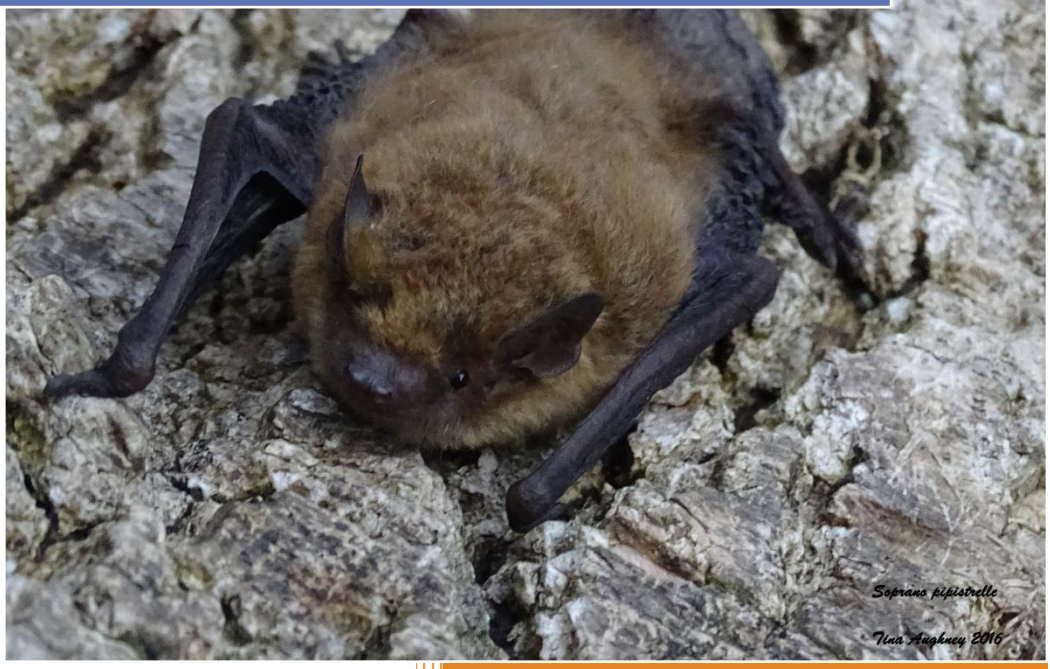
2023

Monitoring of purpose built bat house at Bective Demesne, Bective, Co. Meath.



Dr Tina Aughney

Bat Eco Services

Bat Eco Services, Ulex House, Drumheel, Lisduff, Virginia, Co. Cavan. A82 XW62.

Licensed Bat Specialist: Dr Tina Aughney (tina@batecoservices.com, 086 4049468)
NPWS licence C17/2023 (Licence to handle bats, expires 23rd January 2026);
NPWS licence 27/2023 (Licence to photograph/film bats, expires 31st December 2024);
NPWS licence DER/BAT 2022-36 (Survey licence, expires 24th March 2025).

Statement of Authority: Dr Aughney has worked as a Bat Specialist since 2000 and has undertaken extensive survey work for all Irish bat species including large scale development projects, road schemes, residential developments, wind farm developments and smaller projects in relation to building renovation or habitat enhancement. She is a monitoring co-ordinator and trainer for Bat Conservation Ireland. She is a co-author of the 2014 publication *Irish Bats in the 21st Century.* This book received the 2015 CIEEM award for Information Sharing. Dr Aughney is a contributing author for the Atlas of Mammals in Ireland 2010-2015.

All analysis and reporting is completed by Dr Tina Aughney. Data collected and surveying is completed with the assistance of a trained field assistant.

Mr. Shaun Boyle (Field Assistant) NPWS licence DER/BAT 2022-37 (Survey licence, expires 24th March 2025).

Client: Bective Stud Ltd.

Project Name & Location: Bective Demesne, Bective, Navan, Co. Meath

Report Revision History

Date of Issue	Draft Number	Issued To (process of issuing)
19th July 2022	Draft 1 – Examination of temperature data in Bat House, installation of hot box	By email to VEON, John Fleming Architects & Bective Stud Ltd.
23rd March 2023	Draft 2 – Monitoring of Bat House	By email to VEON, John Fleming Architects & Bective Stud Ltd.
1st September 2023	Draft 3 – collation of all data for Derogation Licence application	By email to VEON & Bective Stud Ltd.
4th September 2023	Final report	By email to VEON & Bective Stud Ltd.

Purpose

This document has been prepared as a Report for Bective Stud Ltd. Only the most up to-date report should be consulted. All previous drafts/reports are deemed redundant in relation to the named site.

Bat Eco Service accepts no responsibility or liability for any use that is made of this document other than by the client for the purposes for which it was originally commissioned and prepared.

Carbon Footprint Policy

It is the policy of Bat Eco Services to provide documentation digitally in order to reduce carbon footprint. Printing of reports etc. is avoided, where possible.

Bat Record Submission Policy

It is the policy of Bat Eco Services to submit all bat records to Bat Conservation Ireland database one year post-surveying. This is to ensure that a high level bat database is available for future desktop reviews. This action will be automatically undertaken unless otherwise requested, where there is genuine justification.

Executive Summary

Project Name & Location: Bective Demesne, Bective, Navan, Co. Meath

Proposed work: Monitoring of purposed built bat house (Bective Bat House)

Purpose: Review of the suitability of the bat bouse as a bat roost.

Citation: Bat Eco Services (2023) Monitoring of purposed built bat house at Bective Demesne, Bective, Co. Meath. Unpublished report prepared for Bective Stud Ltd.

Contents

1. Introduction

Bat Eco Services was commissioned by Bective Stud Ltd. to undertake monitoring of bat house at Bective House, Bective, Co. Meath. The bat house is part of an array of bat mitigation measures required for the proposed development of a five star hotel at the named location. As part of the Derogation Licence application to NPWS in 2020/2021, additional information was requested to determine the potential success of a purposed built bat house as a replacement roost for an existing whiskered bat roost in the loft of Bective Courtyard stable. Therefore, bat surveying was undertaken to gather additional information on the following:

1. Internal temperature of the Bective Bat House and compare to that in the current Whiskered bat roost (i.e. stable courtyard – Bective Courtyard);
2. Static surveillance of the Bective Bat House to determine if bats, particularly whiskered bats and brown long-eared bats, are roosting within this new structure;
3. Determine if potential improvements are required to the bat house and how to implement them;
4. Monitor the bat house post improvement works;
5. Undertake an inspection of bat boxes erected as part of bat mitigation measures;
6. Resurvey existing buildings (i.e. Bective House and Bective Courtyard) for bat usage.

1.1 Bective Bat House

A separate report is available on the construction of the Bat House:

Citation: Bat Eco Services (2022) Construction of a bat house at Bective Demesne, Bective, Co. Meath. Unpublished report prepared for John Fleming Architects.

Construction of the bat house was finished in February 2022. The bat houses was constructed according to the following specifications:

Bat House Design

- 4m x 4m (internal floor space) 1½ storey (internal height of 5m from floor level to highest point of roof space) building constructed from concrete block cladded with natural stone (insulation between the two walls).
- A-roof, constructed of natural slate and 1F bitumous felt (no modern breathable felt was used in the bat house) on timber joists (9 x 2 inch joists). There is no attic space but the roof is open and is part of a loft space.
- Single entrance point is required to be inserted into the wall facing the woodland edge (gable wall, at 4m height). This is an open window of 50cm wide by 20cm high (window slit). This “Pine Marten” proofed externally (i.e. smooth metal sheeting fixed around the base (window sill) and sides of the window slit to prevent Pine Marten climbing into the space).
- The ground floor entrance is a solid door on opposite gable wall to bat entrance point (locked).

Internally, the following is recommended:

- The floor of the building is a layer of crushed stone (2/3 inch down) (minimum use of concrete in order to reduce the negative impact of this material on the thermal conditions of the building) with a upper layer of 804 Clause (crushed) stone.
- A open loft space was constructed with a floor for 2/3 of the potential floor space. A floor was constructed dividing the building into a ground floor and loft floor. Timber joists (9x2 inch

timber) were sheeted with marine ply wood (leaving the timber joists exposed at the ground floor level (i.e. under the ply wood sheets) – this will provide additional roosting space for bats). A safety handrail was installed along the exposed/open end of the loft floor.
- A partition box (one side of which is open to allow bats to fly into the loft space) internally around the widow slit was constructed (marine ply) to reduce light penetrating the loft space.

Additional roosting

- External walls

Nine Bat Tubes were inserted along the external walls to provide roosting sites for crevice dwelling bats. These should be inserted at a minimum of 3m height.

- Internal walls

Four units of Integrated Woodstone Bat Box were attached to the wall at the highest point possible.

Plate 1: Bat house (rear view).

2. Monitoring Survey Methodology

2.1 Temperature Dataloggers

Temperature data loggers (TinyTag Transect 2 dataloggers – Temperature) were installed on 20th December 2021 in the Bat House and the loft space of the known whiskered roost in the stable courtyard. These dataloggers were set to recorded hourly. The data loggers were collected on 10th July 2022 to determine if the temperature in the bat house is similar to that in the stable courtyard loft.

Plate 2: Temperature data logger installed in Bat House.

The temperature data loggers were reinstalled on 10th July 2022 and downloaded again on 6th October 2022 to determine if the structural works within the bat house improved the temperature regime.

The temperature data loggers were, again, reinstalled in the bat house (3 units – loft space, hotbox and ground floor) for additional monitoring periods to compare the potential differences in temperatures within the different spaces of the bat house. The temperature data loggers were reinstalled on 6th October 2022 and remained in place until the final download and removal was completed on 22nd August 2023.

TinyTag software was used to download the hourly temperature readings from each unit and the maximum daily temperature was extracted and graphed.

2.2 Static Surveillance

Wildlife Acoustics SongMeter Bat4 units were installed in the Bat House on various dates in 2022 and 2023. These units were set to record from sunset to sunrise when triggered by a bat echolocation call. The audio files were downloaded and analysed using Kaleidoscope Pro software.

2.3 Daytime Inspections

Any signs or evidence of bat usage was noted during daytime inspections of the bat house. This was undertaken using torches and mirrors (in relation to the bat tubes).

All of the bat boxes erected as part of the bat mitigation measures recommended in Bat Eco Services (2020) was undertaken by physically checking bat boxes during the daytime. In relation to bat boxes that were inaccessible (i.e. due to their design), a strong torch was used to shine into the box from the ground level or a torch and mirror was used from the height of a double ladder to view into the bat box. In relation to bat boxes that were accessible (i.e. front partition door was part of design) were opened and checked for bats and bat evidence. This was completed on 19th March 2023.

2.4 Summer Roost Surveys

Surveys were undertaken at dusk from 10 minutes prior to sunset to 90 minutes after sunset.

- Whiskered bat maternity roost

Survey Equipment: Anabat Scout Full Spectrum Bat Detector and Petersson D200 Heterodyne Bat Detector coupled with Guide Pro19 thermal imagery scope (filming watched post-survey).

- Brown long-eared maternity roost

Survey Equipment: Elekon Bat Logger M2 Spectrum Bat Detector and Petersson D200 Heterodyne Bat Detector. A Sony Camcorder (with night shot capability) filming assisted with Infra-red (DedoLight DLOBML-IR860 connected to 7.2V 6.6Ah Sony-NPF ion battery).

- General surveys of Bective House

Survey Equipment: Depending on the surveyor, the following equipment was used: Anabat Scout Full Spectrum Bat Detector, BatLogger M2 Full Spectrum bat detector, Anabat Walkabout Full Spectrum bat detector, Echometer Touch Pro Full Spectrum bat detector and Petersson D200 Heterodyne bat detectors.

GuideIR Pro19 and Pro25 thermal imagery scopes (filming watched post-survey) were also deployed to film. Filming time was completed to coincide with dusk survey periods.

- Bat House

Survey Equipment: Anabat Scout Full Spectrum Bat Detector, BatLogger M3 Full Spectrum Bat Detector and Petersson D200 Heterodyne Bat Detector coupled with Guide Pro19 & Pro25 thermal imagery scopes (filming watched post-survey).

3. Results & Recommendations

3.1 Bective Bat House

3.1.1 Monitoring Period 1 – Bective Bat House

Monitoring Period 1 refers to information gathered from 1st December 2021 to the 9th July 2022.

3.1.1.1 Temperature Dataloggers

The temperature data loggers indicated that the temperature in the stable courtyard loft (Bective Courtyard – Whiskered bat roost)was generally higher compared to that recorded on the data logger located in the bat house (Bective Bat House). The temperatures are similar for the first 4 months of the monitoring but start to deviated from the 20th April 2022 (coinciding with leaf growth on trees adjacent to the bat house). Therefore to demonstrate the difference in the data, recordings from the 20th April 2022 were extract and a second graph is presented below to represent these results.

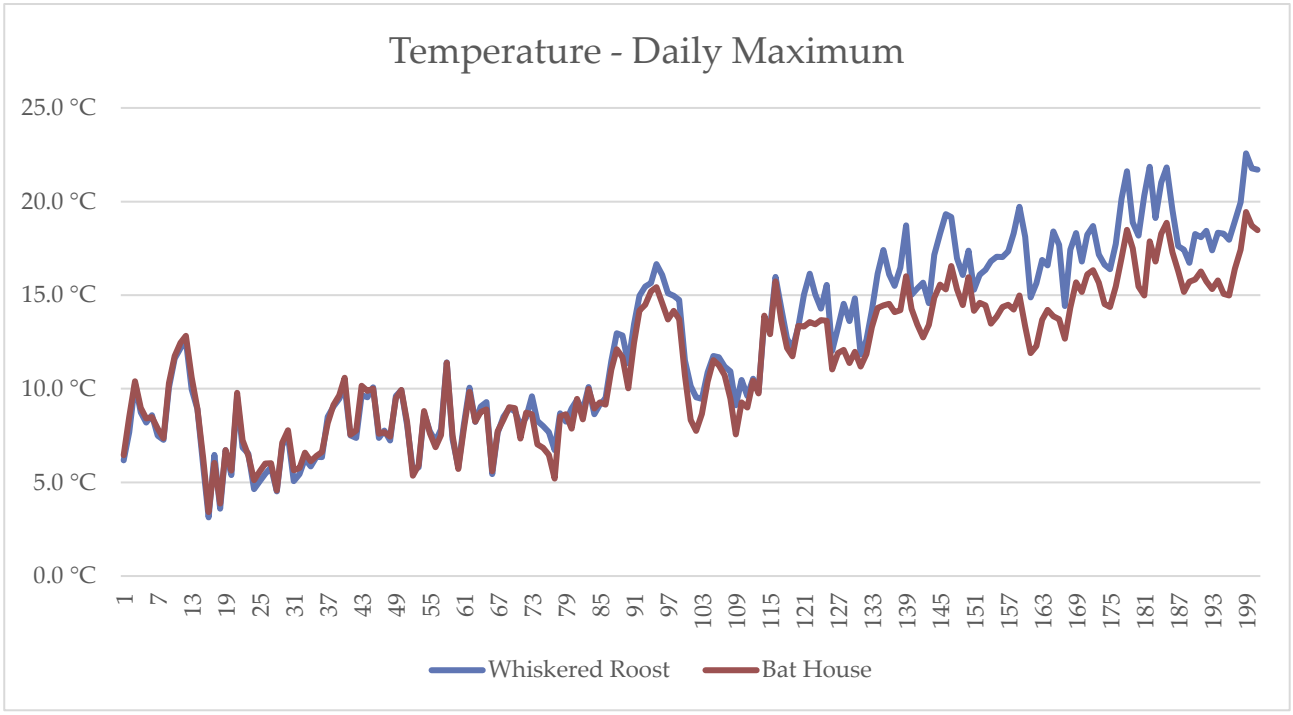


Figure 1: Daily maximum temperature recorded in the stable courtyard loft (Whiskered Roost) and Bat House from 21/12/2021 to 9/7/2022.

The average daily maximum temperature for the period extract (20th April to 9th July 2022, n=81 days) for the Whiskered Bat Roost (stable courtyard loft) is 17.3 ºC with a range of 11.8 to 22.6 ºC. In comparison, the average daily maximum temperature for the period extract (20th April to 9th July 2022, n=81 days) for the Bat House (stable courtyard loft) is 14.9 ºC with a range of 19.4 to 22.6 ºC. Therefore the maximum daily temperature in the Bat House is on average 2.4 ºC cooler. Maternity bat roosts tend require higher temperatures compared to other roost types. Schofield (2008) details this in relation to lesser horseshoe bats, however, little information was available on whiskered bat requirements. As a consequence, details from Schofield (2008) are present below,

Schofield (2008) reported that lesser horseshoe bats form clusters to create an optimum temperature of 34ºC in maternity roost spaces and that these clusters tend to be 14ºC warmer than the loft space occupied by a maternity colony. Therefore, it may be extrapolated that achieving 20ºC temperature

within the attic space is the goal in order to ensure that the loft is a potentially suitable space for a maternity colony of lesser horseshoe bats.

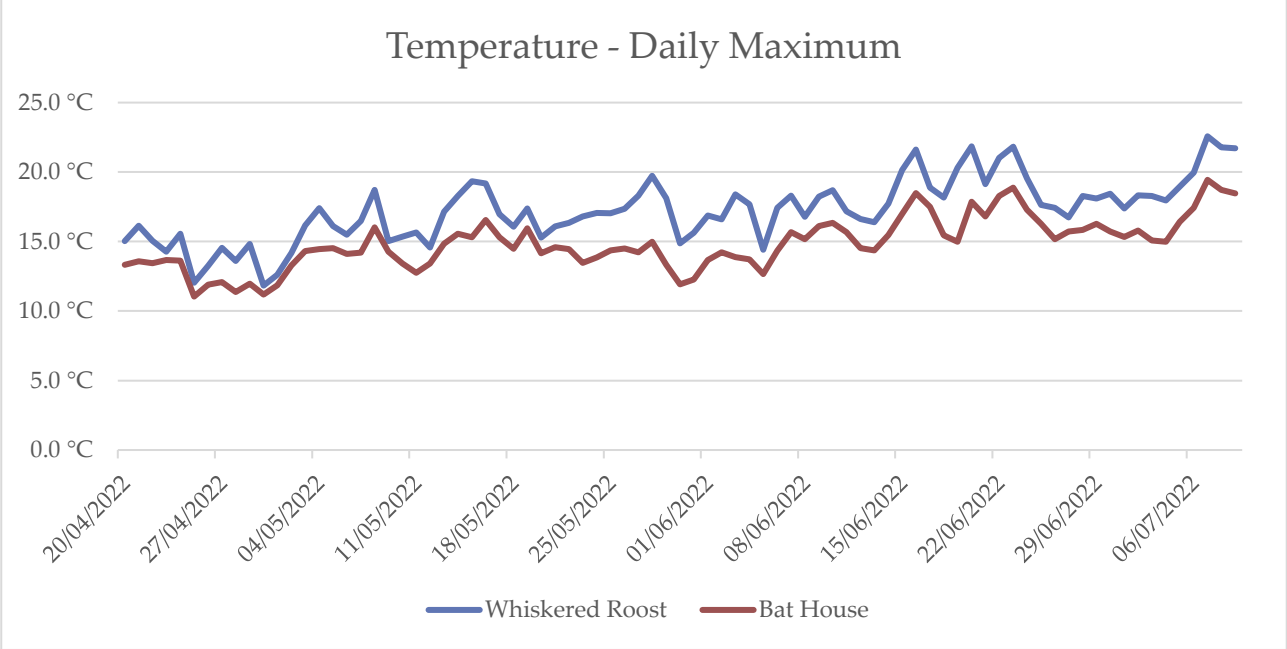


Figure 2: Daily maximum temperature recorded in the stable courtyard loft of Bective Courtyard (Whiskered Roost) and Bective Bat House from 20/4/2022 to 9/7/2022.

3.1.1.2 Static Surveillance

Static surveillance was undertaken from the 9th June 2022 to 11th July 2022 in both the loft space of the stable courtyard and the bat house. While >15,000 audio files were recorded from the statics on the unit located in the loft space of the stable courtyard (included calls from roosting whiskered bats and soprano pipistrelles but also other at species commuting and foraging within the courtyard), thereby emphasising the extensive usage of this building, no bats were recorded roosting in the bat house (a total of 4 audio files were logged, all noise files). The recording log of the static unit located in the bat house was checked to ensure that it was operating and this was the case. Therefore, no bats entered the internal space of the bat house during this surveillance period. Extensive foraging for brown long-eared bats, whiskered bats and soprano pipistrelles were noted in the woodland surrounding the bat house during the emergence survey completed on 10th July 2022.

3.1.1.3 Recommendations

This cooler temperature is more than likely due to the fact that the bat house is located under mature tree canopy while the current Whiskered Bat Roost (stable courtyard loft of Bective Courtyard) is open to full solar radiation (which heats the loft space up and therefore makes it a warmer loft space). The bat specialist expressed concern that this scenario may occur when the location of the bat house was being finalised in 2021. During discussions, it was emphasized that if the temperatures within the bat house are not similar to the temperatures in the current roost, then an additional heating source maybe be required or alternative steps were needed to improve the internal structure in order to increase the temperatures in the bat house. As this is the case, it was recommended to that such steps were undertaken as soon as possible in order to complete additional temperature monitoring for the remainder of the summer 2022.

One option was to install a heating source in the loft of the bat house to increase the temperatures. The following specifications were recommended:

- Single heating source with thermostat to be installed on the wall of the loft space of the bat house (wall furthest from the bat exit point. Heating source will be of suitable size to heat the volume of the bat house to a temperature of 25ºC.

However this option is not-passive (and therefore will require on-going maintenance) and, also, there is no source of energy close by. Solar panels were discussed but due to the operation of adjacent paddocks for horses, this was considered not to be a suitable option by the client.

A second option was to install a Hot Box in the attic space – this is a ply wood box that is built into the roof space and is constructed in such a way to trap any warm air already in the bat house and to retain it longer. Therefore this was the next step undertaken.

3.1.2 Monitoring Period 2 – Bective Bat House

Monitoring Period 2 refers to information gathered from the 11th July 2022 (post installation of hot box) to 28th August 2022.

3.1.2.1 Hot Box Installation

A hot box was installed on 19th July 2022. The dimensions of the hot box is 100cm x 120xm x 90cm.

Plate 3a: Hot box installed in roof of bat house.

Plate 3b: Hot box installed in roof of bat house.

3.1.2.2 Temperature Data Logger

A temperature data logger was placed inside the hot box to monitor temperature hourly for a minimum of two weeks surveillance to determine if this improved the temperature within the bat house. This data was compared to temperature data collated from the Whiskered Bat Roost (i.e. stable courtyard loft) and the data logger in the general attic space of the bat house.

The graph below displays the temperature data collected. The temperature data recorded in the whiskered bat roost was generally consistently higher compared to both data loggers in the bat house. The average daily maximum temperature recorded in the whiskered bat roost during this surveillance period was 22.7oC while the average daily maximum temperature in the bat house attic was 20oC. Eleven days of this surveillance period coincided with the hotbox construction being completed. While the average maximum temperature was lower in the hotbox for the surveillance period (19oC), the daily maximum temperature was higher for 8 of the 11 nights compared to the daily maximum temperature of the attic space of the bat house. Therefore, it was deemed that the hotbox provided an additional tool to increase the temperature of the bat house.

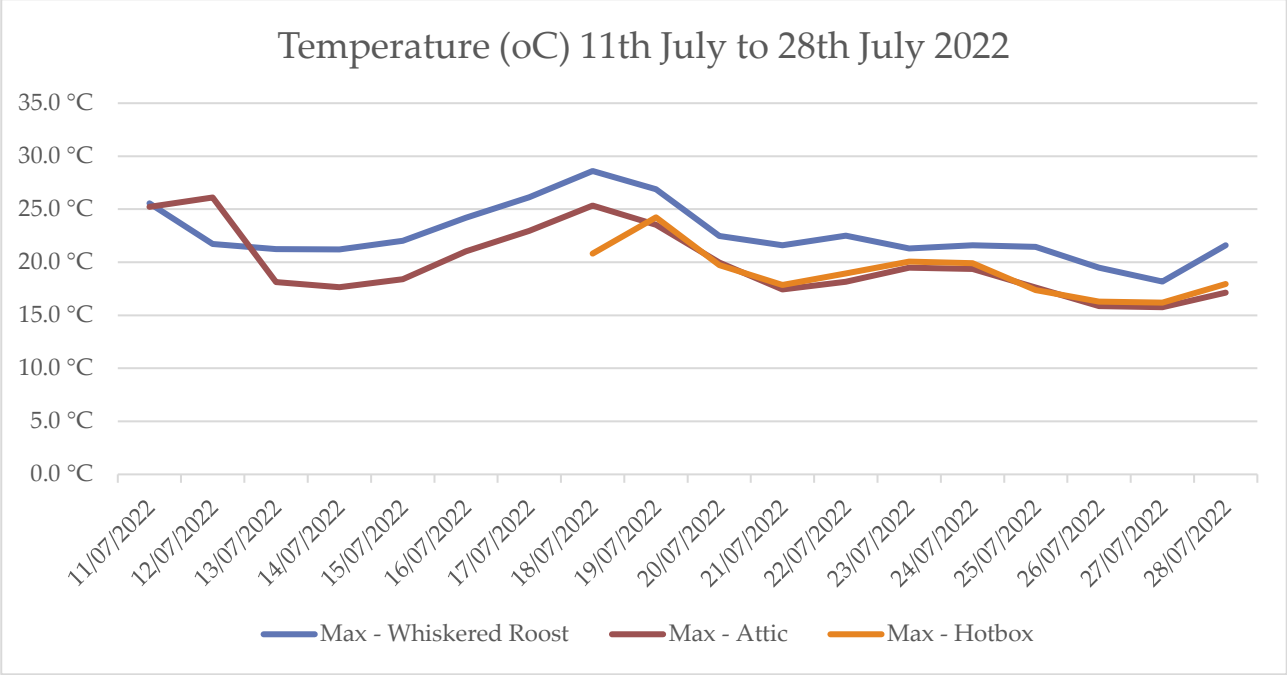


Figure 3: Daily maximum temperature recorded in the stable courtyard loft of Bective Courtyard (Whiskered Roost) and Bective Bat House from 11/7/2022 to 28/7/2022.

3.1.2.3 Recommendations

Further discussion was undertaken on what additional structural changes to the bat house could be undertaken to increase the internal temperature. Consultation was also undertaken with the Vincent Wildlife Trust and a question was posted on the UK Bat Workers Facebook Page to seek guidance in relation to whiskered bat roost design. However, little information was available for this bat species.

The original design of the internal space was to keep the loft open to the ground floor in order to increase the volume of the bat house and therefore make it more suitable for brown long-eared bats. However, in hind sight, this increased volume meant that the limited solar radiation has a greater volume to heat within the bat house on a daily basis. Therefore, the decision was made to alter the existing 2/3 floor area of loft in order to create a separate loft space from the ground floor by adding a full floor across the loft (with a open trap door entrance to allow bats to fly between the ground floor room and new loft room (opening = 500mm by 500m). The underside of this new floor was also to be insulated to ensure that any warm air was trapped within the loft space for a longer period in the 24 hour cycle.

3.1.3 Monitoring Period 3 – Bective Bat House

Monitoring Period 3 refers to information gathered up to the 31st August 2022 (post installation of new loft floor and additional insulation of the underside of the new loft floor) to 6th October 2022 (n=37 days).

3.1.3.1 Loft Floor Installation

The loft floor was installed on 31st August 2022. This consisted of a full floor, insulated on the underside and a entrance hole (with trip boards) of 500mm square. A ladder is required to access the loft space from the ground floor.

Plate 4: New insulated loft floor – showing underside of loft floor.

3.1.3.2 Temperature Data Logger

Temperature data loggers continued to be located inside the whiskered bat roost (loft space of stable courtyard), loft space of the bat house and inside the hot box (bat house) to monitor temperature hourly from 31st August to 6th October 2022.

The graph below displays the temperature data collected. The average daily maximum temperature for this monitoring period in the Whiskered Bat Roost (stable courtyard loft – Bective Courtyard) was 17.2 ºC with a range of 13.1 to 21.7 ºC. In comparison, the average daily maximum temperature for the same period for the Bat House (general attic space) was 15.3 ºC with a range of 11.9 to 17.9 ºC. In relation to the hotbox, the average daily maximum temperature for the same period was 15.7 ºC with a range of 12.3 to 18.6 ºC. Therefore the maximum daily temperature in the Bective Bat House is on average 1.5 ºC cooler that the Whiskered Bat Roost. Comparing this to the average temperatures recorded in Monitoring Period 1, there is a less temperature difference between the Whiskered Bat Roost and the Bat House as a result of the works undertaken.

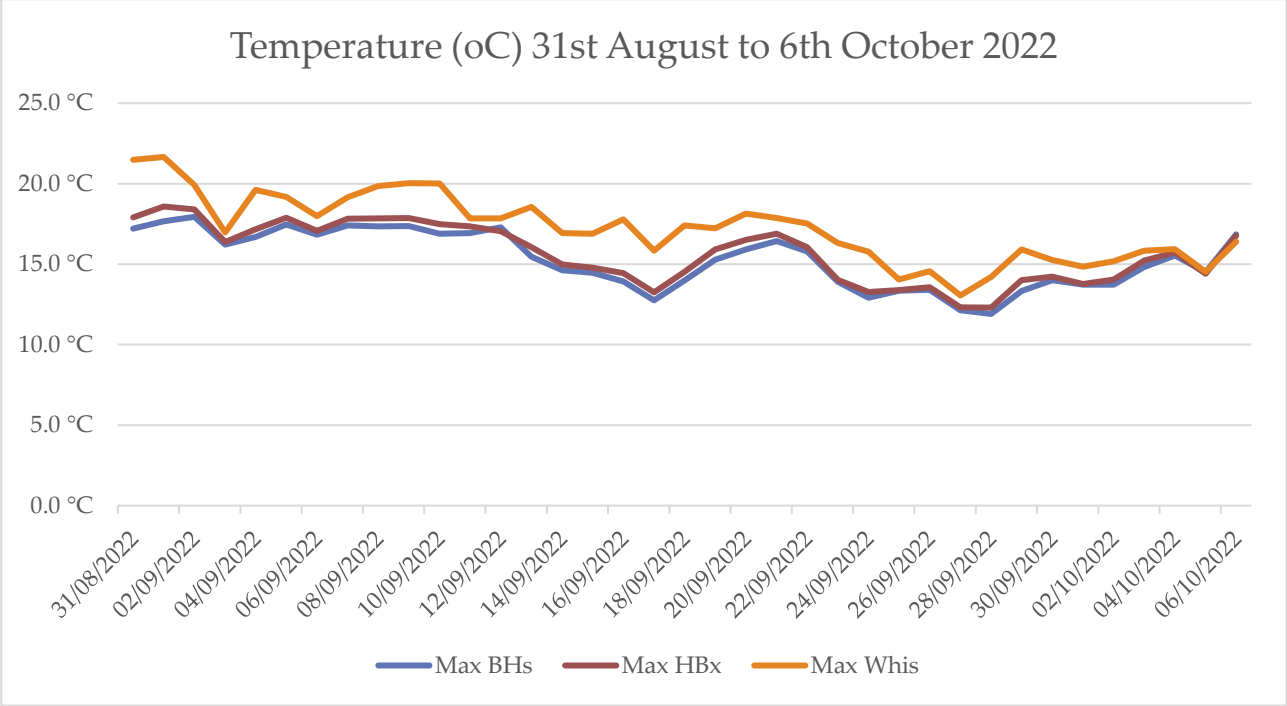


Figure 4: Daily maximum temperature recorded in the stable courtyard loft of Bective Courtyard (Whiskered Roost) and Bective Bat House from 11/7/2022 to 28/7/2022.

3.1.4 Monitoring Period 4 – Bective Bat House

Monitoring Period 4 refers to information gathered in 2023.

3.1.4.1 Bat House Daytime Inspection

The bat house was inspected during the daytime for evidence of bat usage on 5th February 2023. A small number of brown long-eared bat droppings and potential Whiskered bat droppings were recorded in the bat house. The bat tubes within the external walls of the bat house were also inspected using a torch and mirror and a single brown long-eared bat (in torpor) and a single soprano pipistrelle (in semi-torpor) were recorded in two separate bat tubes.

3.1.4.2 Static Surveillance

A static unit was placed inside the loft of the bat house from 25th January to 5th February (11 nights). During this surveillance period, one Whiskered bat call was recorded on 25th January 2023 at 18:45 hrs and maybe indicative of a bat roosting in the bat house. In relation to brown long-eared bats, the second target bat species, a greater level of activity for this species was noted. Two calls were recorded on the 25th January 2023 and these were at 18:34 hrs and 18:47 hrs. On the 2nd February 2023, 14 brown long-eared bat calls were recorded from 02:58 hrs to 03:05 hrs. On the 4th February 2023, 4 brown long-eared bat calls were recorded at 19:52 hrs to 20:14 hrs.

A static unit was place inside the loft of the bat house again from 20th March to 20th April (30 nights). During this surveillance period, a total of five Whiskered bat call were recorded on the following dates: 8th April (22:57hrs), 18th April (23:57 hrs) and 19th April (22:11 hrs, 23:29 hrs and 23:45 hrs). In relation to brown long-eared bats, the second target bat species, a greater level of activity for this species was noted: a total of 24 calls were recorded. The time stamp of each of these calls is present in the table below.

Table 1: Brown long-eared bat calls recorded during March/April 2023 Static Surveillance of bat house.

DATE	TIME (24hr)	MANUAL ID
29/03/2023	00:28:16	Plecotus auritus
03/04/2023	04:53:43	Plecotus auritus
05/04/2023	23:21:53	Plecotus auritus
09/04/2023	01:02:26	Plecotus auritus
17/04/2023	23:24:06	Plecotus auritus
18/04/2023	22:31:16	Plecotus auritus
18/04/2023	23:27:17	Plecotus auritus
18/04/2023	22:31:33	Plecotus auritus
18/04/2023	23:15:52	Plecotus auritus
18/04/2023	22:31:50	Plecotus auritus
18/04/2023	23:26:54	Plecotus auritus
18/04/2023	22:30:39	Plecotus auritus
19/04/2023	01:16:10	Plecotus auritus
19/04/2023	01:15:04	Plecotus auritus
19/04/2023	01:21:02	Plecotus auritus
19/04/2023	02:14:10	Plecotus auritus
19/04/2023	00:38:23	Plecotus auritus
19/04/2023	22:33:48	Plecotus auritus
20/04/2023	00:19:39	Plecotus auritus
20/04/2023	00:18:36	Plecotus auritus
20/04/2023	00:21:19	Plecotus auritus
20/04/2023	00:21:24	Plecotus auritus
20/04/2023	00:19:54	Plecotus auritus
20/04/2023	00:19:46	Plecotus auritus

A static unit was place inside the loft of the bat house again from 15th May to 11th June and 21st June to 7th August 2023. During this surveillance period, a total of 76 Whiskered bat calls were recorded. The time stamp of each of these calls is present in the table below. Additional audio recordings of brown long-eared bats were also recorded and are presented in Table 3.

Table 2: Whiskered bat calls recorded during May to August 2023 Static Surveillance of bat house.

DATE	TIME	MANUAL ID		DATE	TIME	MANUAL ID
15/05/2023	23:23:24	Myotis mystacinus		**30/06/2023**	03:14:07	Myotis mystacinus
15/05/2023	22:54:38	Myotis mystacinus		**30/06/2023**	03:16:15	Myotis mystacinus
18/05/2023	00:09:21	Myotis mystacinus		**30/06/2023**	03:16:20	Myotis mystacinus
19/05/2023	01:01:38	Myotis mystacinus		**30/06/2023**	03:16:26	Myotis mystacinus
26/05/2023	01:15:40	Myotis mystacinus		**30/06/2023**	03:18:15	Myotis mystacinus
28/05/2023	22:54:22	Myotis mystacinus		**30/06/2023**	03:18:30	Myotis mystacinus
28/05/2023	01:05:52	Myotis mystacinus		**30/06/2023**	03:16:53	Myotis mystacinus
29/05/2023	01:19:16	Myotis mystacinus		**30/06/2023**	03:18:42	Myotis mystacinus
04/06/2023	23:52:35	Myotis mystacinus		**03/07/2023**	02:30:17	Myotis mystacinus
05/06/2023	23:09:07	Myotis mystacinus		**03/07/2023**	01:58:59	Myotis mystacinus
07/06/2023	00:46:24	Myotis mystacinus		**03/07/2023**	02:57:05	Myotis mystacinus
07/06/2023	00:45:56	Myotis mystacinus		**03/07/2023**	02:56:52	Myotis mystacinus
07/06/2023	00:26:16	Myotis mystacinus		**03/07/2023**	02:57:14	Myotis mystacinus
07/06/2023	00:45:26	Myotis mystacinus		**03/07/2023**	02:04:00	Myotis mystacinus

07/06/2023	01:18:18	Myotis mystacinus		**04/07/2023**	02:25:24	Myotis mystacinus
07/06/2023	01:42:57	Myotis mystacinus		**04/07/2023**	02:32:04	Myotis mystacinus
07/06/2023	02:14:06	Myotis mystacinus		**05/07/2023**	01:25:02	Myotis mystacinus
07/06/2023	00:48:06	Myotis mystacinus		**05/07/2023**	02:26:39	Myotis mystacinus
08/06/2023	00:32:41	Myotis mystacinus		**10/07/2023**	02:28:11	Myotis mystacinus
11/06/2023	23:30:16	Myotis mystacinus		**11/07/2023**	02:37:46	Myotis mystacinus
11/06/2023	02:42:48	Myotis mystacinus		**14/07/2023**	02:09:35	Myotis mystacinus
21/06/2023	00:27:59	Myotis mystacinus		**14/07/2023**	00:31:26	Myotis mystacinus
21/06/2023	00:27:43	Myotis mystacinus		**14/07/2023**	02:32:59	Myotis mystacinus
21/06/2023	02:48:59	Myotis mystacinus		**15/07/2023**	03:55:45	Myotis mystacinus
25/06/2023	02:38:38	Myotis mystacinus		**16/07/2023**	02:38:53	Myotis mystacinus
25/06/2023	02:37:42	Myotis mystacinus		**16/07/2023**	02:39:04	Myotis mystacinus
25/06/2023	02:05:37	Myotis mystacinus		**16/07/2023**	02:38:32	Myotis mystacinus
25/06/2023	02:38:00	Myotis mystacinus		**16/07/2023**	02:39:10	Myotis mystacinus
25/06/2023	02:38:17	Myotis mystacinus		**16/07/2023**	23:26:18	Myotis mystacinus
25/06/2023	02:46:49	Myotis mystacinus		**18/07/2023**	02:58:40	Myotis mystacinus
25/06/2023	02:46:42	Myotis mystacinus		**18/07/2023**	03:26:48	Myotis mystacinus
25/06/2023	02:46:27	Myotis mystacinus		**18/07/2023**	03:26:55	Myotis mystacinus
25/06/2023	02:46:09	Myotis mystacinus		**18/07/2023**	03:33:15	Myotis mystacinus
30/06/2023	03:13:39	Myotis mystacinus		**19/07/2023**	01:42:12	Myotis mystacinus
30/06/2023	03:16:34	Myotis mystacinus		**19/07/2023**	02:04:48	Myotis mystacinus
30/06/2023	03:17:44	Myotis mystacinus		**25/07/2023**	01:09:38	Myotis mystacinus
30/06/2023	03:15:23	Myotis mystacinus		**03/08/2023**	22:58:28	Myotis mystacinus
30/06/2023	03:06:45	Myotis mystacinus		**07/08/2023**	00:53:58	Myotis mystacinus

Table 3: Brown long-eared bat calls recorded during May to August 2023 Static Surveillance of bat house.

DATE	TIME	MANUAL ID
07/06/2023	00:47:22	Plecotus auritus
14/06/2023	02:24:52	Plecotus auritus
25/06/2023	02:39:11	Plecotus auritus
30/06/2023	03:17:27	Plecotus auritus
30/06/2023	03:17:06	Plecotus auritus
05/07/2023	03:09:56	Plecotus auritus
05/07/2023	00:58:29	Plecotus auritus
13/07/2023	22:29:01	Plecotus auritus
16/07/2023	02:37:03	Plecotus auritus
16/07/2023	02:38:43	Plecotus auritus
18/07/2023	03:37:58	Plecotus auritus
30/07/2023	03:25:39	Plecotus auritus

3.1.4.3 Temperature Data Logger

Temperature data loggers continued to be located inside the loft space of the bat house and inside the hot box (bat house) while a third unit was located within the ground floor of the bat house to monitor temperature hourly from 26th January to 22nd August 2023. The temperature records are presented on the graph below. The daily maximum temperature for the ground floor of the bat house was consistently lower that the temperatures within the loft and hotbox of the bat house. Therefore the new “full” floor was ensuring that there was a higher temperature in the loft space.

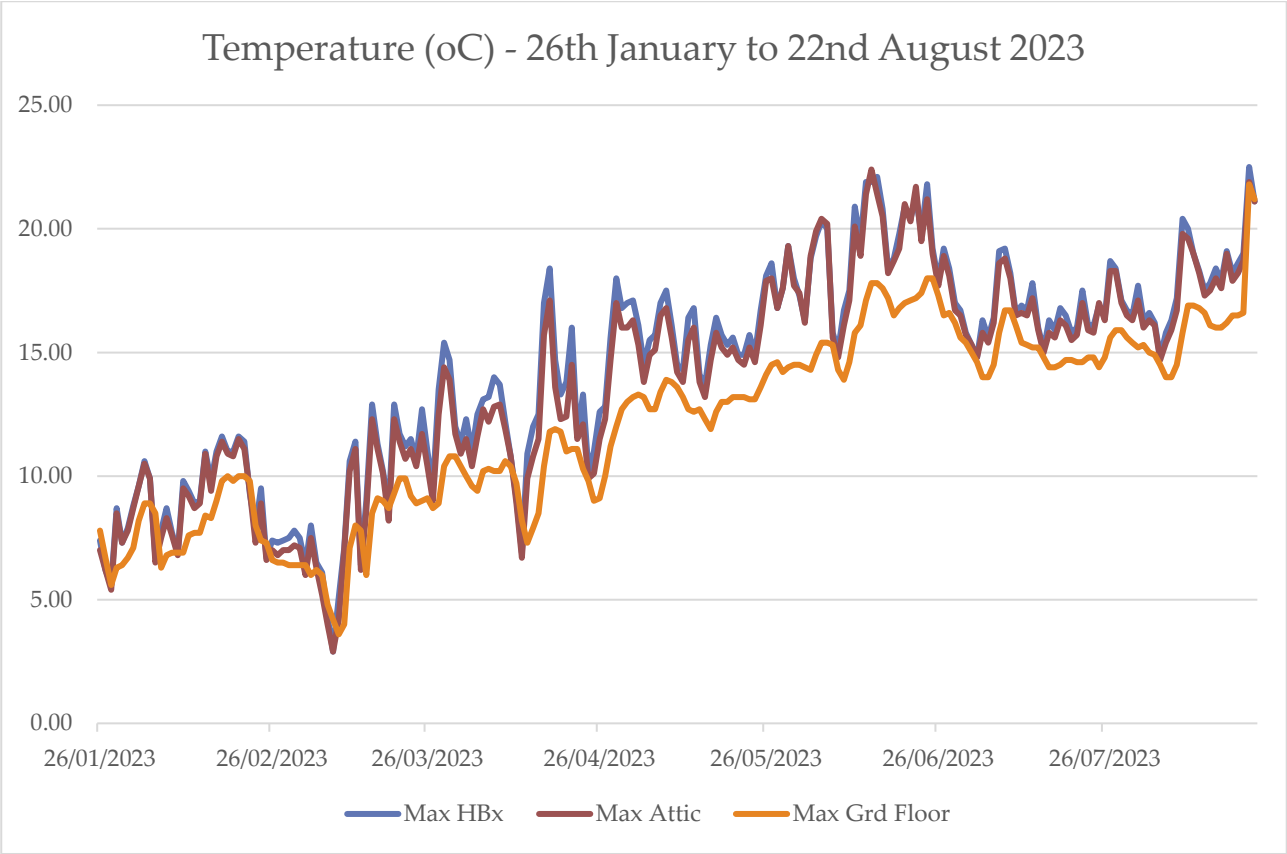


Figure 5: Daily maximum temperature recorded in Bective Bat House from 26th January to 22nd August 2023.

The temperature data was extracted for the period of 15th May to 22nd August 2023 to coincide with summer static surveillance and the dusk emergence survey. The average daily maximum temperature for the same period for the Bat House (loft) was 17.41 ºC with a range of 13.2 to 22.4 ºC. In relation to the hotbox, the average daily maximum temperature for the same period was 17.41 ºC with a range of 13.7 to 22.5 ºC. The average daily maximum temperature for the same period for the ground floor room of the Bat House was 15.4 ºC with a range of 11.9 to 21.8 ºC.

3.1.4.4 Dusk Emergence Survey 2023

A dusk emergence survey of the bat house was undertaken on 22nd August 2023. Thermal imagery scopes were set up to record potentially emerging bats to the rear and to the front of the bat house while surveyors were positioned on either side of the bat house. This ensured that all walls of the bat house were covered. This filming was coupled with the use of full spectrum bat detectors (Anabat Scout and Bat Logger M2).

During this survey the following results were recorded:

- Three whiskered bats were confirmed emerging from the eaves of the bat house at 21:21 hrs, 21:30 hrs and 21:38 hrs.
- Six brown long-eared bats were confirmed emerging from the eaves (5 individuals) and one from a bat tube (rear wall of bat house) at 21:01 hrs, 21:02 hrs, 21:04 hrs (2 individuals), 21:07 hrs and 21:11 hrs.
- 10 soprano pipistrelles were recorded emerging from the bat tube located on the front wall of the bat house (Plate 5a) while one additional individual was recorded emerging from a bat tube located on the rear wall of the bat house.

Plate 5a: Soprano pipistrelle emerging from bat tube (front of bat house).

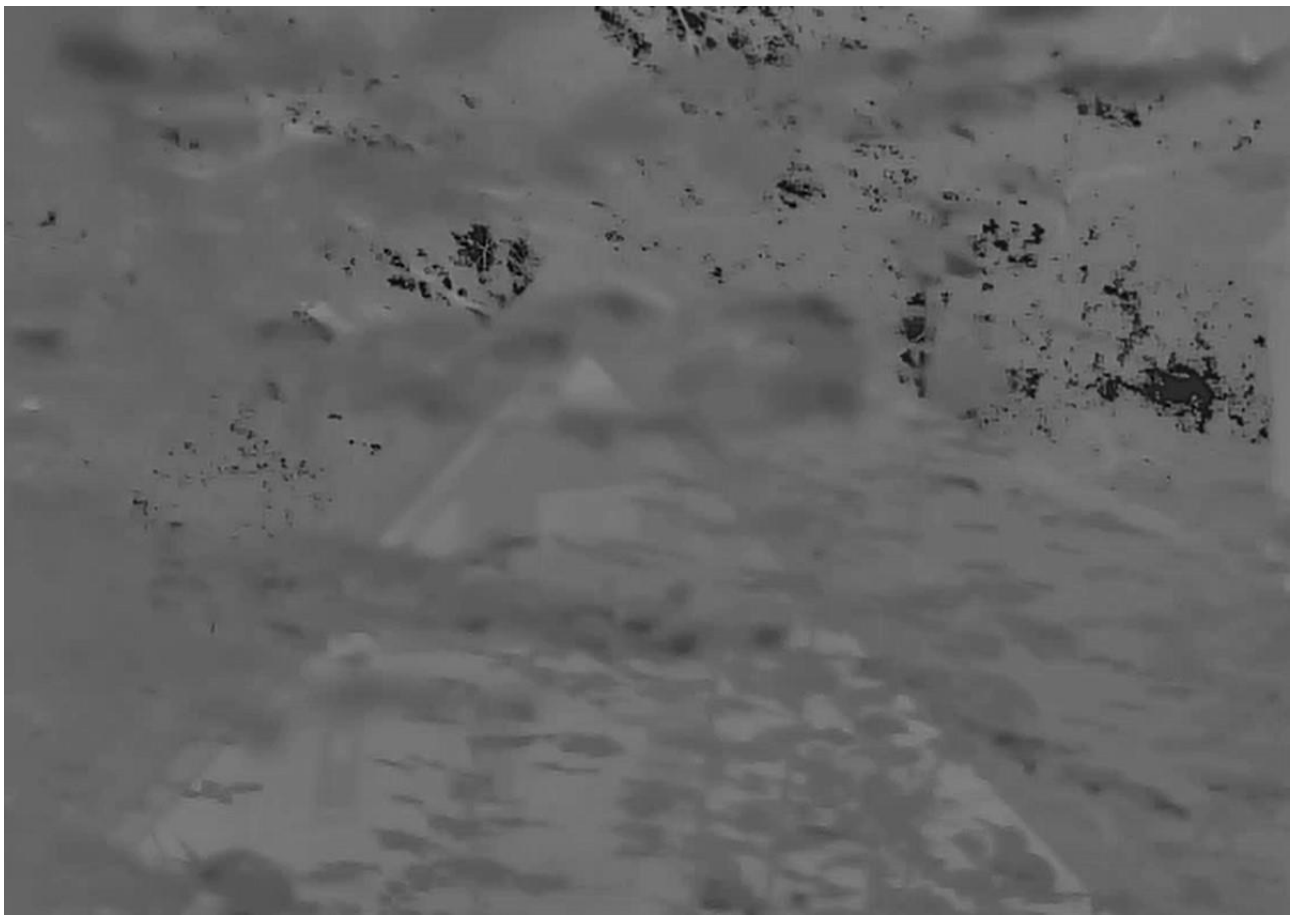


Plate 5b: Thermal imagery film screenshot of rear of bat house (greater degree of leaf foliage present).

Therefore a total of three whiskered bats, six brown long-eared bats and 11 soprano pipistrelles were recorded roosting in the bat house on the 22nd August 2023.

3.2 Bective House & Stable Courtyard 2022 & 2023

The following details dusk emergence surveys undertaken primarily in relation to the Whiskered bat roost in the loft of the stable courtyard building and the Brown long-eared bat roost recorded in section of building that joins Bective House and Bective Courtyard.

3.2.1 Summer Roost Surveys 2022

As part of on-going bat mitigation measures monitoring a number of surveys were completed in 2022 in relation to the two roosts recorded in this area:

- Whiskered bat maternity roost
- Brown long-eared maternity roost

3.2.1.1 Dusk Survey 29th July 2022

Weather Conditions: Full cloud cover, 15ºC, dry and calm.

- Whiskered bat maternity roost

Results: 13 whiskered bat were recorded emerging from the loft room.

- Brown long-eared maternity roost

Results: 10 brown long-eared bats were recorded entering the room with the attic hatch, some of which did not emerge directly from the hatch opening in the ceiling. However, an additional opening in the attic was recorded in a second room with brown long-eared droppings present on the floor below the opening. Therefore it is likely the bats are also emerging from this point too.

During this survey, seven soprano pipistrelles were also recorded roosting between the window pane and ply wood sheeting located in the room where brown long-eared bats were recorded emerging from the attic space. A collection of bat droppings was also noted in this tight space indicating that the bats roost here regularly. This additional bat roosting information will inform bat mitigation steps required in relation to proposed development works.

Plate 6: Soprano pipistrelles roosting between window pane and ply wood sheeting

3.2.1.2 Dusk Bat Survey 1st September 2022

Weather Conditions: Clear sky, 15ºC, dry and calm.

- Whiskered bat maternity roost

Results: 11 whiskered bat were recorded emerging from the loft room.

- Brown long-eared maternity roost

The surveyor was located along the corridor adjacent to the room with attic hatch previously recorded as the brown long-eared exit point. The camcorder was also located in the corridor to capture, on film, potential emerging brown long-eared bats from numerous rooms along the corridor with access points to attic. A total of 6 brown long-eared bats were recorded flying along the corridor and travelling into an adjacent room and/or down corridor in the main house to exit the structures.

In addition, a single bat (likely to be a *Pipistrellus* species) was recorded emerging from timber frame around the doorway.

Plate 7: Bat emerging from timber door frame during filming – Red Circle.

3.2.2 Summer Roost Surveys 2023

As part of on-going bat mitigation measures monitoring a number of surveys were completed in 2023 in relation to the two roosts recorded in this area:

- Whiskered bat maternity roost
- Brown long-eared maternity roost
- General area of Bective House and Bective Courtyard

3.2.2.1 Dusk Survey 15th May 2023

Weather Conditions: Clear sky, 14ºC, dry and calm.

- Whiskered bat maternity roost

Results: 6 whiskered bat were recorded emerging from the loft room (windows as per Plate 8). No bats were recorded emerging from the gaps in the slates of the roof (as per image – Plate 10.

- Brown long-eared maternity roost

Results: A total of three brown long-eared bats were recorded at any one time in the room. The bats, as per other years of surveys, did not emerge from the loft of the room previously recorded as a brown long-eared bat maternity roost. Instead, the bats entered the room from the adjacent corridor and therefore it was not possible to determine the number of brown long-eared bats present. The activity levels were as follows: 15 sightings of bats entering the loft, 16 sightings of bats exiting the loft.

Plate 8: Thermal imagery filming of access points to loft room (two windows on the 1st floor) of stable courtyard (i.e. Whiskered bat roost)

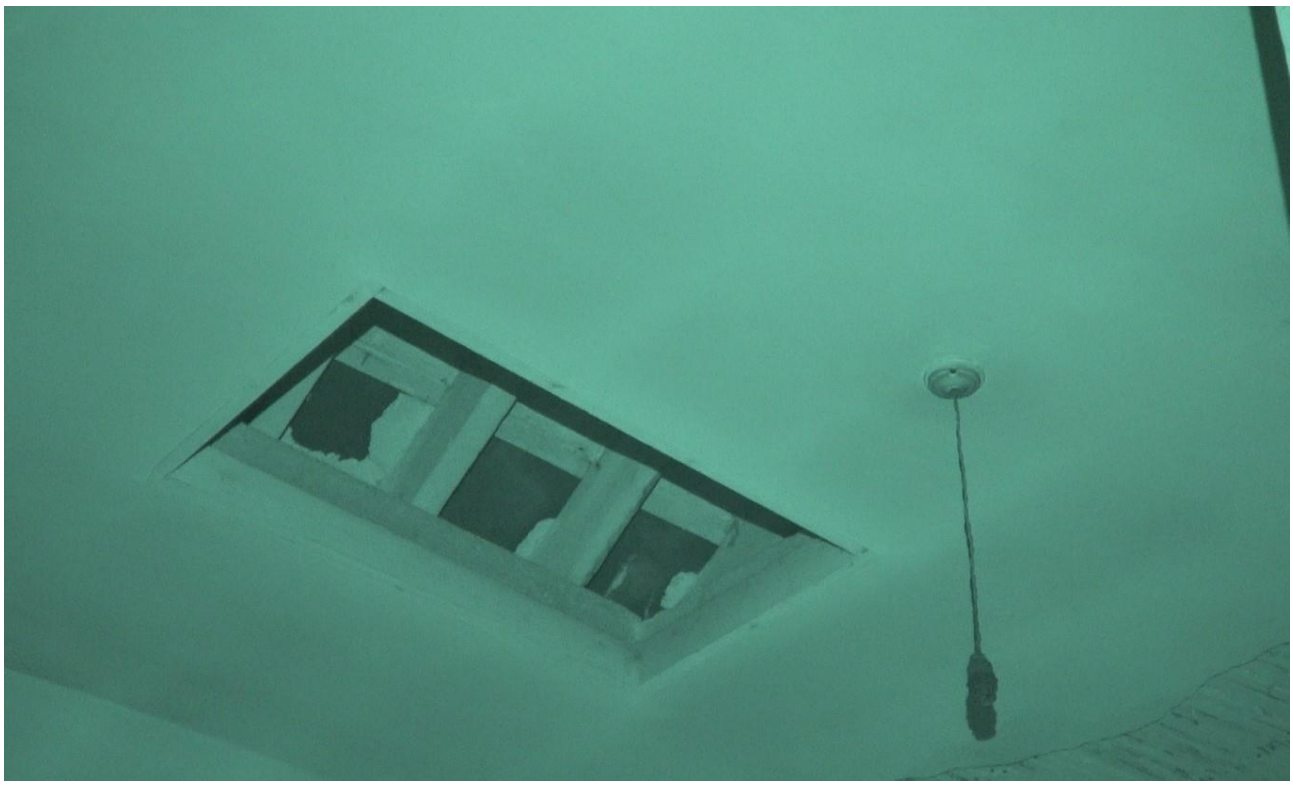


Plate 9: Image of loft entrance where brown long-eared bat activity was recorded using IR filming.

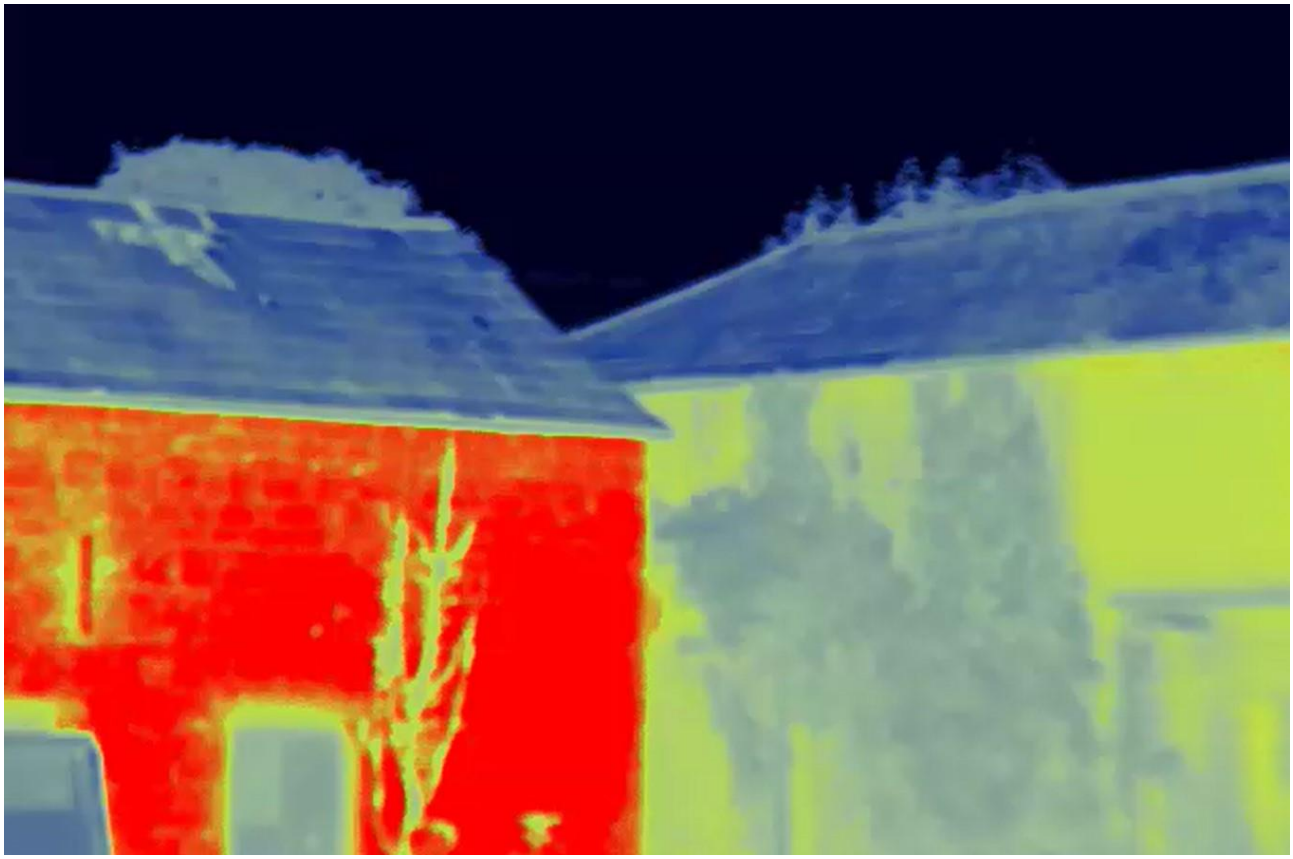


Plate 10: Additional thermal imagery filming of the rear section of stable courtyard building to determine if bats were exiting from the gaps in the slates of the roof – building to right hand-side of screen shot.

3.2.2.2 Dusk Survey 12th August 2023

Weather Conditions: Full cloud cover, 18ºC, dry and calm.

This survey was undertaken with the support of three surveyors from VEON. VEON surveyors were located around the external sections of Bective House while the author was located within the courtyard. Thermal imagery scopes were position as shown in screenshots while the IR camera was located in the corridor outside the room with the loft entrance previously recorded as a brown long-eared maternity roost.

- Whiskered bat maternity roost

Results: 6 whiskered bat were recorded emerging from the loft room, with the first whiskered bat emerging at 21:42 hrs. An additional 3 soprano pipistrelles were recorded emerging from the loft prior to the whiskered bats and a 4th soprano pipistrelle was recorded emerging from open first floor window of Bective House.

- Brown long-eared maternity roost

Results: as per May survey, brown long-eared bat activity consisted of individual bats flying along the corridor towards the loft room and a small number of bats exiting the loft room, indicating emerging bats. A total of five brown long-eared bats potentially emerged from the loft room.

- Bective House & Courtyard

A low level of bat activity was recorded by the VEON team during the survey. Three bat species were recorded: Leisler's bat, soprano pipistrelle and common pipistrelle. Leisler's bats were recorded from 21:11 hrs commuting through the survey area. The first soprano pipistrelle was recorded at 21:37 hrs and this coincided with an individual bat recorded emerging from Bective House (See Plate 10). Common pipistrelles were occasionally recorded from 21:38 hrs but these were generally commuting individuals.

Plate 11: Thermal imagery filming of front of Bective House.

Plate 12: Thermal imagery filming of rear of Bective House. Red circle – window (exit point).

Therefore a total of 6 whiskered bats, five brown long-eared bats and 4 soprano pipistrelles were recorded roosting in Bective House and Courtyard on the 12th August 2023. This is a reduction of bat usage compared to previous survey years.

3.3 Bat Box Inspections

A bat box inspection was undertaken on 19th March 2023. Of the 19 bat boxes checked, eight had evidence of bat usage. The bat species primarily using the bat boxes are Leisler's bats (Plate 13). The results of this inspection is present in Table 4.

Plate 13: Two Leisler's bats recorded roosting in a bat box during inspection.

Table 4: Results of bat box inspections completed on 19th March 2023.

No.	Tree Number	Tree Species	Location	Bat Box Type	ITM Easting	ITM Northing	Aspect	19/03/2023
1	99	Beech	Site A - adjacent to river, public road side	Green Vivara	685769	760988	NW	No bat evidence
2	98	Beech	Site A - adjacent to river, public road side	Brown Vivara	685769	760988	SE	x1 Leisler's bat, 1cm droppings, bird poo
3	95	Beech	Site A - adjacent to river, public road side	Small Grey Vivara	685170	760979	S	Small no. of bat droppings
4	97	Beech	Site A - adjacent to river, public road side	Brown Vivara	685759	760979	S	No bat evidence, bird poo
5	96	Beech	Site A - adjacent to river, public road side	Small Grey Vivara	685764	760956	SE	No bat evidence
6	94	Beech	Site A - adjacent to river, public road side	Small Grey Vivara	685663	760857	SW	No bat evidence, bird poo
7	93	Beech	Site A - adjacent to river, public road side	Small Grey Vivara	685649	760844	SW	No bat evidence, bird poo
8	92	Beech	Site A - adjacent to river, public road side	Green Vivara	685651	760844	NW	No bat evidence
9	91	Beech	Site B - Gate Lodge	Small Grey Vivara x2	685447	760515	S	No bat evidence
10	90	Beech	Site B - Gate Lodge	Brown Vivara	685452	760514	S	x2 Leisler's bats, 1cm bat droppings, bird poo
11	89	Beech	Site B - Gate Lodge	Brown Vivara	685450	760520	E	2cm of Leisler's bat droppings, bird poo
12	88	Beech	Site C - Along Avenue (LHS)	Small Grey Vuvara x2	685508	760570	E	No bat evidence
13	87	Beech	Site C - Along Avenue (LHS)	Brown Vivara	685574	760621	W	2cm of Leisler's bat droppings, bird poo
14	86	Beech	Site C - Along Avenue (LHS)	Brown Vivara	685602	760666	E	3cm of Leisler's bat droppings, bird poo
15	85	Beech	Site C - Along Avenue (LHS)	Green Vivara	685611	760681	E	No bat evidence
16	84	Beech	Site C - Along Avenue (RHS)	Brown Vivara	685681	760674		2cm of Leisler's bat droppings, bird poo
17	83	Beech	Site C - Along Avenue (RHS)	Brown Vivara	685688	760667	S	1cm of Leisler's bat droppings, bird poo
18	82	Beech	Site C - Along Avenue (RHS)	Small Grey Vivara x2	685749	760768	S	No bat evidence

19	81	Beech	Site C - Along Avenue (RHS)	Green Vivara	685741	760777	S	No bat evidence
20	No tag	Beech	Bat House Site	Miramare	685959	761228	W	Too high to check with ladder & torch
21	No tag	Beech	Bective House Site - LHS	Miramare	686448	761445	S	Too high to check with ladder & torch
22	No tag	Beech	Bective House Site - RHS	Miramare	686454	761412	S	Too high to check with ladder & torch
23	No tag	Beech	Bective House Site - RHS	Miramare	686452	761404	NW	Too high to check with ladder & torch

4. Discussion

The primary purpose of the Bective Bat House is to provide alternative roosting for two bat species: whiskered bat and brown long-eared bat. These are the two bat species most likely to be impacted by the proposed development of Bective House and Courtyard. Construction of the Bective Bat House was completed in February 2022. At least two years of monitoring is required as per Figure 20 of Marnell *et al.* (2022) (See Appendix for table) for alternative roosts of rarer bat species. Monitoring of the bat roost was started in December 2021.

Monitoring in 2022 of the bat house informed the author that structural changes were required to the bat house, post construction, to improve the internal space for roosting bats. Such structural changes were undertaken at the end of the summer of 2022 and therefore additional monitoring was required in 2023. Bat activity was recorded, as a consequence of these changes, in 2023 three species of bat was confirmed to be roosting in the bat house and bat tubes of the bat house: whiskered bat, brown long-eared bat and soprano pipistrelles.

Bat usage of the two known maternity roosts in 2022 were similarly to those results report by Bat Eco Services (2020). However, surveys in 2023 documented a reduction in the bat usage of Bective House and Courtyard. This may be due to the continued derelict state of the buildings and/or the suitable provision of roosting in the bat house.

A total of three whiskered bats, six brown long-eared bats and 11 soprano pipistrelles were recorded roosting in the bat house on the 22nd August 2023. A total of 6 whiskered bats, five brown long-eared bats and 4 soprano pipistrelles were recorded roosting in Bective House and Courtyard on the 12th August 2023. Therefore the potential total number of bats recorded in the two locations are as follows: 9 whiskered bats, 11 brown long-eared bats and 15 soprano pipistrelles. In 2022, the highest number of individuals recorded for each species in Bective House and Courtyard were as follows: 13 whiskered bats, 10 brown long-eared bats and 7 soprano pipistrelles. Therefore it is likely that the whiskered bat, brown long-eared bat and soprano pipistrelle populations have spilt between the two locations.

This bat usage of the bat house also coincides with a reduction in bat usage of Bective House and Bective Courtyard buildings, thereby confirming that the bat house is an alternative roosting site to existing bat roosts recorded during the primary bat surveys reported by Bat Eco Services (2020).

The bat box scheme is also successfully providing alternative roosting for Leisler's bats, a species that maybe primarily impacted on tree felling works undertaken in the survey area (Please note: supervision of such tree felling works was undertaken by the author and mitigation measures presented in Bat Eco Services (2020) were followed).

5. Conclusions

Monitoring of the bat usage of the bat house confirms that it is a suitable alternative roosting site to existing bat roosts recorded during the primary bat surveys reported by Bat Eco Services (2020). Therefore the bat house will provide alternative roosting for three bat species, the primary bat species recorded roosting in Bective House and Courtyard: whiskered bat, brown long-eared bat and soprano pipistrelle. This will ensure that there is roosting provision during and post development works of Bective House and Courtyard.

The bat box scheme is also successfully providing alternative roosting for Leisler's bats, a species that maybe primarily impacted on tree felling works undertaken in the survey area.

Due to the transient nature of bats, it is essential that additional bat mitigation measures detailed in Bat Eco Services (2020) are following in the treatment of bats during the development of Bective House and Courtyard to ensure that no bats are harmed during the works.

6. Bibliography

Bat Eco Services (2020) Bat assessment of proposed development at Bective Demesne, Bective, Co. Meath. Unpublished report prepared for John Fleming Architects.

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Schofield, H. (2008). *The Lesser Horseshoe Bat Conservation Handbook*. Herefordshire, England: The Vincent Wildlife Trust.

7. Appendices

7.1 Appendix 1 Figure 20 (Marnell *et al.*, 2022)

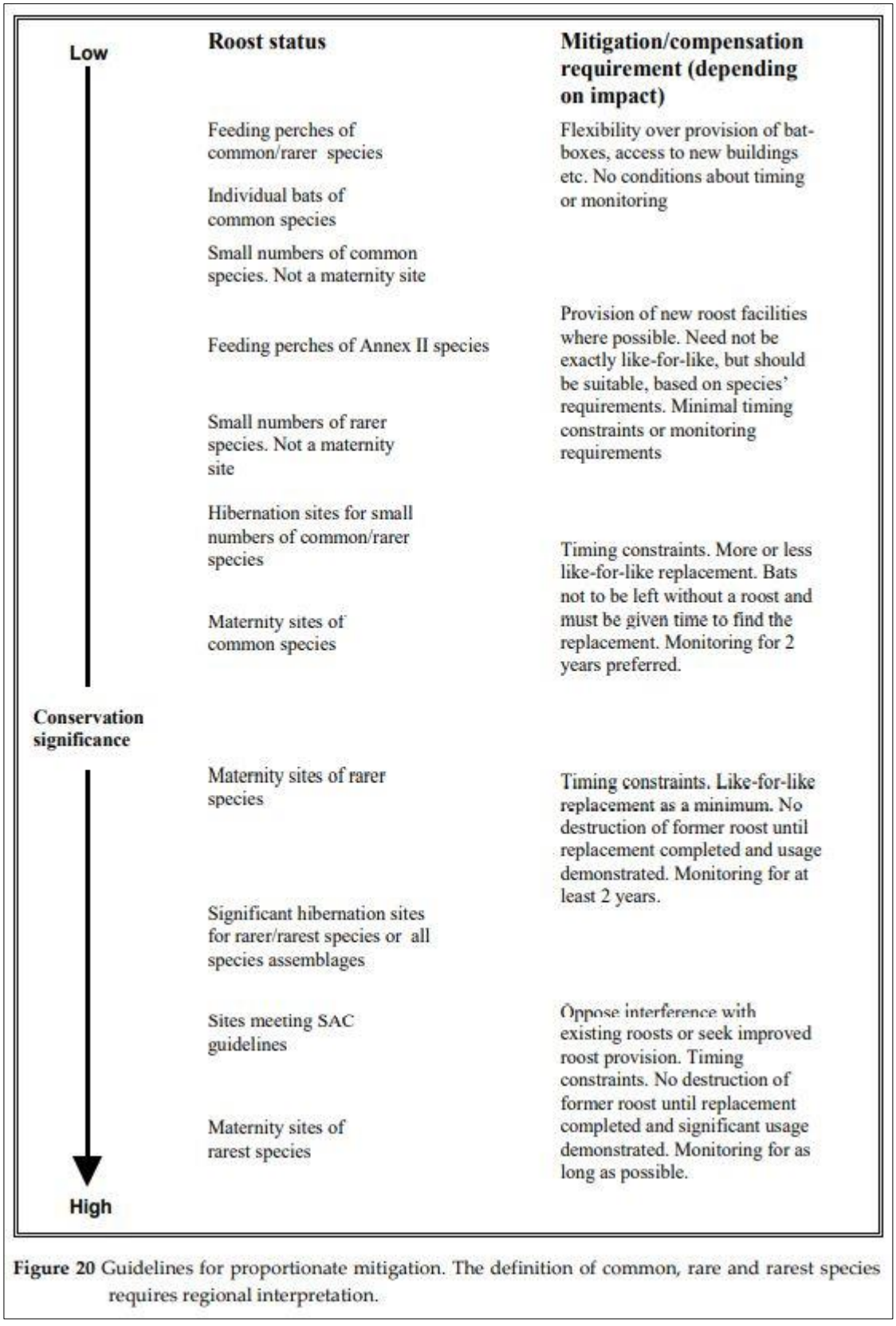

Figure 20 Guidelines for proportionate mitigation. The definition of common, rare and rarest species requires regional interpretation.

Figure A: Figure 20 (p 46) Reproduced from Marnell *et al.* (2022).