Irish Bat Monitoring Schemes

Annual Report for 2025

Roche N., Clarke, D., Healy, K., & Langton S. (2026)

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1.0 EXECUTIVE SUMMARY

This annual report provides information on monitoring schemes managed by Bat Conservation Ireland:

- Car-Based Bat Monitoring (All Ireland)
- All Ireland Daubenton's Bat Waterway Monitoring
- Brown Long-eared Bat Roost Monitoring
- Lesser Horseshoe Bat Monitoring

2025 was the second warmest year on record with above average rainfall for most parts. Both the spring and summer 2025 were the warmest on record. There were five named storms during the year. The most violent of these, Storm Éowyn, passed close to Ireland on January 24th 2025, and broke records for gusts and sustained windspeeds. This storm caused widespread damage to structures and woodland/forest habitats across Ireland.

For the Car-Based Bat Monitoring Scheme 57 individuals participated in surveys of 28 squares around the island. Online training courses were provided in a number of new teams and new team members via Zoom. Data from 55 surveys, all of which had >10 completed transects, were available. In total 14,425 bat passes were recorded, 50% of which were common pipistrelles. The soprano pipistrelle was second most frequently recorded bat species and Leisler's the third most common.

Trends were analysed using a combination of data from both Tranquillity (which were used up to 2019) and Batlogger detectors (which were used from 2017 onwards), using a covariate to account for differences in the two. Trends of the three target species continued to increase in 2025. Confidence intervals of the common pipistrelle, soprano pipistrelle and Leisler's bats are all well above their baseline indices indicating they each show a significantly increasing trend.

Nathusius' pipistrelle trends are still unclear but the trendline has now been declining since 2020. The brown long-eared roadside trend has been increasing slightly since 2020, although confidence intervals still indicate a reasonably stable trend. Numbers of observations of both these species are extremely low using the car-based method, leading to wide error bars.

The yearly estimate for the *Myotis* spp. group declined slightly in 2025 but the upper confidence interval remains above the baseline index.

Training courses were online as part of the All-Ireland Daubenton's Bat Waterway Monitoring Scheme in 2025. Two hundred and fifty-six waterway sites were surveyed by 224 teams in 2025. Of these 256 sites, 226 (89.7%) were surveyed twice in the month of August. A total of 20,729 'Sure' Daubenton's bat passes were recorded on 231 waterway sites (90.2%). The trend line for Daubenton's bat across the island appears to be fairly steady from year to year with error bars consistently encompassing the baseline.

For Brown Long-eared Bat Roost Monitoring, 51 volunteers participated in 2025, which included three roost owners. Volunteers provided count data for 35 roost sites while an additional four roosts were surveyed by the coordinator. Three roosts were surveyed by the coordinator and volunteers. In total, 101 monitoring surveys were carried out at 42 roosts. Using the highest results for each roost monitored in 2025, the total number of brown long-eared bats counted was 1,355 individuals. Average counts in 2025 were the lowest since the early years of the survey, and this has resulted in the curve dipping downwards, rather than following the gentle downwards slope of recent years. As always with trend analyses, results like this where one year's results have a big influence on the curve, should be treated with caution because they frequently prove to be a temporary anomaly. It will therefore be interesting to see if this decline continues next year, or whether numbers bounce back to be more in line with previous results.

NPWS and VWT regional staff forwarded count data from 118 lesser horseshoe bat sites in winter 2025 and 127 sites in summer 2025. In winter 2025, 10,244 bats were counted, and 12,071 bats were counted in summer 2025. From 2012 onwards there has been excellent consistency in counts at lesser horseshoe sites, which improves the robustness of the monitoring dataset. Over the past 20 years this species has increased in winter by an average of 3.37% per annum. Summer trends mirror this, slightly less steeply (2.94% per annum since 2005). A high number of new sites have been found by local NPWS staff in the past few years, in 2025, 13 new sites were added to the roost database.

2.0 GENERAL INTRODUCTION

2.1 Why Monitor Ireland's Bats?

Bats constitute a large proportion of the mammalian biodiversity in Ireland. Nine species of bat are known to be resident in Ireland and form almost one third of Ireland's land mammal fauna. Bats are a species rich group widely distributed throughout the range of habitat types in the Irish landscape. Due to their reliance on insect populations, specialist feeding behaviour and habitat requirements, they are considered to be valuable environmental indicators of the wider countryside (Walsh *et al.,* 2001).

Irish bats are protected under domestic and EU legislation. Under the Republic of Ireland's Wildlife Act (1976) and Wildlife (Amendment) Act (2000) it is an offence to intentionally harm a bat or disturb its resting place. Bats in Northern Ireland are similarly protected under the Wildlife (Northern Ireland) Order 1985.

The EU Habitats Directive (92/43/EEC) lists all Irish bat species in Annex IV and one Irish species, the lesser horseshoe bat (*Rhinolophus hipposideros*), in Annex II. Annex II includes animal species of community interest whose conservation requires the designation of Special Areas of Conservation (SACs) because they are, for example, endangered, rare, vulnerable or endemic. Annex IV lists various species that require strict protection. Article 11 of the Habitats Directive requires member states to monitor all species listed in the Habitats Directive and Article 17 requires States to report to the EU on the findings of monitoring schemes. The Conservation (Natural Habitats, etc.) (Amendment) (Northern Ireland) (EU Exit) Regulations 2019 ensured that this legislation remained in place in Northern Ireland upon the exit of the UK from the EU.

Ireland and the UK are signatories to a number of conservation agreements pertaining to bats such as the Bern and Bonn Conventions. The Agreement on the Conservation of Populations of European Bats (EUROBATS) is an agreement under the Bonn Convention and Republic of Ireland and the UK are two of the 39 parties to the Agreement. The Agreement has an Action Plan with priorities for implementation. One of the current priorities is to produce guidelines on standardised bat monitoring methods across Europe. Battersby (2010), in a EUROBATS publication outlined various methods for surveillance and monitoring of bats. This publication is currently being updated by a Eurobats Advisory Committee.

The Red Data List for Mammals in Ireland (Marnell *et al*., 2019) lists all the Irish bat species and, therefore all of the bat species monitored by the Irish Bat Monitoring Programme, as Least Concern. One of the species included in BCIreland's monitoring, Leisler's bat (*Nyctalus leisleri*), was previously listed as considered Near Threatened (Marnell *et al.,* 2009). It had been assigned this threat status because Ireland is considered a world stronghold for the species (Mitchell-Jones *et al*., 1999). However, the status of the European Leisler's bat population is also Least Concern (Temple and Terry 2007). This species is still, however, infrequent in the rest of Europe compared with Ireland where it is quite common.

2.2 Red and Amber Alerts

There are no precise biological definitions of when a population becomes vulnerable to extinction but the British Trust for Ornithology (BTO) has produced Alert levels based on IUCN-developed criteria for measured population declines. Species are considered of high conservation priority (Red Alert) if their population has declined by 50% or greater over 25 years and of medium conservation priority (Amber Alert) if their populations have declined by 25-49% over 25 years (Marchant *et al*., 1997). These Alerts are based on evidence of declines that have already occurred but if Alerts are *predicted* to occur based on existing rates of decline in a shorter time period then the species should be given the relevant Alert status e.g. if a species has declined by 2.73% per annum over a 10-year period then it is predicted to decline by 50% over 25 years and should be given Red Alert status after 10 years. Monitoring data should be of sufficient statistical sensitivity (and better, if possible) to meet these Alert levels. In addition, the data should also be able to pinpoint population increases should these occur (for more details on Power analysis for Car-Based Bat Monitoring see Roche *et al*., 2009 and for the Daubenton's Waterways Survey see Aughney *et al.,* 2009).

2.3 The Monitoring Schemes

Despite high levels of legal protection for all species, until 2003 there was no systematic monitoring of any species apart from the lesser horseshoe bat in Ireland. To redress this imbalance, The Car-Based Bat Monitoring Scheme was first piloted in 2003 and targets the two most abundant pipistrelle species (common and soprano pipistrelles) and Leisler's bat (Catto *et al*., 2004). These species are relatively easy to detect and distinguish from each other on the basis of echolocation calls. The car-based survey makes use of a full spectrum bat detector which picks up a range of ultrasound which can be recorded in the field and analysed post-survey. This method therefore allows survey work to be carried out by individuals with little or no experience in bat identification since this is completed post survey work.

The car-based monitoring scheme was followed in 2006 by the All-Ireland Daubenton's Bat Waterways Monitoring Scheme (e.g. Aughney *et al.,* 2007). 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 of 'bat passes' of this bat species for four minutes at each of the 10 fixed points on linear waterways. The onset of this scheme was a very significant development in bat monitoring here since it represented the first large-scale recruitment of members of the public to bat conservation-related work.

In 2007, a brown long-eared bat monitoring scheme was piloted (Aughney *et al.*, 2011). This project concentrates on counts of brown long-eared bats at their roosts and is conducted by individuals with a greater level of experience in bat identification than is necessary for Daubenton's or car-based surveys. This survey protocol involves at least two counts per annum (May to September) using three potential survey methods depending on the structure, access and location of bats within, and emerging from, the roost. A full report on the brown long-eared roost monitoring scheme is provided in Aughney *et al.,* 2011.

BCIreland took over management of the lesser horseshoe bat monitoring dataset in November 2013. Surveys for this scheme are mainly carried out by staff of the NPWS and VWT, along with a small number of volunteers and ecological consultants. Each year counts are carried out at specific lesser horseshoe sites. Surveys take place in summer at dusk and are usually carried out using bat detectors, although video cameras and/or internal counts are also sometimes carried out depending on site characteristics and staff availability. The dates for surveying in summer are May 23rd to July 7th. Winter surveys are carried out in January and February each year using internal counts, sometimes aided by still photography.

The Car-Based Bat Monitoring Scheme and All-Ireland Daubenton's Bat Waterway surveys are all-Ireland schemes. The brown long-eared roost monitoring has, so far, been based in the Republic of Ireland only. The lesser horseshoe bat is confined to the Republic of Ireland. Regular monitoring under BCIreland management is, therefore, in process for six bat species for the Republic of Ireland, one of which is the only resident Annex II species on the island, and for four bat species in Northern Ireland. Additional BCT UK Field Surveys are also undertaken in Northern Ireland. Data collected from those surveys feed into the BCT's UK reporting mechanisms.

2.4 Weather in 2025

2025 was the second warmest year on record with above average rainfall for most parts. Five named storms directly affected Ireland.

The survey season kicked off in January with counts at lesser horseshoe hibernacula. Weather-wise, a cold Arctic airmass descended on Ireland for the first third of the month of January, bringing snow to the south and southwest. After this, on January 24th Storm Éowyn broke windspeed records with hurricane force winds in the west and caused widespread forest and woodland damage across the country. Overall, mean temperatures in winter 2025 were above average and rainfall was above average in the south.

Spring 2025 was the warmest, sunniest spring on record in Ireland. Air temperatures were well above average at the majority of stations. Summer surveying began in May with brown long-eared bat and lesser horseshoe bat counts. This month continued the theme of high pressure dominance with an easterly airflow and plenty of sunshine. The last week of the month was unsettled, however, with rain and showers.

Continuing with the record-breaking theme for 2025, the summer was also the warmest on record. Nighttime temperatures were particularly elevated. While the weather was often quite cloudy, it remained relatively warm and dry with occasional hot spells due to heat domes to the south and east. Low pressures occasionally became more dominant and as a result, June was warm but with above average rainfall. July remained warm with almost average rainfall and August was very warm with above average rainfall at all stations.

All weather data derived from www.meteireann.ie.

3.0 CAR-BASED BAT MONITORING

3.1 Methods

Training of surveyors is carried out in June and early July each year. Survey teams are provided with all equipment needed for the survey including: a Batlogger M detector (Elekon Electronics), two SD cards, instruction manuals, recording sheets, batteries, flashing beacon and a first aid kit. Surveyors are also provided with a Dropbox link to share data, and a return postal label so the box can be posted back to BCIreland at the end of the season.

Batlogger M detectors are used to record bat calls. For details of the trial phasing in the use of Batloggers to replace earlier Tranquility Transect time expansion detectors, see Aughney et al. (2020). Batlogger M detectors record in real time and have a GPS chip. Sound and location data files are recorded onto an SD card in the detector, thus there is no need for recording hardware or connecting leads, which were, at times, a source of equipment failure with the former equipment set up for the survey.

In 2020 a new training video was uploaded to YouTube and to the Car monitoring Facebook page to provide further information on how to use the detector and other equipment for the survey.

- https://www.youtube.com/watch?v=09_x6dylqE8

Each year survey teams complete surveys of a mapped route within a defined 30km Survey Square. Routes cover 15 x 1.609km (1 mile) Monitoring Transects each separated by a minimum distance of 3.2km (2 miles).

Surveyors are asked to undertake the survey on two dates, one in mid to late July (Survey 1, S1) and one in early to mid-August (Survey 2, S2). Transect coverage begins 45 minutes after sundown. Each of the 1.609km transects is driven at 24km (15 miles) per hour (at night) while continuously recording on the Batlogger detector.

The Batloggers are pre-loaded with parameters for the survey. Surveyors are asked to affix the detector to the window clamp so that the microphone is facing out of the window and slightly to the rear of the car. 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.

On completion of surveys, data is forwarded to BCIreland for analysis. In 2025 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 manually identified bat calls are used to create trends although we plan to check automated identification methods against manual identification as identification algorithms continue to improve.

Calls are identified to species level where possible. Species that can be identified accurately using this method are the common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle (*Pipistrellus pygmaeus*), and Nathusius' pipistrelle (*Pipistrellus nathusii*). Pipistrelle calls with a peak in echolocation between 48kHz and 52kHz are recorded as 'Pipistrelle unknown' because they could be either common or soprano pipistrelles. Leisler's bat (*Nyctalus leisleri*), a low frequency echolocating species, can also be easily identified using this method. Occasional calls of *Myotis* bats are recorded but these are noted as *Myotis* spp. since they could belong to one of a number of species in the genus – Daubenton's, whiskered or Natterer's (*Myotis daubentonii, M. mystacinus* or *M. nattereri*). Occasional social calls of brown long-eared bats (*Plecotus auritus*) are also recorded.

Data for each survey were gathered into Excel spreadsheets and imported to the tailor-made MySQL database.

For the purposes of providing volunteer feedback, data listing bat species, date, time and location 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.

3.1.1 Statistical Analysis

3.1.1.1 Routine Yearly Trend Analysis

In previous years, when the detector used was a Tranquility time expansion detector the response variable was the number of passes per survey. From 2020 when we changed to Batlogger M full spectrum detectors, we switched to the number of sound files with the species present and we do not account for multiple passes when analyzing the data. In practice this change makes very little difference to the trend since the vast majority of the former Tranquility detector snapshots only had a single pass anyway.

For overall yearly trends as in previous years, the full GAM approach has been used as described by Fewster *et al*. (2000). 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 (based on number of 0.32s recordings per survey, sonogram length or the actual survey time) is used as an offset, which effectively does something very similar to analysing the passes per minute, but allows use of a Poisson error distribution.

For Nathusius' pipistrelle and brown long-eared bats, trend models were constructed based on a binomial distribution. This is because both species sometimes occur in the same transect on multiple occasions but there are, much more often, transects with no occurrences and, therefore, a large number of zeros in the dataset. We have previously fitted these trends 'backwards', with the penultimate year used as the base year. However, now that there is a reasonably long timeline of data, it is possible to do a more conventional approach, with the base year near the start.

The analyses have been carried out using the first 15 x 1.6km transects only, from 2003-2008, so that results are comparable with the reduced 2009-present sampling plan.

The spline curves have five degrees of freedom, which is the default recommended by Fewster for this length of data. Surveys with less than 650 0.32s snapshots (or equivalent sonogram length) or less than eight one mile transects are excluded. 2006 is used as the base year as this was the first year with more than 20 survey sites (squares).

Generalised Additive Models (GAMs) have been fitted to the annual means to give a visual impression of the trend over time. Curved trend lines have been applied to the data.

3.1.1.2 Street Lighting Analysis

This year we carried out an analysis of lighting impacts on bat activity. We repeated an approach used in earlier work – a mixed REML model of log-transformed number of passes per minute at a one mile transect level. A quadratic term for the start time of each transect was included, expressed as minutes after sunset. This was to allow for the temporal pattern of activity, mainly pipistrelles which show a marked rise in activity until around 3 hours after sunset.

3.2 Results

Training via Zoom was provided to new surveyors in Donegal (G89), Dublin (O04), Fermanagh (H13), Antrim (H79), Mayo (G20), Westmeath (N11), Carlow/Wicklow (S78) & Limerick (R88). A number of surveyors who were carrying out the survey for the second year also attended these sessions.

Additional telephone and Whatsapp support conversations were held with several teams to address queries about the surveys in 2025.

All equipment was posted to surveyors.

Survey work in 2025 was carried out from mid to end July and a repeat survey was carried out in early to mid-August. The median date of the first survey in 2025 was 24th July. The median date of the second survey was 19th August.

Twenty seven squares were surveyed in July 2025. All of these yielded usable data. Twenty eight squares were surveyed in August 2025 (see Figure 3.1). All of these, yielded usable data. In total 1,327km of monitoring transects were surveyed and approximately 360hrs of survey time was spent on the scheme by the volunteers.

Overall, the quality of data collected in 2025 was excellent. No errors arose with data being lost due to faulty cards in 2025.

Squares that were surveyed in 2025 cover the length and breadth of the island with squares in the north, west, south and east of the island included, along with a good spread of squares in the midlands (see Figure 3.1).

The total number of bat passes recorded in 2025 was 14,425.

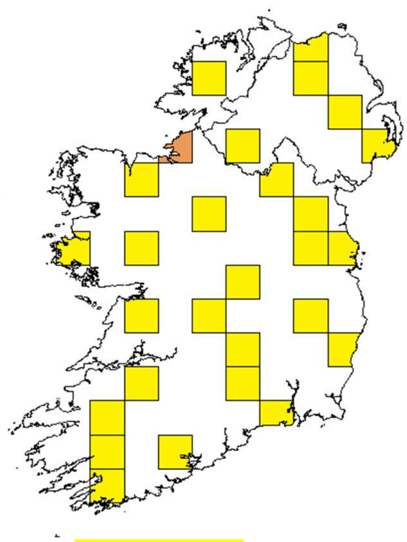


Figure 3.1: Location of 30km Survey Squares, yellow squares were surveyed twice, brown squares were surveyed once.

Table 3.1: Mean bat encounter data (**Tranquility** detector), per 1.609km/1 mile transect, not corrected to encounters per km or per hour, Car-Based Bat Monitoring Scheme 2003-2019.

Year	No. Transects	Common pipistrelle	Soprano pipistrelle	Pipistrelle unid.	Nath. Pip.	Leisler's bat	Myotis spp.	Brown long-eared
2003	173	1.25	0.474	0.453	0.000	0.301	0.040	
2004	543	1.94	0.707	0.267	0.000	0.524	0.052	
2005	596	1.36	0.559	0.272	0.002	0.527	0.035	
2006	879	1.71	0.652	0.256	0.033	0.895	0.030	
2007	878	1.78	0.645	0.308	0.015	0.634	0.036	0.019
2008	853	1.80	0.816	0.222	0.007	0.649	0.030	0.002
2009	781	1.22	0.717	0.243	0.032	0.490	0.032	0.010
2010	798	1.42	0.680	0.350	0.070	0.811	0.024	0.013
2011	780	1.53	0.783	0.343	0.022	0.777	0.037	0.017
2012	677	1.34	0.783	0.310	0.047	0.768	0.027	0.027
2013	730	1.46	0.811	0.417	0.021	0.749	0.011	0.027
2014	745	1.98	1.083	0.398	0.043	0.997	0.026	0.017
2015	796	1.92	1.018	0.544	0.014	0.867	0.046	0.009
2016	759	2.10	1.203	0.529	0.040	0.926	0.026	0.009
2017	801	2.25	1.242	0.610	0.030	0.828	0.021	0.009
2018	790	2.34	1.262	0.576	0.023	0.780	0.018	0.011
2019	733	2.08	1.209	0.453	0.083	0.969	0.005	0.007
Mean Per Transect		**1.76**	**0.884**	**0.379**	**0.030**	**0.761**	**0.028**	**0.013**

* Note that the detector records for just 1/11th of the time spent surveying so to determine the actual number of bat encounters per km this must be divided by 0.146 (the total distance sampled for each 1.609km transect).

Table 3.2: Mean bat encounter data (**Batlogger** detector), per 1.609km/1 mile transect, not corrected to encounters per km or per hour, Car-Based Bat Monitoring Scheme 2016-2025.

Year	No. Transects	Common pipistrelle	Soprano pipistrelle	Pipistrelle unid.	Nath. Pip.	Leisler's bat	Myotis spp.	Brown long-eared
2016	114	4.97	4.27	1.47	0.05	1.09	0.193	0.009
2017	265	5.88	4.732	0.977	0.117	1.049	0.128	0.011
2018	445	5.26	3.497	1.097	0.022	1.097	0.072	0.011
2019	636	5.36	3.931	1.299	0.200	1.456	0.069	0.031
2020	645	6.82	4.132	1.464	0.183	1.423	0.127	0.020
2021	809	7.121	4.005	1.319	0.119	1.771	0.068	0.031
2022	695	6.738	4.132	1.353	0.191	2.144	0.086	0.036
2023	781	8.661	5.941	1.539	0.062	1.729	0.047	0.047
2024	796	7.858	5.264	1.105	0.187	1.936	0.150	0.043
2025	825	8.765	5.196	1.204	0.061	2.067	0.115	0.068
Mean Per Transect		**7.165**	**4.618**	**1.299**	**0.129**	**1.7081**	**0.108**	**0.037**

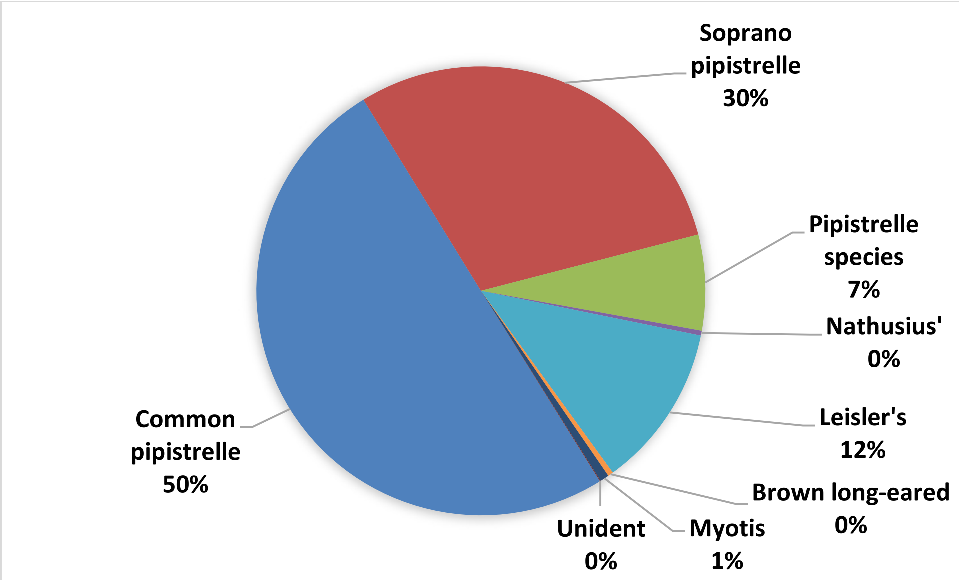


Figure 3.2: Proportion of bat species encountered (Batlogger Detectors) during the survey in 2025. Total number of bat encounters, n=14,425. Excepting social calls of Leisler's bats and brown long-eared bats, which are unlikely to be mistaken for those of other species, bat social calls were noted during sonogram analysis but are not included in the above pie chart or in any statistical analyses. 'Pipistrelle species' refers to pipistrelle bat passes between 48 and 52kHz that cannot be assigned to a specific species.

Overall encounter rates varied between squares and between surveys. In general, the squares with highest encounter rates were found in the east/midlands and south of the island. These included squares W56 and N11 where over 400 bat encounters each were recorded during at least one survey night. Encounter rates per hour for each survey in each square (Batlogger) are shown in Appendix 1, Tables A1.1 and A1.2 with the overall average shown in Table 3.2 below.

Table 3.2: Average number of bat encounters per hour for all surveys (Batlogger), 2025. Total = total number of encounters for all species per hour. Means derived from total number of encounters divided by total time spent sampling by the detector corrected to 1 hour.

All Surveys 2025	Common pipistrelle	Soprano pipistrelle	Pipistrelle unknown	Nathusius' pipistrelle	Leisler's bat	Brown long-eared	Myotis spp.	Total/hr
Overall Mean	117.92	70.35	16.72	0.77	27.38	0.90	1.54	235.71
Standard Deviation	**±67.03**	**±33.78**	**±10.39**	**±1.70**	**±19.04**	**±1.37**	**±2.13**	**±98.09**
Minimum	**1.84**	**19.19**	**1.56**	**0.00**	**0.00**	**0.00**	**0.00**	**43.24**
Maximum	**276.60**	**175.32**	**70.31**	**9.03**	**106.61**	**7.10**	**9.76**	**434.81**

3.2.1 Common pipistrelle, *Pipistrellus pipistrellus*

3.2.1.1 2025 Results

The overall average number of common pipistrelle encounters per hour was 119.8 during Survey 1 and 120.3 in Survey 2 in 2025. The overall average number of common pipistrelle encounters per hour for both survey periods was 120.06 (see Table 3.2). The square with the highest number of records for the species was S12 (Tipperary, Survey 1).

Common pipistrelles were the most frequently encountered species during the monitoring scheme in 2025 and in all survey years to-date. Figure 3.3 illustrates low, medium and high encounter rate squares for common pipistrelles in 2025 for each of the surveyed 30km squares. As in previous years this map shows lower common pipistrelle encounter rates in the north and north-west while squares with the highest encounter rates are located in the south and east of the country. Common pipistrelles are often absent from surveys in L64 (Connemara) although the species is increasingly recorded there – this may be because batlogger detectors record for most of the survey time, unlike the old Tranquility detectors that just recorded for 1/11th of the survey time, thus increasing the chances of detecting the species where it occurs.

3.2.1.2 Trends

Figure 3.4 shows the results of a Generalised Linear Model (GLM) applied to the Car-based Bat Monitoring data for the common pipistrelle, along with Generalised Additive Model (GAM) smoothed curves. Common pipistrelles showed increases in the early years and error bars around the trend have now well exceeded the baseline. This means that the common pipistrelle increased significantly since the start of the car-based bat monitoring scheme. While the increase has not been continuous year on year, and both 2022 and 2024 saw slight drops in the yearly estimates, the 2025 yearly estimate was the highest ever recorded for the species. This has pulled the trend line strongly upwards again.

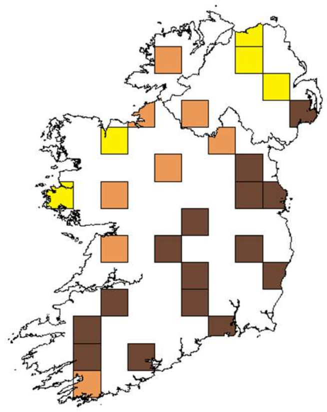


Figure 3.3: Survey squares colour coded according to common pipistrelle encounter rates (per hour) in 2025. The overall average rate of common pipistrelle encounters for all squares in 2024 was 120hr^{-1}..

No data
Encounter rate >0≤60hr^{-1}
Encounter rate >60≤120hr^{-1}
Encounter rate >120hr^{-1}

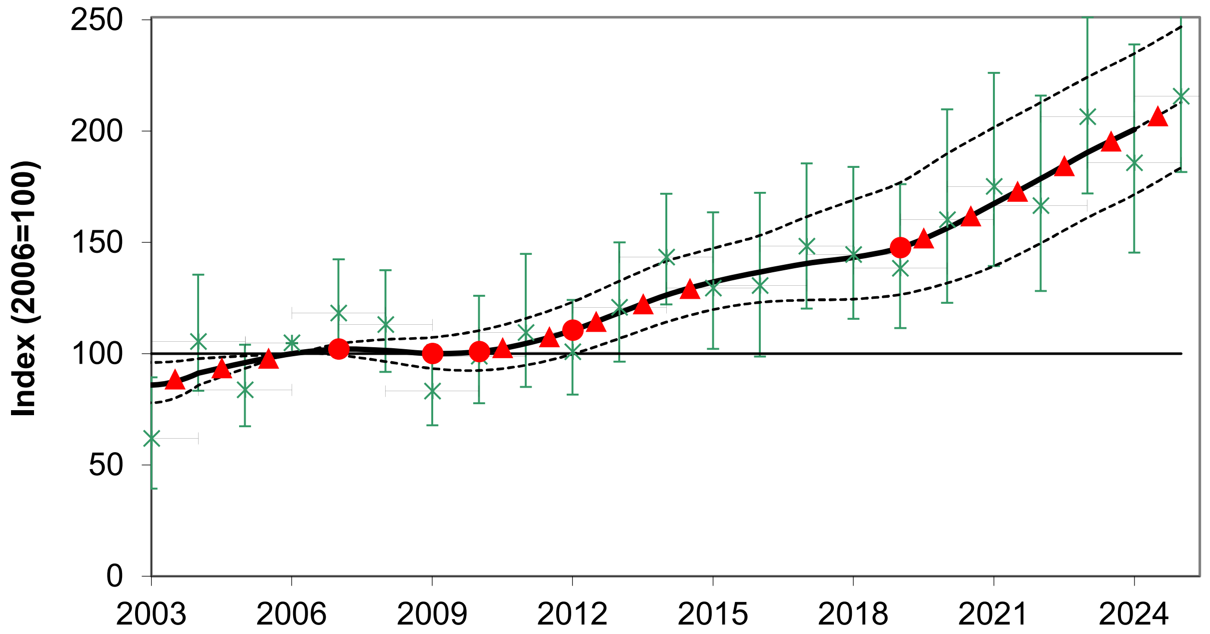


Figure 3.4: Results of the GAM/GLM model for common pipistrelle passes per survey, All-Ireland. Points are estimated annual means derived from the Generalised Linear Model (GLM) and the bars are 95% bootstrapped confidence limits. The heavy black line is the fitted Generalised Additive Model (GAM) curve with 95% confidence limits shown by the lighter black lines. All estimates are adjusted to 1,125 0.32s snapshots or equivalent time recording on a Batlogger. The end of the smoothed trend is shown with a broken line to illustrate uncertainty for 2024-2025 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).

Table 3.4: GAM results for common pipistrelles with 95% confidence limits (using first 15 transects only 2003-2008). Values are modeled estimates adjusted to 1,125 snapshots per survey or equivalent time recording on a Batlogger.

			Smoothed		95% limits		unsmoothed	
Year	*Sites*	*Counts*	*index*	*s.e.*	*lower*	*Upper*	*fit*	*s.e.*
2003	7	9	86.00	4.69	78.00	96.06	57.16	11.96
2004	17	27	91.24	3.11	85.83	97.78	100.64	13.08
2005	17	31	95.97	1.47	93.37	99.04	78.95	9.33
2006	25	45	100.00	0.00	100.00	100.00	100.00	0.00
2007	26	46	102.06	1.32	99.33	104.48	113.46	11.17
2008	23	42	101.45	2.52	96.49	106.41	108.19	11.42
2009	28	53	100.07	3.58	93.34	107.33	78.38	9.14
2010	27	53	100.92	4.56	92.49	110.42	94.01	12.62
2011	28	53	104.56	5.36	94.83	115.83	104.60	15.11
2012	27	45	110.54	6.01	99.84	123.25	96.07	10.81
2013	26	49	118.42	6.59	106.88	132.65	115.98	13.55
2014	27	49	126.29	6.96	114.22	141.53	138.59	13.08
2015	28	53	132.16	7.17	119.85	147.37	124.69	15.55
2016	28	51	136.72	7.77	123.10	153.15	125.84	18.63
2017	28	70	140.53	9.38	124.11	161.55	143.50	16.47
2018	28	81	143.28	11.29	124.55	169.15	139.67	17.30
2019	28	92	147.63	12.74	126.60	176.96	133.52	16.35
2020	25	45	156.40	14.38	131.72	189.90	155.43	21.66
2021	28	54	167.39	15.72	139.36	201.68	170.30	21.64
2022	27	47	178.60	16.16	149.65	212.87	161.72	22.04
2023	27	53	190.34	15.98	161.15	224.26	201.63	20.20
2024	27	52	200.77	15.86	171.49	234.90	180.91	23.46
2025	28	55	213.00	16.24	183.63	246.89	210.87	20.37

3.2.2 Soprano pipistrelle, *Pipistrellus pygmaeus*

3.2.2.1 2025 Results

The overall average number of soprano pipistrelle encounters per hour was 67.2 during Survey 1 in 2025 and 75.9 during Survey 2; see Tables A1.1 and A1.2 (Appendix). The overall average number of soprano pipistrelle encounters per hour for both survey periods was 71.6.

The highest number of discrete soprano pipistrelle passes was recorded from Survey 2 in G53 (County Sligo). When corrected for time spent surveying the highest encounter rates per hour were recorded from Survey 2 in G53 and S78 (Carlow/Wicklow), 175.3 and 144.7 per hour, respectively.

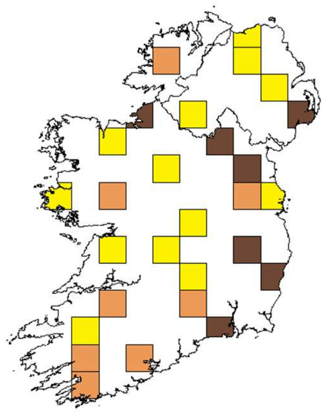


Figure 3.5: Survey squares colour coded according to soprano pipistrelle encounter rates (per hour) in 2025. The overall average rate of soprano pipistrelle encounters for all squares in 2025 was 71.6hr^{-1}.

No data
Encounter rate >0≤70hr^{-1}
Encounter rate >70≤100hr^{-1}
Encounter rate >100hr^{-1}

Figure 3.5 illustrates low, medium and high encounter rate squares for soprano pipistrelles in 2025. As in previous years, the pattern of activity levels across the island are more difficult to distinguish than for common pipistrelles. In 2025 the highest encounter rate squares were mainly found along the south and east coasts, but high numbers were also recorded in Sligo and Cavan. Soprano pipistrelles were recorded on all survey routes in 2025.

3.2.2.2 Trends

Figure 3.6 shows the results of a Generalised Linear Model (GLM) applied to Car-based Bat Monitoring data for the soprano pipistrelle, along with Generalised Additive Model (GAM) smoothed curves. Confidence intervals remain well above the baseline value indicating that the species has significantly increased over the duration of the monitoring scheme. While 2018 and 2019 saw a slight decrease, the upward trend resumed in 2020. In 2023 the trendline veered sharply upwards. The 2024 and 2025 estimates dropped slightly and so the trendline has levelled out a little since 2023.

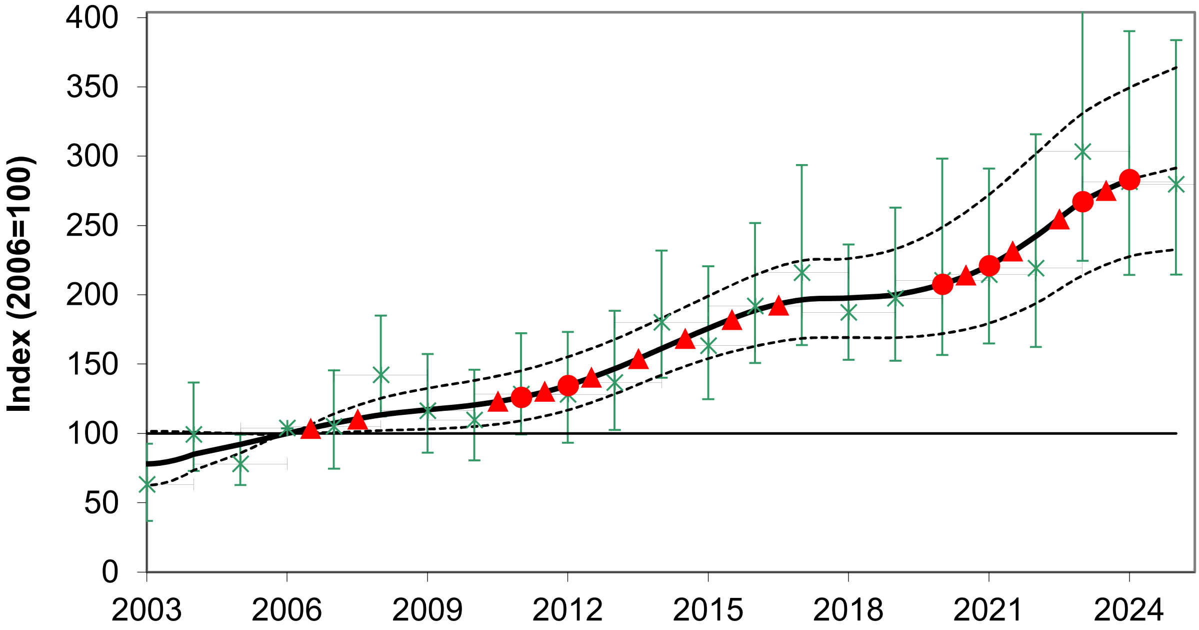


Figure 3.6: Results of the GAM/GLM model for soprano pipistrelle passes per survey, all-Ireland. Points are estimated annual means derived from the Generalised Linear Model (GLM) and the bars are 95% bootstrapped confidence limits. The heavy black line is the fitted Generalised Additive Model (GAM) curve with 95% confidence limits shown by the lighter black lines. All estimates are adjusted to 1,125 0.32s snapshots or equivalent time recording on a Batlogger. The end of the smoothed trend is shown with a broken line to illustrate uncertainty for 2024-2025 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).

Table 3.5: GAM results for soprano pipistrelles with 95% confidence limits (using first 15 transects only 2003-2008). Figures are modeled estimates adjusted to 1,125 snapshots per survey or equivalent time recording on a Batlogger.

			Smoothed		95% limits		Unsmoothed	
Year	***Sites***	***Counts***	***index***	***s.e.***	***Lower***	***Upper***	***fit***	***s.e.***
2003	7	9	78.18	9.88	62.77	101.75	59.31	14.40
2004	17	27	85.12	6.97	73.65	101.08	95.41	16.62
2005	17	31	92.33	3.58	86.04	100.10	74.26	9.01
2006	25	45	100.00	0.00	100.00	100.00	100.00	0.00
2007	26	46	107.42	3.40	100.73	114.22	101.29	18.45
2008	23	42	113.47	5.99	102.22	125.42	138.35	19.04
2009	28	53	117.19	7.58	103.25	132.71	112.52	18.07
2010	27	53	120.63	8.62	105.07	138.32	105.89	17.23
2011	28	53	126.16	9.43	109.26	145.34	124.49	19.19
2012	27	45	134.69	9.90	116.92	155.31	124.35	20.08
2013	26	49	146.73	10.04	128.56	167.91	132.87	21.54
2014	27	49	161.39	10.28	142.21	183.21	176.32	23.64
2015	28	53	175.86	11.26	154.16	199.15	159.34	24.34
2016	28	51	188.74	12.90	163.03	214.34	188.18	25.39
2017	28	70	196.50	14.27	168.64	224.78	212.16	33.09
2018	28	81	197.79	14.68	169.28	226.18	183.50	20.65
2019	28	92	200.23	16.21	169.21	233.13	193.55	28.33
2020	25	45	207.65	19.60	172.05	248.78	206.64	36.88
2021	28	54	221.12	23.63	179.58	272.31	210.62	32.49
2022	27	47	242.24	27.51	193.88	301.76	215.40	39.60
2023	27	53	267.35	30.00	214.05	330.92	299.35	52.99
2024	27	52	283.24	30.84	227.65	349.39	277.66	44.94
2025	28	55	291.54	32.68	232.87	363.99	275.79	42.91

3.2.3 Leisler's bat, *Nyctalus leisleri*

3.2.3.1 2025 Results

The overall average number of Leisler's bat encounters per hour was 30.6 during Survey 1 in 2025 and 25.2 during Survey 2, (see Appendix Tables A1.1 and A1.2) bringing the overall average number of Leisler's bat encounters per hour for both surveys to 27.9.

The surveys with the highest number of Leisler's bat encounters, and encounters per hour, were the from the second survey in Killarney (V96), and the first survey in County Down (J33).

Leisler's bat was the third most frequently encountered species during the monitoring scheme in most years including 2025. Figure 3.7 illustrates low, medium and high encounter rate squares for Leisler's bat in 2025. As in some previous years, low encounter rate squares were typically more frequent in the western and north western half of the island.

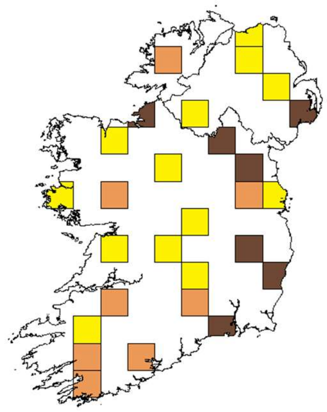


Figure 3.7: Survey squares colour coded according to Leisler's bat encounter rates (per hour) in 2025. The overall average rate of Leisler's encounters for all squares in 2025 was 27.9hr^{-1}.

No data
Encounter rate >0≤15hr^{-1}
Encounter rate >15≤30hr^{-1}
Encounter rate >30hr^{-1}

3.2.3.2 Trends

Figure 3.8 shows the results of the Generalised Linear Model (GLM) applied to Car-based Bat Monitoring data for Leisler's bat, along with Generalised Additive Model (GAM) smoothed curves. The estimate for Leisler's bat rose significantly above the baseline in the first ten years of the survey. Yearly estimates then levelled out from 2015 to 2018. This was followed by an even steeper increase from 2019 to 2022. The estimates for 2023 to 2025 were slightly lower than 2022 but the trendline still shows an increase, albeit at a slower rate. Lower confidence intervals have risen well above the baseline over the 22 years of the survey, indicating a significant increase in the species in that time.

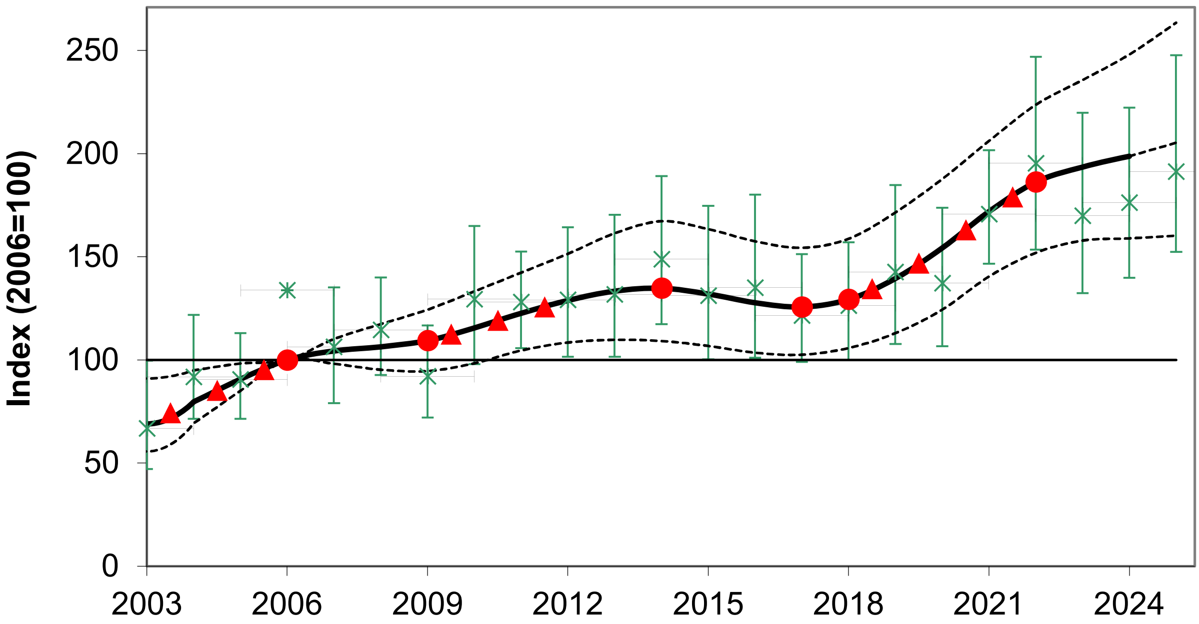


Figure 3.8: Results of the GAM/GLM model for Leisler's bat passes per survey. Points are estimated annual means derived from the Generalised Linear Model (GLM) and the bars are 95% bootstrapped confidence limits. The heavy black line is the fitted Generalised Additive Model (GAM) curve with 95% confidence limits shown by the lighter black lines. All estimates are adjusted to 1,125 0.32s snapshots or equivalent time recording on a Batlogger. The end of the smoothed trend is shown with a broken line to illustrate uncertainty for 2024-2025 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).

Table 3.6: GAM results for Leisler's bat with 95% confidence limits (using first 15 transects only 2003-2008). Figures are modelled estimates adjusted to 1,125 snapshots per survey or equivalent time recording on a Batlogger.

			smoothed		95% limits		Unsmoothed	
Year	*Sites*	*Counts*	*index*	*s.e.*	*lower*	*Upper*	*Fit*	*s.e.*
2003	7	9	69.03	8.99	55.68	91.00	32.98	13.55
2004	17	27	79.63	6.47	69.41	94.97	58.00	12.83
2005	17	31	90.69	3.32	85.11	98.31	56.70	10.76
2006	25	45	100.00	0.00	100.00	100.00	100.00	0.00
2007	26	46	104.42	3.18	98.16	110.18	72.57	14.20
2008	23	42	106.41	5.86	95.29	117.43	80.75	12.35
2009	28	53	109.38	7.89	94.64	124.40	58.37	11.50
2010	27	53	115.59	9.16	98.40	133.28	95.63	17.69
2011	28	53	122.64	9.69	104.64	142.35	94.22	12.07
2012	27	45	128.86	10.86	108.48	151.49	95.33	15.86
2013	26	49	133.38	12.87	109.80	161.41	97.91	17.45
2014	27	49	134.77	14.42	109.21	167.29	114.98	18.43
2015	28	53	131.95	14.53	106.81	163.44	97.42	19.64
2016	28	51	127.79	13.73	103.54	157.53	101.22	20.03
2017	28	70	125.68	12.88	102.55	154.38	87.77	13.19
2018	28	81	129.38	13.14	105.81	158.77	92.53	14.26
2019	28	92	139.57	14.61	112.99	171.53	108.88	19.44
2020	25	45	154.28	15.72	124.39	187.73	103.42	17.40
2021	28	54	171.89	16.70	140.49	206.19	136.91	13.77
2022	27	47	186.25	18.14	151.97	223.72	161.59	23.86
2023	27	53	193.52	19.91	157.90	235.70	136.10	21.86
2024	27	52	198.81	22.60	158.96	248.07	142.45	21.04
2025	28	55	205.30	26.58	160.29	263.46	157.55	23.92

3.2.4 Nathusius' pipistrelle, *Pipistrellus nathusii*

3.2.4.1 2025 Results

The overall average number of Nathusius' pipistrelle encounters per hour increased from 2020 on account of the widespread use of Batloggers, which record continuously during each transect. The average encounter rate was 1.26hr^{-1} during Survey 1 and 0.31hr^{-1} during Survey 2, see Tables A1.1 and A1.2 (Appendix).

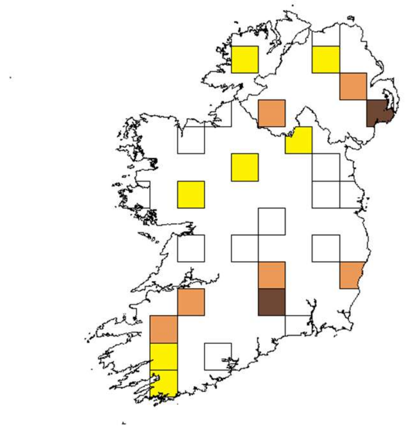


Figure 3.9: Survey squares indicating abundance of Nathusius' pipistrelle records from the 2025 car-based bat monitoring scheme. The overall average rate of Nathusius' encounters for all squares in 2025 was 0.78hr^{-1}.

No encounters
Encounter rate >0≤1hr^{-1}
Encounter rate >1≤2hr^{-1}
Encounter rate >2hr^{-1}

Figure 3.9 illustrates squares where the species was present in 2025 with the squares colour coded according to the species' activity levels. Most Nathusius' pipistrelle passes were recorded from square J33 (Down), unlike previous years when J06 (east of Lough Neagh) generally held the record. The overall average number of Nathusius' pipistrelle encounters per hour for both survey periods was 0.78, see Table 3.2.

3.2.4.2 Trends

Figure 3.10 shows the results of fitting a binomial GLM/GAM model for the proportion of one mile transects with Nathusius' pipistrelle passes, with a covariate for detector. Nathusius' pipistrelle increased from zero values recorded in the first two years of the monitoring scheme, although activity levels tend to fluctuate widely from year to year. The highest annual estimate to-date was recorded in 2020. Since then, the trendline has headed downwards with 2025 the lowest yearly estimate since 2006. However, these results are clearly quite unstable with very large error bars, and so this trend should be treated with caution.

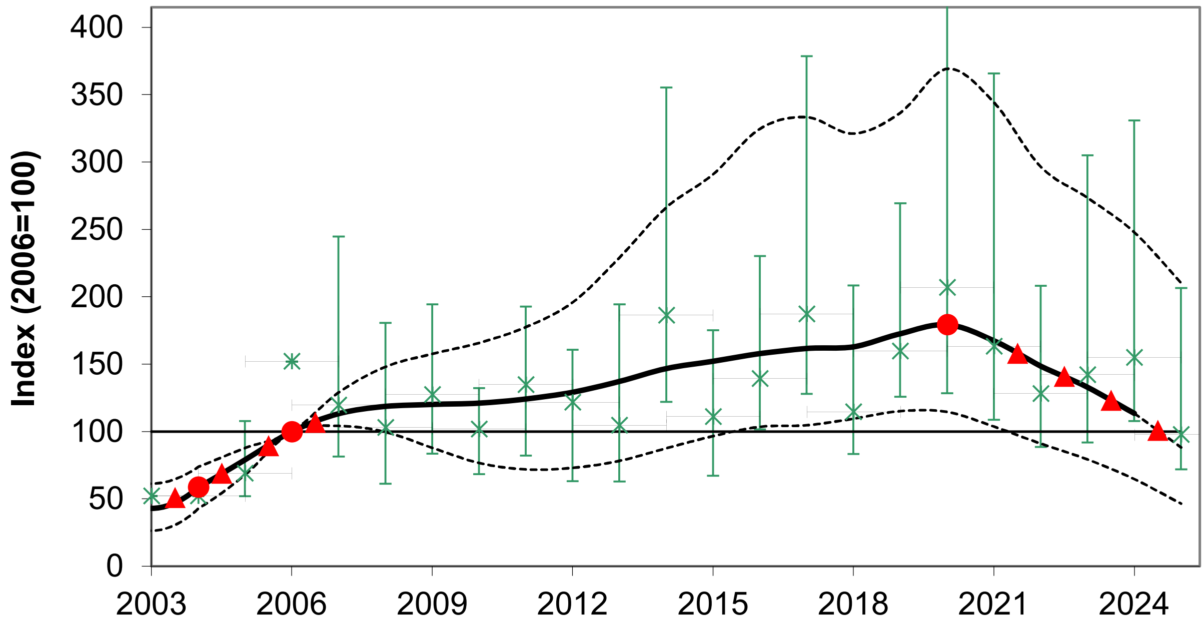


Figure 3.10: Results of a Binomial GLM modelling for the proportion of one mile (1.6km) transects with Nathusius' pipistrelle present, all-Ireland. The black line is the smoothed GAM curve, with 95% confidence limits shown by the lighter black lines. Points are estimated annual means and are shown to illustrate the variation about the fitted line. The end of the smoothed trend is shown with a broken line to illustrate uncertainty for 2024-2025 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).

3.2.5 *Myotis* spp.

3.2.5.1 2025 Results

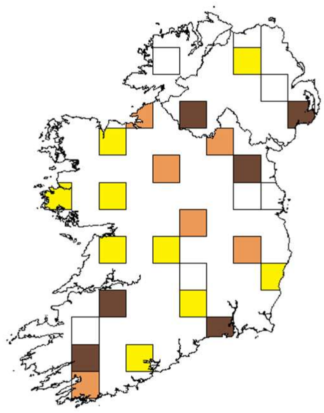


Figure 3.11: Survey squares indicating abundance of *Myotis* species records from the 2025 car-based bat monitoring scheme. The overall average rate of *Myotis* encounters for all squares in 2025 was 1.57hr^{-1}.

No encounters
Encounter rate >0≤1hr^{-1}
Encounter rate >1≤2hr^{-1}
Encounter rate >2hr^{-1}

The overall average number of *Myotis* species encounters per hour in 2025 was 1.57. On average, 1.43 *Myotis* bat passes were recorded per hour during Survey 1 and 1.7 during Survey 2 in 2025, see Tables A1.1 and A1.2 (Appendix 1).

Figure 3.11 illustrates squares where this species group was recorded in 2025, and colour coded according to the species group's activity levels.

3.2.5.2 Trends

Myotis spp. yearly estimates are highly variable. On the whole, the trendline was reasonably constant until a changepoint around 2015 (see Figure 3.12), when it started to decline. This decline then levelled out around 2020 and since then it has stabilised somewhat. This year's estimate is a little lower than 2024. The upper confidence intervals remain slightly above the baseline.

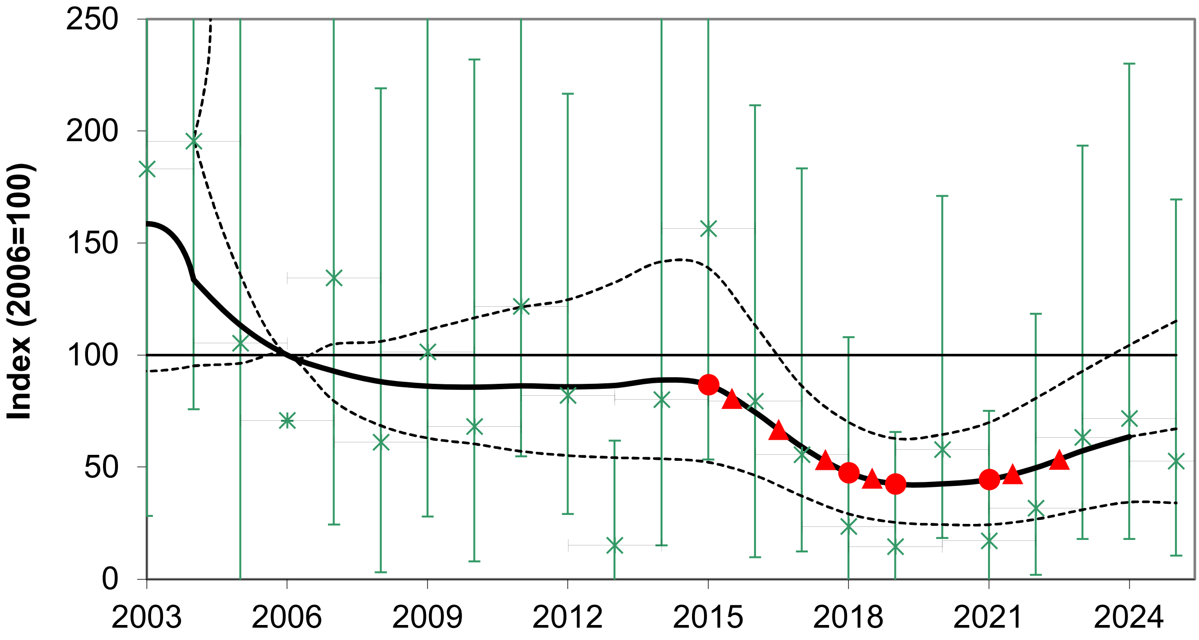


Figure 3.12: Results of the GAM/GLM model for *Myotis* spp. passes per survey. Points are estimated annual means derived from the Generalised Linear Model and the bars are 95% bootstrapped confidence limits. The heavy black line is the fitted Generalised Additive Model curve with 95% confidence limits shown by the lighter black lines. All estimates are adjusted to 1,125 0.32s snapshots or the equivalent time recording on Batlogger detectors. 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.

3.2.6 Brown long-eared bat, *Plecotus auritus*

3.2.6.1 2025 Results

The overall average number of brown long-eared encounters per hour for both months was 0.92 in 2025, see Table 3.2 and Appendix 1 Tables A1.1 and A1.2.

Figure 3.13 illustrates squares where this species was recorded in 2025.

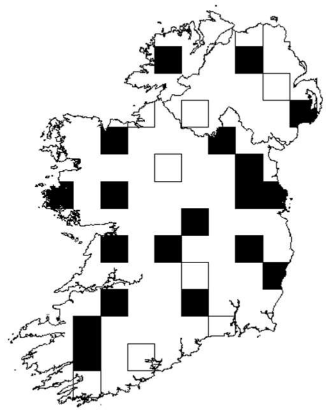


Figure 3.13: Survey squares indicating presence (black) or absence (white) of brown long-eared bat records from the 2025 Car-based Bat Monitoring Scheme.

Of all the species encountered during the monitoring scheme, the brown long-eared bat is typically the least common. The methodology of this monitoring scheme means that encounter rate for this species is expected to be low and therefore it is not a target species.

3.2.6.2 Trends

This species is recorded in very low numbers by the Car-based Bat Monitoring Scheme.

The annual trend has been analysed using a binomial model, the results are shown in Section 5 alongside trends derived from the dedicated Brown Long-eared Bat Roost monitoring surveys.

3.2.7 Other Vertebrates

As in previous years, surveyors were asked to record living and dead vertebrates that they encountered while surveying, during and between transects. This resulted in the collection of 271 records of living vertebrates (apart from bats, sheep and other farm animals) and 6 records of dead vertebrates in 2025 from 51 surveys. Figure 3.14 is a pie chart illustrating proportions of living vertebrate observations attributed to species or species groups. As in previous years, records are dominated by cats, which in 2025 accounted for 57% of all records collected. Foxes were the second most commonly recorded 'other vertebrate'. Dogs accounted for the next highest number of records (16 records).

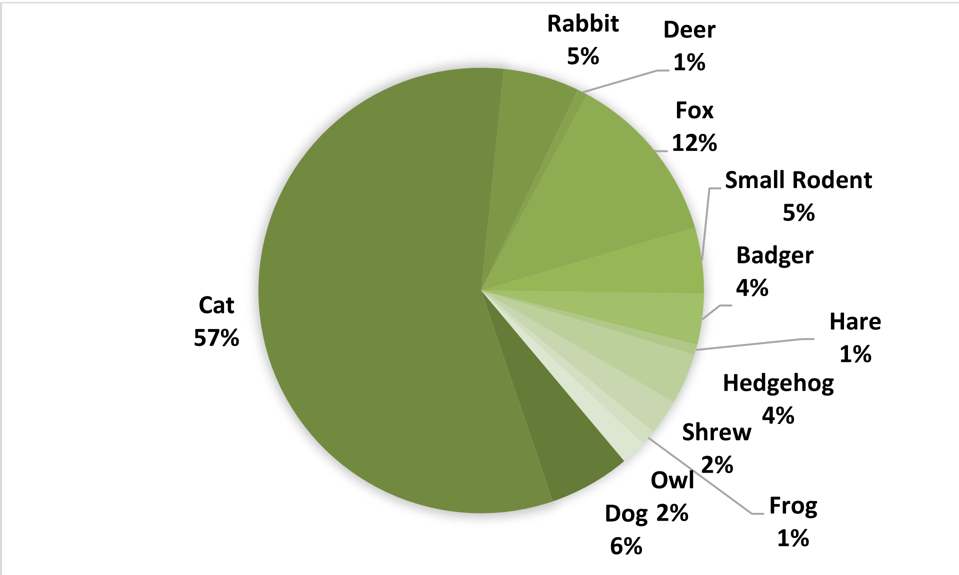


Figure 3.14: Living vertebrates, other than bats, observed during 2025, n=271. The category 'Owl' includes two unidentified owls, two long-eared owls and one barn owl. Small rodents includes 9 mice, three rats and one unidentified small mammal.

3.2.7.1 Dead vertebrates

The number of dead specimens recorded from roadsides totalled 11 in 2025. These included one or two specimens each of rabbit, rat, hare, cat, badger, hedgehog, fox and shrew.

3.2.8 Street Lighting

Test statistics from the model are shown in Table 3.7 below. All species are shown for completeness, but these are only really reliable for the more common species. When we analysed this data in 2012, the impact of streetlights was only statistically significant for Leisler's (Mathews et al., 2015), and this is still by far the strongest relationship, with all four light types showing a positive association with bat passes. However, differences are now also statistically significant for common pipistrelle, with a highly significant positive relationship with orange lights and a more borderline negative relationship with LED lights.

Table 3.7: P-values for terms in the REML models. Streetlight variables are fitted as log-transformed numbers.

	Common pip	Soprano pips	Unsure pip	Myotis spp	Leisler's	Nath pip	Brown long-ear
Streetlights							
orange	0.005	0.580	0.304	0.433	0.004	0.949	0.859
yellow	0.525	0.814	0.725	0.452	0.000	0.301	0.871
white	0.726	0.678	0.454	0.799	0.023	0.565	0.838
LED	0.027	0.435	0.216	0.117	0.000	0.279	0.092
Time after sunset							
linear	<0.001	<0.001	0.007	0.974	0.936	0.745	0.136
quadratic	<0.001	<0.001	0.007	0.920	0.165	0.670	0.205

Figure 3.15 shows estimated values from the models for the three most common species. The black bar is the predicted number of passes per minute when no lights are present, whilst the other four are the predicted number if there are 20 lights per transect of the appropriate colour. Predictions are averaged on the log-scale over other terms in the model and so their absolute value is not necessarily realistic, but their values provide a good impression of the relative magnitude of effects.

As well as the three most common species, Myotis bats are also in Figure 3.15, as there is a hint that there may be a negative relationship with LED lights. The relationship is some way short of statistical significance, and may well just be a chance effect, but it is worth noting, given the low numbers of encounters with these species.

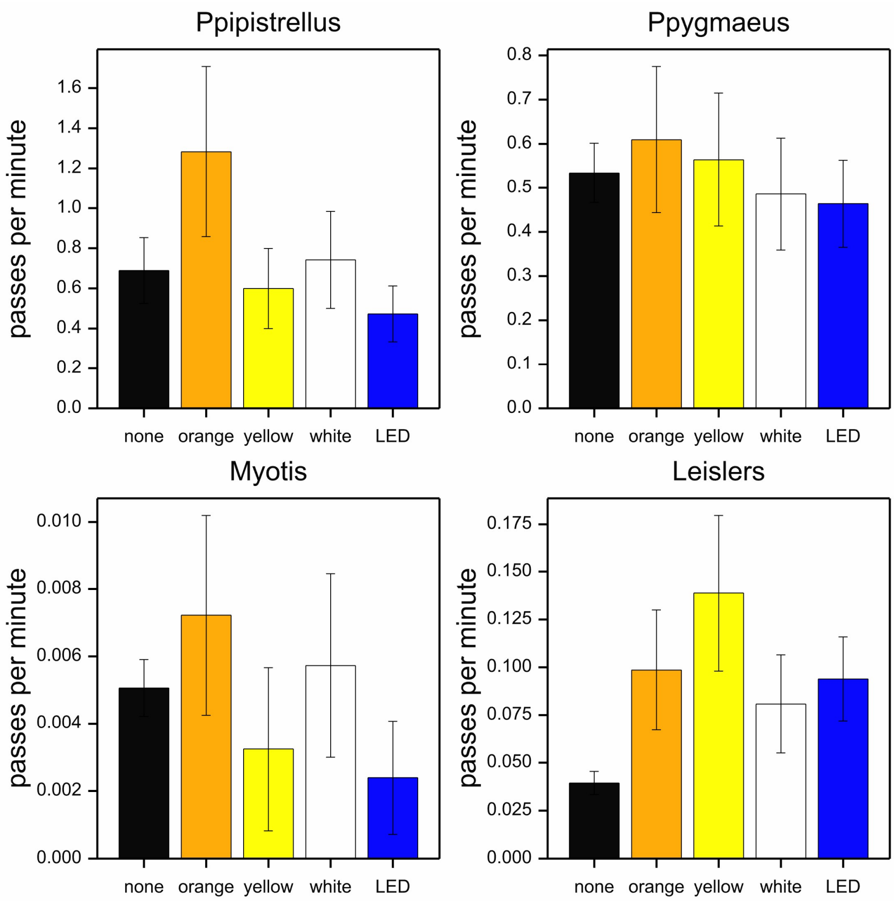


Figure 3.15: Predictions from the REML models for number of passes per minute with no lights (black) or 20 lanterns per transect of each other colour/type. Standard errors are approximate because the model is fitted on the log scale.

3.3 Discussion

3.3.1 Volunteer uptake

Fifty nine individuals undertook the survey in 2025. Four new teams were trained in with additional new members of existing teams in three locations also trained in. Results were excellent overall with few equipment errors. All data was incorporated into existing trends using a covariate for detector type.

3.3.2 Survey Coverage in 2025

Usable data was available for 55 complete surveys thereby exceeding the target for achieving sufficient power to detect trends. Twenty eight out of 28 squares were surveyed at least once.

3.3.3 Dataset

The dataset consisted of 14,425 bat encounters in 2025. This is roughly three to four times the number of bat records we typically gathered from the survey using Tranquility detectors prior to 2020.

The common pipistrelle was the most frequently encountered species, as in all previous years. It constituted 50% of all the bat observations. Soprano pipistrelles accounted for 30% of observations. Leisler's bat accounted for 12% of total bat encounters.

3.3.4 Species Abundance and Yearly Trends

Definite conclusions from a monitoring project based on the road network, such as a Car-based Bat Monitoring Scheme, can only be made in relation to roadside habitats. Inferences from the roadside monitoring to wider bat populations can be made but are based on the assumption that population trend data collected from the roadside will mirror that of the wider population. Some caution is needed in doing this since population trends in a non-random subsample of available habitats will not necessarily be representative of the population as a whole (Buckland *et al.* 2005). Along roads various threats, pressures and biases may be acting to impact on bat activity there. Artificial light at night is particularly important because the extent and type of roadside lighting is currently undergoing a change to LED-based lanterns across Ireland. See 3.3.6 below.

3.3.4.1 Common pipistrelles

The activity distribution of this species followed its usual pattern with higher encounter rate squares located in the southern half of the country.

According to the trend model this species has increased slowly but significantly since 2003. Overall, since the first year of the survey in 2003, there has been a year on year increase of 4.21%, representing a total change of +147%. The more recent, six year, trend has been for a slightly more rapid increase, at 6.3% per annum.

3.3.4.2 Soprano pipistrelles

The pattern of activity distribution for the soprano pipistrelle has never been as clear as for common pipistrelles although this species shows some western bias in some years

The highest yearly estimate for the species was recorded in 2023 and the trend line showed a particularly steep increase between 2022 and 2023. There has been an overall significant year on year increase of 6.2%, representing a total increase of +273% since 2003.

3.3.4.3 Leisler's Bat

This species tends to show an eastern and southern bias. While this is not always discernible from a single year of surveys, in 2025 the higher occurrence squares were in the east, with an additional high occurrence square in Sligo. There has been a particularly steep increase in the species in Northern Ireland in the past six years of 12% per annum (Clarke et al. (2026)), compared with 6.6% per annum across the island of Ireland.

Overall, Leisler's bat increased by 197% from 2003 to 2025. This represents a yearly increase of 5% per annum over the 22 years.

3.3.4.4 Nathusius' Pipistrelle

Nathusius' pipistrelle increased from zero values in the first two years of the monitoring scheme. However, it should be noted, that squares in Northern Ireland, where this species has a stronghold, were not surveyed for the first few years of the survey.

The use of Batloggers, which record constantly during the transects rather than for 1/11th of the time (Tranquility detectors), means that more records for the species were picked up from 2020 onwards.

Trend analysis for this species is carried out using presence-absence (binomial) rather than count data. Despite the use of a binomial model, error bars around the trend are still very wide due to the low number of records for the species picked up during the survey.

Results indicate that the species increased in the past 20 years, on average by 0.55% per annum. However, the trend has dipped recently with a change of -10.6% per annum noted for the past six years. The large error bars for this species means that the trend should be treated with caution.

3.3.4.5 *Myotis* spp.

Confidence limits for this species grouping are quite wide due to the low encounter rates. While there is considerable year-to-year variation in estimates, the net trend has been downwards since the start of the survey – year on year the index dropped by -3.8% per annum over 22 years. This decline has recently changed direction, however, with the trend in the last six years showing a year on year increase of 7.9%. In 2025. The upper confidence intervals are currently above the baseline index.

3.3.4.6 Brown Long-eared Bat

This species is the least frequently observed by the Car-based Bat Monitoring Scheme. Results from the Brown Long-eared Bat Roost Monitoring Scheme are described in Section 5.

3.3.5 Other Vertebrates

Other vertebrates were recorded in 2025 as in previous years, and again, cats were the most commonly observed animal. In decreasing order foxes, dogs, rabbits and dogs and small rodents and were the next most common roadside species/species groups. Five owls were observed in 2025.

3.3.6 Street Lighting

This initial analysis indicates that LED lighting impacts bat activity along roadsides. Leisler's bats are attracted to transects that are lit with LED lanterns and show significantly higher activity levels along lit transects, in general, than along dark roads. This model implies that LED lights are not, however, as attractive to Leisler's bats as yellow lights. Common pipistrelles may be actively avoiding LED-lit roadsides. Both Myotis species and Brown long-eared bats may be actively avoiding roads with LED lights, although both occur in very low numbers on car monitoring transects so these results are uncertain.

Next year we plan to include habitat information in these models, to try to rule out the possibility that the relationships are driven by urbanisation, or other factors related to habitat, rather than a relationship with lighting per se. We also plan to refit the models as Poisson GLMMs with an offset for sonogram length.

4.0 ALL-IRELAND DAUBENTON'S BAT WATERWAY MONITORING SCHEME

4.1 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).

Prior to the allocation of sites, all surveyors are contacted by email to determine their willingness to participate in the coming year's surveys. An information pack consisting of a detailed description of the methodology, maps, survey forms and online training facilities are provided for each survey team. Heterodyne bat detectors are also available to loan for the duration of the summer months. In 2025 training took place virtually using the Zoom platform (four training sessions) and additional training videos were made available through the BCIreland YouTube channel.

In 2025 we developed and implemented a new online web form that was used to recruit volunteers. Previous surveyors were first given the opportunity to reclaim their site from 2024 using this new system. After a defined timeframe (once the first online training session had taken place), the opportunity was opened to all potential volunteers who had expressed interest in participating. In brief, volunteers were emailed a link to an interactive Google Map that provided locations and details of all available waterways sites. Volunteers were able to select their chosen waterway on the map and thus sign up for the scheme through submitting an online form. Once done, they were issued with an automatic email containing links to all documents relevant to the surveys and their specific site.

Surveyors undertake a daytime survey of their allocated site 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 that 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 several other parameters including air temperature, weather data and waterway characteristics, such as the width of the waterway and the smoothness of the surface water.

Surveyors are asked to undertake the survey on two dates, one between the 1st and 15th August (Survey 1, S1) and the repeat survey between the 16th and 30th August (Survey 2, S2). On completion of surveys, survey forms are returned to BCIreland for analysis and reporting. In 2025, we also developed a new online results submission form for volunteers to submit their results electronically.

4.1.1 Statistical Analysis

For statistical analysis, a log-transformation is carried out on data at the ten individual points within each survey; this effectively calculates the mean number of passes for the survey and helps to reduce the influence of the very high counts sometimes recorded due to one or two bats repeatedly passing the observation point. In previous years, bat pass counts were used in a REML model (log-transformed) to investigate the potential relationships with recorded variables. Since 2010, the dataset (2006-2025) has been entered into a model looking at the impact of the various covariates on the probability of observing bats at a given spot i.e. a binomial model (Binomial GLMM/GAM model).

Analyses are based on data from dates between day numbers 205-250 (i.e. 24th July and 7th September, if not a leap year) which is designed to give approximately one week either side of the official survey period to maximise the amount of data available. Consequently, the majority of submitted surveys are included in the model as only a few surveys from the second week in September are excluded.

For analyses based on bat passes, both counts excluding and including 'Unsure' Daubenton's bat passes were used. For binomial analyses, the presence of both 'Sure' and 'Unsure' Daubenton's bat passes at each survey spot were used. Surveys where no bat passes were recorded are also included in the analysis.

To assess trends, two different methods are used. One is a Generalised Linear Model (GLM) with a Poisson error distribution which is applied to the entire dataset (i.e. 2006-2025) and the other is a GLM with a binomial distribution. The first is undertaken in order to compare the trends with the BCT waterways survey (e.g. Barlow *et al.*, 2015) while the latter is also reported since presence/absence models such as this are considered to be more effective in dealing with the issue of multiple encounters with the same individual bats, a problem common to static detector surveys.

The trend datasets only include waterway sites surveyed for two or more years as waterway sites surveyed in a single year do not contribute to information on trends.

For the GLM with Poisson distribution, Daubenton's bat activity per annum was modeled using four different measures ('Sure' passes only, 'Unsure' and 'Sure' passes combined, a maximum of 48 passes per survey, a maximum of 48 passes with covariates included in the model). The model with the maximum number of bat passes per survey spot is set to 48 passes (both Sure and Unsure) (i.e. one pass per 5 seconds) because it is considered that volunteers differ greatly in how they record continuous activity and this truncation reduces the uncertainty associated with higher counts. This approach is similar to the approach used for assessing Daubenton's trends in Britain in the National Bat Monitoring Programme (NBMP) undertaken by the BCT and also for trends in bird populations.

The binomial (presence/absence) model uses the proportion of survey spots with bats present at each waterway site (e.g. 0.7 if Daubenton's bats were observed at seven of the ten survey spots). Bootstrapping is used to find standard errors using logistic regression (a GLM with a logit link function) (Fewster *et al.*, 2000). A smoothed GAM trend is also fitted (to highlight the change in trend) to the results without co-variates to give a general indication of the trend.

4.1.2 Online Training in 2025

No in-person training courses were organised in 2025. BCIreland ran four online training sessions for volunteers virtually using the Zoom platform. BCIreland also produced online training videos in 2020 and these were uploaded to the BCIreland YouTube channel.

4.2 Results

4.2.1 Training and Volunteer Participation

A total of 220 potential new volunteer teams registered in 2025 to participate in the monitoring survey. These volunteers were invited to attend one of the Zoom training sessions and 197 people registered to receive training. Four live Zoom sessions were organised for volunteers to participate in on the following dates: 16th, 17th, 19th, and 22nd July 2025.

All bat detectors to be loaned to volunteers were sterilized using disinfectant wipes and were posted to surveyors. Since 2020, it has been a BCIreland policy to discourage the sharing of bat detectors between survey teams. In preparation for 2025, additional bat detectors were purchased to ensure that there were enough detectors available for volunteers.

A total of 256 waterway sites were surveyed by 224 survey teams in 2025. This is the highest number of sites ever to be surveyed in a single season in the 20 years since the scheme began. Sixty-seven new survey teams participated in 2025 surveying 75 waterway sites. Overall, twenty-four teams surveyed two or more waterway sites (n=61).

A total of 18 different bat detector models were used by survey teams in 2025. The Bat Magenta Bat 4 heterodyne bat detector was the most common model (n=131 surveys, 51.2%) (see Table A2.1 & A2.2, Appendix 2), principally because this is the detector model provided by BCIreland for volunteers.

4.2.2 Waterway Sites Surveyed

A total of 645 waterway sites were registered in 2025. Results of 256 surveyed waterway sites were received in time for statistical analysis.

Seven (1.1%) of the waterway sites surveyed in 2025 have been surveyed each year since 2006 while 73 (11.3%) of the waterway sites have been surveyed for only one year between 2006 and 2025 (Table 4.1). BCIreland encourages new survey teams to take on "Free" sites with a particular emphasis on waterways sites previously only surveyed once in order to further reduce the dataset of single survey waterway sites. In 2025, 11 waterway sites with only one previous survey were targeted and successfully surveyed.

Table 4.1: Number of years each waterway site across the island was surveyed during 2006-2025 as part of the All Ireland Daubenton's Bat Monitoring Scheme.

No. of Yrs	No. of Waterways	No. of Yrs	No. of Waterways
1	73	11	20
2	58	12	22
3	84	13	20
4	57	14	15
5	50	15	21
6	42	16	20
7	37	17	10
8	30	18	15
9	31	19	9
10	24	20	7

Of the 256 sites surveyed (Figure 4.1), 31 were located in Northern Ireland and 225 in the Republic of Ireland. Sites surveyed in 2025 were distributed throughout the island with every county except one (Fermanagh) on the island of Ireland represented.

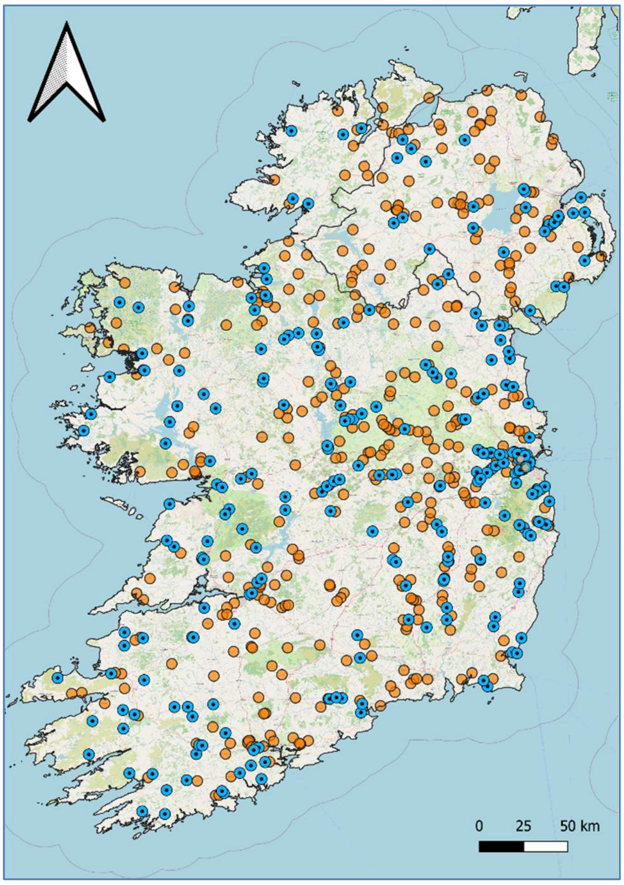


Figure 4.1: Location of all waterway sites surveyed across the island from 2006-2025 as part of the All Ireland Daubenton's Bat Monitoring Scheme. Blue circles with dot: 2025 waterway sites only (n = 256), Orange circles: all other registered waterway sites 2006-2025 (n = 389).

In 2025 a total of 13 canals (47 waterway sites), three channels and 130 rivers (206 waterway sites) were surveyed. In 2025 the Grand Canal had 20 sites surveyed along its length while the Royal Canal had 12 sites surveyed. The River Dodder had the most waterways sites surveyed with nine along its length, the Barrow had eight sites, the Shannon had seven sites, while the Boyne and the Lagan both had six sites. (Figure 4.2).

Overall, for the 2006-2025 dataset there are 548 waterways sites located on rivers (n=295 rivers), 93 waterway sites on canals (n=23 canals) and the remaining four waterway sites are channels, such as the North Slobs in Co. Wexford (n=4 channels).

Of the four provinces, the highest number of waterway sites surveyed in 2025 were surveyed in Leinster (n=112, Figure 4.3. Dublin had the highest number of waterways sites surveys surveyed (24), followed by Cork (21), Kildare (17), Wicklow and Antrim (both 14). For a more detailed breakdown of country and provincial results, see Table A2.1 in the Appendices.

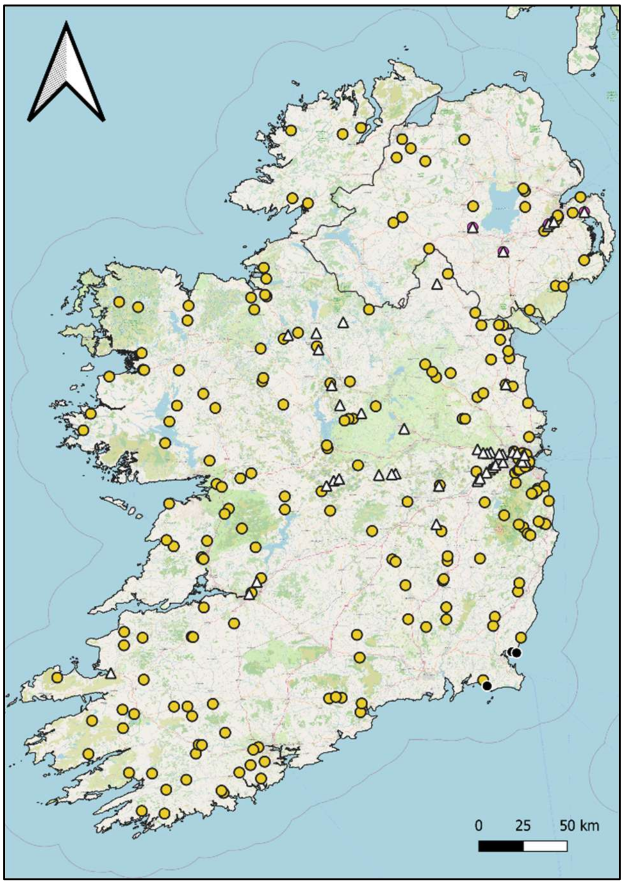


Figure 4.2: Different type of waterways surveyed in 2025 as part of the All-Ireland Daubenton's Bat Monitoring Scheme. Gold circles = River sites (n = 206), White triangles = Canals (n = 47), Black circles = Channels (n = 3).

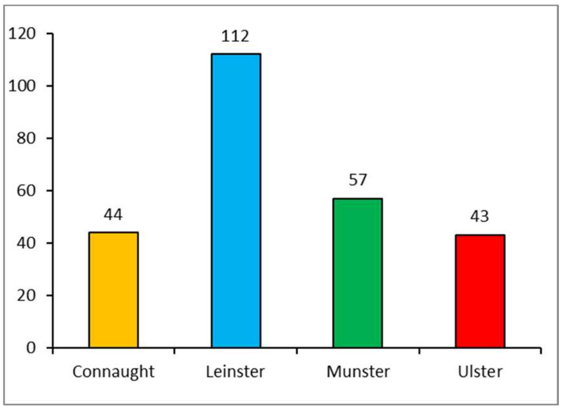


Figure 4.3: Number of waterway sites surveyed in each province in 2025 as part of the All-Ireland Daubenton's Bat Monitoring Scheme.

4.2.3 Completed Surveys

A total of 482 completed surveys from 256 waterway sites were returned to BCIreland in 2025. Two hundred and thirty-nine surveys were completed in the first survey period (Survey 1: 1st – 15th August) while 243 surveys were completed in the second survey period (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 2025, a total of 226 repeated surveys (89.7% of waterway sites) were completed while 30 single surveys were completed (see Figure 4.4) which was an improvement on 2024. The years 2007 and 2010 had the highest rates of repeat surveys of all survey years to-date (95% and 93% respectively).

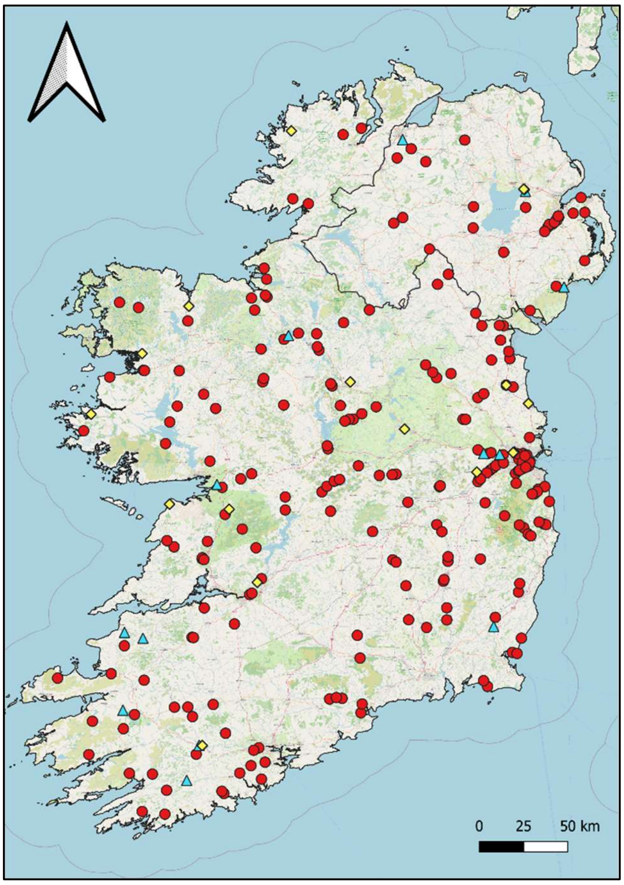


Figure 4.4: Waterways surveyed either twice (Survey 1 & Survey 2) or only once (Survey 1 only or Survey 2 only) in 2025 as part of the All-Ireland Daubenton's Bat Monitoring Scheme. Red circles = Survey 1 & Survey 2 (n = 226); Blue triangles = Survey 1 only (n = 13); Yellow diamonds = Survey 2 only (n = 17).

In 2025 'Sure' Daubenton's bat passes were recorded on 231 sites (90.2%) (Figure 4.5). At each of the 10 survey spots of each completed survey, volunteers recorded Daubenton's bat activity for four minutes generating 40 minutes of data per completed survey. In total, 20,729 'Sure' Daubenton's bat passes and 3,253 'Unsure' Daubenton's bat passes were recorded during 628 hours and 7 minutes of surveying in 2025. The number of Daubenton's bat passes recorded in 2025 was higher than for 2024 (18,294) and was the highest number of 'sure' passes since 2011.

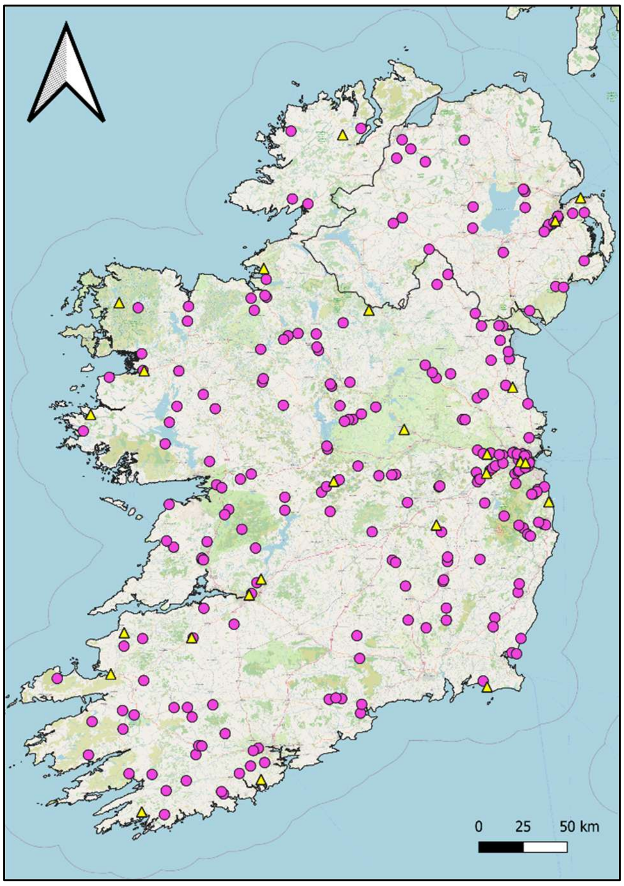


Figure 4.5: Location of waterways sites with Daubenton's bat recorded in 2025 as part of the All-Ireland Daubenton's Bat Monitoring Scheme. Pink circles: Daubenton's bat recorded (n=231); Yellow triangles: Daubenton's bat not recorded (n=25).

Taking the surveys that were returned in time for statistical analysis and were completed between Day 205 to 250 (n=482 surveys, See Table A2.3 in the Appendices) the mean number of 'Sure' Daubenton's bats passes per survey was 43.5 passes, which is the highest mean number of sure passes since 2022. Daubenton's bats were recorded at 54.1% of survey spots in 2025, which is slightly below the mean recorded over the 20 years of the monitoring scheme (mean = 55.5%). It should be noted that data shown in the same table (A2.3) in our previous report from 2024 will show different values for some calculations. This is because an issue was identified in how some sites with 'zero' Daubenton's bat counts were being treated as incomplete surveys in the statistical analyses used, thus affecting the overall values reflected in this table. This issue has been rectified and the results presented in Table A2.3 here reflect the true values.

In 2025 waterway sites located in Munster recorded the highest mean number of bat passes (Mean no. = 57.8 'Sure' bat passes). Both Munster and Connaught tend to have the highest mean number of bat passes over all survey years, while Ulster tends to have the lowest number of bat passes over the years. However, in 2025 Leinster had a higher mean number of bat passes compared to Connaught (47.6 and 30.5 respectively) while Ulster recorded a mean number of 27.5 'sure' bat passes, which was slightly higher than 2024 (25.6). For a full break down of descriptive results for 2006-2025 see Table A2.3, Appendix 2.

4.2.4 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. This particular model is chosen to facilitate comparison with British data from the BCT.

On an All-Ireland level, there has been a fluctuating trend since 2006, with levels having troughed in 2008 and again 2013-2014. A peak was observed in 2011 and then again 2015-2016. In the subsequent years until 2023 there was a slight dip in the trend, but in 2024 and 2025 there was a slight upturn. Overall, the species is showing a relatively stable trend. The smoothed index is currently 3.83% above the 2007 base year value which is equivalent to a mean 0.21% annual increase, although this increase is not considered significant as confidence intervals still encompasses the baseline index.

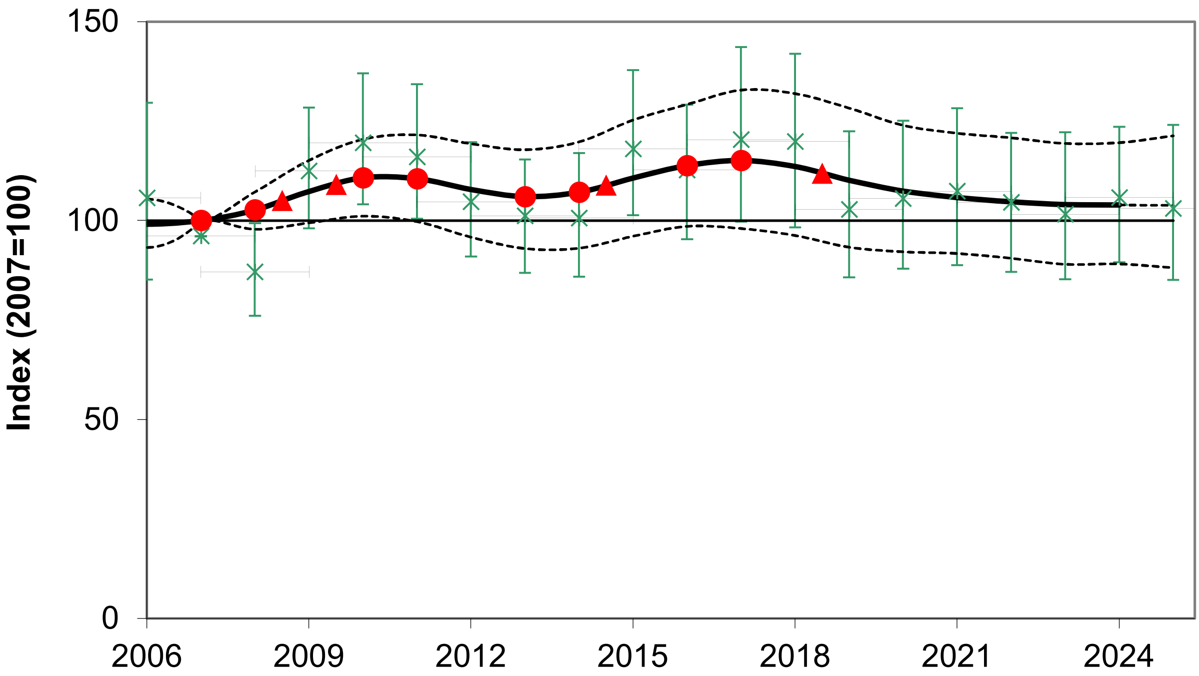
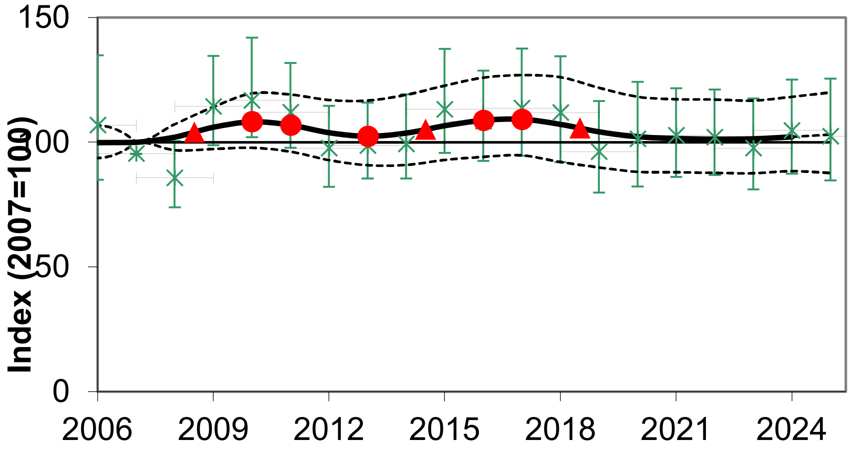


Figure 4.6: All Ireland results of the GAM (95% confidence interval) model for total number of Daubenton's 'All bat' passes (both 'Sure' and 'Unsure'). Green points are estimated annual means and are shown to illustrate the variation about the fitted line. Red circles indicate significant (P=<0.05) change 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). Please see appendices for the accompanying table.

4.2.5 Country Trend Models

There are 20 years of data available for analysis and therefore the trend models for Republic of Ireland and Northern Ireland were investigated separately. A total of 541 waterways sites are located in the Republic of Ireland and 104 waterway sites are located in Northern Ireland. Waterway sites with at least two years of data were used for trend models. Therefore, in 2025 there were 480 waterways sites available for Republic of Ireland and 86 waterway sites for Northern Ireland. In 2025, a total of 566 waterway sites (86.5%) were used for trend analysis.

Between 2024 and 2025, there was a slight increase in the mean number of Daubenton's bat passes recorded in the Republic of Ireland (Figure 4.7., top chart). Conversely, in Northern Ireland there has been a downward trend over the last few monitoring seasons, with a significant year to year decrease observed in the mean number of bat passes recorded from 2020-2024. (Figure 4.7, bottom chart). The Northern Ireland trend is continuing to head downwards as of 2025, closing the gap between it and the Republic of Ireland trend which remains close to the baseline value. Confidence limits for Northern Ireland are wide due to the relatively small sample size and so differences are not significantly different using a randomisation test (P=0.330).



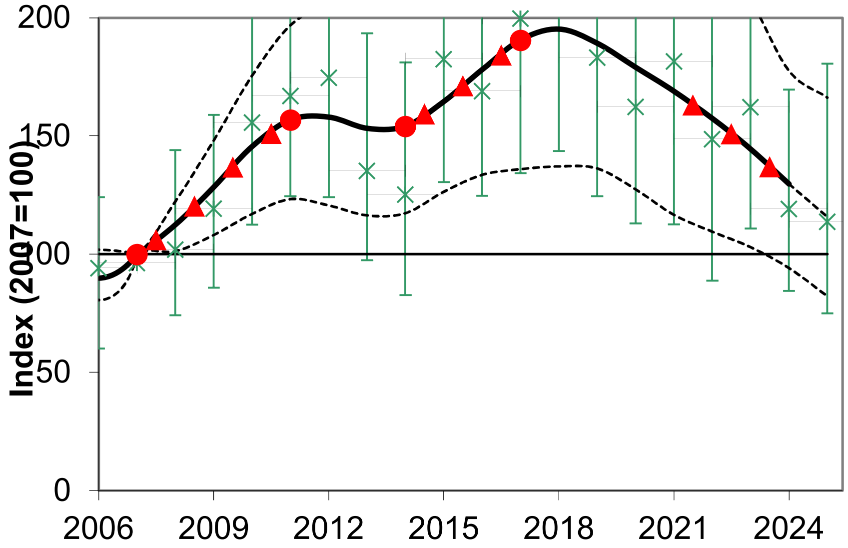


Figure 4.7 (previous page): Poisson GAM results for the Republic of Ireland (above) and Northern Ireland (below). Green points are unsmoothed means and the bars are 95% bootstrapped confidence limits. The black line is the fitted GAM curve with 95% confidence limits shown by the dotted lines. Red triangles show a significant year-to-year change and red circles a significant changepoint (where the slope changes). Please see appendices for accompanying tables.

4.2.6 Robustness of Dataset

BCIreland encourages new survey teams to take on "old" waterway sites in order to strengthen the data. In 2025 new survey teams were encouraged to take on previously registered waterway sites. This approach is reducing the number of single survey waterway sites and increasing the number of annual repeat surveys of registered waterway sites.

At the end of 2023, 100 (15.5%) of the waterway sites had been surveyed for only one year. In 2024 this was reduced to 84 waterway sites (13%) (Figure 4.8) and in 2025, this was reduced again to 73 waterways sites (11.3%). This is an aspect of the survey that we strive to improve on every year as increasing the number of repeat surveys at sites helps to improve the accuracy of the trend analysis.

There are 645 waterway sites in the dataset and on average only 35-40% are surveyed annually. As a result, there is still a large number of sites that have only been surveyed for one to four years in the full dataset (n=252, 39.1%).

On a county-by-county basis, the five counties with the highest percentage of single year survey sites are Counties Westmeath (32.1%, n=9), Tyrone (32%, n=8), Monaghan (30%, n=3, Mayo (28%, n=7),) and Carlow (20%, n=4).

Table 4.2 shows the number of years of data contributed by each waterway site surveyed in 2025. While there is a much larger number of waterway sites surveyed for just one, two or three years in the full dataset (i.e. 2006-2025, see Table A2.5 in the Appendices for details), the 2025 waterway site dataset shows a more even distribution.

Table 4.2: Number of years each waterway site surveyed in 2025 has been surveyed as part of the All-Ireland Daubenton's Bat Monitoring Scheme.

	Sites Surveyed in 2025		
No. of Years	**N sites**	**% of Total**	**Cumulative %**
1	1	0.4	0.4
2	12	4.7	5.1
3	27	10.5	15.6
4	16	6.2	21.9
5	19	7.4	29.3
6	20	7.8	37.1
7	14	5.5	42.6
8	16	6.2	48.8
9	14	5.5	54.3
10	9	3.5	57.8
11	8	3.1	60.9
12	12	4.7	65.6
13	15	5.9	71.5
14	10	3.9	75.4
15	16	6.2	81.6
16	13	5.1	86.7
17	8	3.1	89.8
18	12	4.7	94.5
19	7	2.7	97.3
20	7	2.7	100.0

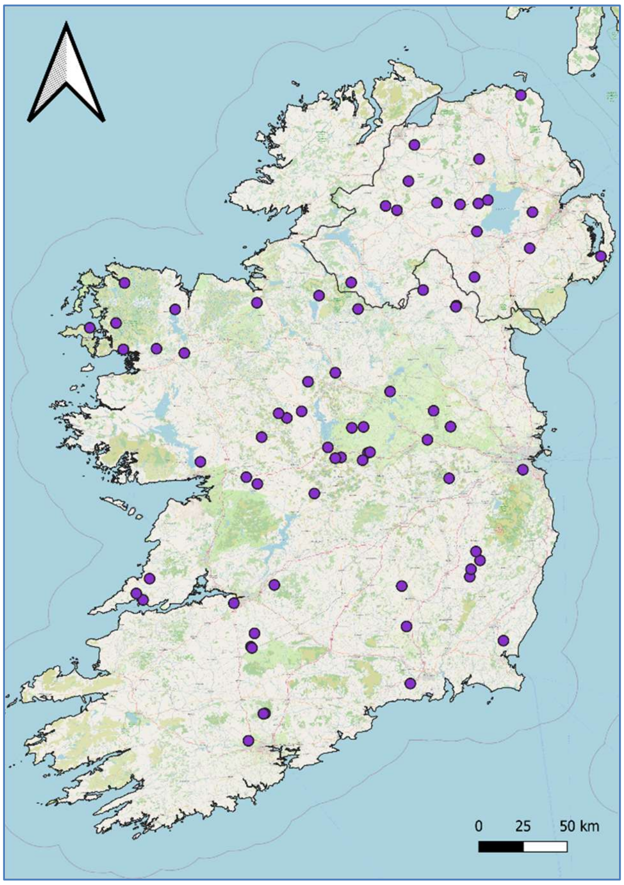


Figure 4.8: Waterways surveyed for one year only (2006-2025 dataset), n=73 (Purple circles).

4.3 Discussion

4.3.1 Volunteer Uptake 2025

A large number of volunteers continue to participate in the All-Ireland Daubenton's Bat Waterways Survey. A total of 220 potential new volunteers registered in 2025 and 197 of these attended online training. Sixty-seven new survey teams were recruited in 2025 and successfully completed surveys along 75 waterway sites. This far exceeds our usual annual recruitment of 30-40 new survey teams, which is what is typically required to ensure that the target number of waterway sites are surveyed annually.

While a small core group of survey teams have participated in the programme for each of the twenty years, there is still need for a recruitment drive each year since a certain percentage of volunteers are lost from the survey every year. Prior to COVID-19 this recruitment drive usually involved 3 - 15 in-person training courses per year. However, since 2020, BCIreland has provided online training. This has reduced the amount of time required for training, allowing the scheme co-ordinator to undertake extra surveys to reduce the number of single surveyed waterway sites. This new type of training has also lowered the scheme's carbon footprint by reducing travel to training courses. While the lack of physical training reduced volunteer recruitment in 2020, online training course recruitment has been strong every year since 2021, which is encouraging.

In future, we feel that a combination of physical and online training could be a good combination to optimise recruitment and training while leaving some time free to carry out additional surveys where we have poor uptake by volunteers. The feasibility of this will be assessed annually and will be determined by work commitments of the monitoring co-ordinators.

It has become a policy since 2020 to encourage volunteers to choose a waterway site from the list of available registered sites. This has resulted in a greater uptake of registered waterway sites by new volunteer teams compared to the survey years prior to 2020. This policy has increased the robustness of the dataset and therefore should continue to be the standard practice for future operational years.

4.3.2 Changes in 2025

Changes have been implemented in how volunteers choose their survey site, sign up for the scheme and how they submit their results. Volunteers are now issued with a link to an online interactive map where waterways sites can be claimed, automatically signing up volunteers to the scheme after they choose a site and complete an online form. All of the relevant documents pertaining to the survey, as well as the site-specific details for their chosen waterway, are now emailed to volunteers automatically after they sign up. The process for submitting survey results has also changed. After surveys are completed, volunteers submit their results directly into an online form. Overall, the new system has reduced some of the most time-consuming administrative tasks associated with running the scheme which has been welcome. However, there were some technical issues with the interactive map and online forms which took additional time in 2025. In 2026 we aim to resolve all issues so that the system will be further improved.

4.3.3 Survey Coverage in 2025

This year had the highest number of sites completed in the history of the scheme (256) which was a great achievement. It also yielded the highest number of individual surveys (482) with the second highest being 474 in 2014. In relation to repeat surveys i.e. sites that were successfully surveyed twice during the designated survey windows in August, 2025 had 226 (88.3% of the total) which was also the highest number of repeat surveys completed in the 20 years of the survey. Surveys were carried out in all but one of the 32 counties of the island in 2025 (no survey was successfully completed in Fermanagh in 2025). The highest coverage for a single county was Dublin with 24 surveyed waterways sites and was closely followed by Cork with 21 surveyed sites. A large number of sites are consistently surveyed in these two counties each year, owing mostly to the high number of volunteers located in Co. Dublin and the large number of registered waterways in Co. Cork.

4.3.4 Dataset & Distribution

The 2025 dataset consisted of 20,729 Daubenton's bat passes. Daubenton's bat was recorded on the majority of waterway sites surveyed in 2025 (90.2%), thus re-confirming this species' wide distribution on linear waterways across the island. Daubenton's bat was recorded in every county surveyed, from the most northerly waterway sites in Co. Antrim to waterway sites in south-west Co. Kerry and also at sites on the western seaboard in Co. Mayo. A similar widespread distribution of this species was reported by the BCT's National Bat Monitoring Programme where Daubenton's bat has been recorded at sites spanning areas in northern Scotland to southern England (www.bats.org.uk). This monitoring scheme is, therefore, making a considerable contribution to our knowledge of the distribution range of Daubenton's bat on the island of Ireland.

4.3.5 Lighting & Habitats

Lighting and habitat data was last assessed in detail for data up to and including the survey of 2021 (Aughney, Roche & Langton, 2022). If lighting is present at a waterway site, this has a significant negative effect on the number of Daubenton's bats recorded. White lights, in particular, have the largest negative effects. This is an important issue particularly in urban areas, where waterways are often the last remaining dark conduits through a landscape of artificial surfaces and buildings. It is important that dark wildlife refuges are part of wider landscape management policies.

While our previous data has indicated that the presence of hedgerows and reeds at the survey spots of the waterways sites do not have a strong influence on bat passes, trees do have a significant positive impact. This fact could be used as a management tool to increase the wildlife value of linear waterways, particularly in urban areas. Trees can also be used to buffer lighting impacts as part of landscape tools (BCT, 2018).

4.3.6 Yearly Trends

From 2009-2022 we examined trends using both a Poisson Generalized Linear Model (GLM), which focusses on Daubenton's bat counts, and a binomial model, which focusses on presence/absence of Daubenton's bat at individual survey spots. The latter is considered to be an effective way to establish trends since the impact of bat detector model on observed passes is diminished and other effects such as surveyor skill are likely to have less of an impact on overall trends (MacKenzie *et al*, 2006). However, over the years there has been very little difference in the trends when both models are compared. As with last year's report, for the 2025 report we decided to only use the Poisson model in our reporting of the Daubenton's survey data. Moreover, the Poisson method is more directly comparable with the BCT's reporting in the UK, since it is the same model used in their analyses. Although we will still continue to carry out the analysis on Daubenton's data using both Poisson and Binomial models to assess any differences, we will focus on only reporting the data using the Poisson model henceforth.

GLM/GAM analysis has shown evidence of declines and increases in Daubenton's bat activity throughout the duration of the monitoring scheme. The overall trend has fluctuated since 2006, and in some cases declines in particular years may have been attributable to poor weather (i.e. high rainfall and/or low temperatures) in August of that year but the overall trend since 2006 has been reasonably stable, with an increase in Daubenton's bat activity being observed in 2025.

In comparison with Ireland, the smoothed index for Daubenton's bats for the United Kingdom in 2023 was 4.2% above the 1999 base year value, however this change is not statistically significant (Bat Conservation Trust, 2025). It has been relatively stable since 1999, sitting close to or slightly above the baseline.

4.3.7 Robustness of Dataset

The trend datasets only include waterway sites surveyed for two or more years. The 2006-2025 dataset contains 73 waterway sites that have only one year of data. Due to our policy of targeting single surveyed waterways sites when recruiting new volunteers, this number has been steadily decreasing.

To increase the robustness of the dataset, particular counties are targeted for surveying to decrease the number of single surveyed waterway sites. Since 2020 there, there has been an aim to include at least 80% of waterways sites in the dataset for trend analysis. This has been achieved.
For 2026, efforts to reduce single survey waterway sites will be continued. The five counties with the highest proportion of single year survey waterway sites will be targeted in 2025: they are Westmeath, Tyrone, Monaghan, Mayo, and Carlow. It was disappointing that no surveys were successfully completed in Fermanagh in 2025 so there will be a special effort made in 2026 to recruit volunteers there and have some surveys completed in that county. In addition, BCIreland will also target waterway sites that have not been surveyed in the last five years. This dataset consists of 207 waterway sites, 31 in Northern Ireland and 176 in the Republic of Ireland.

There are 645 waterway sites in the dataset and on average only 35-40% are surveyed annually. The volunteer capacity achieved annually is a realistic value and therefore it is unlikely that a larger number of the registered waterway sites can be surveyed. Therefore, the policy of discouraging the establishment of new registered waterway sites is important and should continue for the operation of this monitoring survey.

5.0 BROWN LONG-EARED BAT ROOST MONITORING SCHEME

5.1 Methods

The Brown Long-eared Roost Monitoring Scheme methodology was designed by BCIreland. For a full description of the Preliminary Roost Assessment and Survey Methodology, see Aughney *et al.* (2011).

5.1.1 Annual Roost Counts

Suitable roosts are monitored yearly by either Internal counts (2 counts) or External Emergence Dusk Counts (2-3 counts) during the specified survey periods (See Table A3.1, Appendix 3). In general, buildings with no access to the roof space are surveyed by Emergence Dusk Counts only. Buildings with exit points too high to clearly see emerging bats (i.e. greater than two floors high) are monitored using Internal Counts if the roof space is accessible. Not all individual brown long-eared bats leave the roost site every night, especially during poor weather conditions (Entwistle *et al.*, 1996) therefore internal validation is completed post emergence survey where possible. Buildings with both access to roof space and visible exit points are assessed by whichever method can be used with greatest ease and that results in reliable roost numbers.

Due to COVID-19, an extra effort was undertaken to reduce the number of internal surveys undertaken in 2020. Internal surveys were only undertaken for roosts with large attic spaces and with PPE worn by the surveyor.

Dates for survey periods are as follows: Survey 1: 16th May to 15th June; Survey 2: 16th June to 31st July & Survey Period 3: 1st August to 30th August. Volunteer survey teams are encouraged to adhere to these survey dates, where possible.

Internal counts are undertaken by a licensed surveyor and counts are completed during the day using a red-light torch. The entire internal space of the roost is examined and individual brown long-eared bats are counted. Emergence Dusk Surveys are completed using bat detectors with surveyors located at all known exit points from the roost. Surveys begin 20 minutes after sunset and continue until no bats exit the building for a full ten minutes of surveying.

Due to the difficulty of detecting brown long-eared bats emerging from some roosts, night vision aids (NVAs) are used. Sony HandyCam FDR-AX33 and FDR-AX53 with night-shot capability along with infrared illuminators and Guide Pro 19 & 25 thermal imagery scopes are deployed. The camcorder is positioned on a tripod (1.5m high) while the IR illuminators are attached to a separate tripod (1m high, two per roost site). Illuminators are shone onto the building in the general vicinity of known exit points. In relation to the thermal imagery scope, the scope is also erected on a tripod (1.5m) and positioned to record emerging bats. Recordings are completed from 20 minutes after sunset for the duration of the roost count. Film footage is examined post-surveying.

On completion of surveys, survey forms are returned to BCIreland for analysis and reporting.

5.1.2 Statistical Analysis

The effects of Northings and Eastings, day number (i.e. survey date), weather data, building type, start time, and internal/external counts were examined using a Generalised Linear Mixed Model (GLMM).

To assess trends, a Generalised Linear Model (GLM), with confidence limits based on bootstrapping at the site level, was applied to the 2007-2025 data. Data from all sites counted in two or more years are included in the trend dataset.

The trend is smoothed using GAM and the yearly estimates are expressed as an index with 2008 as the base year. The models use a negative binomial distribution, rather than the Poisson distribution previously used (and as used for the GLMM), as it fits the data better and gives slightly more precise results.

The models were completed with and without covariates for drizzle/rain, for internal counts before mid-May and for external counts after mid-September, factors that were significant from GLMM models.

5.2 Results

5.2.1 Volunteer Participation in 2025

Forty two roosts were surveyed in 2025, thirty five of which were monitored solely by volunteer teams and/or roost owners. The coordinator assisted surveying at three additional roosts including County Galway (n=1), County Dublin (n=1), and County Mayo (n=1) while training in new volunteers. Four roosts were surveyed by the coordinator. In total, 51 volunteers, including roost owners, participated in the monitoring scheme in 2025.

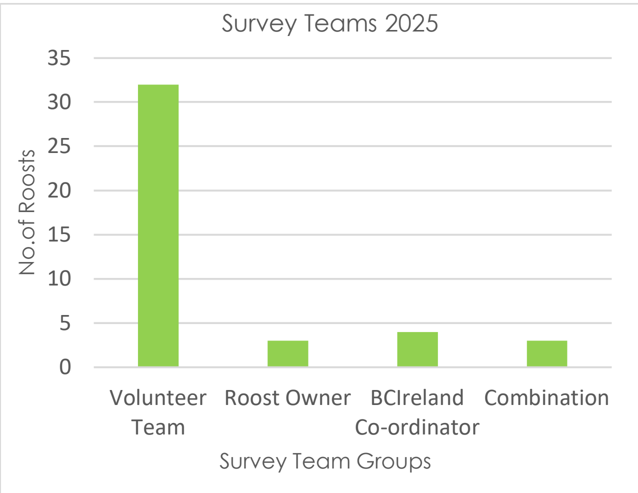


Figure 5.1: Type of Survey Team participation in 2025.

Kildare Bat Group, Wicklow Bat Group, Cavan Bat Group, Gorey Bat Group, Donegal Bat Group and Midland Bat Group surveyed one roost each.

5.2.2 Monitored Roosts in 2025

Brown long-eared roosts monitored in 2025 were distributed in 20 counties. The highest number of roosts were located in Counties Cavan (n=6), Galway (n=5), Cork (n=4), and Wicklow (n=5 each). One roost, verified as suitable for inclusion in 2021, was monitored again in 2022 and 2023 (County Offaly). A new roost was temporarily added to the 2023 survey calendar (County Westmeath). This roost was surveyed again in 2024 and is now included in the monitoring scheme. Two new roosts were surveyed by the coordinator in County Donegal (n=1), and County Mayo (n=1) in 2024 and 2025 inclusive. In 2025, these two roosts were included in the dataset. Another roost in County Offaly (n=1) was included in the dataset but counts did not take place in 2025 due to access. Forty six roosts were surveyed in total in 2025, four of these are not included in the trend dataset as it was the first year of monitoring these include County Donegal (n=3), and County Mayo (n=1).

In total there are data for 69 roosts in the brown long-eared monitoring dataset (2007 to 2025). Nineteen of these roosts are no longer monitored due to absence of bats, development and access issues over the years. In 2021, 49 roosts were deemed still suitable for monitoring or reassessment for the next contract round of monitoring (Aughney *et al*., 2022). However, one of the roosts deemed no longer suitable was monitored as part of the Ecosystem Services study by UCD and therefore counts for that site continued to be included in the dataset (Site Code 2021) until the end of 2023. Another roost was no longer suitable for monitoring due to development impacting the roost. This means that there were 47 roosts registered for monitoring in 2025, distributed across 21 counties. From this list, 42 were surveyed in 2025. The counties currently with no roosts are Louth, Kerry, Carlow, Limerick and Leitrim. Potential new roosts have been identified for scoping surveys in 2026; these include County Leitrim (n=2), County Wicklow (n=1), County Donegal (n=1), County Meath (n=1), County Westmeath (n=1), and County Louth (n=1). The coordinator is currently working with local biodiversity officers to identify suitable roosts in Counties Kerry and Carlow.

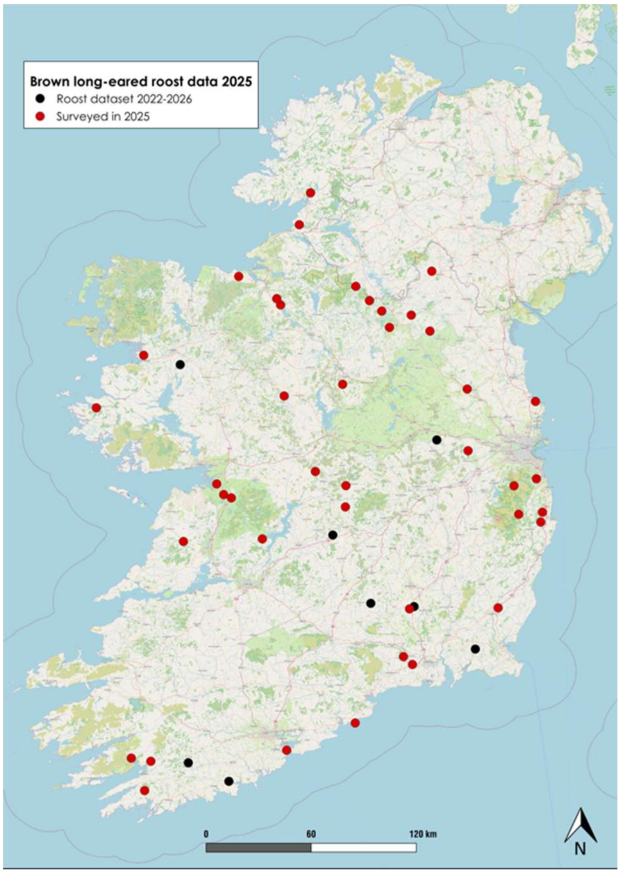


Figure 5.2: Brown long-eared roosts surveyed in 2025 as part of the Brown Long-eared Bat Roost Monitoring Scheme. Red circles = Roosts surveyed in 2025; Black circles = Roosts not surveyed in 2025.

Tables A3.2 and A3.3 (in Appendix 3) indicate how regularly roosts are monitored. Table A3.2 shows that that around two thirds of the roosts in the dataset have been monitored for at least 10 years, whilst Table A3.3 shows that there is an excellent level of consistency in the roosts surveyed over the last ten years, which is a positive factor for accurate trend analysis.

The majority of roosts surveyed in 2025 were surveyed by external Dusk Emergence Counts only (n=38, 90%). An additional four roosts were monitored by internal counts only. A total of 92 external surveys and nine internal counts were undertaken in 2025. (see Appendix 3, Table A3.5 for summary of surveys completed).

The buildings surveyed included churches, houses, an agricultural barn, large buildings/houses and a category named "other", representing two medieval towers and 12th century stone structure. The majority of the buildings surveyed were churches (Figures 5.3 & 5.4).

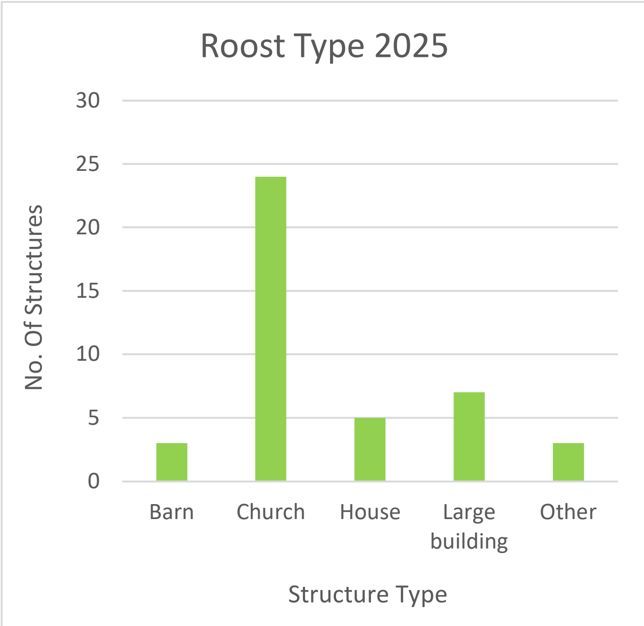


Figure 5.3: Type of buildings monitored in 2025.

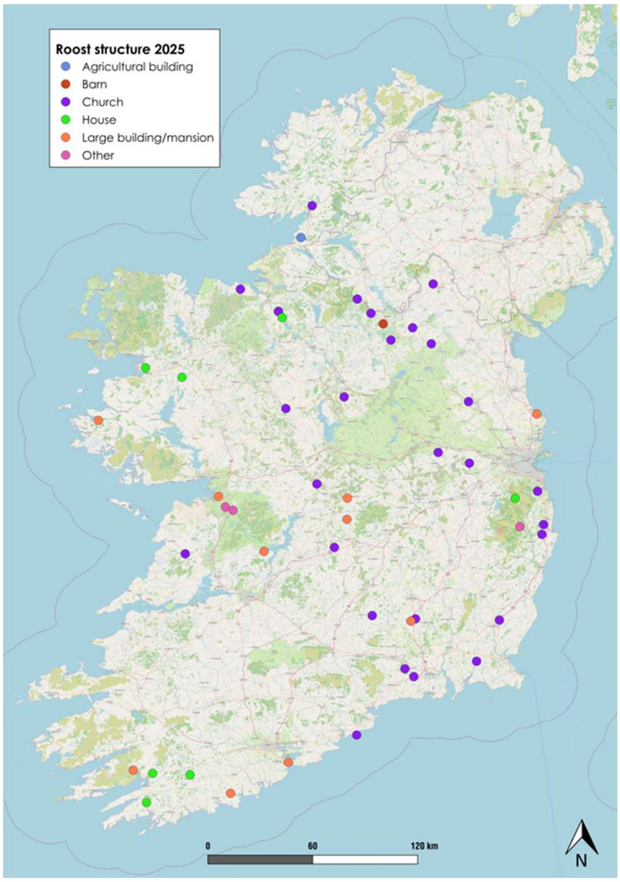


Figure 5.4: Distribution of types of buildings surveyed in 2025. Pink circles = Large building / houses; Green circles = Houses; Purple circles = Churches; Blue circles = Agricultural buildings, Red circles = barn, and Orange = Other.

In 2025, a total of 1,355 individual bats were counted in the 42 roosts. The mean number of bats per roost in 2025 was 32.3 individuals and the median count was 25 individuals.

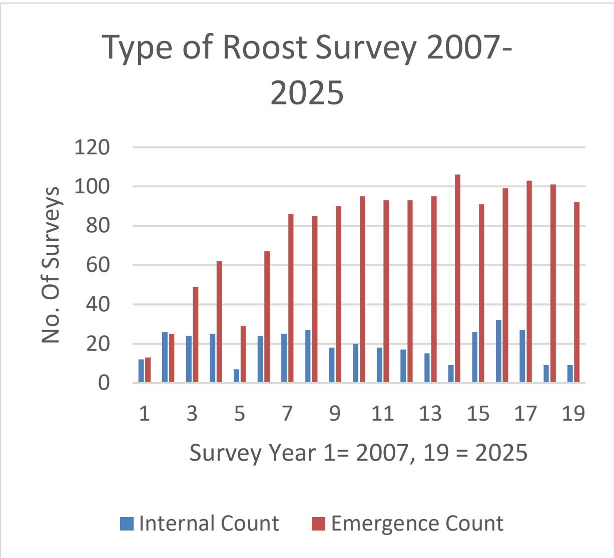


Figure 5.5: Type of roosts surveyed 2007 - 2025

5.2.3 Monitored Roosts 2007-2025

The Brown Long-eared Bat Roost Monitoring Scheme was introduced in 2007 and continued until 2010. There was no funding available in 2011 to implement the scheme, but during this season, volunteer teams undertook a minimum of one survey at 34 roosts. The scheme was reinstated in 2012.

A total of 1,845 surveys are included in the 2007-2025 dataset. Four roosts have been monitored for each of the nineteen years of the scheme (See Table 5.2).

Table 5.1: Number of roosts monitored and surveys completed for each year of the Brown Long-eared Roost Monitoring Scheme 2007-2025

Survey Year	Roosts	Surveys
2007	16	25
2008	31	51
2009	36	73
2010	41	87
2011	35	36
2012	41	91
2013	49	111
2014	48	112
2015	47	108
2016	47	115
2017	47	111
2018	45	110
2019	43	110
2020	45	115
2021	44	117
2022	46	131
2023	47	131
2024	41	110
2025	42	101

Table 5.2: Number of years of data for each roost monitored in 2007-2025 as part of the Brown Long-eared Roost Monitoring Scheme.

Number of years	Number of sites	% of total
2	6	9.2
3	1	1.5
4	5	7.7
5	3	4.6
6	2	3.1
7	3	4.6
8	3	4.6
9	2	3.1
10	7	10.8
11	2	3.1
12	4	6.2
13	4	6.2
14	7	10.8
15	10	15.4
16	6	9.2
17	6	8.5
18	4	6.1
19	4	5,8

Most surveys were completed by External Dusk Emergence Counts (n=1,474, 79.9%) compared to Internal Counts (n=370, 20.1%), see Table A3.5, Appendix 3 for more details). From 2011 to 2025 the external Dusk Emergence Count was the preferred method of survey as this was shown by statistical analysis to be a more reliable method to collect information for this monitoring scheme (Aughney *et al.*, 2011). As shown in Figure 5.5, the number of roosts monitored by Internal Counts has reduced from year to year. In 2007, 44% of roosts were monitored by Internal Counts while in 2020, this figure decreased to 9%. But this low figure was influenced by COVID-19 restrictions in 2020. In 2021, 2022 and 2023, the number of internal counts increased slightly due to the surveying of a selection of roosts as part of the UCD Ecosystem Services study.

5.2.4 Statistical Analysis

The effects of Northings and Eastings, day number (i.e. survey date), weather data, start time, type of building (different construction parameters) and Internal Counts/external Dusk Emergence Counts are examined annually using a Generalised Linear Mixed Model (GLMM). From analysis of the 2007-2024 dataset, three terms were statistically significant; rain, cloud conditions, roost type and day number. In previous years, terms that were significant included survey period, start time and type of survey (internal versus external roost counts), but these parameters are having less of an influence as the monitoring scheme progresses and surveys are carried out in a more standardised manner (e.g. strictly adhering to completing surveys in the three set survey periods).

There are no major changes to the GLMM model. One interesting feature however concerns the term for felt, which was statistically significant prior to the 2021 results. Figure 5.6 shows a bar chart of mean counts by roofing felt status; between 2009 and 2017 there is a clear picture of roofs without felt having higher average counts, but this is not the case in subsequent years.

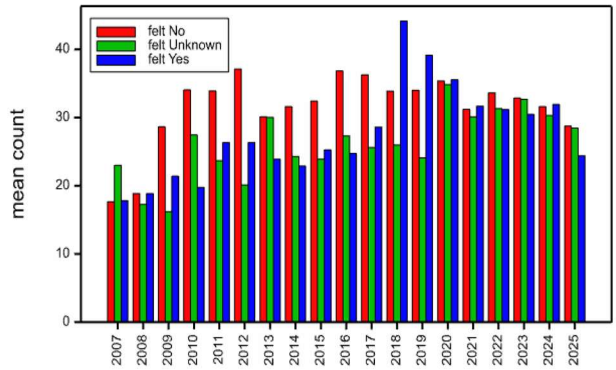


Figure 5.6: Mean Count and presence of roof felt 2007-2025.

Roost type is no longer statistically significant at the conventional 5% level, churches still have the highest counts (F=2.34 with 4 and 56 d.f., P=0.066).

Weather data and rain is still significant with higher numbers recorded in drier conditions, as would be expected. As in previous years there has been a tendency for external counts to be higher than internal counts early in the season, but internal to be higher than external later in the year. This trend continues for the 2007-2025 dataset. For the 2025 dataset this interaction term between internal counts and day number is still significant (F=10.64 with 1 and 1134 d.f., P<0.001) with external counts tending to be higher early in the season and internal ones later on. This pattern has been evident (although not always statistically significant) for many years, and as a result, it is a covariate in the GAM model.

Additional statistical analysis was undertaken to investigate the mean time the first bat emerged during external surveys in previous years and this was repeated in 2025. Surveyors counted the number of bats during emergence according to ten minute survey blocks. The ten minute block data was used to calculate the approximate mean emergence time (based on treating bats as if they all emerged at the mid-point of the block) and a time of last emergence, to the nearest 10 minute survey block.

Firstly looking at the relationship with counts:

- **First emergence**: when counts are lower the time of first emergence tends to be later (F= 34.02 with 1 and 701 d.f., P<0.001)
- **Mean emergence time**: whilst there are signs of a negative relationship between the number of bats emerging and the mean emergence time, this is not statistically significant (F=2.76 with 1 and 704 d.f., P=0.097).
- **Last emergence time**: when counts are high, the time of last emergence is later (F=10.01 with 1 and 701 d.f., P=0.002).

These relationships are shown graphically in Figure 5.7, which plots all the data, expressing each count as a proportion of the average count for the roost.

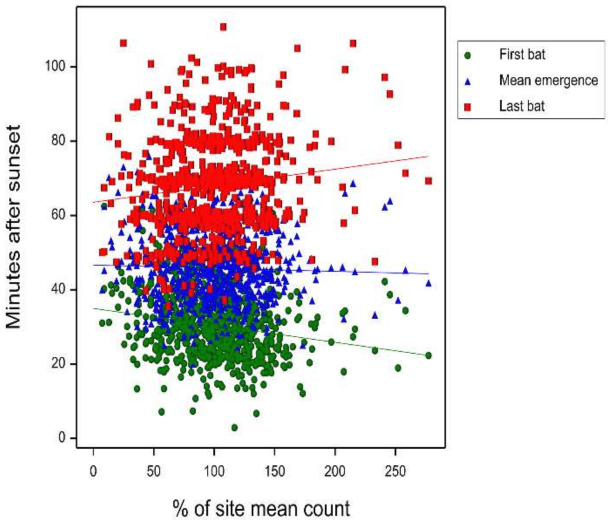


Figure 5.7: First, mean and last emergence times plotted against counts as a proportion of the site mean count. (Note: Last emergence times are only known to the nearest ten minute block). Lines are linear regression lines. Note – this graph is repeated in Appendix 3 in a larger format.

The relationship between the emergence times and the weather data recorded by surveyors (temperatures, cloud, wind and rain) was also investigated. First emergence times relative to sunset were around 2.5 minutes earlier with full cloud, compared to a clear night (F=12.14 with 2 and 871 d.f., P<0.001). The mean emergence time relative to sunset is approximately four minutes earlier at the end of August compared to the start of June i.e. first emergence times tend to be slightly earlier relative to sunset for surveys completed later in the monitoring season (F=15.09 with 3 and 704 d.f., P<0.001) for the linear effect of day number) with a change of around 1 minute per month.

Cloud also has a highly significant impact of similar magnitude on mean emergence times (F=8.8 with 2 and 740 d.f., P=0.001) with emergence times in full cloud around 2.5 minutes earlier than on a clear night. The mean was three minutes later in breezy conditions compared to a calm night (F=7.46 with 2 and 877 d.f., P=0.001). Again, there is a significant relationship with day number, with earlier emergence relative to sunset later in the monitoring season (F=37.39 with 1 and 536 d.f. <0.001).

Last emergence times (based on the last block with bats) are not significantly related to cloud (F=1.34 with 2 and 746 d.f., P=0.263). The linear effect of day number is significant (F=9.82 with 1 and 547 d.f., P=0.002), with the time of the last bat emerging from the roost getting earlier relative to sunset by just under 1 minute per month.

Figure 5.8 shows these relationships (see Appendix Table A3.6 for more details).

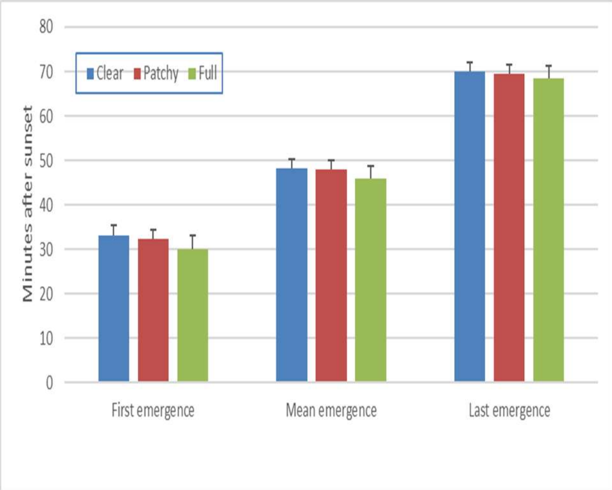


Figure 5.8: Emergence times in different cloud conditions. Bars show estimates from REML models with 95% confidence limits. Note – this graph is repeated in Appendix 3 in a larger format.

There are statistically significant year to year differences in mean emergence times relative to sunset (F=2.27 with 12 and 293 d.f., P=0.009), but there is little sign of a consistent pattern (Figure 5.9).

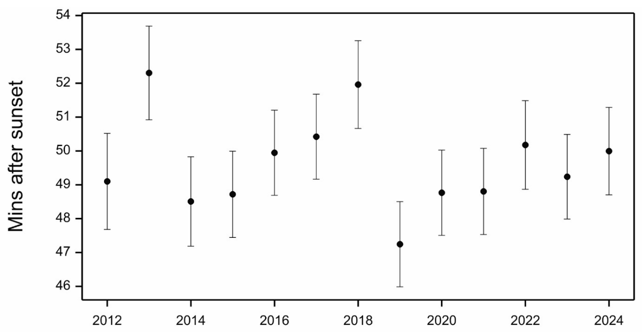


Figure 5.9: Mean emergence times relative to sunset for each year. These are predicted means from the REML model, adjusted for the effect of other factors in the model. Bars are plus or minus one standard error. Note – this graph is repeated in Appendix 3 in a larger format.

It is also worth noting that there is a considerable amount of roost-to-roost variation in the emergence times, as well as some signs of year-to-year variation within roosts (maybe due to factors such as levels of shading by trees). However, there is no sign of a consistent year-to-year pattern across all roosts.

5.2.5 Yearly Trends

Results from a GAM model, expressing the trend as an index with 2008 as the base year, is shown in Figure 5.9 (See Table A3.8, Appendix 3 for more details). The models use a negative binomial distribution, rather than the Poisson distribution used previously (and as used for the GLMM), as this seems to fit the data better and gives slightly more precise results.

The models have been fitted with and without covariates for drizzle/rain, for Internal Counts before mid-May and for external Dusk Emergence Counts after mid-September. The model with covariates is slightly more precise (i.e. narrower confidence limits) and is shown in Figure 5.10. Average counts in 2025 were the lowest since the early years of the survey, and this has resulted in the curve dipping downwards, rather than following the gentle downwards slope of recent years. As always with trend analyses, results like this where one year's results have a big influence on the curve, should be treated with caution because they frequently prove to be a 'blip.' It will therefore be interesting to see if this decline continues next year, or whether numbers bounce back to be more in line with previous results.

The trend derived from the limited number of brown long-eared bat calls picked up during the car-based bat monitoring scheme is shown in Figure 5.11. Error bars are very wide on this trend graph which illustrates the extent of uncertainty using the car monitoring dataset to derive trends for this species.

The Car-based Bat Monitoring Scheme brown long-eared trend has fluctuated over the years. The trend showed an increase from 2008 to 2013 followed by a subsequent decline. More recently the trend has begun to increase since 2019. Overall, the error bars encompass the baseline, indicating that the trend has not been significantly increasing or decreasing. Error bars are much wider for Car-based Bat Monitoring data, however, since this scheme only picks up social calls of relatively few brown long-eared bats during July and August roadside surveys. By way of comparison, just 56 brown long-eared bat passes were recorded from 825 x 1.6km transects across Ireland in 2025, compared with over 1,355 individuals counted from 42 roosts during the Brown Long-eared Bat Roost Monitoring Scheme in the same year.

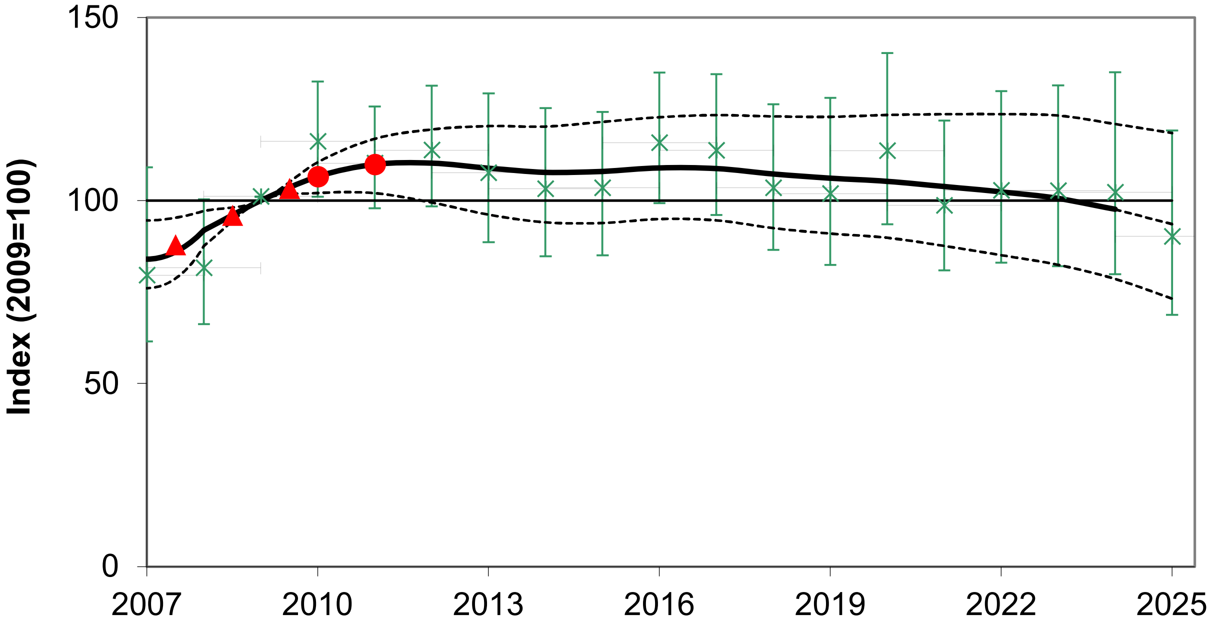


Figure 5.10: Brown long-eared bat annual trend from the Brown Long-eared Bat Roost Monitoring Scheme. GAM curves with covariates. The black line is the smoothed GAM curve, with 95% confidence limits shown by the black dotted lines. Green points are estimated annual means and are shown to illustrate the 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).

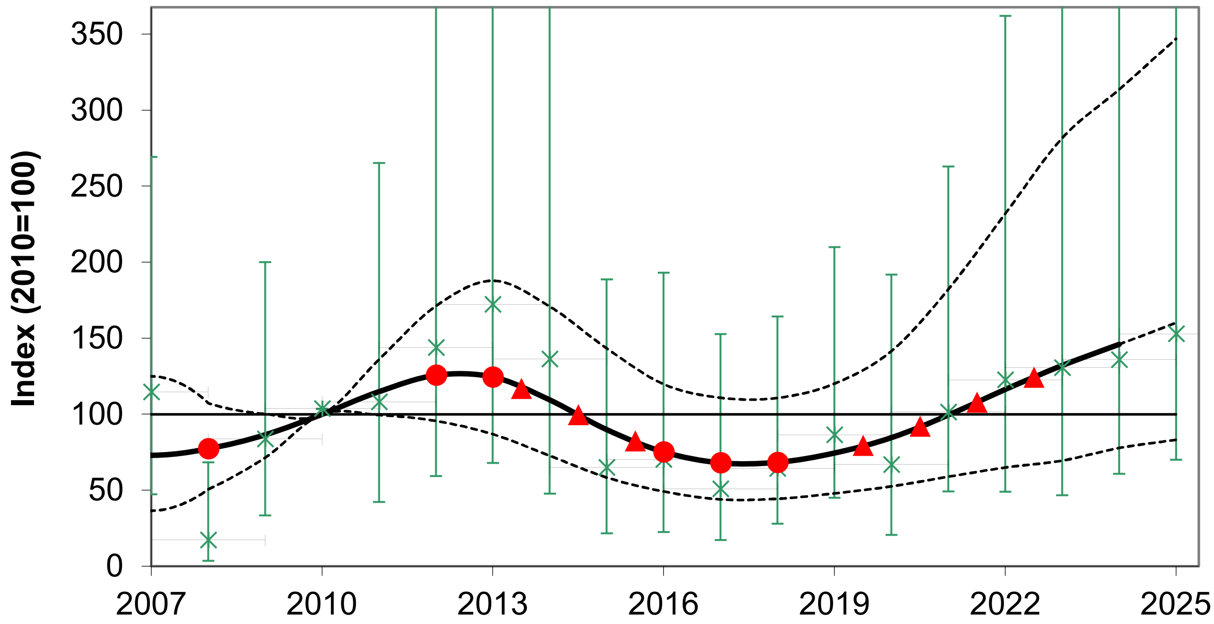


Figure 5.11: Brown long-eared bat annual trend from the car-based bat monitoring scheme (binomial analysis). GAM curves with covariates for detector type. The black line is the smoothed GAM curve, with 95% confidence limits shown by the black dotted lines. Green points are estimated annual means and 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).

5.3 Discussion

5.3.1 Volunteer Uptake

The main function of the coordinator in relation to volunteer teams is to ensure that suitable roosts are assigned and monitored and that the volunteers are fully trained in the survey methodology. Volunteers recruited for this monitoring scheme need to have some experience in identifying bats using bat detectors. Therefore, there is a smaller potential pool of volunteers within the country with sufficient expertise available to participate in the scheme, compared with Daubenton's waterways surveys, for example. However, teams organised to date have carried out the counts very successfully, especially when they have been trained in situ by the coordinator and a team leader is assigned to organise survey dates, collate survey results and return datasheets to BCIreland. Working closely with local bat groups has also proven to be very effective and should continue for any future monitoring of brown long-eared bats.

A targeted social media campaign was launched in February 2025 to recruit experienced bat surveyors across the country to help with brown long-eared bat roost surveys. An information session was delivered online to 41 potential new volunteers in April 2025. Seven online roost profile training sessions were delivered to 9 new volunteers. In 2025, new volunteers helped with existing and new sites in Cork (n=3 volunteers), Kilkenny (n=1 volunteer), Waterford (n=1 volunteer), and Mayo (n=4 volunteers). To help increase volunteer numbers for the scheme, a WhatsApp group was also set up for volunteers who were interested in training and will eventually have a site assigned to them. There are currently 39 volunteers in this group. The co-ordinator posts dates and locations of suitable surveys so that potential new volunteers can shadow.

Twenty-one roosts were targeted for surveying in 2025 using thermal cameras, camcorders and IR illuminators to obtain more accurate counts and identify all roost exits. A volunteer team (Co. Dublin) expressed concerns that exit points previously used by the bat colony may have changed in 2024 as bats were no longer present. To investigate this possibility, this roost was surveyed by the scheme coordinator using thermal imaging in 2025 with the help of the volunteer team. Due to habitat changes, the bats were no longer using the usual access point and so further surveys will be required in 2026 to establish if bats are using other parts of the building or outbuildings.

The majority of the roosts are surveyed by well-established teams, many of which have participated since 2007. This greatly improves the robustness of the data. BCIreland will continue to support current teams and new teams that enter the programme in 2026.

The coordinator is currently working with Biodiversity Officers to find suitable sites and volunteers in counties currently missing from the dataset.

5.3.2 Survey Coverage in 2025

The nineteen years of the monitoring programme has yielded consistently high level of surveying. However, new teams are required for roosts that have not been surveyed from 2018-2025 and this will be a priority again for 2026.

Currently, there are roosts available to be monitored in 21 counties across the country.

One existing roost in County Tipperary was targeted for surveying in 2025, but data was not returned, resulting in one less roost in the dataset.

The participation of roost owners in the monitoring scheme has proven to be a very successful way of gathering data. It encourages roost owners to take a greater interest in their bat roosts and to contribute to the conservation of this species. It has also provided BCIreland with a valuable opportunity to answer queries with regard to bats roosting in houses. BCIreland will continue to encourage and assist roost owners with monitoring of their own roosts.

While some roosts have become unfavourable for monitoring or to access, there is an excellent track record in consistency of monitored roosts. Forty roosts in the current dataset have been monitored in at least ten years. Of the 42 roosts surveyed in 2025, 17 were also surveyed in the base year of 2008. Four roosts have been surveyed for each of the 19 years of the scheme. This is an important factor in ensuring robust population trend analysis.

5.3.3 Dataset & Distribution

Roosts were not chosen at random, due to the constraints of locating suitable roosts for surveying. However, the current roost dataset covers a good geographic range across 20 counties. It would, however, be desirable to ensure that the entire geographic spread of the species in the country is covered by the scheme in the coming years so BCIreland proposes to identify additional brown long-eared roosts in the remaining counties of the Republic of Ireland. Currently there are gaps in the location of monitored roosts, principally Counties Louth, Leitrim, Limerick, Carlow and Kerry. County Mayo is now included in the monitoring scheme as of 2025.

5.3.4 Statistical Analysis

Statistical analysis undertaken in 2011 indicated that Dusk Emergence Counts resulted in more reliable data compared to Internal Counts (Aughney *et al.,* 2011). Where possible, Dusk Emergence Counts are now the preferred survey method for this monitoring scheme. Since 2011 more than 75% of roosts monitored were surveyed by this preferred method. This type of survey requires more volunteer teams and greater time input but it is proving manageable at present.

The timing of the survey, in previous years, had a significant influence on mean counts. But in 2025 this was not the case due to the increased experience of survey teams who strictly follow the survey methodology. BCIreland will continue to provide sunset time tables for volunteer teams to ensure that start times are as accurate as possible.

In 2025, the majority of surveys were completed during good weather conditions. However, occasionally weather conditions change during the survey and this has been shown to reduce the mean counts. BCIreland will continue to emphasise the importance of completing surveys on nights where weather is forecasted to remain dry for the entire survey. With volunteer constraints, limited survey days available and weather is making surveys more difficult.

5.3.5 Yearly Trends

There was an initial increase in the trend until around 2010. This has been followed by a very stable trend. The population index was resting very slightly above the 2009 baseline up to 2024.

Average counts in 2025 were the lowest since the early years of the survey, and this has resulted in the curve dipping downwards, rather than following the gentle downwards slope of recent years. As always with trend analyses, results like this where one year's results have a big influence on the curve, should be treated with caution because they frequently prove to be a temporary anomaly. It will therefore be interesting to see if this decline continues next year, or whether numbers bounce back to be more in line with previous results.

The Bat Conservation Trust's National Bat Monitoring Programme Report (2024) revealed that in Great Britain over the last five years, the Hibernation Survey index shows no significant change, however the Roost Count index has declined significantly. The population of brown long eared bat in Great Britain is considered to have been stable in the long-term (since 1999), while there is evidence to suggest the population may have declined in the short-term (since 2018). Brown long-eared bat populations are considered to have been stable in England over the last five years but are declining in Wales.

(https://www.bats.org.uk/our-work/national-bat-monitoring-programme/reports/nbmp-annual-report)

5.3.6 Additional Technology

Thermal cameras are proving to be useful, resulting in more accurate counts and positive clarification for volunteer teams in relation to their surveying ability. Therefore, night vision aids will continue to be deployed where filming increases the accuracy of routine monitoring surveys. In addition, we will check whether any covariates for night vision technology need to be added to the trend analysis since it is possible the use of such technology boosts emergence count numbers. This will be included in the 2026 dataset.

6.0 LESSER HORSESHOE BAT ROOST MONITORING SCHEME

6.1 Methods

Surveyors are typically trained in the survey methodology in-house by other NPWS staff members. Surveyors are provided with equipment needed for the survey by the NPWS or Vincent Wildlife Trust (VWT).

Each year survey teams complete surveys of specific sites within their district. Surveys take place in summer from dusk and are carried out using bat detectors. Some sites are counted internally. The dates for surveying in summer are May 23rd to July 7th, although counts outside these dates are included in the overall trend series. Winter surveys are carried out in January and February each year.

Data was provided via the Field Recorder app by NPWS regional staff for summer and winter 2025. These data were cleaned, queried (where necessary) and imported to the database using the Excel to Access Import function in MS Access.

6.1.1 Statistical Analysis

For overall yearly trends, a Generalised Linear Model (GLM) with a Poisson error distribution (see Glossary) was applied to the data. Confidence intervals are generated by bootstrapping (Fewster *et al.*, 2000), as used in Generalised Additive Model (GAM) analysis.

Generalised Additive Models (GAMs) have been fitted to the annual means to give a visual impression of the trend over time. Curved trend lines have been applied to the data.

6.2 Results

6.2.1 2025 Dataset

The following survey records were inputted to the app and added to the main database.

Table 6.1: Raw monitoring data collected in 2025

Year	Season	Counts	Sites
2025	Winter	136	127
2025	Summer	142	118

These records include some null counts, surveys that could not be completed because no access was possible and multiple counts in the same season at some sites.

The number of records on the database currently stands at 7,021 but this includes some records for other species and data that cannot be used in trend analysis due, for example, to insufficient information in the Correct Date field.

NPWS staff regularly carry out additional surveys of old sites where no bats have been found in some years. Conservation rangers in many areas have also explored derelict buildings that have potential to harbour roosts. In total, 13 sites required new codes on the database in 2025, these were located throughout the range for the species in each of the six counties, with the exception of Galway.

Data for 2025 received from the NPWS and VWT were of a very high standard and had very few issues that needed to be queried, thus ensuring efficient processing and importing.

In winter 2025 (January and February), 136 site visits were carried out. The sum of maximum counts for all sites in winter 2025 was 10,244. The maximum number of bats recorded in a single hibernaculum was 1,021 bats in Newgrove, Co. Clare and the second largest number, 874 bats, was recorded at Moorehall, Co. Mayo. The mean number of bats per winter site in 2025 was 80.6 while the median number was 9.

For summer 2025, 142 discrete survey records were provided for 118 sites. At 13 of these, lesser horseshoe bats were either absent or no count was possible due to access or other constraints. In total, a maximum of 12,071 bats were counted during summer 2025. The maximum count at any one site was 574 bats at William King, Kilgarvan, (Site Code 522) on June 18th 2025. Overall, the mean summer roost size was 104 and median roost size was 63.5 in 2025.

6.2.2 Overall Winter Dataset

There are a total of 2,210 counts with a mean of 72.2 (s.e. 2.76) and a median of 19 bats that can be used for winter trend analysis. Counts of zero bats constitute 11.3% of observations, but this excludes sites where the species were never observed. Table 6.2 shows the number of winter sites by year and county at five yearly intervals until 2020 and annually thereafter.

Table 6.2: Numbers of winter sites by year and county. The table shows numbers of roosts

a) numbers of sites

	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024	2025	All yrs
Clare	2	6	6	11	15	24	26	12	24	25	30	24	47
Cork	1	1	2	1	10	11	8	4	4	7	17	17	22
Galway	0	0	2	0	18	23	14	6	13	17	11	10	34
Kerry	2	5	1	0	24	21	33	12	29	36	33	36	50
Limerick	0	0	0	0	8	8	6	4	9	12	0	10	15
Mayo	0	0	1	0	9	12	8	6	9	11	12	9	17
All	5	12	12	12	84	99	95	44	88	108	103	106	185

b) percentage of all sites in each year

	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024	2025	All yrs
Clare	40.0	50.0	50.0	91.7	17.9	24.2	27.4	27.3	27.3	23.1	29.1	22.6	25.4
Cork	20.0	8.3	16.7	8.3	11.9	11.1	8.4	9.1	4.5	6.5	16.5	16.0	11.9
Galway	0.0	0.0	16.7	0.0	21.4	23.2	14.7	13.6	14.8	15.7	10.7	9.4	18.4
Kerry	40.0	41.7	8.3	0.0	28.6	21.2	34.7	27.3	33.0	33.3	32.0	34.0	27.0
Limerick	0.0	0.0	0.0	0.0	9.5	8.1	6.3	9.1	10.2	11.1	0.0	9.4	8.1
Mayo	0.0	0.0	8.3	0.0	10.7	12.1	8.4	13.6	10.2	10.2	11.7	8.5	9.2
All	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Tables 6.3 and 6.4 indicate the consistency with which winter sites are monitored, which is important in producing accurate trend estimates. Table 6.3 shows that over half the winter sites in the current dataset have been monitored in at least ten years. Table 6.4 shows that there has been an excellent level of consistency in the winter roosts surveyed over the last few years, although there were far fewer sites counted in winter 2021 due to Covid restrictions.

Table 6.3: Numbers of years of data from each winter roost.

Number of years	Number of sites	% of total	Cumulative %
2	31	16.8	16.8
3	15	8.1	24.9
4	9	4.9	29.7
5	10	5.4	35.1
6	7	3.8	38.9
7	6	3.2	42.2
8	6	3.2	45.4
9	6	3.2	48.6
10	5	2.7	51.4
11	6	3.2	54.6
12	6	3.2	57.8
13	10	5.4	63.2
14	4	2.2	65.4
15	8	4.3	69.7
16	8	4.3	74.1
17	7	3.8	77.8
18	5	2.7	80.5
19	7	3.8	84.3
20	5	2.7	87.0
21	8	4.3	91.4
22	4	2.2	93.5
23	2	1.1	94.6
24	1	0.5	95.1
25	2	1.1	96.2
26	1	0.5	96.8
27	2	1.1	97.8
29	1	0.5	98.4
30	2	1.1	99.5
33	1	0.5	100.0

Table 6.4: Numbers of winter roosts monitored in each year (diagonal in italics) and common to each pair of years (off diagonal). For example 88 sites were monitored in 2022 and 59 of these were also counted in 2024.

	1986	1990	1995	2000	2005	2010	2015	2020	2021	2022	2023	2024	2025
1986	*16*												
1990	4	*5*											
1995	2	2	*12*										
2000	3	1	3	*12*									
2005	5	2	2	3	*12*								
2010	13	4	5	7	9	*84*							
2015	12	4	8	10	11	70	*99*						
2020	12	4	9	10	12	60	67	*95*					
2021	6	4	4	5	7	29	34	40	*44*				
2022	8	3	7	8	10	52	59	72	40	*88*			
2023	11	4	8	9	12	64	73	79	41	80	*108*		
2024	12	4	7	10	11	54	64	66	30	59	74	*103*	
2025	12	4	5	7	11	57	59	69	31	65	78	83	*106*

6.2.3 GLMM Model

The generalised linear mixed model (GLMM) fitted in previous years was refitted and remains a good fit for the data (e.g. see Roche et al. 2024).

6.2.4 Winter Trends

As in previous years, the full GAM approach described by Fewster et al was used, expressing results as an index with 2009 set to 100. The model is fitted from 1986. To contribute to the winter trend, a site must have had the species present at some point and must be counted in at least two years. Data from surveys conducted between 26th December and 7th March are used.

Results are shown in Figure 6.1 using a model with a quadratic term for day number.

The estimated annual mean for 2025 is again well up on the low value in 2022. Another winter of strong counts means that the curve is heading strongly upwards after a period of stability between 2018 and 2022.

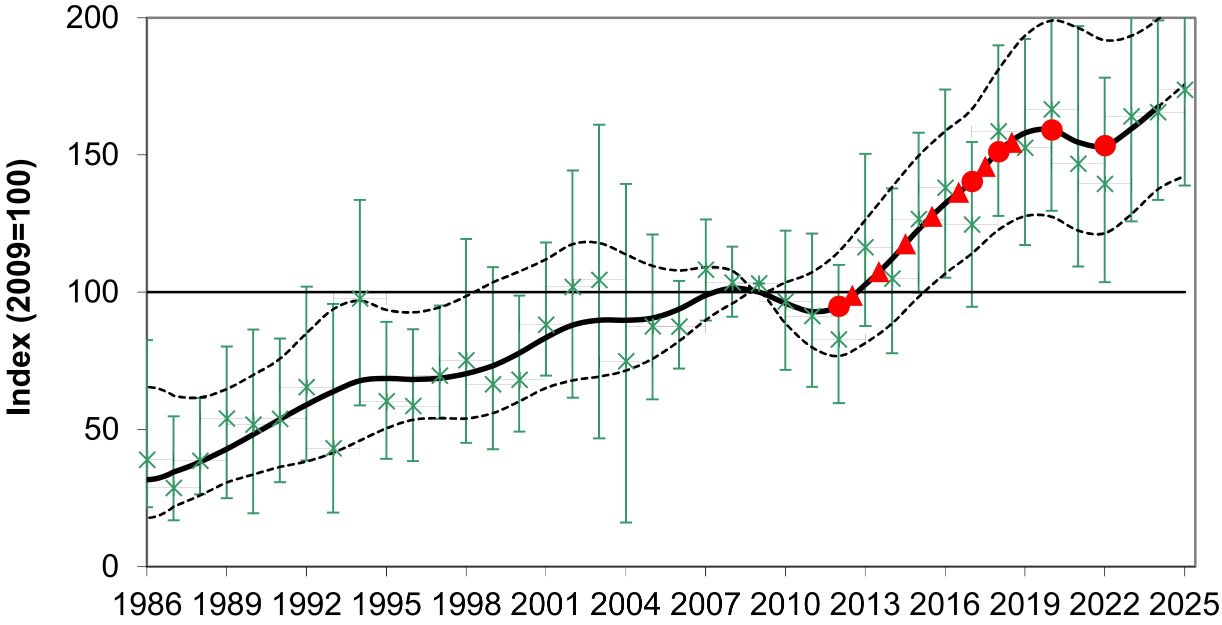


Figure 6.1: Lesser horseshoe bat hibernacula yearly trend GAM results using quadratic day number as a covariate. Points are estimated annual means derived from the Generalised Linear Model and the bars are 95% bootstrapped confidence limits. The heavy black line is the fitted Generalised Additive Model curve with 95% confidence limits shown by the broken red lines. Red circles indicate significant (P<0.05) change points, where the slope of the smoothed trend line changes.

Detailed yearly GLM results are shown in Table 6.5 using results from the model above (counts with a quadratic term for day no). The trend for the lesser horseshoe bat in winter has been one of increases since the start of the survey (38 years, 1986-2025). The annual growth rate has been 4.5% per annum in winter. This is similar to the medium term (12 year, 2013-2025) growth rate at 4.86% per annum, while more recently, the short term trend (6 year, 2019-2025) has decelerated a little to 1.8% per annum.

Table 6.5: GAM results for winter counts of lesser horseshoe bat sites (covariate = day number grouped) with 95% confidence limits.

	smoothed		95% limits		unsmoothed			
Year	**index**	**s.e.**	**lower**	**Upper**	**Fit**	**s.e.**	**sites**	**Counts**
1986	31.69	12.81	17.82	65.48	35.75	15.78	16	17
1987	34.48	10.86	21.87	62.30	25.42	13.12	10	13
1988	38.20	9.62	26.02	61.67	35.42	9.52	16	17
1989	42.93	9.12	30.67	64.76	50.81	13.80	3	3
1990	48.24	9.60	33.60	69.91	48.49	17.17	5	7
1991	53.72	10.60	36.36	75.79	50.61	13.25	5	7
1992	59.04	12.28	38.39	85.11	62.19	17.05	9	12
1993	63.85	13.63	41.48	93.80	39.91	19.59	13	15
1994	67.78	13.44	45.95	96.93	94.44	20.46	39	43
1995	68.61	11.27	50.42	93.57	57.10	13.17	12	16
1996	68.28	9.84	53.52	92.67	55.35	12.01	17	17
1997	68.75	10.58	54.15	94.48	66.37	10.46	21	22
1998	70.37	12.09	54.02	98.58	71.97	18.88	6	6
1999	73.27	12.82	55.95	103.60	63.25	17.03	13	13
2000	77.88	12.55	60.27	107.59	64.83	12.99	12	12
2001	83.54	12.20	65.15	112.01	84.89	12.15	25	25
2002	88.05	12.50	67.89	117.53	98.71	23.07	10	10
2003	89.84	12.44	69.29	117.94	101.30	30.77	9	10
2004	89.82	10.87	71.45	113.77	71.57	34.03	8	10
2005	90.64	8.64	75.77	109.59	84.39	15.08	12	21
2006	93.89	6.54	82.21	107.93	84.22	8.19	82	83
2007	98.92	4.93	89.89	109.10	105.03	9.40	46	46
2008	101.44	2.99	95.91	107.79	100.28	6.61	49	49
2009	100.00	0.00	100.00	100.00	100.00	0.00	87	92
2010	95.93	3.83	88.61	103.59	93.42	13.20	84	91
2011	92.95	7.09	79.89	107.33	88.11	14.77	87	94
2012	94.85	9.62	76.78	114.78	79.52	12.62	79	87
2013	102.80	11.70	81.52	126.37	113.14	16.09	84	86
2014	112.19	12.70	88.62	138.31	101.76	15.34	96	101
2015	122.96	13.05	98.32	149.72	123.36	15.08	99	106
2016	132.33	13.32	106.79	158.68	134.78	17.65	108	113
2017	140.36	13.57	114.10	166.69	121.44	15.36	102	115
2018	151.22	14.91	122.71	181.12	155.39	15.82	105	129
2019	158.01	16.65	127.73	193.47	149.39	19.43	108	114
2020	159.16	17.92	127.48	198.95	163.42	19.36	95	103
2021	154.62	18.51	122.45	196.27	143.58	22.34	44	49
2022	153.35	17.65	121.52	191.80	136.26	19.18	88	97
2023	159.61	16.53	128.47	193.42	160.80	20.75	108	124
2024	167.54	15.76	137.55	199.49	162.33	16.98	103	120
2025	175.72	16.71	142.48	208.83	170.45	17.90	106	115

6.2.5 Overall Summer Dataset

There are a total of 3,077 counts with a mean of 92.9 (s.e. 2.0) and a median of 50 bats. 12.1% of observations are zero (note this excludes sites where the species were never observed in the May-August period).

Table 6.6: Numbers of summer sites by year and county.

a) numbers of sites

	1992	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**All years**
Clare	1	14	10	7	6	29	38	34	28	30	32	35	75
Cork	0	0	0	7	15	10	19	18	13	23	22	7	43
Galway	3	0	3	1	2	9	9	3	12	11	11	11	15
Kerry	5	0	26	9	22	28	49	47	54	57	48	26	113
Limerick	2	0	0	0	1	7	8	4	8	6	6	12	17
Mayo	1	1	3	0	2	9	5	7	9	11	11	10	12
All	12	15	42	24	48	92	128	113	124	138	130	101	275

b) percentage of all sites in each year

	1992	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**All years**
Clare	8.3	93.3	23.8	29.2	12.5	31.5	29.7	30.1	22.6	21.7	24.6	34.7	27.3
Cork	0.0	0.0	0.0	29.2	31.2	10.9	14.8	15.9	10.5	16.7	16.9	6.9	15.6
Galway	25.0	0.0	7.1	4.2	4.2	9.8	7.0	2.7	9.7	8.0	8.5	10.9	5.5
Kerry	41.7	0.0	61.9	37.5	45.8	30.4	38.3	41.6	43.5	41.3	36.9	25.7	41.1
Limerick	16.7	0.0	0.0	0.0	2.1	7.6	6.2	3.5	6.5	4.3	4.6	11.9	6.2
Mayo	8.3	6.7	7.1	0.0	4.2	9.8	3.9	6.2	7.3	8.0	8.5	9.9	4.4
All	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Tables 6.7 and 6.8 indicate the consistency with which summer sites are monitored, which is important in producing accurate trend estimates. Table 6.8 shows that around half of the sites in the current dataset have been monitored in at least seven years. Table 6.8 shows that there is an excellent level of consistency in the summer roosts surveyed. More than half of the roosts surveyed in the earlier years were monitored in the most recent summer season.

Table 6.7: Numbers of years of data from each summer roost.

Number of years	Number of sites	% of total	Cumulative %
2	49	17.8	17.8
3	40	14.5	32.4
4	20	7.3	39.6
5	31	11.3	50.9
6	15	5.5	56.4
7	5	1.8	58.2
8	7	2.5	60.7
9	7	2.5	63.3
10	3	1.1	64.4
11	8	2.9	67.3
12	5	1.8	69.1
13	3	1.1	70.2
14	5	1.8	72.0
15	10	3.6	75.6
16	6	2.2	77.8
17	7	2.5	80.4
18	6	2.2	82.5
19	4	1.5	84.0
20	8	2.9	86.9
21	9	3.3	90.2
22	12	4.4	94.5
23	7	2.5	97.1
24	2	0.7	97.8
25	4	1.5	99.3
26	1	0.4	99.6
29	1	0.4	100.0

Table 6.8: Numbers of summer roosts monitored in each year (diagonal in italics) and common to each pair of years (off diagonal). For example 136 sites were monitored in 2023 and 70 of these were also recorded in 2015.

1992	*12*											
1995	1	*15*										
2000	2	3	*42*									
2005	1	1	4	*24*								
2010	0	4	9	12	*48*							
2015	7	11	21	19	38	*92*						
2020	7	11	23	15	32	72	*128*					
2021	4	9	20	17	36	70	91	*113*				
2022	6	10	25	13	28	68	88	86	*124*			
2023	7	10	24	15	33	70	90	90	108	*138*		
2024	7	10	20	12	35	66	82	80	95	112	*130*	
2025	7	12	18	8	23	56	61	55	73	79	81	*101*
	1992	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**

6.2.6 GLMM

The generalised linear mixed model (GLMM) fitted in previous years was refitted and remains a good fit for the data (e.g. see Roche et al. 2024).

6.2.7 Summer Trends

As in previous years, the full GAM approach has been used expressing results as an index with 2009 set to 100. The model has been fitted from 1992.

Results are shown in Figure 6.2 for the model with a quadratic term for day number and a variable identifying internal counts.

The trend for the lesser horseshoe bat in summer, similar to winter, has been one of increases over the course of the monitoring scheme. Since the start of the survey (33 years, 1992-2025) the growth rate has been 2.1% per annum in summer. This is slightly lower than the medium-term growth rate (12 year, 2013-2025) which is 2.78% per annum. The more recent short term (six year 2019-2025) trend is 2.24% per annum.

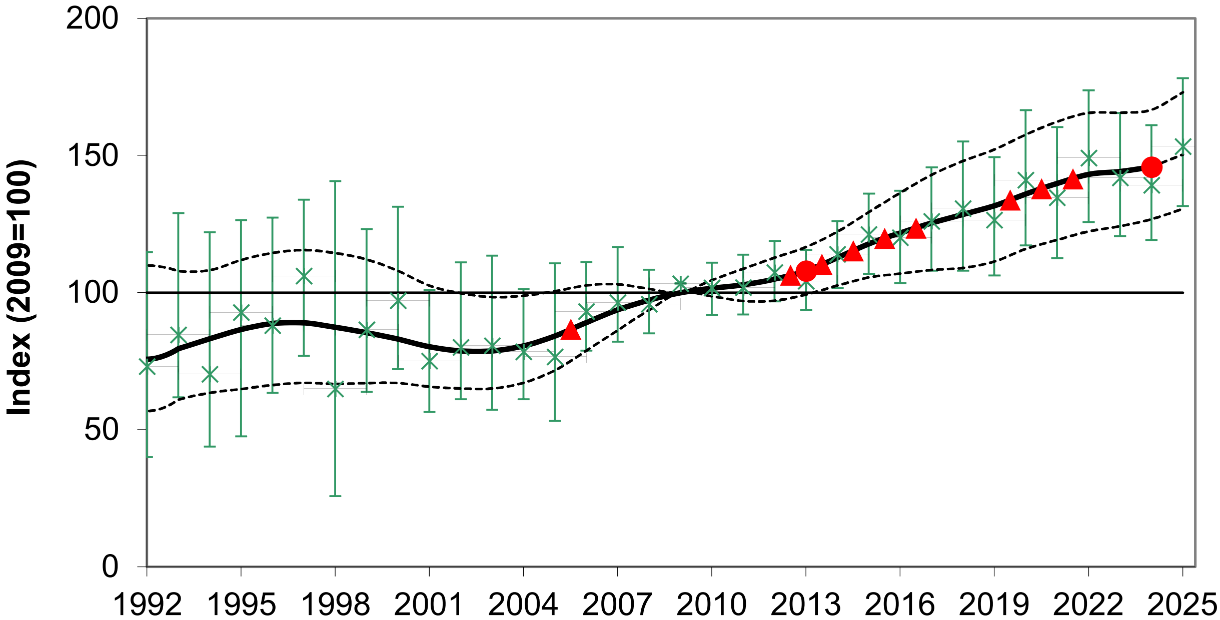


Figure 6.2: Lesser horseshoe bat summer trend GAM results using a quadratic term for day number and a variable identifying internal counts. Points are estimated annual means derived from the Generalised Linear Model and

the bars are 95% bootstrapped confidence limits. The heavy black line is the fitted Generalised Additive Model curve with 95% confidence limits shown by the broken red lines. Red circles indicate significant (P<0.05) change points, where the slope of the smoothed trend line changes.

Table 6.9: GAM results for summer counts of lesser horseshoe bat sites (day number and internal counts) with 95% confidence limits.

	Smoothed		95% limit		Unsmoothed			
Year	index	s.e.	lower	upper	Fit	s.e.	Sites	Counts
1992	75.75	13.79	56.80	109.92	69.73	18.86	12	16
1993	79.51	12.18	60.97	107.83	81.30	18.05	11	24
1994	83.16	11.56	63.44	108.18	66.94	20.51	9	12
1995	86.53	11.82	64.85	111.88	89.52	19.33	15	19
1996	88.72	12.25	66.30	114.47	84.72	16.21	3	3
1997	89.02	12.75	67.10	115.53	102.74	14.63	24	32
1998	87.37	12.54	66.70	114.42	61.62	30.12	22	29
1999	85.37	11.56	67.01	112.11	83.20	15.16	62	80
2000	83.00	10.30	67.02	107.93	93.84	15.39	42	47
2001	80.28	9.45	65.69	102.53	71.79	11.62	29	50
2002	78.74	8.97	65.04	99.77	76.73	12.76	43	48
2003	78.79	8.57	65.03	98.36	77.30	14.51	23	35
2004	80.56	8.12	67.15	98.88	75.15	10.37	48	58
2005	84.22	7.35	71.68	100.51	73.31	14.67	24	31
2006	89.15	6.08	78.85	102.63	89.81	8.18	121	127
2007	93.74	4.24	86.30	103.05	93.10	8.82	87	102
2008	97.29	1.94	93.67	101.36	92.48	5.93	72	92
2009	100.00	0.00	100.00	100.00	100.00	0.00	121	149
2010	101.56	1.53	98.66	104.56	98.50	4.82	48	67
2011	102.88	2.97	96.93	108.73	98.53	5.69	102	130
2012	104.92	3.89	97.07	112.76	104.08	5.61	96	129
2013	107.96	4.38	99.29	116.64	100.87	5.60	107	129
2014	112.72	4.97	102.60	122.23	110.68	6.20	110	137
2015	117.78	6.03	105.54	129.37	117.92	7.34	92	117
2016	121.81	7.44	106.94	136.41	116.73	8.59	103	130
2017	125.41	8.85	108.27	142.96	122.65	9.79	109	136
2018	128.57	9.95	109.00	147.99	127.35	11.87	101	134
2019	131.69	10.43	111.34	152.19	123.19	11.03	140	160
2020	135.98	10.74	115.95	157.64	137.77	12.49	128	148
2021	139.86	10.96	119.23	162.34	131.27	12.17	113	131
2022	143.15	10.87	122.33	165.51	145.80	12.32	124	157
2023	144.13	10.44	124.23	165.61	138.58	11.77	138	149
2024	145.81	10.26	126.78	166.65	135.84	10.70	130	146
2025	150.37	11.02	130.54	173.00	150.03	11.90	101	123

6.3 Discussion

6.3.1 Survey Coverage in 2025

Very good coverage was achieved in winter and summer 2025. Both seasons have contributed a huge body of information to the dataset. Consistent year-on-year surveying means that annual trends are more reliable and precise. Additional surveys were also carried out at many sites across the range for the species. These checks have yielded interesting new records in some areas, for example a new cave site in Limerick and a small hibernacula in Westport town.

6.3.2 Yearly Trends

According to trend models, the lesser horseshoe bat increased significantly from the early years of the survey. While some caution is needed when interpreting trends from early years due to low sample sizes, we can be reassured by the fact that summer and winter trends have tended to converge, increasing up to the early 2000s, levelling out somewhat in the mid-2000s and more recently increasing again. Some low counts in sites in 2022 resulted in a downturn in the winter trend but higher estimates from 2023 to 2025 has pulled the trendline up again.

Overall, over the past 20 years the species increased by between 94.72% (winter) and 82.1% (summer), equating to a 3.37% yearly increase in winter and a 2.94% increase in summer.

Very similar increases have been reported for the same species in Britain. The lesser horseshoe bat in summer across south west England and Wales, increased by 73.5% from 1999 to 2023. Even higher increases were reported from winter counts (202.4%) in the same timeframe (Bat Conservation Trust, 2024).

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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 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.l 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.

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APPENDIX 1

Car-Based Bat Monitoring

Table A1.1: Average number of bat encounters per hour for each survey square, Batlogger detector, Survey 1, 2025 (number of 1 mile transects (n) = 15 for each survey unless otherwise stated). Ppip = *Pipistrellus pipistrellus*, Ppyp = *Pipistrellus pygmaeus*, Punknown = Unidentified pipistrelle echolocating between 48 and 52kHz, Pnath = *Pipistrellus nathusii*, Nleis = *Nyctalus leisleri*, Paur=Brown long-eared bat, Myotis = *Myotis* spp., Allbats = total number of encounters for all species. Data derived from total number of encounters divided by total time spent sampling, corrected to 1hr.

Square	No Transects	Ppip	Ppyg	Punknown	Pnath	Nleis	Paur	Myotis	Allbats
C72	15	41.77	19.19	5.64	0.00	58.70	0.00	0.00	125.31
G20	15	19.95	50.21	8.25	0.00	20.63	0.69	0.00	99.73
G53									
G89	15	92.51	135.38	15.79	0.00	10.15	0.00	0.00	253.84
H13	15	73.19	47.66	12.77	1.70	17.02	0.00	5.96	159.15
H40	15	67.54	99.80	24.19	0.00	7.06	3.02	2.02	203.64
H79	15	40.81	30.20	5.71	0.00	22.85	1.63	0.82	102.02
J06	15	19.53	26.29	2.25	2.25	43.56	0.00	0.00	93.89
J33	10	127.28	63.23	15.60	9.03	68.16	0.82	8.21	292.34
L64	15	1.84	21.16	12.88	0.00	2.76	2.76	1.84	43.24
M24	15	84.81	63.16	26.17	0.00	22.56	0.00	0.00	196.69
M87	15	92.26	56.54	17.86	0.00	28.77	0.00	1.98	197.41
N11	15	116.05	87.47	15.59	0.00	13.86	2.60	0.87	236.42
N74	15	212.68	64.39	9.76	0.00	15.61	1.95	0.00	305.37
N77	15	171.07	106.78	29.42	0.00	14.16	4.36	3.27	329.06
O04	15	130.10	38.93	5.70	0.00	29.44	0.00	0.00	204.17
R22	15	221.46	128.73	17.10	3.60	55.81	1.80	5.40	434.81
R28	15	78.50	30.72	7.68	0.00	11.95	0.00	0.85	129.70
R88	15	148.62	58.28	23.31	0.00	40.80	0.97	0.97	272.96
S12	15	276.60	73.37	22.77	6.75	26.99	0.84	0.00	407.31
S15	15	193.08	77.41	6.23	2.67	23.13	0.00	0.00	302.52
S78	15	115.67	98.76	20.46	0.00	31.14	0.89	2.67	269.60
T05	15	187.45	126.53	26.24	3.75	44.99	0.94	0.94	390.84
V93	15	112.13	55.53	19.22	0.00	38.45	0.00	0.00	225.33
V96	15	177.48	75.94	23.04	0.85	55.46	0.85	0.00	333.63
V99	15	222.25	23.26	11.20	3.45	48.24	0.00	0.00	308.40
W56	15	105.91	68.38	5.84	0.00	49.20	0.00	0.83	230.16
X49	15	103.73	86.60	21.89	0.00	25.69	0.00	1.90	239.81
Average		**119.79**	**67.18**	**15.28**	**1.26**	**30.64**	**0.89**	**1.43**	**236.57**
Stdev		±69.91	±33.49	±7.79	±2.31	±17.57	±1.17	±2.10	±100.02

Table A1.2: Average number of bat encounters per hour for each survey square, Batlogger detector, Survey 2, 2024 (number of 1 mile transects (n) = 15 for each survey unless otherwise stated). Ppip = *Pipistrellus pipistrellus*, Ppyp = *Pipistrellus pygmaeus*, Punknown = Unidentified pipistrelle echolocating between 48 and 52kHz, Pnath = *Pipistrellus nathusii*, Nleis = *Nyctalus leisleri*, Paur=Brown long-eared bat, Myotis = *Myotis* spp., Allbats = total number of encounters for all species. Data derived from total number of encounters divided by total time spent sampling, corrected to 1hr.

Square	No Transects	Ppip	Ppyg	Punknown	Pnath	Nleis	Paur	Myotis	Allbats
C72	15	26.79	28.58	2.68	0.00	30.36	0.00	0.00	88.41
G20	15	39.12	92.82	17.90	0.00	12.60	0.00	1.99	164.42
G53		90.84	175.32	16.35	0.00	9.08	0.00	1.82	293.41
G89	15	92.33	72.94	18.47	0.92	16.62	1.85	0.00	203.13
H13	15	88.31	60.85	16.33	0.74	42.30	0.00	2.23	210.76
H40	15	68.59	73.49	35.27	0.98	20.58	0.00	3.92	202.83
H79		48.63	22.64	10.90	0.84	12.58	0.84	0.00	96.41
J06	15	5.48	19.56	1.56	1.56	30.52	0.00	0.00	58.68
J33	10	118.02	50.58	19.52	0.00	32.83	7.10	9.76	237.81
L64	15	2.90	60.95	16.45	0.00	11.61	0.00	0.00	91.91
M24	15	106.90	79.96	26.93	0.84	13.47	2.53	1.68	232.31
M87	15	65.02	64.02	21.01	1.00	38.01	0.00	2.00	191.05
N11	15	136.19	52.07	10.01	0.00	9.01	1.00	3.00	211.29
N74	15	191.94	80.87	11.69	0.00	31.18	1.95	0.00	318.59
N77	15	144.63	105.39	19.06	0.00	10.09	0.00	2.24	282.53
O04	14	171.74	41.07	13.07	0.00	22.40	1.87	0.00	250.14
R22	15	125.58	67.44	10.85	0.00	49.61	0.00	5.43	258.91
R28	15	74.87	44.60	14.34	0.00	0.00	1.59	0.80	136.19
R88	15	135.46	69.61	19.75	0.00	10.35	0.00	0.00	235.17
S12	15	217.73	96.19	13.12	0.00	28.86	0.00	0.87	356.76
S15	15	118.81	58.59	15.46	0.00	2.44	0.00	0.00	195.30
S78	15	188.37	144.77	22.67	0.00	15.70	2.62	0.87	375.00
T05	15	248.81	81.11	19.14	0.00	13.67	1.82	0.91	366.38
V93	15	91.55	97.65	27.47	1.02	14.24	0.00	2.03	233.96
V96	15	190.43	99.32	29.16	0.91	106.61	0.00	4.56	431.89
V99	15	233.46	54.11	10.05	0.00	49.47	3.09	0.00	350.18
W56	15	171.94	97.61	14.33	0.00	25.07	0.00	0.00	309.85
X49	15	174.86	133.40	70.31	0.00	46.87	0.00	3.61	429.04
Average		**120.33**	**75.91**	**18.71**	**0.31**	**25.22**	**0.94**	**1.70**	**243.30**
Stdev		±67.17	±35.59	±12.50	±0.48	±21.18	±1.57	±2.22	±100.41

APPENDIX 2

All Ireland Daubenton's Waterways Survey

Table A2.1: Total number of waterway sites surveyed (2006-2025) and returned by February 2026.
NB – figures may be different from previous years reporting as any results returned late are added and reported thereafter.

Province and country

Year	Republic of Ireland	Northern Ireland		Ulster	Connaught	Munster	Leinster		TOTAL
2006	120	14		19	27	35	53		**134**
2007	182	20		26	31	42	103		**202**
2008	150	31		37	29	38	77		**181**
2009	174	36		45	30	46	89		**210**
2010	177	36		48	29	40	96		**213**
2011	186	44		52	33	48	97		**230**
2012	182	36		47	31	46	94		**218**
2013	194	34		47	25	46	110		**228**
2014	218	36		60	36	45	113		**254**
2015	216	37		52	40	57	104		**253**
2016	213	32		50	36	56	103		**245**
2017	199	34		45	30	58	100		**233**
2018	207	36		56	33	54	100		**243**
2019	202	36		54	37	50	97		**238**
2020	199	33		56	31	52	93		**232**
2021	196	31		53	32	48	94		**227**
2022	216	27		42	33	59	109		**243**
2023	216	31		43	43	53	108		**247**
2024	219	31		43	40	59	108		**250**
2025	225	31		43	44	57	112		**256**

Note: Tables A2.1 detail the total number of waterway sites returned to BCIreland by February 2026. This is greater than the number of waterway sites reported in statistical tables below as statistical analysis was completed on surveys returned by February 2025. In addition, total numbers of waterways sites reported in previous reports will also differ as survey sheets returned late are added to the dataset for the next year of reporting. Only surveys completed within the Day 205-250 are also only included in the statistical analysis.

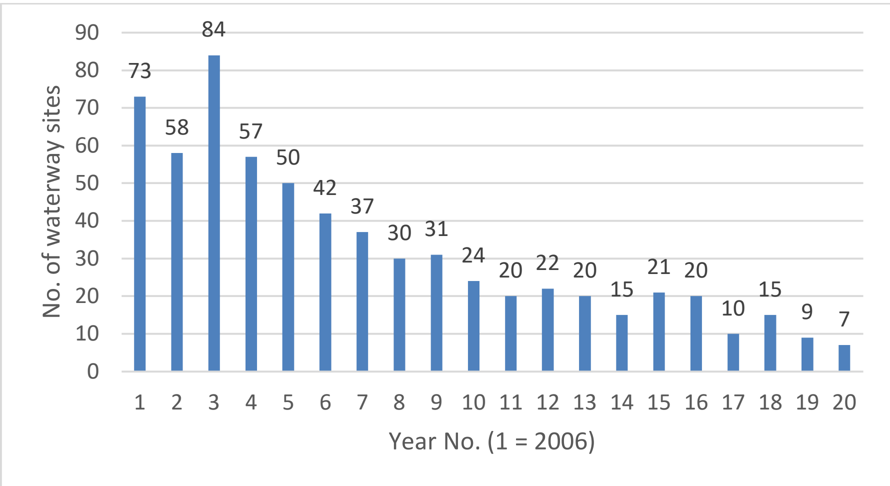

Figure A2.1: Number of years each waterway sites across the island were surveyed during 2006-2025 as part of the All-Ireland Daubenton's Bat Monitoring Scheme.

Table A2.2: Bat detector models used by survey teams in different years (2006-2025).
The table shows numbers of sites, and percentages, excluding those outside the usual date range.

a) Numbers of sites

year	2006	2009	2012	2015	2018	2019	2020	2021	2022	2023	2024	2025
detector												
Magenta Mk II	5	1	4	3	3	3	4	4	4	4	4	0
Magenta Mk III	31	26	10	7	5	5	5	7	6	2	1	1
Bat Box III	47	48	36	35	20	20	23	19	14	8	6	3
Pettersson D100	10	23	15	18	14	12	16	10	12	16	7	5
Pettersson D200	10	9	15	34	42	34	15	13	17	13	9	10
Bat Box Duet	6	24	21	9	17	10	11	11	11	11	12	8
Petersson D230	3	1	2	2	1	1	1	1	2	2	2	2
Petersson D240x	5	6	5	1	3	1	2	2	2	3	3	1
Sky SBR 2100	2	0	0	0	0	0	0	0	0	0	0	0
Mini-3	4	8	6	0	0	1	1	1	1	0	0	0
Magenta Bat 4	0	26	59	93	77	87	86	87	104	111	131	130
Not noted	11	10	1	5	3	3	3	8	5	2	5	15
U30 Bat detector	0	0	0	0	0	0	0	0	0	0	0	0
Bat Box IIId	0	10	17	12	21	18	12	14	10	14	13	14
Magenta Bat 5	0	13	18	17	22	27	22	25	33	41	38	45
Ciel Electronics	0	3	9	17	8	7	12	7	12	3	2	3
Anabat	0	1	0	0	7	9	18	18	9	3	1	5
Echo Meter Touch	0	0	0	0	0	0	0	0	0	2	3	1
Echo Meter Touch 2	0	0	0	0	0	0	0	0	0	7	7	3
Echo Meter Touch 2 Pro	0	0	0	0	0	0	0	0	0	0	0	1
Elekon Batscanner	0	0	0	0	0	0	0	0	0	3	4	4
SSF BAT2	0	0	0	0	0	0	0	0	0	2	1	2
SSF BAT3	0	0	0	0	0	0	0	0	0	0	1	0
Bat Box 1	0	0	0	0	0	0	0	0	0	0	0	3

b) Percentage of sites

year	2006	2009	2012	2015	2018	2019	2020	2021	2022	2023	2024	2025
detector												
Magenta Mk II	3.7	0.5	1.8	1.2	1.2	1.3	1.7	1.8	1.7	1.6	1.6	0.0
Magenta Mk III	23.1	12.4	4.6	2.8	2.1	2.1	2.2	3.1	2.5	0.8	0.4	0.4
Bat Box III	35.1	23.0	16.5	13.8	8.2	8.4	10.0	8.4	5.8	3.2	2.4	1.2
Pettersson D100	7.5	11.0	6.9	7.1	5.8	5.0	6.9	4.4	5.0	6.5	2.8	2.0
Pettersson D200	7.5	4.3	6.9	13.4	17.3	14.3	6.5	5.7	7.0	5.3	3.6	3.9
Bat Box Duet	4.5	11.5	9.6	3.6	7.0	4.2	4.8	4.8	4.5	4.5	4.8	3.1
Petersson D230	2.2	0.5	0.9	0.8	0.4	0.4	0.4	0.4	0.8	0.8	0.8	0.8
Petersson D240x	3.7	2.9	2.3	0.4	1.2	0.4	0.9	0.9	0.8	1.2	1.2	0.4
Sky SBR 2100	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mini-3	3.0	3.8	2.8	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.0
Magenta Bat 4	0.0	12.4	27.1	36.8	31.7	36.6	37.2	38.3	43.0	44.9	52.4	50.8
Not noted	8.2	4.8	0.5	2.0	1.2	1.3	1.3	3.5	2.1	0.8	2.0	0.0
U30 Bat detector	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bat Box IIId	0.0	4.8	7.8	4.7	8.6	7.6	5.2	6.2	4.1	5.7	5.2	5.5
Magenta Bat 5	0.0	6.2	8.3	6.7	9.1	11.3	9.5	11.0	13.6	16.6	15.2	17.6
Ciel Electronics	0.0	1.4	4.1	6.7	3.3	2.9	5.2	3.1	5.0	1.2	0.8	1.2
Anabat	0.0	0.5	0.0	0.0	2.9	3.8	7.8	7.9	3.7	1.2	0.4	2.0
Echo Meter Touch	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.2	0.4
Echo Meter Touch 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	2.8	1.2
Elekon Batscanner	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.6	0.4
SSF BAT2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.4	1.6
SSF BAT3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.8

Table A2.3: Basic descriptive statistics shown by year, province and for All-Ireland. 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) Connaught

Year	n complete surveys	mean sure	mean unsure	all	All (max 48 per spot)	% surveys with bats	% spots with bats
2006	51	66.1	21.6	87.7	77.1	92.2	55.7
2007	59	55.7	10.5	66.2	62.2	96.6	56.4
2008	47	45.3	6.4	51.7	46.9	95.7	53.6
2009	52	72.9	8.6	81.5	74.2	86.5	62.1
2010	55	68.9	5.8	74.7	71.7	92.7	63.8
2011	59	58.8	5.4	64.3	61.6	89.8	60.5
2012	58	53.3	6.4	59.7	57.4	93.1	59.5
2013	44	61.8	2.5	64.3	58.2	79.1	50.2
2014	71	48.7	9.6	58.3	54.5	88.7	58.6
2015	75	42.5	8.2	50.7	47.0	85.3	54.9
2016	66	58.5	9.5	68.0	63.0	93.9	61.7
2017	52	53.0	7.2	60.1	53.6	88.5	54.8
2018	57	73.6	5.9	79.6	70.4	79.6	56.1
2019	66	36.4	4.2	40.6	38.4	84.8	46.2
2020	56	43.8	5.0	48.8	45.2	89.3	53.2
2021	60	39.0	5.1	44.0	41.6	90.0	51.5
2022	59	37.9	3.8	41.8	37.6	84.7	48.1
2023	75	33.9	7.6	41.5	39.4	91.8	56.0
2024	75	24.6	5.9	30.5	29.9	91.8	45.2
2025	82	30.5	6.4	36.9	34.8	93.6	51.4
All years	1219	48.8	7.3	56.1	52.0	89.6	54.8

b) Leinster

Year	n complete surveys	mean sure	mean unsure	all	All (max 48 per spot)	% surveys with bats	% spots with bats
2006	102	43.9	27.2	71.2	51.1	94.1	61.5
2007	194	37.5	6.7	44.2	43.4	89.7	55.5
2008	135	33.4	5.6	39.0	38.0	85.9	52.9
2009	165	38.1	7.9	46.0	45.0	90.1	55.4
2010	178	49.4	10.0	59.3	55.7	95.5	63.5
2011	169	44.7	9.2	54.0	53.0	94.1	62.3
2012	176	35.6	9.4	45.1	44.2	90.3	56.4
2013	203	37.6	7.9	45.5	44.0	89.6	52.7
2014	213	38.3	8.3	46.6	42.4	89.2	52.8
2015	190	42.4	8.0	50.4	47.3	92.6	54.3
2016	186	39.2	8.0	47.3	41.6	86.6	52.5
2017	183	40.6	8.2	48.8	44.3	91.8	53.0
2018	173	36.2	5.9	42.1	38.6	88.8	46.8
2019	175	40.4	7.3	47.7	44.6	86.3	50.7
2020	162	35.9	6.7	42.6	40.8	92.6	52.2
2021	171	41.6	9.6	51.2	49.5	90.0	52.1
2022	194	46.7	11.9	58.6	53.2	90.1	57.2
2023	193	42.4	10.1	52.5	46.6	95.1	56.2
2024	201	41.8	11.6	53.3	51.3	91.1	59.3
2025	214	47.6	7.8	55.4	50.4	93.3	57.5
All years	3577	40.7	9.0	49.8	46.3	90.8	55.1

c) Munster

Year	n complete surveys	mean sure	mean unsure	all	All (max 48 per spot)	% surveys with bats	% spots with bats
2006	64	47.0	13.8	60.8	58.0	95.2	61.3
2007	80	48.4	7.3	55.8	52.1	90.0	50.8
2008	68	39.3	7.6	46.8	42.9	91.2	49.7
2009	78	42.3	6.5	48.8	43.8	89.2	46.5
2010	76	48.1	12.3	60.4	58.7	94.7	59.6
2011	85	57.6	17.4	75.0	68.4	97.6	63.4
2012	84	48.7	12.2	60.8	59.3	98.8	62.1
2013	86	50.4	12.0	62.4	60.2	95.3	62.8
2014	80	50.8	8.2	59.0	53.4	89.9	58.6
2015	105	47.2	10.4	57.6	54.9	94.3	60.9
2016	103	52.9	8.3	61.2	57.6	89.3	58.8
2017	109	55.2	10.1	65.3	59.3	90.8	62.1
2018	100	55.9	9.7	65.6	62.5	89.1	61.4
2019	92	39.5	8.3	47.8	47.3	96.7	56.9
2020	101	45.8	8.0	53.9	52.6	92.0	53.2
2021	91	43.4	6.0	49.4	48.4	92.3	55.8
2022	106	55.0	6.6	61.6	56.6	93.3	55.3
2023	100	45.1	8.5	53.6	51.9	93.7	56.3
2024	112	50.8	9.4	60.3	57.3	91.0	60.2
2025	106	57.8	5.0	62.9	56.2	88.7	54.9
All years	1826	49.4	9.3	58.7	55.3	92.6	57.7

d) 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	60.3
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	61.0
2018	96	37.5	7.0	44.5	43.2	90.3	55.3
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	30.8	4.2	35.0	33.7	96.8	52.9
2024	78	25.6	4.6	30.2	28.1	85.1	42.5
2025	80	27.5	4.3	31.8	29.9	87.7	46.6
All years	1641	37.6	7.0	44.6	42.7	91.4	54.1

e) 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	59.2
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	55.6
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	54.6
2014	474	40.2	8.1	48.3	44.2	89.9	52.8
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	57.0
2018	426	45.9	7.0	52.9	49.2	88.0	53.3
2019	426	37.4	6.9	44.4	42.5	89.2	51.8
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	52.3
2022	439	44.1	8.1	52.2	47.8	89.7	54.0
2023	446	39.8	8.4	48.2	44.6	94.5	55.7
2024	466	38.5	9.0	47.5	45.5	90.3	54.5
2025	482	43.5	6.4	49.9	45.5	91.4	54.1
All years	8263	43.2	8.4	51.6	48.4	91.1	55.5

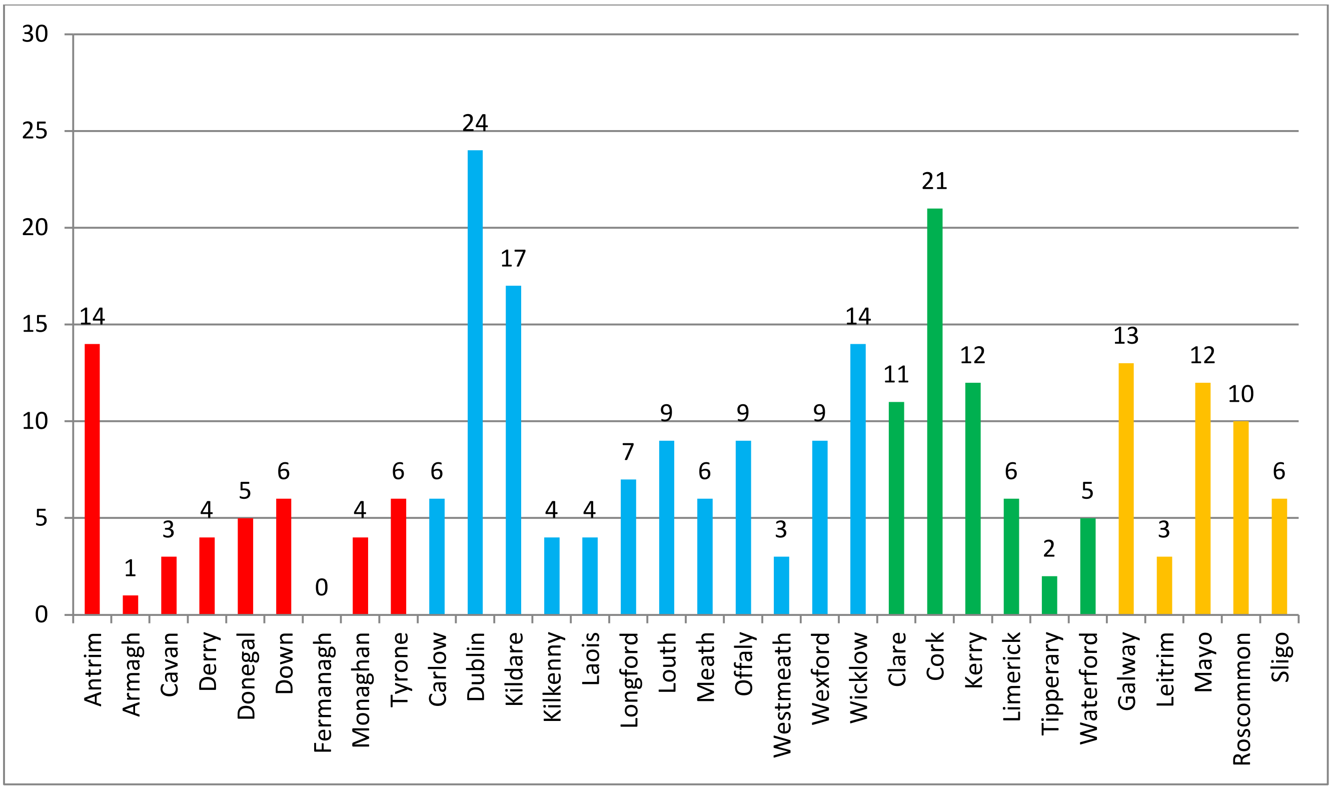

Figure A2.2: Number of waterway sites surveyed in each county in 2025.

Table A2.4: Single Surveys listed per county (in descending order) along with percentage: 2006-2025 Dataset

County	Total No. of Waterway Sites	Single Year Survey	%
Antrim	30	2	6.7
Armagh	9	1	11.1
Carlow	19	4	21.1
Cavan	12	1	8.3
Clare	19	3	15.8
Cork	51	3	5.9
Derry	17	2	11.8
Donegal	16	0	0.0
Down	13	2	15.4
Dublin	32	1	3.1
Fermanagh	10	1	10.0
Galway	29	5	17.2
Kerry	21	0	0.0
Kildare	36	0	0.0
Kilkenny	17	2	11.8
Laois	11	1	9.1
Leitrim	12	1	8.3
Limerick	26	4	15.4
Longford	13	1	7.7
Louth	11	0	0.0
Mayo	25	7	28.0
Meath	27	1	3.7
Monaghan	10	3	30.0
Offaly	22	3	13.6
Roscommon	18	3	16.7
Sligo	16	1	6.3
Tipperary	16	1	6.3
Tyrone	25	8	32.0
Waterford	16	1	6.3
Westmeath	28	9	32.1
Wexford	15	1	6.7
Wicklow	23	0	0.0

Table A2.5: Numbers of years of data from each waterway site (excludes surveys outside the usual date range).

Number of years	Sites surveyed in 2024			All sites ever surveyed		
	N sites	% of total	Cumulative %	N sites	% of total	Cumulative %
1	0	0.0	0.0	84	13.0	13.0
2	16	6.4	6.4	73	11.3	24.4
3	17	6.8	13.2	73	11.3	35.7
4	25	10.0	23.2	60	9.3	45.0
5	19	7.6	30.8	51	7.9	53.0
6	13	5.2	36.0	36	5.6	58.5
7	18	7.2	43.2	39	6.1	64.6
8	12	4.8	48.0	28	4.3	68.9
9	13	5.2	53.2	26	4.0	73.0
10	11	4.4	57.6	23	3.6	76.6
11	13	5.2	62.8	24	3.7	80.3
12	16	6.4	69.2	25	3.9	84.2
13	12	4.8	74.0	15	2.3	86.5
14	15	6.0	80.0	21	3.3	89.8
15	13	5.2	85.2	18	2.8	92.5
16	8	3.2	88.4	15	2.3	94.9
17	10	4.0	92.4	14	2.2	97.0
18	10	4.0	96.4	10	1.6	98.6
19	9	3.6	100.0	9	1.4	100.0
20	7	2.7	100.0	7	1.1	100.0

Table A2.6: Matrix of waterway sites surveyed in all possible pairs of years (e.g. 250 sites were surveyed in 2024 and 137 of these were also surveyed in 2020). Numbers on the diagonal (italics) are total sites surveyed in each year.

	2006	**2009**	**2012**	**2015**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
2006	*132*											
2009	79	*209*										
2012	66	118	*218*									
2015	65	114	140	*253*								
2018	50	96	116	153	*243*							
2019	54	93	112	138	180	*238*						
2020	49	84	111	140	163	172	*232*					
2021	48	86	106	135	157	154	176	*227*				
2022	60	95	109	139	146	151	152	163	*242*			
2023	57	93	109	133	144	146	142	152	166	*247*		
2024	51	85	113	130	136	142	137	138	153	171	*250*	
2025	59	89	107	121	127	131	125	135	145	162	182	*256*

Table A2.7: Poisson GAM results with 95% confidence limits for Daubenton's bats (2006-2025). Covariates include survey start time, surveyor skills and degree of smooth water as recorded by survey teams.

				Smoothed		95% conf limits		Unsmoothed		95% conf limits	
Year	**Sites**	**Surveys**	**Mean**	**Index**	**s.e.**	**Lower**	**Upper**	**Fitted**	**s.e.**	**Lower**	**Upper**
2006	114	206	54.24	99.12	3.10	93.24	105.35	109.64	10.84	89.14	133.57
2007	173	306	48.50	100.00	0.00	100.00	100.00	100.00	0.00	100.00	100.00
2008	159	270	40.37	102.68	2.42	97.83	107.21	91.05	6.28	80.01	103.30
2009	181	310	50.89	107.35	4.05	99.44	115.14	116.34	8.07	101.99	132.37
2010	196	357	58.50	110.77	5.05	101.12	120.43	123.49	8.59	108.06	140.92
2011	219	387	59.04	110.52	5.64	99.75	121.54	119.95	8.32	104.39	138.25
2012	217	397	52.13	107.83	6.02	95.85	119.31	108.62	7.69	94.94	123.67
2013	224	408	48.72	106.03	6.36	92.98	117.82	105.14	7.34	90.82	119.27
2014	243	452	45.13	107.14	6.78	93.07	119.78	104.56	7.89	89.83	120.95
2015	246	454	50.37	110.69	7.26	96.07	125.28	121.92	9.30	105.33	141.74
2016	244	440	49.73	113.82	7.80	98.56	129.19	116.61	8.92	99.24	133.09
2017	224	391	52.01	115.12	8.37	98.02	132.80	124.24	11.05	103.68	147.54
2018	234	405	50.29	113.59	8.54	96.26	131.91	123.74	11.12	102.26	145.83
2019	233	410	42.57	110.16	8.30	93.31	128.29	106.72	9.23	89.70	126.39
2020	230	409	43.37	107.44	8.10	92.16	123.95	109.45	9.73	91.88	129.03
2021	227	417	44.12	105.82	8.05	91.75	121.96	111.31	10.09	92.76	132.19
2022	242	438	48.08	104.71	7.97	90.53	120.81	108.46	9.44	91.05	125.96
2023	243	435	45.61	104.06	7.86	89.03	119.38	105.52	9.61	89.17	126.15
2024	246	459	46.99	103.93	7.91	89.11	119.59	109.65	8.85	93.48	127.55
2025	253	474	46.10	103.83	8.62	88.16	121.30	106.97	9.93	89.03	128.00

Total Sites: 566
Base Year: 2007 (Index = 100)
Total change since base year = 3.83%
Mean increase/decrease: 0.21%

Table A2.9a: Poisson GAM results with 95% confidence limits for Daubenton's bats (2006-2025) in Northern Ireland.

				Smoothed		95% conf limits		Unsmoothed		95% conf limits	
Year	**Sites**	**Surveys**	**Mean**	**Index**	**s.e.**	**Lower**	**Upper**	**Fitted**	**s.e.**	**Lower**	**Upper**
2006	12	24	34.92	89.93	5.61	80.62	101.90	97.93	17.99	63.85	127.81
2007	18	30	38.73	100.00	0.00	100.00	100.00	100.00	0.00	100.00	100.00
2008	25	44	44.73	112.43	5.61	101.25	122.34	105.71	18.06	77.96	147.76
2009	31	50	48.22	128.32	10.61	108.13	148.12	123.04	18.82	89.51	162.69
2010	32	58	51.14	145.50	14.92	117.05	175.56	159.49	26.69	116.17	221.41
2011	41	78	57.29	156.88	18.33	123.31	196.82	170.77	25.84	128.23	229.35
2012	36	64	61.05	158.00	20.50	120.63	205.49	178.40	29.62	127.89	243.82
2013	31	59	40.93	153.27	21.01	116.41	203.17	139.00	22.03	101.19	197.21
2014	34	65	37.26	154.19	21.94	117.37	204.91	129.09	24.15	86.45	184.87
2015	35	69	55.64	164.67	24.69	126.44	222.39	186.35	36.77	134.24	275.31
2016	32	61	48.48	178.09	28.37	133.57	246.88	172.69	30.16	128.44	243.21
2017	33	54	58.17	190.59	32.56	135.98	266.73	203.52	39.90	137.98	302.96
2018	32	60	50.65	195.25	34.94	137.15	277.50	223.03	45.43	147.31	323.31
2019	34	61	42.43	189.21	34.34	136.27	273.47	186.95	42.08	128.24	295.67
2020	34	57	36.89	179.04	33.29	127.44	265.73	166.08	32.18	116.71	246.48
2021	32	58	33.88	168.94	33.05	116.63	245.44	185.31	44.94	116.38	307.42
2022	28	55	30.98	157.45	30.84	109.54	231.67	152.43	38.62	92.51	241.92
2023	29	54	37.30	144.49	26.32	102.96	207.70	166.00	34.69	114.58	247.53
2024	28	52	30.94	129.70	22.37	94.13	177.55	122.93	22.88	88.15	173.32
2025	31	57	27.09	115.77	21.95	82.24	166.24	117.57	28.08	78.67	184.33

Total Sites: 86
Base Year: 2007 (Index = 100)
Total change since base year = 15.77%
Mean increase/decrease: 0.82%

Table A2.9b: Poisson GAM results with 95% confidence limits for Daubenton's bats (2006-2025) in Republic of Ireland.

				Smoothed		95% conf limits		Unsmoothed		95% conf limits	
Year	**Sites**	**Surveys**	**Mean**	**Index**	**s.e.**	**Lower**	**Upper**	**Fitted**	**s.e.**	**Lower**	**Upper**
2006	102	182	56.79	99.80	3.51	93.69	106.74	111.44	12.24	89.58	139.50
2007	155	276	49.57	100.00	0.00	100.00	100.00	100.00	0.00	100.00	100.00
2008	134	226	39.52	102.09	2.71	96.83	107.24	90.27	7.01	78.49	105.02
2009	150	260	51.40	105.99	4.52	97.29	114.15	118.85	8.97	103.44	139.23
2010	164	299	59.92	108.21	5.54	97.81	119.58	121.36	10.01	106.65	146.53
2011	178	309	59.48	106.90	5.99	96.24	119.13	116.62	8.87	102.42	136.44
2012	181	333	50.42	103.84	6.28	92.83	116.95	102.20	8.05	86.77	119.25
2013	193	349	50.03	102.39	6.65	90.79	116.71	103.26	7.88	90.02	120.42
2014	209	387	46.45	103.64	7.16	90.90	119.03	103.88	8.87	90.12	123.82
2015	211	385	49.43	106.61	7.65	92.92	122.71	117.69	10.11	100.36	142.01
2016	212	379	49.93	108.80	8.08	94.15	125.93	112.95	9.65	97.11	133.27
2017	191	337	51.02	109.16	8.51	94.75	126.90	118.28	11.39	99.19	142.17
2018	202	345	50.23	107.22	8.59	92.07	126.09	116.50	11.39	96.59	139.09
2019	199	349	42.59	104.16	8.29	89.91	121.84	100.81	9.55	84.41	121.06
2020	196	352	44.42	102.27	8.04	88.14	118.24	105.87	10.75	86.89	128.87
2021	195	359	45.77	101.53	7.80	88.00	117.24	107.35	9.54	90.70	126.30
2022	214	383	50.53	101.26	7.57	87.74	117.12	106.60	8.92	91.46	125.75
2023	214	381	46.79	101.38	7.51	87.58	116.72	102.22	9.45	85.76	122.15
2024	218	407	49.04	102.20	7.74	88.43	118.21	109.22	9.46	92.04	129.68
2025	222	417	48.70	103.05	8.68	87.70	119.98	106.94	10.36	89.32	130.07

Total Sites: 480
Base Year: 2007 (Index = 100)
Total change since base year = 3.05%
Mean increase/decrease: 0.17%

APPENDIX 3

Brown Long-eared Bat Roost Monitoring Scheme

Preliminary Roost Assessment

Brown long-eared roosts selected and surveyed in this monitoring scheme were collated from a number of sources:

- BCIreland database
- BCIreland committee members
- NPWS regional staff
- General survey of buildings deemed suitable for this bat species

All new roosts, when first considered for inclusion in the monitoring scheme, were assessed by completing a daytime check of the building. This involved a survey of the roof space and when the building was accessible, safe, and brown long-eared droppings or actual brown long-eared bats were observed, then a preliminary assessment was undertaken. The preliminary assessment involved surveying the building by using at least two of the methods listed in Table A3.1 below. Once a site was deemed suitable for inclusion in the scheme (i.e. more than eight individuals were present and it was possible to safely count bats at the site by watching emerging bats or by entering the roof space), monitoring was then completed year-on-year using the most suitable method with an aim of counting the colony at each roost twice per year.

Table A3.1: Methods of assessing the most suitable protocol for counting brown long-eared bats at each roost. The assessment is carried out using at least two of Methods A-C below. Dates for surveying: Survey 1 1st May to June 15th, Survey 2 June 16th to July 31st, Survey 3 August 1st to 31st August.

	Method A	**Method B**	**Method C**
Description	Interior daytime count	Emergence Dusk Count	Interior Post Emergence Count
No. of counts per season	2	2 or 3	2 (usually in conjunction with Method B)
Dates when counts can be conducted	Survey Period1 & Survey Period 3	Survey Period 1 (preferred), Period 2 and Period 3 (preferred)	Survey Period 1 & Survey Period 3
Surveyor	Licensed	Licence not necessary	Licensed
Method	Count of bats present in roost.	Surveyors present at all known exit points, surveying starts 20 minutes after sunset. Count in 10min blocks. Count for 60mins or stop when no bats emerge for 10mins. Note if bats are seen or just heard. Direction of flight also noted.	Enter roost at start and end of emergence. Count bats present on both occasions. Numbers of bats before and after emergence are compared with total observed emerging.
Equipment	Red-light torch	Bat detector and red-light torch	Red-light torch
Other recorded details	Internal roof details, dimensions, presence of roof felt etc.	Weather conditions.	Weather conditions
Other info	Dead bats collected	Fine weather survey only.	Only undertaken in buildings with safe access in hours of darkness.

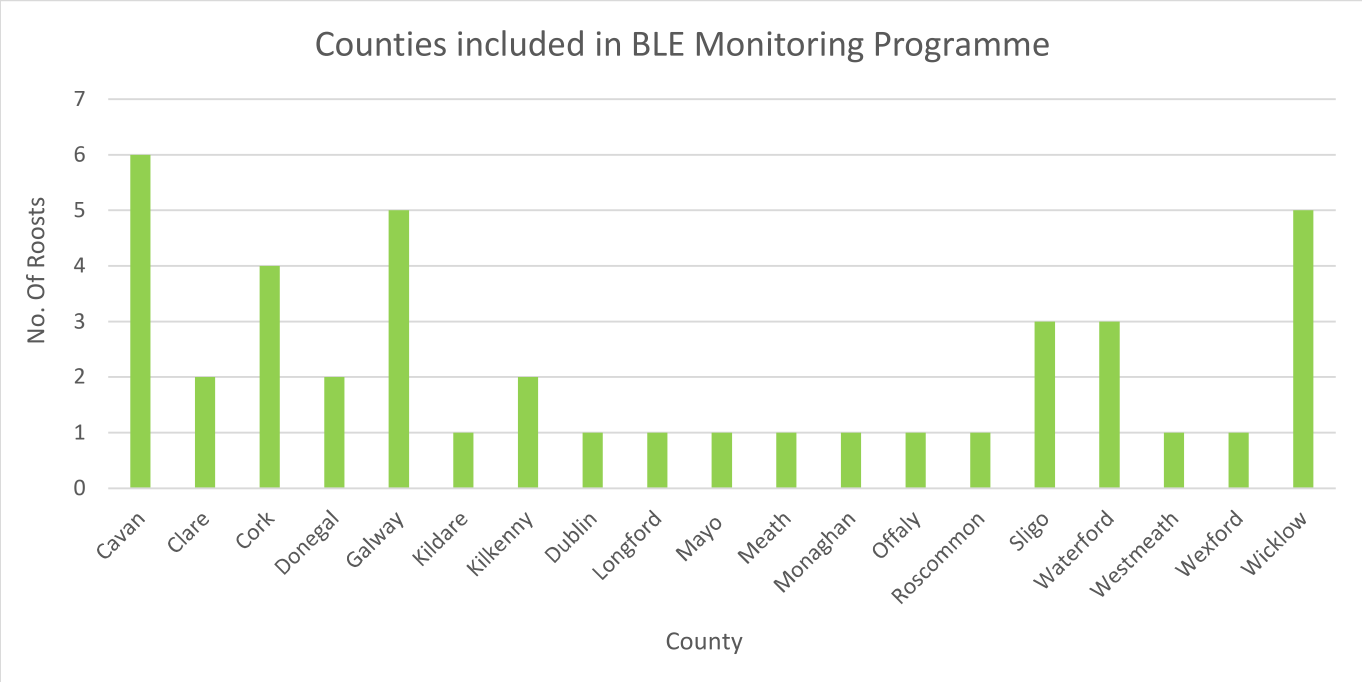

Figure A3.1: Distribution of brown long-eared bat roosts monitored in 2025 by county.

Table A3.2: Types of roost in different survey years. Numbers of roosts monitored as part of the Brown Long-eared Roost Monitoring Scheme 2007-2025.

a) numbers of roosts

year	2007	2010	2013	2016	2019	2020	2021	2022	2023	2024	2025	All
type												
Agric shed	0	0	0	0	0	0	0	0	1	2	2	2
Barn	0	2	4	2	1	1	1	1	1	1	1	4
Church	5	18	24	26	24	26	24	25	26	24	23	30
House	3	7	7	8	6	7	7	7	7	6	6	12
Large bld etc	6	12	12	8	9	8	9	10	9	8	7	18
Other	2	2	2	3	3	3	3	3	3	3	3	3
All types	16	41	49	47	43	45	44	46	47	44	42	69

b) percentage of all roosts in each year

year	2007	2010	2013	2016	2019	2020	2021	2022	2023	2024	2025	All
type												
Agric shed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	4.5	4.8	2.9
Barn	0.0	4.9	8.2	4.3	2.3	2.2	2.3	2.2	2.1	2.3	2.4	5.8
Church	31.2	43.9	49.0	55.3	55.8	57.8	54.5	54.3	55.3	54.5	54.8	43.5
House	18.8	17.1	14.3	17.0	14.0	15.6	15.9	15.2	14.9	13.6	14.3	17.4
Large bld etc	37.5	29.3	24.5	17.0	20.9	17.8	20.5	21.7	19.1	18.2	16.7	26.1
Other	12.5	4.9	4.1	6.4	7.0	6.7	6.8	6.5	6.4	6.8	7.1	4.3
All types	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Note: site 2140 previously categorised as a barn is now listed as an agricultural shed.

Table A3.3: Numbers of years of data from each roost. Brown Long-eared Roost Monitoring Scheme 2007-2025.

Number of years	Number of sites	% of total	Cumulative %
1	1	1.4	1.4
2	7	10.1	11.6
3	2	2.9	14.5
4	4	5.8	20.3
5	4	5.8	26.1
6	1	1.4	27.5
7	2	2.9	30.4
8	2	2.9	33.3
9	1	1.4	34.8
10	1	1.4	36.2
11	2	2.9	39.1
12	4	5.8	44.9
13	8	11.6	56.5
14	3	4.3	60.9
15	2	2.9	63.8
16	6	8.7	72.5
17	6	8.7	81.2
18	9	13.0	94.2
19	4	5.8	100.0

Table A3.4: Numbers of roosts monitored in each year (diagonal in italics) and common to each pair of years (off diagonal). For example 47 sites were monitored in 2023 and 42 of these were also recorded in 2021. Brown Long-eared Roost Monitoring Scheme 2007-2025.

	2007	2010	2013	2016	2019	2020	2021	2022	2023	2024	2025
2007	*16*										
2010	13	*41*									
2013	11	36	*49*								
2016	10	30	42	*47*							
2019	9	26	36	41	*43*						
2020	9	28	38	43	42	*45*					
2021	9	26	36	41	40	42	*44*				
2022	10	28	38	43	42	44	44	*46*			
2023	8	27	38	42	40	43	42	44	*47*		
2024	7	23	32	37	38	38	37	39	40	*44*	
2025	8	23	31	36	37	37	37	38	39	41	*42*

Tables A3.3 and A3.4 are useful because they indicate the consistency with which roosts are monitored, which is important in producing accurate trend estimates. Table 2 shows that around two thirds of the roosts in the dataset have been monitored for at least 10 years, whilst Table 3 shows that there is an excellent level of consistency in the roosts surveyed over the last ten years.

Table A3.5: Total numbers of roosts, roost surveys and types of surveys completed in each year. Brown Long-eared Roost Monitoring Scheme 2007-2024.

Year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Total No. Roosts	16	31	36	41	35	41	49	48
Total No. Surveys	25	51	73	87	36	91	111	112
Internal Count	12	26	24	25	7	24	25	27
Emergence Count	13	25	49	62	29	67	86	85
Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Total No. Roosts	47	47	47	45	43	45	44	46
Total No. Surveys	108	115	111	110	110	114	117	131
Internal Count	18	20	18	17	15	9	26	32
Emergence Count	90	95	93	93	95	105	91	99

Year	**2023**	**2024**	**2025**
Total No. Roosts	47	41	42
Total No. Surveys	130	110	101
Internal Count	27	9	9
Emergence Count	103	101	92

Figure 5.6: Felt roof and count comparison. One interesting feature however concerns the term for felt, which was statistically significant prior to the 2021 results. Figure 5.6 shows a bar chart of mean counts by roofing felt status; between 2009 and 2017 there is a clear picture of roofs without felt having higher average counts, but this is not the case in subsequent years.

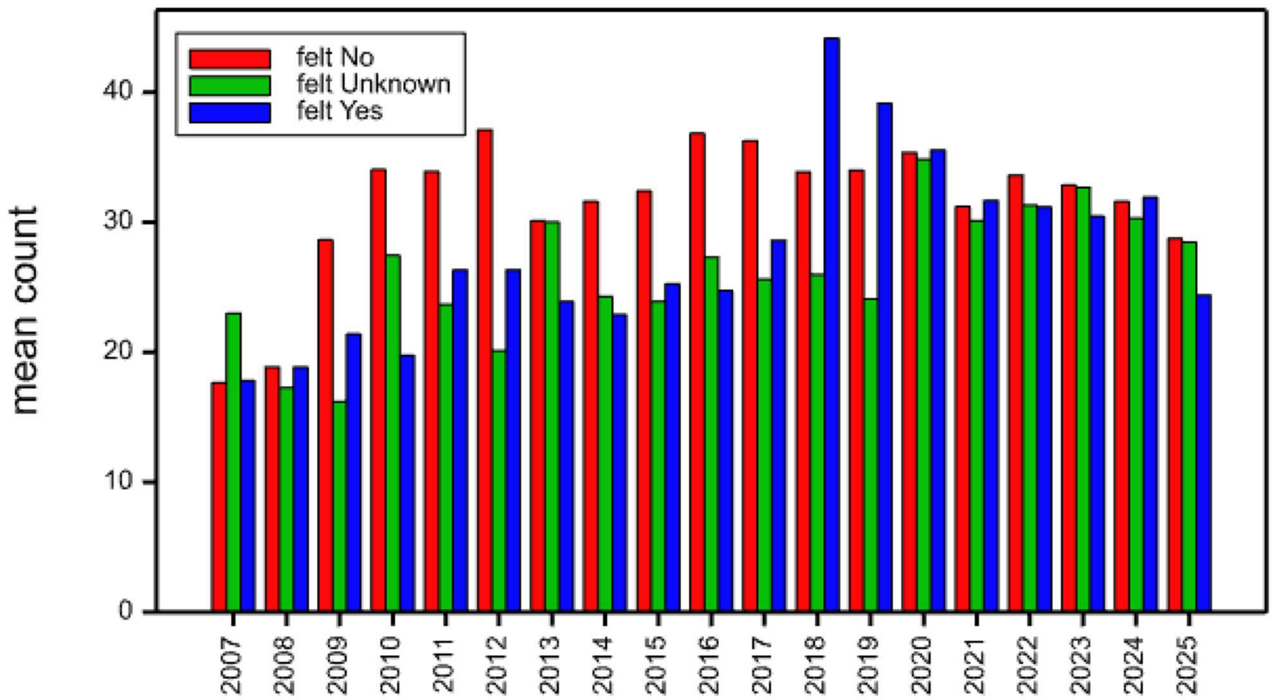

Figure 5.7: Emergence times in different cloud conditions. Bars show estimates from REML models with 95% confidence limits.

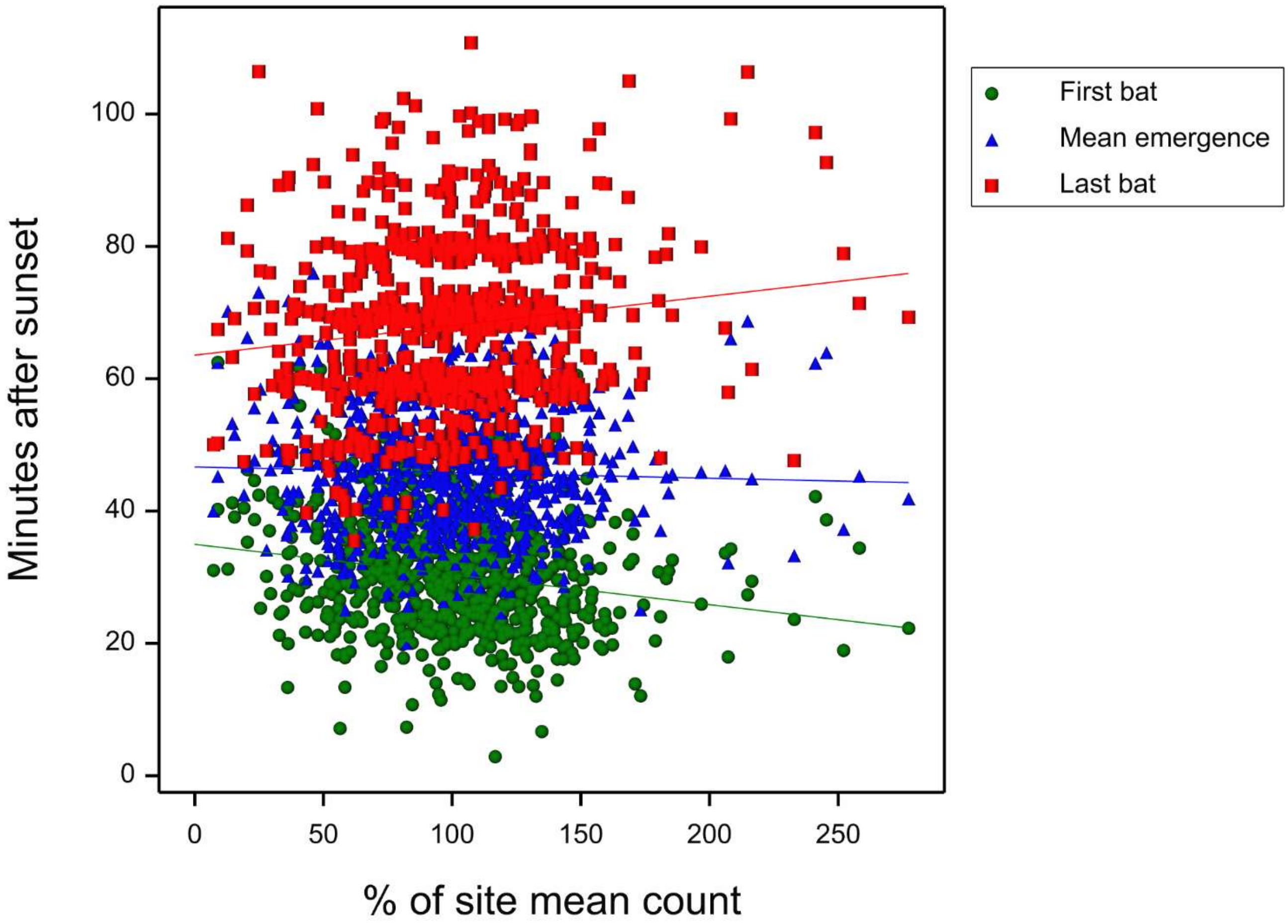

Figure 5.8: First, mean and last emergence times plotted against counts as a proportion of the site mean count. (Note: Last emergence times are only known to the nearest ten minute block). Lines are linear regression lines.

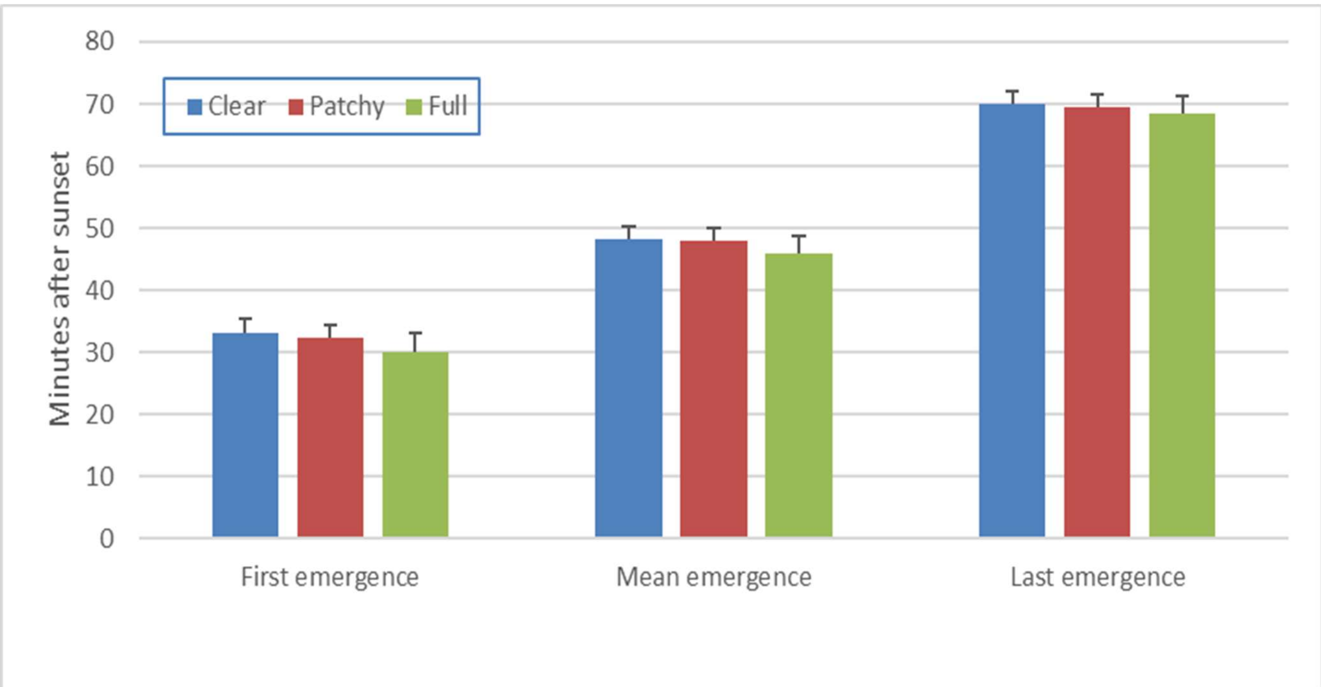

Figure 5.9: Mean emergence times relative to sunset for each year. These are predicted means from the REML model, adjusted for the effect of other factors in the model. Bars are plus or minus one standard error.