



BAT CONSERVATION IRELAND

Irish Bat Monitoring Schemes: Daubenton's, Car-based & Woodland Bat Monitoring Northern Ireland

Annual Report for 2024

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TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY	4
2.0 INTRODUCTION	6
2.1 Red and Amber Alerts	7
3.0 DAUBENTON'S WATERWAYS SURVEY	8
3.1 Introduction	8
3.1.1 Monitoring Daubenton's bats.....	8
3.2 Methods	8
3.2.1 Statistical Methods.....	9
3.3. Results	9
3.3.1 Training and Volunteer Participation: Northern Ireland 2024 & 2006-2024.....	9
3.3.2 Waterway Sites Surveyed in Northern Ireland.....	9
3.3.3 Completed Surveys 2024.....	11
3.3.4 Bat Records & Robustness of Dataset.....	11
3.3.5 Trends – Poisson GLM.....	11
3.3.6 Country Trend Models.....	13
3.4 Discussion	15
3.4.1 Volunteer Uptake in Northern Ireland.....	15
3.4.2 Survey Coverage in 2024 in Northern Ireland.....	15
3.4.3 Dataset & Distribution in Northern Ireland.....	15
3.4.4 Yearly Trends.....	16
4.0 CAR-BASED BAT MONITORING	17
4.1 Introduction	17
4.1.1 What is a Car-based Bat Monitoring Scheme?.....	17
4.1.2 Overall Aims of Car-Based Bat Monitoring Scheme.....	17
4.2 Methods	18
4.2.1 Analysis.....	19
4.2.2 Other Vertebrates.....	19
4.3 Results	20
4.3.1 Volunteer Uptake in Northern Ireland.....	20
4.3.2 Survey Coverage in 2024 in Northern Ireland.....	20
4.3.3 Roadside Bat Species in 2024 in Northern Ireland.....	21
4.3.4 Bat Records.....	23
4.3.5 Roadside Bat Trends.....	23
4.3.6 Other Vertebrates on Roadsides in Northern Ireland in 2024.....	28
4.4 Discussion	29
5.0 WOODLAND BAT MONITORING	30
5.1 Introduction	30
5.2 Methods	30
5.2.1 Site selection.....	30
5.2.2 Volunteer recruitment and training.....	31
5.2.3 Monitoring.....	31
5.2.4 Statistical power analysis.....	32
5.2.5 Calls Library.....	32
5.3 Results	32
5.3.1 Overall Results.....	32
5.3.2 Power analysis results.....	33
5.3.3 Northern Ireland Results.....	34

5.4 Discussion.....	34
6.0 REFERENCES AND SOURCES OF INFORMATION	36
7.0 ACKNOWLEDGEMENTS.....	38
8.0 GLOSSARY.....	39
9.0 APPENDIX 1.....	40
10.0 APPENDIX 2.....	42

1.0 EXECUTIVE SUMMARY

This annual report provides information on Bat Conservation Ireland's monitoring schemes in Northern Ireland:

- Car-Based Bat Monitoring Scheme
- All Ireland Daubenton's Bat Waterway Monitoring Scheme
- Pilot Woodland Bat Monitoring Scheme

For detailed analysis of all-island data in 2024 see Roche *et al.* (2025).

The first systematic car-based bat monitoring system in Europe was devised for the Republic of Ireland (ROI) in 2003 by the Bat Conservation Trust (BCT, UK). The scheme has been administered by Bat Conservation Ireland (BCIreland) since 2004 with funding from the National Parks and Wildlife Service (NPWS) of the Department of Housing, Local Government & Heritage and the Northern Ireland Environment Agency (NIEA). The main aim of the scheme is to monitor roadside populations of common pipistrelle, soprano pipistrelle and Leisler's bat and to collect sufficient data to identify trends in these bat populations.

The method involves driving a known survey route at 24kmph with a bat detector clamped to the open window of the passenger door. Each survey route consists of 15, 1.6km transects, separated by a 3.2km gap to minimise the possibility of repeat encounters with the same bats. Recordings are analysed by BCIreland using Kaleidoscope Pro software. In Northern Ireland, routes have been mapped in five, 30km blocks. Surveys are carried out in July and August by trained volunteers. Volunteers are mainly Northern Ireland Bat Group members and interested volunteers with their team-mates.

All-island trends show that, even though 2024 yearly estimates for the target species (common pipistrelle, soprano pipistrelle and Leisler's bat) dropped slightly compared to 2023, the trend lines for all three are still increasing. We also looked at NI only trends for these species and, for soprano pipistrelles and Leisler's bats, these mirrored those of All-Ireland, albeit with much wider error bars. The one exception was common pipistrelles which saw a slight downturn in the trend in Northern Ireland in 2024. In 2024 in Northern Ireland, encounter rates for most species (bat passes per hour) were lower than the island-wide average. Nathusius' pipistrelles and Leisler's bats occurred in higher encounter rates in Northern Ireland compared with the rest of the island.

The All Ireland Daubenton's Bat Waterways Monitoring Scheme has been in operation in Northern Ireland since 2006 under Bat Conservation Ireland management. Since 2006, a total of 104 waterway sites have been surveyed in Northern Ireland. A small number of waterway surveys have also been on-going in Northern Ireland under the management of BCT, UK since their introduction of the survey since 1997.

All training completed in 2024 was online. BCIreland is required to survey a minimum of thirty waterways sites per year. In 2024, 31 waterway sites were surveyed. A total of 57 surveys were completed with 1,412 'sure' Daubenton's bat passes recorded on 26 of the 31 waterway sites surveyed.

Despite some variation in yearly estimates, the all-Island Daubenton's bat trend appears to be fairly steady from year to year with error bars consistently encompassing the baseline. Trend analysis was also undertaken for Northern Ireland data only. Over the duration of the

monitoring programme, there has been a higher increase in the population trend for Daubenton's bats in Northern Ireland compared to the Republic of Ireland and compared to the All-Ireland dataset. But the difference is not statistically significant.

For the first time, woodland surveys took place in Northern Ireland in 2024 as part of the newly established All-Ireland Woodland Bat Monitoring Scheme. Nine woodland sites were surveyed to assess the presence and activity levels of whiskered bat and Natterer's bat, as well as other woodland bat species. Natterer's bat was present at eight of the nine sites surveyed (88.9%) while whiskered bat was present at seven sites (77.8%). There were six sites (66.7% of the total) where both species were present.

2.0 INTRODUCTION

Bats in Northern Ireland are protected under the Wildlife (Northern Ireland) Order 1985. The European Bats Agreement (EUROBATS) is an agreement under the Bonn Convention and Ireland and the UK are two of the 39 range states. Devising strategies for monitoring of populations of selected bat species in Europe is among the resolutions of EUROBATS. Ireland, including Northern Ireland, holds important European populations of Leisler's bat (*Nyctalus leisleri*) (Stebbing, 1988).

To fulfill international obligations under the Convention on Biological Diversity and Agenda 21 agreed in 1992, Local Biodiversity Plans must be devised. The 1992 global agreement requires signatory parties to "identify components of biodiversity ... and monitor, through sampling and other techniques, the components of biological diversity identified" (Article 7).

Scientifically rigorous methods of surveillance and monitoring are essential and require well-planned strategies to achieve statistically defensible results (Battersby, 2010). However, bats are difficult to monitor because they are nocturnal and difficult to identify when flying. In addition, individual species differ in their detectability (using bat detectors) and in their foraging and roosting strategies. Therefore, it is essential that appropriate methods of surveillance and monitoring are undertaken for specific species of bat (Battersby, 2010) and that the most appropriate method is chosen based on a general understanding of the roosting habitats, foraging behaviour, seasonal movements and the influence of environmental factors on local abundance and distribution (Kunz, 2003; Warren & Witter, 2002). Methods used to determine trends in bat populations can include foot-based bat detector surveys (e.g. BCT, 2011), car-based surveys (e.g. Roche et al., 2011) or roost counts either at summer roosts (Warren & Witter, 2002) or hibernacula (Tuttle, 2003).

This report presents the results of two long-term monitoring schemes managed by BCIreland, as well as a new pilot scheme that is currently being rolled out.

The All Ireland Daubenton's Bat Waterway Monitoring Scheme is a foot-based survey designed by BCT, UK to monitor the Daubenton's bat (*Myotis daubentonii*). This scheme has proven to be a suitable monitoring tool for this bat species and has been in place since 2006.

The second scheme, Car-based Bat Monitoring, aims to be the primary tool for monitoring roadside populations of common pipistrelles (*Pipistrellus pipistrellus*), soprano pipistrelle (*P. pygmaeus*) and Leisler's bat (*Nyctalus leisleri*) in Ireland. The protocol was initially devised and piloted by The Bat Conservation Trust (BCT) in 2003 as an initiative of The Heritage Council and undertaken in the Republic of Ireland (Catto et al., 2004). It is a peer-assessed monitoring tool for these three bat species (Roche et al., 2011). Other species are also recorded during the surveys. We also analyse trends in species that occur less commonly along the roadside transects including Nathusius' pipistrelle (*P. nathusii*) and *Myotis* species (which may include any or a combination of *M. daubentonii*, *M. nattereri* and *M. mystacinus*). The error bars surrounding the trends in these species are much wider, however, and should therefore be approached with a high degree of caution.

The third scheme that began with a pilot study in 2023, is the Woodland Bat Survey. This targets *Myotis nattereri* and *M. mystacinus*. These two species are not currently monitored under any schemes north or south of the border. In 2024, trial walking transects were carried out along newly mapped routes in a number of woodland sites in Northern Ireland. This scheme is discussed in Section 5.

2.1 Red and Amber Alerts

Monitoring and surveillance protocols need to be able to inform conservation bodies of the trends of the faunal group being investigated. Population trends are often used to identify species that require conservation measures (Dunn, 2002) and confirming a population decline can be used as a rationale to adopt or implement conservation measures. The degree of population decline is also considered to be a valuable evaluation tool with which to identify wildlife populations in trouble (Dunn, 2002). Rates of population change are regularly used as indicators of the conservation status of species e.g. the conservation alerts defined by The British Trust for Ornithology (BTO). The BTO has developed Alert Levels based on IUCN-developed criteria for measured population declines. Species are considered of high conservation priority (i.e. Red Alert) if their population declines by 50% or more over a 25-year period. Species are considered of medium conservation priority (i.e. Amber Alert) if there is a decline of 25-49% over 25 years (Marchant et al., 1997). A 50% and 25% decline over 25 years translates into an annual decline of 2.73% or 1.14% respectively. These Alerts are based on evidence of declines that have already occurred or can be predicted to occur based on statistically robust monitoring data that are sensitive enough to meet Alert Levels.

Monitoring data should be of sufficient statistical sensitivity (and better, if possible) to meet these Alert levels. In relation to the All-Ireland Daubenton's Bat Waterway Monitoring Scheme, the 2006-2008 Synthesis Report (Aughney et al., 2009) included power analysis to evaluate the number of waterway sites that need to be monitored to detect Red and Amber Alerts. Power Analysis indicated that if 150 to 200 waterway sites were surveyed each year, it should be possible to detect Red Alerts in around 6 years and Amber Alerts in 10 years. Results of Power Analysis also showed that a core of 67-75 waterway sites surveyed twice annually and additional 25-

33 sites randomly surveyed each year are required to determine Amber Alerts after 15.4 years.

In relation to The Car-based Bat Monitoring Scheme, Power Analysis undertaken on the 2003-2008 All-Ireland dataset confirmed that when 20 x 30km squares are surveyed twice annually a Red Alert decline can be detected within 8, 11 and 12 years for common pipistrelles, soprano pipistrelles and Leisler's bats, respectively (Roche et al., 2009). Amber Alerts take roughly twice as long to detect. This time frame is considered acceptable to meet Alert levels in a sufficient length of time.

3.0 DAUBENTON'S WATERWAYS SURVEY

3.1 Introduction

The All-Ireland Daubenton's Bat Waterways Monitoring Scheme is a project funded by the National Parks and Wildlife Service (NPWS) of the Department of Heritage, Housing and Local Government, Republic of Ireland and Northern Ireland Environment Agency (NIEA) Environment Fund. This scheme aims to be the primary tool for monitoring Daubenton's bats on the island of Ireland.

The All-Ireland Daubenton's Waterways Scheme has been carried out yearly since 2006 under the management of Bat Conservation Ireland.

3.1.1 Monitoring Daubenton's bats

This scheme follows a survey methodology devised by the Bat Conservation Trust (BCT UK). Narrow band, heterodyne detectors are used, so volunteers who conduct the survey are trained in the identification of Daubenton's bat prior to field work. Surveyors count the number 'bat passes' of this bat species for four minutes at each of the ten fixed points on linear waterways. All data collected for Northern Ireland by the All-Ireland Daubenton's Bat Waterways Monitoring Scheme also feeds into the BCT's UK reporting mechanisms.

The present report summarises the main results for Northern Ireland from 2006-2024 with emphasis on 2024 only. A sufficient number of waterway sites are now surveyed annually in Northern Ireland to allow trend analysis for this jurisdiction alone. For more details on all-island Daubenton's trends and details on variables affecting all-island Daubenton's activity and other results see Roche *et al.* (2025).

3.2 Methods

The All-Ireland Daubenton's Bat Waterway Monitoring Survey methodology is based on that currently used in BCT's UK National Bat Monitoring Programme (NBMP) (Anon, 2004). It is undertaken as an all-island survey.

Prior to the allocation of sites, all surveyors are contacted by email to determine their willingness to participate in the coming year's surveys. Newly recruited surveyors are invited to attend an evening training course organised for the months of June and July. This training course consists of a PowerPoint presentation followed by a discussion of potential survey areas. Prior to Covid-19, these training courses were in person, but since the onset of the pandemic we have developed new training videos to illustrate the method and our training courses have taken place online via Zoom. This has an advantage in that people do not have to travel to attend the course, which we found could be a barrier to participation in the past.

An information pack consisting of a detailed description of the methodology, maps, survey forms and online training details are provided for each survey team. Heterodyne bat detectors are also available for loan for the duration of summer months.

Newly recruited surveyors are provided with a list of survey sites that are not assigned to any survey team. In order to have a more robust dataset for trend analysis BCIreland prefers to reallocate previously surveyed sites where possible. Seasoned surveyors are usually reassigned the same sites that they have surveyed in previous years.

Surveyors undertake a daytime survey of their allocated sites to determine its safety and suitability for surveying. At the chosen site, ten points (i.e. survey spots) approximately 100m apart are marked out along a 1km stretch of waterway. The surveyors then revisit the site on two evenings in August and start surveying 40

minutes after sunset. At each of the ten survey spots, the surveyor records Daubenton's bat activity as bat passes for four minutes using a heterodyne bat detector and torchlight (Walsh *et al.*, 2001).

Bat passes are either identified as 'Sure' Daubenton's bat passes or 'Unsure' Daubenton's bat passes. A 'Sure' Daubenton's bat pass is where the surveyor, using a heterodyne detector, has heard the typical rapid clicking echolocation calls of a *Myotis* species and has also clearly seen the bat skimming the water surface. Bat passes that are heard and sound like *Myotis* species but are not seen skimming the water surface may be another *Myotis* species. Therefore, these bat passes are identified as 'Unsure'. The number of times a bat passes the surveyor is counted for the duration of the four minutes. Therefore, counting bat passes is a measure of activity and results are quoted as the number of bat passes per survey period (No. of bat passes/40 minutes). Surveyors are also requested to record a number of parameters including air temperature, weather data and waterway characteristics, such as width and smoothness.

Surveyors are asked to undertake the survey on two dates, one between the dates of 1st to 15th August (Survey 1, S1) and a repeat survey between the dates of 16th to 31st August (Survey 2, S2). On completion of surveys, survey forms are returned to BC Ireland for analysis and reporting.

3.2.1 Statistical Methods

Trend analysis was carried out with data from 2006-2024 using Poisson Generalised Linear Model (GLM) which is applied to the data with the results expressed as an index and 2007 used as the base year. This model, which includes both sure and unsure passes, has the maximum number of passes set to 48 and includes covariates. The covariates were determined using a binomial GLMM model. This trend method is used to

facilitate comparison with BCT Daubenton's trend data from Britain.

Due to the much larger number of sites included, the All-Ireland trend is a much more robust dataset. However, Northern Ireland trend analysis was completed with the current 2006-2024 dataset.

3.3. Results

3.3.1 Training and Volunteer Participation: Northern Ireland 2024 & 2006-2024

In 2024 BC Ireland set up four online training courses, via Zoom, for volunteers to participate in. These took place on 16th, 18th, 20th, and 23rd July 2024. Some other online training presentations and training aids were also available on the BC Ireland YouTube channel. A total of 48 volunteers participated in 2024 in Northern Ireland, the same number as for 2023. Five new survey teams were recruited in 2024.

3.3.2 Waterway Sites Surveyed in Northern Ireland

A total of 31 waterway sites were surveyed in Northern Ireland in 2024, the majority of which were located in County Antrim (Table 3.1). Waterway sites surveyed in 2024 are distributed throughout the six counties (Figure 3.1).

In 2024 a total of three canals (six waterway sites) and 18 rivers (25 waterway sites) were surveyed. The Lagan Canal had three waterway sites surveyed along its length and the River Lagan had five.

Table 3.1. Total number of registered waterway sites surveyed in each county in Northern Ireland (2006-2024) and the number of sites surveyed for each of those counties in 2024.

Counties	2006-2024	2024
Derry	17	3
Antrim	30	14
Armagh	9	3
Down	13	5
Fermanagh	10	1
Tyrone	25	5

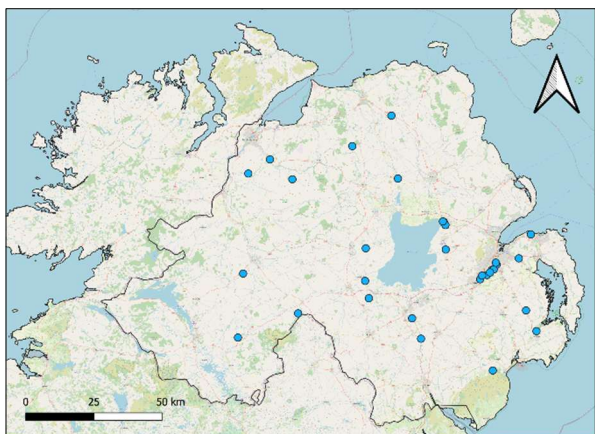


Figure 3.1. Location of waterway sites surveyed in Northern Ireland as part of the All-Ireland Daubenton's Bat Waterway Monitoring Scheme in 2024 (QGIS).

Of the 104 waterways sites that have been surveyed in Northern Ireland, no waterway site has been surveyed each year since 2006 (Figure 3.2). Over the 19 years of the scheme, most sites (72 waterway sites, 69%), have been surveyed for six or fewer years. Waterway sites surveyed for two years or more are included in population trend analysis. On a county-by-county basis, County Tyrone has the highest number of sites that have been only surveyed once (32%, n=8).

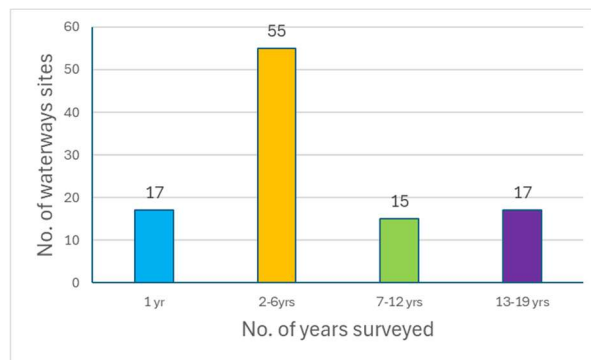


Figure 3.2. Total number of years each waterway site has been surveyed in Northern Ireland as part of the All-Ireland Daubenton's Bat Waterway Monitoring Scheme in 2006-2024, n = 104.

Table 3.2. Number of years each waterway site has been surveyed as part of the Northern Ireland Daubenton's Bat Monitoring Scheme.

No. of Years	No. of waterway sites
1	17
2	11
3	16
4	13
5	11
6	4
7	2
8	4
9	2
10	1
11	4
12	2
13	2
14	3
15	5
16	5
17	2
18	0
19	0

As of 2024, Eighty-seven (83.7%) of the 104 waterways sites that have been surveyed in Northern Ireland have at least two years of survey data (Figure 3.3). This represents 15.6% of the total number of waterway sites on the island with at least two years of survey data.

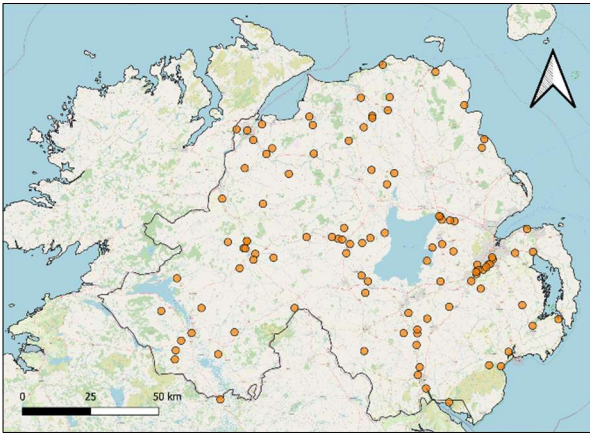


Figure 3.3. Location of all waterway sites surveyed in Northern Ireland during the 2006-2024 period (QGIS).

There are 645 waterway sites in the All-Ireland dataset and on average only a third of these are surveyed annually. Many sites in the full dataset have only been surveyed for one year ($n=84$ waterways, 13%). This is similar for Northern Ireland with 17 waterway sites (16.3%) surveyed for one year only. BC Ireland encourages new survey teams to take on “old” waterway sites in order to strengthen the data.

3.3.3 Completed Surveys 2024

A total of 57 completed surveys from 31 Northern Ireland waterway sites were returned to BC Ireland in 2024. For Survey 1 (1st – 15th August) 29 surveys were completed and 28 surveys were completed in Survey 2 (16th – 30th August). Waterway sites with repeated surveys (i.e. surveys completed in both sampling periods S1 and S2) provide more robust data for monitoring. In 2024, 26 repeated surveys (83.9% of waterway sites) were completed.

In 2024, ‘Sure’ Daubenton’s bat passes were recorded on 26 Northern Ireland waterway sites (83.9%) (see Figure 3.4).

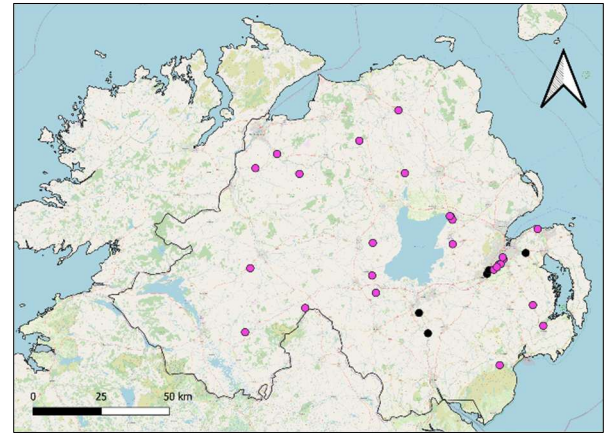


Figure 3.4. Waterway sites where Daubenton’s bats were recorded as being present (pink circles) or absent (black circles) in Northern Ireland in 2024 (QGIS).

At each of the 10 survey spots volunteers record Daubenton’s bat activity for four minutes, generating 40 minutes of data per completed survey. In total, 1,412 ‘Sure’ Daubenton’s bat passes and 265 ‘Unsure’ Daubenton’s bat passes were recorded during 68 hours and 51 minutes of surveying in Northern Ireland. The mean number of ‘Sure’ Daubenton’s bat passes per survey in Northern Ireland in 2024 was 24.8 and was lower than the mean number of passes per survey in 2023 ($n=30.9$). The 2024 Northern Ireland mean number of passes was also lower than the 2024 All-Ireland average ($n=39.2$).

For a full break down of all of the descriptive results recorded for 2024 and for the 2006-2024 dataset see Table 1, Appendix 1.

3.3.4 Bat Records & Robustness of Dataset

All bat records derived from the Daubenton’s Bat Waterway Monitoring Scheme for Northern Ireland were sent to the BCT and CEDaR in January 2025.

3.3.5 Trends – Poisson GLM

To assess trends, a Poisson Generalised Linear Model (GLM) was applied to the data with the results expressed as an index and 2007 used as the base year. Just one of the models is reported here, the model that includes both sure and unsure passes, with

a maximum of 48 passes per spot. This particular model is chosen to facilitate comparison with data from the BCT. A total of 558 waterway sites that were surveyed for two years or more are included in this analysis in 2024. Waterway sites only surveyed for one year do not contribute to information on trends and are therefore omitted from the analysis.

On an All-Ireland level there has been a fluctuating trend since 2006, with levels having troughed in 2008 and 2013-2014. A peak was observed in 2011 and then again 2015-2017. In the subsequent years until 2023 there was a slight dip in the trend, but in 2024 there was an upturn with the highest

Daubenton's bat activity levels recorded since 2018. Overall, the species is showing a relatively stable trend. On average the numbers of passes recorded in 2024 were higher than 2023, and these were higher compared to most of the last six years, so there has been a slight upward curve in the trendline since last year.

The smoothed index is currently 6.73% above the 2007 base year value which is equivalent to a mean 0.38% annual increase, although this increase is not considered significant as confidence intervals still encompasses the baseline index (Figure 3.5).

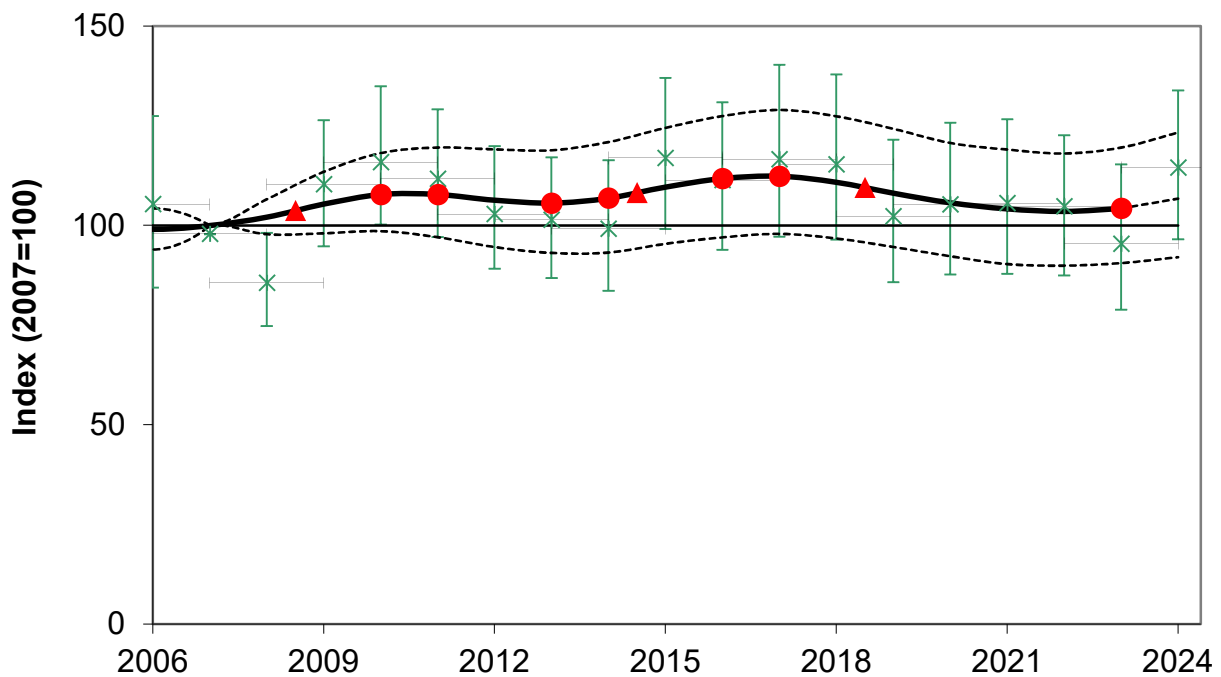


Figure 3.5. Results of Daubenton's bat Poisson GAM/GLM trend including both sure and unsure passes, with covariates, for All-Ireland data. Green points are estimated annual means and are shown to illustrate the variation about the fitted line. Red circles indicate significant ($P < 0.05$) change points, where the slope of the smoothed trend line changes. Red triangles indicate that the difference in the smoothed index between consecutive years is statistically significant ($P < 0.05$). See appendices for accompanying table.

Table 3.3. Poisson GAM results with 95% confidence limits for Daubenton's bats (2006-2024). Covariates include survey start time, surveyor skills and degree of smooth water as recorded by survey teams.

Year	Sites	Surveys	Mean	Smoothed		95% conf limits		Unsmoothed		95% conf limits	
				Index	s.e.	Lower	Upper	Fitted	s.e.	Lower	Upper
2006	107	199	56.87	99.02	2.71	93.97	104.31	107.48	11.21	86.59	129.60
2007	167	304	51.08	100.00	0.00	100.00	100.00	100.00	0.00	100.00	100.00
2008	162	276	42.57	102.05	2.25	97.80	106.56	87.73	5.92	76.94	100.29
2009	185	325	52.03	105.34	3.91	98.03	113.46	112.44	7.76	96.89	128.54
2010	201	369	58.88	107.75	5.03	98.58	118.16	117.97	8.75	102.35	137.04
2011	219	389	58.50	107.77	5.69	97.07	119.56	113.85	8.17	99.23	131.26
2012	215	394	52.18	106.34	6.13	94.58	119.10	104.98	7.84	91.29	122.07
2013	221	404	48.80	105.62	6.51	93.11	118.87	103.57	7.91	88.93	119.25
2014	240	446	45.46	106.84	6.92	93.21	120.92	101.28	8.69	85.76	118.52
2015	241	444	51.13	109.61	7.31	95.40	124.50	119.09	9.86	101.22	139.18
2016	242	438	49.85	111.78	7.64	97.01	127.45	113.52	9.49	96.02	133.08
2017	225	400	51.25	112.33	7.91	97.89	128.99	118.73	11.26	99.33	142.43
2018	231	402	50.57	110.84	7.89	96.76	127.41	117.41	10.74	98.63	140.06
2019	230	410	42.78	108.10	7.66	94.62	124.25	104.40	9.19	87.92	123.67
2020	226	402	43.74	105.72	7.51	92.28	120.69	107.36	9.78	89.83	127.95
2021	219	402	44.72	104.16	7.40	90.31	119.05	107.68	10.02	90.01	128.78
2022	237	428	48.81	103.54	7.30	89.93	118.06	106.89	8.82	89.63	124.80
2023	237	427	44.70	104.28	7.43	90.55	119.55	97.55	9.05	81.05	117.52
2024	184	331	54.11	106.73	8.11	92.04	123.32	116.64	9.44	98.69	136.07

3.3.6 Country Trend Models

A trend model for Northern Ireland was investigated separately. The trend analysis was completed for data from Northern Ireland (n=87 waterway sites) separately from the All-Ireland dataset using the Poisson model, with both sure and unsure passes (max 48 per spot), with covariates. For Northern Ireland, the smoothed trend showed an increase in the initial years, followed by a decline since 2018. Overall, there has been increase of 28.58%, which represents a yearly increase of 1.49% since

the baseline year, 2007 (Figure 3.6, Table 3.4). Although the index value is greater for Northern Ireland in comparison to that for the Republic of Ireland (n=458 waterway sites), the confidence limits are wide due to the relatively small sample size. Also, values are not significantly different using a randomisation test between the two datasets. For the Republic of Ireland data, the smoothed trend indicates an increase of 10.16%, which represents a yearly increase of 0.57% since the baseline year in 2007.

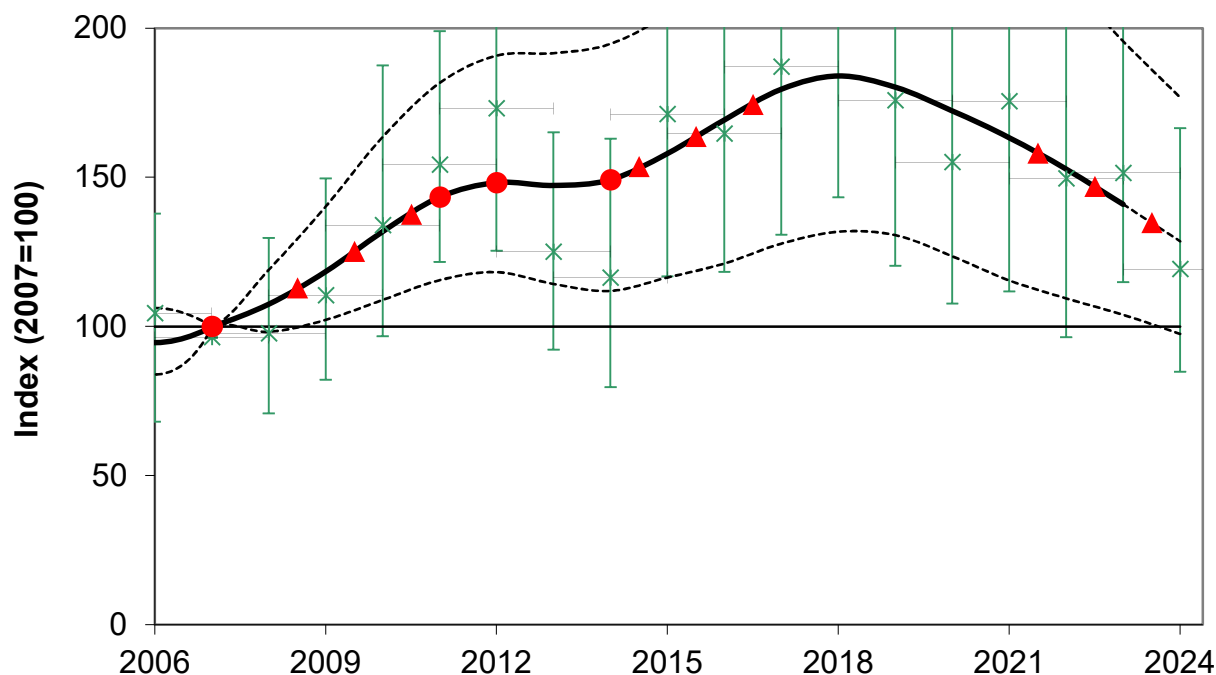


Figure 3.6. Northern Ireland results of Poisson GAM model (max 48 'sure' and 'unsure' passes), with covariates (survey start time, surveyor skills and degree of smooth water as recorded by survey teams), shown with 95% confidence limits. Green points are estimated annual means and are shown to illustrate the variation about the fitted line.

Table 3.4. Northern Ireland Poisson GAM results with 95% confidence limits for Daubenton's bats (2006-2024). Covariates include survey start time, surveyor skills and degree of smooth water as recorded by survey teams.

Year	Sites	Surveys	Mean	Smoothed		95% conf limits		Unsmoothed		95% conf limits	
				Index	s.e.	Lower	Upper	Fitted	s.e.	Lower	Upper
2006	13	26	47.85	94.57	6.02	83.91	106.22	108.05	19.76	71.69	94.57
2007	19	35	38.86	100.00	0.00	100.00	100.00	100.00	0.00	100.00	100.00
2008	30	51	44.06	107.48	5.58	98.21	119.01	101.25	14.69	74.49	107.48
2009	35	62	46.02	118.39	10.06	102.21	140.23	114.09	17.59	85.74	118.39
2010	36	70	46.29	131.81	13.27	108.90	163.54	137.54	23.37	100.37	131.81
2011	42	80	55.86	143.40	15.56	115.54	181.64	157.80	20.75	125.29	143.40
2012	35	63	62.00	148.22	17.47	118.23	190.78	176.73	29.28	128.99	148.22
2013	31	59	40.93	147.24	18.42	114.26	191.63	128.65	18.48	95.91	147.24
2014	34	65	37.26	149.20	19.90	111.93	194.75	119.98	20.86	83.35	149.20
2015	35	69	55.64	157.96	22.65	116.42	205.54	174.79	32.60	120.40	157.96
2016	32	61	48.48	169.30	25.99	121.12	227.26	168.27	26.32	121.93	169.30
2017	34	56	56.55	179.55	29.49	127.78	250.43	190.64	35.33	134.38	179.55
2018	32	60	50.65	183.96	31.41	131.76	260.84	212.33	40.77	146.95	183.96
2019	34	61	42.43	180.21	30.92	130.62	250.65	179.42	37.80	123.96	180.21
2020	34	57	36.89	172.31	29.60	123.55	240.42	158.71	27.01	111.35	172.31
2021	32	58	33.88	163.32	28.50	115.43	229.83	179.13	38.48	115.40	163.32
2022	28	55	30.98	152.75	26.14	109.43	215.56	153.25	35.33	100.01	152.75
2023	31	56	35.05	140.97	22.70	103.95	195.62	155.02	25.97	118.57	140.97
2024	21	39	37.18	128.58	19.97	97.53	176.82	122.85	22.34	88.42	128.58

3.4 Discussion

3.4.1 Volunteer Uptake in Northern Ireland

Twenty-nine survey teams (with a minimum two individuals per team), undertook the survey in 2024 in Northern Ireland, the same number as in 2023. There had been a reduction of teams participating from Northern Ireland since 2011. This decline was successfully reversed in 2015 and participation has remained relatively consistent over the past nine years. The number of new teams that were recruited was lower in 2024 however, with only five new teams participating in 2024 compared to nine in 2023.

While a core group of survey teams have participated in the programme since the early years, there is still a need for a continued recruitment drive since a certain percentage of volunteers are lost to the survey every year. Since the Covid-19 pandemic, all recruitment training events have taken place online. For the most part this has worked very well and has continued to at least maintain the numbers of volunteers taking part in the scheme, which is reassuring. There may be the need however, to revisit conducting periodic in-person training events in Northern Ireland if participation rates decrease in future years.

In addition, BC Ireland continues to work closely with the Lagan Valley Volunteers, which has proven very successful over the years with management of six volunteer teams in County Antrim completed by the volunteer co-ordinator. In 2018, a new link was formed with the Lagan Valley Rivers Trust and this continued in 2024.

3.4.2 Survey Coverage in 2024 in Northern Ireland

A total of 57 surveys were completed at 31 waterways sites. The waterway sites were located in all six counties in Northern Ireland with the largest coverage in County Antrim. The County Antrim coverage is primarily a consequence of BC Ireland working closely with the Lagan Valley Volunteers, who surveyed six waterway sites in 2024 and have consistently participated in the scheme for many years.

The data collected is more robust when waterway sites are surveyed for two or more years. Therefore, waterway sites with only one survey year completed over the duration of the scheme will continue to be targeted for re-surveying in 2025 (n=17 waterway sites). This aim has been actioned in the last few years and as a result, the number of waterways sites only surveyed for one year was reduced again in 2024.

3.4.3 Dataset & Distribution in Northern Ireland

The 2024 dataset consisted of 1,412 'Sure' Daubenton's bat passes. Daubenton's bat was recorded on the majority of the waterway sites surveyed in 2024, thus re-confirming this species' wide distribution on linear waterways across Northern Ireland. Daubenton's bats were recorded in every county from the most northern sites in Antrim to waterway sites along the Fermanagh/Cavan border. A similar widespread distribution of this species was also reported by the BCT NBMP where Daubenton's bats were recorded from northern Scotland to southern England (www.bats.org.uk). This monitoring scheme continues, therefore, to make a considerable contribution to our knowledge of the distribution range of Daubenton's bat.

The large dataset currently held by BC Ireland for this species is a potentially useful source of mapping information on a county, river catchment and river level. Such representation may prove useful for future county planning and conservation work in relation to waterways.

The dataset for Northern Ireland now stands at 104 waterway sites surveyed over the 19 years of the scheme. However, waterway sites need to be surveyed more consistently from year to year to provide statistically robust data. No waterway site has been surveyed in each of the 19 years of the scheme. A continued effort will be undertaken in 2025 to survey waterway sites that have only been surveyed once in the 19 years of the scheme (n=17 sites). Repeat surveys improve the statistical power of the data and increase the ability to detect trends.

3.4.4 Yearly Trends

While across the island Daubenton's bat activity has decreased slightly since the survey began in 2006, this decrease is not considered significant. More recently, the trend from 2016-2024 has been relatively stable overall.

As sufficient data is now being collected on an annual basis, separate trend analysis for Northern Ireland has been completed annually since 2017. Over the duration of the monitoring programme, there has generally been a greater increase in the population trend for Daubenton's bats in Northern Ireland compared to the Republic of Ireland but the differences are not significant.

4.0 CAR-BASED BAT MONITORING

4.1 Introduction

This project aims to be the primary tool for monitoring roadside populations of common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle (*P. pygmaeus*) and Leisler's bat (*Nyctalus leisleri*) in Ireland. The protocol was initially devised and piloted by The Bat Conservation Trust (BCT) in 2003 as an initiative of The Heritage Council and undertaken in the Republic of Ireland (Catto et al., 2004). Funding was provided by the Northern Ireland Environment Agency (NIEA) from 2006 to carry out surveys within Northern Ireland as part of an overall All-Ireland survey for the two countries, managed by Bat Conservation Ireland (BCIreland). Data from the Northern Ireland surveys are specifically the subject of this report. Within the context of monitoring aims, i.e. to use monitoring data to detect Amber and Red Alert declines of selected populations, the data collected from Northern Ireland alone would not be sufficient to provide statistically robust data. However, we report on the NI-only trends in this report.

The present report summarises the main results for Northern Ireland in the period 2006-2024 with some of the specific results for 2024.

4.1.1 What is a Car-based Bat Monitoring Scheme?

This protocol is a method of monitoring bats while driving. Monitoring is carried out using a bat detector which picks up the ultrasonic (high pitched) echolocation calls made by bats and converts them to a frequency audible to the human ear. From 2003 to 2019, time expansion detectors were used. These detectors essentially make short recordings of a

broad range of ultrasound and replay the sounds at a slower speed. All sounds were recorded to minidisks initially, and from 2012, smartphones were used to record bat detector sounds and georeferencing information.

From 2016 to 2019 a new type of bat detector was phased into the survey. Batlogger M (Elekon Electronics) full spectrum detectors record snapshots of ultrasound on a continuous basis along with GPS data, and all data is stored on the device's SD card. This removes the requirement for a secondary recording device.

Batloggers were first trialed in small numbers in 2016 and were then used in increasing numbers each year, each time in tandem with Tranquillity detectors. This meant that sufficient data had been collected from 2016 to 2019 to allow a full swap over to Batloggers alone in 2020 and these devices have been used since then.

The monitoring is carried out along mapped routes with 15 transects each within five 30km x 30km survey squares in Northern Ireland. Each transect along the route is driven at a prescribed speed (15mph).

Training of two new teams in Northern Ireland in 2024 was carried out via Zoom and the equipment boxes were posted to volunteers.

4.1.2 Overall Aims of Car-Based Bat Monitoring Scheme

1. Provide a method of monitoring that can be implemented by relatively few surveyors and that does not require highly trained individuals.
2. Provide a method of data collection that is
 - objective
 - easily repeatable
 - cost effective.

3. Ensure sufficient data is collected that will allow early recognition of Red and Amber Alert declines in certain Irish bat species' populations.
4. The species targeted for monitoring are:
 - common pipistrelle
 - soprano pipistrelles
 - Leisler's bat
5. Nathusius' pipistrelle (*P. nathusii*) is not encountered in sufficiently high numbers to allow robust monitoring of its populations, nonetheless this species is recorded by the survey and we produce a trend index, albeit with very wide confidence intervals.
6. *Myotis* bats, i.e. Daubenton's, Natterer's and whiskered bats (*Myotis daubentonii*, *M. nattereri* and *M. mystacinus*) are not identified to species level and are recorded in very low numbers. Nonetheless, we produce a trend index for this species group which is the subject of discussion in this report.
7. Record other vertebrate wildlife during survey periods.
8. To extrapolate information on bat activity within survey squares to determine 'hotspot' areas, and/or areas of high bat diversity.

4.2 Methods

This Car-based Bat Monitoring Scheme was designed by the BCT in 2003. To date much bat monitoring work has been done in other countries by foot-based trained volunteers (e.g. the UK National Bat Monitoring Programme (NBMP)). In Ireland, however, a lack of trained bat workers in Ireland meant that such monitoring work was not feasible until relatively recently. The car-based method ensures that large areas can be covered in one night and the use of a time-expansion or full spectrum detector means that volunteers do not need to be skilled in bat

identification to collect the data accurately.

Training of surveyors has been carried out in summer prior to Survey 1 each year. In 2024 two new Northern Ireland teams were trained in via Zoom. Issues and queries from teams were discussed via Zoom, email or WhatsApp prior to the survey.

Starting 45 minutes after sundown, surveyors drive a mapped route within a defined 30km **Survey Square**. The survey routes cover 15 x 1.609km (1 mile) **Monitoring Transects** each of which is separated by a minimum distance of 3.2km (2 miles). Surveyors are asked to carry out the survey on two dates, one in mid to late July (Survey 1, S1) and one in early to mid-August (Survey 2, S2). Each of the 1.609km transects is driven at 24km (15 miles) per hour while continuously recording using a Batlogger M detector.

In 2024 all surveyors across the island were provided with Batlogger M full spectrum detectors. The Batloggers are pre-loaded with parameters for the survey. Surveyors are asked to affix the detector to the clamp so that the microphone is facing out of the window and slightly to the rear of the car in the same direction as the former set up (time expansion Tranquility detector). The Batlogger records audio and GPS location data to the device's SD card. Surveyors switch the Batlogger on to record at the start of each transect and switch it off at the end. The result is a folder containing multiple matched audio (.wav) and GPS (.xml) files for each survey evening.

The survey coordinator requests that problems arising during the survey season are communicated to BC Ireland so that back up survey teams can be arranged if possible.

On completion of surveys, data is forwarded to BC Ireland for analysis. Teams

were strongly advised to make a backup copy prior to posting the SD card or to upload the data to a Dropbox folder which was provided to them for the survey. In this way, we hoped to prevent loss of survey data due to SD cards becoming corrupted or lost in the post.

Data from Batloggers were analysed using Wildlife Acoustics Kaleidoscope Pro software (both automated and manual settings). At present, manual identifications from Kaleidoscope are being used for all data and trend analysis.

We will continue to assess automated analysis methods and at some point may retrospectively analyse all data when automated identification is considered to be sufficiently high enough quality.

Data from Batloggers were gathered into Excel spreadsheets imported to BCireland's purpose-built Car-based Bat Monitoring MySQL database.

For the purposes of providing volunteer feedback, spreadsheets listing bat species, date, time, location and accuracy were uploaded to Google Maps and bat locations were pinned to a map for each route, with icons of differing colour and shape denoting a particular bat species.

In 2024 training videos continued to be available at the Bat Conservation Ireland YouTube channel.

4.2.1 Analysis

For overall yearly trends of the island-wide populations a Generalised Linear Model with Poisson error distribution is applied to the data. Covariates are used to account for differences between the two detector types. For Nathusius' pipistrelles, however, trends are analysed using a binomial model of presence/absence data.

With regard to separate Northern Ireland-only trends, Northern Ireland is problematic because there are only five squares with data, and less in some years. In the past we have dealt with this by using individual one mile transects as the replicates for the bootstrapping process. This was done due to doubts about the reliability of bootstrapping with small numbers of squares, but is not ideal. In 2023 we explored whether reliable bootstrap confidence limits can be obtained using the standard approach with just five squares. This was done by producing 1000 sets of simulated data for five sites over 15 years for both common and soprano pipistrelles, using a modified version of the programs used in 2009 for the power analyses for the Animal Conservation paper (Roche *et al.*, 2011). Results were good, with 95% confidence limits containing the true index value around 93% of the time. This standard method was applied, using 30km squares as replicates, in analyses for common and soprano pipistrelles, and Leisler's bats in Northern Ireland alone.

For Northern Ireland the models were initially run with the usual base year (i.e. 2006, except for brown long-eared which is 2010), but the confidence limits were wide because the 2006 data is at the start of the series when only three squares were surveyed in Northern Ireland. Using 2010 as the base instead gives tighter confidence limits. The results for NI-only and All-Ireland are presented in this report.

4.2.2 Other Vertebrates

Other vertebrates were also recorded by surveyors. From 2006, surveyors were asked to note all vertebrates including cats on their record sheets. In addition, observers had the facility to record whether each specimen was living or dead and whether each was observed during or after the driven transect. This means that recorders were observing living and dead

vertebrates, other than bats, for approximately 43 miles (69km) on each survey evening.

4.3 Results

4.3.1 Volunteer Uptake in Northern Ireland

Since 2007 between 10 and 13 volunteers have carried out the car survey each year. Surveys are carried out in five 30 x 30km squares. The squares cover parts of Counties Fermanagh/Tyrone, Antrim, Down and Derry (see Figure 4.1).

In 2024, 11 surveyors who are members of Northern Ireland Bat Group (NIBG), Bat Conservation Ireland and interested volunteers, along with their team partners, surveyed all five routes in Northern Ireland. All squares were surveyed twice although data for the second survey in H79 was lost and could not be analysed.

4.3.2 Survey Coverage in 2024 in Northern Ireland

Approximately 240km of monitoring transects were covered in Northern Ireland in 2024. The sound recordings made by the Northern Ireland survey teams were of very high quality. In 2024, approximately 552km of roads were surveyed for vertebrates other than bats (vertebrate sightings are noted along the entire route driven and therefore include the distances in between transects).

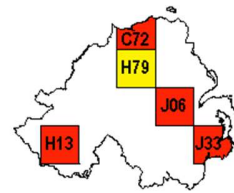


Figure 4.1: Locations of Survey Squares, surveyed for bats in Northern Ireland as part of the Car-based Bat Monitoring Scheme. Red squares were successfully surveyed twice in 2024, the yellow square was successfully surveyed once.

For surveys where GPS data was successfully recorded, it was possible to map bat locations using Google Maps see Figure 4.2.

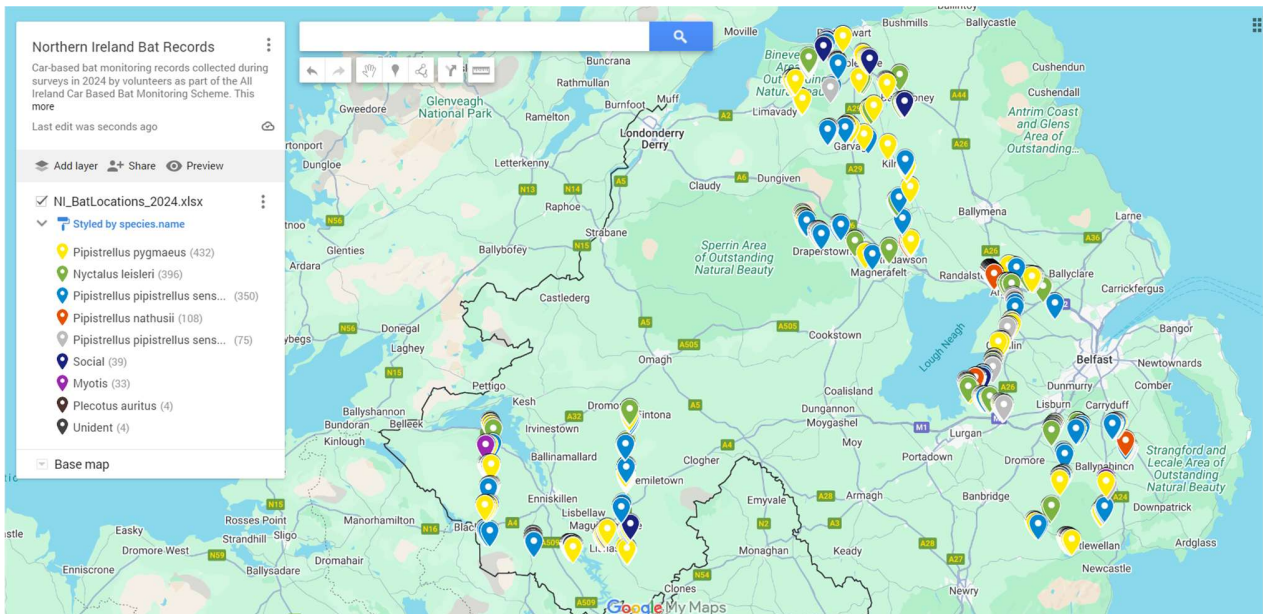


Figure 4.2: Locations of bat records from the car-based bat monitoring scheme in Northern Ireland, 2024, Batlogger Detectors. Map produced using Google Maps.

4.3.3 Roadside Bat Species in 2024 in Northern Ireland

A pie-chart illustrating overall proportions of bat species encountered in Northern Ireland in 2024 is shown in Figure 4.3. Figure 4.4 shows the same breakdown, but for the entire island. The proportion of passes per species varies somewhat between the

whole island and Northern Ireland. For example, Leisler's bats and Nathusius' pipistrelles account for a greater proportion of bat passes in Northern Ireland, while the proportion of common pipistrelles encountered is lower in Northern Ireland than in the island as a whole.

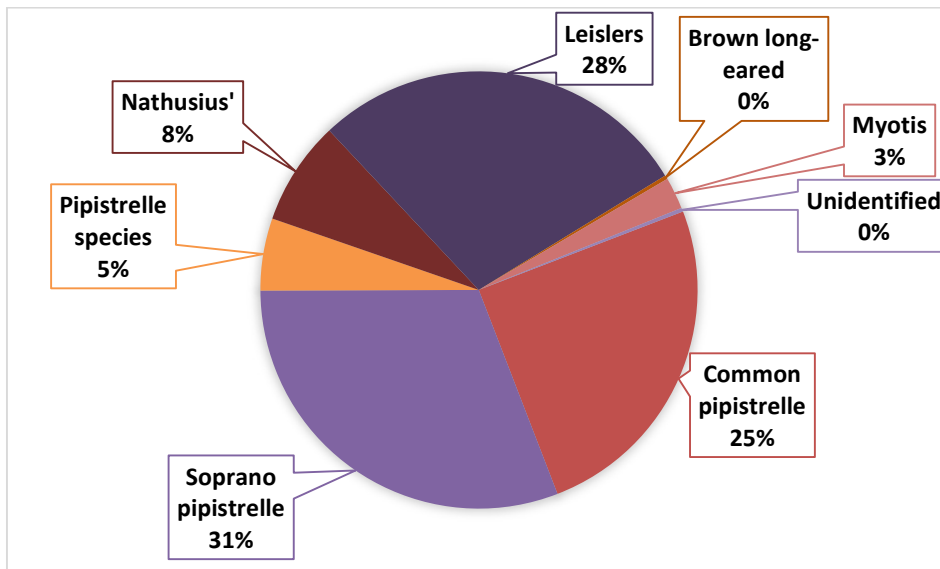


Figure 4.3: Proportion of bat species encountered during the 2024 survey from nine surveys in Northern Ireland using Batlogger detectors. Total number of encounters n=1,402. Excepting social calls of Leisler's bats and brown long-eared bats, which are unlikely to be mistaken for those of other species, bat social calls were noted during sonogram analysis but are not included in the above pie chart or in any statistical analyses

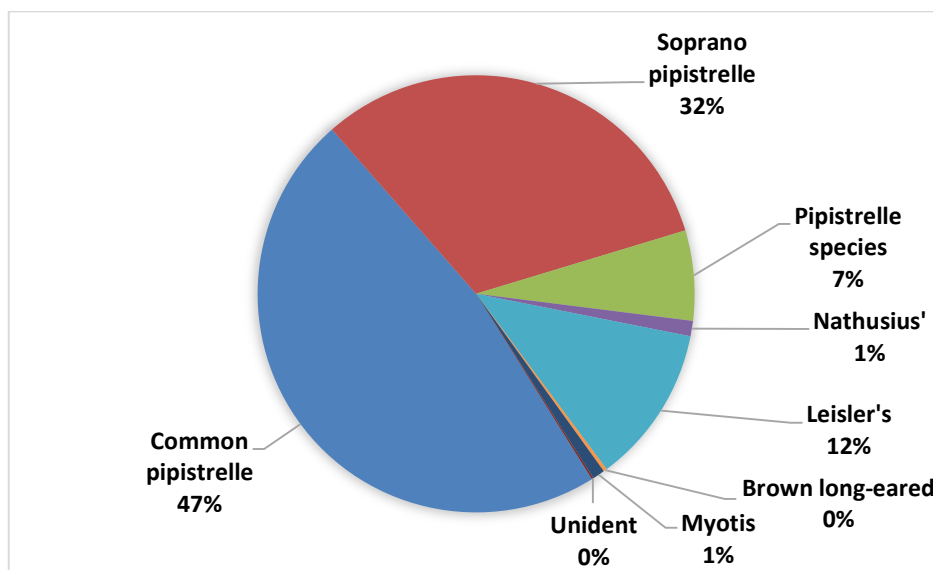


Figure 4.4: Proportion of bat species encountered (Batlogger Detectors) during the survey of the entire island of Ireland in 2024. Total number of bat encounters n=12,740. Excepting social calls of Leisler's bats and brown long-eared bats, which are unlikely to be mistaken for those of other species, bat social calls are not included in the above pie chart or in any statistical analyses.

A detailed break-down of Batlogger detector results for each survey square in Northern Ireland in 2024, not corrected to number of bat encounters per hour or per square, is shown in Table 4.1. Average encounter rates (per hour) for Northern Ireland in 2024, in comparison with the

whole island are shown in Table 4.2. While encounter rates for some bat species in Northern Ireland are typically lower than the island-wide average, in 2024 average encounter rates were higher here for Nathusius' pipistrelles and Leisler's bats.

Table 4.1: All bat encounters from Northern Ireland car-based bat monitoring survey squares, 2024.

Square - Survey	Transects	Common pip *	Soprano pip*	Unknown pip*	Nath pip*	Leisler's bat	Brown long-eared	Myotis species	All bats
C72_1	15	16	21	3		22			63
C72_2	15	12	37	1		56			106
H13_1	15	113	85	14	3	46		10	271
H79_1	15	53	85	18		6	1	6	169
H79_2	15	34	36	6	4	55	1		136
J06_1									
J06_2	15	19	41	5	21	63		9	161
J33_1	15	28	51	16	77	72	1	4	249
J33_2	10	40	24	6	3	56	1	4	134
TOTAL		350	432	75	108	396	4	33	1402

*Common pip: common pipistrelle (*Pipistrellus pipistrellus*); Soprano pip: soprano pipistrelle (*P. pygmaeus*); Unknown pip: Unknown pipistrelle; Nath pip: Nathusius' pipistrelle (*P. nathusii*)

Table 4.2: Average bat encounter rates (per hour) in 2024 in each Northern Ireland survey square, for Northern Ireland as a whole (n=9), and the whole island (n=52).

	Common pip *	Soprano pip*	Unknown pip*	Nath pip*	Leisler's bat	Brown long-eared	Myotis spp.	All bats
C72	12.56	26.43	1.77	0.00	35.75	0.00	0.00	76.95
H13	63.91	65.50	12.33	1.15	20.00	0.39	6.16	169.44
H79	30.06	31.83	5.30	3.54	48.62	0.88	0.00	120.24
J06	17.15	33.70	7.55	35.17	49.54	0.35	4.87	149.49
J33	34.23	36.20	5.51	1.24	33.26	0.41	1.65	112.51
Northern Ireland	31.75	39.50	6.63	8.74	36.19	0.35	2.82	126.33
<i>All-Ireland</i>	<i>102.58</i>	<i>67.99</i>	<i>14.32</i>	<i>2.12</i>	<i>24.89</i>	<i>0.56</i>	<i>1.93</i>	<i>214.70</i>

*Common pip: common pipistrelle (*Pipistrellus pipistrellus*); Soprano pip: soprano pipistrelle (*P. pygmaeus*); Unknown pip: Unknown pipistrelle; Nath pip: Nathusius' pipistrelle (*P. nathusii*)

As in previous years, the overall common pipistrelle encounter rate recorded from Northern Ireland squares in 2024 (31.75hr⁻¹) was lower than the island-wide average (102.6hr⁻¹) (See Table 4.2).

The average encounter rate for soprano pipistrelles for Northern Ireland (39.5hr⁻¹) was also lower than the island-wide average (67.99hr⁻¹).

Encounter rates with Leisler's bat have been variable over the years and Northern Ireland's encounter rate of 36.2hr⁻¹ in 2024 was slightly higher than the island-wide average of 24.9hr⁻¹.

While *Nathusius' pipistrelles* were absent from Car-based Bat Monitoring survey recordings in Northern Ireland in 2008, in 2009 this species was recorded from three Northern Irish 30km squares. It has been recorded in Northern Ireland every year since then, generally in one or two survey squares, one of which usually includes J06. Survey square J06 is situated along the eastern shores of Lough Neagh. In 2024 *Nathusius' pipistrelle* was recorded from H13, H79, J06 and J33.

4.3.4 Bat Records

All bat records derived from the Car-based-bat Monitoring Scheme for Northern Ireland have been forwarded to the BCT and CEDaR, as in previous years.

4.3.5 Roadside Bat Trends

The following graphics for both all-island and Northern Ireland roadside bat trends from both Tranquility and Batlogger detectors are derived from Poisson GLM models with GAM smoothing (for common pipistrelle, soprano pipistrelle, Leisler's bat

and *Myotis* spp.) and a covariate for detector type.

The trend for *Nathusius' pipistrelle* (all-Ireland), however, is a binomial GLM model (also with a covariate for detector) based on the proportion of one mile transects passes of this species.

A Northern Ireland-only trend (Poisson GLM) is shown for three species: common pipistrelle, soprano pipistrelle and Leisler's bats, although the error bars for Leisler's bats are extremely wide. Trends for remaining species in Northern Ireland alone are not provided due to the very wide confidence limits.

As can be seen from the graphs (Figures 4.5-4.10), common pipistrelles, soprano pipistrelles and Leisler's bats significantly increased during the monitoring period (2003-2024) across Ireland. The trends for Northern Ireland show similar levels of increase for soprano and Leisler's bats, albeit with much wider error bars. However, for common pipistrelles, a drop in the yearly estimate for Northern Ireland in 2024 meant that the lower confidence interval dropped below the baseline. The increases in Northern Ireland for soprano pipistrelle and Leisler's bat are considered significant since the lower error bars of both are above the 2010 baseline.

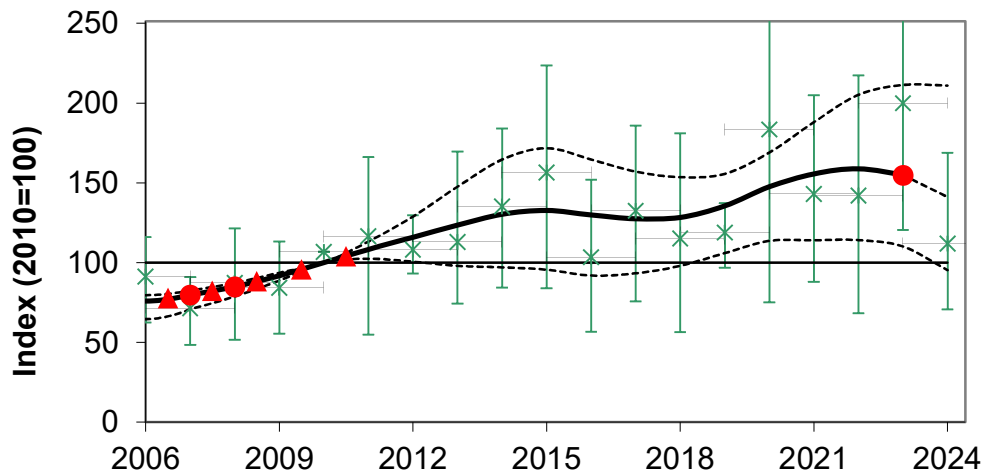


Figure 4.5: Results of the GAM/GLM model for **common pipistrelle, Northern Ireland** only. Points are estimated annual means derived from the Generalised Linear Model (GLM) and the bars are 95% bootstrapped confidence limits. The heavy black line is the fitted Generalised Additive Model (GAM) curve with 95% confidence limits shown by the lighter black lines. Both Tranquility and Batlogger data are included, with a covariate for detector to adjust for their different sensitivities. The response variable is the number of snapshots/soundfiles with the species present. The log of total survey time is used as an offset. The end of the smoothed trend is shown with a broken line to illustrate uncertainty for 2023-2024 and the possibility that the slope will change with coming years' data. Red circles indicate significant ($P < 0.05$) change points, where the slope of the smoothed trend line changes. Red triangles indicate that the difference in the smoothed index between consecutive years is statistically significant ($P < 0.05$).

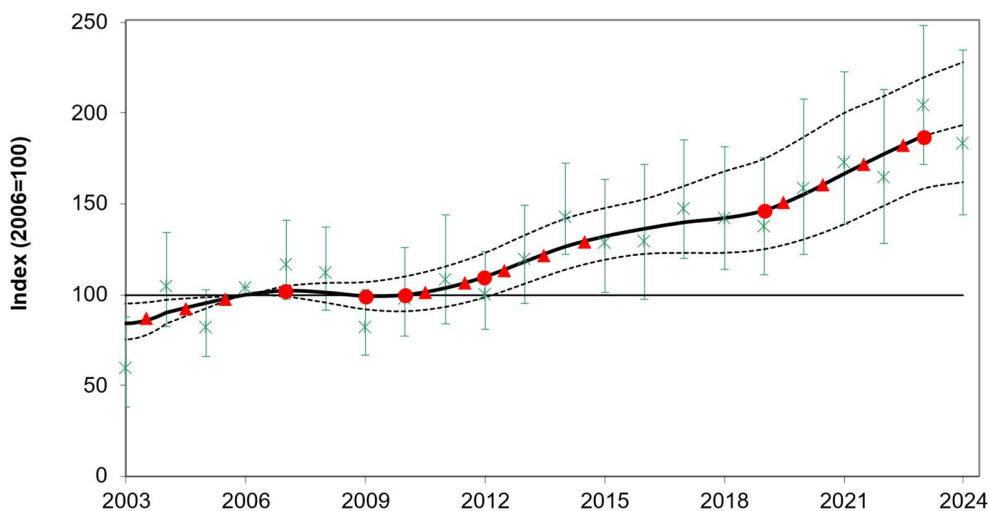


Figure 4.6 (previous page): Results of the GAM/GLM model for **common pipistrelle, all-Ireland**. Points are estimated annual means derived from the Generalised Linear Model (GLM) and the bars are 95% bootstrapped confidence limits. The heavy black line is the fitted Generalised Additive Model (GAM) curve with 95% confidence limits shown by the lighter black lines. Both Tranquility and Batlogger data are included, with a covariate for detector to adjust for their different sensitivities. The response variable is the number of snapshots/soundfiles with the species present. The log of total survey time is used as an offset. The end of the smoothed trend is shown with a broken line to illustrate uncertainty for 2023-2024 and the possibility that the slope will change with coming years' data. Red circles indicate significant ($P < 0.05$) change points, where the slope of the smoothed trend line changes. Red triangles indicate that the difference in the smoothed index between consecutive years is statistically significant ($P < 0.05$).

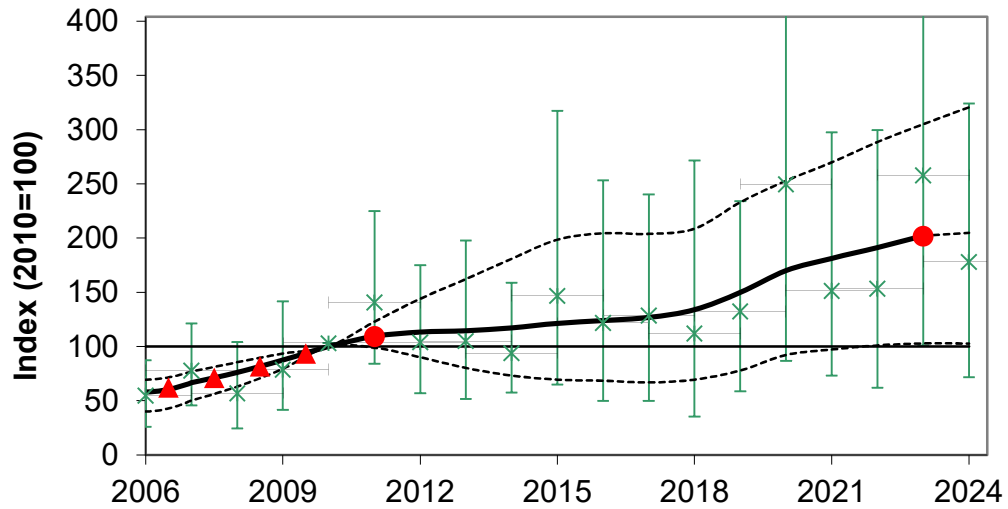


Figure 4.7: Results of the GAM/GLM model for **soprano pipistrelle, Northern Ireland only**. Points are estimated annual means derived from the Generalised Linear Model (GLM) and the bars are 95% bootstrapped confidence limits. The heavy black line is the fitted Generalised Additive Model (GAM) curve with 95% confidence limits shown by the lighter black lines. Both Tranquility and Batlogger data are included, with a covariate for detector to adjust for their different sensitivities. The response variable is the number of snapshots/soundfiles with the species present. The log of total survey time is used as an offset. The end of the smoothed trend is shown with a broken line to illustrate uncertainty for 2023-2024 and the possibility that the slope will change with coming years' data. Red circles indicate significant ($P < 0.05$) change points, where the slope of the smoothed trend line changes. Red triangles indicate that the difference in the smoothed index between consecutive years is statistically significant ($P < 0.05$).

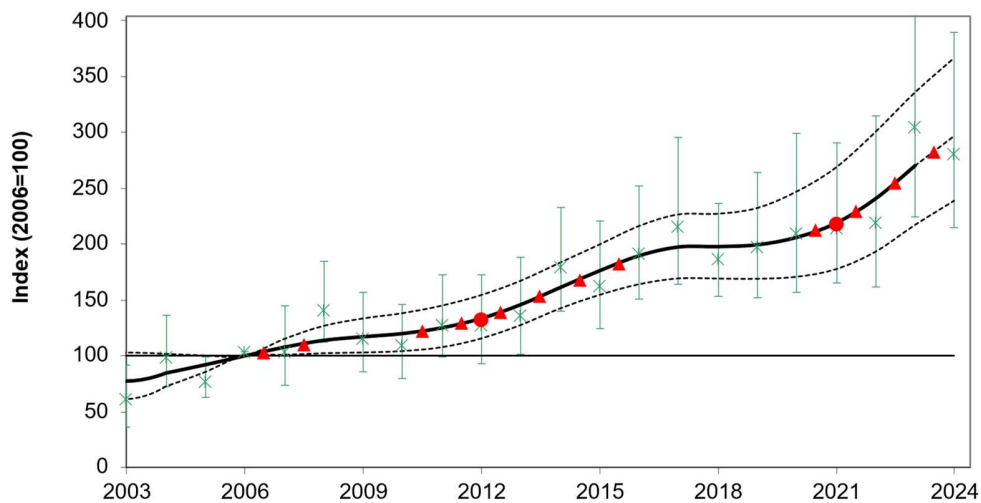


Figure 4.8: Results of the GAM/GLM model for **soprano pipistrelle all-Ireland**. Points are estimated annual means derived from the Generalised Linear Model (GLM) and the bars are 95% bootstrapped confidence limits. The heavy black line is the fitted Generalised Additive Model (GAM) curve with 95% confidence limits shown by lighter black lines. Both Tranquility and Batlogger data are included, with a covariate for detector to adjust for their different sensitivities. The response variable is the number of snapshots/soundfiles with the species present. The log of total survey time is used as an offset. The end of the smoothed trend is shown with a broken line to illustrate uncertainty for 2023-2024 and the possibility that the slope will change with coming years' data. Red circles indicate significant ($P < 0.05$) change points, where the slope of the smoothed trend line changes. Red

triangles indicate that the difference in the smoothed index between consecutive years is statistically significant ($P < 0.05$).

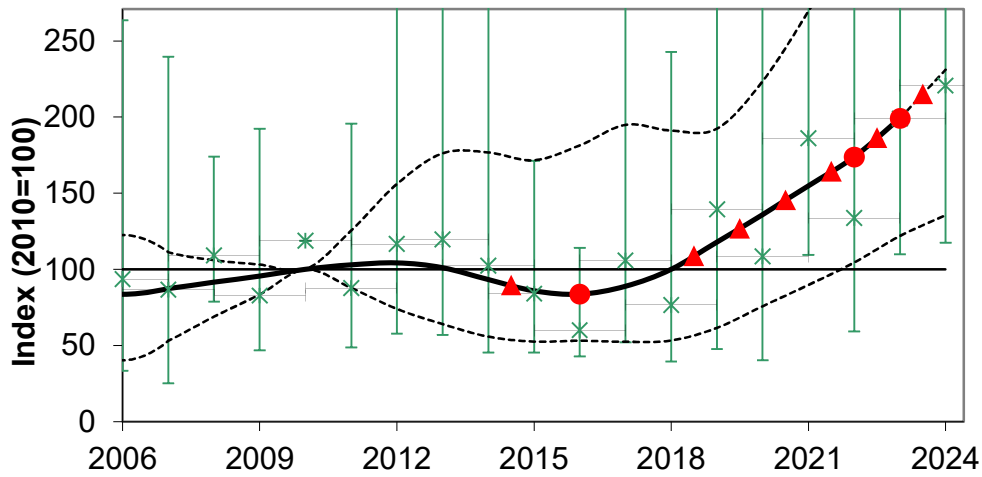


Figure 4.9: Results of the GAM/GLM model for **Leisler's bat, Northern Ireland only**. Points are estimated annual means derived from the Generalised Linear Model (GLM) and the bars are 95% bootstrapped confidence limits. The heavy black line is the fitted Generalised Additive Model (GAM) curve with 95% confidence limits shown by the lighter black lines. Both Tranquility and Batlogger data are included, with a covariate for detector to adjust for their different sensitivities. The response variable is the number of snapshots/soundfiles with the species present. The log of total survey time is used as an offset. The end of the smoothed trend is shown with a broken line to illustrate uncertainty for 2023-2024 and the possibility that the slope will change with coming years' data. Red circles indicate significant ($P < 0.05$) change points, where the slope of the smoothed trend line changes. Red triangles indicate that the difference in the smoothed index between consecutive years is statistically significant ($P < 0.05$).

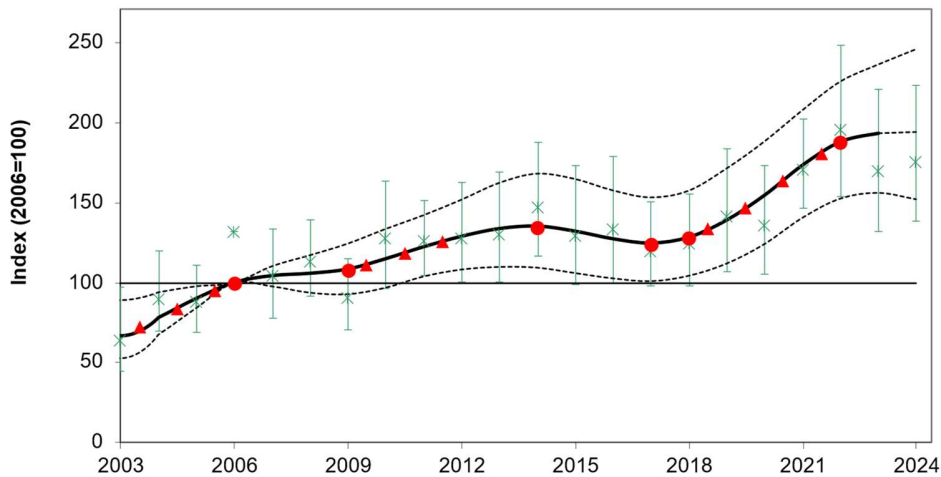


Figure 4.10: Results of the GAM/GLM model for **Leisler's bat** passes per survey (all Ireland). Points are estimated annual means derived from the Generalised Linear Model (GLM) and the bars are 95% bootstrapped confidence limits. The heavy black line is the fitted Generalised Additive Model (GAM) curve with 95% confidence limits shown by the lighter black lines. Both Tranquility and Batlogger data are included, with a covariate for detector to adjust for their different sensitivities. The response variable is the number of snapshots/soundfiles with the species present. The log of total survey time is used as an offset. The end of the smoothed trend is shown with a broken line to illustrate uncertainty for 2023-2024 and the possibility that the slope will change with coming years' data. Red circles indicate significant ($P < 0.05$) change points, where the slope of the smoothed trend line

changes. Red triangles indicate that the difference in the smoothed index between consecutive years is statistically significant ($P < 0.05$).

Nathusius' pipistrelle (Figure 4.11) appeared to be significantly increasing until 2022, a low estimate in 2023 means that the lower error bar dipped below the baseline. Error bars are particularly wide for *Nathusius' pipistrelle*, due to the low number of records for the species.

Relatively few encounters with *Myotis* spp. are recorded every year. Nonetheless the

use of the Batlogger has resulted in reduced error bars for this species group index. The decline we observed in this species group for six years running, levelled out a little in 2022 and the higher yearly estimates in 2023 and 2024 means that upper error bars now encompass the baseline, see Figure 4.12.

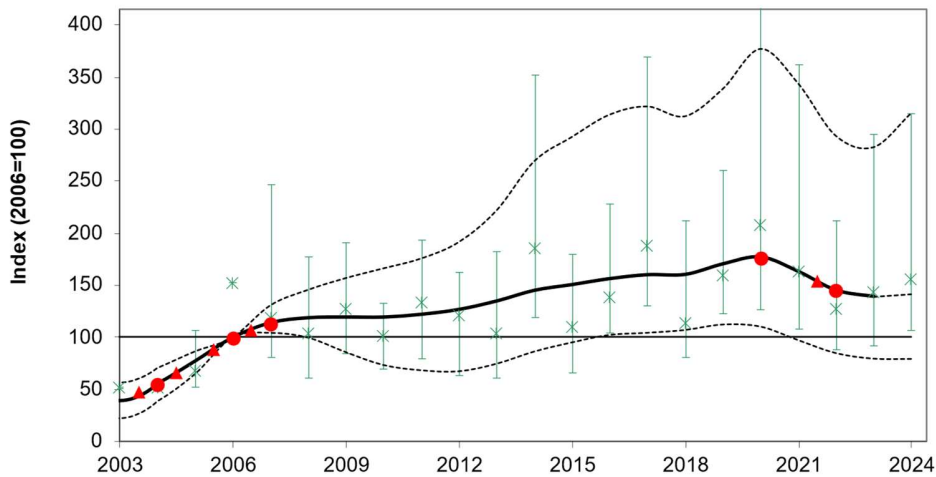


Figure 4.11: Results of Binomial GLM modeling for proportion of transects with ***Nathusius' pipistrelle*** present, all-Ireland. The black line is the smoothed GAM curve, with 95% confidence limits shown by the lighter black lines. Points are estimated annual means and are shown to illustrate the variation about the fitted line. The end of the smoothed trend is shown with a broken line to illustrate uncertainty for 2023-2024 and the possibility that the slope will change with coming years' data. Red circles indicate significant ($P < 0.05$) change points, where the slope of the smoothed trend line changes. Red triangles indicate that the difference in the smoothed index between consecutive years is statistically significant ($P < 0.05$).

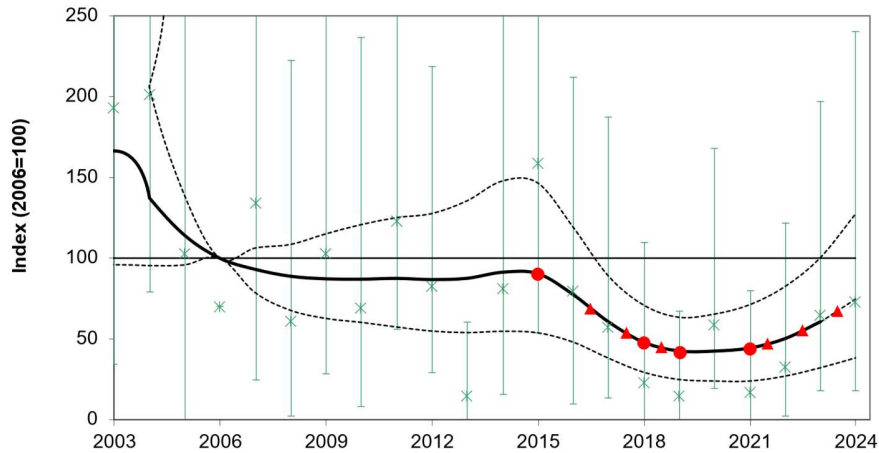


Figure 4.12: Results of the GAM/GLM model for *Myotis spp.* passes per survey. Points are estimated annual means derived from the Generalised Linear Model (GLM) and the bars are 95% bootstrapped confidence limits. The heavy black line is the fitted Generalised Additive Model (GAM) curve with 95% confidence limits shown by the lighter black lines. Both Tranquility and Batlogger data are included, with a covariate for detector to adjust for their different sensitivities. The response variable is the number of snapshots/soundfiles with the species present. The log of total survey time is used as an offset. The end of the smoothed trend is shown with a broken line to illustrate uncertainty for 2023-2024 and the possibility that the slope will change with coming years' data. Red circles indicate significant ($P < 0.05$) change points, where the slope of the smoothed trend line changes. Red triangles indicate that the difference in the smoothed index between consecutive years is statistically significant ($P < 0.05$).

4.3.6 Other Vertebrates on Roadsides in Northern Ireland in 2024

Domestic cats were the most frequently encountered vertebrate species during the car surveys ($n=17$, 55%). Foxes were the

second most frequently encountered species ($n=7$, 23%). Other species recorded were badgers ($n=4$) and one specimen each of mouse, deer and hedgehog. No dead vertebrates were recorded by surveyors in Northern Ireland in 2024.

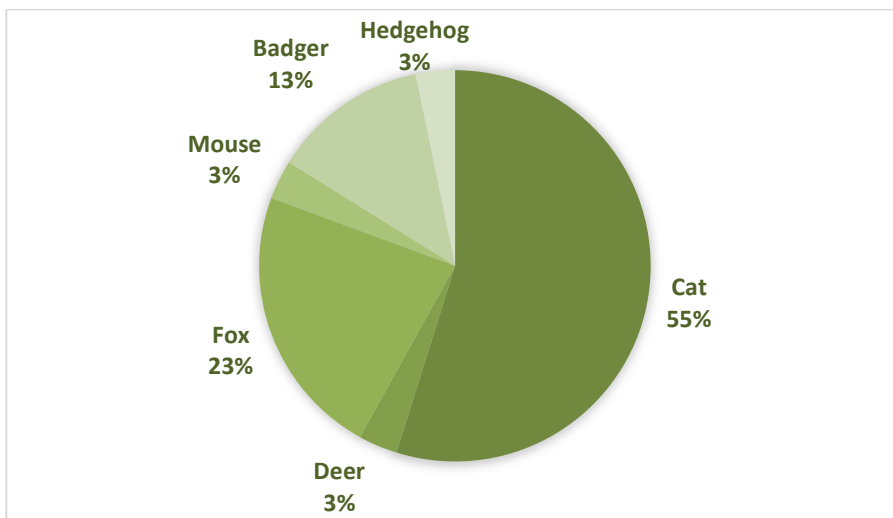


Figure 4.12: Living vertebrates, other than bats, observed during car-based bat monitoring surveys in Northern Ireland, 2024, $n=31$ from eight surveys.

4.4 Discussion

Car-based Bat Monitoring surveys have been successfully carried out in Northern Ireland from 2006 to 2024. We trained in two new Northern Irish survey teams in 2024 via Zoom.

While yearly encounter rates vary widely, in general, common pipistrelles are usually recorded less frequently in Northern Ireland than on the island as a whole. Since the common pipistrelle is more abundant towards the centre and south of the island (e.g. see Lundy *et al.* 2011), lower encounter rates with this species may be anticipated in the north. This may be due to cooler climate and/or differing habitat types in northern parts of the island. The all island trend for common pipistrelle has been one of steady increases. Although the estimate for 2024 (all Ireland) was lower than the previous year, this did not make much impact on the upward trend. On the other hand increases by common pipistrelles in Northern Ireland have not been as consistent. In the medium term (12 years since 2012), the common pipistrelle has increased on an all island basis by 4.82% per annum, while in Northern Ireland the increase has been much more moderate at 1.66% per annum.

Average roadside encounter rates of soprano pipistrelles in Northern Ireland vary somewhat but, on the whole, tend to be roughly similar to island-wide levels. The soprano pipistrelle has increased significantly since the start of the survey – its all-island roadside population increased by 121% from 2012-2024, a per annum increase of 6.87%. The Northern Ireland only trend has been similar over the past 12 years with a 5.06% per annum increase. It showed a slight dip in 2021-2022 but increased yearly estimates in 2023 and

2024 meant that the trend resumed upwards.

Nathusius' pipistrelles are recorded more often in Northern Ireland than the island-wide or Republic of Ireland average. Nathusius' pipistrelle was recorded from squares J06, H79, H13 and J33 in Northern Ireland in 2024. The species has been recorded in square J06 in most years of the survey. This survey route is situated close to Lough Neagh which is considered the stronghold for the species. Nathusius' pipistrelle is not specifically targeted by this monitoring scheme due to its overall low encounter rate. However, a binomial model of Nathusius' encounters for the whole island is used (e.g. see Roche *et al.*, 2013). Nathusius' pipistrelle showed an increasing trend in the early years of the survey. This then stabilized somewhat and has recently shown a decrease so the error bars again encompass the baseline (despite correcting for the change in bat detector type).

Numbers of Leisler's bats increased significantly from 2003 to a peak in 2014 and then declined from 2015 to 2018. However, 2019 to 2024 saw a resumption of an increasing trend. Over the past 12 years (2012-2023) the all Ireland roadside population of Leisler's bats has increased by 50.9%, or 3.5% per annum. In Northern Ireland the species has also been increasing, albeit at a higher rate. Over the past 12 years in Northern Ireland Leisler's bats increased by a total of 121.7% or 6.9% per annum.

Over the 21 years of the survey (2003-2024) the *Myotis* bat composite index has declined by 3.8% per annum. However, this decline has recently levelled out and the more recent, six year trend (2018-2024), has been upwards at a rate of 7.6% per annum.

5.0 WOODLAND BAT MONITORING

5.1 Introduction

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. These species rely mainly on woodland habitat for foraging opportunities (Smith and Racey, 2008). Brown long-eared bats (*Plecotus auritus*) are also strongly associated with woodlands and deciduous trees (Swift 1998; Murphy, Greenaway and Hill, 2012).

In 2023, BCIreland conducted a pilot woodland monitoring scheme targeting these species. We received a funding commitment through the DAERA Environment Fund towards this project. However, we were notified of the funding too late to undertake field work in Northern Ireland. Instead, we focused on carrying out the pilot scheme in ROI along with collecting reference echolocation call data for a call library across the island, including sites in Northern Ireland.

Ten sites were surveyed during the 2023 pilot. These were located in counties Cavan (four sites), Kildare (one site), Meath (one site), and Wicklow (four sites). At each of these sites we used five of passive (static) bat detectors left in situ recording all night for up to five nights on three separate survey periods (June, July and August). Simultaneously, we carried out post-sundown walking transects in each woodland while using Anabat Scout bat detectors once in each month of June, July and August.

The primary objectives of the pilot scheme were to trial the use of these two different survey methods 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.

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 conducted in 2024.

In 2024, we expanded the scheme to include new sites in the ROI as well as establishing several sites in Northern Ireland.

5.2 Methods

5.2.1 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) That 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 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 to the site was conducted to walk the survey route and if it was suitable, to designate the survey stopping points (outlined in Section 5.2.3). Where site visits by the scheme coordinator were not possible either due to time constraints or large travelling distances to the sites involved, the walking route was set out by the volunteer who would be conducting the survey, 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.

5.2.2 Volunteer recruitment and training

Volunteers were recruited mainly 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 in the ROI, and also the NPWS (ROI). In NI, volunteers were mainly 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 volunteers training was in person on the 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, end and all of the survey stopping points along the walking route.

5.2.3 Monitoring

A walking route of approximately 4km in length is mapped in each woodland. These transects include five stopping points, each representative of different types of habitats in the woodland. At each woodland site at least one of the stopping points is at an interface between agricultural or grassland landscape and woodland edge to increase the likelihood of detecting Natterer's bat.

The device used for walking transects is an Anabat Scout (Titley Scientific), which is a full spectrum bat detector. Transects consist of walking at a pace of approx. 3.4km an hour along the walking route with the detector turned on. At each of the five stopping points, surveyors stop for a period of five minutes, rotating themselves and the detector to face in different directions.

Walking transects typically take 1.5hrs to complete. Transects were carried out

three times at each site over the course of the summer with one survey conducted in each of the months of June, July, and August.

All recorded data from each Anabat Scout device was processed using Kaleidoscope Pro software. For more detailed information about the protocol used to analyse these data, see the final report 'All-Ireland Woodland Bat Monitoring Scheme: Report for 2024 (Clarke, Langton and Roche, 2025).

5.2.4 Statistical power analysis

The power analyses described in Section 5.3.2 use 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 (2000), changing the number of sites and years considered in order to determine the numbers required to detect change with 80% power.

5.2.5 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.

5.3 Results

5.3.1 Overall Results

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 2.

Table 5.1 shows a summary of the total number of audio files recorded for each species of interest in the survey. 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.

Table 5.2 also shows a comparison of annual means for each species as the mean number of audio files per transect recorded in the 2023 and 2024 surveys.

Table 5.1. Overall number of files from each species of interest recorded during the All-Ireland Woodland Bat Monitoring Scheme in 2024.

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

Table 5.2. Mean no. of audio files 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 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.

There were also differences in activity between the different months (Figure 5.1) 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.

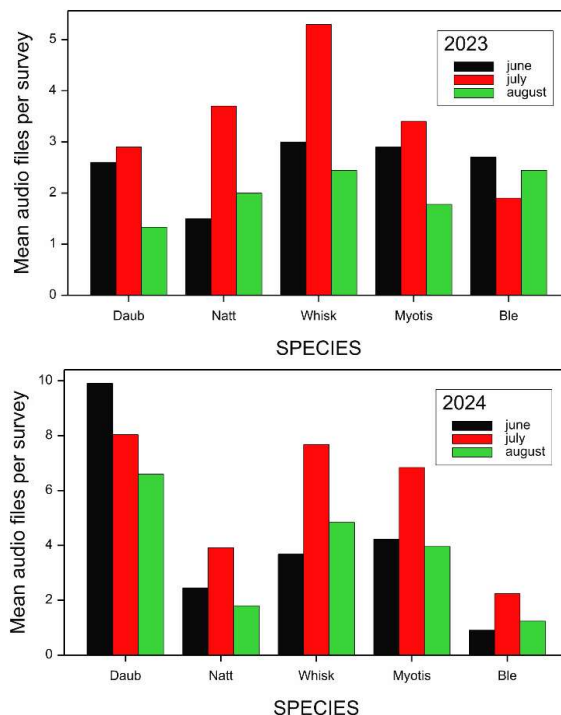


Figure 5.1: mean numbers of audio files per survey recorded in each month in 2023 and 2024.

5.3.2 Power analysis results

Results in Table 5.3 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 5.3. Number of years taken for walked transects to detect change with 80% power using various numbers of sites.

species change	Natterer's Bat		Whiskered bat	
	Amber	red	amber	red
N sites				
10	>25	23	>25	24
20	>25	17	>25	17
50	22	12	25	12
75	19	10	21	11
100	17	9	19	10

5.3.3 Northern Ireland Results

Either whiskered or Natterer's bat calls were recorded at each of the sites surveyed in Northern Ireland in 2024. Both whiskered and Natterer's bat were recorded at six of the nine sites surveyed (66.7%), while two sites recorded the presence of Natterer's bat only and one site recorded whiskered bat only. A map of these results is displayed in Figure 5.2.

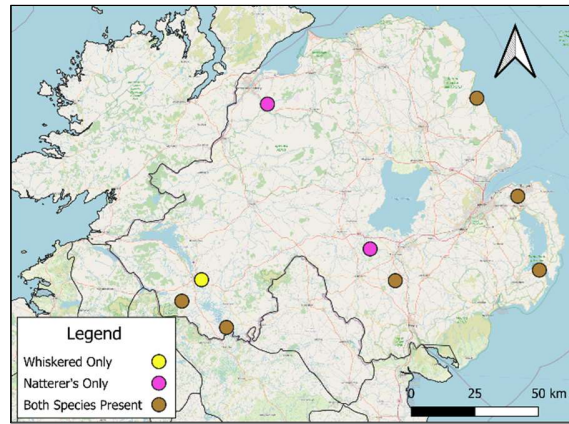


Figure 5.2. Woodland sites surveyed in NI in 2024. Brown circles indicate sites where both whiskered and Natterer's bats were recorded, pink circles represent sites where only Natterer's bat was recorded and yellow circles represent sites where only whiskered bats were recorded.

A breakdown of the different target species in terms of how many audio files were recorded and the percentage of sites in NI that these were found at, is displayed below (Table 5.4).

Table 5.4. The number of audio files and the percentage of sites that these were found at during the woodland bat monitoring scheme in NI in 2024.

Species	No. of files	% of sites
Whisk	159	77.8
Natt	74	88.9
Daub	318	77.8
<i>Myotis</i> spp.	184	100
BLE	45	88.9

5.4 Discussion

Given the paucity of information regarding the status of woodland bat species in Ireland, there is an urgent need to establish an island-wide annual monitoring scheme for woodland bats. Woodland coverage across the island of Ireland is low compared to other European countries, 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.

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 good survey coverage for 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 recruitment of sites and the provision of volunteers to the scheme in 2024, which was instrumental to its success.

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 these woodland bats at the monitoring sites included so far. 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 (see Table 5.2) so it remains to be seen if this will be a trend in future years.

There was a large number of audio files containing Daubenton's bat (Table 5.1), with more than half of these being from surveys carried out in NI. Some of this can be attributed to random variation, but there were two particular sites in NI (Glenarm Forest and Clandeboye Estate) that had a large amount of Daubenton's bat activity (See Appendix 2 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 concerted effort will be made to only select sites where it is less likely to encounter large amounts of Daubenton's bat activity during the walking transects i.e. avoiding sites with walking routes directly around lakes or along rivers which is their most prominent foraging habitat.

In 2024, surveys were carried out at 26 sites. A statistical power analysis of this data suggests that this would be sufficient to detect red alert declines (50% decline over 25 years) within 15-20 years. This is reasonable, but 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 project that by 2028 there will be 70-75 sites included in the scheme, which will further reduce the number of survey years required to detect alert level changes.

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 (see the report by Clarke, Langton and Roche (2025) for full details), with the latter option being more achievable for volunteers and more favourable in terms of the timing and management of the scheme. Therefore, we have decided to proceed with two surveys at each site from 2025 onwards.

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8.0 GLOSSARY

Bootstrapping

This is a method for estimating the sampling distribution of an estimator by resampling with replacement from the original sample. In the context of population indices the resampling is done for entire sites and ensures that confidence limits and significance levels are unaffected by any temporal correlation in the data. It also allows for the effects of 'overdispersion' which occurs when data are more variable than expected from a Poisson distribution.

Covariate

This is a variable that is possibly predictive of the outcome under study. A covariate may be of direct interest or be a confounding variable or effect modifier.

Doppler Effect

Apparent change in frequency of a sound (measured in kilohertz, kHz) as a result of movement, either of the source or the observer. The apparent frequency of a sound increases as the source of the sound moves towards an observer or the observer move towards it and decreases as the source moves away from an observer or the observer moves away from it.

GLM

Generalised Linear Model: a generalisation of ordinary regression and analysis of variance models, allowing a variety of different error distributions and different link functions between the response variable and the explanatory variables. The models used here have a Poisson error distribution and a logarithmic link.

GAM

Generalised additive model: these models allow a smooth, non-parametric curve to be fitted to an explanatory variable, within a GLM. In estimating population indices they are used to smooth out year-to-year variation (Fewster *et al.* 2000).

Offset

A covariate with a fixed slope of 1.0, in this case implying that the total count doubles if the number of recording intervals doubles.

Poisson Distribution

The Poisson distribution is a discrete probability distribution. It expresses the probability of a number of events occurring in a fixed time if these events occur with a known average rate, and are independent of the time since the last event. It is frequently used as the basis of statistical models of counts of organisms or events.

Power Analysis

Analysis of the power (probability) to reject a false null hypothesis. A test with high power has a large chance of rejecting the null hypothesis when this hypothesis is false. In the case of the present project the null hypothesis would state that there is no decline in bat populations. Power is measured as a percentage, and greater power reflects the increased likelihood of detecting a declining trend (as outlined for Red or Amber Alerts). The power analysis carried out for the present project is one-tailed (i.e. examines a declining trend only) at $P=0.05$ (which is equivalent to $P=0.1$ for a two sided test).

REML

Restricted (or residual) maximum likelihood (REML) is a method for fitting linear mixed models. In contrast to conventional maximum likelihood estimation, REML can produce unbiased estimates of variance and covariance parameters. This method assumes the data are normally distributed.

9.0 APPENDIX 1

All-Ireland Daubenton's Bat Waterway Survey

Note: All waterway site results received by February 2024 were submitted for analysis. Similarly, waterway sites received late from previous years of monitoring will have been added, subsequently, to the dataset for future analysis. Consequently, the totals for each year will differ from previous reports.

Summary statistics

Table 1: basic stats shown by year and province. The final column refers to surveys with either sure or unsure Daubenton's passes. All values are per completed survey of 10 spot counts. Excludes surveys outside days 205-250.

a) Ulster

Year	n complete surveys	mean sure	mean unsure	all	All (max 48 per spot)	% surveys with bats	% spots with bats
2006	35	32.1	16.9	49.0	48.4	88.6	53.7
2007	49	29.9	8.7	38.6	37.7	95.9	56.9
2008	61	39.8	9.9	49.7	48.7	96.7	56.9
2009	80	46.0	9.6	55.6	53.1	95.0	60.2
2010	93	48.8	7.5	56.3	53.0	90.3	58.2
2011	96	54.1	9.5	63.6	59.5	92.7	62.7
2012	81	50.7	9.4	60.1	57.0	93.8	60.7
2013	83	32.2	8.2	40.5	38.9	89.2	53.3
2014	110	30.8	6.6	37.4	34.4	91.8	45.0
2015	97	47.4	6.3	53.6	51.8	88.7	58.0
2016	87	42.0	5.9	47.9	46.7	92.0	56.3
2017	72	47.9	8.9	56.8	52.2	95.7	61.6
2018	96	37.5	7.0	44.5	43.2	90.3	56.0
2019	93	30.7	6.8	37.5	36.7	90.3	52.9
2020	96	33.3	3.8	37.1	36.6	92.7	51.5
2021	96	27.6	4.7	32.3	32.2	89.6	49.9
2022	80	27.9	4.0	31.9	31.0	87.5	49.0
2023	78	28.8	4.6	33.4	32.9	97.1	55.3
2024	78	40.7	6.9	47.6	43.2	83.9	57.9
All years	1561	38.6	7.2	45.8	43.9	91.7	55.3

b) All Ireland

Year	n complete surveys	mean sure	mean unsure	all	All (max 48 per spot)	% surveys with bats	% spots with bats
2006	252	47.6	21.3	68.8	57.8	93.2	59.1
2007	382	41.6	7.7	49.3	47.4	91.6	54.8
2008	311	37.7	7.0	44.7	42.5	90.7	53.1
2009	375	45.8	8.1	53.9	50.8	90.5	55.2
2010	402	51.7	9.3	60.9	57.8	93.8	61.6
2011	409	51.6	10.4	62.1	59.0	93.9	62.4
2012	399	44.0	9.6	53.6	51.9	93.2	58.9
2013	416	41.7	8.2	50.0	47.8	89.6	54.7
2014	474	40.2	8.1	48.3	44.2	89.9	52.9
2015	467	44.5	8.2	52.7	49.9	91.0	56.7
2016	442	45.8	7.9	53.7	49.5	89.4	56.1
2017	416	47.2	8.7	55.9	50.8	91.8	57.2
2018	426	45.9	7.0	52.9	49.2	88.0	54.3
2019	426	37.4	6.9	44.4	42.5	89.2	51.9
2020	415	38.8	6.1	44.9	43.3	92.0	52.4
2021	418	38.4	7.0	45.4	44.1	90.4	52.2
2022	439	44.1	8.1	52.2	47.8	89.7	54.2
2023	446	39.2	8.7	47.8	44.4	93.6	56.1
2024	466	48.1	10.8	58.9	56.0	91.1	63.9
All years	7781	43.6	8.6	52.2	49.0	91.1	56.1

10.0 APPENDIX 2

Woodland	Grid Ref.	WT Date	No. of audio files with the following bat species				
			Natt	Whisk	Daub	Myo	BLE
Ardress 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
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
		27/08/2024	0	0	4	8	2

Woodland	Grid Ref.	WT Date	No. of audio files with the following bat species				
			Natt	Whisk	Daub	Myo	BLE
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