BTO RESEARCH REPORT 784

Passive acoustic monitoring with Radnorshire Wildlife Trust, 2024 – piloting the rewilding monitoring framework

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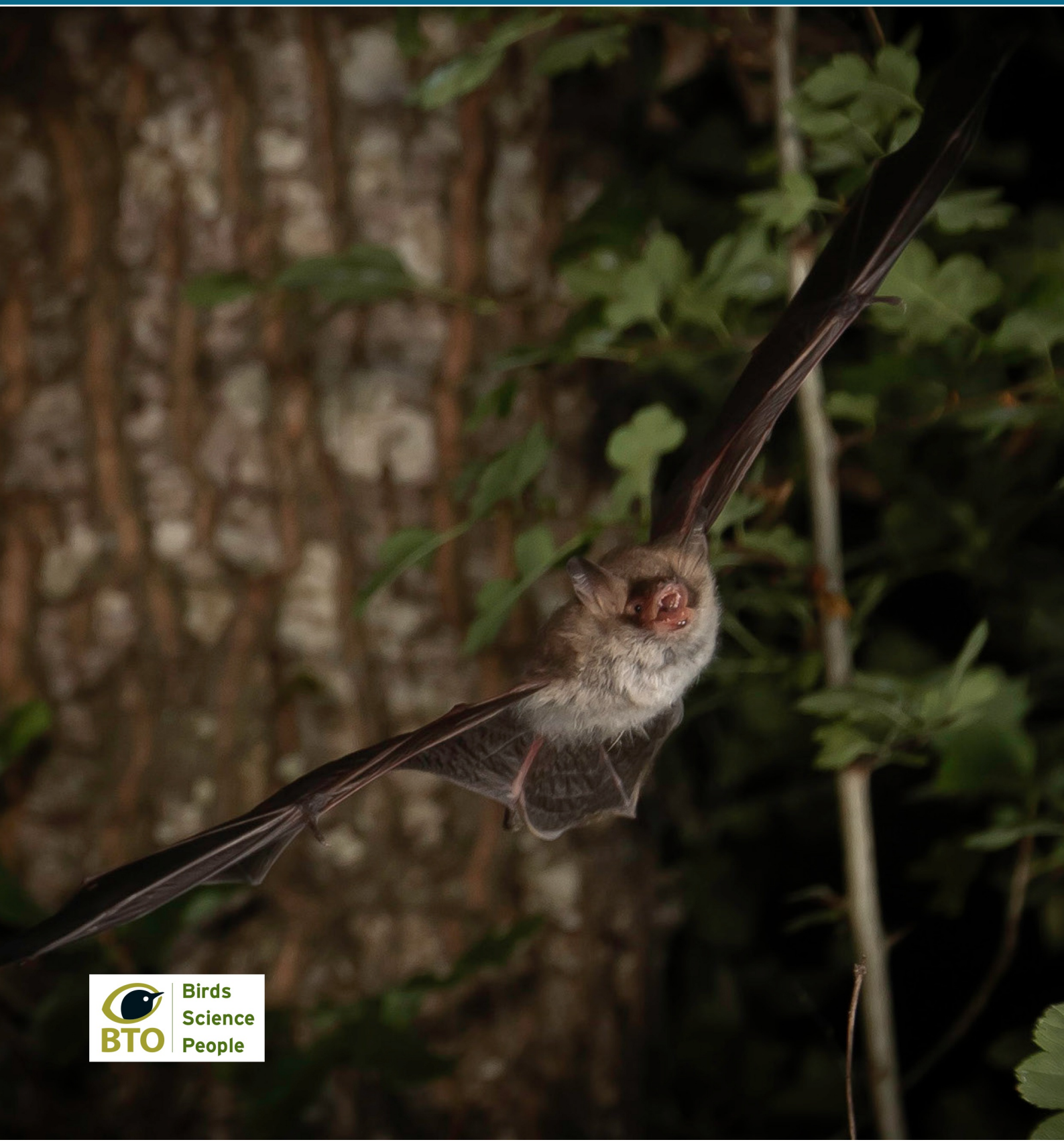

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SUMMARY

Background This report presents results from the first year of Passive Acoustic Monitoring as part of the pilot of the Rewilding Monitoring Framework. These data will contribute to baselining and monitoring rewilding progress and its impact on biodiversity.

Coverage The project focuses on two taxa: bats and small mammals that produce ultrasound. Bats have been chosen as a key indicator in the Rewilding Monitoring Framework.

Results In total, this study identified 10 species including at least 8 bat species and 2 small mammal species.

1. BACKGROUND

Over recent years, Rewilding Britain has increasingly been providing support to the Rewilding Network, which connects members rewilding at scale across Britain on what to measure and how to measure, in order to evidence change over time.

Rewilding is a dynamic, unpredictable process that can challenge the monitoring approaches used to track changes at more traditional nature conservation sites. Although rewilding sites collect data and can demonstrate ecological, social and economic changes to a certain extent, there is, as yet, no framework that lays out the most appropriate, measurable metrics for monitoring rewilding progress.

2. AIMS AND OBJECTIVES

We aimed to pilot the use of passive acoustic monitoring (PAM) to baseline and monitor changes in biodiversity at Rewilding Britain member sites. PAM can be used to monitor three key indicators included in the Rewilding Britain monitoring framework: birds, bats and soundscapes. In this project, we focus on bats and small mammals that produce ultrasound on rewilding sites in 2024.

3. METHODS

Planning, deployment of recording equipment, collation of audio recordings and processing through the BTO Acoustic Pipeline were undertaken by the Radnorshire Wildlife Trust (CJ). Acoustic identification verification, data analysis and reporting were undertaken by BTO (SEN and AAB).

3.1 Static recorder protocol

Our protocol enabled passive acoustic recorders (Song Meter Mini Bats) to to automatically trigger and record the calls of bats and small terrestrial mammals.

The recorders were placed out to record over a minimum of seven consecutive days at each location. Multiple days of recording increase the chance of recording species if present and are likely to reduce the impact of weather-related variation, whilst also being easy to implement logistically (once a recorder is on site, it is easy to leave it in situ for multiple days and nights).

Survey sites were taken from a 500 m grid over the whole project area, where half of the grid squares were chosen as sampling sites to achieve good coverage. For larger sites (>1000 ha), half of the sampling squares are surveyed in the first year, and half in the following year. By doing this, we aim to provide representative survey coverage of the area of interest in any year, whilst managing the sampling effort needed each year by site staff. For a 2,000 hectare site, which equates to 80 x 500-m squares, 40 sampling squares would be surveyed in total, with 20 sampling squares/year. In this project, surveys were carried out in June and July, which covers the breeding season of bats.

The recorders were programmed to bats and small mammals with an ultrasonic microphone. A sample rate 256,000 Hz and a high pass filter of 13,000 Hz which defined the lower threshold of the frequencies of interest for the triggering mechanism. Ultrasonic recording was set to continue until no trigger was detected for a 2 second period up to a maximum of 5 seconds and activated to trigger between sunset until sunrise the following day. The recorders were mounted on 2 m poles and deployed at least 1.5 m in any direction from vegetation, water or other obstructions to avoid recording sound reflected off these surfaces.

3.2 Processing recordings and species identification

Monitoring on this scale with automated passive real-time recorders can generate a very large volume of recordings, efficient processing of which is greatly aided by a semi-automated approach for assigning recordings to species.

3.2.1 Ultrasonic recordings

For the ultrasonic / bat processing, the site staff had their own online user account, and desktop software through which they could upload recordings directly to the cloud-based BTO Acoustic Pipeline for processing. This system captures the metadata (name and email address of the person taking part, the survey dates and locations at which the acoustic recorders were deployed), which are matched automatically to the results. Once a batch of recordings is processed, the user is emailed automatically, and the raw results are then downloadable through the user account as a csv file. These provisional results are provided with the caveat that additional auditing of the results and recordings must be carried out to manually confirm identifications.

The ultrasonic processing through the BTO Acoustic Pipeline applies machine learning algorithms to classify sound events in the uploaded recordings. The classifier allows up to four different "identities" to be assigned to a single recording, according to probability distributions between detected and classified sound events. From these, species identities are assigned by the classifier, along with an estimated probability of correct classification. Specifically this is the false positive rate, which is the probability that the Pipeline has assigned an identification to the wrong species. However, we scale the probability, so that the higher the probability, the lower the false positive rate. To give an example, given a species identification with a probability of 0.9, there is a 10% chance that the identification is wrong. Our recommendation, which is supported in Barré *et al.* (2019), is that identifications with a probability of less than 0.5 (50%) are discarded. However, manually auditing of a sample of recordings (wav files) that are below this threshold was carried out to be confident that we were losing very little by doing this.

For bats and small mammals where we were interested in producing a measure of activity, we manually checked all the recordings of a species. With the exception of the most common species, Common Pipistrelle *Pipistrellus pipistrellus* and Soprano pipistrelle *Pipistrellus pygmeaus*, we checked a random sample of 1,000 recordings to quantify the error rate in the dataset.

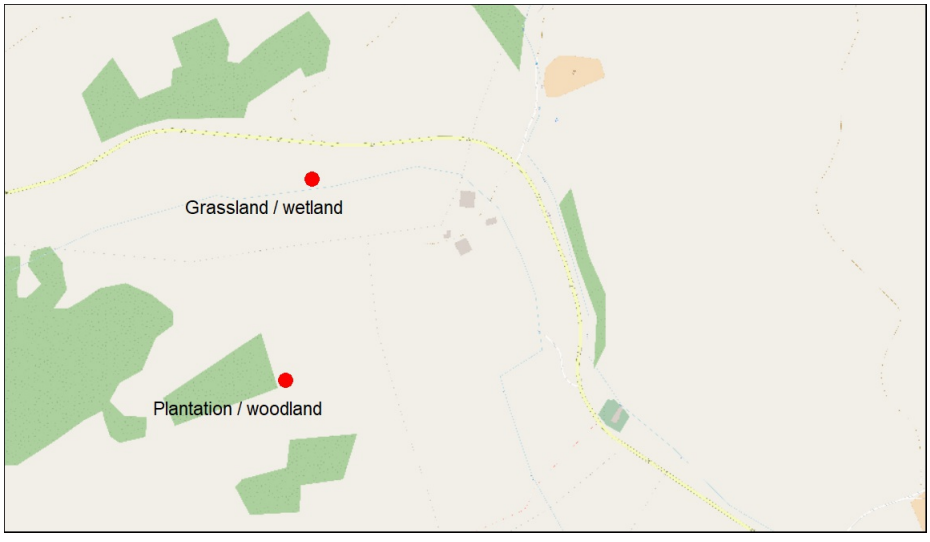
Verification of species identification was carried out by SN through the manual checking of spectrograms using software SonoBat (http://sonobat.com/) which was used as an independent check of the original species identities assigned by pipeline. The spectrograms shown in this report, were also produced using SonoBat. All subsequent analyses use final identities upon completion of the above inspection and (where necessary) correction steps.

4. RESULTS

4.1 Survey coverage

The distribution of sites surveyed during 2024 are shown below. Collectively across all these sites, 12 days of recording effort was conducted. The recording effort spanned 12 different days and 2 months.

Map of the study area showing locations where audio recorders were deployed in 2024.



4.2 General results

20,888 ultrasonic recordings were collected which, following analyses and validation, were found to include 14,529 bat identifications, and 23 small terrestrial mammal identifications. Following validation, the presence of at least eight bat species and two small mammal species can be confirmed.

In the following tables, we consider conservation status of bats and small mammals using categories from the IUCN Red List of Threatened Species (www.iucnredlist.org/): Critically Endangered, Endangered, Vulnerable, Near Threatened, and Data Deficient.

The full list of the species detected, the proportion of sites a species was detected and the conservation status.

Bats

Species (/call type)	No. of recordings following validation	No. of different sites (% of total)	Conservation status
Brown Long-eared Bat, *Plecotus auritus*	21	2 (100%)	
Common Noctule, *Nyctalus noctula*	23	2 (100%)	
Common Pipistrelle feeding buzzes, *Pipistrellus pipistrellus*	914	2 (100%)	
Common Pipistrelle social calls, *Pipistrellus pipistrellus*	245	2 (100%)	
Common Pipistrelle, *Pipistrellus pipistrellus*	11,466	2 (100%)	
Daubenton's Bat feeding buzzes, *Myotis daubentonii*	1	1 (50%)	
Daubenton's Bat, *Myotis daubentonii*	261	2 (100%)	
Lesser Horseshoe Bat, *Rhinolophus hipposideros*	1	1 (50%)	
Natterer's Bat feeding buzzes, *Myotis nattereri*	1	1 (50%)	
Natterer's Bat, *Myotis nattereri*	90	2 (100%)	
Soprano Pipistrelle feeding buzzes, *Pipistrellus pygmaeus*	132	2 (100%)	
Soprano Pipistrelle social calls, *Pipistrellus pygmaeus*	11	2 (100%)	
Soprano Pipistrelle, *Pipistrellus pygmaeus*	902	2 (100%)	
Whiskered or Brandt's Bat, *Myotis mystacinus or M. brandtii*	461	2 (100%)	Data deficient

Small mammals

Species	No. of recordings following validation	No. of different sites (% of total)	Conservation status
Common Shrew, *Sorex araneus*	1	1 (50%)	
Eurasian Pygmy Shrew, *Sorex minutus*	22	1 (50%)	

Average number of recordings / night (rounded to nearest whole number) of bats and small mammals by site as a measure of activity.

Bats

Species	Plantation / woodland	Grassland / wetland
Brown Long-eared Bat	5	2
Common Noctule	3	8
Common Pipistrelle	3,040	136
Common Pipistrelle feeding buzzes	250	2
Common Pipistrelle social calls	78	4
Daubenton's Bat	86	13
Daubenton's Bat feeding buzzes	0	1
Lesser Horseshoe Bat	1	0
Natterer's Bat	23	3

Species	Plantation / woodland	Grassland / wetland
Natterer's Bat feeding buzzes	0	1
Soprano Pipistrelle	235	121
Soprano Pipistrelle feeding buzzes	56	13
Soprano Pipistrelle social calls	2	4
Whiskered or Brandt's Bat	266	1

Small mammals

Species	Plantation / woodland	Grassland / wetland
Common Shrew	1	0
Eurasian Pygmy Shrew	4	0

The number of species of IUCN (International Union for Conservation of Nature) Red List species detected overall.

	Number of species
All bats	8
IUCN Red Listed Threatened Species - Near threatened	0
IUCN Red Listed Threatened Species - Vulnerable	0
All small mammals	2

The number of IUCN (International Union for Conservation of Nature) Red List species detected at each site.

	Plantation / woodland	Grassland / wetland
All bats	7	8
IUCN - Near threatened	0	0
IUCN - Vulnerable	0	0
All small mammals	2	0

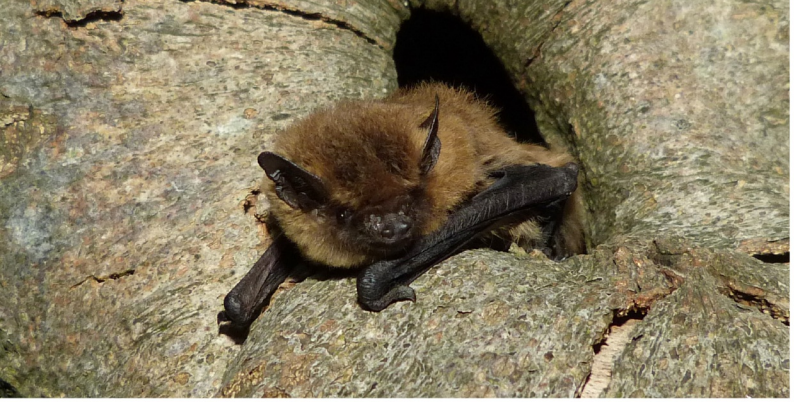
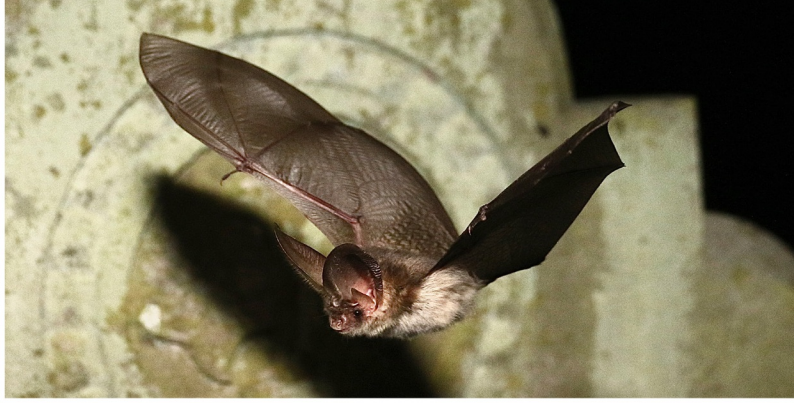
5. CONCLUDING REMARKS

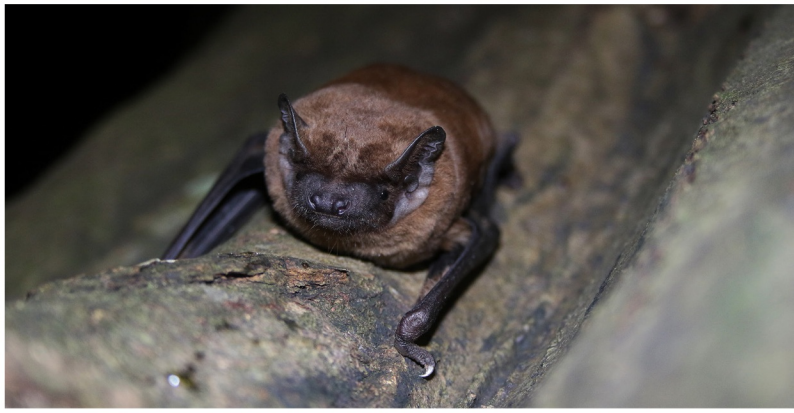
In this report we demonstrate how PAM can be used to collect data over multiple taxonomic groups, including for bats which are a key indicator on the Rewilding Monitoring Framework.

If carried out at regular intervals, in the future, these data can be valuable to measure changes in species presence and activity for these taxonomic groups during the rewilding process.

6. REFERENCES

Barré, K., Le Viol, I., Julliard, R., Pauwels, J., Newson, S.E., Julien, J.F., Fabien, C., Kerbiriou, C. & Bas, Y. 2019. Accounting for automated identification errors in acoustic surveys. *Methods in Ecology and Evolution*.



Images: Common Pipistrelle, by John Black; Brown Long-eared Bat, by Chris Damant; Noctule, by Chris Damant; Whiskered Bat, by Chris Damant.
Cover image: Natterer's Bat, by Chris Damant.

Passive acoustic monitoring with Radnorshire Wildlife Trust, 2024 – piloting the rewilding monitoring framework

This report presents the main findings from survey work delivered using passive acoustic monitoring devices deployed with Radnorshire Wildlife Trust in 2024. Through the surveys that we support we aim to improve knowledge and understanding of species distribution and activity, covering a range of taxonomic groups, including birds, bats, small terrestrial mammals and insects. Through the approach we provide robust datasets that can be used to inform better decision-making processes.

The use of acoustic monitoring can be particularly useful for species that are rare or unexpected in the survey area, or that are traditionally regarded as too difficult to identify (such as bats in the genera *Myotis* or *Nyctalus*). Where such species are recorded, we provide additional information to support their identification, inspiring a culture of critical thinking and the use of emerging technologies to improve the current knowledge base.

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