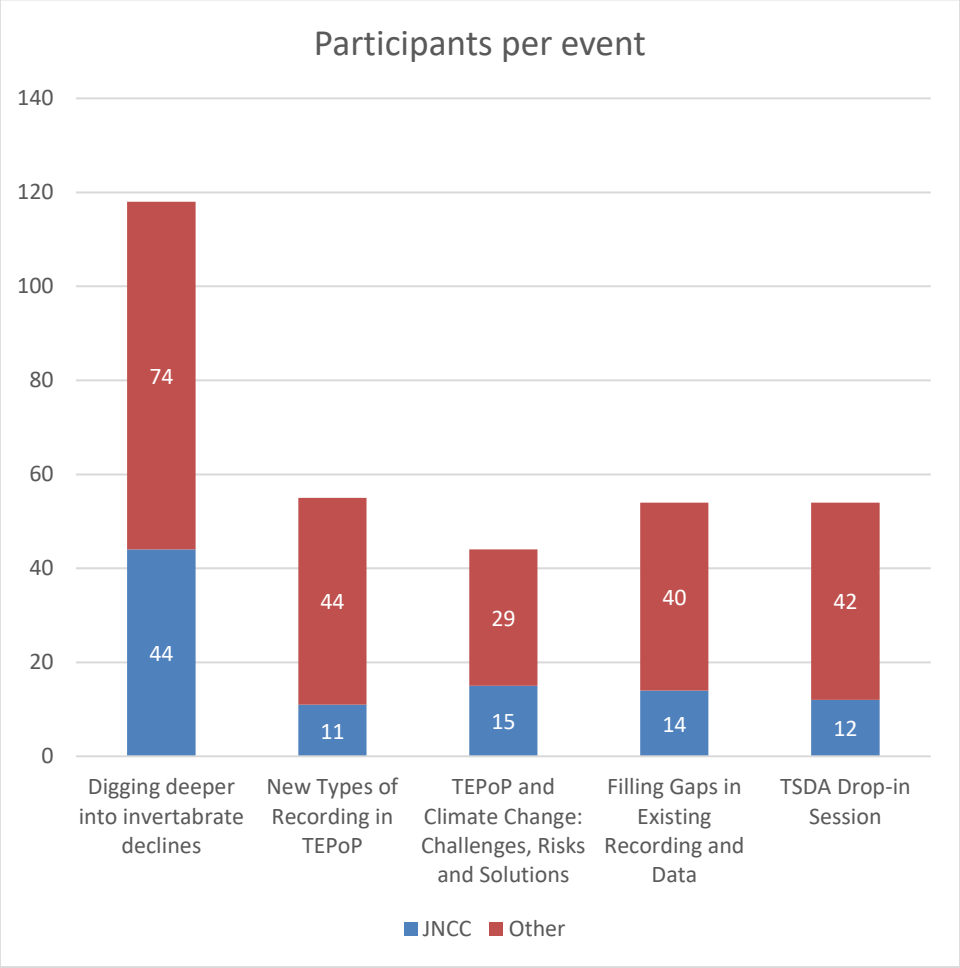
TEPoP Festival 2023 Summary

In autumn 2023, JNCC hosted the seventh annual UK Terrestrial Evidence Partnership of Partnerships (TEPoP) festival. The festival consisted of five online events which were held between 17 October and 23 November, comprised of a mix of presentations and workshops. Most events were recorded and can be viewed on YouTube (links in event titles below).

While TEPoP consists of 17 organisations involved in terrestrial monitoring and engaging volunteer recorders, the Festival attracted many other organisations interested in biodiversity monitoring and surveillance. Over 200 different individuals participated at one or more of the events, with participants attending each event shown in the figure below.



Participating Organisations:
Amphibian and Reptile Conservation Trust; Bat Conservation Trust; Biodiversity Information Services; Botanical Society of Britian & Ireland; British Trust for Ornithology; Butterfly Conservation; Department for Environment, Food & Rural Affairs; Department of Agriculture, Environment and Rural Affairs; Greater Lincolnshire Nature Partnership; Greenspace Information for Greater London; Joint Nature Conservation Committee; Lancashire County Council; Merseyside Biobank; National Biodiversity Network; Natural England; Natural History Museum; Natural Resources Wales; NatureScot; North Wales Environmental Information Services; Nottingham Trent University; Peoples Trust for Endangered Species; PlantLife; Royal Society for the Protection of Birds; Sefton Council; South East Wales Biodiversity Records Centre; UK Centre for Ecology & Hydrology; West Wales Biodiversity Information Centre; Wiltshire Wildlife Trust.

Session 1: Invertebrate declines: evidence and solutions

This session consisted of two presentations from UKCEH and BTO highlighting how data from citizen science programmes are being used to monitor invertebrates across the UK, as well as how this data can contribute to agricultural land management decisions.

James Pearce-Higgins from BTO led the first talk which explored the link between insect declines and bird populations. He discussed a piece of work that he was involved in which identified a number of key invertebrate groups which are important for driving changes in bird populations and are vulnerable to climate change. These groups were soil invertebrates, foliar insects, aerial insects, and aquatic insects. James also outlined three case studies which illustrated how long-term declines in invertebrate populations are useful for explaining changes in insectivorous bird populations. Such declines in insect populations were attributed to climate change and land-use change. He concluded by highlighting a need for improved insect abundance monitoring, which should preferably be coordinated with locations used for bird monitoring to strengthen the evidence base of linkages between these two taxonomic groups.

The second talk was given by **Francesca Mancini from UKCEH** who discussed her recent work investigating invertebrate biodiversity declines in croplands. Her work categorised the UK into regions of high, low or no cropland cover and quantified trends in the distribution and annual population growth rates of different groups of invertebrates within these regions. Her work showed that there is a lot of heterogeneity across taxonomic groups and crop types, but that trends tend to be negative for the majority of taxa across crop cover types. Declines are generally more severe in high cropland cover regions, particularly for spiders, but with a notable exception of hoverflies. These results highlight that the attempts to make agriculture more sustainable in Britian have not been successful at slowing down or reversing the declines of invertebrates.

Session 2: New Types of Recording in TEPoP

Niki Newton from JNCC began the event by introducing the Terrestrial Surveillance Development and Analysis (TSDA) project, which is a partnership between BTO, UKCEH and JNCC. The partnership works across TEPoP schemes to explore ways to add value to existing data through cross-scheme analysis and volunteer capacity development. There are three strategic challenges for work undertaken in the current period of 2022-2027: (1) how can TEPoP data adapt to new requirements for evidence? (2) how can TEPoP schemes exploit new data streams? and (3) how can TEPoP schemes develop a volunteer-entered approach to monitoring?

The first TSDA work package talk was given by **Maddie Harris from JNCC** on the results of two surveys which aimed to understand citizen scientists' motivations and barriers to measuring habitat. The surveys indicated a high level of interest in habitat monitoring across various types of habitat recording. In general, respondents were confident to carry out some habitat surveys, with confidence decreasing for finer habitat types and features. There could be a demand for training to improve confidence, with people showing particular interest in instructions to follow in the field and ongoing support. Respondents who were already citizen scientists generally said that they would prefer to carry out habitat surveys at the same time as their other surveys. The app 'EarthTrack' received middling reviews regarding user-friendliness, and respondents' confidence to answer questions that the app asked were high, but there was a strong interest for training to improve confidence regardless of respondents' current level of confidence. **Kirsi Peck (JNCC)** continued by talking about a forward look of this project to choose appropriate habitat classifiers and determine if habitat recording should be incorporated into other schemes, be developed into a new scheme, or a hybrid of the two. Moving forward, there is a need for collaborative effort to develop and pilot the surveys.

Next, **Michael Pocock from UKCEH** discussed scoping the potential for new technologies in TEPoP. In this TSDA work package, a wide range of technologies were considered which may change schemes' processing and user experiences, and how schemes collect and analyse data. He detailed a range of benefits of new technologies, including reducing errors and filling gaps, before looking at challenges such as the potential to exacerbate biases and increase waste, ecological disturbances, and pollution. He suggested prioritizing technologies according to their readiness, commonality across schemes, and transformative potential.

After this, **Jenna Lawson from UKCEH** gave a talk on the challenges and opportunities of using data from passive acoustic monitoring. Using case studies from her previous work, Jenna described advantages and challenges with different technologies available and for both species-specific and soundscape analyses. Many typical analysis methods and questions can be applied to species classifiers, while soundscape analysis answers questions about the overall level of sounds in ecosystems, which can be broadly broken down into biotic, abiotic, and anthropogenic sounds. Some caveats and challenges include a difficulty with collecting sufficient training data for species-specific analyses, and that soundscape indices can be disrupted by anthropogenic sounds and geophony (non-biological ambient sounds e.g. wind, rain, thunder).

To finish, **Ella Browning from BCT** introduced a workshop on the use of probabilistic data in biodiversity recording and conservation research. She described the use of acoustics in BCT surveys and the classifier outputs that are produced. The performance of the classifier underlies how well it does, and this varies depending on the species that is studied. Discussions that followed looked at what monitoring is currently being scoped or carried out that use monitoring techniques that produce data with a classification probability/score, and issues and challenges surrounding the use of probabilistic data. These discussions are currently being synthesised into a report which will be available from spring 2024.

Session 3: TEPoP and Climate Change: Challenges, Risks and Solutions

Niki Newton from JNCC introduced the session by highlighting the recognition of the joint threat of climate change and biodiversity loss. TEPoP schemes need to consider potential challenges that climate change may pose, as well as how schemes may be contributing to climate change.

Blaise Martay from BTO gave a talk on BTO's work on creating climate change adaption indicators to determine how adaptation actions are reducing the negative impacts of climate change on biodiversity. A key finding from workshops was that different organisations had different priorities of what they wanted indicators to do, and that a suite of indicators is likely to be the best option to build up evidence on how effective climate adaption is. Seven indicators were prioritised which were assessed against criteria created in the workshops surrounding usability, accuracy, and availability of data. These scores will be used to select a small suite of indicators to take forwards to test whether they are accurate in their ability to measure change and be expanded to other taxa. Once they have been tested, they will be more formally developed, achieving a way of monitoring climate change adaptions in the UK across a range of taxa, ideally showing spatial and potentially habitat and species differences to highlight priority areas.

Oli Pescott from UKCEH gave the next presentation on the impacts of climate change on habitat. Answering questions about climate change may be biased if the range of climate change exposure that areas of the UK have, do and will face are not representatively sampled. He went on to talk about a paper that he was involved in which created metrics of climate change exposure for 1km grid cells across the UK, which can be matched to landcover maps to explore schemes' coverage. These results uncover biases in scheme data, as most surveyed squares are in the southeast of England, which experience greater exposures than other regions – a pattern which is set to be exacerbated under future climate scenarios. When these biases are uncovered, it is important to assess, mitigate and communicate them properly.

Simon Gillings from BTO went on to talk about the climate change impacts of the schemes. One of the strengths of TEPoP schemes is the large number of sites which are visited multiple times; however, more travel leads to increased carbon emissions. Simon gave an overview of his paper on understanding the modes of transport and carbon emissions associated with travel to survey sites, using the BTO/JNCC/RSPB Breeding Bird Survey as a case study. In 2019, about 286 000 km were travelled to reach survey squares. The mode of travel varied depending on the location and distance travelled, but most visits were carried out by car, which were also used to complete the longest journeys. The total transport equates to approximately 46.8 tonnes of CO_{2e}, 97% of which is attributed to car travel. These emissions are small in a national context but significant in the sector. Simon stressed the importance of not criticising the volunteers but encouraging the organisers of monitoring schemes to consider the emission costs of their programmes. Moving forwards, carbon should be factored into survey designs to maximise data and knowledge gain per carbon emitted, such as by combining surveys at the same site visit when possible.

Nicki du Plessis from JNCC introduced the workshop part of the event on preparing biodiversity monitoring schemes for climate change by talking about linkages between climate change and biodiversity, and the policy context across all four UK countries. Participants were asked to discuss how climate change is and will affect the schemes, and how we can account for this going forward through survey design. A synthesis of points raised is available on the JNCC website, and some key ideas are summarised below:

What challenges does climate change bring to biodiversity monitoring?

- Sampling representatively over climate change exposures and vulnerable habitats and species
- Phenological and range mismatch with sampling
- Health and saftey and access concerns for volunteers with increased extreme weather (heat stroke, flooding etc.)
- Separating climate change from other pressures
- Need a greater understanding of species and ecological interactive responses to climate change
- Challenges surrounding schemes' contributions to emissions

How can schemes respond to these challenges?

- Monitor new variables including environmental variables, range shifts and habitat changes
- Ensure data are representative of climate change exposures and vulnerable habitats and species
- Revisit assumptions and biases (e.g. assumptions of linearity of relationships and constant phenological patterns through time, and accounting for weather-dependant detectability in analyses)
- Extend/alter sample seasons
- Prioritise time to plan and review responses to climate change
- Adjust H&S advice for volunteers
- Use scheme data to inform on climate change mitigation strategies involving spatial planning/prioritisation (tree planting,

Session 4: Filling Gaps in Existing Recording and Data

Nicki du Plessis from JNCC introduced this event by highlighting the value of TEPoP data but also the potential biases it has. This event was comprised of presentations and a workshop which shared updates on work that aims to understand, communicate, and reduce scheme bias across the UK.

Michael Pocock from UKCEH spoke about work he has been involved in which aims to reduce the effect of bias. In unstructured surveys, he demonstrated the potential that 'Targeting Revisits' maps have in influencing where volunteers survey to maximise sites that can be used for occupancy analyses. A second aspect to reducing the effect of bias is to improve the data analysis through a missing data framework. He showed that the amount and type of data gaps have an effect on how much bias influences the output, and how easily it can be accounted for in

the analysis. There are three ways to reduce the influence of bias: (1) equalise surveys across strata, (2) up/down weighting data, and (3) estimating missing data. These methods will all increase the variance of the results, and their success depends on a range of factors that need to be considered. This work is going to be used to trial bias adjustments in TEPoP monitoring schemes and on unstructured data. Read the preprint here.

Paul Woodcock from JNCC then gave a presentation on communicating the strengths and limitations of TEPoP data. The risk of bias depends on what the data are being used for and the suitability of the data depends on scheme coverage. It is therefore important to communicate the coverage of schemes consistently and clearly. Paul proposed a template for schemes to do this in a standardised way by describing their purpose, scope, methods and information about taxonomic, geographic and environmental coverage. Moving forwards, he also proposed a cross-scheme briefing note to describe strengths and limitations of data in an accessible non-technical and standardised way to improve understanding and confidence amongst users of TEPoP data.

The next talk was given by **Ailidh Barnes from BTO** which outlined a TSDA project conducted in Northern Ireland on the barriers, challenges, and solutions to improving biological recording. Compared to the rest of the UK, Northen Ireland's biodiversity monitoring data are sparse. Interviews and an in-person workshop with scheme organisers and stakeholders discussed a number of barriers and potential solutions and opportunities to filling these geographic and taxonomic gaps which are detailed in her report. The most commonly suggested and highest-ranking barrier was the capacity of organisations to coordinate data collection. Next steps from this piece of work are to finish writing up the report, apply the findings to other areas and encourage further discussions to implement solutions and recommendations. Ailidh went on to lead a workshop session discussing barriers and solutions to filling gaps in biological recording across the UK. A synthesis of all points raised is available on the JNCC website, and some key ideas on how to increase TEPoP coverage are shown below:

- Increase staff recruitment and retention through higher salaries and longer-term contracts.
- Increase the number of volunteers and the amount of training and support that they receive.
- Support data verification, quality assurance and development of new approaches to analysis.
- Increase, and better target education, engagement, and outreach.
- Financially support data management systems, verification, and related staff time.
- Invest in new technologies to increase coverage and lower barriers to entry.
- Pay professionals to fill gaps and increase sample size.

The event closed with three short 5-minute presentations highlighting upcoming tasks which aim to fill and better analyse gaps in current TEPoP data. These tasks were discussed again in the TSDA drop-in sessions, where you can find out more about them.

Session 5: TSDA Drop-in Sessions

This was a Terrestrial Surveillance Development and Analysis (TSDA) partnership event consisting of a series of 30-minute drop-in sessions covering each of the coming year's TSDA tasks that have been covered in previous events. In each session, presenters gave an overview of the task, and attendees had the opportunity to give their input, ask questions, and express interest in being involved in the task going forward. Expressions of interest to get involved in any of these tasks can still be done via this form.

The first presentation was led by **Diana Bowler from UKCEH** and covered **'Identifying priorities for technological development'**. In previous talks, Michael Pocock outlined work which reviewed a range of different tools and technologies for their potential application in the

TEPoP schemes. This work will be finished in this short task by asking for feedback on the review and making a decision on the most promising opportunities.

Next, **Kirsi Peck from JNCC** led a discussion around '**Citizen science habitat recording'**. Previous talks highlighted the potential of habitat data collection in current or new TEPoP schemes, revealing generally positive attitudes from volunteers. The next stages will move on to develop a road map to enable volunteers to collect habitat data, confirm the purpose of the data collection, explore habitat classifiers, look at what has already similarly been done, explore how EO habitat maps might benefit schemes, look at habitat recording tools, explore options for how to carry out habitat surveys, and engage with scheme leads.

James Pearce-Higgins from BTO led the next session on **'Further development of climate change adaptation indicators'**. His previous talk described the development and evaluation of climate adaptation indicators, showing a proposed series of outcome measures based on altered species and ecosystem responses to climate change. Building on this, this task will scope and identify a number of possible adaptation indicators, in order to develop one or more potential draft adaptation indicators for further consideration and reporting.

Alun Jones from JNCC led discussions around the TSDA task **'Scoping the potential for multi-taxon analysis using co-located data'**. This area of TSDA work aims to start scoping multi-taxon metrics, while considering this type of data's potential uses in the context of different UK country initiatives. It will assess what is possible to deliver using the Tracking the Impact project's current co-located data, and assess what it may be able to deliver in terms of metrics with greater temporal coverage, and potentially in conjunction with other data sets.

Diana Bowler form UKCEH led a discussion around '**Adding value to unstructured data'**. Unstructured data typically includes some data that could be regarded as semi-structured, but this cannot be separated from the more opportunistically collected data due to a lack of metadata. Improved metadata would help the modelling of this data and increase the reliability of trend estimates. Moving forwards, tasks include assessing whether you can work out how much of the data are collected in a more structured way, retrospectively adding value by identifying and using the additional data/metadata and exploring the use of tools (iRecord) to capture metadata.

James Pearce-Higgins from BTO introduced '**Integrating freshwater data across schemes'.** The aim of this task is to evaluate how partnership scheme data might contribute to our understanding of biological changes in freshwaterways, providing a highly policy-relevant example of how scheme data may be collated and used to report on changes. Next steps include scoping work to look at potential data and species of interest across the schemes, recognising other beneficial data outside of the schemes, and identifying key questions that would be useful to answer to develop a more significant program of work.

The last session was led by **Diana Bowler from UKCEH** and focused on discussions around '**Testing the missing data solutions'.** In a previous event, Michael Pocock introduced the use of 'missing data thinking' to classify different types of data gaps and identify whether they would likely lead to biased trend predictions. They highlighted potential solutions that have not yet been trialled in the TEPoP monitoring schemes. This task aims to test these solutions for unstructured schemes with simulated data, aiming to develop general guidelines about the types of species that are more or less likely to be affected by data gaps, and potentially test the hypotheses with an example dataset.

Festival Feedback

Feedback was invited online from event participants following the festival. Feedback submitted indicated that participants thought the events were ideal in length. Participants value the online recordings, though signposting to these could be made clearer. However, some participants highlighted that they would value meeting in person for future TEPoP events, so we will be considering how we might include opportunities to do this in TEPoP plans for next year.

Feedback also indicated that participants would value the inclusion of scheme-specific updates next year.

If you wish to add any further thoughts on the events, or ideas for future events, please reach out to us at TEPoP@jncc.gov.uk.