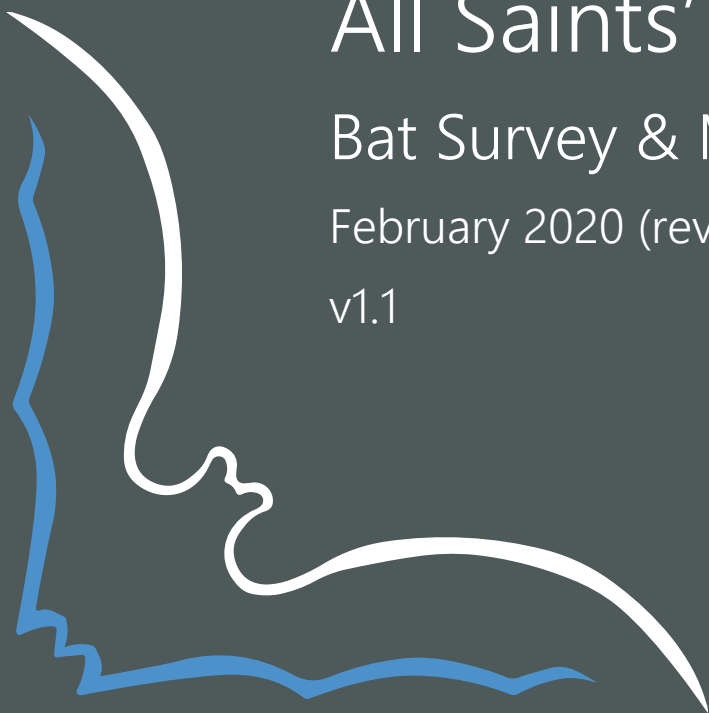


Wild Wings Ecology



Bats in Churches Project: All Saints' Church, Toftrees Bat Survey & Management Plan Report February 2020 (revised v1.1 June 2020) v1.1



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1. Summary

All Saints' Church Tofrees 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 population. This work was undertaken as part of Natural England's Bats in Churches Project (funded by Heritage Lottery Fund).

All Saints' Church is home to maternity colonies of Natterer's bats and common pipistrelles. A soprano pipistrelle and a brown long-eared bat were also 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 church interior and, given the scale of the impact on this small church (despite a now modest-sized bat population), this would seem justified providing adequate mitigation and compensation measures can be implemented and carefully monitored to minimise the risks to the bats.

The proposed management plan would involve construction of four artificial roosts (rafter bat boxes) around existing access points in the church interior: two at the west end of the south side of the nave, one at the west end of the north side of the nave and one at the east end of the south side of the nave. 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 colonies). During this time, temporary blocking of the (many) other potential access points along the north and south sides of the nave (and possible chancel) would be undertaken, along with the installation of several one-way excluders (to prevent potential future issues with bats becoming trapped inside the building). In addition, roosting opportunities would be enhanced in the upper section of the tower, coupled with blocking of access from the tower to the church interior. Access to the existing common pipistrelle exterior roost (in the church structure but without access to the interior) would be retained (north side of the chancel).

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 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 All Saints, Toftrees 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. All Saints' Church, Toftrees

2.2.1. Location

All Saints' Church is located at Shereford Road, Toftrees, Fakenham, Norfolk, NR21 7EA (grid reference: TF 89790 27569), see Figures 1 & 2. There are two woodland County Wildlife Sites located to the south, Little Model Wood (c.650m away) and Great Model Wood (c.900m away), see Figure 2.

2.2.2. Statement of Significance

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

"This is a modest, essentially medieval country church, its chancel refurbished in the early seventeenth century and the building restored in the mid-nineteenth. This seems always to have been a small community and the church now holds the history of the settlement with a magnificent Romanesque font, a good c.1300 indent, the 1620 memorial to the likely builder of the former Toftrees Hall and an 1861 hatchment and churchyard monument to the priest who was perhaps responsible for the restoration.

There is a long history of bats in the church and it is clear from the wide spread of droppings and urine stains that they are active throughout the building. The stonework of the font (of high significance) bears little evidence of damage from bats, but like the pavement floor, it is presumably absorbing urine, as the font cover and the collection of black marble ledgers around the font are certainly heavily stained. The mid-nineteenth century benches are of a very unusual and attractive design and their surfaces are being damaged by urine too. The number of significant fittings is small and it is feasible to protect them with temporary covers. [The Bat Roost Visit Report/Light Touch Survey from 2017] suggests that repairing the roof and restricting the bats from entering the church through it would be a vital first step. Infilling the tower arch, so preventing bat access down from the tower, could also be an opportunity to improve the facilities for the congregation, but would be expensive."

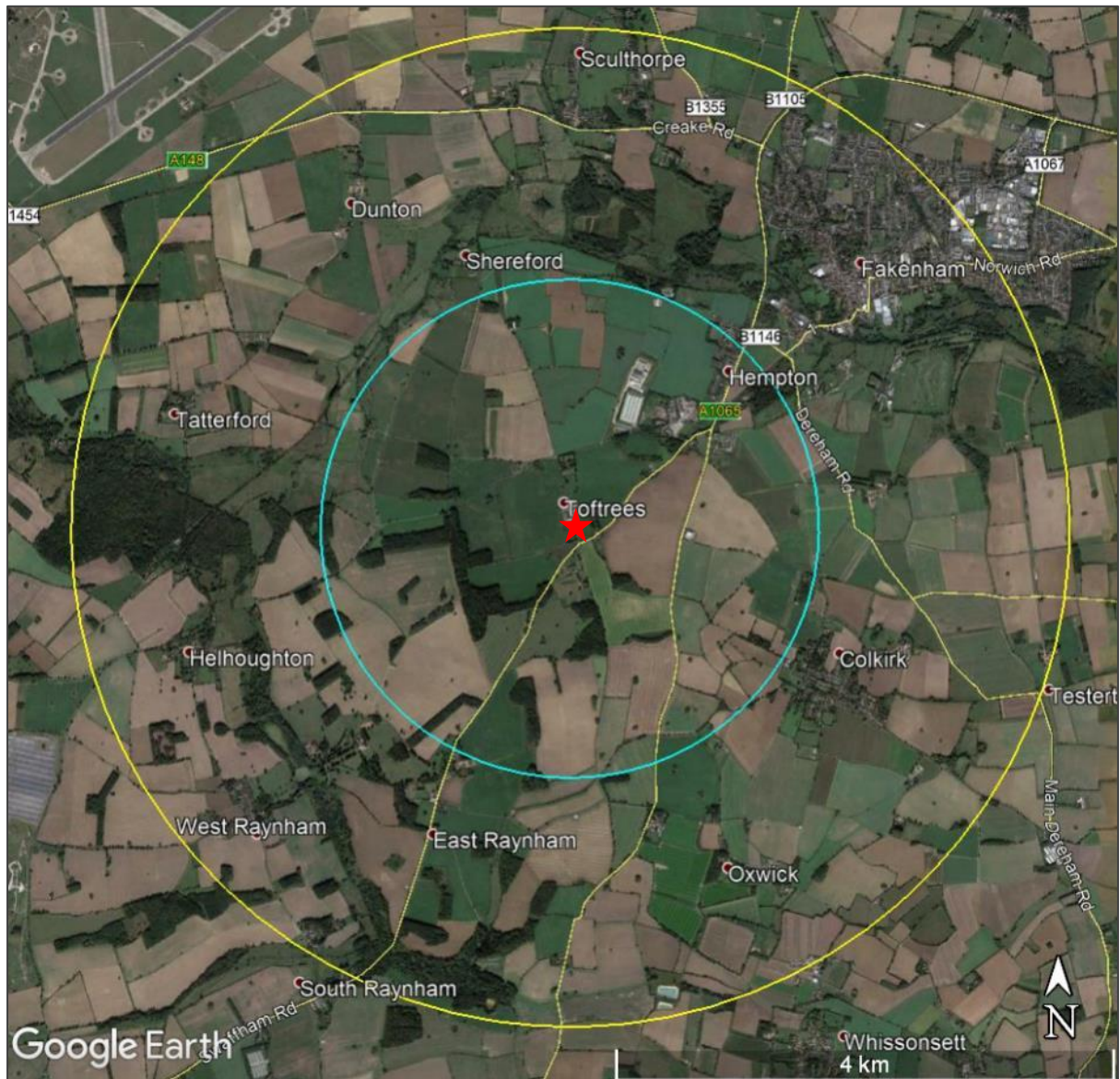


Figure 1. Location of All Saints' Church, Toftrees (red star) on Google Earth Pro 2018 aerial image. Blue circle indicates the 2km radius Core Sustenance Zone¹ (CSZ) around the church for the common pipistrelle colony, the yellow circle indicates the 4km radius CSZ around the church for the Natterer's bat colony.

¹ "A Core Sustenance Zone refers to the area surrounding a communal bat roost within which habitat availability and quality will have a significant influence on the resilience and conservation status of the colony using the roost." (Bat Conservation Trust, 2016).



Figure 2. Location of All Saints' Church, Toftrees (circled in red) on Google Earth Pro 2018 aerial image. Two nearby County Wildlife Sites (CWS) are outlined in green: Little Model Wood CWS (ref 1259) and Great Model Wood CWS (ref 1260).

2.2.3. History of bat use/previous bat survey work

Toftrees Church has been involved in the development of bats in churches management approaches. The church was part of a University of Bristol research project (Defra-funded 2011-2013 - Zeale *et al.* 2014) – which trialled use of acoustic deterrents 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):

- Toftrees Church estimated colony size >100 Natterer's bats (2011-2013).
- Six adult female Natterer's bats from Toftrees Church were radio-tracked through the night for an average of two nights per bat, giving the following information:
 - Mean home range (100% minimum convex polygon) 870ha
 - Core foraging area 75ha
 - Mean maximum range span (mean maximum nightly distance from roost to centroid of cluster core foraging area) 4.6km (mean for all eight church sites was 4km)
 - Preferred habitats were woodland, followed by pasture
- During the 13-day acoustic deterrent trial (with control, deterrent and post-deterrent periods, 15 bats radio-tagged) there were 79 instances of bats roosting outside of the church (substantially higher number compared to the five other church sites), 29 of which were in trees, 12 in inhabited buildings (and being shared simultaneously by at least two radio-tagged bats on at least one occasion) and six unknown - none were considered to be alternative colony roosts.
- Short-term acoustic deterrent trials did not succeed in significantly reducing dropping deposition below the main roost, assumed to be because Toftrees is a small church with a large bat population (i.e. high deposition of droppings from bats in flight). However, acoustic deterrent use did result in large numbers of bats being excluded from the church, presumably because in this small church there were limited alternative roosts sufficiently far away from the deterrent.
- For all Natterer's bats radio-tracked at all eight church study sites:
 - 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 suitable alternative 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.

3. Methodology

3.1. Visual inspection

A detailed daytime visual inspection of the church was undertaken on the 9th 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 12th 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, Colin Vogel, was 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 a 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).

Dusk emergence surveys were undertaken on: 22nd May, 1st July and 12th August 2019. Dusk emergence surveys are best suited to obtaining accurate counts (most, if not all the bats, are likely to emerge during the survey period and in a manner that is relatively easy to count), determining exit locations, species and, internally, roost locations. Note that where a bat is recorded re-entering the church during an emergence survey, the subsequent bat to emerge (if applicable and if of the same species) is not counted to avoid potentially counting the same individual emerging more than once during a survey, thereby giving a minimum count as the total.

The dawn re-entry survey was carried out on 5th June 2019. 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. Dawn surveys are less well suited to reliably recording numbers of bats roosting at a church. This is because accurate counts of bats re-entering at larger roosts can be difficult due to 'dawn swarming' behaviour and because some bats will almost certainly have already returned to the roost before the survey commences. However, with modest numbers of bats at this church, the 'dawn swarming'

effect was limited and the dawn survey count here is considered reliable. Note that where a bat is recorded emerging from the church during a re-entry survey, the subsequent bat to re-enter (if applicable and if of the same species) is not counted to avoid potentially counting the same individual re-entering more than once during a survey, thereby giving a minimum count as the total.

Survey details, including surveyors, timings and weather conditions (which were suitable), are provided in Table 2.

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 and Figure 3 for surveyor positions). 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). Surveyors also utilised two-way radios to corroborate observations between surveyors and especially for comparing exterior and interior observations during surveys (e.g. exterior versus interior exit and re-entry locations and determining if any roosts were exterior roosts only). Tally counters were used to aid accurate recording of numbers. Bat call recordings were subsequently reviewed and analysed using Kaleidoscope Viewer (Wildlife Acoustics).

Table 1. Surveyor names, initials (as used in Table 2 and Figure 3) 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
Ben Jervis BSc (Hons), MSc MCIEEM ²	BJ	Level 2 Bat Survey Class Licence (CL18)	2016-25752-CLS-CLS
Christine Hipperson BSc (Hons) MCIEEM ²	CH	Level 2 Bat Survey Class Licence (CL18)	2015-16077-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
Ash Murray BSc (Hons)	AM	Level 2 Bat Survey Class Licence (CL18)	2015-16562-CLS-CLS
Karl Charters BSc (Hons)	KC	Level 2 Bat Survey Class Licence (CL18)	2015-13353-CLS-CLS
John Worthington-Hill BSc (Hons), MSc	JWH	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)

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

Dusk/ dawn survey	Date	Survey timings			Weather conditions				
		Sunset/ sunrise	Survey start	Survey end	Start temp. (°C)	End temp. (°C)	Precipitation	Windspeed (Beaufort Scale)	Cloud cover (%)
Dusk 1	22/05/19	21:00	20:45	22:45	13.2	12.0	Nil	0	10
Surveyors: CP, SG, PP, KC, CH, JWH									
Dusk 2	01/07/19	21:24	21:09	23:03	16.0	11.2	Nil	2	30
Surveyors: CP, HN, JWH, CH, SG, AM									
Dusk 3	12/08/19	20:30	20:15	22:30	16.2	12.9	Nil	1	30
Surveyors: CP, HN, BJ, CH, SG									
Dawn 1	05/06/19	04:30	02:45	04:20	10.3	10.0	Nil	1	5
Surveyors: CP, AM, CH, BJ, SG, JWH									

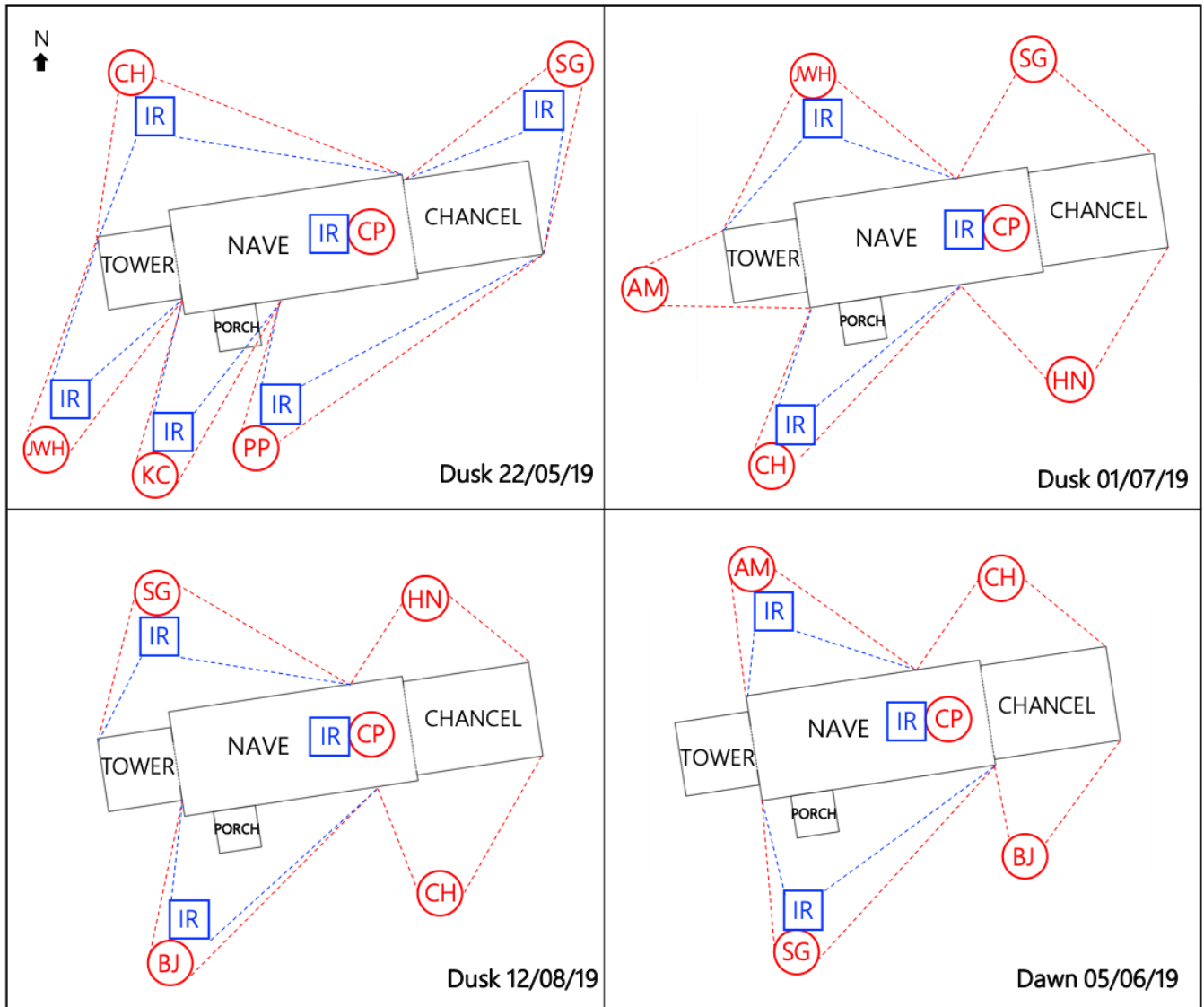


Figure 3. Bat activity survey locations of: surveyors (red circles with surveyor initials (see Table 1), fields of view indicated by red dashed lines) and infrared cameras (blue squares labelled 'IR', fields of view indicated by blue dashed lines) overlaid on simplified church plan (not to scale). Surveyors 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 All Saints' Church, Toftrees 'Light Touch Survey' 'Bats in Churches Heritage Lottery Fund Heritage Grant Bat Roost Visit Report Form' from 12th 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 9th May 2019 are summarised here and, for the visual inspection element, in Figure 4. Annotated photographs of the church are provided in Appendix 3.

All Saints is a medieval flint church with slate (nave and porch) and lead (chancel and tower) roof coverings. It is a small church, with no aisles and a relatively squat tower.

Long-term impacts from bats can be seen throughout the church: staining/bleaching from bat droppings/urine on floors, walls, pews, ledgers and wall plaques. At the time of the visual inspection, Natterer's-type droppings were scattered throughout the church, but concentrated beneath the main Natterer's bat roost above the arch at the west end of the nave (where it meets the tower), see Figure 4. There were also some Natterer's-type droppings on the tower floor. The tower stairs and bell chamber had a scattering of old droppings (mostly pipistrelle-type, some Natterer's-type) and there was also a scattering of pipistrelle-type droppings in the chancel. The building appears to be highly 'bat-porous', with potential bat access along the length of the nave and chancel eaves (both north and south sides) and at the eaves of the tower roof.

Previous research (Zeale *et al.* 2014) established the presence of another Natterer's roost location, towards the western end of the nave in the northern side of the roof (interior, see 10. on Figure 4). There is a large wooden bat box inside the church positioned on the southern wall of the nave (east end), but with no signs of use (believed to have been put up by the Zeale *et al.* 2014 research project). Major bat access points at the time of the research project were located at eaves level at the west and east ends of the south side of the nave and at the west end of the north side of the nave.

The church representatives described concerns about: bats in the church interior, droppings and urine (and the substantial cleaning burden they create), damage to furnishings/artefacts/memorials, impacts on use of the church for worship and community activities/use, smell and concerns about implications for building repair works.

Measures taken to date to try to manage the impact of bats on the church include plastic sheet coverings, cleaning and acoustic deterrent trials (Zeale *et al.* 2014, see 2.2.3). Coverings and cleaning are not sufficient to mitigate the damage from droppings and

urine and are not sustainable or manageable in the long-term. The church representatives' preferred solution would be for the Natterer's bat maternity colony to be excluded from the interior of the church.

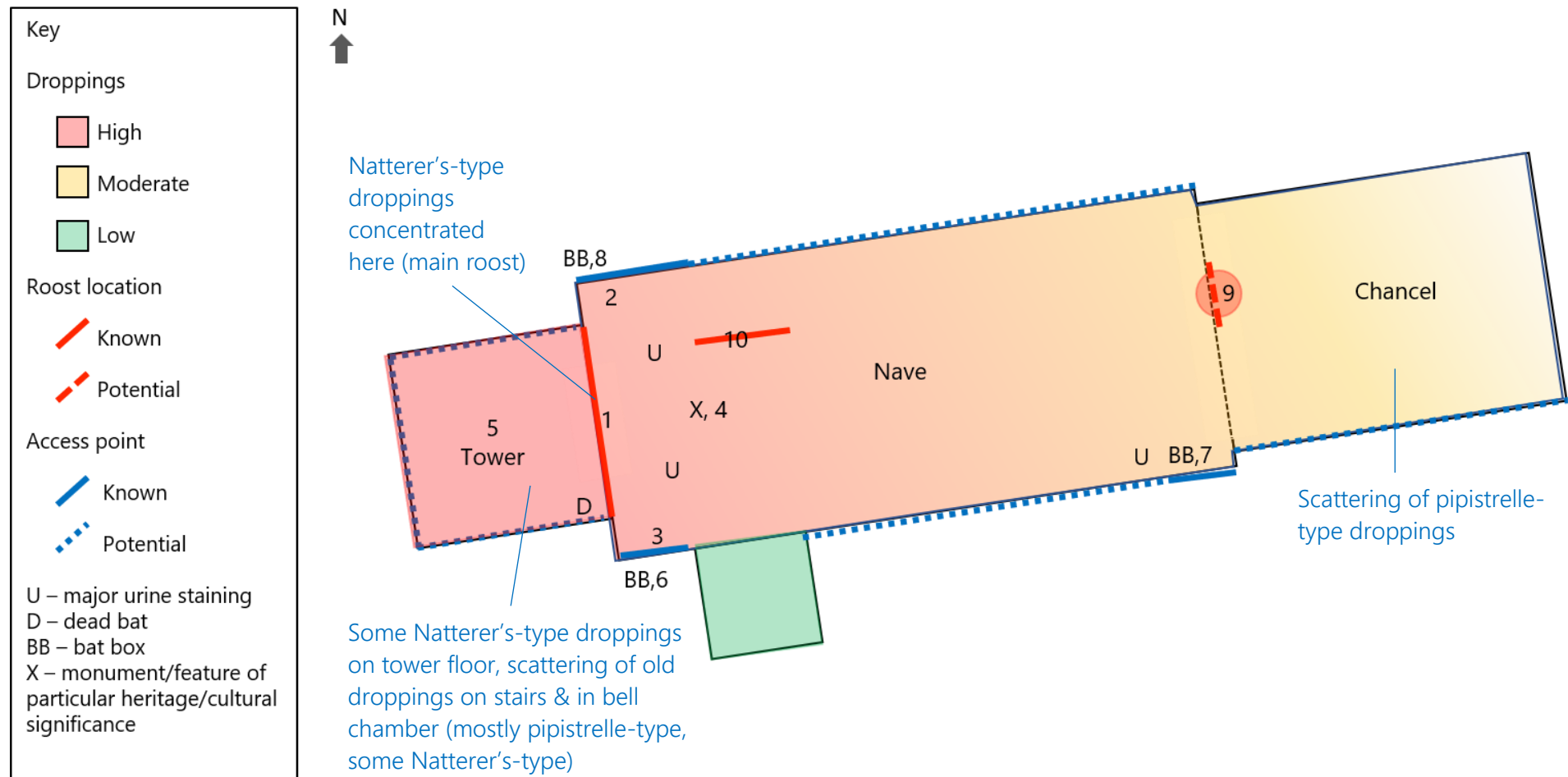


Figure 4. Visual inspection results from Light Touch Survey 12/09/17, updated 09/05/19 (annotated on plan in blue). Plan not to scale. (1) Main roosting location for Natterer's bats, against the tower wall in roof timbers above the tower arch, sheeting covers the ground in this area to collect/protect against droppings and urine. (2) Known Natterer's bat exit location, colony hand-netted here during Zeale *et al.* (2014) research. (3) Known Natterer's bat exit location, colony hand-netted here during Zeale *et al.* (2014) research. (4) Location of Norman font, covered to prevent damage from droppings and urine. (5) Gaps from ground floor into the tower, very few droppings in tower room. (6) External bat box has fallen off the wall, no signs of use by bats. (7) Internal bat box - no signs of use. (8) External box, no signs of use. (9) Potential roost location, concentration of pipistrelle-type droppings on the chancel side of the arch. (10) Radio-tagged Natterer's bats roosted here during Zeale *et al.* (2014) research.

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)
- Bat sp. = bat (species not determined – usually as no vocalisation detected)

The highest bat count was recorded during the dawn survey, with a total of 40 bats recorded returning to the church to roost. The highest count of Natterer's bats was 14 and for common pipistrelles was 26 (both on 6th June dawn survey). Two brown long-eared bats (1st July) and a single soprano pipistrelle (12th August) were also recorded, giving a total of four species recorded using the church during the surveys (see Tables 3-6).

Most emergence and re-entry (for both Natterer's bats and common pipistrelles) was at eaves level at the west end of the nave, on both the north and south sides (Figures 5 & 6). Smaller numbers also emerged/re-entered at the chancel (most of which were thought to be common pipistrelles exiting/re-entering the exterior eaves' roost) and the tower. The church is very 'bat-porous', with a considerable number of different access points.

The main Natterer's bat roost was located at the west end of the chancel/chancel arch (A in Figure 7), with evidence of roosting also at the west end of the nave (nave/tower arch, B in Figure 7). There were also more minor roosts in the roof at the western end of the nave (E & F in Figure 7). Common pipistrelles roosted at the nave roof apex, above the 4th truss from the west end (C in Figure 7) and lower down the nave roof on the southern aspect, above the 2nd truss from the west end (above the door, G in Figure 7). There was also evidence of common pipistrelles roosting internally in the chancel roof (D in Figure 7), although the exact location could not be determined. In addition, there was a small exterior roost of common pipistrelles (north side of the chancel, H in Figure 7).

Table 3. Emergence/re-entry counts by species for the dusk survey on 22nd May 2019.

Species	Emergence	Re-entry	Time of first exit/entry	Time of last exit/entry	Total
<i>P.pip</i>	22	1*	21:20	22:35	22
<i>M.nat</i>	7	0	21:53	22:29	7
<i>P. sp.</i>	1	0	21:22	21:33	1
Total					30

*Re-entry was the last bat to be observed by the surveyor during the survey (22:35) so does not affect total count

Table 4. Emergence/re-entry counts by species for the dusk survey on 1st July 2019.

Species	Emergence	Re-entry	Time of first exit/entry	Time of last exit/entry	Total
<i>P.pip</i>	11	0	21:51	21:59	11
<i>M.nat</i>	8	0	22:15	22:50	8
<i>P.aur</i>	2	0	22:09	22:27	2
Bat sp.	6	0	21:22	21:33	6
Total					27

Table 5. Emergence/re-entry counts by species for the dusk survey on 12th August 2019.

Species	Emergence	Re-entry	Time of first exit/entry	Time of last exit/entry	Total
<i>P.pip</i>	15	0	20:41	21:23	15
<i>M.nat</i>	10	0	22:15	22:50	10
<i>P.pyg</i>	1	0	20:54	20:54	1
<i>P. sp.</i>	1	0	22:09	22:27	1
Bat sp.	3	0	21:22	21:33	3
Total					30

Table 6. Emergence/re-entry counts by species for the dawn survey on 5th June 2019.

Species	Emergence	Re-entry	Time of first exit/entry	Time of last exit/entry	Total
<i>P.pip</i>	2*	28	02:48	04:02	26
<i>M.nat</i>	0	14	03:03	03:23	14
Total					40

*Emergence occurred in-between re-entries (03:11-03:33), so were deducted from total (minimum count)

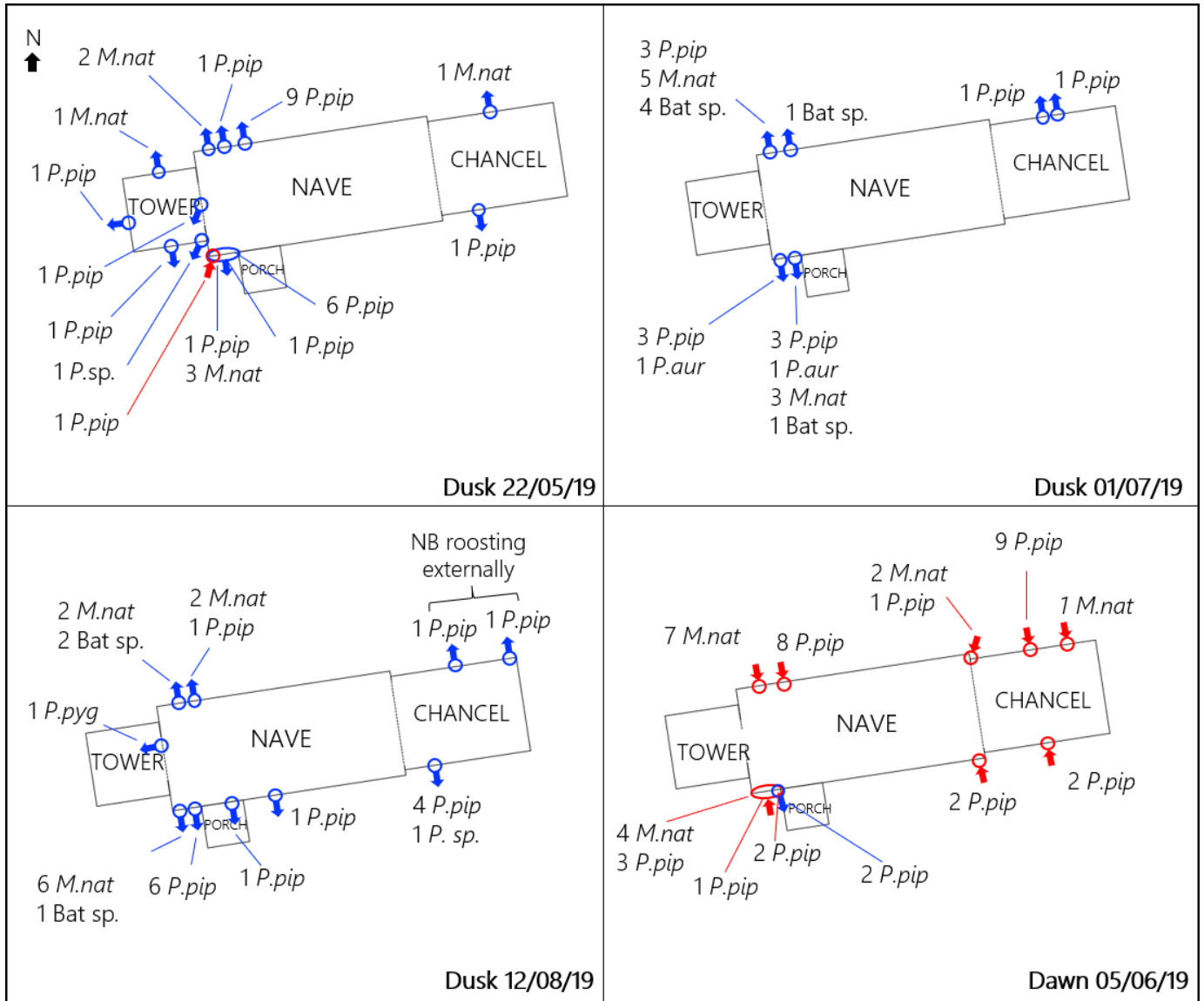


Figure 5. Results from the bat activity surveys (dusk 22nd May, 1st July and 12th August 2019 and dawn 5th August 2019) shown on a simplified plan of the church: emergence (blue circle & arrow)/re-entry (red circle and arrow) locations, species and numbers. Note the cluster of emergence/re-entry activity located at the western end of the nave, south side (to the west of the porch), consisted of three separate access points (observed during the May dusk and June dawn survey).

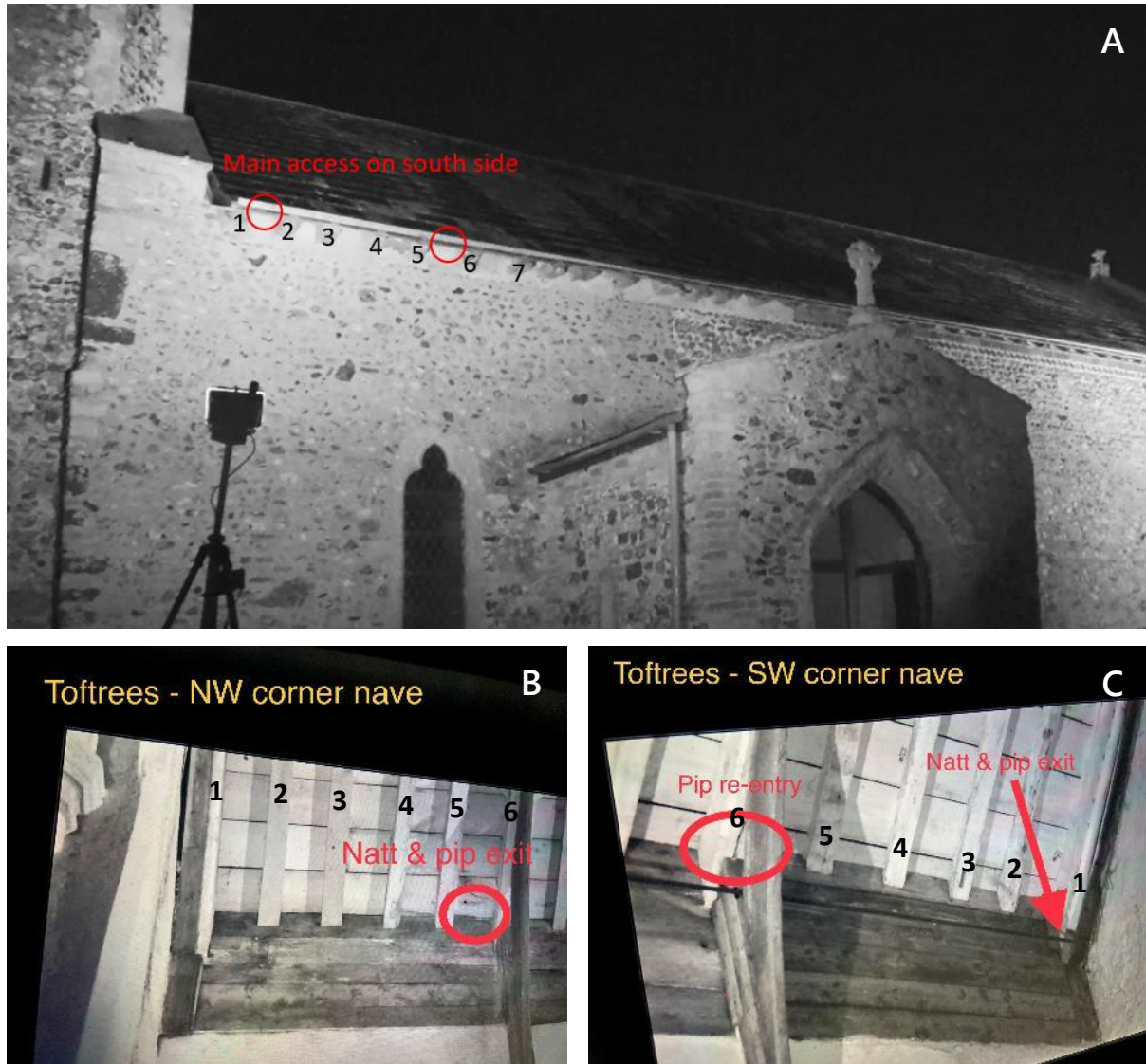


Figure 6. A. Infrared image of the southern elevation of the church, with protruding rafters numbered 1-7 (west to east) and main access points circled in red. B. & C. Interior activity surveys – photos of infrared camcorder field monitor annotated during surveys (with rafters numbered from west to east, i.e. those in A on the southern exterior, west end, corresponding with those in C on the interior): B. shows the main access point on the north side of the nave (west end) and C. shows the two main access points on the south side of the nave (west end).

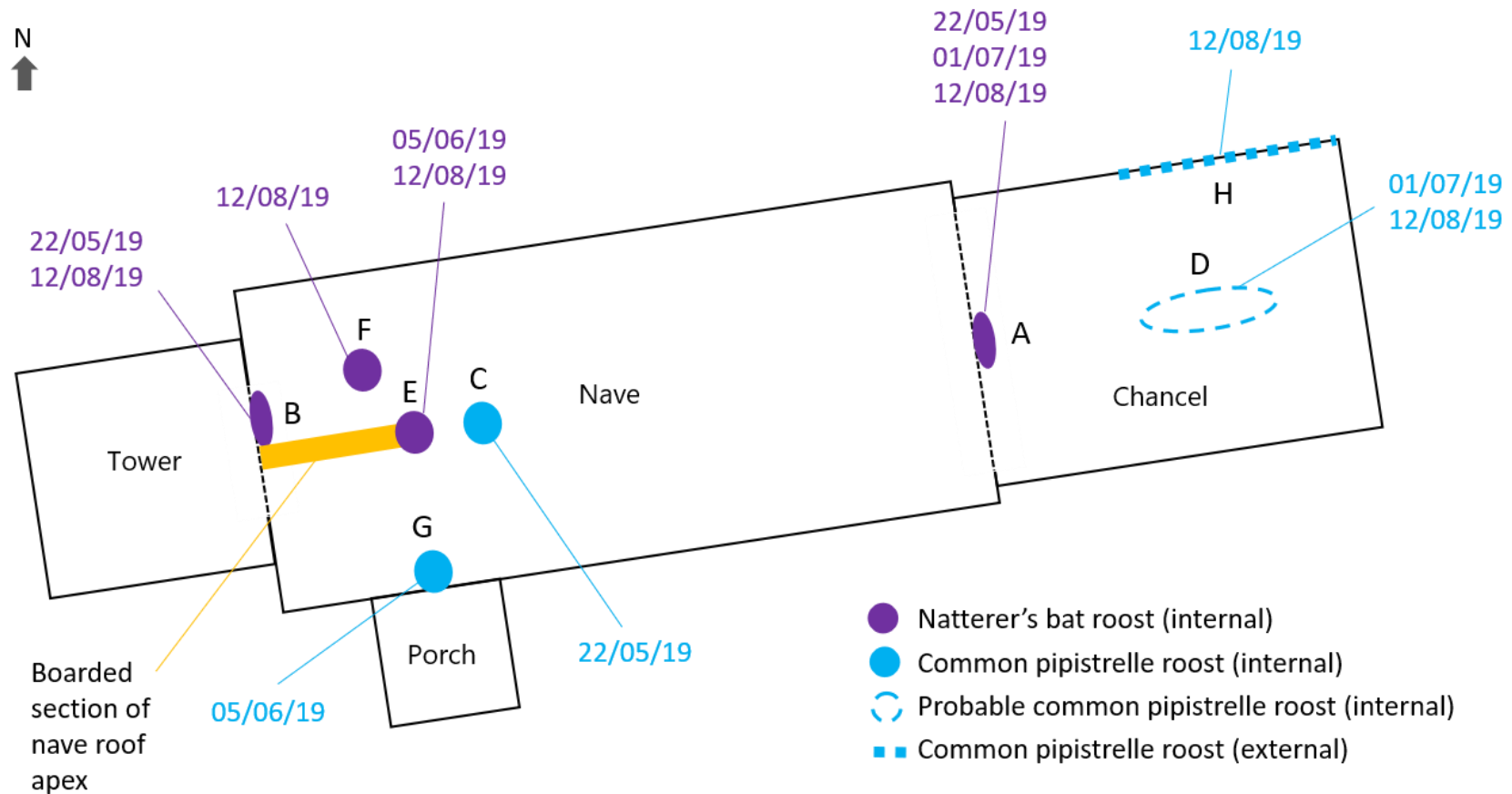


Figure 7. Roost locations (labelled A-G) of Natterer's bats (purple) and common pipistrelles (blue) identified during activity surveys (survey dates given) through either internal observations of bats emerging/re-entering the roosts at these locations/through concentrations of droppings on the floor beneath these locations (A-G) or through internal and external simultaneous observations confirming bats were roosting externally i.e. re-entering from the outside but not passing through to the building's interior (H).

5. Discussion

The data indicate that All Saints' is home to small Natterer's bat and common pipistrelle maternity colonies (maternity status based on numbers and seasonality), with occasional (day roost) use by two other species (brown long-eared bat and soprano pipistrelle). The main Natterer's bat roosts are located in the chancel arch (chancel side) and at several locations at the western end of the nave (including above the nave/tower arch). Common pipistrelle roosts are at two locations in the nave roof (towards the western end, one at the apex and one in the south side of the roof) with a probable roost in the chancel roof also (see Figure 7). The church is quite 'bat-porous' with a large number of individual access points used at eaves level along the nave and chancel, but concentrated at the west of the nave (both north and south elevations, see Figures 5 & 6). There is also an exterior (i.e. bats do not pass through to the interior) common pipistrelle roost on the north side of the chancel.

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

Natterer's bat colony size as follows:

- 2011-2013: >100 (see 2.2.3)
- 2019: 7-14 (four counts May-August, see 4.2)

It is not known what the colony size for common pipistrelles was in the past (or even if one was present); the presence of a common pipistrelle colony is not mentioned in the Zeale *et al.* (2014) research. It is possible that while Natterer's bat numbers at the church have decreased, numbers of common pipistrelles roosting there may have increased.

The decreased numbers of Natterer's bats 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 that none of the alternative roosts used by the colony during the Zeale *et al.* (2014) research were identified as potential colony roosts, 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 and level of monitoring. 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. Despite the modest colony sizes, in this small church the impacts on the building are significant, sustained and difficult to manage by alternative means. Partial exclusion (from the interior) 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 and common pipistrelle maternity colonies to contained locations/exterior roosts 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 proposed approach makes use of the knowledge gained from the bats in churches research studies (Zeale *et al.* 2014 and Packman *et al.* 2015) and will offer a range of roosting opportunities suitable for the species and roost types present.

5.1. Proposed management plan

At a progress meeting on 12th November 2019 (attended by the Churchwarden Colin Vogel, Bats in Churches Engagement Officer Diana Spencer and Ecologist C. Packman), management options and proposals were discussed and an approach agreed. The Churchwarden asked if the large interior bat box at the east end of the south side of the nave could be removed. This box has been in place for more than 5 years, has been checked periodically 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 have no objection to this being removed in light of the proposed measures to be implemented.

In addition to the measures proposed below, it would be worth investigating if there is potential to enhance roosting opportunities for bats in the nearby woodland County Wildlife Sites (Little Model Wood and Great Model Wood, see Figure 2), if the woodlands are suitable for this purpose and if the landowners can be contacted and are willing to grant permission for this e.g. bat boxes (design suitable for use by Natterer's bats and common pipistrelles) erected on trees. Natterer's bats are primarily a woodland bat and enhanced roost provision close to suitable foraging areas could potentially help ease pressure on the church in the longer-term. Both Natterer's bats and common pipistrelles are known to use woodland bat boxes.

The proposed management approach is as follows (refer to Figure 8 for church plan annotated to show locations of proposed interventions and Figure 9 for images illustrating some of the proposed measures):

Rafter bat boxes x4

- Rafter bat boxes to be built-in at four access points (including the major access locations and to provide a range of conditions): two at the west end of the south side of the nave (between rafters 1-2 and 5-6, counting from the west end of the nave), one at the west end of the north side of the nave (between rafters 5-6, counting from the west end of the nave, see Figure 6) and one at the east end of the south side of the nave (exact location to be confirmed, but probably in easternmost bay).
- We are not proposing use of a heat mat for the box on the northern elevation or roost cameras for monitoring purposes as there is no electrical supply at the church.
- 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 (and likely associated negative impacts on the bat population).
- 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/early May 2021).
- 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 (night-time), in Year 2.

Blocking & one-way excluders

- Blocking of alternative access points into the church interior along the eaves of the north and south sides of the nave (other than the access points at the locations of the rafter bat boxes and one-way excluders) and chancel, if needed.
- Blocking would be temporary/reversible (with foam sponges which allow air through)
- Fitting of one-way excluders at 2-4 access locations along north and south 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).
- Monitoring would determine if further blocking is required on a reactive basis (a cherry picker may be needed).

Enhancements to tower

- Access to the tower (from eaves of tower roof) retained and a range of suitable bat roost niches/wooden crevice bat boxes to be erected in the upper section of the tower (on each aspect and including some features suitable for hibernation use).
- Blocking of gaps between the first floor of the tower and the church interior.

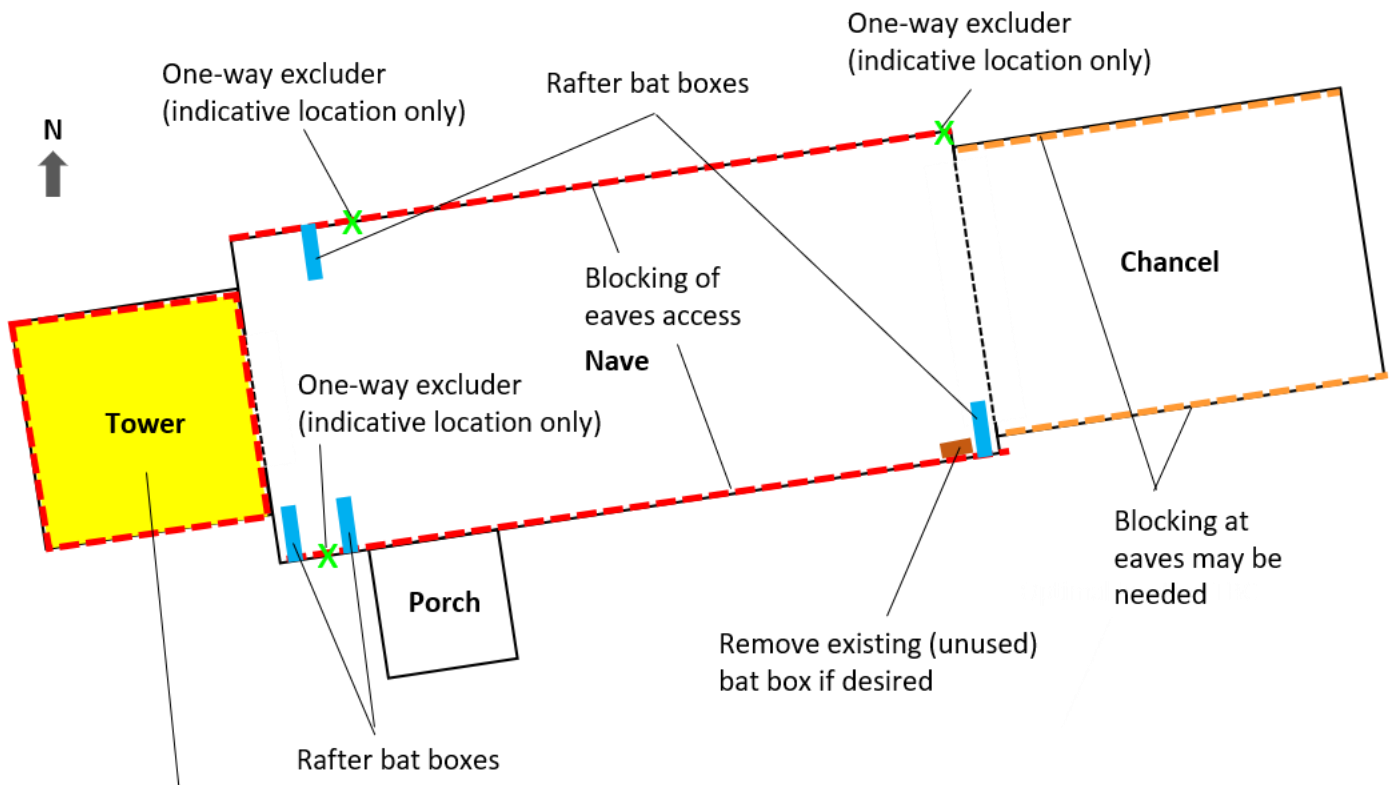
Access to existing exterior church roost retained

- Access to the existing exterior common pipistrelle roost (north side of chancel) to be retained.

Monitoring methods

- Without an electrical supply at the church, there is no scope to use roost cameras for monitoring uptake of rafter boxes.
- **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 (if Favourable Conservation Status² is being maintained or not); particularly important in light of observed declines in numbers here in recent years. Ringling was originally undertaken as part of the Zeale *et al.* (2014) work so would enable this to be renewed and continued to maximise information gained.
- Regular **activity surveys** (and **visual inspections**) to check numbers, access locations and roost locations. A static detector may also be left inside the church to monitor activity, if needed.

² In Article 1(i) of the European Union Habitats Directive, the conservation status of a species is defined as ‘*the sum of the influences acting on the species concerned that may affect the long term distribution and abundance of its populations*’ and further that ‘**conservation status will be taken as “favourable” when: population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis**’.



Enhance roost suitability with provision of roost niches/boxes in upper section of tower, access retained at tower eaves, blocking of gaps around first floor to church interior

Figure 8. Annotated church plan showing locations of the proposed management interventions. Note exact locations (and numbers) of one-way excluders would be determined during the blocking work.



Figure 9. Illustrations of proposed measures.

Summary of roost options provided/retained:

- Four interior rafter bat boxes (x2 west end of south side of nave, x1 west end of north side of nave and x1 east end of south side of nave).
- One exterior roost retained (common pipistrelles, north side of chancel).
- Access to tower retained and roost options/availability enhanced.
- Explore potential for roost enhancements (bat boxes) in nearby CWS woodlands.

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 fully 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.

The proposed approach will provide a range of different roost options and conditions and uses a phased approach, thereby maximising the likelihood of uptake by the bats and minimising the risk of impacting negatively on the bat population. Comprehensive monitoring is *essential* to assess the effectiveness of the approach both in terms of reducing the impact of bats on the church *and* protecting the bat population (i.e. has Favourable Conservation Status been maintained?) and also to determine the suitability of this approach to help other churches in future.

5.2. Schedule of works

The schedule of works for Year 1 (2020) and Year 2 (2021), the first and second phases of the management plan 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 x4 (access to interior retained)	Grey	Grey	Red	Red	Red	Blue	Blue
*Initial temporary blocking of eaves north and south sides of nave & fitting of one-way excluders	Grey	Grey	Red	Red	Red	Blue	Blue
*Installation of roost enhancements to tower & blocking of gaps between first floor of tower and church interior	Grey	Grey	Red	Red	Red	Blue	Blue
Visual inspections, bat activity survey monitoring (can be done with social-distancing protocols)	Grey	Grey	Blue	Blue	Blue	Blue	Blue
* Ringing session x1	Grey	Grey	Red	Red	Blue	Blue	Blue
*Additional blocking, if required (subject to findings from monitoring)	Grey	Grey	Red	Red	Red	Blue	Blue
Investigate options for woodland CWS bat boxes	Grey	Grey	Blue	Blue	Blue	Blue	Blue

****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 x4 to access points (blocking access to church interior)	Blue	Blue	Red	Red	Blue	Blue
Visual inspections, bat activity survey monitoring	Blue	Blue	Blue	Blue	Blue	Blue
Ringing sessions x2	Blue	Blue	Red	Red	Blue	Blue
Additional blocking, if required (subject to findings from monitoring)	Blue	Blue	Red	Red	Blue	Blue

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 All Saints Toftrees. Additional monitoring through annual trapping surveys and ringing 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 timeframes.

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 (2016) Core sustenance zones: determining zone size. Bat Conservation Trust, London. Available at https://cdn.bats.org.uk/pdf/Resources/Core_Sustenance_Zones_Explained_04.02.16.pdf?mtime=20190219173135&focal=none
- 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 All Saints' Church, Toftrees, 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>
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Appendix 1: Bat Roost Visit Report Form, Sept 2017

'Bats in Churches Heritage Lottery Fund Heritage Grant Bat Roost Visit Report Form' – completed 12th 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 (main access circled in red).

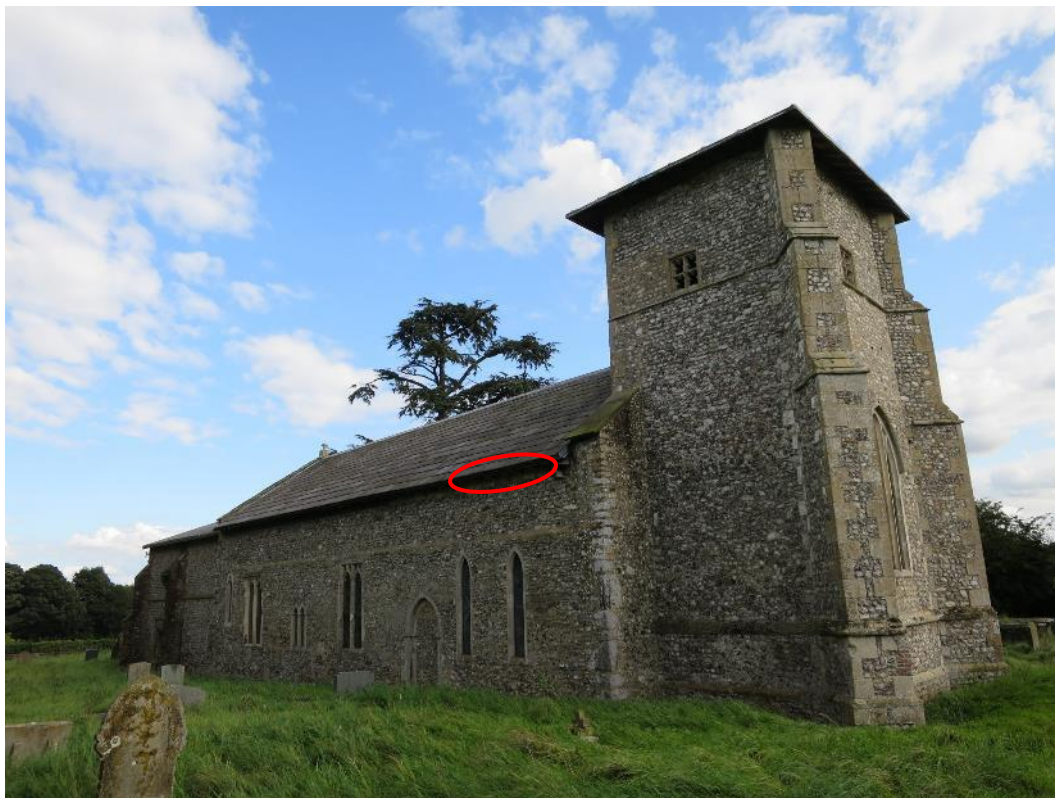


Photo 2. Northern elevation (main access circled in red).



Photo 3. North-eastern end of chancel, with 'exterior' common pipistrelle roost area circled in red (access at eaves, around ivy patch, roost H in Figure 7).



Photo 4. Nave interior (from west end facing east).



Photo 5. Chancel interior (facing east). Probable common pipistrelle roost above central ridge beam/sarking boards circled in red (roost D in Figure 7).



Photo 6. West end of chancel roof interior. Natterer's bat roost access circled in red (roost A in Figure 7).



Photo 7. West end of nave roof interior, nave/tower arch and tower. Natterer's bat roost circled in red (B in Figure 7). Note droppings' staining on walls.



Photo 8. Nave roof interior (west end), roosts circled in red and labelled (see Figure 7). C is a common pipistrelle roost, E & F are Natterer's bat roosts.



Photo 9. Bat box on south side of nave interior (east end).



Photo 10. Typical access to/from the outside at eaves (circled in red).



Photo 11. Tower roof interior.



Photo 12. Bat droppings at west end of nave (beneath roost B, Figure 7) with staining/bleaching to ledger.



Photo 13. Font covered with plastic sheeting for protection from bat droppings/urine.



Photo 14. Bat urine bleaching on pews.

Appendix 4: Budget/estimated costs

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