



JNCC Report 811

**Tracking the Impact: Assessing a Landscape-Scale Approach
for Biodiversity Monitoring**

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Summary

This report presents an initial case study analysis of the Tracking the Impact (TTI) project – a landscape-scale approach to biodiversity monitoring in the central Chilterns National Landscape. The initiative combines local sampling intensification (using national monitoring scheme protocols at higher densities across the local area) and co-location of data collection to monitor birds, butterflies, and plants at the landscape-scale. To understand the potential for replicating the TTI-style approach to biodiversity monitoring elsewhere, stakeholders are interested in what questions this approach could help to answer and for whom it might benefit. This knowledge will be useful in informing the extent to which there is a case for taking a similar approach in other landscapes of interest.

Drawing on the first four years of TTI species data (2020–2023) and a supporting literature review, the report finds that local sampling intensification allows for comparisons to be made between landscape-level and national biodiversity data and provides early insights into species richness, abundance, and potential trends. A TTI-style approach to biodiversity monitoring is likely to be valuable to a wide range of stakeholders, including landowners, co-operatives of landowners, protected area stakeholders, Local Nature Recovery Strategy (LNRS) Responsible Authorities, and those running agri-environmental schemes, by enabling species trend analysis, regional comparisons and site-level biodiversity assessments.

The report recommends that other landscape-scale initiatives consider adopting a TTI-style approach. Local sampling intensification is a scalable, scientifically robust method for enhancing biodiversity monitoring and generating data that is both locally relevant and nationally comparable.

Contents

Summary.....	d
Figures.....	f
Tables.....	g
Abbreviations.....	h
1. Introduction.....	1
2. What insight could data collected through local sampling intensification provide?.....	2
2.1. How many monads were surveyed for each taxonomic group annually?.....	4
2.2. How does protocol coverage change over time within monads?.....	5
2.3. Species richness of bird, butterfly and plants, and differences between the TTI and national levels.....	7
2.4. Temporal trends.....	9
2.5. Assumptions, limitations and uncertainty in the data.....	11
2.6. Potential future analysis for TTI.....	12
3. Potential applications of local sampling intensification.....	13
3.1. Monad level data.....	13
3.2. Landscape level data.....	14
3.3. Policy relevance.....	14
3.4. Comparing landscape level data with national and regional trends.....	15
3.5. Comparing ecological performance within a landscape.....	15
4. Conclusions and next steps.....	17
References.....	18
Appendix 1: Additional results from TTI analysis.....	22
Farmland and Woodland Bird Indicators.....	22
Farmland and Woodland Butterfly Indicators.....	26
Plant Indicators.....	30
Red-listed Species.....	42
Priority-listed Species.....	48

Figures

Figure 1. Map of the Tracking the Impact project area in the central area of the Chilterns National Landscape..	3
Figure 2. Number of sampled monads within the Tracking the Impact project area surveyed by each protocol (BBS, NPMS, WCBS) from 2020 to 2023.....	5
Figure 3. Stacked bar plot demonstrating the change in monad coverage by 0, 1, 2 or 3 protocols each year between 2020 and 2023.....	6
Figure 4. Maps demonstrating the spatial distributions of monads within the central Chilterns Tracking the Impact area for each year of the study.....	7
Figure 5. Differences in mean abundance per monad at the TTI-level and the national level for each species in the Farmland Bird Indicator as defined by Defra (2025).....	22
Figure 6. Differences in mean abundance per monad at the TTI-level and the national level for each species in the Woodland Bird Indicator as defined by Defra (2025).....	22
Figure 7. Differences in mean abundance per monad at the TTI-level and the national level for each species in the Farmland Butterfly Indicator as defined by Defra (2024a).....	26
Figure 8. Differences in mean abundance per monad at the TTI-level and the national level for each species in the Woodland Butterfly Indicator as defined by Defra (2024a).....	26
Figure 9. Results for the proportion (expressed as a percentage) of reported abundance classes for each plant species in the Arable Field Margins Indicator as defined by JNCC (2024a) at the TTI-level and the national level.....	30
Figure 10. Results for the proportion (expressed as a percentage) of reported abundance classes for each plant species in the Lowland Grassland Indicator as defined by JNCC (2024a) at the TTI-level and the national level.....	31
Figure 11. Results for the proportion (expressed as a percentage) of reported abundance classes for each plant species in the Broadleaved Woodlands and Hedges Indicator as defined by JNCC (2024a) at the TTI-level and the national level.....	32
Figure 12. Differences in mean abundance per monad at the TTI-level and the national level for each Amber and Red-Listed bird species as defined by JNCC (2023).....	42
Figure 13. Differences in mean abundance per monad at the TTI-level and the national level for each butterfly species classified as either Near Threatened or Vulnerable as defined by JNCC (2023).....	43
Figure 14. Results for the proportion (expressed as a percentage) of reported abundance classes for each plant species categorised as Critical, Vulnerable or Near Threatened as defined by JNCC (2023) at the TTI-level and the national level.....	43
Figure 15. Differences in mean abundance per monad at the TTI-level and the national level for each Priority listed bird species as defined by JNCC (2024b).....	48
Figure 16. Differences in mean abundance per monad at the TTI-level and the national level for each Priority listed butterfly species as defined by JNCC (2024b).....	49
Figure 17. Results for the proportion (expressed as a percentage) of reported abundance classes for each Priority-listed plant species as defined by JNCC (2024b) at the TTI-level and the national level.....	50

Tables

Table 1. Comparison of the national scheme protocols for the Breeding Bird Survey (BBS), Wider Countryside Butterfly Survey (WCBS) and National Plant Monitoring Scheme (NPMS).....	3
Table 2. Total species richness of bird, butterfly and plant species in the TTI project area between the years 2020 and 2023.....	8
Table 3. Total number of indicator species for birds and butterflies (farmland, woodland), and plants (arable field margins, broadleaved woodlands and hedges, lowland grassland) in the TTI project area between the years 2020 and 2023..	8
Table 4. List of all bird species in the UK Farmland and Woodland Bird Indicators with their generalist or specialist classification in that indicator as defined by Defra (2025)..	23
Table 5. List of all butterfly species in the UK Farmland and Woodland Butterfly Indicators as defined by Defra (2024a).....	27
Table 6. List of plant species in the UK Arable Field Margins, Broadleaved Woodlands and Hedges, and Lowland Grassland Indicators as defined by JNCC (2024a).....	33
Table 7. List of all red-listed bird and butterfly species with their Red List classification (Amber/Red for birds and Near Threatened/Vulnerable for butterflies) as defined by JNCC (2023).....	44
Table 8. List of all red-listed plant species with their Red List classification as defined by JNCC (2023).....	47
Table 9. List of all priority-listed bird and butterfly species as defined by JNCC (2024b)....	51
Table 10. List of priority-listed plant species as defined by JNCC (2024b).....	52

Abbreviations

Acronym	Definition
AES	Agri-Environment Scheme
BBS	Breeding Bird Survey
BTO	The British Trust for Ornithology
Defra	Department for Environment, Food and Rural Affairs
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
JNCC	Joint Nature Conservation Committee
LNRS	Local Nature Recovery Strategies
NCEA	Natural Capital and Ecosystem Assessment
NECR	Natural England Commissioned Reports
NERR	Natural England Research Report
NPMS	National Plant Monitoring Scheme
TTI	Tracking the Impact
UKCEH	UK Centre for Ecology and Hydrology
WCBS	Wider Countryside Butterfly Survey
WWF	World Wildlife Fund

1. Introduction

The Tracking the Impact (TTI) project is a landscape-scale conservation initiative taking place in the central area of the Chilterns National Landscape in southern England. Here, landscape-scale is defined as an area of land which ranges from several square kilometres in size to larger areas which could span multiple counties (e.g. an entire catchment area, an agricultural landscape or an urban area). The project makes use of adaptations of national citizen science monitoring scheme protocols; the Breeding Bird Survey (BBS), the Wider Countryside Butterfly Survey (WCBS), and the National Plant Monitoring Scheme (NPMS), to survey birds, butterflies and plants respectively within the project area. To ensure robust survey effort, volunteers are provided with comprehensive training on survey methodology and species identification. As part of the project, there is also an aim to co-locate surveying of these three taxa within the same 1 km² (hereafter referred to as 1 km² monads) across the project area.

Stakeholders (including partners on the national monitoring schemes, those running the TTI project, and landscape scale conservation actors; pers. comm.) are interested in what questions a TTI-style approach to biodiversity monitoring could help to answer and whom it might benefit. This knowledge will be useful in informing whether a similar approach is suitable in other cases (e.g. National Trust landscapes, Local Nature Recovery Strategies, local conservation areas or protected areas).

The context behind why a TTI-style approach to biodiversity monitoring may be of use and a range of questions that this approach could help to answer are explored in Section 2. Potential applications and users of data collected through this approach are identified in Section 3, whilst conclusions and next steps are outlined in Section 4.

This report largely relies on a case study analysis of existing TTI data and brainstorming of potential use cases. A priority for future work would be to identify and engage with potential users and to improve understanding of their perspectives and requirements.

2. What insight could data collected through local sampling intensification provide?

Rapid declines in biodiversity remain a major concern (Cowie *et al.* 2022; IPBES 2019; Ripple *et al.* 2017; WWF 2022). However, biodiversity monitoring provides an opportunity to understand potential causes for these declines, calculate large-scale biodiversity trends, and inform and evaluate conservation actions on-the-ground (Kühl *et al.* 2020; Navarro *et al.* 2017; Niemelä 2000). Biodiversity monitoring can also provide a platform for the public to engage with and learn about nature through citizen science programmes (Turrini *et al.* 2018). Citizen science programmes for biodiversity monitoring can offer robust and repeatable methodologies, wide geographic coverage, and long-term data for analysing trends in space and time (Löhmus *et al.* 2018; Soriano-Redondo *et al.* 2023; Suter *et al.* 2023).

At a national scale, the UK currently has a strong network of biodiversity monitoring schemes that use citizen science across a variety of taxa, such as the BBS, the WCBS and the NPMS. These provide us with a good understanding of the status and trends of a wide range of species populations at the national scale, which are used in many applications such as the UK Biodiversity Indicators, and for monitoring species of conservation concern. However, these schemes are designed for national-level analysis and often lack the sampling density needed at the landscape-scale for landscape-scale insights. Landscape-scale monitoring can infer species responses to local land management and actions, helping to target policy and investment toward the most effective actions, and can also detect early signals of change and highlight spatial variation in trends before they appear nationally (von Holle *et al.* 2020; Lindenmayer *et al.* 2022; Brusse *et al.* 2024; Way & Lightfoot, internal report).

There is a strong need to collect more localised data, especially for policy and decision-making at local scales such as through Local Nature Recovery Strategies (LNRS), Landscape Recovery Schemes and farm clusters, as conservation decisions and management practices often take place at more local spatial scales (e.g. land parcel, landscape or regional level). Yet, many local monitoring efforts lack methodological alignment with national schemes, thereby limiting data integration and comparability. This lack of alignment also makes it difficult to understand whether robust and well-tested protocols are being used across projects. To address this, landscape-scale projects could monitor biodiversity using the same in-field data collection protocols as those used by the national schemes and be based on a similar stratified sampling strategy to the national schemes. However, there has been limited assessment of what analysis could be done with this type of data, or how well it would meet user needs. To better understand the potential of this approach, the TTI project is used as a case study in this report to examine the types of questions that national scheme protocols adapted for sampling at a landscape scale (hereafter referred to as local sampling intensification) might help to answer.

In TTI, volunteers collect annual data on birds, butterflies and plants from a mix of pre-selected and randomly selected 1 km² monads following protocols from the national schemes (Figure 1). In 2023, the survey area for TTI was extended to include the River Chess catchment which covers the east of the central Chilterns. Project organisers endeavoured to cover approximately 20% of the entire project area with surveyed monads. By 2023, 74 monads were surveyed within the project area.

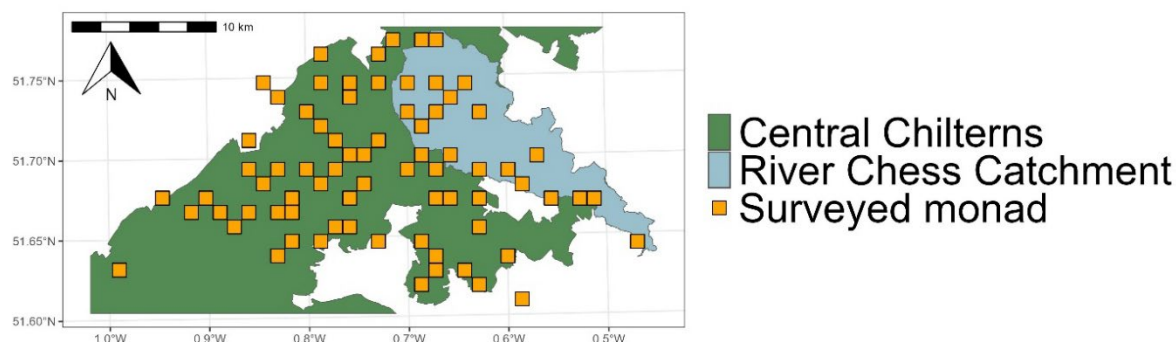


Figure 1. Map of the Tracking the Impact project area in the central area of the Chilterns National Landscape. The Chilterns National Landscape is provided in green, with the River Chess catchment provided in blue. 1 km² monads sampled for birds, butterflies and/or plants between 2020 and 2023 are shown in orange.

The table below demonstrates the similarities and differences between the methodologies for the three sampling protocols (Table 1). BBS and WCBS share similar methods, involving two 1 km transects per monad. The British Trust for Ornithology (BTO) encourages co-location of these surveys nationally (BTO, no date (a)), and TTI has implemented this by encouraging the co-location of transects for birds and butterflies. While co-location of surveys across taxa is introduced as a component of the TTI approach, this report focuses primarily on the value of local sampling intensification. A separate report by the JNCC explores the concept of co-location in greater detail, including its benefits and practical challenges (Workman *et al.* 2026).

In addition, BBS also encourages volunteers to collect habitat data at 200 m intervals along the survey transects, providing fine-scale environmental context. Although habitat data were unavailable for this report, future work could explore species-habitat relationships, though external landscape factors must also be considered to avoid misleading conclusions.

Table 1. Comparison of the national scheme protocols for the Breeding Bird Survey (BBS), Wider Countryside Butterfly Survey (WCBS) and National Plant Monitoring Scheme (NPMS).

Protocol	BBS	WCBS	NPMS
Taxa	Birds	Butterflies	Vascular plants (% cover of bryophytes and lichens are also noted)
Survey frequency	Annually – once April/May & once May/June	Annually – minimum two visits in July/August	Annually – once late spring/early summer & once late summer
Sampling design	Stratified random sampling of 1 km ² monads	Stratified random sampling of 1 km ² monads	Stratified random sampling with habitat weighting
Survey method	Two 1 km transects walked per monad	Two 1 km transects walked per monad	Up to 5 fixed plots surveyed within a 1 km ² monad – recommended is 3 square plots (5 x 5 m) and 2 linear plots (1 x 25 m)

Protocol	BBS	WCBS	NPMS
Species data collected	Abundance of each species & summarised per monad	Abundance of each species & summarised per monad	Abundance of each species recorded using cover scale (i.e. estimates of percentage of ground covered) & summarised into total percentage categories per monad
Habitat data collected?	Yes – basic habitat data collected every 200 m of each 1 km transect	No – but weather data recorded	Yes – detailed habitat and vegetation structure data; where possible, land management information, plant species composition and indicator species presence are also noted

The following questions will be explored in this section using TTI as a case study. Insights from TTI are intended to inform other initiatives considering a similar approach.

1. How many monads were surveyed for each taxonomic group annually?
2. How does protocol coverage change over time within monads?
3. How many bird, butterfly and plant species were recorded from 2020 to 2023?
4. Of the bird, butterfly and plant species recorded, how many are indicator species, red-listed species or priority-listed species, and how do their abundances or percentage covers compare to national averages?

Section 2.4 will discuss the feasibility of producing temporal trends, Section 2.5 outlines data limitations and Section 2.6 will present future analyses opportunities for the TTI data.

2.1. How many monads were surveyed for each taxonomic group annually?

At the time of writing (winter 2024–2025), TTI had count data available for birds, butterflies and/or plants from a total of 74 monads overall from 2020 to 2023. The total number of monads surveyed by one or more protocols increased over time (2020 – 30, 2021 – 46, 2022 – 49, 2023 – 74) and the total number of monads surveyed by each of the three protocols increased from 2020 to 2023 (Figure 2). This pattern of growth over time is to be expected for a project such as TTI, which is a long-term project that began from scratch in 2020. The addition of the River Chess catchment area in 2023 may also have contributed to the increase in monad coverage. Continued growth and increased coverage of more monads from 2020 to 2023 demonstrates the success of the project in maintaining and increasing engagement with local volunteers and the community across the different protocols and shows promise for other initiatives taking a TTI-style approach. The total number of monads surveyed by each of the protocols varied, with BBS having the greatest coverage (74 monads in total), then WCBS (50 monads) and finally NPMS (29 monads). The BBS protocol is the longest running and most well-established nationally of the three protocols undertaken in the TTI area. This, alongside the popularity and relative ease with

which birds can be surveyed means that it is unsurprising that BBS will have the highest number of surveyed monads.

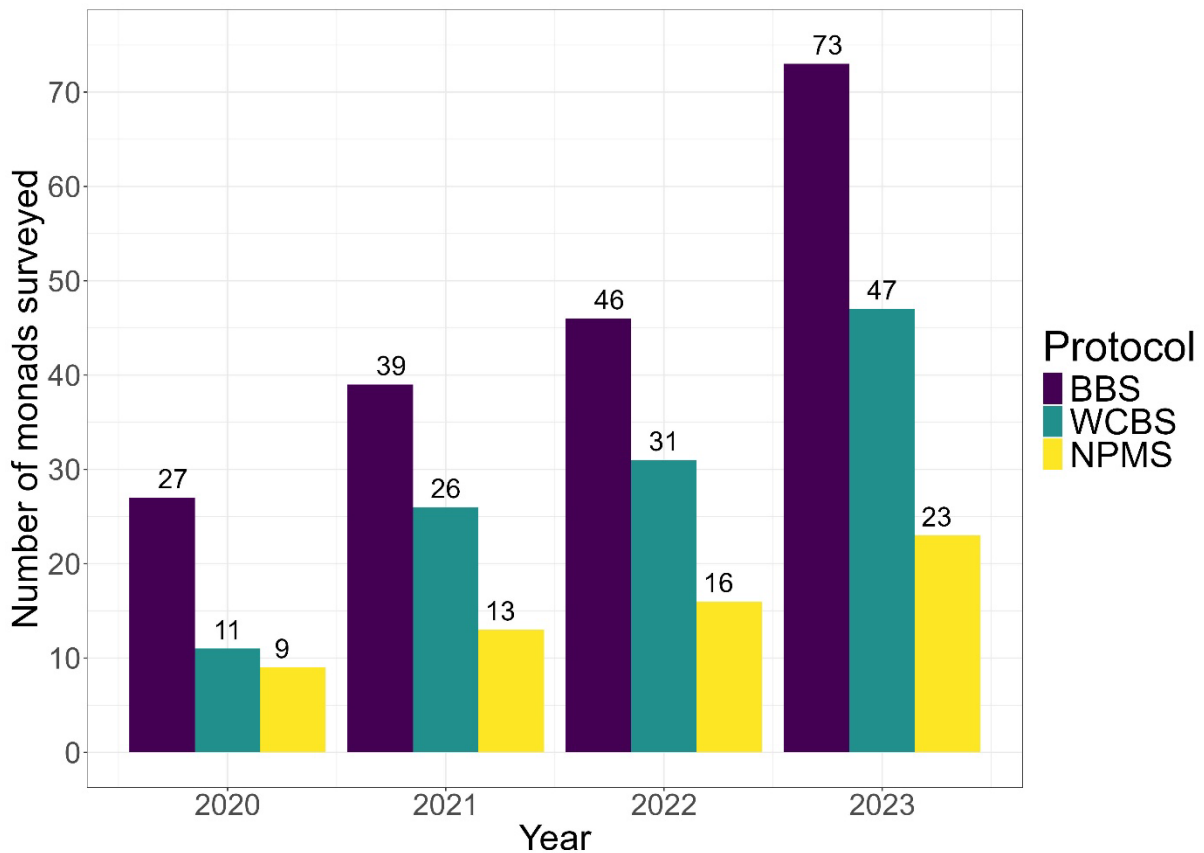


Figure 2. Number of sampled monads within the Tracking the Impact project area surveyed by each protocol (BBS, NPMS, WCBS) from 2020 to 2023.

2.2. How does protocol coverage change over time within monads?

Between 2020 and 2023 monad coverage by protocols improved (Figure 3). 72.4% of monads not surveyed in 2020 were subsequently surveyed by one or more protocols in 2021, and the number of monads not surveyed continued to decline over time. In addition, 14/15 monads that were surveyed by one or more protocols in one year were either surveyed by a different number of protocols or not surveyed by any protocol in the following year. This variation is to be expected in the early years of a long-term project such as TTI due to challenges with maintaining community engagement, attracting and sustaining volunteer numbers, and establishing and maintaining monad coverage by one or more protocols (Golombic 2024). Notably, one monad was successfully surveyed by all three protocols in every year up to 2023.

Fifteen monads were not surveyed between 2020 and 2022 as they were located in the River Chess catchment, which was only added to the TTI project area in 2023. Of the newly included monads in this catchment, nine were surveyed by two or three protocols in their first year, indicating strong volunteer engagement and successful expansion of the project into new areas of the central Chilterns.

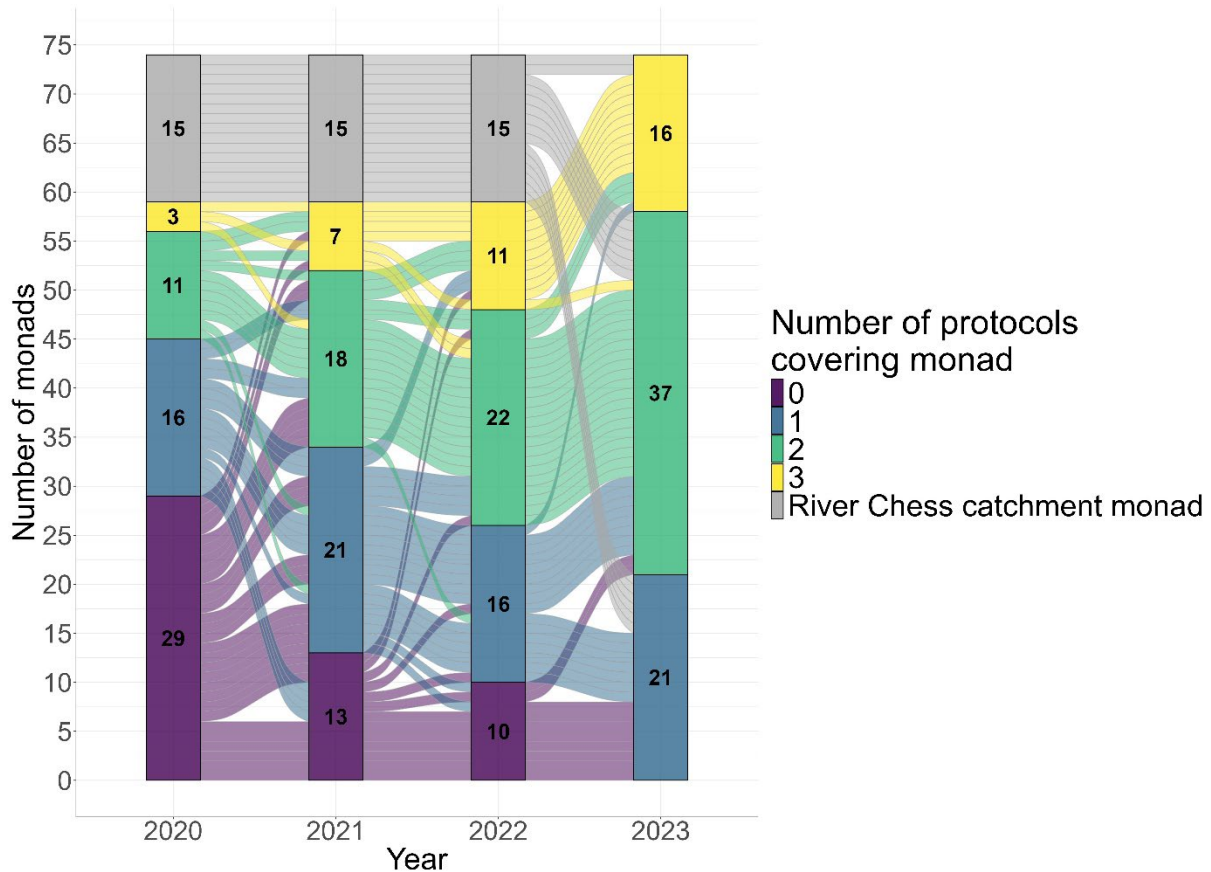


Figure 3. Stacked bar plot demonstrating the change in monad coverage by 0, 1, 2 or 3 protocols each year between 2020 and 2023. Each horizontal line connects 2020 through to 2023 and represents how each monad changes over time in terms of the number of protocols surveying it. For example, in 2020, three monads were surveyed by all three protocols (represented by the yellow bar with number 3 in 2020). The top horizontal line in this group represents one monad surveyed by all three protocols in 2020, 2021, 2022 and 2023, while the other two monads surveyed by all protocols in 2020 saw reductions in the number of protocols surveying them between 2021 and 2023. The number in each bar in each year represents the number of monads covered by 0, 1, 2 or 3 protocols in that year. 15 monads were not surveyed between 2020 and 2022 as these were within the River Chess catchment area. The TTI project area was extended to include the River Chess catchment from 2023 onwards.

Although protocol coverage varied during the early years of the project, the monads surveyed in 2020, 2021, and 2022 were generally well distributed across the north, south, and west of the central Chilterns TTI area (Figure 4). Once the River Chess catchment was included, there was good overall spatial coverage of the entire central Chilterns area by 2023. Achieving broad spatial coverage early in a project is likely to be important for detecting temporal changes that reflect the whole landscape. Additionally, if it is an objective of the project, broad spatial coverage could enable comparisons between monads, for example if monitoring the impact of different management actions. Projects adopting a TTI-style approach are likely to benefit from for similarly even distribution of sampling monads and consider volunteer recruitment strategies that support this goal.

Differences in the frequency of co-location between protocol pairs were also found (Figure 4). In years where only two protocols were conducted within a given monad, BBS and WCBS were co-located most often (37 occurrences), followed by BBS and NPMS (10 occurrences), and WCBS and NPMS (2 occurrences). BBS and WCBS may be the most

popular protocols and see the highest co-location due to taxa popularity, resources available to help volunteers with species identification and/or because of the relative ease in following BBS and WCBS protocols.

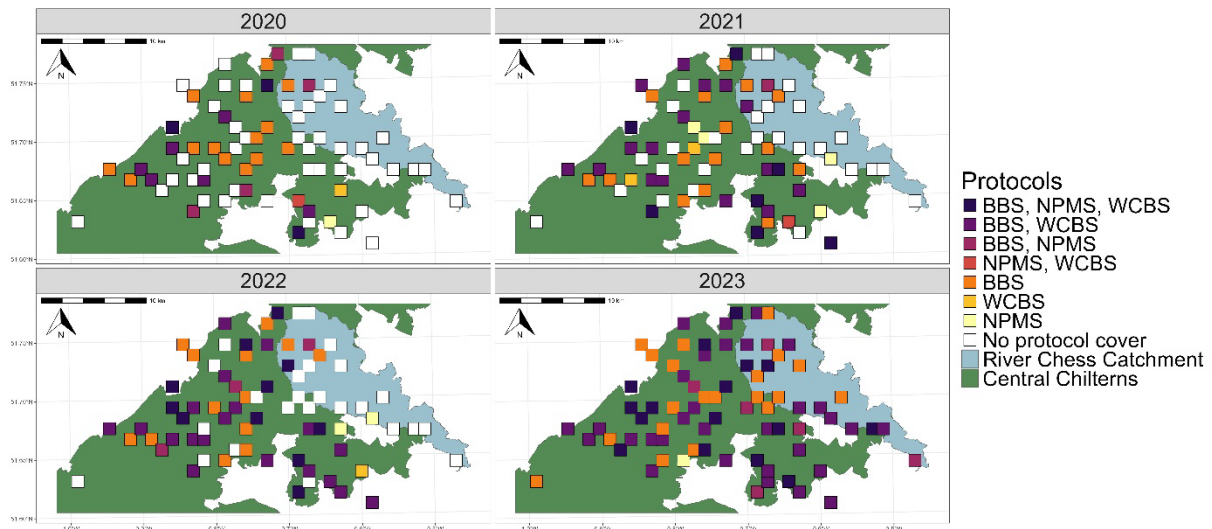


Figure 4. Maps demonstrating the spatial distributions of monads within the central Chilterns Tracking the Impact area for each year of the study (boundary of Chilterns National Landscape outlined in green and boundary of River Chess catchment in blue). The addition of the River Chess catchment area to the east in 2023 is evident by the sudden increase in coverage in the east of the project area. Colours represent the combination of protocols which carry out surveys within each monad.

2.3. Species richness of bird, butterfly and plants, and differences between the TTI and national levels

The TTI data so far provide an early opportunity to explore species richness at the landscape level (Tables 2, 3) and to compare the abundances of nationally important species (e.g. habitat indicator species) and those of conservation concern (e.g. priority-listed and red listed species), against their national averages (Figures 5 to 17, Tables 4 to 10). These initial comparisons are exploratory but other initiatives considering a TTI-style approach could expect to conduct similar analysis within the first four years of monitoring to gain early insights into biodiversity patterns at a landscape-scale. Analysis does not need to be limited to just these species. We chose to focus on this subset of species as they are included in State of Nature reports (Burns *et al.* 2023) and are used to inform biodiversity strategies when helping to set conservation priorities and allocate resources effectively (JNCC, 2024c). Understanding their populations at a landscape scale can also support more effective local land management practices.

Table 2. Total species richness of bird, butterfly and plant species in the TTI project area between the years 2020 and 2023.

Kingdom	Birds	Butterflies	Plants
Total species richness	93	33	355

Table 3. Total number of indicator species for birds and butterflies (farmland, woodland), and plants (arable field margins, broadleaved woodlands and hedges, lowland grassland) in the TTI project area between the years 2020 and 2023. Indicator species are species whose presence, absence or abundance reflects the overall health of a habitat. The total number of red-listed and priority listed bird, butterfly and plant species recorded in the TTI area are also provided.

Kingdom	Birds	Butterflies	Plants
Farmland	18 (7 – generalist, 11 – specialist)	28 (21 – generalist, 7 – specialist)	-
Woodland	28 (12 – generalist, 16 – specialist)	28 (23 – generalist, 5 – specialist)	-
Arable Field Margins	-	-	15
Broadleaved Woodlands and Hedges	-	-	40
Lowland Grassland	-	-	51
Red-listed	47 (25 – Amber, 22 – Red)	6 (4 – Near Threatened, 2 – Vulnerable)	4 (1 – Critical, 2 – Vulnerable, 1 – Near Threatened)
Priority-listed	17	4	2

It is important to note here that the following results are based on static average abundances and do not show change in species populations over time. Bird species generally showed similar mean abundances per monad at the TTI level compared to the national level (Figures 5, 6, 12, 15; Tables 4, 7, 9), with a few notable exceptions. For example, Corn Bunting and Lesser Redpoll had higher mean abundances per monad at the TTI level. However, these estimates are based on a limited number of records (between 1 and 6 per species) and so should be interpreted with caution. Continued monitoring and increased sampling effort across the TTI area would help to determine whether these higher abundances reflect genuine landscape-level support for these species or are statistical outliers. Conversely, some common, habitat generalist species, such as Woodpigeon, Starling, Rook and Jackdaw had lower mean abundances per monad at the TTI level compared to the national level. These discrepancies may be due to differences in habitat availability between the TTI area and the broader national dataset. National level data, derived from all BBS monads across England, encompass a broader range of habitat types than those found within the TTI area. As a result, generalist species may appear more abundant nationally due to their wider habitat use.

For butterflies, national level mean abundances per monad were generally higher than those recorded at the TTI level (Figures 7, 8, 13, 16; Tables 5, 7, 9), likely due to the broader habitat range represented nationally. Butterfly data from the TTI area are based on fewer WCBS monad surveys compared to BBS coverage, and increased WCBS sampling could

help clarify whether butterfly populations in the TTI area are tracking national averages in a similar manner to birds or are in fact generally larger in the central Chilterns. Notably, some chalk grassland specialists such as Adonis Blue and Chalk-hill Blue showed similar mean abundances at both TTI and national levels (differences of 0.11 and 0.5 respectively). These species are of particular interest given the Chilterns' chalk grassland habitats, and targeted monitoring could help assess how local management actions influence their populations.

For plant species, 28–34% of species across three habitat indicators (Arable Field Margins, Broadleaved Woodland and Hedges, and Lowland Grassland) had the same abundance category most frequently reported at both TTI and national levels (Figures 9, 10, 11, 14, 17; Tables 6, 8, 10). However, NPMS is the least commonly implemented protocol in the TTI area, with only 23 of 74 monads surveyed in 2023. Greater NPMS coverage would improve confidence in assessing whether plant species abundances in the TTI area align with national patterns. Similarly, conclusions on red-listed and priority-listed plant species are limited due to low record counts (1–3 per species). Denser sampling using a TTI-style approach could:

1. strengthen landscape-scale assessments of vulnerable species;
2. contribute valuable records to national datasets; and
3. enhance understanding of species distributions and abundance at local levels.

2.4. Temporal trends

Using data from TTI, the BTO and UK Centre for Ecology and Hydrology (UKCEH) have conducted some exploratory analyses (unpublished) to produce species-level temporal trends for birds and butterflies respectively. Results generated in this report should be considered separately to those produced by BTO and UKCEH as the two are not directly comparable. Here we explore average abundance per monad over time while BTO and UKCEH explore population trends for the entire TTI area over time.

Building on the work by BTO and UKCEH, potential next steps could include: i) generating temporal trends for groups of species (e.g. indicator species or species of conservation concern), ii) comparing temporal trends for individual species or species groups at the TTI level with national level trends or iii) comparing TTI level trends with trends from a subset of national monads from similar habitat types (e.g. the Big Chalk project).

Due to current limitations with the TTI data, it was challenging to explore such trends for birds, butterflies and plants at this time. However, the early work conducted by BTO and UKCEH demonstrates that producing single species trends is possible. This suggests that other initiatives may also be able to undertake similar analyses during the early stages of their projects and, over time, expand to more detailed trend analyses such as those suggested above.

Current limitations with the TTI data which prevented further analysis of temporal trends are as follows:

2.4.1. Short time series

With only four years of data, the current time series for the TTI project is potentially too short to detect meaningful ecological trends. Due to natural variability and delayed responses to environmental pressures (Newbold *et al.* 2018), longer-term data is needed to more accurately understand biodiversity trends, with studies reporting that reliable trend estimates require at least ten years of data (White 2019). However, for long-term projects such as TTI

which conduct successful landscape scale monitoring, and engage with volunteers, local communities and farmers, it is important to demonstrate the value of their volunteers' contributions. As BTO and UKCEH have shown, reporting species-level trends using available data is more beneficial than not reporting any results at all. TTI is committed to continuing long-term monitoring. As more data are collected over time, it will become increasingly feasible to produce reliable and meaningful ecological insights that build on early analyses and potentially contribute to broader national comparisons.

2.4.2. Low spatial coverage

Within the TTI area, the average annual coverage per species was 14.31 monads for birds, 12.31 for butterflies, and 1.97 for plants. While there is no strict rule, biodiversity monitoring programmes suggest that a species should ideally be recorded in at least 30 monads per year across multiple years to support statistically robust trend analysis (Löhmus *et al.* 2018; Massimino *et al.* 2025). This threshold improves confidence in detecting meaningful ecological patterns. In practice, few species within TTI currently meet this benchmark. BTO and UKCEH did not impose this 30-monad requirement, acknowledging that in areas where the landscape is relatively homogenous compared to the national level (such as the TTI area) lower spatial coverage may still yield useful insights due to reduced variability in the range of habitats and species abundances. While higher coverage is preferable, producing trends with available data, while clearly stating limitations, is more valuable than withholding results entirely.

Of the data currently available for TTI, 18 species (all birds) met the 30-monad threshold annually from 2021 to 2023, and 29 species (14 bird and 15 butterfly) met this requirement in 2022 and/or 2023. Of the 18 consistently recorded bird species, four are part of the farmland bird indicator and ten are included in the woodland bird indicator. These subsets could be used to explore multispecies trends, though it's important to note that they represent only part of the full indicator groups.

With this data it is important to note that statistical limitations remain. Small sample sizes and short time series reduce the ability to detect significant trends, particularly for rarer species. This results in wide confidence intervals around trend estimates, making interpretation more difficult (Chapman *et al.* 2024). Even with increased monad coverage, some species may never reach the 30-monad threshold due to their rarity or low detectability. While trends could still be generated for these species, they must be interpreted with caution and clearly caveated. Additionally, care should be taken if including rarer or harder-to-detect species in multispecies trends as these species may be underrepresented or masked entirely within the overall trend. To overcome this, initiatives considering a TTI-style approach could separate species into common and rare groups and produce trends for each group independently. This would help ensure that the dynamics of rarer species are not overlooked in aggregated analyses.

Greater monad coverage by bird and butterfly surveyors in 2022 and 2023 however suggests that if maintained or improved, reliable trend analyses could become more feasible for a wider range of species. This highlights the importance of consistent spatial and temporal data collection over time, especially for projects considering a TTI-style approach. Short-term initiatives may struggle to achieve the necessary coverage and continuity for robust trend analysis.

2.4.3. Detectability

To produce unbiased estimates of species abundance and trends, it is important to account for detection probability in survey analyses. When species, particularly rare ones, are encountered infrequently or have low sample sizes, detection probability cannot be reliably

modelled. This can lead to downward bias in occupancy or abundance estimates. Detection probability can also vary across years or monads due to fewer species' observations or inconsistent surveying of an area, making trend estimates less precise and more sensitive to outliers (MacKenzie *et al.* 2002). The BBS incorporates detection probability into its methodology by recording birds within predefined distance bands, helping to ensure reliable trend estimates (BTO, no date (b)). The WCBS does not directly take detection probability into account but mitigates detection bias through standardised survey protocols (same route, same time of year) and repeated surveys multiple times per season (increasing the chance of detecting species missed in previous visits). For initiatives considering a TTI-style approach, consistent surveying of a defined set of monads over time is essential. This increases the chance of detecting rarer species and allows for more accurate modelling of detection probability, helping to reduce bias in trend estimates.

2.4.4. Trends for plant species

Data collected for plant species differ from that for birds and butterflies. Plant abundance is recorded using a cover scale, which estimates the percentage of ground covered by a species and assigns it to a category, whereas birds and butterflies are recorded as counts of individuals per monad. Despite these differences, national-level population trends for indicator plant species are produced using hierarchical modelling approaches capable of analysing categorical abundance data. However, as a general rule, at least 30 monads where a species is recorded are needed to detect trends with reasonable confidence (Pescott *et al.* 2019). This threshold also applies when producing trends for specific habitats or regions. If TTI or similar initiatives wish to produce plant species trends in the future, careful consideration will be needed to determine whether the available data are sufficient and whether the methods used are compatible with national approaches. Furthermore, any landscape-scale trends should be generated using the same analytical processes as national trends if they are to be directly comparable.

2.5. Assumptions, limitations and uncertainty in the data

As outlined above, temporal and spatial limitations in the dataset currently restrict the ability to produce robust trends which build on the work conducted by BTO and UKCEH. Additionally, the first two years of data collection (2020 and 2021) coincided with the Covid-19 pandemic and marked the beginning of the project. These factors could have impacted the establishment of a volunteer base and engagement with the local community, making consistent monad coverage difficult during the early phase. However, results indicate that in more recent years, protocol coverage has been maintained or increased. If monad coverage by each protocol is maintained and if coverage across the project area increases, particularly for WCBS and NPMS, then long-term trends in birds, butterflies, and plants could be explored further. This recommendation applies not only to TTI but also to other initiatives considering a TTI-style approach.

During the review process, plant experts identified that some records of rarer plant species in the TTI dataset were likely incorrect. While BBS records are verified in-house and WCBS records are verified via iRecord, there is currently no formal verification process for plant records submitted through TTI surveys. This issue could be addressed by appointing a qualified verifier, either a paid expert or a skilled volunteer, but this may be challenging and costly for a local-level project. In this report, potentially incorrect plant records have been retained but flagged as improbable based on expert advice.

Other broad assumptions that should be acknowledged when comparing TTI data to national patterns:

- **Climate:** Some species may be more common in the Chilterns due to the warmer southern English climate and so may have naturally higher average abundances per monad compared to the national average.
- **Disturbance:** Species distributions may be influenced by how remote or disturbed the area is compared to the national average.
- **Volunteer Experience:** Species that are harder to identify may be under-recorded in areas with less experienced volunteers.

These factors introduce uncertainty and should be considered when interpreting results or making comparisons across scales. However, such assumptions can be explicitly accounted for using statistical modelling approaches. For example, Generalized Linear Models (GLMs) and Generalized Linear Mixed Models (GLMMs) can incorporate environmental covariates (e.g. climate, land use, disturbance) and random effects (e.g. site or observer) to control for spatial and observer-related variation in species records (Salinas Ruíz *et al.* 2023). Additionally, occupancy models are particularly useful for accounting for imperfect detection, such as under-recording due to observer inexperience or species detectability, and can separate detection probability from true occupancy (Welsh *et al.* 2013; Dennis *et al.* 2017). These methods enhance the robustness of biodiversity trend analyses and allow for more accurate comparisons across regions and time.

2.6. Potential future analysis for TTI

Current comparisons between landscape-level patterns and national averages use data from all national monads, regardless of habitat type. This can make interpretation difficult, as many national monads may not reflect the ecological context of the landscape being studied. To improve comparability, future analyses should focus on national monads with similar habitat characteristics to the landscape of interest to allow for more meaningful comparisons of species abundance and biodiversity performance within equivalent habitat types. To enable these types of comparisons, reliable habitat data for each monad in England could be sourced from national datasets such as the Living England habitat map (Natural England 2024a), or from habitat data collected through BBS or NPMS. However, caution is needed when using volunteer-collected habitat data, as inconsistencies in classification or confidence levels may introduce uncertainty. In addition, the Chilterns National Landscape which is known for its chalk grassland and chalk stream habitats (Chilterns National Landscape, no date) is part of the broader Big Chalk project, which aims to restore and connect chalk and limestone landscapes across southern England. Comparing TTI data to other monads within the Big Chalk network could provide a valuable insight into how well the TTI area supports these species compared to the wider Big Chalk area.

Although the TTI project was not originally designed to monitor biodiversity at the monad level, future work could explore such patterns if specific questions arise or if there is interest in localised results. For instance, one monad within TTI has four years of data from all three protocols (BBS, WCBS, NPMS), offering a unique opportunity to examine trends in birds, butterflies, and plants at a finer scale. This could also be used to engage and provide feedback to volunteers working in that monad.

Alongside the current analysis for TTI, simple simulations were developed to assess the benefits of long-term, highly co-located recording. These simulations aim to evaluate the statistical advantages of co-locating surveys across taxa and will be reported in future work. This will also explore the benefits, challenges, and risks associated with co-located sampling strategies more broadly.

3. Potential applications of local sampling intensification

While TTI was designed for a National Landscape (i.e. an area of countryside that has been officially designated for its distinctive character and natural beauty - formerly known as an Area of Outstanding Natural Beauty), this style of data collection is likely to be useful in a range of cases relevant to other stakeholders. This section summarises the way TTI-style data could be used, the questions that could be answered, and which stakeholders might be interested in these. It is not a formal literature review or based on extensive engagement with such stakeholders. Instead, it focuses on information readily available and based on ongoing light-touch engagement with these stakeholders. It may form the basis of a more thorough stakeholder engagement project in the future.

3.1. Monad level data

TTI-style projects focus on collecting data at the landscape scale. However, for these, species' abundance data (i.e. counts or percentage cover) will be collected for each monad. Although these data may not be robust enough for standalone analysis, they can still be valuable to stakeholders whose land contains a monad. Landowners with a strong connection to their land are often curious about the species present and may appreciate this information. Research from across the UK and Europe has shown that many farmers and landowners are interested in biological monitoring, particularly when they have taken steps to support nature on their land (Herzon & Mikk 2007; Ahnström *et al.* 2013; Klebl *et al.* 2024). Beyond general interest, species data can be used to calculate ecosystem metrics such as species richness and functional diversity. These metrics offer insights into ecosystem health and the services the land provides (Dyer *et al.* 2010). For instance, greater abundance and diversity of flora and fauna may indicate a healthier ecosystem and one that delivers services relevant to the stakeholder, such as pollination or soil health for farmers.

By collecting multi-taxon data, a TTI-style project can offer a more holistic view of the ecosystem and help assess the services it provides. This knowledge can also inform more effective land management by identifying 'easy wins'. For example, a stakeholder aiming to support a particular species is more likely to succeed if that species is already present on their land or nearby. A protected area manager might choose to plant or conserve Red Fescue if White Marbled butterflies are found in a neighbouring monad, knowing this is more likely to succeed in increasing butterfly abundance than introducing a plant for a butterfly not found in the area.

Additionally, landowners who generate income from their land, such as through camping, glamping, or farm shops could use the presence of charismatic or rare species to promote their support for wildlife, potentially attracting more customers or justifying higher prices. This impact could be amplified if the data were used to support formal environmental certification, similar to how organic labels influence food pricing. Even outside of financial incentives, stakeholders may wish to share this information to raise public awareness, for example, by creating notice boards in protected areas to highlight species visitors might encounter.

Finally, the semi-random stratified sampling approach used in TTI means that monads may not align with areas where stakeholders have focused conservation efforts (e.g. a field enrolled in an agri-environment scheme or a rare habitat within a protected area). If monitoring is intended to evaluate specific interventions, more targeted site-level surveys may be more effective. However, these alone may not provide insights into the broader spatial impacts of those activities.

3.2. Landscape level data

Stakeholders responsible for large areas of land, such as the National Trust, National Landscapes or farmer clusters are likely to benefit from landscape-scale species abundance data. This includes both managers of non-contiguous land (e.g. the Crown Estate) and contiguous land (e.g. protected area authorities). Many of these organisations have explicit environmental goals or strategies. For example, the National Trust has pledged to create and restore 25,000 hectares of wildlife habitat, and farmer clusters, such as those in the Chilterns, aim to produce food sustainably while supporting biodiversity. For such groups, having access to annual species abundance data can help assess the impact of their efforts or establish ecological baselines, especially when they lack the capacity to do so independently.

In addition to raw abundance data, temporal trends can be calculated for species which ideally have been surveyed in 30 or more monads annually. However, as shown by BTO and UKCEH, trends can be produced for species which do not meet the 30-monad threshold, but these trends should be interpreted with caution. While meeting this threshold is not feasible at the monad level (where only one record per year is available per species), it becomes possible at the landscape scale for common species, especially in schemes with high coverage. These trends can help large landowning stakeholders track progress against biodiversity goals and secure and evaluate funding outcomes. For example, some Agri-Environment Scheme (AES) funding, such as the Landscape Recovery scheme, is only available to landholdings between 500 and 5,000 acres. Individual farms may not qualify, but farmer clusters can meet this requirement collectively. These groups would benefit from biodiversity monitoring at a broader scale and may be particularly interested in landscape-level species trends in response to landscape scale management actions.

Landscape-scale monitoring is essential for understanding genuine changes in species populations at the local level. Monad level data may show increased abundance, but this could reflect redistribution of individuals to the intervention location rather than true population growth. Monitoring across landscapes is more likely to capture entire populations, provides more reliable indicators of ecological change and helps distinguish between fluctuations in distribution within the landscape and actual population increases. This is valuable not only for landowners aiming for impactful interventions but also for policy stakeholders and funding bodies who need to evaluate the effectiveness of environmental policies, assess value for money and measure progress towards biodiversity targets.

3.3. Policy relevance

LNRS are a major policy tool for biodiversity recovery in England. They aim to identify priority areas for nature, map valuable habitats and propose coordinated actions for nature recovery (DEFRA 2023). These strategies are led by Responsible Authorities (RAs), typically county councils or other designated bodies (e.g. Natural England, National Parks, Broads Authority, Regional Mayors). Decisions are made at the landscape scale, making data at this level particularly relevant. However, there is currently no formal monitoring framework established as part of LNRS or committed funding for monitoring implementation. A recent feasibility study which considered scaling up TTI to cover the Buckinghamshire and Milton Keynes LNRS suggests that TTI-style projects could meet LNRS monitoring needs assuming that long-term funding is provided, a suitable host organisation is in place, and the data are explored further to see what could be achieved with it (Daly & Meany 2024). In addition, these projects should be scientifically robust, locally organised, engaging with citizen scientists, and compatible with national surveillance schemes. This would align with the original LNRS vision to be a locally led process that ensures quality and connects with national efforts.

Alongside LNRS, AES are another key lever for biodiversity recovery, especially given that farmland covers over 70% of UK land (Defra 2024b). Their goals include conserving wildlife and enhancing landscape quality and character (Waygood 2024). However, in previous engagement with Natural England, landscape recovery under Environmental Land Management (an England-focused AES) has been highlighted as a significant data gap. Typical AES monitoring focuses only on managed areas with actions, therefore, misses broader landscape effects such as species dispersal or spillover. A TTI-style project could address this gap by establishing a landscape baseline, monitoring changes post-AES implementation and linking biodiversity outcomes to specific land management practices. Analysing TTI-style data alongside land management data (either collected separately or in an adapted version of TTI), could give an indication of how successful particular combinations of practices were at supporting biodiversity in the surrounding landscape. Projects like LandSpAES demonstrate how intensified local sampling can reveal the effects of specific interventions on particular taxa (Staley *et al.* 2022).

Many policy decisions, within and beyond LNRS and AES, are made at the landscape level. Yet, biodiversity data at this scale remains sparse and inconsistently collected across the UK. National datasets may not respond quickly to local policy changes, and they may be less useful for guiding area-specific decisions. In contrast, a densified, locally driven monitoring network could detect changes in species abundance and diversity more rapidly, improve the policy feedback loop, and reveal the combined impact of interventions across a landscape (Way & Lightfoot, internal report). With consistent uptake of comparable methods nationwide, policy teams could evaluate intervention effectiveness and cost-efficiency, predict policy outcomes and refine strategies to meet biodiversity targets.

3.4. Comparing landscape level data with national and regional trends

Using local sampling intensification in a TTI-style project enables direct comparison between species trends observed at the landscape level and those recorded nationally. For some taxa, regional (e.g. breeding bird trends for English regions) or county-level trends (e.g. via the NCEA BTO webapp) are also available. These datasets are generated using the same protocols, ensuring compatibility and comparability. This is particularly valuable for stakeholders managing large areas of land such as National Landscapes or LNRS RAs who need to evaluate local outcomes within a broader context. For example, if Greenfinch numbers remain stable in an LNRS area that promotes wild bird seed and hedgerow maintenance, while national numbers decline due to external factors like weather, the local strategy may still be considered successful. Similarly, if a surveyed landscape includes multiple protected areas or is dominated by a single large, protected area (e.g. a National Landscape), comparing local species trends with regional data can reveal spillover effects where conservation benefits extend beyond protected boundaries. This strengthens the case for continued protection and support.

Beyond these specific use cases, most stakeholders interested in biodiversity trends will benefit from placing their local data in a national or regional context. Such comparisons help interpret results more meaningfully and assess the relative success of local interventions.

3.5. Comparing ecological performance within a landscape

Research has shown that farmers are interested in knowing how their farm compares ecologically to those in the surrounding area (Natural England 2024b). Therefore, insights can also be gained by comparing groups of monads within a landscape, rather than only looking at national or regional comparisons. This approach is useful regardless of whether the land is spatially contiguous or fragmented. For example, farmer clusters or organisations

like the National Trust which manage multiple sites across a landscape can compare species abundance or diversity from their landholdings to surrounding areas. This helps assess how effectively their land supports biodiversity relative to nearby sites and can highlight the success of specific interventions. Comparisons between areas with similar environmental conditions, habitats, or species populations can also provide contextual insights that complement broader-scale data. A practical application might involve comparing two areas of the same habitat type managed by a stakeholder, especially if different conservation practices have been applied in each.

Policy stakeholders can use this approach to evaluate the effectiveness of protected areas. Many protected areas are required to report on biodiversity outcomes, often with limited resources. Comparing monads inside and outside these areas can indicate whether protection is having a measurable impact or whether additional measures are needed. While TTI was not specifically designed for this type of analysis, its high sampling density across a relatively small area may provide enough data to support robust conclusions. However, care must be taken when interpreting results, especially for mobile species. These species may disperse into adjacent areas, artificially inflating populations nearby, or conversely, be drawn into protected zones, reducing numbers in surrounding areas.

4. Conclusions and next steps

The Tracking the Impact (TTI) project provides a compelling case study for how local sampling intensification using national biodiversity monitoring protocols can generate valuable insights at the landscape scale. Over its first four years, TTI has demonstrated that it is possible to collect multi-taxon data across a defined landscape using citizen science approaches, and that such data can be used to explore species richness, indicator species presence, and early comparisons with national trends.

This report argues that TTI-style data can support a wide range of applications, including estimating species trends and abundances across spatially and non-spatially contiguous landscapes, comparing local biodiversity patterns with national and regional statistics, and assessing ecological performance within a landscape. These applications are relevant to other initiatives and stakeholders, including landowners, landowner cooperatives, local conservation areas, protected area managers, LNRS Responsible Authorities, and AES administrators.

To maximise the utility of TTI-style data, it is recommended that projects should plan for sustained data collection over multiple years to enable robust trend analysis. This is particularly important for detecting ecological change and informing policy or management decisions. While not available for the analyses in this report, future consideration should be given to incorporating habitat and land management information either as collected as part of existing survey protocols, through existing national datasets, or through targeted local collection. This will improve the ability to link biodiversity outcomes to specific actions or habitat types. The stakeholder analyses in this report is indicative, therefore a priority for future work is to engage directly with potential users to validate assumptions, understand their data needs, and co-develop use cases.

In summary, this report provides a strong foundation for advocating the TTI-style approach as a scalable, scientifically robust, and policy-relevant method for landscape-scale biodiversity monitoring.

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Appendix 1: Additional results from TTI analysis

Farmland and Woodland Bird Indicators

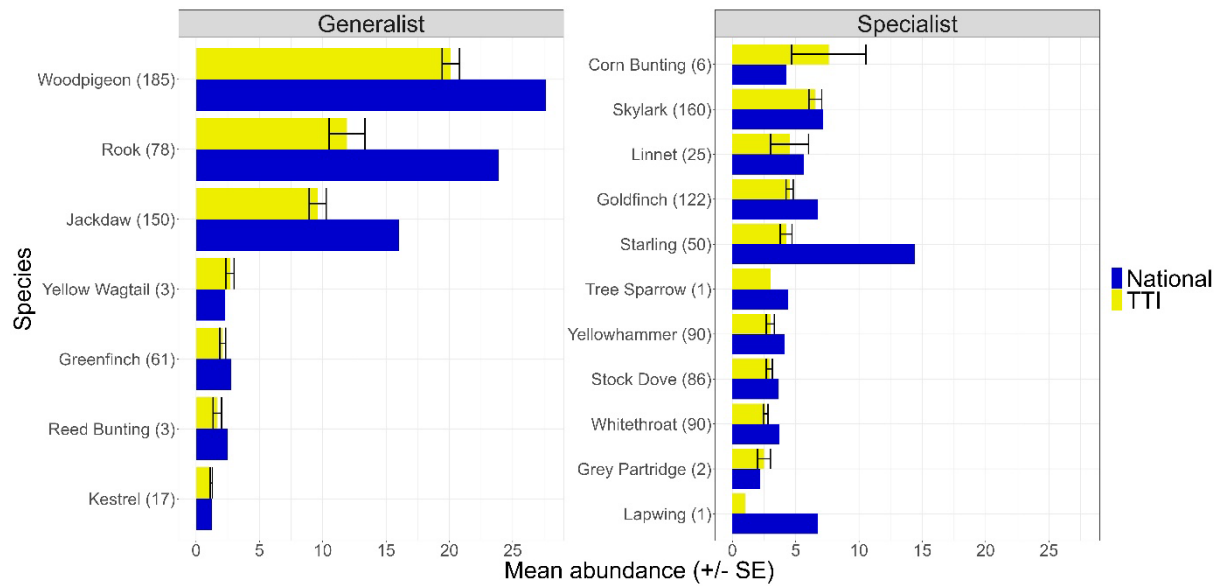


Figure 5. Differences in mean abundance per monad at the TTI-level and the national level for each species in the Farmland Bird Indicator as defined by Defra (2025). Species are split into whether they are classified as generalists or specialists. The number provided in brackets beside each species represents the total number of monads between 2020 and 2023 in which the species was recorded in the TTI area. Standard error values are provided for results from the TTI area. Based on the data available, standard error could not be calculated for the national level.

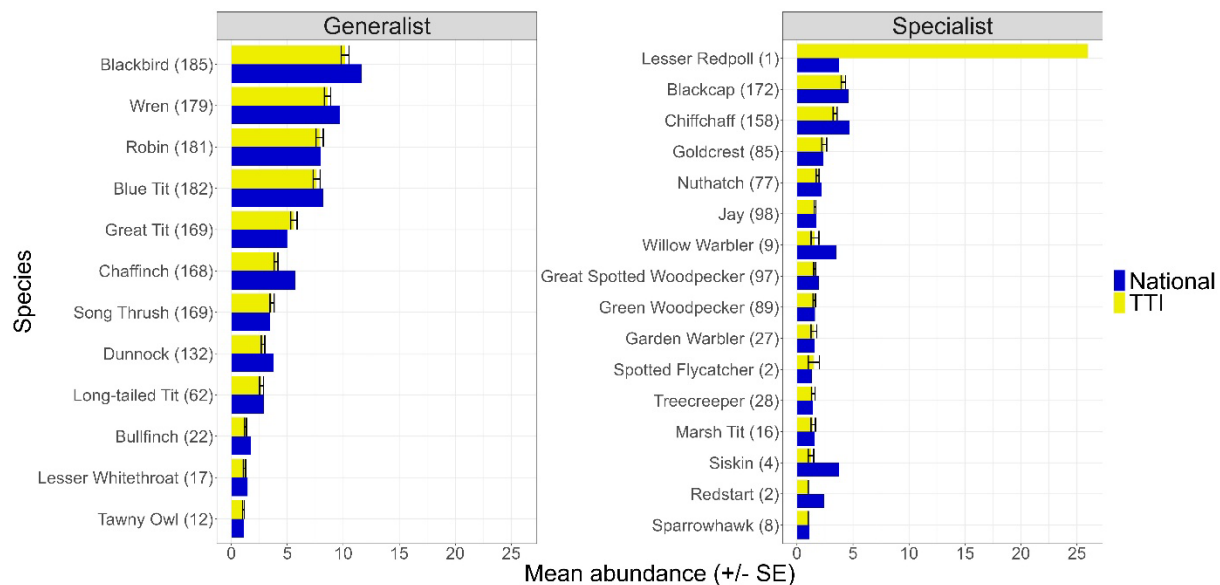


Figure 6. Differences in mean abundance per monad at the TTI-level and the national level for each species in the Woodland Bird Indicator as defined by Defra (2025). Species are split into whether they are classified as generalists or specialists. The number provided in brackets beside each species represents the total number of monads between 2020 and 2023 in which the species was recorded in the TTI area. Standard error values are provided for results from the TTI area. Based on the data available, standard error could not be calculated for the national level.

Table 4. List of all bird species in the UK Farmland and Woodland Bird Indicators with their generalist or specialist classification in that indicator as defined by Defra (2025). The mean abundance per monad of that species within the TTI project study area and at the national level are provided, along with the difference in the mean abundance per monad between TTI and national levels. The total number of records for each species at the TTI level and the national level are also provided.

Indicator	Species	Generalist/ Specialist	Mean abundance per monad		Difference in mean (national – TTI)	Total Records	
			TTI	National		TTI	National
Farmland	Corn Bunting	Specialist	7.62	4.24	-3.38	6	606
	Yellow Wagtail	Generalist	2.67	2.27	-0.4	3	626
	Grey Partridge	Specialist	2.5	2.21	-0.29	2	525
	Kestrel	Generalist	1.19	1.23	0.04	17	2,036
	Skylark	Specialist	6.55	7.19	0.64	160	6,532
	Greenfinch	Generalist	2.1	2.75	0.65	61	4,699
	Stock Dove	Specialist	2.93	3.67	0.74	86	4,566
	Reed Bunting	Generalist	1.67	2.51	0.84	3	1,692
	Whitethroat	Specialist	2.63	3.68	1.05	90	5,774
	Yellowhammer	Specialist	3	4.1	1.1	90	4,034
	Linnet	Specialist	4.52	5.62	1.1	25	4,336
	Tree Sparrow	Specialist	3	4.41	1.41	1	488
	Goldfinch	Specialist	4.52	6.75	2.23	122	8,431
	Lapwing	Specialist	1	6.76	5.76	1	1,522
	Jackdaw	Generalist	9.6	16.05	6.45	150	8,002
	Woodpigeon	Generalist	20.12	27.65	7.53	185	9,945
	Starling	Specialist	4.24	14.44	10.2	50	5,502
Rook	Generalist	11.92	23.87	11.95	78	4,849	

Indicator	Species	Generalist/ Specialist	Mean abundance per monad		Difference in mean (national – TTI)	Total Records	
			TTI	National		TTI	National
Woodland	Lesser Redpoll	Specialist	26	3.74	-22.26	1	201
	Great Tit	Generalist	5.58	4.98	-0.6	169	8,710
	Spotted Flycatcher	Specialist	1.5	1.31	-0.19	2	362
	Song Thrush	Generalist	3.64	3.49	-0.15	169	8,048
	Goldcrest	Specialist	2.43	2.35	-0.08	85	3,116
	Treecreeper	Specialist	1.45	1.45	0	28	1,274
	Tawny Owl	Generalist	1.08	1.11	0.03	12	277
	Garden Warbler	Specialist	1.5	1.56	0.06	27	1,355
	Green Woodpecker	Specialist	1.54	1.61	0.07	89	3,108
	Jay	Specialist	1.61	1.69	0.08	98	3,145
	Sparrowhawk	Specialist	1	1.08	0.08	8	912
	Marsh Tit	Specialist	1.44	1.58	0.14	16	444
	Long-tailed Tit	Generalist	2.69	2.89	0.2	62	4,082
	Robin	Generalist	7.88	8	0.12	181	9,493
	Lesser Whitethroat	Generalist	1.18	1.46	0.28	17	1,134
	Great Spotted Woodpecker	Specialist	1.57	1.94	0.37	97	5,096
	Nuthatch	Specialist	1.84	2.2	0.36	77	2,750
	Blackcap	Specialist	4.14	4.58	0.44	172	8,149
	Bullfinch	Generalist	1.26	1.78	0.52	22	1,834
	Blue Tit	Generalist	7.62	8.23	0.61	182	9,308
Dunnock	Generalist	2.83	3.77	0.94	132	8,233	
Wren	Generalist	8.6	9.71	1.11	179	9,753	
Chiffchaff	Specialist	3.4	4.7	1.3	158	8,203	

Indicator	Species	Generalist/ Specialist	Mean abundance per monad		Difference in mean (national – TTI)	Total Records	
			TTI	National		TTI	National
Woodland	Redstart	Specialist	1	2.44	1.44	2	485
	Blackbird	Generalist	10.16	11.64	1.48	185	9,794
	Chaffinch	Generalist	4	5.73	1.73	168	8,694
	Willow Warbler	Specialist	1.6	3.53	1.93	9	2,880
	Siskin	Specialist	1.25	3.72	2.47	4	498

Farmland and Woodland Butterfly Indicators

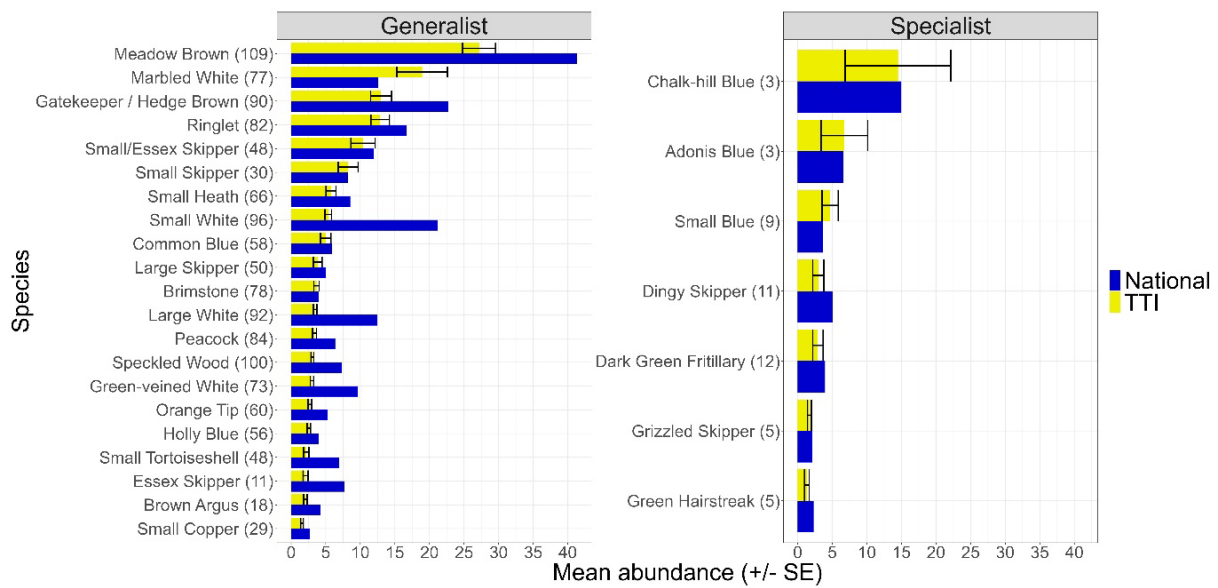


Figure 7. Differences in mean abundance per monad at the TTI-level and the national level for each species in the Farmland Butterfly Indicator as defined by Defra (2024a). Species are split into whether they are classified as generalists or specialists. The number provided in brackets beside each species represents the total number of monads between 2020 and 2023 in which the species was recorded in the TTI area. Standard error values are provided for results from the TTI area. Based on the data available, standard error could not be calculated for the national level.

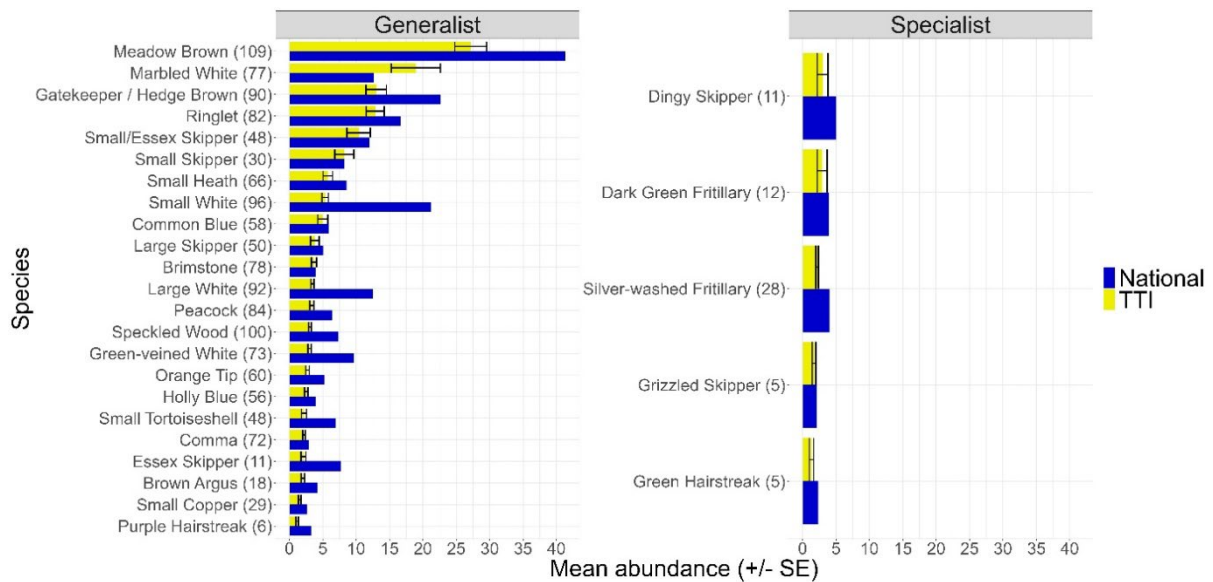


Figure 8. Differences in mean abundance per monad at the TTI-level and the national level for each species in the Woodland Butterfly Indicator as defined by Defra (2024a). Species are split into whether they are classified as generalists or specialists. The number provided in brackets beside each species represents the total number of monads between 2020 and 2023 in which the species was recorded in the TTI area. Standard error values are provided for results from the TTI area. Based on the data available, standard error could not be calculated for the national level.

Table 5. List of all butterfly species in the UK Farmland and Woodland Butterfly Indicators as defined by Defra (2024a). The mean abundance per monad of that species within the TTI project study area and at the national level are provided, along with the difference in the mean abundance per monad between TTI and national levels. The total number of records for each species at the TTI level and the national level are also provided.

Indicator	Species	Generalist/ Specialist	Mean abundance per monad		Difference in mean (national – TTI)	Total Records	
			TTI	National		TTI	National
Farmland	Marbled White	Generalist	18.94	12.59	-6.35	77	786
	Small Blue	Specialist	4.7	3.68	-1.02	9	22
	Adonis Blue	Specialist	6.75	6.64	-0.11	3	22
	Small Skipper	Generalist	8.24	8.21	-0.03	30	999
	Brimstone	Generalist	3.67	3.97	0.3	78	776
	Grizzled Skipper	Specialist	1.71	2.12	0.41	5	8
	Chalk-hill Blue	Specialist	14.5	15	0.5	3	36
	Common Blue	Generalist	5	5.94	0.94	58	1,083
	Green Hairstreak	Specialist	1.33	2.31	0.98	5	26
	Dark Green Fritillary	Specialist	2.94	3.97	1.03	12	154
	Small Copper	Generalist	1.56	2.67	1.11	29	650
	Large Skipper	Generalist	3.83	5.05	1.22	50	738
	Holly Blue	Generalist	2.54	3.99	1.45	56	998
	Small/Essex Skipper	Generalist	10.39	11.97	1.58	48	1,500
	Dingy Skipper	Specialist	3	5.04	2.04	11	27
	Brown Argus	Generalist	2.04	4.22	2.18	18	360
	Orange Tip	Generalist	2.71	5.3	2.59	60	336
	Small Heath	Generalist	5.76	8.55	2.79	66	764
Peacock	Generalist	3.36	6.37	3.01	84	1,833	

Indicator	Species	Generalist/ Specialist	Mean abundance per monad		Difference in mean (national – TTI)	Total Records	
			TTI	National		TTI	National
Farmland	Ringlet	Generalist	12.86	16.7	3.84	82	1,857
	Speckled Wood	Generalist	3.07	7.29	4.22	100	2,058
	Small Tortoiseshell	Generalist	2.19	6.92	4.73	48	1,605
	Essex Skipper	Generalist	2.09	7.74	5.65	11	325
	Green-veined White	Generalist	3.01	9.64	6.63	73	1,845
	Large White	Generalist	3.46	12.47	9.01	92	2,465
	Gatekeeper / Hedge Brown	Generalist	13.01	22.69	9.68	90	2,269
	Meadow Brown	Generalist	27.17	41.35	14.18	109	2,792
	Small White	Generalist	5.37	21.17	15.8	96	2,659
Woodland	Marbled White	Generalist	18.94	12.59	-6.35	77	786
	Small Skipper	Generalist	8.24	8.21	-0.03	30	999
	Brimstone	Generalist	3.67	3.97	0.3	78	776
	Grizzled Skipper	Specialist	1.71	2.12	0.41	5	8
	Comma	Generalist	2.17	2.9	0.73	72	1,460
	Common Blue	Generalist	5	5.94	0.94	58	1,083
	Green Hairstreak	Specialist	1.33	2.31	0.98	5	26
	Dark Green Fritillary	Specialist	2.94	3.97	1.03	12	154
	Small Copper	Generalist	1.56	2.67	1.11	29	650
	Large Skipper	Generalist	3.83	5.05	1.22	50	738
	Holly Blue	Generalist	2.54	3.99	1.45	56	998
	Small/Essex Skipper	Generalist	10.39	11.97	1.58	48	1,500

Indicator	Species	Generalist/ Specialist	Mean abundance per monad		Difference in mean (national – TTI)	Total Records	
			TTI	National		TTI	National
Woodland	Silver-washed Fritillary	Specialist	2.18	4.01	1.83	28	339
	Dingy Skipper	Specialist	3	5.04	2.04	11	27
	Purple Hairstreak	Generalist	1.17	3.24	2.07	6	147
	Brown Argus	Generalist	2.04	4.22	2.18	18	360
	Orange Tip	Generalist	2.71	5.3	2.59	60	336
	Small Heath	Generalist	5.76	8.55	2.79	66	764
	Peacock	Generalist	3.36	6.37	3.01	84	1,833
	Ringlet	Generalist	12.86	16.7	3.84	82	1,857
	Speckled Wood	Generalist	3.07	7.29	4.22	100	2,058
	Small Tortoiseshell	Generalist	2.19	6.92	4.73	48	1,605
	Essex Skipper	Generalist	2.09	7.74	5.65	11	325
	Green-veined White	Generalist	3.01	9.64	6.63	73	1,845
	Large White	Generalist	3.46	12.47	9.01	92	2,465
	Gatekeeper / Hedge Brown	Generalist	13.01	22.69	9.68	90	2,269
	Meadow Brown	Generalist	27.17	41.35	14.18	109	2,792
Small White	Generalist	5.37	21.17	15.8	96	2,659	

Plant Indicators

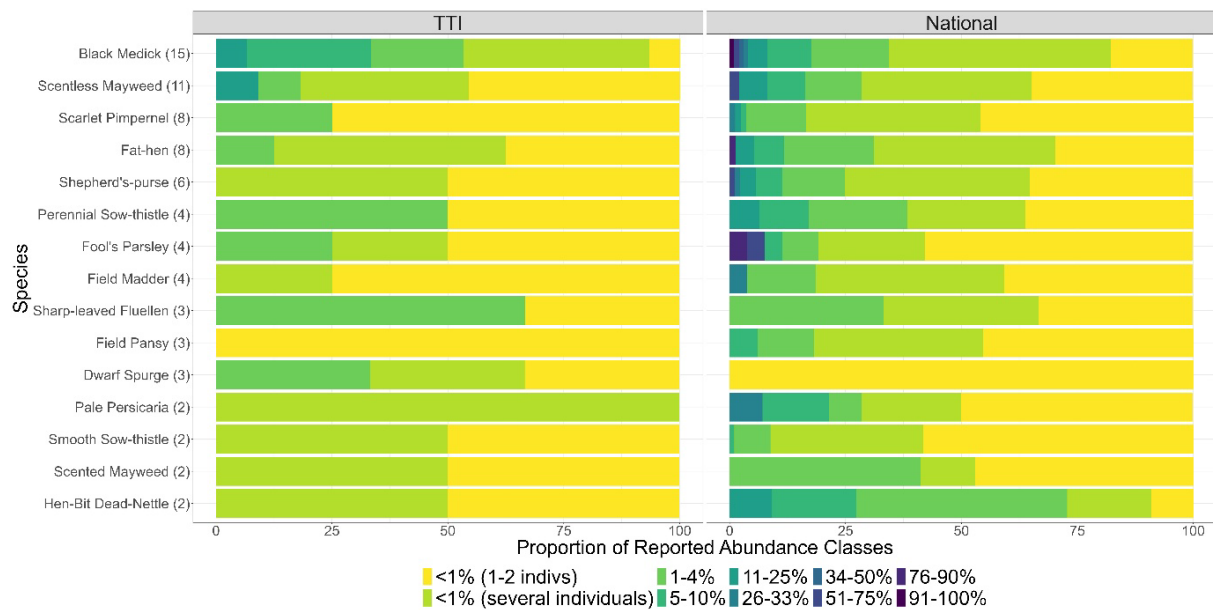


Figure 9. Results for the proportion (expressed as a percentage) of reported abundance classes for each plant species in the Arable Field Margins Indicator as defined by JNCC (2024a) at the TTI-level and the national level. The number of records across the time period (2020–2023) which report a given plant species under a designated abundance class (smallest class = < 1% 1–2 individuals, largest class = 91–100%) are each expressed as a proportion of the total number of records for that plant species. The number provided in brackets beside each species represents the total number of records between 2020 and 2023 for that species in the TTI area.

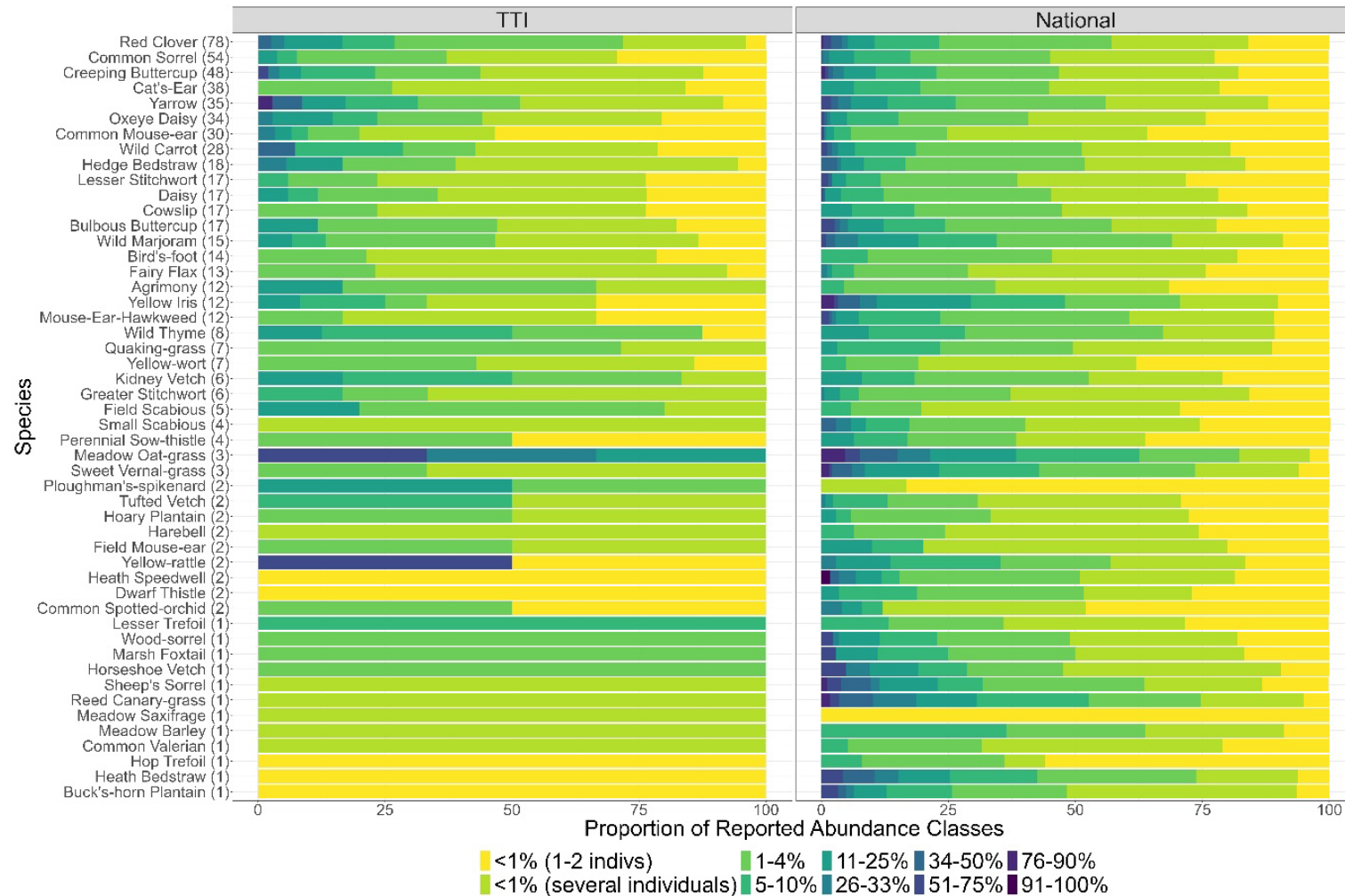


Figure 10. Results for the proportion (expressed as a percentage) of reported abundance classes for each plant species in the Lowland Grassland Indicator as defined by JNCC (2024a) at the TTI-level and the national level. The number of records across the time period (2020–2023) which report a given plant species under a designated abundance class (smallest class = < 1% 1–2 individuals, largest class = 91–100%) are each expressed as a proportion of the total number of records for that plant species. The number provided in brackets beside each species represents the total number of records between 2020 and 2023 for that species in the TTI area.

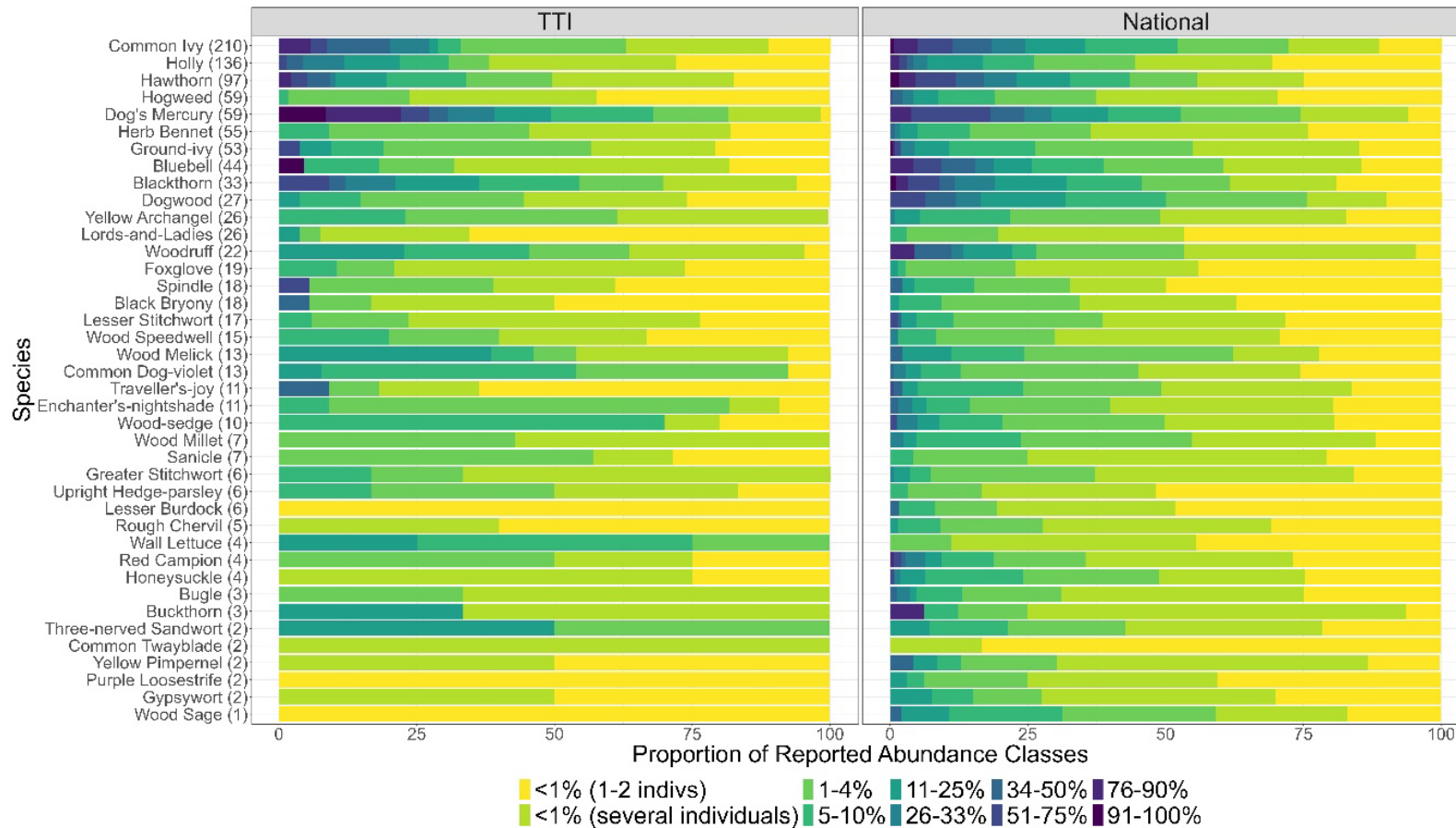


Figure 11. Results for the proportion (expressed as a percentage) of reported abundance classes for each plant species in the Broadleaved Woodlands and Hedges Indicator as defined by JNCC (2024a) at the TTI-level and the national level. The number of records across the time period (2020–2023) which report a given plant species under a designated abundance class (smallest class = < 1% 1–2 individuals, largest class = 91–100%) are each expressed as a proportion of the total number of records for that plant species. The number provided in brackets beside each species represents the total number of records between 2020 and 2023 for that species in the TTI area.

Table 6. List of plant species in the UK Arable Field Margins, Broadleaved Woodlands and Hedges, and Lowland Grassland Indicators as defined by JNCC (2024a). The most frequently reported abundance category, with the proportion of records in which that abundance was recorded, is provided in brackets for the TTI and national levels. The total number of records for each species at the TTI level and the national level are also provided.

Indicator	Species	Most frequently reported abundance categories (with proportion of records)		Total Records	
		TTI	National	TTI	National
Arable Field Margins	Black Medick	< 1% (several individuals) (40%)	< 1% (several individuals) (47.9%)	15	96
	Dwarf Spurge	< 1% (1–2 individuals) (33.3%); < 1% (several individuals) (33.3%); 1–4% (33.3%)	< 1% (1–2 individuals) (100%)	3	1
	Fat-hen	< 1% (several individuals) (50%)	< 1% (several individuals) (39%)	8	77
	Field Madder	< 1% (1–2 individuals) (75%)	< 1% (1–2 individuals) (40.7%); < 1% (several individuals) (40.7%)	4	27
	Field Pansy	< 1% (1–2 individuals) (100%)	< 1% (1–2 individuals) (45.5%)	3	33
	Fool's Parsley	< 1% (1–2 individuals) (50%)	< 1% (1–2 individuals) (57.7%)	4	26
	Hen-Bit Dead-Nettle	< 1% (1–2 individuals) (50%); < 1% (several individuals) (50%)	1–4% (45.5%)	2	11
	Pale Persicaria	< 1% (several individuals) (100%)	< 1% (1–2 individuals) (50%)	2	14
	Perennial Sow-thistle	< 1% (1–2 individuals) (50%); 1–4% (50%)	< 1% (1–2 individuals) (36.2%)	4	47
	Scarlet Pimpernel	< 1% (1–2 individuals) (37.5%)	< 1% (1–2 individuals) (45.9%)	8	85

Indicator	Species	Most frequently reported abundance categories (with proportion of records)		Total Records	
		TTI	National	TTI	National
Arable Field Margins	Scented Mayweed	< 1% (1–2 individuals) (50%); < 1% (several individuals) (50%)	< 1% (1–2 individuals) (47.1%)	2	17
	Scentless Mayweed	< 1% (1–2 individuals) (45.5%)	< 1% (several individuals) (36.7%)	11	49
	Sharp-leaved Fluellen	1–4% (66.7%)	< 1% (1–2 individuals) (33.3%); < 1% (several individuals) (33.3%); 1–4% (33.3%)	3	3
	Shepherd's-purse	< 1% (1–2 individuals) (50%); < 1% (several individuals) (50%)	< 1% (several individuals) (39.8%)	6	88
	Smooth Sow-thistle	< 1% (1–2 individuals) (50%); < 1% (several individuals) (50%)	< 1% (1–2 individuals) (58.3%)	2	103
Broadleaved Woodlands and Hedges	Black Bryony	< 1% (1–2 individuals) (50%)	< 1% (1–2 individuals) (37.2%)	18	183
	Blackthorn	< 1% (several individuals) (24.2%)	< 1% (several individuals) (19.3%)	33	601
	Bluebell	< 1% (several individuals) (25%)	< 1% (several individuals) (25.1%)	44	323
	Buckthorn	< 1% (several individuals) (66.7%)	< 1% (several individuals) (68.8%)	3	16
	Bugle	< 1% (several individuals) (66.7%)	< 1% (several individuals) (44%)	3	84
	Common Dog-violet	5–10% (46.2%)	1–4% (32.2%)	13	180
	Common Ivy	1–4% (10%)	1–4% (20.2%)	210	1,103

Indicator	Species	Most frequently reported abundance categories (with proportion of records)		Total Records	
		TTI	National	TTI	National
Broadleaved Woodlands and Hedges	Common Twayblade	< 1% (several individuals) (100%)	< 1% (1–2 individuals) (83.3%)	2	6
	Dog's Mercury	5–10% (18.6%)	1–4% (21.8%)	59	400
	Dogwood	< 1% (several individuals) (29.6%); 1–4% (29.6%)	1–4% (25.5%)	27	110
	Enchanter's-nightshade	1–4% (72.7%)	< 1% (several individuals) (40.5%)	11	200
	Foxglove	< 1% (several individuals) (52.6%)	< 1% (1–2 individuals) (44%)	19	141
	Greater Stitchwort	< 1% (several individuals) (66.7%)	< 1% (several individuals) (47%)	6	164
	Ground-ivy	1–4% (37.7%)	< 1% (several individuals) (30.2%)	53	461
	Gypsywort	< 1% (1–2 individuals) (50%); < 1% (several individuals) (50%)	< 1% (several individuals) (42.5%)	2	40
	Hawthorn	< 1% (several individuals) (33%)	< 1% (1–2 individuals) (25.1%)	97	1,297
	Herb Bennet	< 1% (several individuals) (36.4%); 1–4% (36.4%)	< 1% (several individuals) (39.5%)	55	659
	Hogweed	< 1% (1–2 individuals) (42.4%)	< 1% (several individuals) (33.1%)	59	1,079
	Holly	< 1% (several individuals) (16.9%)	< 1% (1–2 individuals) (30.7%)	136	472
Honeysuckle	< 1% (several individuals) (75%)	< 1% (several individuals) (26.5%)	4	309	

Indicator	Species	Most frequently reported abundance categories (with proportion of records)		Total Records	
		TTI	National	TTI	National
Broadleaved Woodlands and Hedges	Lesser Burdock	< 1% (1–2 individuals) (100%)	< 1% (1–2 individuals) (48.4%)	6	62
	Lesser Stitchwort	< 1% (several individuals) (52.9%)	< 1% (several individuals) (33.1%)	17	148
	Lords-and-Ladies	< 1% (1–2 individuals) (65.4%)	< 1% (1–2 individuals) (46.6%)	26	352
	Purple Loosestrife	< 1% (1–2 individuals) (100%)	< 1% (1–2 individuals) (40.6%)	2	32
	Red Campion	1-4% (50%)	< 1% (several individuals) (37.6%)	4	287
	Rough Chervil	< 1% (1–2 individuals) (60%)	< 1% (several individuals) (41.5%)	5	65
	Sanicle	1-4% (57.1%)	< 1% (several individuals) (54.2%)	7	24
	Spindle	< 1% (1–2 individuals) (38.9%)	< 1% (1–2 individuals) (50%)	18	46
	Three-nerved Sandwort	1-4% (50%); 11–25% (50%)	< 1% (several individuals) (35.7%)	2	14
	Traveller's-joy	< 1% (1–2 individuals) (63.6%)	< 1% (several individuals) (34.6%)	11	136
	Upright Hedge-parsley	< 1% (several individuals) (33.3%); 1–4% (33.3%)	< 1% (1–2 individuals) (51.7%)	6	60
	Wall Lettuce	5–10% (50%)	< 1% (1–2 individuals) (44.4%); < 1% (several individuals) (44.4%)	4	18

Indicator	Species	Most frequently reported abundance categories (with proportion of records)		Total Records	
		TTI	National	TTI	National
Broadleaved Woodlands and Hedges	Wood-sedge	5–10% (70%)	< 1% (several individuals) (30.8%)	10	78
	Wood Melick	< 1% (several individuals) (38.5%); 11–25% (38.5%)	1–4% (37.8%)	13	45
	Wood Millet	< 1% (several individuals) (57.1%)	< 1% (several individuals) (33.3%)	7	42
	Wood Sage	< 1% (1–2 individuals) (100%)	1–4% (27.9%)	1	147
	Wood Speedwell	< 1% (1–2 individuals) (33.3%)	< 1% (several individuals) (40.8%)	15	130
	Woodruff	< 1% (several individuals) (31.8%)	< 1% (several individuals) (42.2%)	22	45
	Yellow Archangel	< 1% (several individuals) (19.2%); 1–4% (19.2%)	< 1% (several individuals) (33.6%)	26	110
	Yellow Pimpernel	< 1% (1–2 individuals) (50%); < 1% (several individuals) (50%)	< 1% (several individuals) (56.5%)	2	23
Lowland Grassland	Agrimony	1–4% (25%)	< 1% (several individuals) (34.2%)	12	111
	Bird's-foot	< 1% (several individuals) (57.1%)	< 1% (several individuals) (36.4%); 1–4% (36.4%)	14	22
	Buck's-horn Plantain	< 1% (1–2 individuals) (100%)	< 1% (several individuals) (45.2%)	1	62
	Bulbous Buttercup	< 1% (several individuals) (35.3%); 1–4% (35.3%)	1–4% (32.8%)	17	189
	Cat's-Ear	< 1% (several individuals) (28.9%)	< 1% (several individuals) (33.5%)	38	236

Indicator	Species	Most frequently reported abundance categories (with proportion of records)		Total Records	
		TTI	National	TTI	National
Lowland Grassland	Common Mouse-ear	< 1% (1–2 individuals) (53.3%)	< 1% (several individuals) (39.3%)	30	466
	Common Sorrel	< 1% (several individuals) (16.7%)	< 1% (several individuals) (32.3%)	54	507
	Common Spotted-orchid	< 1% (1–2 individuals) (50%); 1–4% (50%)	< 1% (1–2 individuals) (48%)	2	25
	Common Valerian	< 1% (several individuals) (100%)	< 1% (several individuals) (47.4%)	1	19
	Cowslip	< 1% (several individuals) (52.9%)	< 1% (several individuals) (36.6%)	17	131
	Creeping Buttercup	< 1% (several individuals) (43.8%)	< 1% (several individuals) (35.3%)	48	999
	Daisy	< 1% (several individuals) (41.2%)	< 1% (several individuals) (32.9%); 1–4% (32.9%)	17	225
	Dwarf Thistle	< 1% (1–2 individuals) (100%)	1–4% (32.9%)	2	85
	Fairy Flax	< 1% (several individuals) (69.2%)	< 1% (several individuals) (46.8%)	13	94
	Field Mouse-ear	< 1% (several individuals) (50%); 1–4% (50%)	< 1% (several individuals) (60%)	2	10
	Field Scabious	1–4% (60%)	< 1% (several individuals) (51%)	5	51
	Greater Stitchwort	< 1% (several individuals) (66.7%)	< 1% (several individuals) (47%)	6	164
Harebell	< 1% (several individuals) (100%)	< 1% (several individuals) (50%)	2	78	

Indicator	Species	Most frequently reported abundance categories (with proportion of records)		Total Records	
		TTI	National	TTI	National
Lowland Grassland	Heath Bedstraw	< 1% (1–2 individuals) (100%)	1–4% (31.3%)	1	355
	Heath Speedwell	< 1% (1–2 individuals) (100%)	1–4% (35.6%)	2	59
	Hedge Bedstraw	< 1% (several individuals) (55.6%)	1–4% (35.3%)	18	133
	Hoary Plantain	< 1% (several individuals) (50%); 1–4% (50%)	< 1% (several individuals) (39.1%)	2	69
	Hop Trefoil	< 1% (1–2 individuals) (100%)	< 1% (1–2 individuals) (56%)	1	25
	Horseshoe Vetch	1–4% (100%)	< 1% (several individuals) (42.9%)	1	21
	Kidney Vetch	1–4% (33.3%); 5–10% (33.3%)	1–4% (34.2%)	6	38
	Lesser Stitchwort	< 1% (several individuals) (52.9%)	< 1% (several individuals) (33.1%)	17	148
	Lesser Trefoil	5–10% (100%)	< 1% (several individuals) (35.8%)	1	53
	Marsh Foxtail	1–4% (100%)	< 1% (several individuals) (33.3%)	1	36
	Meadow Barley	< 1% (several individuals) (100%)	5–10% (36.4%)	1	11
	Meadow Oat-grass	11–25% (33.3%); 26–33% (33.3%)	5–10% (24.3%)	3	107
Meadow Saxifrage	< 1% (several individuals) (100%)	< 1% (1–2 individuals) (100%)	1	1	

Indicator	Species	Most frequently reported abundance categories (with proportion of records)		Total Records	
		TTI	National	TTI	National
Lowland Grassland	Mouse-Ear-Hawkweed	< 1% (several individuals) (25%)	1–4% (37.2%)	12	137
	Oxeye Daisy	< 1% (several individuals) (35.3%)	< 1% (several individuals) (35%)	34	157
	Perennial Sow-thistle	< 1% (1–2 individuals) (50%); 1–4% (50%)	< 1% (1–2 individuals) (36.2%)	4	47
	Ploughman's-spikenard	1–4% (50%); 11–25% (50%)	< 1% (1–2 individuals) (83.3%)	2	6
	Quaking-grass	1–4% (71.4%)	< 1% (several individuals) (39.1%)	7	133
	Red Clover	1–4% (16.7%)	1–4% (33.9%)	78	469
	Reed Canary-grass	< 1% (several individuals) (100%)	1–4% (22%); 5-10% (22%)	1	59
	Sheep's Sorrel	< 1% (several individuals) (100%)	1–4% (31.9%)	1	182
	Small Scabious	< 1% (several individuals) (100%)	< 1% (several individuals) (34.3%)	4	35
	Sweet Vernal-grass	< 1% (several individuals) (66.7%)	1–4% (30.8%)	3	383
	Tufted Vetch	< 1% (several individuals) (50%); 5–10% (50%)	< 1% (several individuals) (40%)	2	130
	Wild Carrot	< 1% (several individuals) (17.9%)	1–4% (32.6%)	28	92
Wild Marjoram	< 1% (several individuals) (40%)	1–4% (34.5%)	15	110	

Indicator	Species	Most frequently reported abundance categories (with proportion of records)		Total Records	
		TTI	National	TTI	National
Lowland Grassland	Wild Thyme	1–4% (37.5%); 5–10% (37.5%)	1–4% (39.1%)	8	64
	Wood-sorrel	1–4% (100%)	< 1% (several individuals) (33%)	1	88
	Yarrow	< 1% (several individuals) (40%)	< 1% (several individuals) (32.1%)	35	430
	Yellow-rattle	< 1% (1–2 individuals) (50%); 51-75% (50%)	< 1% (several individuals) (26.5%)	2	102
	Yellow-wort	< 1% (several individuals) (42.9%); 1–4% (42.9%)	< 1% (several individuals) (42.9%)	7	21
	Yellow Iris	< 1% (1–2 individuals) (33.3%); < 1% (several individuals) (33.3%)	1–4% (22.7%)	12	119

Red-listed Species

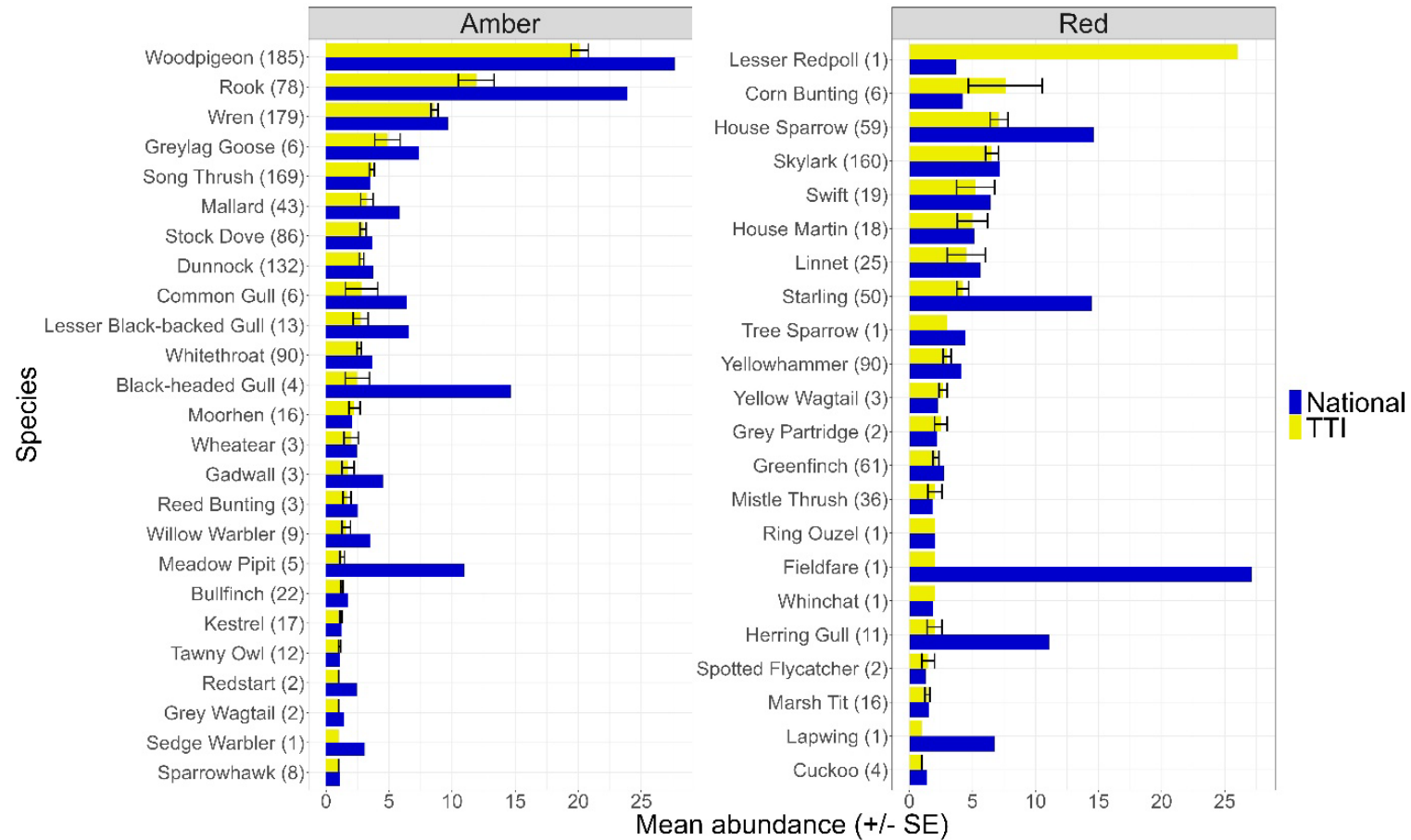


Figure 12. Differences in mean abundance per monad at the TTI-level and the national level for each Amber and Red-Listed bird species as defined by JNCC (2023). The number provided in brackets beside each species represents the total number of monads between 2020 and 2023 in which the species was recorded in the TTI area. Standard error values are provided for results from the TTI area. Based on the data available, standard error could not be calculated for the national level.

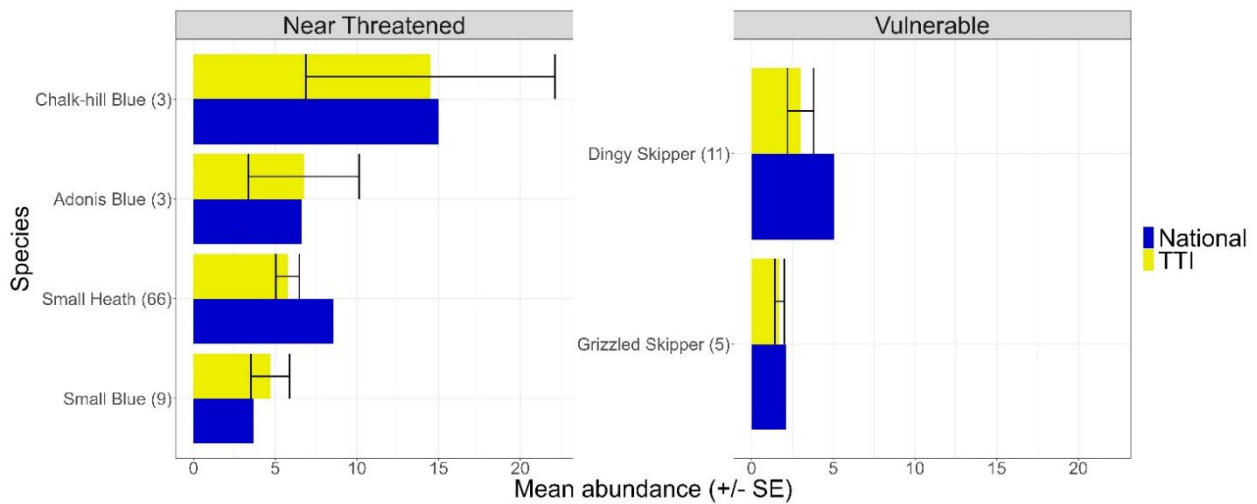


Figure 13. Differences in mean abundance per monad at the TTI-level and the national level for each butterfly species classified as either Near Threatened or Vulnerable as defined by JNCC (2023). The number provided in brackets beside each species represents the total number of monads between 2020 and 2023 in which the species was recorded in the TTI area. Standard error values are provided for results from the TTI area. Based on the data available, standard error could not be calculated for the national level.

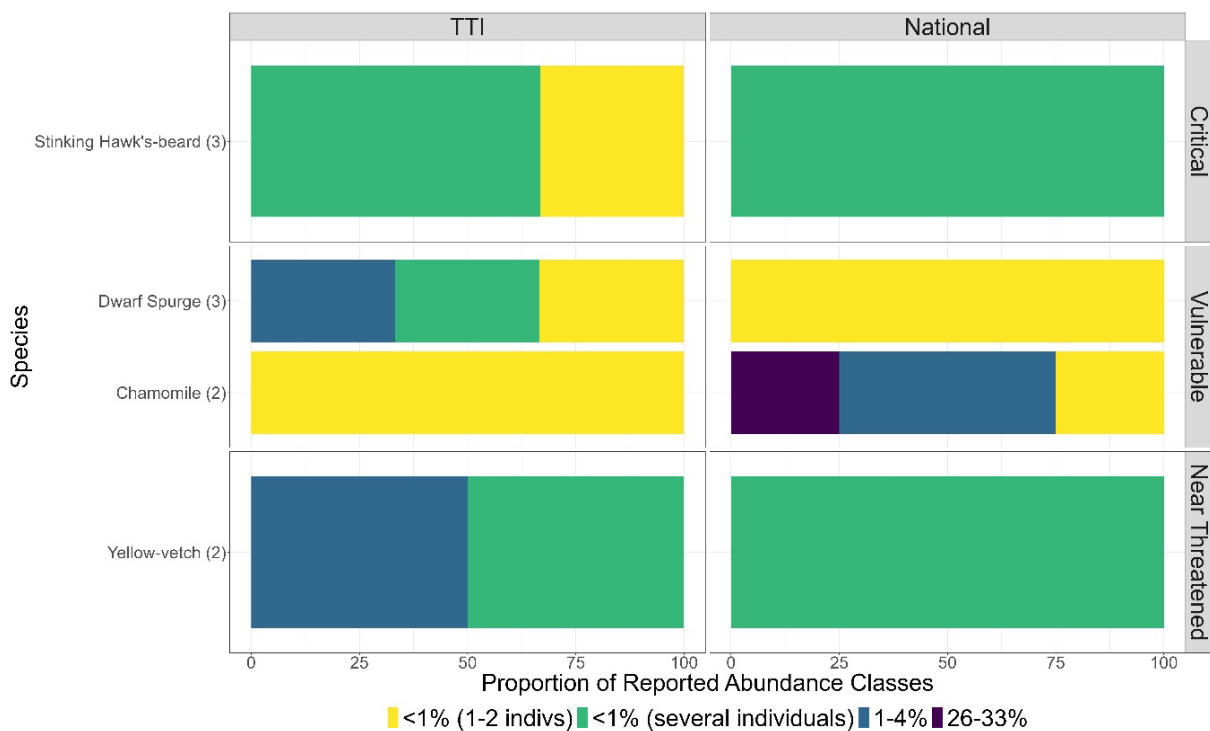


Figure 14. Results for the proportion (expressed as a percentage) of reported abundance classes for each plant species categorised as Critical, Vulnerable or Near Threatened as defined by JNCC (2023) at the TTI-level and the national level. The number of records across the time period (2020–2023) which report a given plant species under a designated abundance class (smallest class = < 1% 1–2 individuals, largest class = 91–100%) are each expressed as a proportion of the total number of records for that plant species. The number provided in brackets beside each species represents the total number of records between 2020 and 2023 for that species in the TTI area.

Table 7. List of all red-listed bird and butterfly species with their Red List classification (Amber/Red for birds and Near Threatened/Vulnerable for butterflies) as defined by JNCC (2023). The mean abundance per monad of that species within the TTI project study area and at the national level are provided, along with the difference in the mean site abundance between TTI and national levels. The total number of records for each species at the TTI level and the national level are also provided.

Taxa	Species	Red List category	Mean abundance per monad		Difference in mean (national – TTI)	Total Records	
			TTI	National		TTI	National
Bird	Moorhen	Amber	2.26	2.07	-0.19	16	2,160
	Song Thrush	Amber	3.64	3.49	-0.15	169	8,048
	Tawny Owl	Amber	1.08	1.11	0.03	12	277
	Kestrel	Amber	1.19	1.23	0.04	17	2,036
	Sparrowhawk	Amber	1	1.08	0.08	8	912
	Grey Wagtail	Amber	1	1.45	0.45	2	699
	Wheatear	Amber	2	2.45	0.45	3	625
	Bullfinch	Amber	1.26	1.78	0.52	22	1,834
	Stock Dove	Amber	2.93	3.67	0.74	86	4,566
	Reed Bunting	Amber	1.67	2.51	0.84	3	1,692
	Dunnock	Amber	2.83	3.77	0.94	132	8,233
	Whitethroat	Amber	2.63	3.68	1.05	90	5,774
	Wren	Amber	8.6	9.71	1.11	179	9,753
	Redstart	Amber	1	2.44	1.44	2	485
	Willow Warbler	Amber	1.6	3.53	1.93	9	2,880
	Sedge Warbler	Amber	1	3.07	2.07	1	713
	Greylag Goose	Amber	4.88	7.39	2.51	6	1,543
	Mallard	Amber	3.24	5.86	2.62	43	4,649
	Gadwall	Amber	1.75	4.52	2.77	3	261
Common Gull	Amber	2.83	6.43	3.6	6	300	

Taxa	Species	Red List category	Mean abundance per monad		Difference in mean (national – TTI)	Total Records	
			TTI	National		TTI	National
Bird	Lesser Black-backed Gull	Amber	2.75	6.56	3.81	13	2,972
	Woodpigeon	Amber	20.12	27.65	7.53	185	9,945
	Meadow Pipit	Amber	1.29	10.96	9.67	5	1,630
	Rook	Amber	11.92	23.87	11.95	78	4,849
	Black-headed Gull	Amber	2.5	14.65	12.15	4	2,199
	Lesser Redpoll	Red	26	3.74	-22.26	1	201
	Corn Bunting	Red	7.62	4.24	-3.38	6	606
	Yellow Wagtail	Red	2.67	2.27	-0.4	3	626
	Grey Partridge	Red	2.5	2.21	-0.29	2	525
	Spotted Flycatcher	Red	1.5	1.31	-0.19	2	362
	Mistle Thrush	Red	2.02	1.84	-0.18	36	3,033
	Whinchat	Red	2	1.85	-0.15	1	67
	Ring Ouzel	Red	2	2.04	0.04	1	74
	House Martin	Red	5	5.14	0.14	18	2,228
	Marsh Tit	Red	1.44	1.58	0.14	16	444
	Cuckoo	Red	1	1.41	0.41	4	1,382
	Skylark	Red	6.55	7.19	0.64	160	6,532
	Greenfinch	Red	2.1	2.75	0.65	61	4,699
	Yellowhammer	Red	3	4.1	1.1	90	4,034
	Linnet	Red	4.52	5.62	1.1	25	4,336
Swift	Red	5.25	6.43	1.18	19	2,504	
Tree Sparrow	Red	3	4.41	1.41	1	488	

Taxa	Species	Red List category	Mean abundance per monad		Difference in mean (national – TTI)	Total Records	
			TTI	National		TTI	National
Bird	Lapwing	Red	1	6.76	5.76	1	1,522
	House Sparrow	Red	7.12	14.65	7.53	59	6,168
	Herring Gull	Red	2	11.12	9.12	11	3,539
	Starling	Red	4.24	14.44	10.2	50	5,502
	Fieldfare	Red	2	27.14	25.14	1	161
Butterfly	Small Blue	Near Threatened	4.7	3.68	-1.02	9	22
	Adonis Blue	Near Threatened	6.75	6.64	-0.11	3	22
	Chalk-hill Blue	Near Threatened	14.5	15	0.5	3	36
	Small Heath	Near Threatened	5.76	8.55	2.79	66	764
	Grizzled Skipper	Vulnerable	1.71	2.12	0.41	5	8
	Dingy Skipper	Vulnerable	3	5.04	2.04	11	27

Table 8. List of all red-listed plant species with their Red List classification as defined by JNCC (2023). The most frequently reported abundance category, with the proportion of records in which that abundance was recorded, is provided in brackets for the TTI and national levels. The total number of records for each species at the TTI level and the national level are also provided.

Taxa	Species	Red List category	Most frequently reported abundance categories (with proportion of records)		Total Records	
			TTI	National	TTI	National
Plant	Chamomile (record improbable based on expert advice)	Vulnerable	< 1% (1–2 individuals) (100%)	1–4% (50%)	2	4
	Dwarf Spurge	Vulnerable	< 1% (1–2 individuals) (33.3%); < 1% (several individuals) (33.3%); 1–4% (33.3%)	< 1% (1–2 individuals) (100%)	3	1
	Stinking Hawk's-beard	Critical	< 1% (several individuals) (66.7%)	< 1% (several individuals) (100%)	3	1
	Yellow-vetch	Near Threatened	< 1% (several individuals) (50%); 1–4% (50%)	< 1% (several individuals) (100%)	2	1

Priority-listed Species

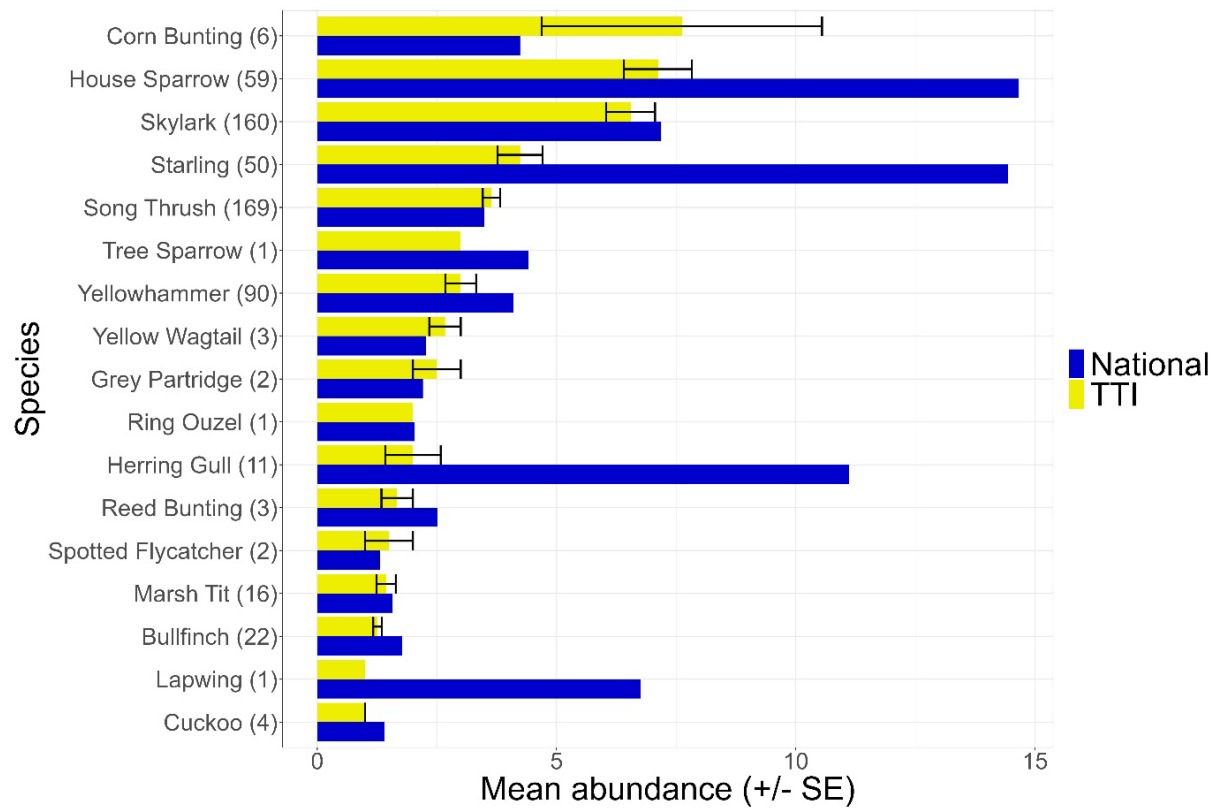


Figure 15. Differences in mean abundance per monad at the TTI-level and the national level for each Priority listed bird species as defined by JNCC (2024b). The number provided in brackets beside each species represents the total number of monads between 2020 and 2023 in which the species was recorded in the TTI area. Standard error values are provided for results from the TTI area. Based on the data available, standard error could not be calculated for the national level.

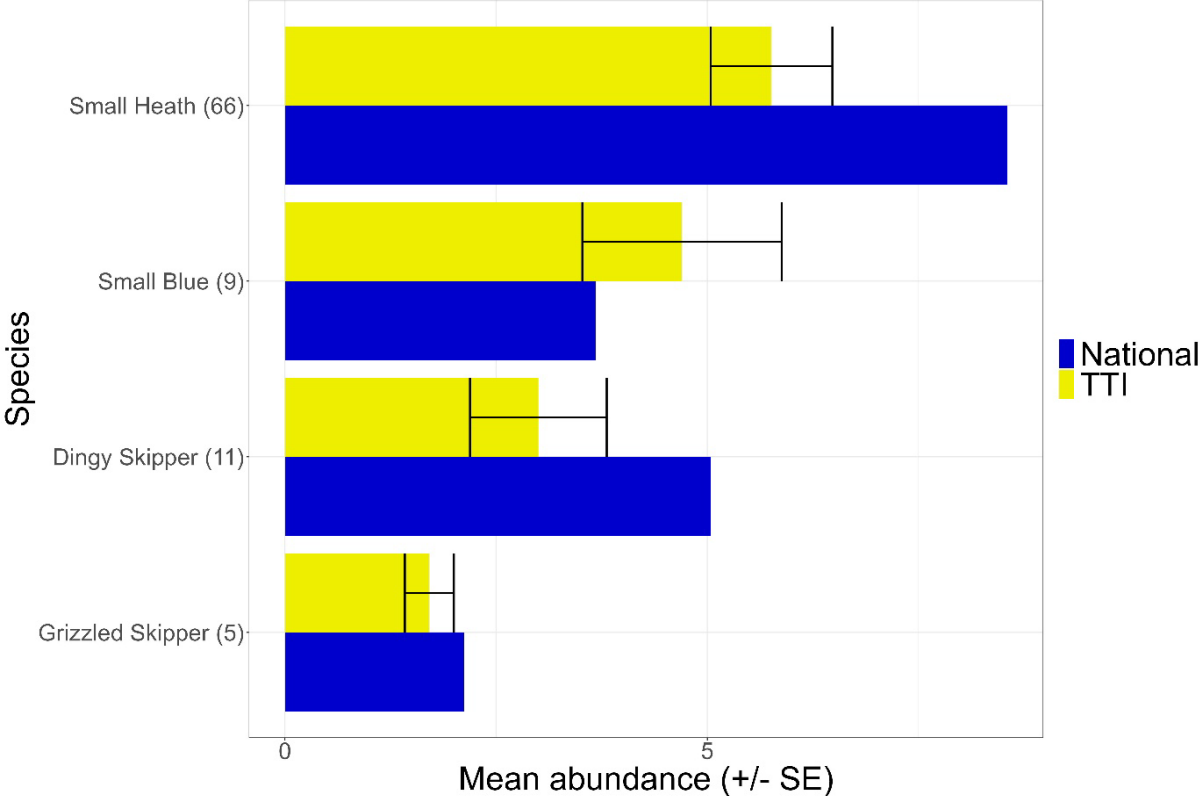


Figure 16. Differences in mean abundance per monad at the TTI-level and the national level for each Priority listed butterfly species as defined by JNCC (2024b). The number provided in brackets beside each species represents the total number of monads between 2020 and 2023 in which the species was recorded in the TTI area. Standard error values are provided for results from the TTI area. Based on the data available, standard error could not be calculated for the national level.

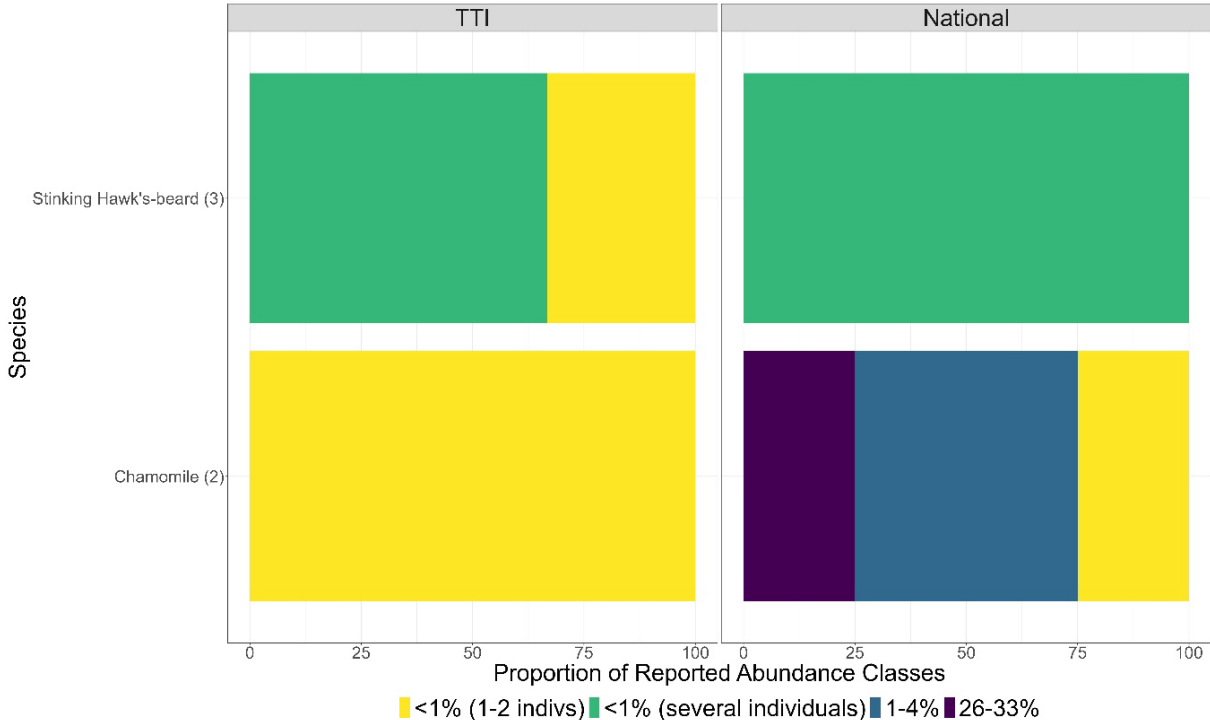


Figure 17. Results for the proportion (expressed as a percentage) of reported abundance classes for each Priority-listed plant species as defined by JNCC (2024b) at the TTI-level and the national level. The number of records across the time period (2020–2023) which report a given plant species under a designated abundance class (smallest class = < 1% 1–2 individuals, largest class = 91–100%) are each expressed as a proportion of the total number of records for that plant species. The number provided in brackets beside each species represents the total number of records between 2020 and 2023 for that species in the TTI area.

Table 9. List of all priority-listed bird and butterfly species as defined by JNCC (2024b). The mean abundance per monad of that species within the TTI project study area and at the national level are provided, along with the difference in the mean abundance per monad between TTI and national levels. The total number of records for each species at the TTI level and the national level are also provided.

Taxa	Species	Mean abundance per monad		Difference in mean (national – TTI)	Total Records	
		TTI	National		TTI	National
Bird	Corn Bunting	7.62	4.24	-3.38	6	606
	Yellow Wagtail	2.67	2.27	-0.4	3	626
	Grey Partridge	2.5	2.21	-0.29	2	525
	Spotted Flycatcher	1.5	1.31	-0.19	2	362
	Song Thrush	3.64	3.49	-0.15	169	8,048
	Ring Ouzel	2	2.04	0.04	1	74
	Marsh Tit	1.44	1.58	0.14	16	444
	Cuckoo	1	1.41	0.41	4	1,382
	Bullfinch	1.26	1.78	0.52	22	1,834
	Skylark	6.55	7.19	0.64	160	6,532
	Reed Bunting	1.67	2.51	0.84	3	1,692
	Yellowhammer	3	4.1	1.1	90	4,034
	Tree Sparrow	3	4.41	1.41	1	488
	Lapwing	1	6.76	5.76	1	1,522
	House Sparrow	7.12	14.65	7.53	59	6,168
	Herring Gull	2	11.12	9.12	11	3,539
Starling	4.24	14.44	10.2	50	5,502	
Butterfly	Small Blue	4.7	3.68	-1.02	9	22
	Grizzled Skipper	1.71	2.12	0.41	5	8
	Dingy Skipper	3	5.04	2.04	11	27
	Small Heath	5.76	8.55	2.79	66	764

Table 10. List of priority-listed plant species as defined by JNCC (2024b). The most frequently reported abundance category, with the proportion of records in which that abundance was recorded, provided in brackets for the TTI and national levels. The total number of records for each species at the TTI level and the national level are also provided.

Taxa	Species	Most frequently reported abundance categories (with proportion of records)		Total Records	
		TTI	National	TTI	National
Plant	Chamomile (record improbable based on expert advice)	< 1% (1–2 individuals) (100%)	1–4% (50%)	2	4
	Stinking Hawk's-beard	< 1% (several individuals) (66.7%)	< 1% (several individuals) (100%)	3	1