



BAT CONSERVATION
IRELAND

All-Ireland Woodland Bat Monitoring Scheme 2024

Clarke D., Langton S., and Roche N. (2025)

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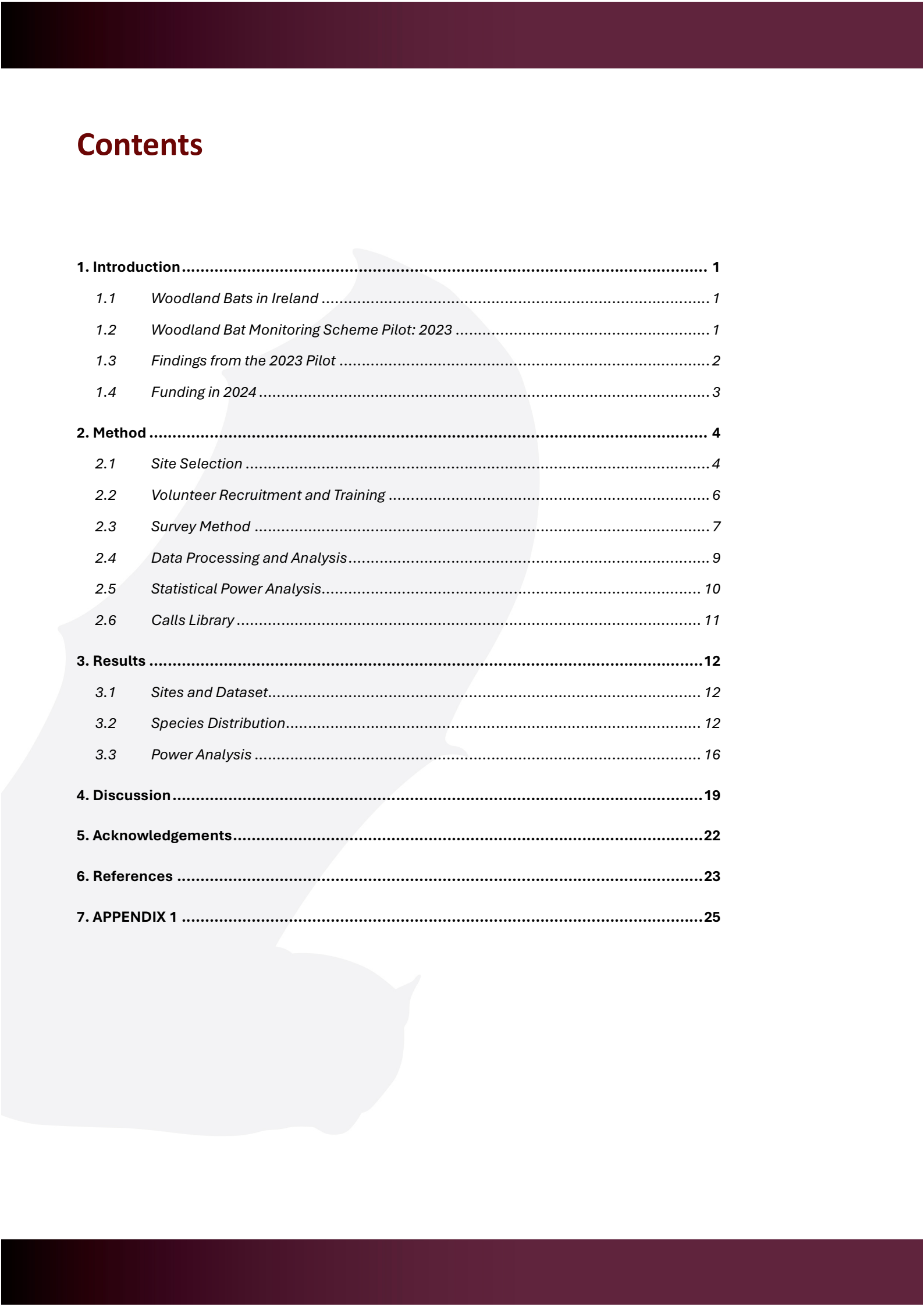
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Contents



1. Introduction.....	1
1.1 <i>Woodland Bats in Ireland</i>	<i>1</i>
1.2 <i>Woodland Bat Monitoring Scheme Pilot: 2023</i>	<i>1</i>
1.3 <i>Findings from the 2023 Pilot</i>	<i>2</i>
1.4 <i>Funding in 2024</i>	<i>3</i>
2. Method	4
2.1 <i>Site Selection</i>	<i>4</i>
2.2 <i>Volunteer Recruitment and Training</i>	<i>6</i>
2.3 <i>Survey Method</i>	<i>7</i>
2.4 <i>Data Processing and Analysis.....</i>	<i>9</i>
2.5 <i>Statistical Power Analysis.....</i>	<i>10</i>
2.6 <i>Calls Library</i>	<i>11</i>
3. Results	12
3.1 <i>Sites and Dataset.....</i>	<i>12</i>
3.2 <i>Species Distribution.....</i>	<i>12</i>
3.3 <i>Power Analysis</i>	<i>16</i>
4. Discussion.....	19
5. Acknowledgements.....	22
6. References	23
7. APPENDIX 1	25

1. Introduction

1.1 Woodland Bats in Ireland

Woodland bat species, namely the *Myotis* species Natterer's bat (*Myotis nattereri*) and Whiskered bat (*Myotis mystacinus*), comprise an important portion of the Irish bat fauna (Figure 1). These species rely mainly on woodland habitat for foraging opportunities (Smith & Racey, 2008). Brown long-eared bats (*Plecotus auritus*) are also strongly associated with woodlands and deciduous trees (e.g. Murphy et al., 2012; Swift, 1998).

Whiskered bat is one of the most rarely recorded bat species in Ireland. The paucity of records may be at least partly due to difficulty discriminating between the *Myotis* species and/or because it tends to roost in low numbers and exhibits regular roost switching (Buckley et al., 2013; Roche et al., 2014). While it occurs in all provinces it tends to be more frequently recorded in the southern half of the island (Roche et al., 2014).

Natterer's bat has been recorded more frequently than whiskered bats (Roche et al., 2014), although this may be because it tends to roost in higher numbers and is very roost faithful. It tends to favour wooded habitats early in the evening while later moving to forage in hedgerow and pasture habitats (Lundy et al., 2012). Similar to whiskered bats its core areas tend to occur in the east and south of the island although it has also been recorded across the island (Roche et al., 2014).

Currently there is no monitoring scheme on the island of Ireland that targets Natterer's or whiskered bats. This is something that BCIreland is determined to address. Brown long-eared bats are monitored in the Republic of Ireland with roost counts.

1.2 Woodland Bat Monitoring Scheme Pilot: 2023

In 2023, BCIreland conducted a pilot woodland bat monitoring scheme. This was funded in the Republic of Ireland by the NPWS, with additional grant assistance from four Local Authorities (Wicklow, Meath, Kildare and Cavan).

The primary objectives of the pilot scheme were to trial and compare the use of two different survey methods i.e. the use of bat detectors in a static surveillance capacity and in a walking transect approach, to:

- (i) compare their effectiveness in surveying the woodland species of interest (mainly Natterer's bat and whiskered bat, but also Brown-long eared bat),
- (ii) to compare the statistical power of the two methods in detecting declines in bat activity at amber and red alert levels of decline (25% and 50% decline in activity levels, respectively),
- (iii) assess the general feasibility of proceeding with an All-Ireland version of the scheme using either survey method.

1.3 Findings from the 2023 Pilot

Both methods were effective in detecting the woodland bat species (Aughney et al., 2024), with a substantially larger amount of data collected by the static surveillance (1,484 nights in total from all devices and survey periods) compared to 29 nights of data for walking transects. Unsurprisingly, this was reflected in the mean number of audio files with bats present per night for each method. With the static devices, the mean number of audio files per night with Natterer's bat was 30.2, for whiskered it was 132, and brown long-eared was 80.4. Using the walking transects the mean number of audio files was 4 for Natterer's bat, 6.8 for whiskered bat and 3 for brown long-eared bats.

Despite the higher number of recorded files with the static surveillance, power analysis of the data revealed, that when it comes to detecting declines in activity of Natterer's bat and whiskered bat, there is relatively little difference between the two methods. Alert level declines can certainly be detected slightly sooner and with fewer sites using static surveillance but following detailed analysis of the time, costs and data resulting from each of these methods we decided to proceed using the walking transect method for the surveys in 2024.

In 2024, we expanded the scheme to include several new sites in both the Republic of Ireland and Northern Ireland.

1.4 Funding in 2024

In the Republic of Ireland, funding was obtained primarily through the Local Biodiversity Action Fund which is a fund made available to Local Authorities via the National Parks and Wildlife Service to support biodiversity focussed initiatives taking place in their county. Applications for this fund were made to each local authority where surveys were planned for 2024 in order to cover the costs for equipment and the running of the scheme. In Northern Ireland, we received a funding commitment through the Department of Agriculture, Environment and Rural Affairs (DAERA) Environment Fund towards this project.

A)



B)



Figure 1. Whiskered bat *Myotis mystacinus* (top image) and Natterer's bat *Myotis nattereri* (bottom image). Image credit Paul van Hoof.

2. Method

2.1 Site Selection

Woodlands were selected based on a number of requirements which included habitat suitability, public access, suitable walking routes/trails and the potential availability of survey teams in the area. In relation to the site characteristics, some of the more specific criteria included the following:

- (i) The site was a well-established woodland (natural broadleaved woodland is preferable, but non-native species such as conifer stands could be included) with about 4km of a walking track/route. A walking loop is preferable where possible so that the same ground does not have to be repeated during the transect. This is not always possible depending on the layout of individual sites.
- (ii) There should be at least one stopping point that is adjacent or close to either agricultural/open pasture or open grassland habitat. These are important foraging areas for Natterer's bat.

With these criteria in mind, sites were provisionally selected based on recommendations from people who possessed local knowledge of suitable sites. This was subsequently followed up by the scheme coordinator with some GIS work to devise a potential walking route for the surveys. Then, a site visit was conducted to walk the survey route and if it was suitable, to designate the survey stopping points (details outlined in Methods section). Where site visits by the scheme coordinator were not possible either due to time constraints or large travelling distances involved, the walking route was set out by the lead volunteer, while liaising closely with the scheme coordinator and adhering to the route selection criteria. Once sites were selected for the scheme, detailed documents that included site maps and descriptions of the walking routes were created by the scheme coordinator for each site. An example of a site map is shown in Figure 2 and an image of a typical walking path in a woodland is shown in Figure 3.

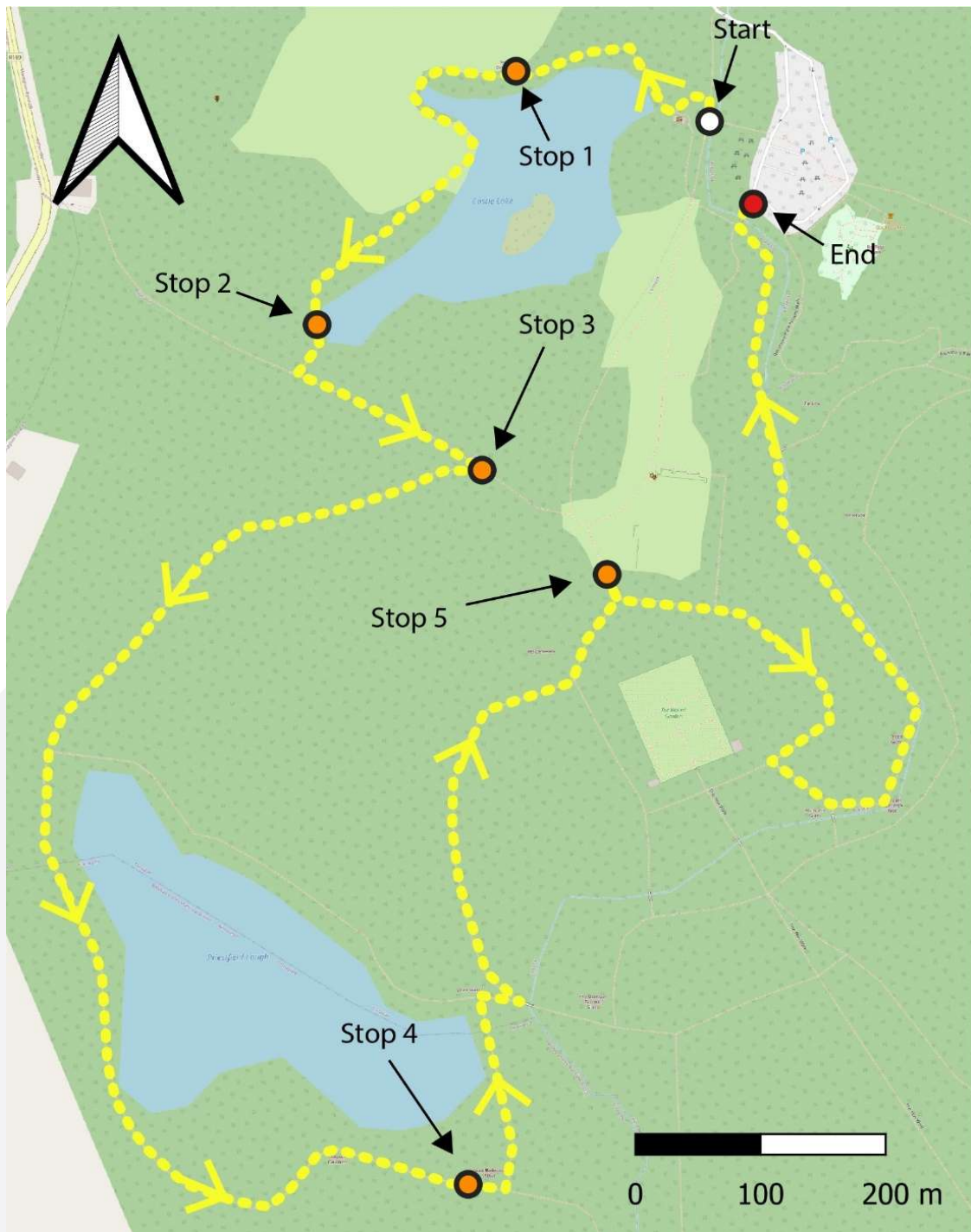


Figure 2. Example of a walked transect route at a woodland site surveyed in the woodland scheme.



Figure 3. A typical woodland path used for one of the walking transect routes in the woodland bat monitoring scheme.

2.2 Volunteer Recruitment and Training

Volunteers were mainly recruited by advertising the scheme on BCIreland's social media channels, but also through liaising with staff such as the Biodiversity Officers at various Local Authorities and the NPWS in the ROI. In NI, volunteers were primarily recruited through the involvement of organisations including the National Trust, the Woodland Trust and Northern Ireland Bat Group. In the case of the National Trust and Woodland Trust, some of the selected sites for the scheme were actively managed by these organisations, so volunteers based at these sites were already very familiar with the sites in question.

Most volunteers were trained online via Zoom during the months of May-June 2024, but in the case of the National Trust volunteer training was in person on 6th June 2024. Following training, volunteers were provided with access to a folder with survey files (e.g. site description, survey protocol, and survey sheets) as well as a secure folder to which they could upload the raw recorded files from the monitoring device. Bat detectors were loaned to volunteers for the duration of the survey period (June-August) and were delivered either via courier/post or given to volunteers in person. In addition to the detectors, volunteers also received (where applicable) reflectors for marking the start point, end point and all of the survey stopping points along the walking route.

2.3 Survey Method

Walking transect routes were designed during the daytime, mapped (GPS) and habitat/management parameters noted. The survey co-ordinator designed the walking transect route (approx. 4 km) and selected the five stopping points for each woodland. Stopping points aimed to sample different habitat types present within the woodland or adjacent to the woodland (e.g. agricultural fields). At least one stopping point was located along the interface between agricultural or grassland landscape and woodland edge to increase the likelihood of detecting Natterer's bats.

The survey co-ordinator fixed a circular reflective marker on a point at eye level or as close as possible to eye level to indicate each starting and stopping point. These proved extremely useful to surveyors when walking at night under the woodland canopy.

Each route was located along accessible tracks but not always along the main trails in order to include more cluttered zones.

The methodology for walking transects was similar to that presented in Boston et al. (2017) with some slight modifications. The device used for walking transects is an Anabat Scout (Titley Scientific), which is a full spectrum bat detector (Figure 4).

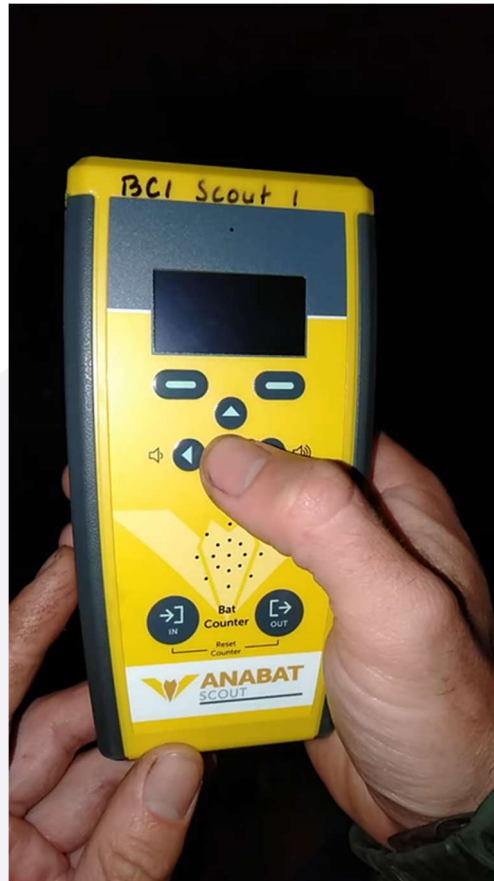


Figure 4. The Anabat Scout full spectrum bat detector used for the surveys.

The walking transect surveys were carried out as follows:

1. Surveys commenced 40 minutes after sunset.
2. Surveys were carried out in 'good weather' where temperature at the start of the survey was $>10^{\circ}\text{C}$, wind $<20\text{km/h}$ and no rain. Weather conditions were recorded at the start of the survey.
3. Three transects were completed, one each during the months of June, July and August.
4. Surveyors commenced at the designated starting point with their detectors switched on, walked to the first stopping point at a slow walking pace of approximately 3.4km/hr .
5. Time was noted when each stationary position was reached. At the stopping point, surveyors recorded for 5 minutes while rotating the detector around to face in different directions.
6. The surveyors then resumed walking to the next stopping point and so on until the transect was completed.

7. Each walking transect took approximately 1.5hrs to complete.
8. Following the completion of the surveys, data was either downloaded from Anabat Scout SD cards by the surveyors and shared with the survey coordinator via a cloud sharing platform, returned via courier to the survey coordinator, or in some cases collected in person from the surveyors.

2.4 Data Processing and Analysis

All recorded data from each Anabat Scout device was processed using Kaleidoscope Pro software. Sound recordings of bat echolocation activity (sonograms) are recorded as .wav files and are stored in a folder for a particular session on the monitoring device (i.e. in this case a separate folder of files for each night). Therefore, files from each transect were processed together in a batch while using the software's audio ID function to 'screen' the files and auto-assign bat species identifications to the recorded files. After this, each assigned auto ID in the output files was manually checked to verify the software's auto ID results. Manual checking of files involved the following steps:

- All species identified files assigned by the auto ID as *Myotis* and *Plecotus* species were manually confirmed.
- Manual checking of all other bat species, to check if there were *Myotis* or *Plecotus* calls present that were not identified by the auto ID and therefore could be reassigned.
- All 'UNIDENTIFIED' audio files were manually checked.
- All 'NOISE' audio files were manually checked.

An example of a sonogram which shows bat activity is shown in Figure 5. Once all of the files were processed and verified, tables of these results data were compiled, and the results were sent to our statistician for statistical analyses.

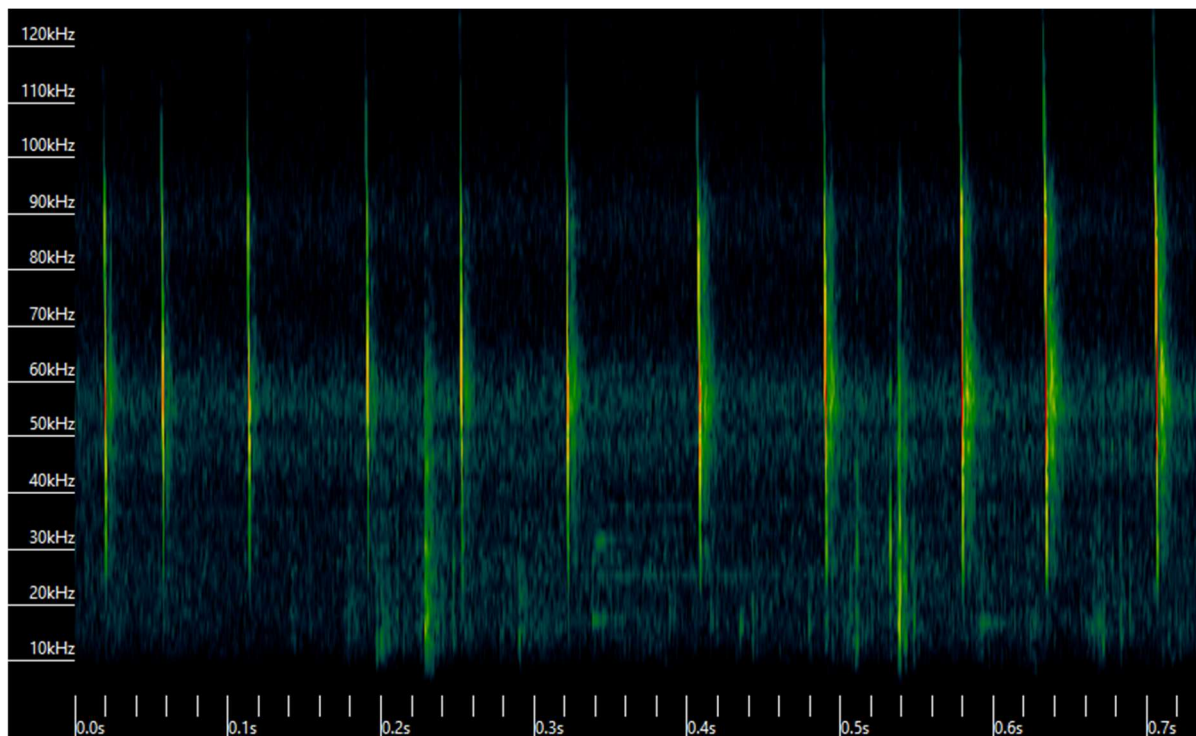


Figure 5. Sonogram showing an echolocation call from a Natterer's bat, processed during the 2024 sonogram analysis for 2024 using Kaleidoscope Pro. The sonogram shows multiple 'pulses' emitted by the bat as it uses echolocation in the wooded environment, each of which is represented visually here with each vertical line. The x-axis in this image shows the duration of the recorded call shown in seconds (in this case all of this activity is occurring in under one second). The y-axis indicates the frequency in Khz within which these pulses are occurring, in this case mostly spanning 20-120Khz which is typically the range for this species.

2.5 Statistical Power Analysis

Power analysis uses a simulation approach, broadly based on that used to estimate the power of car-based monitoring in Ireland (Roche et al., 2011) and NBMP surveys in Great Britain (Barlow et al., 2015). Briefly, this involves calculating the variance of the transformed data, then using these variances to produce a large number of simulated datasets with a variety of levels of change over a 25-year period (in this case red and amber alert levels). 'Amber' refers to a population decline of 1.41% p.a. (25% over 25 years), while 'red' refers to a population decline of 2.73% p.a. (50% over 25 years). A Poisson GAM model is then fitted to each dataset using the method described by Fewster et al. (2000), changing the number of sites and years considered in order to determine the numbers required to detect change with 80% power.

2.6 Calls Library

Known roosts (or foraging areas) for all of Ireland's bat species were visited during the summer months in 2023 and calls of emerging bats were recorded using three full spectrum bat detectors: Anabat Scout, Anabat Walkabout and Wildlife Acoustics MiniBat. These calls were forwarded to Chris Scott to update the bat auto-identification software BatClassifyIreland, which is still in development.

BatClassifyIreland will allow BCireland to provide an Irish auto-id software free to any potential user that collects full spectrum bat audio files. This is important as it has been shown that there are regional differences in the echolocation calls of bat species (i.e. regional accents) which can make European bat analysis software less suitable for individual countries.

3. Results

3.1 Sites and Dataset

A total of 26 sites were surveyed across the island as part of the All-Ireland Woodland Bat Monitoring Scheme in 2024. This consisted of 17 sites in the ROI and nine sites in NI. The ten sites in the ROI that were originally established in the 2023 pilot study were re-surveyed in 2024, along with seven new sites located in counties Sligo (two sites), Monaghan (two sites), Longford (two sites) and Kildare (one site). In NI, sites were established in Armagh (two sites), Fermanagh (three sites), Down (two sites), Antrim (one site) and Derry (one site). A full table of the site locations and individual results for each site can be found in Appendix 1. In total, 72 nights of data were recorded comprising more than 35,000 individual recordings, each of which was manually verified for the presence of woodland bats.

In addition to Natterer's bat and whiskered bat, we also assessed the presence of other bat species including Daubenton's bat, brown long eared bat and a 'Myotis' category. This latter category consisted of audio files that were clear enough to be identified as belonging to one of the *Myotis* species of bat, but which did not have enough information present within the call structure to make a definitive species confirmation.

3.2 Species Distribution

Of the 26 sites surveyed in 2024, Natterer's bat was detected at 23 (88.5% of total, Table 1). whiskered bat was also detected at 23 (88.5%) of the sites surveyed, while both species were detected at 20 (76.9%) of the sites. For sites that detected either whiskered or Natterer's bat, there were three sites for each category where one species was present and not the other (Figure 6).

A total of 197 audio files containing Natterer's bat were recorded in 2024. The highest number of files containing Natterer's bat that was recorded at a site during the survey was 30, which was recorded at Clara Vale in Co. Wicklow (see Appendix 1 for full results). This site also had the highest mean number audio files with Natterer's bat, with a mean of 10 files per transect. This was followed by Ardress House (Co. Armagh) with 25 audio files with Natterer's bat and a mean of 8.3 files per transect, and then by Derrycassin, Co. Longford, with 24 files and a mean of 8 files per transect.

For whiskered bat, there were a total of 297 audio files with whiskered bat activity. The site with the highest number of audio files containing bat calls was from Clare Glen in Co. Armagh, with a total of 68 and a mean number of 32 per transect. The second highest total was found at was Derrycassin, Co. Longford with 45 and a mean of 15 per transect, followed by Dun na Ri Forest, Co. Cavan with a total of 37 and a mean of 12.3 files per transect.

Daubenton's bat was also frequently recorded at the woodland sites surveyed (80.8% of sites) with the highest number of audio files with this species present compared to any other (594 files). Similarly, the unspecified *Myotis spp.* category had the third highest total out of all of the species of interest, with 363 files. Although brown long-eared bat was detected at 20 of the 26 sites (76.9%) a lower amount of audio files containing this species was recorded than for any other. The highest number was recorded at Crom Estate in Co. Fermanagh, with a total of 19 files and a mean of 6.3 per transect.

Table 1. Summary of the total number of audio files recorded for each species of interest in the survey.

Species	No. of files	% of sites
Whisk	394	88.5
Natt	197	88.5
Daub	584	80.8
<i>Myotis spp.</i>	363	92.3
BLE	107	76.9

A comparison of the annual mean number of files with calls from each species recorded in the 2023 and 2024 surveys is shown in Table 2. There are some noticeable differences between the results recorded in 2023 and 2024, in particular for Daubenton's bat where numbers were much higher in 2024 than 2023. However, it is likely that most of these differences are largely the result of random variation. In practice, at least five years of data are needed before a consistent trend can be demonstrated, except in the most extreme population crashes.

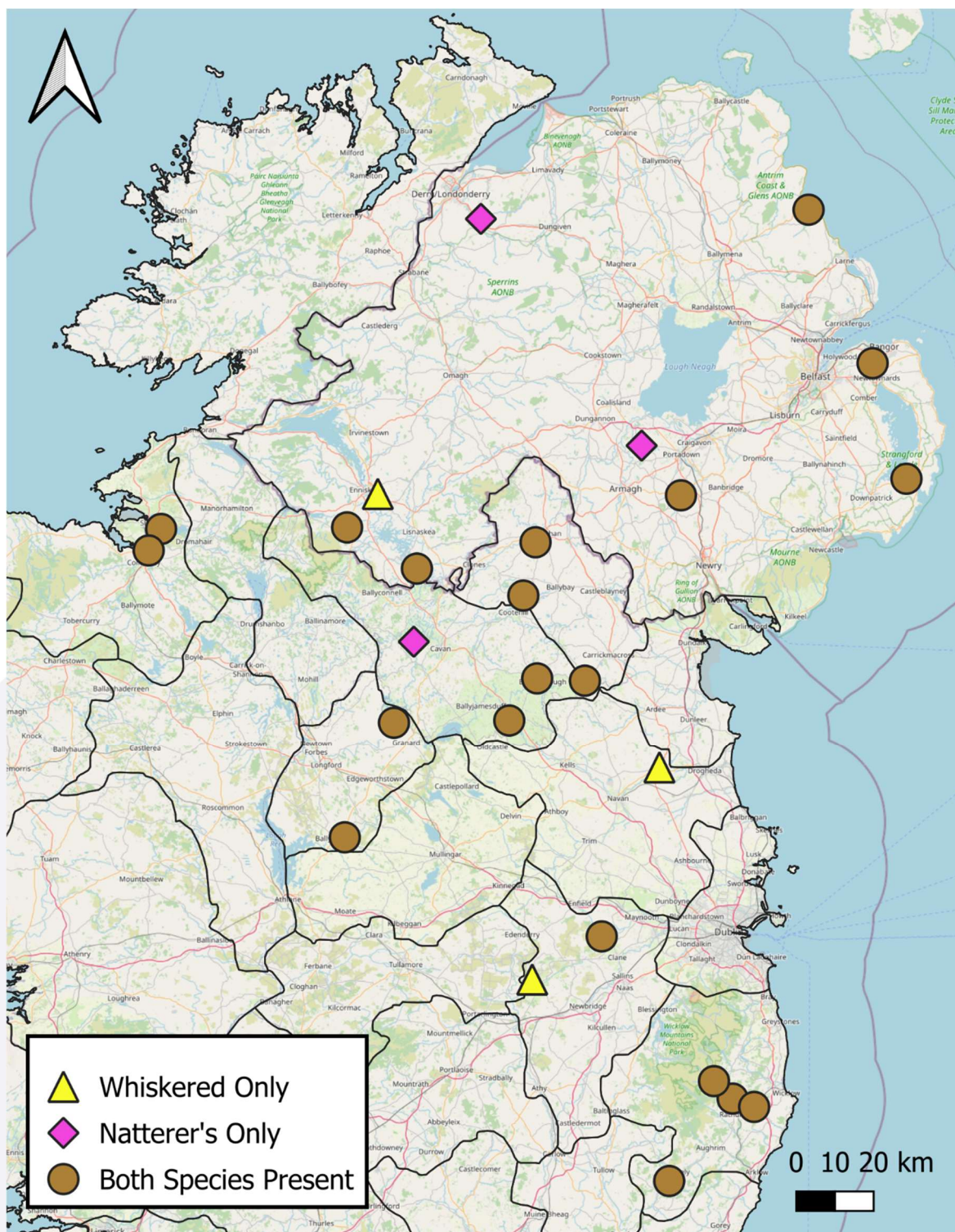
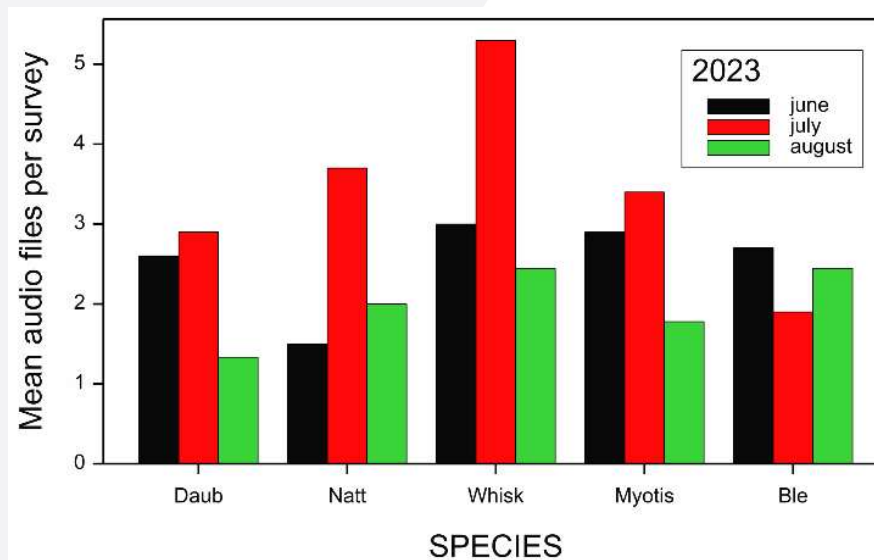


Figure 6. Presence of whiskered bat and Natterer's bat at sites surveyed in the All-Ireland Woodland Bat Monitoring Scheme 2024. Sites where only whiskered bat was found are indicated by the yellow circles. Pink diamonds represent sites where only Natterer's bat was detected, while brown circles represent sites where both species were present.

Table 2. Mean no. of audio files containing calls from each species per transect recorded in the 2023 and 2024 surveys.

Yr	N		Mean audio files per transect				
	Sites	Surv	daub	natt	whisk	Myo	BLE
2023	10	29	2.31	2.41	3.62	2.72	2.34
2024	26	72	8.11	2.74	5.47	5.04	1.49

There were also differences in activity between the different months (Figure 7) and these are statistically significant for both whiskered bats and the Myotis category ($F=4.16$ with 2 and 43 d.f., $P=0.022$ and $F=3.41$ with 3 and 42 d.f., $P=0.042$ respectively); in both cases the July means are highest. Natterer's bat were also close to significance ($F=2.66$ with 2 and 45 d.f., $P=0.081$) again with July having the highest value. There is also a significant interaction between month and year for Daubenton's bat, with the increase being more marked in July and August, after allowing for site differences.



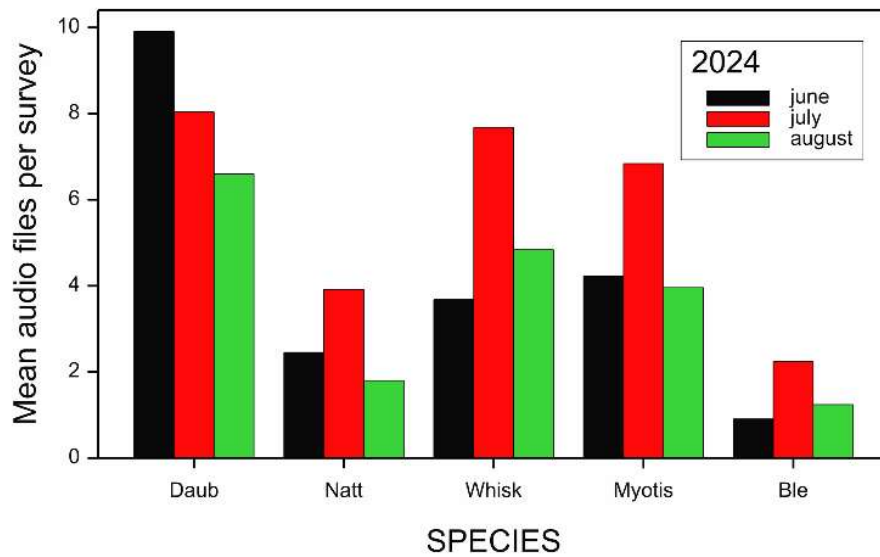


Figure 7. Mean number of audio files (y-axis) with bat species (x-axis) per survey recorded in each month in the 2023 (top chart, previous page) and 2024 (bottom chart) surveys.

3.3 Power Analysis

Results in Table 3 show the number of years taken to detect amber or red level alerts (i.e. a 25% or 50% decline over 25 years) with 80% power. Results are for three surveys per year at each site, at approximately monthly intervals.

In the case of whiskered bat, the number of years before trends can be detected with 80% power is slightly greater than the values estimated in 2023, particularly for the amber alerts. For example, last year we estimated it would take 22 years to detect an amber alert decline with 50 sites, whereas our new estimate is 25 years.

By contrast, for Natterer's bat the estimated time to detect trends is markedly shorter than estimated last year. However, caution must be applied to these figures. While we now have an estimate of site:year variance, it is actually based on just seven sites monitored in both 2023 and 2024. In the case of Natterer's bat there is a near perfect correlation between the 2023 and 2024 mean numbers of audio files at these seven sites, resulting in the year x site variance being estimated as zero. Whilst this suggests that the variance is small, it is quite likely that this is an underestimate, and that the near perfect correlation is partly due to chance. Therefore, the analysis was re-run at a low, but non-zero value for site:year variation; this only slightly increases the time taken to identify trends.

Table 3. Number of years taken for walked transects to detect a decline in the populations of Natterer’s bat and Whiskered bat with 80% power using various numbers of sites. ‘Amber’ refers to a decline of 1.41% p.a. (25% over 25 years), ‘red’ to 2.73% p.a. (50% over 25 years). Three replicate surveys per site per year.

N Sites	Natterer’s Bat		Whiskered Bat	
	Amber	Red	Amber	Red
10	>25 yrs	23 yrs	>25 yrs	24 yrs
20	>25 yrs	17 yrs	>25 yrs	17 yrs
50	22 yrs	12 yrs	25 yrs	12 yrs
75	19 yrs	10 yrs	21 yrs	11 yrs
100	17 yrs	9 yrs	19 yrs	10 yrs

Power analyses were also carried out to investigate how the alert values might change if the number of surveys was reduced from conducting three surveys a year to conducting just two, under different numbers of sites included in the scheme (Table 4). Overall, it was shown that there was relatively little difference made to the alert level changes when conducting two surveys instead of three, with the number of years it takes to reach the amber and alert levels for each species only being slightly less in a three-survey scenario. Furthermore, this difference is reduced when there are more sites involved in the scheme.

Table 4. Number of years taken for walked transects to detect change with 80% power using various numbers of sites and under ‘2 months’ and ‘3 months’ scenarios. ‘Amber’ refers to a decline of 1.41% p.a. (25% over 25 years), ‘red’ to 2.73% p.a. (50% over 25 years).

a) Red alert

N Sites	Natterer’s Bat		Whiskered Bat	
	2 months	3 months	2 months	3 months
10	>25 yrs	21 yrs	>25 yrs	24 yrs
20	18 yrs	15 yrs	19 yrs	17 yrs
50	12 yrs	11 yrs	13 yrs	12 yrs
75	11 yrs	10 yrs	12 yrs	11 yrs
100	10 yrs	8 yrs	10 yrs	10 yrs

b) Amber alert

N Sites	Natterer’s Bat		Whiskered Bat	
	2 months	3 months	2 months	3 months
10	>25 yrs	>25 yrs	>25 yrs	>25 yrs
20	>25 yrs	>25 yrs	>25 yrs	>25 yrs
50	24 yrs	21 yrs	27 yrs	25 yrs
75	22 yrs	18 yrs	24 yrs	21 yrs
100	20 yrs	15yrs	21 yrs	19 yrs

4. Discussion

It is widely accepted that bat populations have declined all over the world during the last few decades. This has been exacerbated by the loss of roosts and hibernacula, the felling of trees and the loss of broadleaved woodland habitat, and the loss and degradation of feeding habitats (Hill & Greenaway, 2008; Razgour et al., 2024). Monitoring schemes assessing the population trends of most of Irish bat species have been in place for almost two decades now (Roche et al., 2025) helping us to better understand the conservation needs of these species. Despite this, relatively little is known about woodland bats in Ireland, highlighting an urgent need to establish an island-wide annual monitoring scheme for these species.

Woodland coverage across the island of Ireland is low compared to other European counties, standing at approximately 11.6% in the ROI (Forest Statistics Ireland, 2023) and approximately 8.7% in Northern Ireland (Northern Ireland Woodland Register and Basemap, 2020) with only a small portion of this in both scenarios comprising of broadleaf or mixed broadleaf-conifer. This means that suitable roosting and foraging habitat for these species is likely to be already limited, further illustrating the need to adopt a comprehensive monitoring scheme focussing on these species in representative woodlands across the island before populations decline any further.

We expanded the All-Ireland Woodland Bat Monitoring Scheme from ten sites in 2023 to 26 sites in 2024, with nine of these situated in Northern Ireland. This has been a very positive step in attaining better survey coverage of woodland bats across the island. In Northern Ireland we had a lot of assistance from other organisations including the National Trust, the Woodland Trust and Northern Ireland Bat Group. All of these organisations contributed significantly to the selection of sites and the recruitment of volunteers, which was instrumental to the success of the scheme in Northern Ireland in 2024.

Although it is still too early in the scheme to predict trends for the target species, it is at least encouraging to see the widespread presence of woodland bats at the monitoring sites. In general, higher numbers of audio files containing whiskered bat were recorded than for Natterer's bat. This was also reflected in the data collected in 2023 (Table 2) so it remains to be seen if this will be a trend seen in future years. The number of files with brown long-eared bat calls were lower than for the *Myotis* species, though this can be explained by the fact that brown-long eared bats must be situated quite close to the detector for their relatively quiet echolocation calls to be picked up. This should not infer, however, that the populations of these bats are lower than either Natterer's or whiskered bat. A capture study conducted in British woodlands in 2005-2006 reported that

over half of the captured bats from 45 woodland sites were brown long-eared bats, followed by Natterer's bat and then whiskered bat (Hill & Greenaway, 2008). Therefore, although acoustic surveys are a very useful index of bat activity, one must interpret echolocation activity with caution when it comes to making assumptions about the relative number of bats in a population.

Habitat type or quality were not assessed during the surveys in 2024, but this is something that will be added to the scheme in future surveys. In British woodlands in 2005-2006, the percentage cover of understorey vegetation was shown to have an effect on the diversity of bats captured, with a positive correlation between understorey cover and the number of bat species captured (Hill & Greenaway, 2008). Other studies have shown that the presence of non-native evergreen shrub *Rhododendron ponticum* can affect the foraging activity of some of the less agile bats that can be found in British woodlands including *Nyctalus noctula*, *Eptesicus serotinus*, *Nyctalus leisleri* (Beason et al., 2020), the latter of which is found in Ireland. Therefore, although the relationship between woodland composition and bat presence or activity is likely to be complex, it would be worthwhile to use some form of habitat grading criteria that may show a relationship between woodland habitat characteristics and bat activity in Ireland over time.

Daubenton's bat (Table 1) were present in a large number of audio files recorded during this survey. More than half of these files were from surveys carried out in Northern Ireland. Some of this can be attributed to random variation, but there were two sites in particular, Glenarm Forest and Clondeboy Estate, that had particularly high levels of Daubenton's bat activity (see Appendix 1 for full table of results). Although there is some overlap in the foraging and roosting habitat of the three *Myotis* species, in future survey years a more concerted effort will be made to select sites where Daubenton's bat are less likely to occur during the walking transects, i.e. by avoiding sites with walking routes directly around lakes or along rivers which is their main foraging habitat.

In Irish woodland bat monitoring trials conducted in 2016-2017 Boston et al. (2017) used acoustic surveys and occupancy modelling to examine trends in whiskered bat and Natterer's bat. The authors discovered that while assessing 20 sites three times a year would be sufficient in terms of detecting red and amber alert declines for whiskered bat, monitoring over 50 sites would be required for Natterer's bat using this approach, as Natterer's bats had lower detectability (Boston et al., 2017). They also highlighted that if the approach of counting bat passes was used instead of occupancy modelling, then potentially a higher number of sites would be needed to detect population declines, although using bat passes would have the advantage of also being more suitable for detecting population increases. As the 2023 pilot and the present study were

conducted using the bat passes approach, we now have more accurate data to re-examine these red and amber alert analyses. In 2024, surveys were carried out at 26 sites. Power analysis of these data suggest that this would be sufficient to detect red alert declines (50% decline over 25 years) within 15-20 years. This is a reasonable timeframe when it comes to detecting declines, but these analyses also found that increasing to nearer 50 sites would give a very useful reduction in the time taken to detect trends (11-12 years for red alert declines). We intend to gradually increase the number of sites surveyed in the coming years to reduce the number of survey years required to detect alert level changes, and to ensure good coverage across the island.

The 2024 analyses also showed that there is a negligible statistical difference in carrying out three surveys per year at each site compared to conducting two surveys. Conducting two surveys will be more achievable for volunteers and is more favourable in terms of reducing time spent on sonogram analysis per site. We recorded generally higher Natterer's bat and whiskered bat activity in June and July than in August, so in a revised survey format with two surveys instead of three, June and July would be the preferred months to conduct the surveys. This format will also allow for sonogram analysis to begin at an earlier stage, which will be welcome considering that the time needed to do this will increase every year until the target number of sites for the overall scheme is reached, or until we have reliable auto ID software. For these reasons, we have decided to proceed with two surveys at each site from 2025 onwards. We believe that using this approach will ensure that the scheme will be viable and given time, will provide meaningful and robust data on the status of woodland bats across Ireland.

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6. References

- Aughney, T., Clarke, D., Langton, S., & Roche, N. (2024). *Monitoring Irish Woodland Bats: 2023 Pilot*. Bat Conservation Ireland.
- Barlow, K. E., Briggs, P. A., Haysom, K. A., Hutson, A. M., Lechiara, N. L., Racey, P. A., Walsh, A. L., & Langton, S. D. (2015). Citizen science reveals trends in bat populations: The National Bat Monitoring Programme in Great Britain. *Biological Conservation*, 182, 14–26. <https://doi.org/10.1016/j.biocon.2014.11.022>
- Beason, R. D., Riesch, R., & Koricheva, J. (2020). Tidying up the cluttered understorey: Foraging strategy mediates bat activity responses to invasive rhododendron. *Forest Ecology and Management*, 475, 118392. <https://doi.org/10.1016/j.foreco.2020.118392>
- Boston, E., Roche, N., Aughney, T., & Langton, S. (2017). *Development of a Woodland Monitoring Scheme for Bats in Ireland 2016—2017* (Irish Wildlife Manuals In press; p. 33). National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.
- Buckley, D. J., Lundy, M. G., Boston, E. S. M., Scott, D. D., Gager, Y., Prodöhl, P., Marnell, F., Montgomery, W. I., & Teeling, E. C. (2013). The spatial ecology of the whiskered bat (*Myotis mystacinus*) at the western extreme of its range provides evidence of regional adaptation. *Mammalian Biology - Zeitschrift Für Säugetierkunde*, 78(3), 198–204. <https://doi.org/10.1016/j.mambio.2012.06.007>
- Fewster, R. M., Buckland, S. T., Siriwardena, G. M., Baillie, S. R., & Wilson, J. D. (2000). Analysis of population trends for farmland birds using generalised additive models. *Ecology*, 81, 1970–1984.
- Forest Statistics Ireland, 2023. Prepared by the Department of Agriculture, Food & the Marine, Ireland, August 2023. Retrieved from <https://www.gov.ie/en/campaigns/a9d3c-forestry-in-ireland/>
- Hill, D. A., & Greenaway, F. (2008). Conservation of bats in British woodlands. *British Wildlife*, 161–169.
- Lundy, M. G., Buckley, D. J., Boston, E. S. M., Scott, D. D., Prodöhl, P. A., Marnell, F., Teeling, E. C., & Ian Montgomery, W. (2012). Behavioural context of multi-scale species distribution models assessed by radio-tracking. *Basic and Applied Ecology*, 13(2), 188–195. <https://doi.org/10.1016/j.baae.2011.12.003>
- Murphy, S. E., Greenaway, F., & Hill, D. A. (2012). Murphy—Patterns of habitat use by female brown long-eared bats presage negative impacts of 2012.pdf. *Journal of Zoology*, 288, 177–183. <https://doi.org/doi:10.1111/j.1469-7998.2012.00936.x>
- Northern Ireland Woodland Register and Basemap. Published by the Department of Agriculture, Environment and Rural Affairs and the Forest Service, April 2020. <https://irishriverproject.com/wp-content/uploads/2023/06/Forest-Service-woodland-register-and-basemap-Stakeholder-summary-report.pdf>
- Razgour, O., Montauban, C., Festa, F., Whitby, D., Juste, J., Ibáñez, C., Rebelo, H., Afonso, S., Bekaert, M., Jones, G., Williams, C., & Boughey, K. (2024). Applying genomic approaches to identify historic population declines in European forest bats. *Journal of Applied Ecology*, 61(1), 160–172. <https://doi.org/10.1111/1365-2664.14540>
- Roche, N., Aughney, T., Marnell, F., & Lundy, M. (2014). *Irish Bats in the 21st Century*. Bat Conservation Ireland.

- Roche, N., Clarke, D., Healy, K., & Langton, S. (2025). *Irish Bat Monitoring Schemes: Annual Report for 2024*. Bat Conservation Ireland.
- Roche, N., Langton, S., Aughney, T., Russ, J. M., Marnell, F., Lynn, D., & Catto, C. (2011). A car-based monitoring method reveals new information on bat populations and distributions in Ireland. *Animal Conservation*, 14(6), 642–651. <https://doi.org/10.1111/j.1469-1795.2011.00470.x>
- Smith, P. G., & Racey, P. A. (2008). Natterer's bats prefer foraging in broad-leaved woodlands and river corridors. *Journal of Zoology*, 275(3), 314–322. <https://doi.org/10.1111/j.1469-7998.2008.00445.x>
- Swift, S. M. (1998). *Long-Eared Bats*. T & A.D. Poyser Ltd.
- Swift, S. M., & Racey, P. A. (1983). Resource partitioning in two species of vespertilionid bats (Chiroptera) occupying the same roost. *Journal of Zoology*, 200, 249–259.

7. Appendix 1

Table of complete results from the walking transects carried out at each site during the 2024 woodland surveys. Sites are listed in alphabetical order.

Woodland	Grid Ref.	WT Date	No. of audio files with the following bat species				
			Natt	Whisk	Daub	Myo	BLE
Address House, Co. Armagh	H 91327 55851	26/06/2024	8	0	0	1	1
		27/07/2024	9	0	0	1	1
		16/08/2024	8	0	0	0	1
Castle Coole, Co. Fermanagh	H 26094 43099	28/08/2024	0	3	10	5	1
Castle Lough, Co. Cavan	N 66296 97616	23/06/2024	0	0	0	0	2
		19/07/2024	5	7	8	1	2
		13/08/2024	1	6	19	1	0
Castle Ward, Co. Down	J5713149454	28/06/2024	2	1	0	3	1
		16/07/2024	0	2	0	0	7
		27/08/2024	1	3	0	0	1
Clandeboyne Est., Co. Down	J 47812 77652	28/06/2024	0	3	41	2	0
		25/07/2024	2	2	37	2	3
		27/08/2024	0	2	39	4	1
Clara Vale, Co. Wicklow	T 17888 92149	25/06/2024	8	1	1	1	1
		17/07/2024	19	2	0	0	6
		07/08/2024	3	3	1	1	2
Clare Glen, Co. Armagh	J 01325 43780	24/07/2024	2	36	14	24	0
		20/08/2024	4	32	17	13	0
Crom Est., Co. Fermanagh	H 35943 24644	28/06/2024	14	18	14	25	7
		30/07/2024	4	19	14	19	10
		31/08/2024	2	13	7	11	2
Dartrey, Co. Monaghan	H 62538 18220	03/07/2024	7	17	9	10	0
		30/07/2024	0	4	11	2	0
		29/08/2024	6	1	3	0	0
Deerpark, Co. Cavan	N 59433 86979	29/07/2024	7	3	4	4	4
		31/08/2024	2	1	2	2	2
Deputy's Pass, Co. Wicklow	T 23455 90159	26/06/2024	0	2	1	1	0
		16/07/2024	1	8	1	2	4
		07/08/2024	1	14	2	4	7
Derrycassin, Co. Longford	N 30475 86135	23/06/2024	6	5	1	2	0
		27/07/2024	18	34	6	25	0
		31/08/2024	0	6	3	6	0
Donadea, Co. Kildare	N 83618 32727	24/06/2024	2	12	28	0	0
		30/07/2024	1	11	0	2	0
		16/08/2024	4	0	0	0	0

Woodland	Grid Ref.	WT Date	No. of audio files with the following bat species				
			Natt	Whisk	Daub	Myo	BLE
Dun na Rí, Co. Cavan	N 78261 97229	19/06/2024	1	10	2	11	0
		20/07/2024	4	22	3	16	1
		12/08/2024	1	5	4	4	1
Faughan Valley, Co. Derry	C 50923 10848	23/06/2024	0	0	5	3	2
		16/07/2024	5	0	11	11	0
Florence Court, Co. Fermanagh	H 18506 34756	27/07/2024	10	11	5	18	1
		24/08/2024	0	12	2	12	2
Glenarm Forest, Co. Antrim	D3094514703	26/06/2024	0	0	89	11	1
		28/07/2024	3	1	58	7	1
		30/08/2024	0	1	40	15	1
Glendalough, Co. Wicklow	T 13011 96499	27/06/2024	0	2	2	6	4
		10/07/2024	3	7	14	19	0
		27/08/2024	7	5	4	3	1
Hazelwood Forest, Co. Sligo	G7225934424	22/06/2024	0	1	0	0	0
		13/07/2024	1	3	1	3	1
		31/08/2024	2	1	0	0	0
Killinthomas, Co. Kildare	N 66109 21512	27/06/2024	0	1	0	1	0
		27/07/2024	0	3	0	2	0
		09/08/2024	0	0	0	0	4
Killykeen Forest, Co. Cavan	H 35311 06436	15/06/2024	1	0	4	0	0
		29/07/2024	0	0	10	0	0
Littlewood, Slane, Co. Meath	N 97406 75671	30/06/2024	0	0	0	0	0
		15/07/2024	0	0	0	0	1
		27/08/2024	0	1	0	0	0
Newcastle Wood, Co. Longford	N 18231 57080	15/06/2024	5	5	13	7	0
		11/07/2024	0	1	2	5	1
		13/08/2024	0	6	6	6	1
Rossmore, Co. Monaghan	H 65406 31501	28/06/2024	0	3	2	4	0
		26/07/2024	0	7	1	1	0
		31/08/2024	1	0	1	3	0
Tomnafinnoge, Co. Wicklow	T 02089 70670	03/07/2024	0	0	6	2	0
		23/07/2024	3	7	1	5	13
		06/08/2024	2	4	1	1	2
Union Wood, Co. Sligo	G 69136 29100	28/06/2024	0	0	0	3	1
		28/07/2024	1	2	0	2	0
		31/08/2024	0	2	0	0	0



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