

Wild Wings Ecology

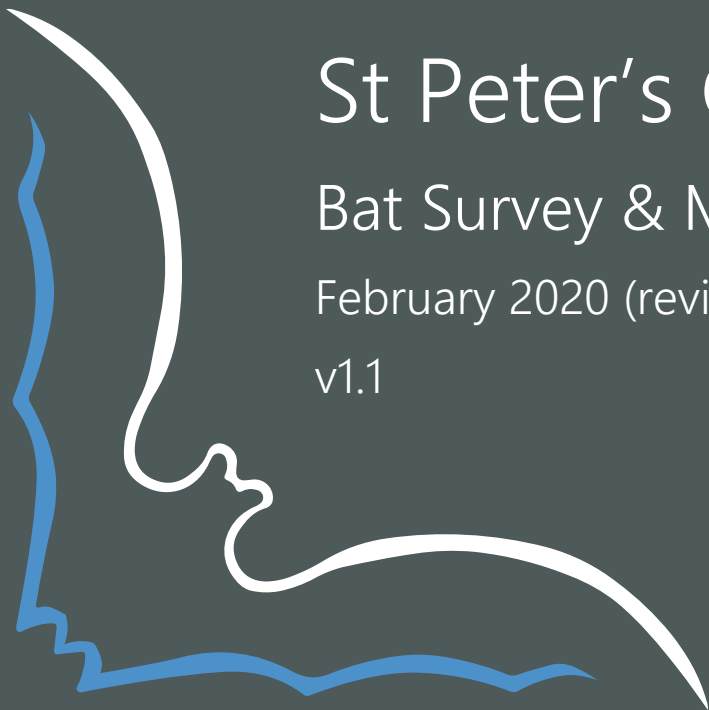


Bats in Churches Project: St Peter's Church, Guestwick

Bat Survey & Management Plan Report

February 2020 (revised v1.1 June 2020)

v1.1



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Document type	Bats in Churches Project – Bat Survey & Management Plan Report
Version	1.1
Author	Dr Charlotte Packman PhD CEcol MCIEEM
Client	Natural England
Site address	St Peter's Church, Wood Dalling Road, Guestwick, Dereham, Norfolk, NR20 5QJ.
Site grid reference	TG 06115 27048
Survey period	May – August 2019
Report date	7 th February 2020, updated 10 th June 2020 (v1.1) with revised Schedule of Works needed due to Covid-19 restrictions

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1. Summary

St Peter's Church Guestwick underwent bat surveys in summer 2019 to inform a proposal for managing the impacts of the bats on the church whilst protecting the church bat populations. This work was undertaken as part of Natural England's Bats in Churches Project (funded by Heritage Lottery Fund).

St Peter's Church is home to a maternity colony of Natterer's bats and possible small maternity colony of common pipistrelles. Soprano pipistrelle, brown long-eared bat and serotine have also been recorded using the church. The church has experienced long-term negative impacts from the presence of bats in the interior of the building, including staining to floors, walls, pews and memorials from bat droppings and urine and the resulting substantial cleaning burden.

The church representatives are keen for the bats to be excluded from the interior of the church and, given the scale of the impacts, this would seem justified providing adequate mitigation and compensation measures can be implemented and carefully monitored to minimise the risks to the bat populations at the church.

The proposed management plan would involve construction of three artificial roosts around existing access points into the church interior: a heated bat box in the north aisle (west end), a heated rafter box in the north aisle (east end) and an unheated rafter box in the south aisle (west end). In Year 1 (2020) these would be installed but not connected up to the entrance points – allowing the bats one season to familiarise themselves with the new roosts whilst still having access to the church interior (thus reducing the risk of desertion and negative impacts on the bat colony). During this time, temporary blocking of the (many) other potential access points along the north and south aisles would be undertaken, along with the installation of several one-way excluders (to prevent potential future issues with bats becoming trapped inside the building). An external bat box would also be erected on a tree in the churchyard. Access to existing exterior roosts (in the church structure but without access to the interior) would be retained (south chancel eaves and possible south nave eaves, west end).

In Year 2 (2021), providing the monitoring results are positive, the interior artificial roosts could be connected-up to the access points, thereby blocking access to the interior whilst providing a variety of roosting spaces.

Natterer's bat colonies at churches in Norfolk appear to have declined in recent years and careful monitoring will be needed to ensure no adverse impacts. Monitoring is also essential to inform future best practice. Monitoring proposed will include: visual inspections, bat activity surveys, infrared roost monitoring cameras and ringing (to allow long-term assessment of how the population is faring).

2. Introduction

2.1. Purpose

Wild Wings Ecology was contracted to undertake bat surveys and produce an ecology report and management plan for Natural England's 'Bats in Churches Project' (funded by Heritage Lottery Fund). The church assessed was St Peter's, Guestwick in Norfolk. This report details the surveys that were undertaken and proposes a management approach to help reduce the impact of the bats on the church whilst minimising risks to the church's bat population.

2.2. St Peter's Church, Guestwick

2.2.1. Location

St Peter's Church is located at Wood Dalling Road, Guestwick, Dereham, Norfolk, NR20 5QJ (grid reference: TG 06115 27048), see Figure 1.

2.2.2. Statement of Significance

Executive Summary of Statement of Significance, written by Richard Halsey (2018):

"Despite a thorough mid-nineteenth century restoration that replaced all the roofs, St Peter's is a complete late-medieval building incorporating a substantial late-eleventh century former central tower. The furnishings of that restoration unusually remain intact, while the principal medieval fixtures and some fragmentary but important c.1450 Norwich stained glass survive too. The fabric is therefore of high architectural, historical, artistic and archaeological significance. The church is also a local landmark and its tower is one of a number that can be seen together across the landscape in this part of Norfolk. Its landscape value is therefore of moderate-high significance.

The main damage to items of heritage significance comes from bats flying around the church and from the maternity roost over the chancel arch. Their impact is being combated by regular cleaning, large plastic sheets in the chancel and the annual cleaning of the walls from a cherry picker. The church walls look clean therefore but the heavily spotted ledgers and furniture demonstrate the problem. The long-term solution can only come from excluding bats from the interior and proposals to persuade the Natterer's bats to roost in external bat boxes should be pursued."

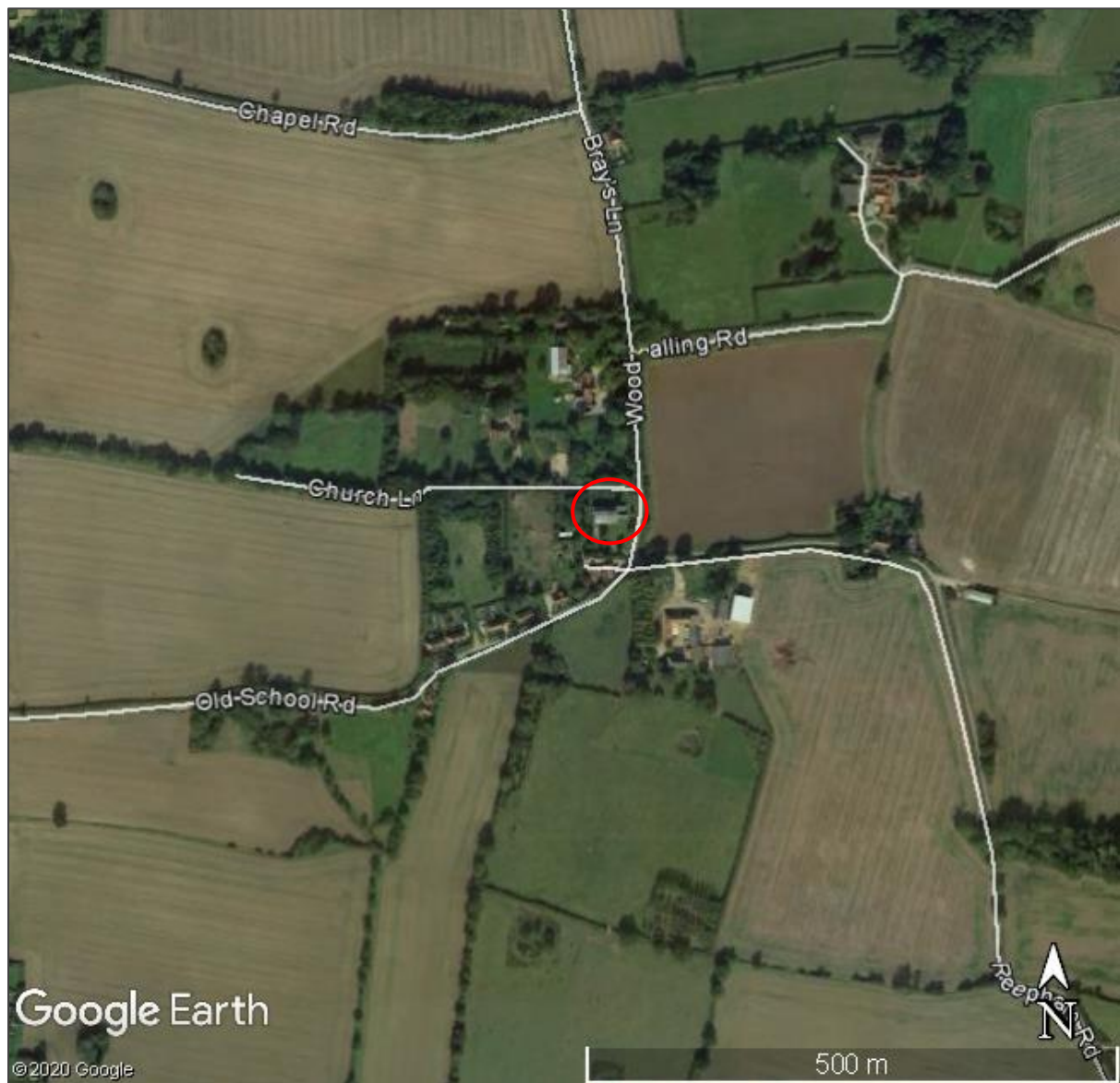


Figure 1. Location of St Peter's Church, Guestwick (circled in red) on Google Earth Pro 2017 aerial image.

2.2.3. History of bat use/previous bat survey work

Guestwick Church has a long involvement in the development of bats in churches management approaches. The church was part of the University of Bristol research projects (Defra-funded 2011-2013 - Zeale *et al.* 2014 and English Heritage-funded 2014 – Packman *et al.* 2015) – which trialled use of acoustic deterrents, both short and longer-term, at the church.

Relevant findings from Defra Research Project: Improving mitigation success where bats occupy houses and historic buildings, particularly churches (Zeale *et al.* 2014):

- Guestwick Church estimated colony size 60-80 Natterer's bats (2011-2013).
- Six adult female Natterer's bats from Guestwick Church were radio-tracked through the night for an average of three nights per bat, giving the following information:
 - Mean home range (100% minimum convex polygon) 758 ha
 - Core foraging area 74 ha
 - Mean maximum range span (mean maximum nightly distance from roost to centroid of cluster core foraging area) 5 km (mean for all eight church sites was 4 km)
 - Some minor overlap in colony home range (100% minimum convex polygon) with the Natterer's bat colony from Wood Dalling Church
 - Preferred habitats were woodland, followed by pasture
 - During the 13-day acoustic deterrent trial (with control, deterrent and post-deterrent periods, 14 bats radio-tagged) there were 12 instances of bats roosting outside of the church, 11 of which were in trees (1 unknown) – none were shared simultaneously by multiple tagged bats and none were considered to be alternative colony roosts
- Short-term acoustic deterrent trials reduced dropping accumulation below the main roost at Guestwick Church to nearly zero.
- For all Natterer's bats radio-tracked at all eight church study sites:
 - Bats roosted almost exclusively in the church buildings
 - Within the churches, bats had numerous roost locations and switched roosts frequently
 - Roosts outside of the church were typically single-occupancy tree roosts
 - Average emergence time was 85 ± 38 minutes after sunset
 - Bats foraged for a total of 373 ± 57 minutes
 - Individual bats were faithful to exclusive foraging patches
 - Bats returned well before sunrise, mean 114 ± 37 minutes before sunrise
 - Bats were rarely recorded night-roosting, with foraging usually in a single session
 - Night-roosting events lasted on average for 27 ± 13 minutes
- The study concluded that Natterer's bats are likely to be highly dependent on the church roosts and if forced out may struggle to find alternative suitable colony roosts.
- Population models suggest that should exclusion/intervention result in even a small reduction in survival rates (e.g. due to becoming energetically stressed) or reduced productivity (perhaps more likely) there would be a declining growth rate for the colony.

- Potential negative impacts of exclusions on the Favourable Conservation Status of church Natterer's bat colonies are highlighted in light of the above two points.

Relevant findings from English Heritage Research Project: Management of bats in churches: a pilot (Packman *et al.* 2015):

- Eleven counts of bats emerging from the church were made between 10th June and 9th September 2014, with numbers ranging from 22 to 57 (mean 41) Natterer's bats, see Figure 2.
- As found by Zeale *et al.* (2015), short-term acoustic deterrent trials were effective in moving the colony from the main/original roost area and preventing dropping deposition at that location.
- During a nine-day spring deterrent trial (with three days each of control, deterrent and post-deterrent periods, eight Natterer's bats radio-tagged) there were 12 instances of a radio-tagged bat roosting outside of the church, of which three were confirmed in trees and one in an uninhabited building (remaining eight unknown) - none of the located roosts were shared simultaneously by multiple tagged bats and none were considered to be alternative colony roosts.
- A longer-term (37-day) trial of acoustic deterrent use at the church successfully moved the Natterer's bats from the chancel arch and south nave (west end) interior roosts to an exterior roost in the south chancel eaves void, see Figures 3 & 4 (without impacting overall numbers roosting at the church) – bringing about an effective reduction of impact (minimal dropping/urine deposition inside the church during the period of the trial).

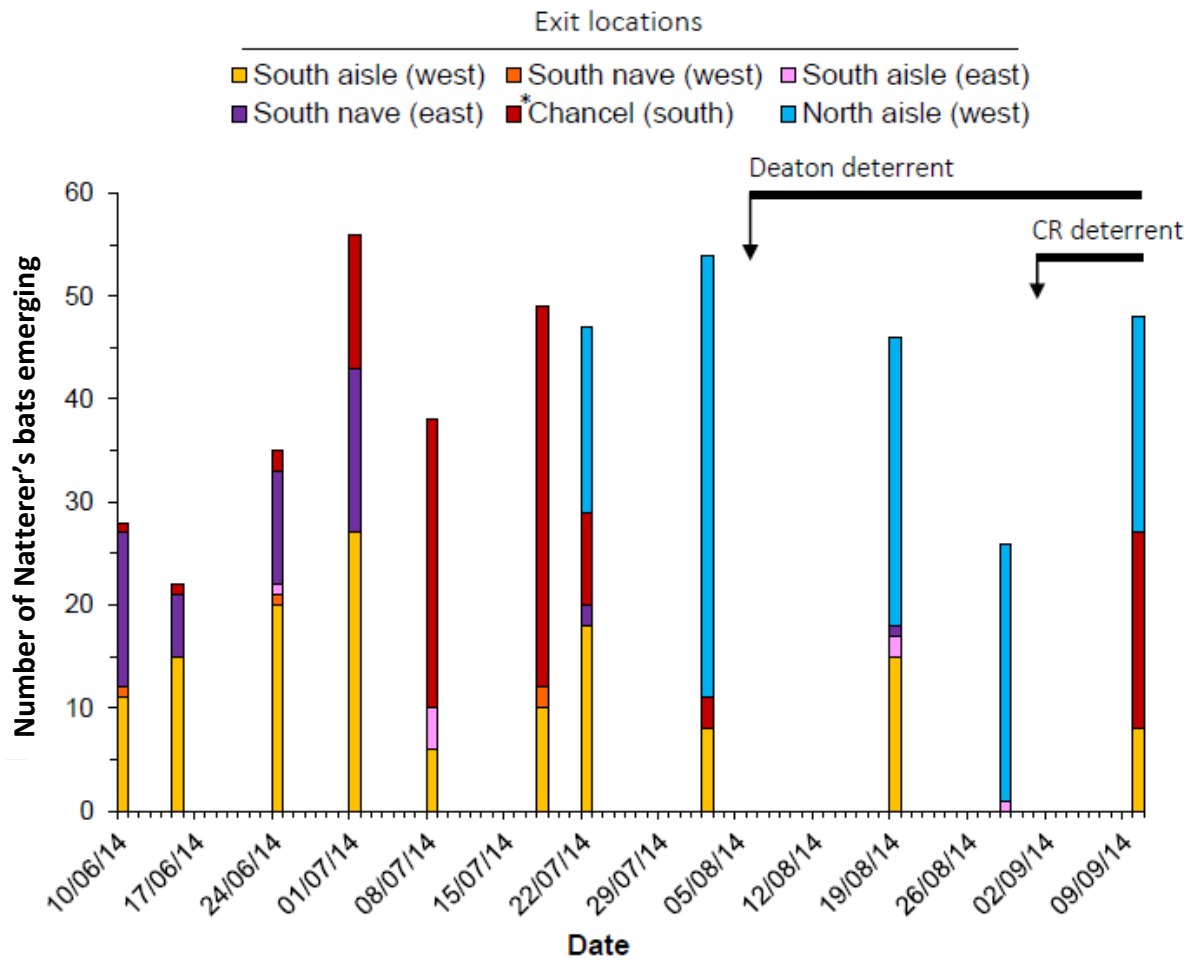


Figure 2. 2014 counts showing numbers of Natterer's bats emerging from different exit points at Guestwick Church, along with application of acoustic deterrents: pairs of Deaton speakers and a set of three Concept Research (CR) speakers. Note bats emerging from 'Chancel (south)', marked with an asterisk, were considered to be utilising a roost separate from the church interior. Taken from Packman *et al.* 2015.

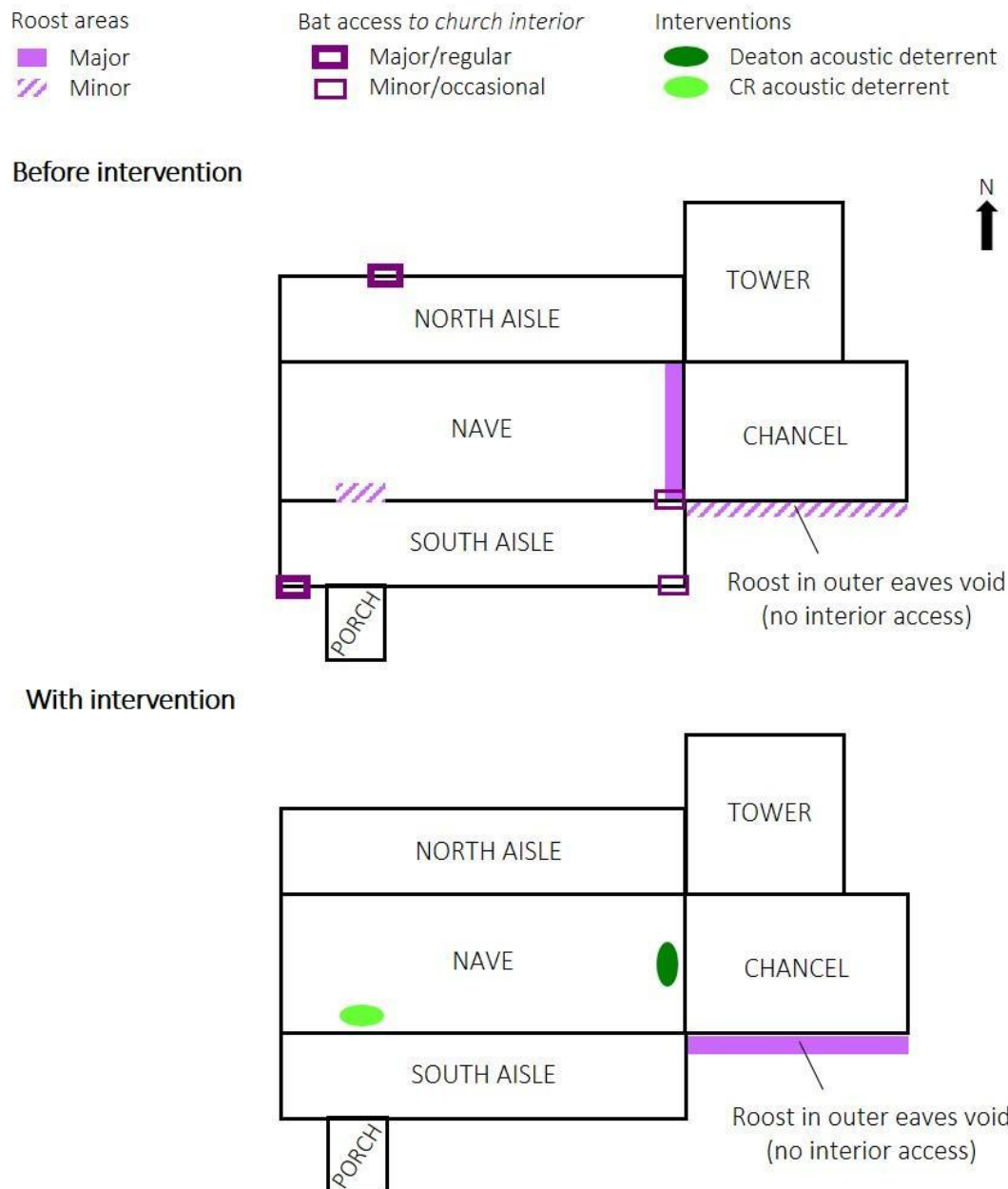


Figure 3. Simplified plan of Guestwick Church (not to scale) showing main roost areas and bat access points to/from the church interior before and during acoustic deterrent trial in 2014. Taken from Packman *et al.* 2015.

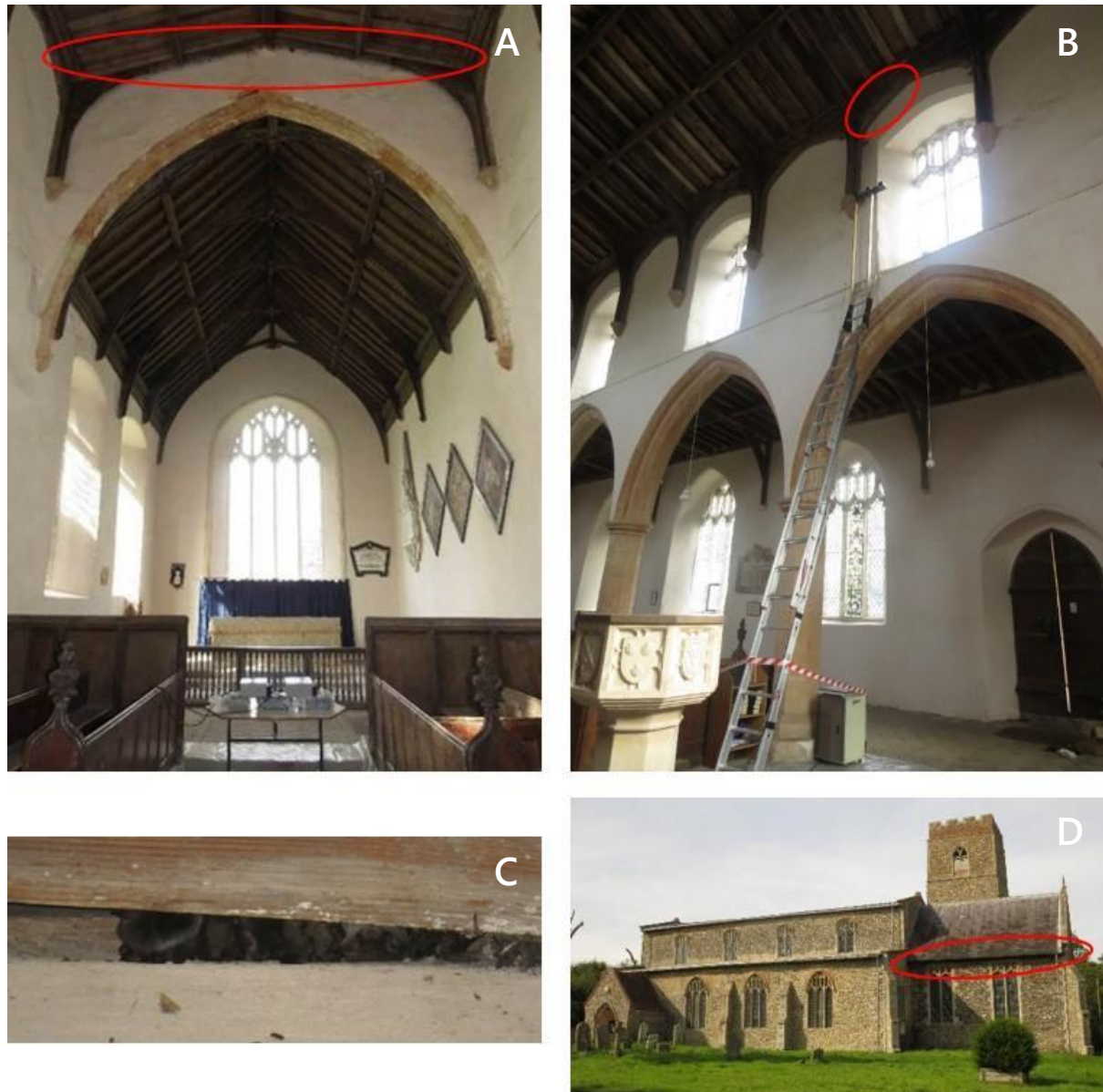


Figure 4. Acoustic deterrent use (37-day trial) at Guestwick Church in 2014. A pair of Deaton speakers under the original chancel arch roost (A), three CR speakers attached to a ladder to temporarily raise them to 1.5m below the next roost location, at the west end (south side) of the nave (B), Natterer's bats inside the roost at the west end of the nave (C) and the final roost location in the outer void of the south chancel eaves (D). Roost locations circled in red. Taken from Packman *et al.* 2015.

Recommendations for Guestwick Church from Packman *et al.* 2015 were:

"Measures aimed at encouraging the bats to only use the exterior chancel eaves roost could substantially reduce dropping accumulation within the church... the suitability of the exterior chancel roost for the maternity period would need to be assessed through trialling this approach for a whole season (April-October). The acoustic deterrents can be used to deter the bats from the main roost locations inside the church (the chancel arch and the west end of the nave) and these locations can subsequently be blocked, encouraging the bats to roost in the exterior chancel eaves (as achieved in Phase 2). If the acoustic deterrents alone are not sufficient to encourage the bats to roost solely in the chancel eaves, exterior access points into the main body of the church would need to be blocked (which may prove challenging). If successful this would allow retention of the roost at the church (in the exterior chancel eaves) but prevent bats from accessing the church interior."

3. Methodology

3.1. Visual inspection

A detailed daytime visual inspection of the church was undertaken on the 8th May 2019 by Dr Charlotte Packman (see Table 1 for surveyor details). The visual inspection provided an update to the 'Light Touch Survey' which was completed on 27th September 2017 (using the 'Bats in Churches Heritage Lottery Fund Heritage Grant Bat Roost Visit Report Form', see Appendix 1, attached as a separate document as contains personal information).

The visual inspection updated information on bat usage of the building (probable species, impacts, photos and observations). A torch, endoscope, binoculars, camera and ladder were available for use during the inspection.

The Churchwarden, Robin Back and Parochial Church Council member Marilyn Back were present for the initial meeting prior to the visual inspection, providing an update on the bat issues at the church and the desired outcomes from the project. The meeting was also attended by Bats in Churches Project Engagement Officer Diana Spencer.

3.2. Bat activity surveys

Bat activity surveys were undertaken between May and August 2019, following the Bats in Churches Class Licence Survey Criteria (see Appendix 2). The activity surveys sought to identify/confirm species using the church, bat numbers, roost locations, exit and re-entry points and observe behaviour (both inside and outside the church).

Five/six surveyors were present for each survey and of these, one surveyor was always positioned inside the church for the duration of the survey (see Table 1 for surveyor details and credentials). The surveys made use of infrared camcorders (Canon XA10/20/30) located inside and outside of the church, with infrared floodlighting. Infrared camera footage was subsequently reviewed using VLC Media Player (or similar). Surveyors were equipped with full spectrum recording bat detectors (mostly Wildlife Acoustics Echo Meter Touch). Bat call recordings were reviewed and analysed using Kaleidoscope Viewer (Wildlife Acoustics).

Table 1. Surveyor names, initials (as used in Table 2 and Figure 5) and credentials.

Surveyor name & qualifications	Initials	Bat licences held	Licence numbers
Dr Charlotte Packman BSc (Hons), MSc, PhD CEcol ¹ MCIEEM ²	CP	Bats in Churches Class Licence (CL32) Level 2 Bat Mitigation Class Licence (CL21) Level 3 Bat Survey Class Licence (CL19) Level 4 Bat Survey Class Licence (CL20)	B32RC001 RC155 2015-16479-CLS-CLS 2015-11760-CLS-CLS
Philip Parker BA (Hons) CEnv ³ MCIEEM ²	PP	Bats in Churches Class Licence (CL32) Level 1 Bat Mitigation Class Licence (CL21) Level 2 Bat Survey Class Licence (CL18)	B32RC007 RC091 2015-14467-CLS-CLS
Christine Hipperson BSc (Hons) MCIEEM ²	CH	Level 2 Bat Survey Class Licence (CL18)	2015-16077-CLS-CLS
Ben Jervis BSc (Hons), MSc MCIEEM ²	BJ	Level 2 Bat Survey Class Licence (CL18)	2016-25752-CLS-CLS
Holly Nichols BSc (Hons)	HN	Level 2 Bat Survey Class Licence (CL18)	2020-44423-CLS-CLS
Steven Gilham BSc (Hons)	SG	Level 2 Bat Survey Class Licence (CL18)	2020-44376-CLS-CLS
John Worthington-Hill BSc (Hons), MSc	JWH	n/a	n/a
David Showler BSc (Hons), MSc	DS	n/a	n/a
Jenny Donelan BSc (Hons), MSc	JD	n/a	n/a

¹CEcol = Chartered Ecologist (with the Chartered Institute for Ecology & Environmental Management)

²MCIEEM = (full) Member of the Chartered Institute for Ecology & Environmental Management

³CEnv = Chartered Environmentalist (with the Society for the Environment)

3.2.1. Dusk emergence surveys

Dusk emergence surveys were undertaken on: 16th May, 3rd July and 30th August 2019. Survey details, including surveyors, timings and weather conditions (which were suitable), are provided in Table 2. Surveyor positions and locations of infrared cameras are shown in Figure 5.

3.2.2. Dawn re-entry survey

The dawn re-entry survey focussed on assessing bat activity inside and outside of the church, identifying/confirming species using the church, roost locations, entry points and observations of behaviour. The dawn survey did not seek to reliably record numbers of bats roosting at the church, as accurate counts of bats re-entering at larger roosts are not possible due to 'dawn swarming' behaviour and because some bats will almost

certainly have already returned to the roost before the survey commences. Refer to the dusk emergence surveys for more accurate roost counts.

The dawn re-entry survey was carried out on 16th August 2019. The Bats in Churches Class Licence Survey Criteria state that the dawn survey should be undertaken between May and mid-June. However, frequent rainfall during the early part of the season meant that the dawn survey had to be postponed multiple times. This was discussed with Natural England and the later time period (still within the optimal survey period) was not considered to be detrimental to the survey data.

Survey details, including surveyors, timings and weather conditions (which were suitable), are provided in Table 2. Surveyor positions and locations of infrared cameras are shown in Figure 5.

Table 2. Bat activity survey timings (24 hr), weather conditions and surveyors (see Table 1 for surveyor details).

			Survey times		Weather conditions				
Dusk/ dawn Survey	Date	Sunset/ sunrise time	Survey start time	Survey end time	Start temp. (°C)	End temp. (°C)	Precipitation	Windspeed (Beaufort Scale)	Cloud cover (%)
Dusk 1	16/05/19	20:47	20:32	22:47	8.9	9.5	Nil	4	5
Surveyors: CP, PP, SG, JWH, BJ, CH									
Dusk 2	03/07/19	21:22	21:07	23:03	9.9	8.7	Nil	1	0
Surveyors: CP, SG, HN, BJ, PP, CH									
Dusk 3	30/08/19	19:50	19:35	21:50	18.8	16.9	Nil	1	30
Surveyors: CP, HN, BJ, CH, SG									
Dawn 1	16/08/19	05:38	03:50	05:33	8.0	8.1	Nil	0	25
Surveyors: CP, HN, DS, JWH, JD									

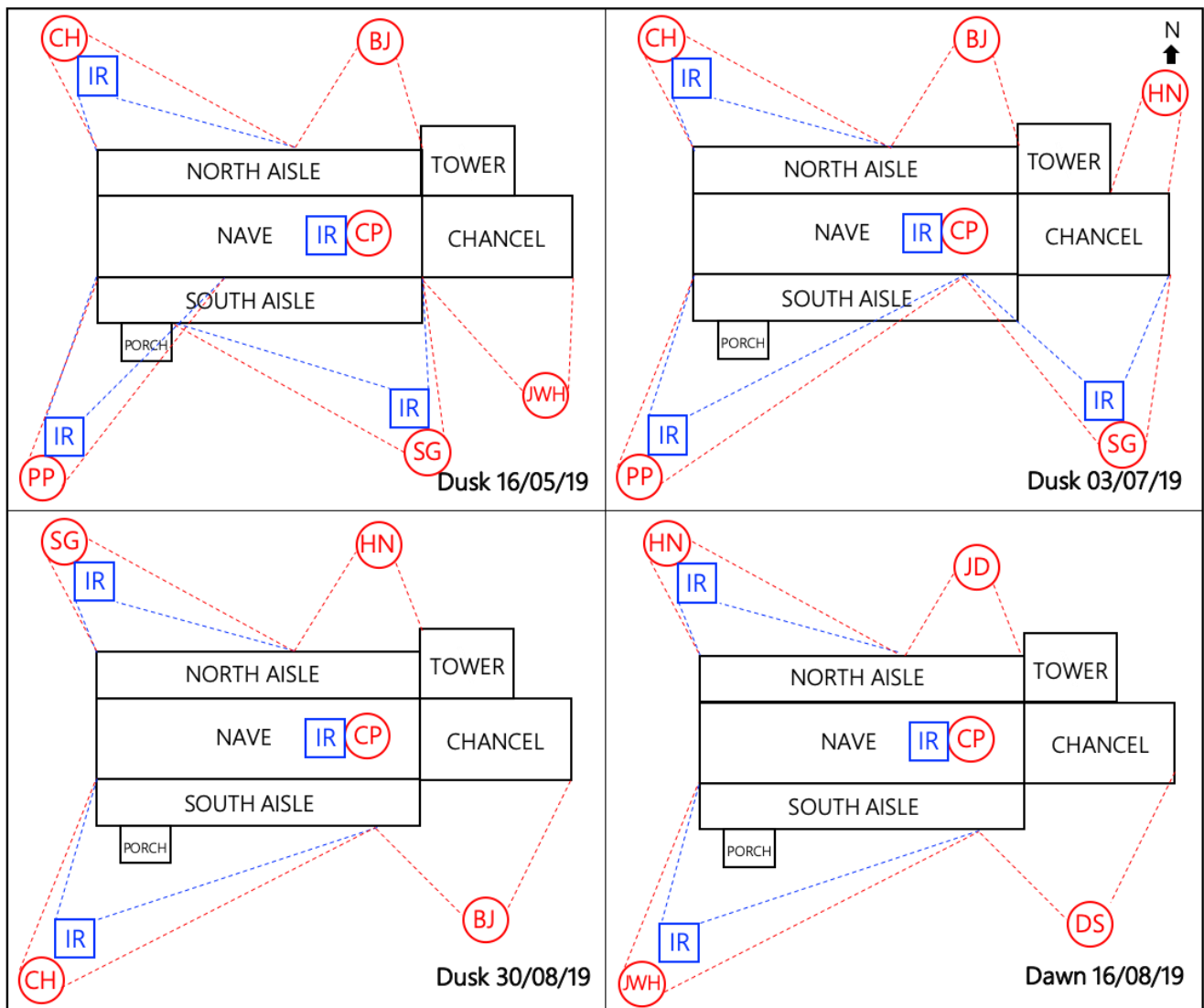


Figure 5. Bat activity survey locations of: surveyors (red circles with surveyor initials (see Table 1), fields of view indicated by red dashed lines) and infrared cameras (blue squares labelled 'IR', fields of view indicated by blue dashed lines) overlaid on simplified church plan (not to scale). Surveyors and cameras positioned outside the church remained in fixed locations for the duration of the survey. The surveyor located inside the church moved around to observe behaviour and assess access points into/out of the church interior, equipped with a mobile infrared camera set-up.

4. Results

4.1. Visual inspection

Refer to the St Peter's Church, Guestwick 'Light Touch Survey' 'Bats in Churches Heritage Lottery Fund Heritage Grant Bat Roost Visit Report Form' from 27th September 2017. This contains personal details (names and addresses etc.) and therefore is not included here but is attached as a separate Appendix (1). The findings from the original Light Touch Survey and updated survey of 8th May 2019 are summarised here and, for the visual inspection element, in Figure 6. Annotated photographs of the church are provided in Appendix 3.

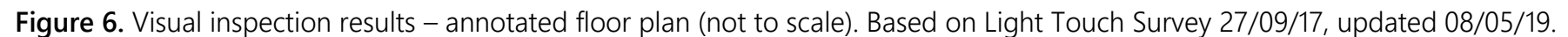
St Peter's is a flint church with lead (nave and aisles), slate (chancel) and pantile (porch) roof coverings. Unusually, the tower is located in the corner where the north aisle meets the chancel (rather than at the typical position at the west end of the nave).

Long-term impacts from bats can be seen throughout the church: staining/bleaching from bat droppings/urine on floors, walls, pews, burials and wall plaques. Droppings are scattered throughout the church, but concentrated beneath the main roosts in the chancel arch (R1) and south side of the nave (western end, approximately in line with the porch, R2), see Figure 6. There are also signs of more minor roosts at the north side of the nave (eastern end, R3) and east end of the chancel (R5). Previous research (Packman *et al.* 2015) also established the presence of a roost in the eaves void on the south side of the chancel (R4), seemingly with no access to the church interior from this roost location. Droppings on the walls suggest there may be other minor/lesser-used roosts in the north and south aisle. There are also a small number of old bat droppings in the tower. Bat droppings present in the church include both 'Natterer's-type' and 'pipistrelle-type' droppings. There is a large wooden bat box inside the church positioned on the northern wall of the south aisle (western end), but with no signs of use (believed to have been put up by the Zeale *et al.* 2014 research project).

There is evidence of bat access at eaves level in the area above the north aisle door (western end), in the south-west corner of the south aisle and (to the exterior roost only) at the south chancel eaves. The building appears to be highly 'bat-porous' with potential access along the lengths of the eaves of both aisles and both sides of the nave and chancel.

The church representatives described concerns about: bats in the church interior, droppings and urine, damage to furnishings/artefacts/memorials and impacts on community activities/use, as well as the substantial cleaning burden created by bat droppings/urine. Measures taken to date to try to manage the impact of bats on the church include plastic sheet coverings, regular cleaning (including cleaning and re-

painting of walls) and acoustic deterrent trials (Packman *et al.* 2015, see 2.2.3). Coverings and cleaning are not sufficient to mitigate the damage from droppings and urine and are not sustainable long-term. The acoustic deterrent trials were promising, but consideration of how this would function long-term is needed. The church representatives' preferred solution would be for the Natterer's bat maternity colony to be excluded from the interior of the church.



4.2. Bat activity surveys

Species in tables/figures/text reported as:

- *P.pip* = *Pipistrellus pipistrellus* (common pipistrelle)
- *P.pyg* = *Pipistrellus pygmaeus* (soprano pipistrelle)
- *P.sp* = *Pipistrellus* species (common/soprano pipistrelle, species not determined)
- *M.nat* = *Myotis nattereri* (Natterer's bat)
- *P.aur* = *Plecotus auritus* (brown long-eared bat)
- *E.ser* = *Eptesicus serotinus* (serotine)
- Bat sp. = bat (species not determined – usually as no vocalisation detected)

4.2.1. Dusk emergence surveys

The highest count of bats at the church during the activity surveys (see Tables 3-5 & Figure 7) was at the dusk emergence survey on 30th August 2019, when a total of 55 bats were recorded exiting the building. The highest count of Natterer's bats was 36 and for common pipistrelles was 14 (also on 30th August). Individual soprano pipistrelle, serotine and brown long-eared bat were also recorded during the surveys, giving a total of five species using the church.

The data confirm the presence of a Natterer's bat maternity colony (and a half-grown pup was found on the floor at the east end of the south aisle, as well as a very small and (not recently) dead pup under the chancel arch during the 3rd July survey) and possibly a small common pipistrelle maternity colony (based on numbers only).

During the 16th May survey the main Natterer's bat roost was on the south nave wall (west end, R2) but for the 3rd July and 30th August surveys the main (maternity) roost was in the chancel arch (R1), see Figures 6 & 8.

The Natterer's bats emerged from the eaves, mostly of the north aisle (western side, eastern side and central) and western side of the south aisle (west of the porch, see Figure 7). The common pipistrelles emerged from multiple, disparate locations, mostly from the north aisle and south nave eaves.

Table 3. Emergence/re-entry counts by species for the **dusk survey on 16th May 2019.**

Species	Emergence	Re-entry	Time of first exit/entry	Time of last exit/entry	Total
<i>P.pip</i>	6	0	21:01	21:18	6
<i>M.nat</i>	32	0	21:32	22:36	32
<i>P.sp.</i>	1	0	21:06	21:06	1
				Total	39

Table 4. Emergence/re-entry counts by species for the **dusk survey on 3rd July 2019.**

Species	Emergence	Re-entry	Time of first exit/entry	Time of last exit/entry	Total
<i>P.pip</i>	5	0	21:27	22:07	5
<i>M.nat</i>	25	0	22:02	22:47	25
<i>E.ser</i>	0	1	22:51	22:51	1
<i>P.pyg</i>	1	0	21:51	21:51	1
Bat sp.	1	0	22:53	22:53	1
				Total	33

Table 5. Emergence/re-entry counts by species for the **dusk survey on 30th August 2019.**

Species	Emergence	Re-entry	Time of first exit/entry	Time of last exit/entry	Total
<i>P.pip</i>	14	0	19:58	20:17	14
<i>M.nat</i>	36	0	20:40	21:14	36
<i>P.aur</i>	1	0	20:24	20:24	1
Bat sp.	4	0	20:11	21:27	4
				Total	55

4.2.2. Dawn re-entry survey

Relatively small numbers of bats were recorded re-entering the church during the dawn survey (see Table 6). Twelve of the 13 Natterer's bats re-entered at the north aisle eaves (western end, just east of the door, see Figure 8 D & E) and one re-entered at the south chancel eaves (presumably to the exterior eaves void roost), see Figure 7. Three common pipistrelles re-entered at the south nave eaves (western end), but were not recorded re-entering the church interior on the inside and therefore are assumed to have been using an exterior roost. The Natterer's bats returned to the roost at R2 (see Figure 6 and Figure 8 A & B), on the south nave wall (western side).

Table 6. Emergence/re-entry counts by species for the dawn survey on 16th August 2019.

Species	Emergence	Re-entry	Time of first exit/entry	Time of last exit/entry	Total
<i>P.pip</i>	0	3	05:03	05:05	3
<i>P.sp.</i>	0	1	04:39	04:39	1
<i>M.nat</i>	0	13	03:54	04:38	13
				Total	17

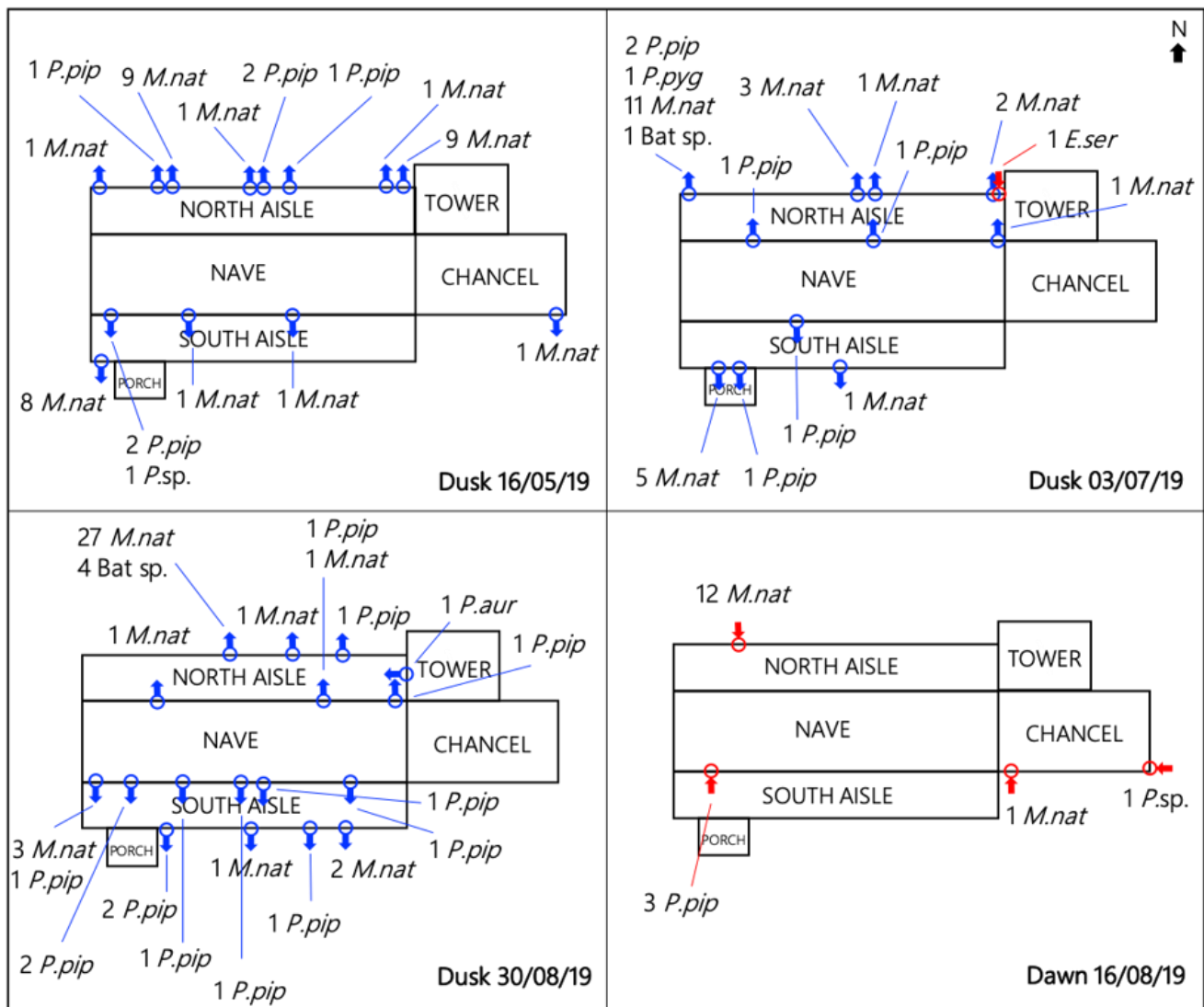


Figure 7. Results from the bat activity surveys (dusk 16th May, 3rd July and 30th August 2019 and dawn 16th August 2019) shown on a simplified plan of the church: emergence (blue circle & arrow)/re-entry (red circle and arrow) locations, species and numbers.

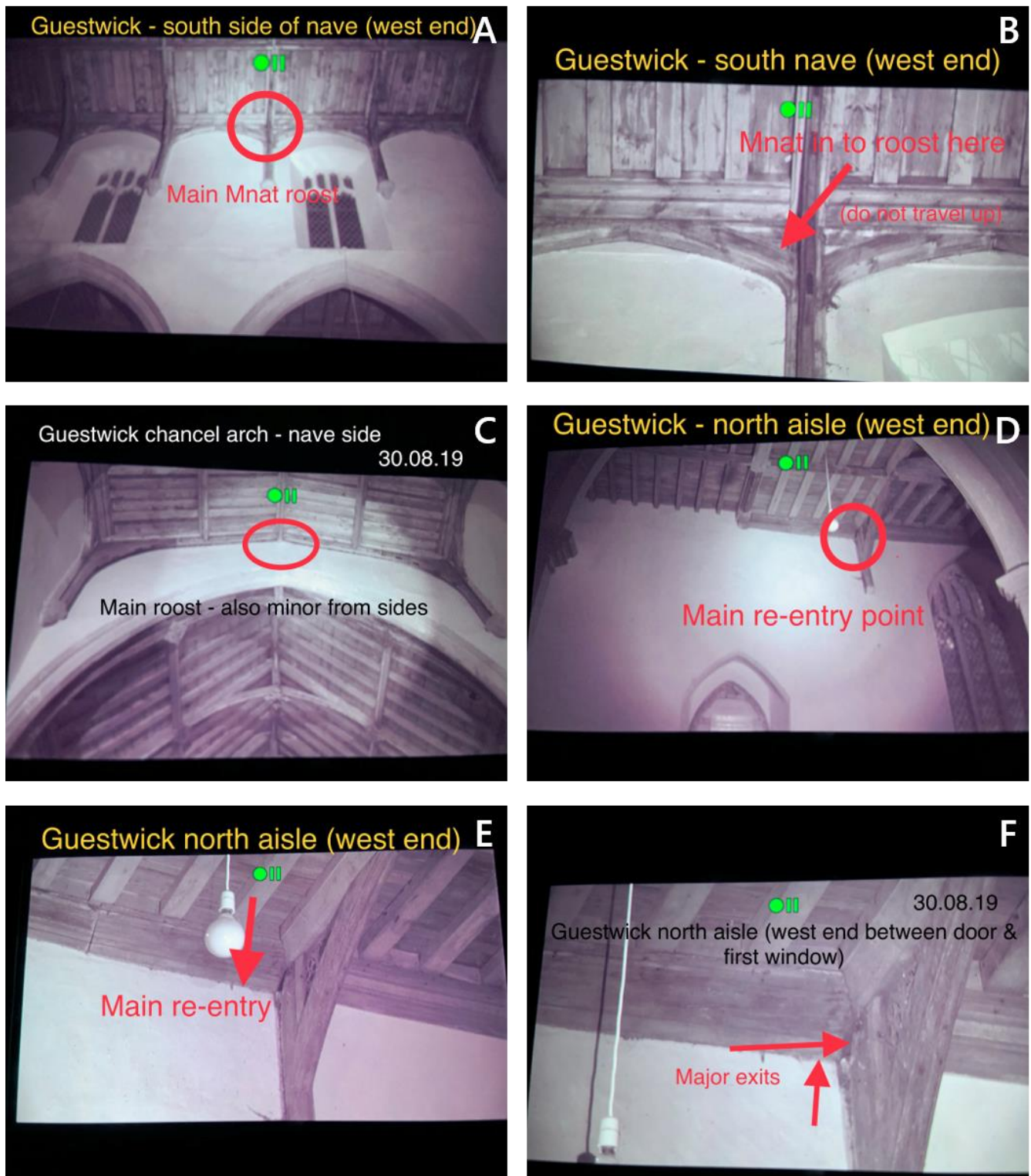


Figure 8. Interior activity surveys – photos of infrared camcorder field monitor annotated during surveys: A. shows the main Natterer's bat roost at south nave wall (western end, R2 in Figure 6), with close up of the roost interior access point shown in B. C. is the other main (maternity) Natterer's bat roost in the chancel arch (nave side, R1 in Figure 6). D. is a major Natterer's bat access point at eaves level in the north aisle (western end, just east of door) with close-ups of this in E., showing down re-entry location and F., showing dusk exit points. Roost locations/access points circled in red or indicated by red arrow(s).

5. Discussion

St Peter's is home to a maternity colony of Natterer's bats and possible small maternity colony of common pipistrelles, with occasional (day roost) use by three other species (soprano pipistrelle, brown long-eared bat and serotine). The main Natterer's bat roosts are located in the chancel arch (maternity use indicated by timing of occupancy, large volume of droppings and dead pups found beneath) and south wall of the nave (western end). The church is very 'bat-porous' with a large number of access points used at eaves level along the aisles and nave. The main Natterer's bat access is in the north aisle (west end), used for both emergence and re-entry. The west end of the south aisle and east end of the north aisle are also well-used for emergence (no re-entry observed at these locations). The common pipistrelles use a large number of access points distributed along the eaves of the aisles and nave (their smaller size perhaps allowing use of a greater number of gaps).

Two potential 'exterior' roosts (i.e. in the outer structure of the building without bats passing into the church interior) have been identified. There is a Natterer's bat roost in the south chancel eaves void: only one bat was observed using this during the four surveys in 2019, however this roost was regularly used during the 2014 surveys and the colony was successfully moved here during a 37-day acoustic deterrent trial in 2014 (Packman *et al.* 2015, see 2.2.3). The second probable exterior roost is at the south nave eaves (west end), used by common pipistrelles.

It is important to note that the Natterer's bat maternity colony at the church appears to have declined substantially in size over the last six years, with numbers recorded in 2019 around half those of the 2011-2013 period.

Natterer's bat colony size as follows:

- 2011-2013: 60-80 (see 2.2.3)
- 2014: 22-57 (11 counts from 10th June to 9th September, see 2.2.3)
- 2019: 25-36 (3 counts: 16th May, 3rd July & 30th August, see 4.2.1)

It is possible that the decreased numbers at the church could be due to factors such as use of alternative roosts in the area (roost switching), and therefore not an actual decline in colony size, but given the very limited use of alternative roosts observed in previous studies at the church (Zeale *et al.* 2014 & Packman *et al.* 2015) it seems more likely that this represents a genuine decline in numbers. This is a concern and needs to be kept in mind when considering intervention options. The reasons for the decline in numbers at the church are not known, but similar patterns have been observed at some other Natterer's bat church colonies in Norfolk, suggesting it could be a more widespread pattern. However, the Bat Conservation Trust's National Bat Monitoring Programme reports no significant decline in Natterer's bat numbers between 2002 and 2018 (based on roost count monitoring at 72 sites in England, Bat Conservation Trust 2019).

The church representatives are keen to have the Natterer's bat maternity colony excluded from the church interior. The impacts on the building are significant, sustained and difficult to manage by alternative means. This approach can only be considered if the risk of negative impacts on the colony can be minimised and carefully monitored, with remedial action taken if necessary. Given the 'bat-porous' nature of the building, physically excluding *all* bats from the interior is likely to be impossible. Moving the Natterer's bat maternity colony to a contained location(s)/exterior roost(s) however may be achievable with a phased approach and close monitoring, and could potentially bring about a substantial reduction in impact, to a more manageable level.

The acoustic deterrent trial in 2014 (Packman *et al.* 2015) demonstrated that it is possible, at least in the short-term, to move the Natterer's bat colony to the exterior south chancel roost, albeit this was late season (early September). Significant numbers of Natterer's bats were recorded using the south chancel roost during July 2014, indicating that it may well have been used as a maternity roost (on 8th and 18th July 2014 it had the highest numbers of bats at the church).

The proposed approach makes use of the knowledge gained from the research studies (Zeale *et al.* 2014 and Packman *et al.* 2015), including the acoustic deterrent trials, but offers a greater range of roosting opportunities and reduces the risk of habituation/failure in the longer-term by relying on acoustic deterrents alone.

5.1. Proposed management plan

At a progress meeting on 31st October 2019 (attended by the Churchwarden Robin Back, Parochial Church Council member Marilyn Back, Bats in Churches Engagement Officer Diana Spencer, Bats in Churches Project Heritage Adviser Rachel Arnold and Ecologist C. Packman), management options and proposals were discussed and an approach agreed. The Churchwarden requested that they could remove the large interior bat box at the west end of the south aisle. This box has been in place for more than 5 years, has been regularly checked but evidence of use has never been recorded and it appears to be unsuitable for bat roost use (smooth interior surfaces, large crevice sizes and limited landing area). Consequently, we had no objection to this being removed.

The proposed management approach is as follows (refer to Figure 9 for aerial image annotated to show locations of proposed interventions and Figure 10 for images illustrating the proposed artificial roosts):

Rafter bat boxes x2

- Rafter bat boxes to be built-in at two of the three major access points: in the north aisle (east end) and in the south aisle (west end).

- The north aisle rafter box will need to be heated (with a low energy heat mat, such as those used in reptile vivariums) to compensate for the northerly aspect (otherwise uptake is unlikely as temperatures would be too cool to be suitable for colony roost use).
- Phased approach: boxes built-in during Year 1 (2020) but not connected up to the entrance points (or connected but with a gap close to the entrance points) - bats can continue to pass through into the church interior while becoming familiar with the new roost provision. This should increase the likelihood of uptake and decrease the risk of bats abandoning the church completely.
- Simple insertion of wood sections to complete the connection/blocking of access through to church interior should be designed-in during Year 1 construction to allow ecologist to complete this, post-emergence, in spring of Year 2.
- Use of small 'no-glow' roost cameras to monitor use of boxes.
- If the results from Year 1 monitoring are positive, rafter bat boxes can be connected up to the entrance locations (thereby preventing bat access into the church interior at these points) in spring Year 2 (April/May 2021).

Interior bat box x1

- Bespoke bat box to be constructed around major access point in the north aisle (west end). As for the rafter box at the east end of the north aisle, this will require heating to compensate for the northerly aspect.
- As specified for the rafter bat boxes: construction in Year 1 (2020), phased approach with access into the church interior to be retained in Year 1 (gap allowing bats to pass through into church interior – with simple wooden insertion to complete the blocking in Year 2), a roost camera for monitoring purposes, and if monitoring results are positive then proceed with sealing box around access point to prevent bats passing through to the interior (spring Year 2, April/May 2021).

Blocking & one-way excluders

- Blocking of alternative access points into the church interior (other than the three main access points at the locations of the rafter bat boxes and interior bat box).
- Fit one-way excluders at 2-4 access locations along north and south aisle eaves (to allow bats to exit at these locations but not re-enter – retaining these as exit-only locations is important when access to the church interior is blocked in Year 2 (to prevent bats from becoming trapped inside the church)).
- Initially temporary (with foam sponges) blocking would be implemented along the length of both aisles, thereby restricting access to the bat box locations/one-way excluders.
- Monitoring would determine if further blocking is required on a reactive basis e.g. nave eaves (which would require a cherry picker).
- Due to the 'bat-porous' nature of the church, deterrence and subsequent blocking of main interior roost locations (i.e. chancel arch and south nave wall, west end) may be

needed (after Year 1) if it is not possible to prevent the Natterer's colony from accessing the interior by blocking alone. This would be achieved by first deterring the bats from the roost areas using **acoustic deterrents** (in a similar approach to Packman *et al.* 2015) and then blocking to prevent access once confident that no bats remain at these locations (determined through monitoring with an infrared camcorder) – as a precaution a temporary one-way excluder would also be fitted at the roost locations in case any bats remain, allowing them to exit.

External tree bat box

- One large crevice-style black bat box, suitable for Natterer's bat maternity use, to be placed on suitable churchyard tree (large ash tree to south of church, adjacent to path).

Access to existing exterior church roosts retained

- Access to the existing exterior church roosts will be retained i.e. the south chancel eaves void (evidence of previous colony use by Natterer's bats) and (possible) common pipistrelle exterior roost at south nave eaves (west end).

Monitoring methods

- Rafter and interior bat box 'no-glow' **infrared roost cameras** (x3) – review recorded footage.
- **Ringling** – this will enable long-term monitoring of the bat population at the church (requires trapping at the church twice per season – pre-maternity i.e. May and post-maternity period i.e. August-September). Ringling will enable us to determine if the same individuals are returning to use the church, provide information on longevity and aid assessment of how the local population is faring in light of observed declines in numbers. Ringling was originally undertaken as part of the Zeale *et al.* (2014) work so would enable this to be renewed and continued.
- Regular **activity surveys** (and **visual inspections**) to check numbers, access locations and roost locations.

Summary of roost options provided/retained:

- Three interior artificial roosts created: rafter bat box in south aisle west end (unheated), rafter bat box in north aisle east end (heated), bat box in north aisle west end (heated).
- One exterior artificial roost created - bat box on tree.
- One/two existing (believed to be) exterior-only roosts retained: south chancel eaves (previous Natterer's bat summer use) and south nave (west end, common pipistrelle summer use).
- Access to tower retained.

It is important to understand that there is no guarantee that the proposed management approach will work: bats can behave in unexpected ways and this approach has not been tested before. However, with a detailed understanding of how bats are using the building, gained from multiple years of survey data as well as research into management techniques, the proposed approach is considered to be the most appropriate option with the highest chance of success and which balances the need to protect both the church and the bat population.

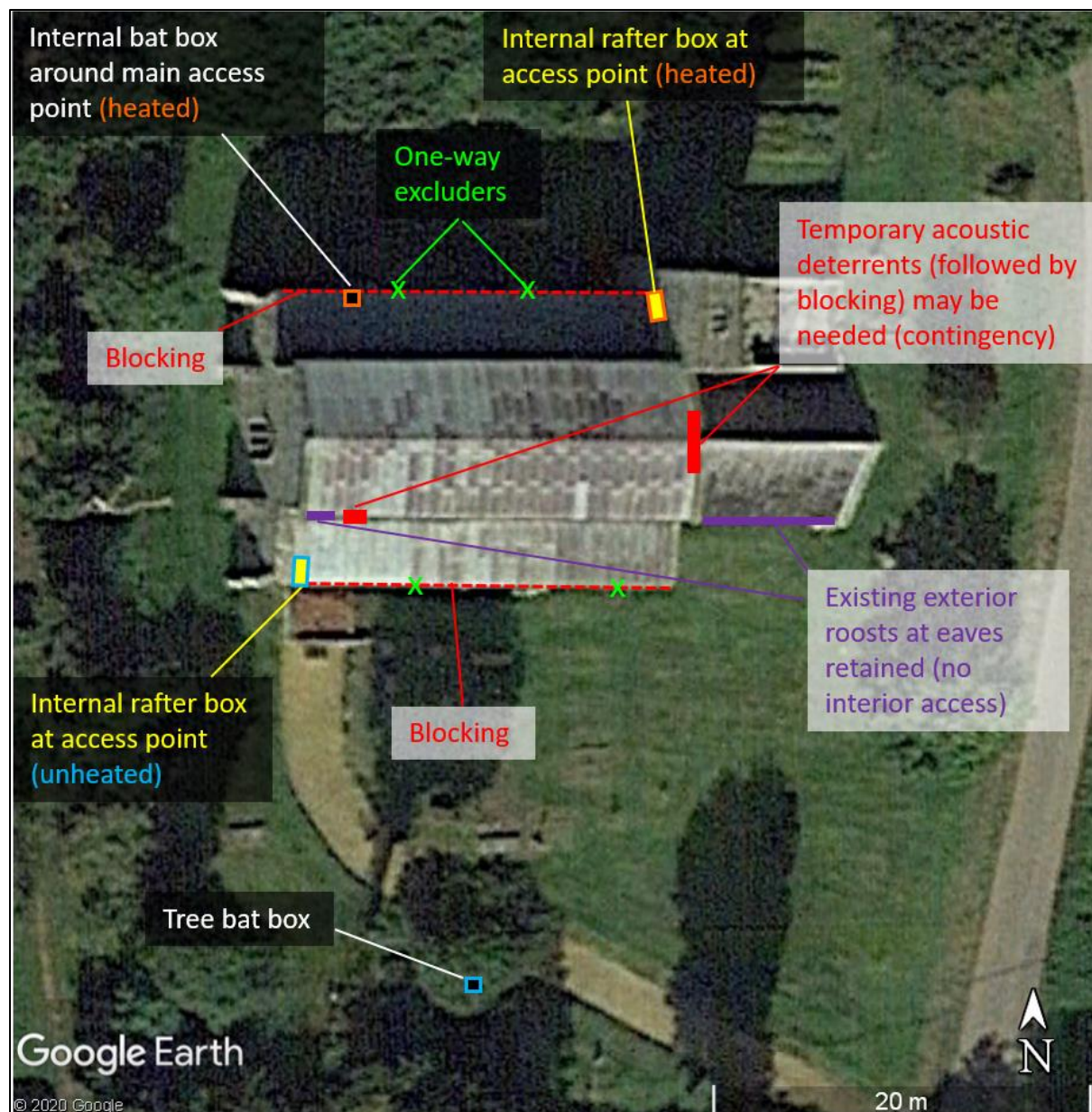


Figure 9. Aerial image (from Google Earth Pro) annotated to show the locations of the proposed management interventions. Note exact locations of one-way excluders would be determined during the blocking work.



Figure 10. Illustrations of proposed artificial roosts.

5.2. Schedule of works

The schedule of works for Year 1 (2020) and Year 2 (2021), the first and second phases of the mitigation implementation, are set out below in Tables 7 & 8 respectively. Note that originally the intention was for Phase 1 works to commence in spring 2020, but due to the Covid-19 pandemic it became clear that would no longer be possible, therefore a revised work schedule is presented here. **This is a provisional work schedule only, some activities are not possible at the current time as they cannot be carried out safely whilst working to Covid-19 protocols (including social-distancing).**

Table 7. Year 1 (2020) schedule of works. Blue indicates proposed timing of works, red when works must not take place (maternity period when bats will be most vulnerable to disturbance) and grey when no works could take place due to Covid-19 restrictions.

Activity	Apr	May	Jun	Jul	Aug	Sep	Oct
* Installation of rafter bat boxes x2 and interior bat box x1 with infrared roost cameras (x3)							
*Initial temporary blocking of north and south aisle eaves & fitting of one-way excluders							
Exterior tree bat box installation							
Visual inspections, bat activity survey monitoring (can be done with social-distancing protocols)							
* Ringing session x1							
*Additional blocking, if required (subject to findings from monitoring)							

****These activities cannot be done at the current time (10.06.2020) as social-distancing is not possible***

Table 8. Year 2 (2021) schedule of works. Blue indicates proposed timing of works, red when works must not take place (maternity period when bats will be most vulnerable to disturbance).

Activity	Apr	May	Jun	Jul	Aug	Sep
Connection of rafter bat boxes x2 and interior bat box x1 to access points (blocking church interior access)						
Visual inspections, bat activity survey monitoring, reviewing of roost camera footage						
Ringing sessions x2						
Additional blocking, if required (subject to findings from monitoring)						

Monitoring in the form of two bat activity surveys per year (one in the pre-maternity and one in the post-maternity period) will continue in Year 3 (2022) and Year 4 (2023), as detailed and costed in the original tender for the ecological works at St Peter's Guestwick. Additional monitoring through annual trapping surveys and ringing, as well as reviewing the infrared roost camera footage, also needs to be factored in. See budget in Appendix 4.

Under the requirements of the Bats in Churches Class Licence, additional monitoring years (after 2023) will be needed and will give important information about longer-term success and impacts (for the bats and the church) and will be particularly useful in light of the ringing programme. Consideration needs to be given to how this will be funded beyond the Bats in Churches HLF Project time-frames.

Cost estimates are provided in a separate Appendix (4, Excel spreadsheet). For accurate costings for capital works it will be necessary to obtain quotes from selected contractors. Costing for ecological aspects should be accurate, providing there are no unexpected eventualities (some contingency elements are specified in the budget breakdown).

6. References

Bat Conservation Trust (2019) The National Bat Monitoring Programme Annual Report 2018. Bat Conservation Trust, London. Available at http://www.bats.org.uk/pages/nbmp_annual_report.html

Halsey, R. (2018) Statement of Significance for St Peter's Church, Guestwick, Norfolk.

Packman, C.E., Zeale, M., Harris, S. and Jones, G. (2015) Management of Bats in Churches – a pilot. English Heritage Research Project: 6199. Available here: <https://research.historicengland.org.uk/Report.aspx?i=15751&ru=%2fResults.aspx%3fp%3d1%26n%3d10%26rn%3d106%26ry%3d2015%26ns%3d1>

Zeale, M.R., Stone, E., Bennitt, E., Newson, S., Parker, S., Haysom, K., Browne, W.J., Harris, S. and Jones, G. (2014) Defra Research Project WM0322 Improving mitigation success where bats occupy houses and historic buildings, particularly churches. Final Report. Available here: <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=One&Completed=2&ProjectID=17863>

Appendix 1: Bat Roost Visit Report Form, Sept 2017

'Bats in Churches Heritage Lottery Fund Heritage Grant Bat Roost Visit Report Form' – completed 27th September 2017.

Attached as a separate document as includes personal details.

Appendix 2: Bats in Churches Class Licence Survey Criteria

Natural England - minimum survey standards for site registration

The following survey standard describes the **minimum** survey effort required to enable registration of a church for the Bats in Churches Class Licence.

1. High quality survey data, accurately reflecting the usage of the building by bats, must be presented representing at least one full active season.
2. Places of worship will vary considerably in size and structural complexity so methods, techniques and frequency of surveys used must be appropriate and adjusted to suit each situation. Survey methods chosen should maximise collection of information. Surveys should continue until the relevant level of information has been collected.
3. At least four surveys, comprising three dusk and one dawn survey, and one thorough physical inspection, must have been completed for each church applying to be registered in the season prior to starting licensable works. Larger and more complex buildings might require a greater survey effort both in terms of numbers of surveys and numbers of surveyors involved.
4. Surveys should be undertaken in the optimum period for bats (as stated in the BCT Good Practice Guidelines) between May-August. At least one dusk activity survey must be presented from each of the following periods and each survey must be conducted at least two weeks apart:
 - a. May to mid-June;
 - b. Mid-June to end July; and
 - c. August to mid-September.
5. Survey data must be presented from the most recent active season prior to the start of works. If licensed works are planned to begin post maternity period and before the following spring, and a full suite of surveys was conducted the previous year, an update survey will be required during early or mid-maternity period in the year that work is to commence.

6. If surveys meeting the requirements were not undertaken in the active season preceding the intended start of works, but were undertaken within 3 years, a reduced survey effort will be acceptable. In these cases a minimum of two update surveys (one of which must be a dusk survey) will be required. Update surveys should be undertaken between May and August but both may be undertaken earlier in the year i.e. pre or during the maternity period, to allow work to take place immediately prior to or after the maternity season.
7. The mandatory dawn survey must be conducted during the early survey period between May and mid-June. It may be timed to take place directly after an emergence survey.
8. A surveyor must be present inside the building during a dawn survey to identify internal access points.
9. If during the update surveys it is identified that usage of the building by bats has changed significantly, any pre-agreed approach to mitigation must be re-appraised.
10. All major entry and exit points for bats on the exterior of the building *must* be identified. Entry and exit points on the interior of the building *should* be identified.
11. Surveys must identify species of bat and approximate numbers of bats of each species using the building. If breeding roosts are present, this will include a clear understanding of where nursery clusters form and how these and all other roost sites within the building are accessed.
12. Special attention should be given to establishing if access to the interior void of the building is required to access roosting locations or if these locations can be accessed by bats directly from the exterior.

Appendix 3: Photographs (general)



Photo 1. Southern elevation.



Photo 2. Northern elevation.



Photo 3. Chancel southern elevation ('exterior' roost located in eaves void).



Photo 4. Typical eaves-level bat access point via missing flints/mortar around protruding rafters.



Photo 5. Tower interior.



Photo 6. Nave interior.



Photo 7. Eastern nave and chancel interior.



Photo 8. Existing bat box in south aisle (west end) – church have requested removal.



Photo 9. Bat urine staining to pulpit.



Photo 10. Bat urine staining to memorials.



Photo 11. Bat urine staining to brass wall plaque.



Photo 12. Bat urine staining to wooden pews.



Photo 13. Bat droppings under chancel arch roost.



Photo 14. Chancel arch maternity roost (circled in red).



Photo 15. South nave (west end) roost (circled in red).

Appendix 4: Budget/estimated costs

Attached as a separate Excel spreadsheet document. Contains confidential/commercially sensitive information.