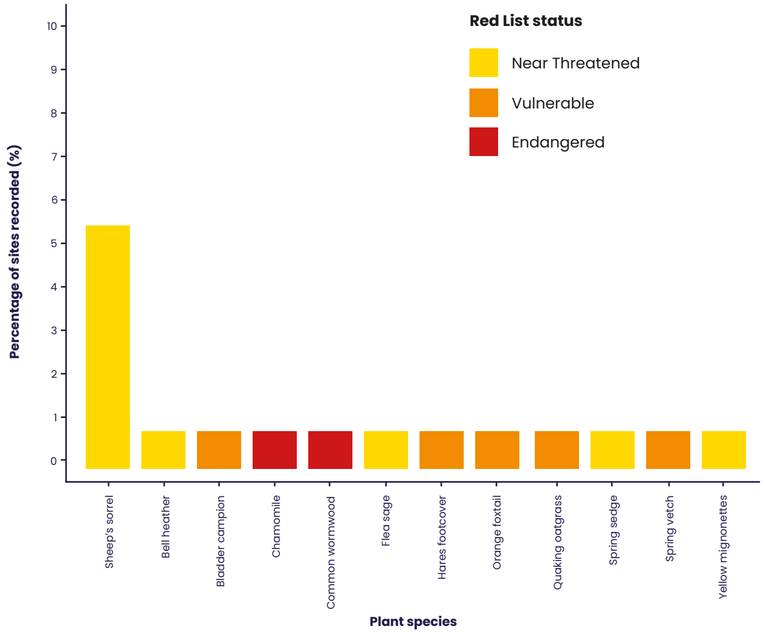


Figure 2. Observation frequency of plant species classified as threatened or near threatened recorded at solar farms. The percentage of sites (a total of 75) on which each threatened (Vulnerable or Endangered) or Near Threatened plant species was observed, arranged by most to least frequently recorded. Note that the y-axis scale is only between 0 and 10% of solar farms.

Variation in botanical biodiversity

Plant species richness varied at both the quadrat and solar farm level. Within quadrats, an average of six plant species were recorded, but this ranged from one to 23. There was also variation at the site level, with an average of 28 species recorded within a solar farm, ranging from nine to 73.

Plant species richness was greatest at solar farms placed into management Categories 5 and 1, where on average, 49 and 46 plant species were recorded within these solar farms, respectively. This is unsurprising given solar farms in Category 1 are considered to be undertaking optimal management for biodiversity and those in Category 5 represent potentially unusual sites for which categories are often not appropriate. However, it should be noted that the sample size of solar farms in both of these categories was small (two in each Category), and a larger sample size would allow for better comparison with sites across categories.

For categories where sample sizes were larger, plant species richness was highest at solar farms in Category 2 (30 species recorded on average), followed by Category 3 (26 species) and Category 4 (23 species; Figure 3).

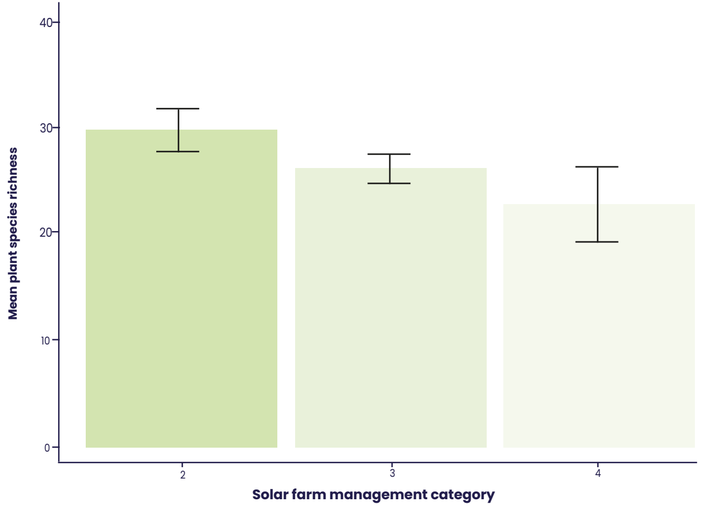
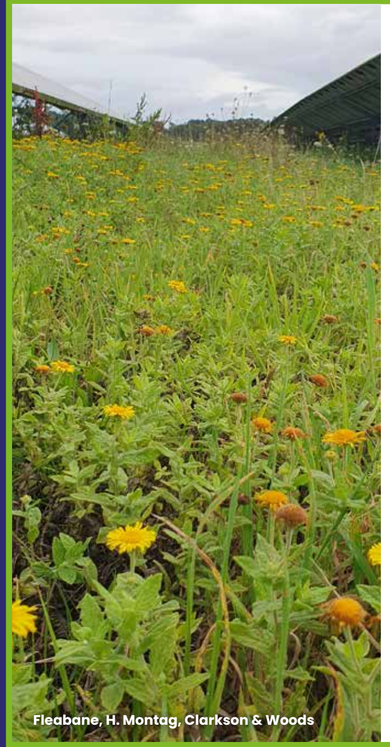


Figure 3. Plant species richness by solar farm management category. Mean plant species richness by solar farm management category. Most solar farms were in Categories 2 (24 sites) and 3 (40 sites), with less in Category 4 (seven sites). Solar farms in Categories 1 and 5 were excluded given surveys were undertaken at only two sites in each category.

Botanical Survey, A Remazeilles Clarkson & Woods

Peer reviewed publication based on Solar Habitat 2024 data



Fleabane, H. Montag, Clarkson & Woods

Botany results

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Plant diversity recorded within solar farms was primarily influenced by site management and survey effort, rather than fixed site characteristics. Solar farms managed with a stronger focus on biodiversity (Categories 1-3) had higher plant diversity than those which were less optimally managed (Category 4). This highlights how less intensive management regimes, which may include reduced cutting and grazing intensity, limited herbicide use and the creation or presence of diverse habitats, can promote richer plant communities within solar farms.

Survey-related variables also affected plant diversity, which increased with the number of quadrats surveyed within a solar farm, reflecting how greater sampling effort can capture more species. Conversely, plant diversity was lower in surveys conducted later in the season (September vs. May), likely due to seasonal changes in plant visibility and phenology.

In contrast, there were no associations with plant diversity and solar farm characteristics such as geographic location, soil type, elevation, age or previous land use. This suggests that, unlike other biodiversity groups, plant diversity is less constrained by fixed site conditions and is more responsive to management practices. Or, other characteristics of vegetation (e.g. plant community composition) is more closely linked to site conditions, rather than diversity. This may also just be the case for this specific sample of solar farms and could be investigated further using a different pool of sites or a larger sample to see if the same results are found.

Overall, the findings demonstrate that plant diversity at solar farms can be enhanced through targeted management, making it a key and actionable lever for improving biodiversity outcomes.

Buttercups, H Blaydes, Lancaster University

Case Study

A Closer Look at Under Panel Habitats

The presence of solar panels creates a different microclimate to other areas of the solar farm, which are less restricted in terms of light and precipitation. In response to this, the habitats that develop directly beneath solar panels can be markedly different to those that established elsewhere within solar farms, likely influenced by the altered microclimate, but also differences in site management actions and other factors. Previous research has focused on measuring microclimatic differences[8] and assessing variation in plant composition across areas within a solar farm[9,10]. However, the plant community that forms under the solar panels and the drivers behind this are still not well understood, and it can be challenging to characterise this relatively unique habitat.

Using botanical data that were submitted to Solar Habitat this year, it was possible to take a closer look at the habitats that were established under the solar panels. A total of 414 quadrats were surveyed under solar panels and on average, four plant species were recorded per metre square, but this ranged from one to 17 species. This shows that although diversity can be low, vegetation establishes under the solar panels and at three solar farms, species richness was so great that the habitat was classified as Lowland Meadow.

A total of 119 plant species were recorded across all under panel quadrats, but the most frequently recorded were Yorkshire fog (*Holcus lanatus*) present in 66% of quadrats, creeping bent (*Agrostis stolonifera*) present in 43% and barren brome (*Bromus sterilisation*), present in 33% (Figure 4). Many of the most frequently recorded species were graminoids, but several broadleaf species were also common (Figure 4).

As well as the number of plant species, the amount of bare ground was also recorded in every quadrat. On average, bare ground occupied 11% of a quadrat surveyed under the solar panels (ranging from 0.5% to 100%), which was greater than average cover recorded between the rows of solar panels (2%), in enhanced areas (3%) and in outside areas (4%). The higher proportion of bare ground may reflect the different approach to site management practices across solar farms, as annual herbicide spraying may be conducted on sites where vegetation growth under panels is problematic. However, injurious weed cover was lowest inside quadrats surveyed under the panels (0.6%), on average, compared to between the rows (1%) and in enhanced and outside areas (2%).

In summary, the data show that plant communities do establish under solar panels, although diversity can be low. This should be considered during pre-construction UKHab and Biodiversity Net Gain (BNG) assessments, as the UKHab code "83 Solar Panel Array" states that mapping should align with "u1b6 Sealed Surface". However, Modified Grassland in poor condition appears to be the most common outcome after habitat assessment, but more formal analysis is needed to quantify this.

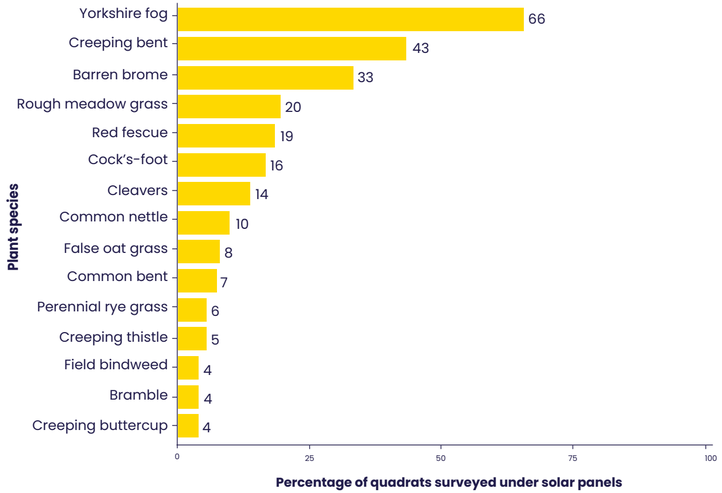

Figure 4. The top 15 most frequently recorded plant species in quadrats under solar panels. The percentage of quadrats in which the most frequently recorded plant species were observed in, considering only quadrats surveyed under solar panels (a total of 414). Species are arranged by most to least frequently recorded and the number at the end of each bar represents the percentage for each plant species.

Under panel habitat, Lancaster University

Invertebrates

Invertebrates are critical components of ecosystems, providing a range of services to both humans and non-human wildlife. Many wild and agricultural plants rely on invertebrates for pollination, meaning they play a role in ecosystem maintenance but also food security. Invertebrates are also an important element of food chains, contributing to the diet of birds, bats and other taxa. Many invertebrate species have become less abundant in recent decades, and/or their distribution has contracted, in response to a range of threats such as habitat loss, degradation, fragmentation and climate change. However, solar farms that provide resources for invertebrates could contribute to alleviating some of these challenges and a growing evidence base indicates that targeted management can have positive impacts on invertebrate abundance and diversity[11].

Ecological monitoring, within solar farms but also in other contexts, tends to focus on bumblebees and butterflies. This is because they are identifiable in the field and unlike other invertebrate groups, generally do not require samples to be collected and examined under a microscope to identify to species level. Bumblebees and butterflies are also some of the larger invertebrates, meaning they are more conspicuous when surveying. Butterflies are considered indicators for other biodiversity groups and wider environmental changes as they are sensitive to fine-scale changes in habitats, weather and climate, meaning they are an ideal group to focus on. Bumblebees can also act as indicators but are often included in monitoring efforts given their important role in the crop pollination. Both of these groups are also relatively well studied compared to other invertebrates, with established national level monitoring schemes centred around walked transect methods.

Transect walks

Bumblebees and butterflies were recorded by ecologists walking transects at 37 solar farms (49% of sites). Transects were generally 100 m in length and individual bumblebees or butterflies within an imaginary 4 x 4 m box around the surveyor were counted and identified to species level in most cases.

A total of 412 transects were walked across all solar farms, either between the rows of solar panels (204 transects; “between”) or in field margins, open areas or areas enhanced for biodiversity (191 transects; “outside”). A further seven transects were walked in control areas and there were ten transects where the location was not recorded. Typically, five transects were walked between panel rows and five in other areas. Indeed, an average of eleven transects were walked at each site, ranging from ten to 17, with more transects typically walked at larger sites or those with more habitat diversity.

Bumblebees and butterflies recorded along transects

Across all transects, a total of 2,687 individual bumblebees and butterflies were counted. There were 207 bumblebees counted compared to 2,480 butterflies, meaning butterflies were almost twelve times more abundant, which broadly mirrors results presented in previous *Solar Habitat* reports and published research12. Butterflies are likely much more abundant on solar farms as many species rely on grasses, which are critical for their lifecycle as they are a caterpillar food source. Rather than grasses, bumblebees may instead be searching for flower-rich areas, which might only be present where management is targeted to create such habitats at solar farms.

Individuals recorded comprised of at least 24 different species, with five bumblebee species and 19 butterfly species observed. The most recorded bumblebee species was the red-tailed bumblebee (Bombus lapidarius; 84 individuals), followed by the white-tailed bumblebee (*Bombus lucorum*) and the common carder bee (*Bombus pascuorum*). However, there were also 38 individual bumblebees recorded where it was not possible to identify them to species level. The most frequently recorded species are similar to those reported in previous years and are included within the “Big Eight” most common species across the UK.

As in previous years, the most frequently recorded butterfly species was the meadow brown (*Maniola jurtina*), accounting for more than 60% of all butterfly observations (1,561 individuals). Meadow brown has been the most frequently recorded species across all *Solar Habitat* reports, which is unsurprising given it is one of the most widespread species in the UK and is often the most abundant butterfly species in many habitats. This species was recorded on 84% of solar farms and is likely so prevalent given its reliance on grassland (Figure 5). Moreover, as a habitat generalist, meadow brown caterpillars feed on a variety of common grass species often recorded within solar farms. Marbled white (*Melanargia galathea*) and small skipper (*Thymelicus slyvestris*) were also abundant, with 190 and 131 individuals recorded, respectively. Both species also utilise common grasses recorded within solar farms, with small skipper almost exclusively relying on Yorkshire fog (the most frequently recorded graminoid) as a caterpillar food plant.

Butterfly species of conservation interest

While most butterfly species recorded along transects were classified as Least Concern (as per the Butterfly Red List[3]), there were two species observed of conservation interest. As in previous years, the small heath (*Coenonympha pamphilus*), a species classified as Vulnerable, was observed along transects walked both between solar panels and in field margins. Small heath was observed at ten solar farms (27% of sites), with 62 individuals recorded across all these sites (Figure 5). Although this species is widespread across the UK, its distribution has reduced significantly over the last five decades and many colonies have disappeared. Another species of conservation interest, the small blue (*Cupido minimus*), was also recorded along transects. Small blue was observed at two solar farms (5% of sites), with two individuals recorded in margin areas of the sites (Figure 5). This species is classified as Near Threatened because of declines in both its national distribution and abundance.

H. Blaydes, Lancaster University

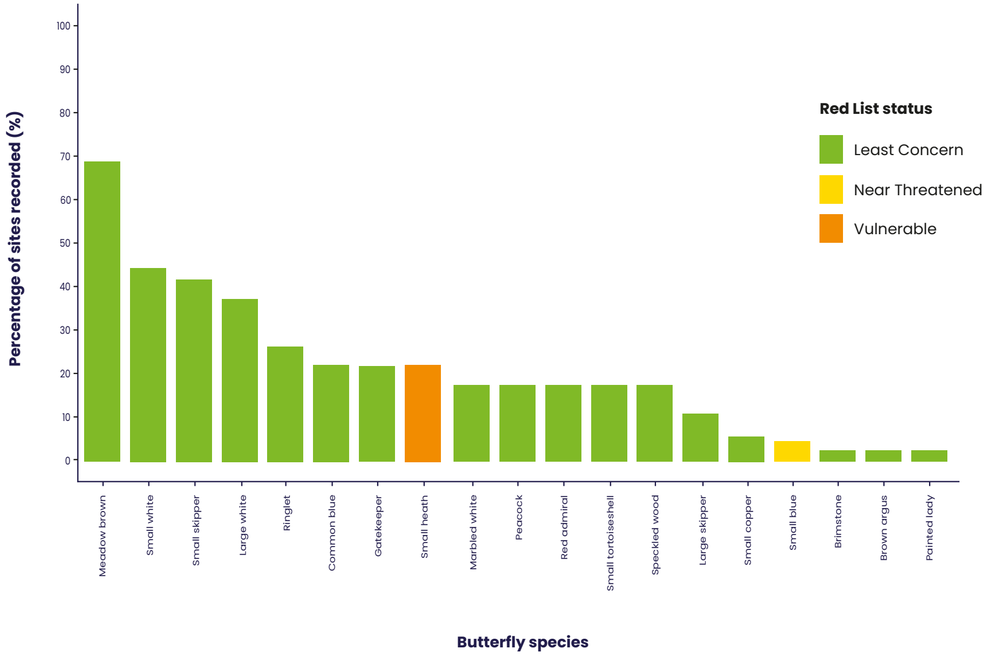

Figure 5. Observation frequency of all butterfly species recorded along transects at solar farms. The percentage of solar farms (a total of 37 sites) on which each butterfly species was observed, arranged by most to least frequently recorded.

Variation in bumblebee and butterfly biodiversity

The average number of bumblebee or butterfly species recorded along a transect was two (per 100 m), but this ranged from zero to nine and differed depending on where the transect was walked. On average, there were twice as many bumblebee or butterfly species recorded along transects walked in "outside" areas (two species), compared to those walked between rows of solar panels (one species).

There was also variation in the number of individuals observed along transects, ranging from zero to 108, but the average was seven. In one case, 100 meadow brown butterflies were observed along one 100 m transect walked through a solar farm margin area. Numbers of individuals were greater along transects walked in "outside" areas, with nine observed on average, compared to four recorded between rows of solar panels. Both the number of species and individuals observed along transects are likely to be higher in "outside" areas as they tend to be managed less intensively and could offer more resources, or structural diversity, for invertebrates.

Outside areas also include field margins, located around the outskirts of solar farms, which may be bordered by hedgerows that provide resources and shelter to many species.

At the solar farm level, the number of bumblebee and butterfly species varied, as did the number of individuals. On average, seven species (ranging from zero to 13) and 73 individuals (ranging from zero to 290) were recorded within a solar farm. However, both species richness and the number of individuals was greater on average at solar farms assigned to management Category 2, compared to sites in Categories 3 and 4 (Figure 6). Although sites in Category 3 were managed with a greater focus on biodiversity, the number of species and individuals was higher at sites in Category 4, but this could be because the sample size for solar farms in Category 4 was relatively small. Similarly, transects were walked at only one solar farm in Category 1 and one solar farm in Category 5 and so these were excluded from Figure 6. However, both sites were relatively biodiverse, with twelve species and 176 individuals recorded at the site in Category 1 and ten species and 68 individuals recorded at the site in Category 5.

Marbled White, H. Blaydes, Lancaster University

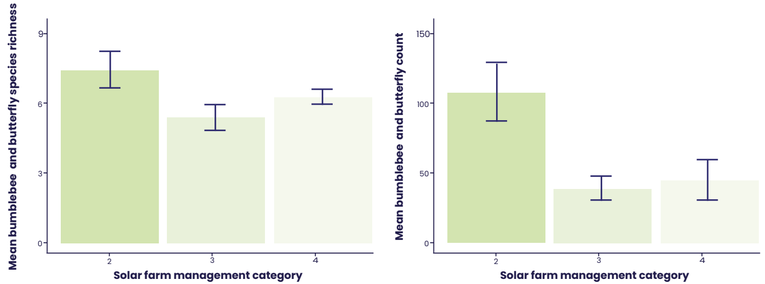

Figure 6. Mean bumblebee and butterfly species richness (left) and count (right) by solar farm management category. Including only solar farms where transects were walked (37 sites). Most solar farms were assigned to Category 2 (15 sites) and 3 (17 sites), with only three sites in Category 4. Solar farms in Categories 1 and 5 were excluded given transects were walked at only one site in each category.

Incidental observations

Observations of invertebrates were also made outside of structured transect walks at 54 solar farms (72% of sites), including those where targeted invertebrate surveys were not undertaken. A total of 3,791 individual invertebrates were observed, comprising of at least 52 different species (not all individuals were identified to species level). These included butterflies (27 species), odonates (nine species), bumblebees (five species), moths (two species) and a range of other invertebrates including beetles, wasps, spiders, hoverflies, hornets and grasshoppers.

As similar to results of transect surveys, most butterfly species were classified as Least Concern in terms of conservation priority, but there were a number of threatened or near threatened species observed. Both small heath (*Coenonympha pamphilus*; 31 individuals) and small blue (*Cupido minimus*, four individuals) were sighted, as they were during structured surveys, at six and three solar farms respectively. However, three silver studded blue (*Plebejus argus*) were also recorded at two solar farms and brown hairstreak (*Thecla betulae*) was recorded at one solar farm, both of which are butterfly species classified as Vulnerable. Moreover, one Wall (*Lasiommata megera*) butterfly was sighted, which is classified as Endangered.

Peer reviewed publication based on Solar Habitat 2024 data

Marbled White, H Fox, Clarkson & Woods

Butterfly results

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Butterfly abundance and diversity were shaped by a combination of solar farm characteristics, site management practices, landscape context, plant diversity and survey effort.

Site management emerged as an important driver of butterfly biodiversity, but with mixed effects. Butterfly abundance was higher at solar farms under more biodiversity-focused management (Category 2), while diversity was unexpectedly lower at the most optimally managed sites (Category 1), likely due to the small sample size in this category. This suggests that while focused management could enhance butterfly numbers, more data from optimally managed sites would help to understand strategies for maximising diversity.

Landscape context also played a key role in explaining variation in butterfly biodiversity across solar farms. Diversity was lower at sites surrounded by higher proportions of arable land, indicating that intensively managed agricultural landscapes may limit species diversity. In contrast, butterfly abundance inside solar farms increased with greater densities of surrounding woody linear features (e.g. hedgerows) which likely provide additional resources, shelter and promote habitat connectivity.

Solar farm characteristics influenced butterfly diversity, but not abundance. Butterfly diversity was lower at solar farms located further north, those at higher elevations and in warmer areas, and varied with soil type. Additionally, butterfly abundance was positively associated with plant species richness, highlighting the importance of diverse vegetation in supporting insects within solar farms.

Survey methods also affected results, with more butterflies recorded during transects walked between June and August (compared to May) and with greater survey effort, whilst diversity varied seasonally.

Overall, butterfly biodiversity at solar farms was influenced by a range of factors but can be enhanced through appropriate management and by promoting plant diversity and landscape connectivity.

Bumblebee, H. Blaydes, Lancaster University

Case Study

Solar farms as potential future refuges for bumblebees

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In the first study to investigate the role of solar farms in future biodiversity conservation, a team from Lancaster University, the UK Centre for Ecology & Hydrology and the University of Reading, assessed if Great Britain's existing solar farms could support bumblebees in the face of a changing countryside[13].

Using a spatial modelling approach, researchers evaluated how the value of habitats created within solar farms might change under a range of land use scenarios for 2050. They investigated three alternative futures of what Great Britain could look like based on 'sustainable', 'middle of the road' and 'fossil-fuelled development' scenarios, downscaled to resolutions relevant to bumblebees[14].

Across these scenarios, the amount of different habitats in landscape surrounding solar farms varied, as did the management of these habitats, with consequences for bumblebee foraging and nesting resources. All futures saw a decrease in agricultural land area surrounding solar farms, compared to the present day, driven by factors ranging from changing diets to increased urbanisation.

The findings suggest that if solar farms within these landscapes are managed for biodiversity (i.e. with wildflower margins rich in bumblebee resources), they could more than double bumblebee numbers (compared to solar farms managed as improved grassland with less resources). However, the positive impacts of solar farm management were largely constrained to the solar farms themselves, as landscape composition had a greater influence on bumblebee numbers in surrounding foraging areas outside of the solar farm boundary.

While solar farms alone will not be able to counteract the effects of all future land use changes on bumblebees and other biodiversity, the findings help to show that site management plays a role in supporting bumblebee populations and that solar farms could be considered as an emerging tool in conservation to help to protect bumblebees in the future.

Bumblebee, H. Blaydes, Lancaster University

Birds

Birds are a highly valued component of the UK's biodiversity and are widely used as indicators of the overall health of the natural environment. As they occupy a broad range of habitats and sit at different levels within food chains, changes in bird populations can reflect wider ecological trends affecting other taxa, including insects, plants and mammals. Birds are also among the best studied biodiversity groups, with several long-running monitoring schemes in place across the country.

Despite their importance, many wild bird populations in the UK have sustained declines in recent decades. The most severe losses have been recorded among farmland and woodland birds, with declines reported since the 1970s. Behind these declines are a variety of interacting factors, including habitat loss and fragmentation, pesticide use and climate change, which can reduce food availability and nesting opportunities.

Against this backdrop, there is growing evidence that well managed solar farms may provide benefits for some bird species, particularly within intensively farmed landscapes. By introducing a mosaic of habitats, solar farms can increase structural diversity and support higher invertebrate abundance, improving foraging opportunities. In addition, reduced disturbance and the presence of fenced boundaries could create relatively safe nesting opportunities. While benefits will be more pronounced for certain species, they suggest solar farms have potential to contribute to supporting bird populations depending on construction techniques, siting and management.

Bird surveys

Bird surveys were undertaken at 29 solar farms (39% of sites), with most sites surveyed once (25 solar farms), others twice (three solar farms) and one surveyed three times. Surveys involved walking a transect through each solar farm, covering all habitats within 50 m of the transect, and recording all birds that were seen or heard. Transects were walked during the main bird breeding season (March to September), with most surveys undertaken in June (44%).

Birds recorded during surveys

In total, 77 bird species were recorded across all surveys including 37 BTO Green Listed species (48%), 19 Amber Listed species (25%) and 17 Red Listed species (22%). A further four species (5%) were recorded which had no status, representing those that are not assessed by the BTO as they are game bird species (e.g. common pheasant, *Phasianus colchicus* and red legged partridge, *Alectoris rufa*) or non-native introduced breeding species (e.g. Canada goose, *Branta canadensis* and golden pheasant, *Chrysolophus pictus*).

The number of individual birds were also counted and a total of 2,865 were recorded across all solar farms. The most abundant Green Listed species was the goldfinch (*Carduelis carduelis*; 246 individuals), followed by blue tit (*Cyanistes caeruleus*; 188 individuals) and blackbird (*Turdus merula*; 166 individuals), which is similar to results presented in previous *Solar Habitat* reports. These species are generalist birds and are widespread across the UK, so would be

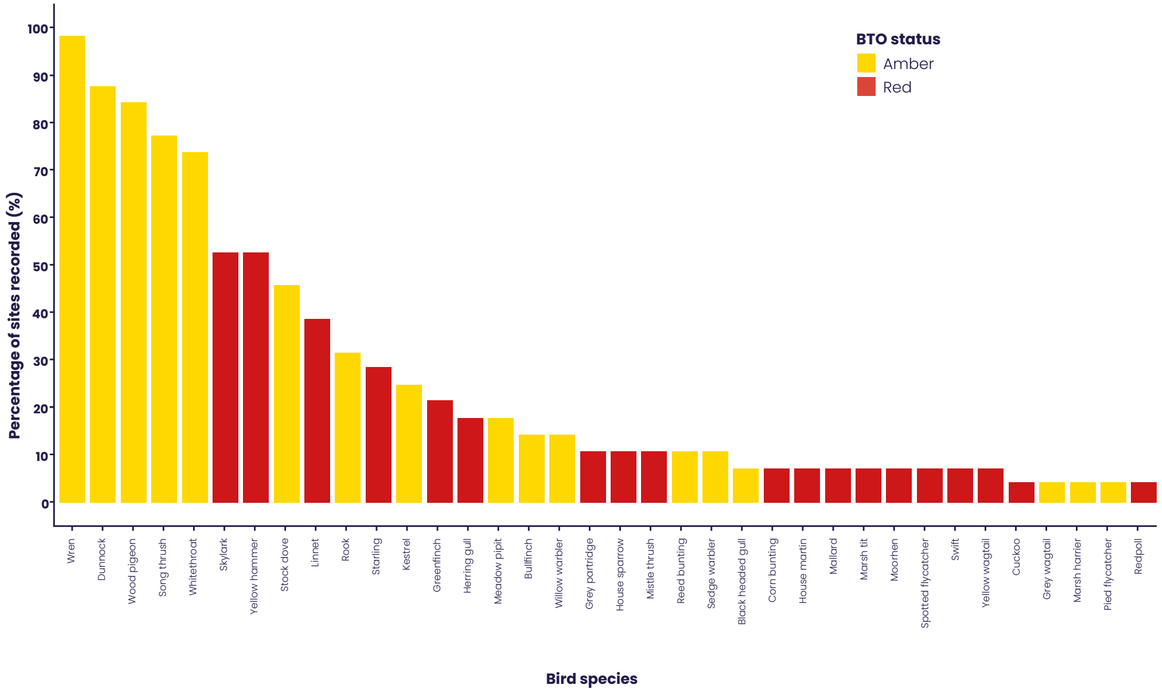

Figure 7. Observation frequency of Birds of Conservation Concern recorded during bird surveys at solar farms. The percentage of solar farms (a total of 29 sites) on which each BTO Amber or Red Listed bird species was observed, arranged by most to least frequently recorded.

expected to be found in high numbers, although goldfinch are seed-eaters and so may benefit from the longer uncut grasses and broadleaved plants that can be found in solar farms, particularly in the margins.

The most abundant Amber Listed species was the wren (*Troglodytes troglodytes*; 218 individuals), followed by wood pigeon (*Columba palambus*; 202 individuals) and greater whitethroat (Sylvia communis; 92 individuals). Wren was recorded on most sites surveyed (97%), with wood pigeon and whitethroat recorded on 83% and 72% of solar farms, respectively (Figure 7). Wren and woodpigeon are widespread bird species that are recent additions to the Amber List, however, they are still present in high numbers in the UK. Greater whitethroat is a migratory bird and numbers have declined significantly. They are more associated with farmland habitats, especially where scrub is present.

The most abundant Red Listed species was starling (*Sturnus vulgaris*; 103 individuals), followed by skylark (*Alauda arvensis*; 78 individuals) and linnet (*Linaria cannabina*; 75 individuals). Although most abundant, starling was recorded at fewer solar farms (eight sites) than both skylark (15 sites) and linnet (eleven sites), possibly because they are typically observed in groups (Figure 7). Interestingly, skylarks continue to be recorded regularly on solar farms, despite the fact that they are unlikely to nest within the solar farm itself. This suggests that solar farms could be providing a foraging resource for this species. As with goldfinches, linnets are also likely to benefit from the uncut seed producing areas and less intensively managed hedgerows.

Variation in bird biodiversity

On average, 21 bird species were recorded during each survey, but this ranged from eleven to 33. The number of individuals observed also varied, ranging from 21 to 243, but the average was 84 per survey.

Both the number of species and individual birds also varied at the site level. However, values are similar to those reported per transect given most solar farms were only surveyed once. On average, 21 bird species were recorded at each solar farm, ranging from eleven to 33. In terms of numbers of individuals, the average number was 86 per solar farm, ranging from 21 to 234. These numbers only include data collected from one bird survey per site (i.e. data from second or third surveys have been removed) to lessen effects of differences in survey effort across sites.

On average, the number of bird species recorded at solar farms was higher at those in Category 2 (23 species) compared to those in Categories 3 (18 species) and 4 (20 species, Figure 8). Interestingly, species richness was slightly higher at sites in Category 4 compared to Category 3, but this could be because the sample size was low for Category 4 (three sites). A similar pattern was observed with the average number of individual birds recorded. On average, the highest number of individuals were recorded at solar farms assigned to Category 2 (95 individuals), followed by Category 4 (90 individuals) and Category 3 (71 individuals; Figure 8). Birds were only surveyed at one solar farm in Category 1 and one solar farm in Category 5 and so these excluded from Figure 8. However, both solar farms were relatively biodiverse, with 19 species and 89 individuals recorded at the site in Category 1 and 17 species and 70 individuals recorded at the site in Category 5.

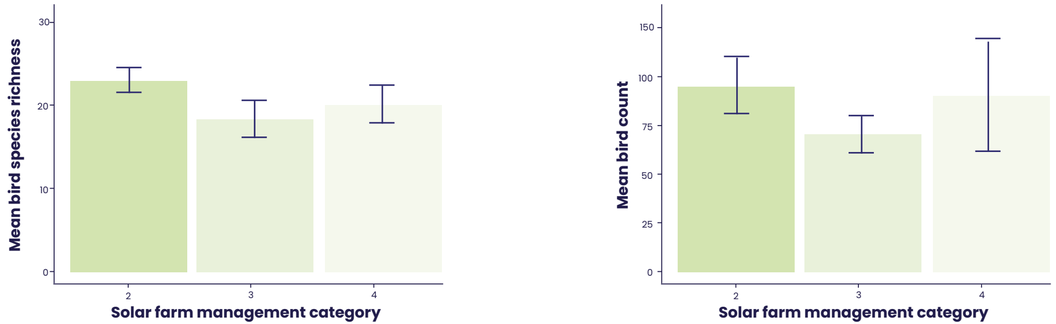

Figure 8. Mean bird species richness (left) and count (right) by solar farm management category. Including only solar farms where bird surveys were undertaken (29 sites) and only one bird survey per solar farm. Most solar farms were assigned to Categories 2 (15 sites) and 3 (nine sites), with only three sites in Category 4. Solar farms in Categories 1 and 5 were excluded given surveys were undertaken at only one site in each category.

Incidental observations

Birds were also observed outside of structured surveys, and incidental observations were made by ecologists at 38 solar farms, including at sites where targeted surveys were not undertaken. A total of 1,601 individual birds were observed, including 75 different species. As with results from structured surveys, around half of species observed were BTO Green Listed (49%; 37 species) but with a significant proportion Amber (24%; 18 species) and Red Listed (24%, 18 species) along with two species (3%) which had no status.

Most species noted during incidental observations were also recorded during structured surveys (80%), but there were 15 species which were not. These included the Amber Listed species greylag goose (*Anser anser*; eleven individuals), lesser black backed gull (*Larus fuscus*; four individuals) and great black backed gull (*Larus marinus*; one individual). However, these birds are likely to have been passing through rather than setting up breeding territories within the solar farm. Red Listed species included curlew (*Numenius arquata*; two individuals), lapwing (*Vanellus vanellus*; one individual) and tree pipit (*Anthus trivialis*; one individual). Again, curlew and lapwing are unlikely to be nesting within the solar array, however, the tree pipit was noted perched on a solar panel and singing. This species nests within clearings in woodlands and so is adapted to cluttered environments; it is therefore considered possible that this species would nest within a solar array.

Oystercatchers, H Blaydes, Lancaster University

Peer reviewed publication based on Solar Habitat 2024 data

Bird results

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Bird biodiversity (both abundance and diversity) was influenced by a combination of solar farm characteristics, site management, landscape context and interactions with other biodiversity groups.

Site characteristics played a prominent role in explaining variation in bird biodiversity across solar farms. Bird abundance and diversity varied geographically, with higher numbers generally observed at more northerly sites and a greater diversity of some groups are more easterly locations. Solar farm age was also important, with higher abundance and diversity – particularly among specialist farmland and woodland birds – at older solar farms, likely reflecting habitat maturation over time. Soil type was the most consistent driver, influencing all aspects of bird biodiversity, with higher diversity and abundance typically associated with pelosol soils, compared to brown soils. When broken down into sub-groups, most of the soils associated with higher biodiversity were calcareous, suggesting these sites were supporting calcareous grassland communities, which tend to be more biodiversity than other grassland habitats. Previous land use also affected abundance, with more birds recorded at sites formerly consisting of rough grassland and fewer at those which were previously improved grassland.

Site management was also associated with bird biodiversity, where certain management categories (particularly Categories 2 and 3) supported higher abundance of specialist farmland birds and greater diversity of generalist woodland birds, although some negative associations were observed for woodland specialists. This suggests that management focused primarily on grassland habitats may not equally benefit all bird groups, especially those more dependent on woodland habitats.

Landscape context strongly influenced bird communities. Greater surrounding arable or improved grassland cover was generally associated with lower bird abundance within solar farms, while higher densities of woody linear features (e.g. hedgerows) supported woodland birds. Effects of surrounding semi-natural habitat and landscape diversity were mixed, reflecting different habitat needs among species groups.

Finally, bird biodiversity was positively associated with plant species richness and, in some cases, invertebrate diversity, highlighting linkages between trophic levels. Overall, the results show that while site management can enhance bird biodiversity, outcomes may depend heavily on site conditions and surrounding landscape context.

Meadow Pipit,
C. MacKenzie, Wychwood Biodiversity

Case Study

Solar farm managed for nature hosts breeding Corn Buntings

Scan to view this paper

Corn Bunting, T.Shannon, British Birds

Farmland birds are the fastest declining group of bird species in the UK, decreasing in abundance on average by 62% since 1970. The Corn Bunting (Emberiza calandra) is one species which was once common across farmland landscapes but has disappeared from much of its former range and is now Red Listed. A new study has documented a breeding population of Corn Buntings using Westmill Solar Farm in West Oxfordshire[15], suggesting that that solar farms managed with a strong emphasis on biodiversity could provide suitable habitat for this vulnerable species.

Researchers at Lancaster University and volunteers at West Oxfordshire Farmland Bird Group found and monitored a total of five nests at Westmill Solar Farm between 2019 and 2023, as well as 36 others on farmland surrounding the site (Figure 9). All nests on the solar farm were successful, compared to around 60% outside the solar farm, and many were located within the array of solar panels. This relatively high success rate may be attributed to reduced risk of predation, which was the main cause of failure outside of the solar farm; fences provide protection mammalian nest predators, such as foxes and badgers, and panels may reduce detection by aerial predators.

The study also conducted a series of behavioural watches of individual Corn Buntings to quantify how these birds were using the solar farm. They revealed that Corn Buntings spent most of their time on the site foraging, with several birds observed 'commuting' to the solar farm to gather invertebrates, which they then fed to nestlings outside the solar farm (Figure 10). This clearly demonstrates that Westmill Solar Farm was an important foraging resource for these birds during the breeding season.

The low-intervention management at Westmill Solar Farm has likely created good conditions for breeding Corn Buntings. For example, allowing wildflower-rich grassland to flourish has likely promoted an abundance of invertebrates across the site, which are essential for nesting birds. Certain design features, such as large gaps between the panel rows and large margins, compared to many solar farms, are likely preferred by farmland species like Corn Buntings which are adapted to open grassland habitats with few linear features.

Whilst the results of this study show what can be achieved when solar farms are managed for biodiversity, Westmill Solar Farm is currently the only site in the UK where nests of ground-nesting birds have been confirmed and monitored. Consequently, further research and investment in nature-friendly design and management is needed to maximise biodiversity uplift on solar farms.

Figure 9. Corn Bunting nesting locations in the three years where they attempted to nest at Westmill Solar Farm (2020, 2022 and 2023). Green dots indicate successful nests and red dots indicate unsuccessful nests. The red line indicates the perimeter of the solar farm.

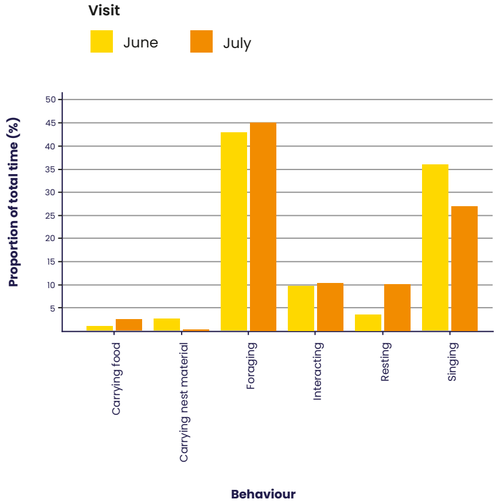


Figure 10. Percentage of time Corn Buntings spent exhibiting each behaviour in focal watches during early vs late season visits..

Brown Hare, H Blaydes, Lancaster University

Mammals

Incidental observations

Observations of mammals were made at a third of solar farms (25 sites) that submitted monitoring data in 2025. Incidental observations are where ecologists note down any mammals they observe, or see signs of (including scat, footprints or feeding remains), whilst carrying out other surveys.

A total of eight species were observed, or signs of their presence recorded. These included badger (*Meles meles*), fox (*Vulpes vulpes*), rabbit (*Oryctolagus cuniculus*), grey squirrel (*Sciurus carolinensis*), common shrew (*Sorex araneus*) and two deer species: muntjac deer (*Muntiacus reevesi*) and roe deer (*Capreolus capreolus*). However, the most frequently counted mammal was the brown hare (*Lepus europaeus*), consistent with observations described in previous *Solar Habitat* reports.

Incidental observations provide a snapshot of mammal biodiversity that can exist on solar farms, but targeted approaches would further understanding. This could include small mammal trapping or surveying using remote cameras.

Case Study

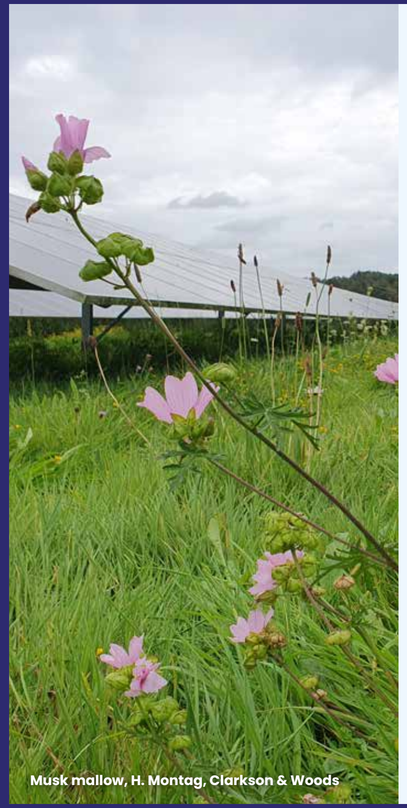
Biodiversity at Bottom Plain Solar Farm

Bottom Plain Solar Farm, owned by NextEnergy Solar Fund, is a 10 MW 15ha site in Dorset that was constructed in 2014 on cultivated arable land. It lies within a wider landscape that comprises a mix of agricultural farming, active quarries and heathland. Adjacent to Bottom Plain is a nationally and internationally designated site for its lowland heathland habitat and rich assemblage of plant, invertebrate, reptile and bird species, including several notably rare and significant. A local farmer, together with the Principal Contractor (O&M), is responsible for managing the vegetation and habitats within the site.

Barn owl using a nest box installed within Bottom Plain Solar Farm.

Birds

Breeding bird surveys were undertaken across three visits between May and July 2025 at Bottom Plain Solar Farm. A total of 42 bird species were recorded including 6 BTO red listed: cuckoo (*Cuculus canorus*), linnet (*Carduelis cannabina*), marsh tit (*Poecile palustris*), skylark (*Alauda arvensis*), spotted flycatcher (*Muscicapa striata*) and starling (*Sturnus vulgaris*). 9 amber listed species were recorded, with meadow pipit (*Anthus pratensis*) and skylark observed to be actively foraging within the array, with the solar farm forming part of the birds' territories, particularly within the edges of the site. This has been observed on other solar farms, whereby individuals have been observed regularly collecting food from within the solar farm and then flying to the adjacent arable field, indicating that the solar farm offers a preferred resource for foraging by skylarks. The spotted flycatcher also appeared to be using the foraging opportunities offered by a 5m uncut grassland strip area within which they were catching insect prey before returning to perch on the panels to rest in between foraging bouts. As well as foraging habitat, the site has also provided nesting opportunities for kestrel (*Falco tinnunculus*, BTO Amber List) and barn owl (*Tyto alba*, a Schedule 1 species) which have been recorded nesting within next boxes that had been installed within the Site.



Musk mallow, H. Montag, Clarkson & Woods

Grassland

An ecological monitoring survey of the solar farm by Clarkson & Woods Ltd. found that the grassland within the site had established into a floristically diverse Lowland Meadow, a Priority Habitat and Habitat of Principal Importance under the Natural Environment and Rural Communities (NERC) Act 2006. This habitat is scarce and exists in fragmented, isolated patches across the UK countryside, having been estimated to have declined by 97% in England and Wales due to changing agricultural land use. The site was previously a field of cultivated arable land and now comprises a range of 10-15 species of vascular plant per m^2. The species diversity varied across the site, with the habitat directly beneath the panels comprising the least diverse area at 10 species per m^2. Although this was the least diverse area, this was more diverse than is typical of under-panel habitat within solar farms and provides an interesting insight into the possibilities of achieving higher distinctiveness habitats here. Under panel grassland habitat is typically recorded to have species diversity of <6 species per m^2, which places it in the UKHab category of 'Modified Grassland', whereas the under-panel habitat at Bottom Plain was classified as the higher distinctiveness habitat type of 'Other Neutral Grassland'.

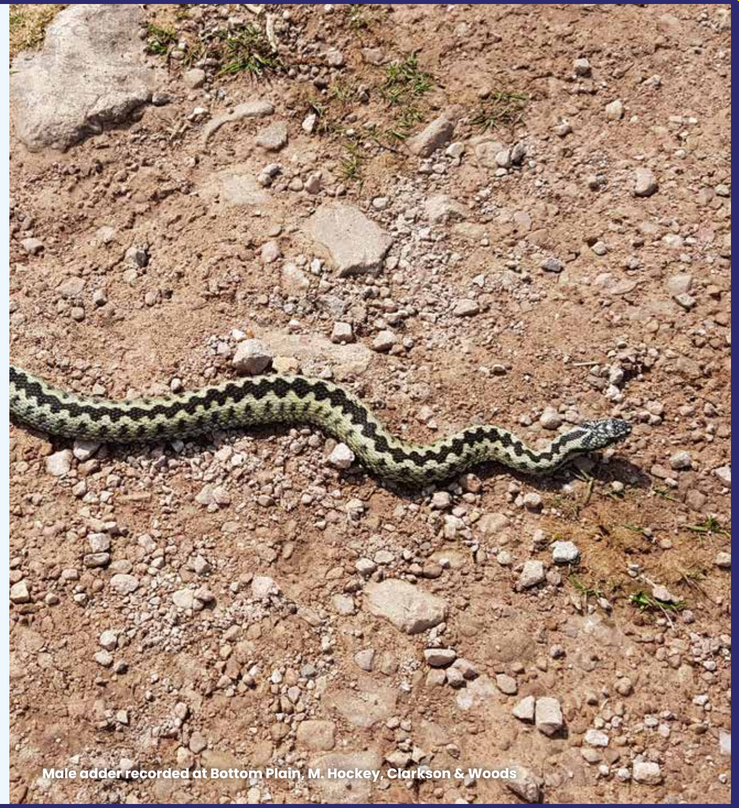
Invertebrates

Although structured invertebrate surveys were not undertaken at Bottom Plain, incidental sightings were noted during site visits. Species of particular interest included silver-studded blue butterfly (*Plebejus argus*), which is a nationally scarce species classified as Vulnerable on the Butterfly Red List. The presence of silver-studded blue butterfly suggests the site may provide valuable nectar and structural habitat resources for invertebrates associated with heathland-edge landscapes. Carrying out structured surveys at this site in the future would be interesting to better understand how the flower rich habitats within Bottom Plain can support invertebrates.

Silver Studded Blue,
C Durigan, Clarkson & Woods

Reptiles

A dedicated reptile survey was conducted by Clarkson & Woods across 2024-2025 at Bottom Plain Solar Farm and four of the total six species of reptiles native to the UK were found. These included adder (*Vipera berus*), common lizard (*Zootoca vivipara*), grass snake (*Natrix helvetica*), and slow worm (*Anguis fragilis*), which qualifies Bottom Plain as a 'Key Reptile Site' according to the dedicated reptile and amphibian conservation charity Froglife. A sand lizard (*Lacerta agilis*) was also recorded by the RSPB within the site previously. These surveys have shown that a range of reptile species are using Bottom Plain and this information can now be drawn on to inform favourable ongoing and future management targeted towards these species. Future monitoring surveys can be undertaken to assess the success of the implemented management.



Male adder recorded at Bottom Plain, M. Hockey, Clarkson & Woods

Lesser knapweed, J Everatt, Wychwood Biodiversity

Looking ahead

As we look to the future, the industry remains committed to continuously enhancing the depth of our analysis by exploring new ways to strengthen the insights from the data collected, to seek opportunities to collaborate and to identify best practice

Grassland Workshop

A workshop on grassland creation, enhancement, and management within solar farms was held on the in March 2026, delivered by the UKRI Sustainable Solar Energy Systems Network Plus. Hosted by Foresight Group in London, the event was led by Clarkson & Woods, Wychwood Biodiversity, Lancaster University and Solar Energy UK. The workshop brought together 30 stakeholders, including academics, asset owners, developers, landscaping contractors, seed suppliers and NGOs.

The workshop aimed to explore key challenges and opportunities associated with establishing and managing biodiverse grasslands on solar farms, with the longer-term goal of developing industry best practice guidance. While effective management approaches have often been assumed, the workshop provided a valuable forum for experts to collaboratively define the important components of genuine best practice.

Discussions focused on several key themes, including seed mix selection and provenance, grassland establishment and management, cutting regimes, grazing strategies, and the practical challenges of managing operational solar farms.

Funding has been secured from the UKRI Sustainable Solar Energy Systems Network Plus to support the development of the best practice guidance, with outputs expected to be shared in due course.

Workshop participants attending the grassland management workshop hosted in London.

CESAB - Standardised Approach for Europe

CESAB (Centre for the Synthesis and Analysis of Biodiversity) is a program funded by the FRB (the French Foundation for Research on Biodiversity) and it supports a group of international researchers to come together and pool expertise and data in order to address issues around biodiversity. A current CESAB group led by Professor Alona Armstrong from Lancaster University and Professor Armin Bischoff from Avignon University is titled “Impacts of European solar energy infrastructure on biodiversity: integrating existing knowledge to enable Nature Positive management and financial investments”.

The group is composed of researchers from the UK, France and Germany and is looking at integrating data from solar farms across Europe to look at biodiversity trends. The project also aims to develop a standardised monitoring protocol for Europe as well as developing a framework to enhance solar farm biodiversity. An evaluation of the current biodiversity related disclosures and credit schemes will be carried out along with an analysis of how these relate to solar farms.

Several papers will be published by the group over the next few years relating to these topics and new relationships have been forged which will enable knowledge sharing and collaboration between the UK and other European countries.

CESAB group visiting French solar farm where biodiversity research is being undertaken

Bringing databases together from across years for Solar Habitat 5

As we look toward the 2026 monitoring season, the *Solar Habitat* series will reach a significant milestone: its fifth consecutive year of publication. To mark this half-decade of data collection, our ambition for the next report is to conduct, where possible a comprehensive, multi-year analysis that aggregates and evaluates the entire five-year dataset. By pooling five years of standardised data, we aim to deliver the most definitive, evidence-based insights to date.

Within the dataset are sites that have been monitored more than once, meaning there is potential to move beyond the year-on-year comparisons of previous editions. There are also sites which have been monitored for years before the standardised approach was applied. This cumulative analysis would allow us to map longer term ecological trajectories, identify definitive successional trends in botany and wildlife colonisation, and begin to measure the shifting baseline of biodiversity on UK solar farms.

Pyramidal orchid, G Parker, Wychwood Biodiversity

Case Study

A decade of data from Southill Solar Farm

This case study presents the results of 10 years of biodiversity data from Southill Solar Farm, charting its evolution from crop field to thriving grassland habitats.

Southill Solar Farm is a 5 MW site constructed in West Oxfordshire in 2016. It is owned by Southill Community Energy (SCE) who with Wychwood Biodiversity developed an ambitious plan to create a wide range of grassland habitats across the site, including 9ha of chalk grassland, broad tussocky field margins and traditional grazing grassland within the solar array.

The site has been monitored annually since 2016 by a combination of the Wychwood team and local ecologists using methods consistent with the SEUK standardised approach to biodiversity monitoring on solar farms.

Overall, grassland diversity has increased from 39 species in 2016 to 62 species in 2025. Grasses have increased from 3 species to 17 species in the same period, while herbs have increased from 35 to 45 species (see figure 11).

It's not just the numbers that have changed, but the composition of the plant community too. In 2016, botany was dominated by common arable herbs such as common poppy (*Papaver rhoeas*), hedge mustard (*Sisymbrium officinale*) and field forget-me-not (*Myosotis arvensis*). But owing to successive seeding, green hay application and careful management (no herbicides, annual hay cut), the composition has shifted towards a chalk grassland community including wild marjoram (*Origanum vulgare*), ribwort plantain (*Plantago lanceolata*), lady's bedstraw (*Gallium verum*) and bird's foot trefoil (*Lotus corniculatus*). Pyramidal orchids (*Anacamptis pyramidalis*) have been found within the solar farm.

The distribution of botany has also changed considerably. In 2016 the main field area was a wheat crop with a few pernicious weeds within, and herbaceous diversity was restricted to the narrow field margins. Today, the botanical diversity is spread across the entire site.

Bumblebees and butterflies have been surveyed annually as part of biodiversity monitoring. The diversity of species has increased dramatically from nine species (six butterflies and three bumblebees) in 2016 to 18 species (14 butterflies and four bumblebees) in 2025 (see figure 12). This dramatic increase over 10 years is likely to be in response to the development of the herb-rich grasslands, which provide a wide range of nectar sources and larval plants across the entire site.

Bumblebees are common species including white-tailed (*Bombus lucorum*), red-tailed bombus (*Lapidaries*) and common carder bombus (*Pascuorum*). Butterflies are mainly common species including meadow brown (*Maniola jurtina*) and peacock, but also brown argus (*Aricia agestis*), a chalk grassland specialist, and the migratory painted lady (*Vanessa cardui*).

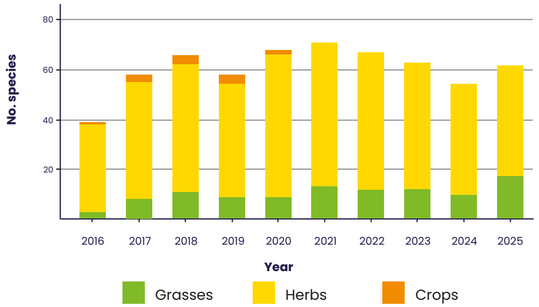


Figure 11. Botanical diversity by year for Southill Solar Farm.

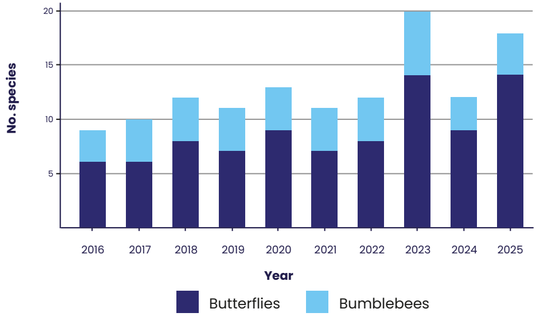


Figure 12. Butterfly and bumblebee species count by year on Southill Solar Farm

Contributors

Monitoring data for Solar Habitat 2026 was provided by:

Wychwood BIODIVERSITY

CLARKSON & WOODS ECOLOGICAL CONSULTANTS

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voltalia

res power for good

Southill COMMUNITY ENERGY

Resources

1. https://solarenergyuk.org/resource/a-standardised-approach-to-monitoring-biodiversity-2025/
2. https://www.bto.org/sites/default/files/publications/bocc-5-a5-4pp-single-pages.pdf
3. https://butterfly-conservation.org/red-list-of-butterflies-in-great-britain
4. https://britishandirishbotany.org/index.php/bib/article/view/195
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6 Langley Street,

London WC2H 9JA

enquiries@solarenergyuk.org

solarenergyuk.org solarenergyuk_ solarenergyuk