Wild Wings Ecology



Bats in Churches Project: Holy Trinity Church Great Hockham Bat Survey & Management Plan Report January 2020 (revised v1.1 June 2020)



© All rights reserved, Wild Wings Ecology Ltd 2020. No part of this document is to be copied or re-used without the explicit permission of Wild Wings Ecology Ltd. Natural England, as the organisation who commissioned this work, are exempt from this requirement and may copy and re-use this report as needed.

Company Registered in England and Wales No. 11682642 VAT Registration No. 309464984

Quality Assurance: This report and the data it contains have been collected and compiled in accordance with the Chartered Institute for Ecology and Environmental Management's (CIEEM) Code of Professional Conduct and the report has been prepared in accordance with CIEEM's Guidelines for Ecological Report Writing.

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	Holy Trinity Church, Great Hockham, Thetford, Norfolk, IP24 1NZ.
Site grid reference	TL 95069 92097
Survey period	May – August 2019
Report date	4 th February 2020, updated 3 rd June 2020 (v1.1) with revised Schedule
	of Works needed due to Covid-19 restrictions

Wild Wings Ecology Ltd, The Enterprise Centre, University of East Anglia, Norwich Research Park, Norwich, Norfolk, NR4 7TJ.

Wild Wings Ecology

Surveys • Training • Research

Email: info@wildwingsecology.co.uk Phone: 01603 339 043 Website: www.wildwingsecology.co.uk



Contents

Figu	ires	& table	S	4
1.	Sun	nmary		6
2.	Intr	oductic	on	7
2.	1.	Purpos	se	7
2.	2.	Holy T	rinity Church, Great Hockham	7
	2.2.	1. Lo	cation	7
	2.2.	2. Sta	atement of Significance	7
	2.2.	3. Hi	story of bat use/previous bat survey work	9
3.	Me	hodolo	ogy	15
3.	1.	Visual	inspection	15
3.	2.	Bat act	ivity surveys	15
4.	Res	ults		20
4.	1.	Visual	inspection	20
4.	2.	Bat act	ivity surveys	23
5.	Dise	cussion		29
5.	1.	Propos	ed management plan	
5.	2.	Schedu	ule of works	36
6.	Ref	erences	5	
Арр	end	x 1: Bat	: Roost Visit Report Form, Sept 2017 (separate document)	40
Арр	end	x 2: Ba	ts in Churches Class Licence Survey Criteria	40
Арр	end	x 3: Ph	otographs (general)	42
Арр	end	x 4: Bu	dget/estimated costs (separate document)	49



Figures & tables

Table of figures

Figure #	Figure description	Page #
1.	Location (landscape scale) of Holy Trinity Church, Great	8
	Hockham (with bat Core Sustenance Zones)	
2.	Holy Trinity Church, Great Hockham and surrounding habitats	9
	(with nearby County Wildlife Site)	
3.	2014 dusk emergence counts showing numbers of Natterer's	12
	bats emerging from different exit points (taken from Packman	
	<i>et al.</i> 2015)	
4.	2014 main roost areas and bat access points to the church	13
	interior before and during acoustic deterrent use (taken from	
	Packman <i>et al.</i> 2015)	
5.	Alternative day roosts used by adult female Natterer's bats	14
	radio-tagged at the church in 2013 & 2014 (taken from	
	Packman <i>et al.</i> 2015)	
6.	2019 bat activity survey locations of surveyors and infrared	19
	cameras	
7.	Visual inspection results from Light Touch Survey 25/09/17,	22
	updated 07/05/19	
8.	Results from 2019 bat activity surveys	25
9.	Roost locations during 2019 bat activity surveys	26
10.	Annotated photo showing main access point and roost location	27
	for brown long-eared bats and main access point into/from the	
	church interior for Natterer's bats	
11.	Annotated infrared photos showing interior roost locations	28
	during 2019 bat activity surveys	
12.	Annotated church plan showing locations of proposed	33
	management interventions (and roosts to be retained/not	
	affected)	
13.	Photos/illustrations of proposed measures	34
14.	Rafter bat box design	35



Table of tables

Table #	Table description	Page #
1.	Surveyor details	17
2.	Bat activity survey details	18
3.	Emergence/re-entry counts for dusk survey 7 th May 2019	24
4.	Emergence/re-entry counts for dusk survey 8 th July 2019	24
5.	Emergence/re-entry counts for dusk survey 27 th August 2019	24
6.	Emergence/re-entry counts for dawn survey 21 st June 2019	24
7.	Year 1 (2020) schedule of works	37
	(revised due to Covid-19 restrictions)	
8.	Year 2 (2021) schedule of works	37



1. Summary

Holy Trinity Church, Great Hockham 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 the Heritage Lottery Fund).

Holy Trinity Church is home to maternity colonies of Natterer's bats and brown longeared bats. Smaller numbers of common and soprano pipistrelles also roost at the building. The church has experienced long-term negative impacts from the presence of bats in the church interior, with staining (from droppings and urine) on floors, walls (including medieval wall paintings), pews, ledger stones, brasses, wall memorials and organ pipes.

The church representatives are keen for the bats to be excluded from the church interior and, given the significant 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 risks to the bats.

The proposed management plan would involve construction of four artificial roosts (rafter bat boxes) around existing access points/roost areas in the church interior (at each end of the north and south aisles) and an exterior bat box on the south nave clerestory wall. The two north aisle rafter bat boxes would be fitted with heat pads to compensate for the northerly aspect and all four rafter boxes would have roost cameras installed to facilitate monitoring. In Year 1 (2020) these would be installed with an interior access slot, allowing the bats to familiarise themselves with the new roost provision whilst still having access to the church interior (thus reducing the risk of desertion and negative impacts on the bat colonies). Access to the existing (suspected) exterior pipistrelle roosts (in the church structure but without access to the interior) would be retained, along with the self-contained brown long-eared bat maternity roost in the chancel roof void (without direct access to the church interior).

In Year 2 (2021), providing the monitoring results are positive, the interior access slots in the rafter bat boxes could be closed up, thereby blocking access to the church interior whilst providing a variety of roosting spaces and conditions.

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. Unusually, at this church the Natterer's bats have a linked maternity roost (location unknown) and a number of alternative tree roosts – consequently radio-tracking should be a priority here. Monitoring proposed will include: visual inspections, bat activity surveys, radio-tracking and ringing (the latter 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 Holy Trinity, Great Hockham 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. Holy Trinity Church, Great Hockham

2.2.1. Location

Holy Trinity Church is located along a track approximately 350m to the south-west of Wretham Road, Great Hockham, Thetford, Norfolk, IP24 1NZ (grid reference: TL 95069 92097), see Figures 1 & 2. There are a significant number of protected sites nearby, the nearest being The Crescent and Fish Pond County Wildlife Site (ref 828) and Land in Great Hockham CWS (ref 2126), located to the west of the church (see Figure 2) and, just beyond that (800m west of the church), Breckland Forest Site of Special Scientific Interest and Breckland Special Protection Area.

2.2.2. Statement of Significance

Executive Summary of Statement of Significance, written by Richard Halsey (2019):

"A mainly fourteenth century aisled church but with an eleventh century west wall which had a tower beyond until the early eighteenth century. The octagonal western bellcote is of 1854, and the interior furnishings are of a similar date. Much medieval fabric survives, including in the roofs, though these were extensively repaired in 1953. It was then that the remarkably complete fifteenth century wall painting over the chancel arch was discovered, an Exaltation of the Holy Cross that incorporated the three dimensional Rood (now missing). Less complete wall paintings were also found on the north aisle wall.

There are some well carved and quite inventive fifteenth century bench ends now at the ends of nineteenth century benches on a 1970s concrete paviour floor. The clear windows were also re-glazed in 1970, this with the floor giving the interior a partly modern character. The wall memorials are mainly simple marble tablets, but a 1673 chancel memorial has the usual memento mori to its frame. There are some black and limestone ledger stones in the chancel and sanctuary floors.



At least three bat species have been using the church this century but the 2017 Light Touch Survey and parishioners' observations suggest there is less activity than in 2013-14, when some bat boxes were installed. Nevertheless, all the walls (including the wall paintings) and horizontal surfaces have bat droppings all over them and bat urine streaks are very visible on the organ pipes and ledger stones. More surveying is recommended to determine the species and their activities in the hope that further measures can be undertaken to exclude them from the church. In the meantime, protection should be given quickly to the north aisle paintings below a roost and, if possible, to the precious chancel arch paintings."



Figure 1. Location (landscape scale) of Holy Trinity Church, Great Hockham (red star) on Google Earth Pro 2018 aerial image. Yellow circle indicates the 2km radius Core Sustenance Zone¹ (CSZ) around the church for common pipistrelles, green circle indicates

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).



the 3km radius CSZ for brown long-eared bats and soprano pipistrelles and the blue circles indicates the 4km CSZ for the Natterer's bat colony.



Figure 2. Holy Trinity Church, Great Hockham (circled in red) with surrounding habitats - Google Earth Pro 2018 aerial image. Nearby County Wildlife Sites (CWS), The Crescent & Fish Pond Wood CWS and Land in Great Hockham CWS are outlined in green.

2.2.3. History of bat use/previous bat survey work

Holy Trinity 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 light and 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):

- Great Hockham Church estimated colony size 60-80 Natterer's bats (2011-2013).
- Light deterrents were trialled at Great Hockham Church in 2013, with the aim of creating 'no-fly zones' to limit dropping and urine deposition from bats flying inside the building. The light deterrents at this church reduced bat activity inside the building (results at different churches were variable) however there was significant light spill into intended 'dark' areas (reducing activity in these areas too). Negative impacts on emergence behaviour and nocturnal bat activity were recorded, with bat emergence times becoming highly variable (often much later than normal) and some bats failing to emerge altogether.
- For all Natterer's bats radio-tracked at eight church study sites (these did not include Great Hockham):
 - 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 \pm 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 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 Status² of church Natterer's bat colonies are highlighted in light of the above two points.

²Article 1(i) of the EU Habitats Directive defines the conservation status of a species as "the sum of the influences acting on the species concerned that may affect the long term distribution and abundance of its populations" and states "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...".



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 9th June and 5th September 2014, with numbers of Natterer's bats present varying substantially during this period. Most notably, numbers were very low throughout June (5-10 Natterer's bats present only), then peaked at 87 Natterer's bats in July (7th) before gradually declining to 19 on 12th August and then rising again to 45 on 5th September (the latter usually at a time when numbers at the churches are falling as bats disperse in the post-maternity period (see Figure 3). This would suggest that Natterer's bats were not giving birth to their pups or raising them in the early stages at the church. Instead it appears that the colony returned once pups were volant, in July.
- Natterer's bats were found to roost at a number of different locations in the nave, south aisle and north aisle (see Figure 4). The major access point was located at the east end of the north aisle, with more minor access points at the west end of the north aisle and east and west ends of the nave (see Figure 4).
- Short-term spring and longer-term late summer acoustic deterrents trials were effective in moving the colony from the main roost area and preventing dropping deposition at that location. However, with multiple roost locations, the effectiveness of acoustic deterrents in reducing the impact of the bats on the church was limited.
- Fifteen adult female Natterer's bats were radio-tagged at the church in mid-May and a further four in early August 2014. The roosting behaviour of bats at this church differed somewhat from the other study churches. There was a higher proportion of occurrences of bats roosting outside of the church during the nine-day spring radio-tracking deterrent trials (all were tree roosts). Furthermore, this was the only church for which a significant alternative colony roost (beyond the church) was located (in a tree used by 19 Natterer's bats simultaneously). However, this alternative colony roost was not used by the bats at the time of giving birth and raising their young pups in June. The majority of the alternative roosts used by the Natterer's bats were in trees in the Hockham Block of Thetford Forest, but there was also a cluster of tree roosts around the churchyard (see Figure 5).



Bat surveys undertaken by Philip Parker Associates in relation to a European Protected Species (EPS) mitigation licence for chancel roof repair works: 28th August 2013

- 96 Natterer's bats recorded emerging from the church.
- 37 brown long-eared bats emerged from the chancel roof void.
- Small numbers of common (4) and soprano pipistrelles (7) were also recorded at the church.



Figure 3. Dusk emergence counts showing numbers of Natterer's bats emerging from different exit points at Great Hockham Church, along with application of the Deaton acoustic deterrent. Taken from Packman *et al.* 2015.





Figure 4. Simplified plan of Great Hockham Church (not to scale) showing main roost areas and bat access points to the church interior before and during deterrent use (Phase 2, August-September trials). Taken from Packman *et al.* 2015.





Figure 5. Alternative day roosts used by adult female Natterer's bats radio-tagged at Great Hockham Church, September 2013 (from Zeale *et al.* (2014), n = 10 bats tagged, four roosts located (A)) and May (n = 15 bats tagged, three roosts located (B)) and August 2014 (n = 4 bats tagged, five roosts located (C)) marked on a forestry base map provided by Forestry Commission. Dashed lines are labelled with the distance from the main roost (Great Hockham Church) to the alternative roost location. Taken from Packman *et al.* 2015.

Recommendations for Great Hockham Church from Packman et al. 2015 were:

"If the full colony returns to Great Hockham an assessment can then be made as to the best strategy for this church. One potential solution could be to encourage the bats to roost in close proximity to the main exit point at the east end of the north aisle (away from the vulnerable organ and ancient wall paintings). However, with low numbers present during the study period and bats roosting in multiple and frequently changing locations throughout the church, it was not possible to attempt this approach during the project. Bats were found to roost at the east end of the north aisle by Zeale et al. (2014), but not during this project, which may have been due to flood damage rendering the area unsuitable for roosting."



3. Methodology

3.1. Visual inspection

A detailed daytime visual inspection of the church was undertaken on the 7th 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 25th 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 details).

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.

PCC member Joanne Wyatt and Churchwarden Jamie Plummer 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).

Dusk emergence surveys were undertaken on: 7th May, 8th July and 27th 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 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 21st 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. 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.

Six/seven 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 6 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 reentry 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 using Kaleidoscope Viewer (Wildlife Acoustics).



Surveyor name & gualifications	Initials	Bat licences held	Licence numbers
Dr Charlotte Packman	СР	Bats in Churches Class Licence (CL32) Level 2	B32RC001
BSc (Hons), MSc, PhD		Bat Mitigation Class Licence (CL21)	RC155
CEcol ¹ MCIEEM ²		Level 3 Bat Survey Class Licence (CL19)	2015-16479-CLS-CLS
		Level 4 Bat Survey Class Licence (CL20)	2015-11760-CLS-CLS
Philip Parker	PP	Bats in Churches Class Licence (CL32) Level 1	B32RC007
BA (Hons)		Bat Mitigation Class Licence (CL21)	RC091
CEnv ³ MCIEEM ²		Level 2 Bat Survey Class Licence (CL18)	2015-14467-CLS-CLS
Ben Jervis	BJ	Level 2 Bat Survey Class Licence (CL18)	2016-25752-CLS-CLS
BSc (Hons), MSc			
MCIEEM ²			
Christine Hipperson	СН	Level 2 Bat Survey Class Licence (CL18)	2015-16077-CLS-CLS
BSc (Hons)			
MCIEEM ²			
Holly Nichols	HN	Level 2 Bat Survey Class Licence (CL18)	2020-44423-CLS-CLS
BSc (Hons)			
Steven Gilham	SG	Level 2 Bat Survey Class Licence (CL18)	2020-44376-CLS-CLS
BSc (Hons)			
Karl Charters	KC	Level 2 Bat Survey Class Licence (CL18)	2015-13353-CLS-CLS
BSc (Hons)			
John Worthington-Hill	JWH	n/a	n/a
BSc (Hons), MSc			
Rebecca Easter BSc	RE	n/a	n/a
(Hons), MSc			
Becky Hazlewood	BHa	n/a	n/a
MSc			
Becca Hipperson	BHi	n/a	n/a
Lisa Gabriel	LG	n/a	n/a

Table 1. Surveyor names, initials (as used in Table 2 and Figure 6) and credentials.

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/	Date	Survey timings			Weather conditions					
dawn survey		Sunset/ sunrise	Survey start	Survey end	Start temp. (°C)	End temp. (°C)	Precipitation	Windspeed (Beaufort Scale)	Cloud cover (%)	
Dusk 1	07/05/19	20:32	20:25	22:00	10	8	Light - became constant	0	90	
Surveyors	s: CP, LG, KC	, RE, PP, JV	VH, BHa							
Dusk 2	08/07/19	21:18	21:03	22:53	14.4	10.6	Nil	0	90	
Surveyors	s: CP, HN, SC	G, BJ, CH, P	P							
Dusk 3	27/08/19	19:56	19:41	21:19	24.4	22.5	Nil	0	80-100	
Surveyors: CP, BJ, HN, SG, JWH, CH										
Dawn 1	21/06/19	04:33	02:38	04:27	10.2	6.2	Nil	1-2	40-50	
Surveyors	s: CP, HN, BH	Hi, BJ, CH, S	SG							





Figure 6. 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 church plan (by Nicholas Warns Architects). 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 Holy Trinity Church, Great Hockham '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 7th May 2019 are summarised here and, for the visual inspection element, in Figure 7. Photographs of the church are provided in Appendix 3.

Holy Trinity is a medieval flint church with pantile (nave and chancel), lead (aisles), peg tile (kitchen and toilet extension) and slate (porch) roof coverings. The original tower collapsed and there is now instead a bellcote supported by what is likely to have been the remains of the tower arch (Halsey 2019).

Long-term impacts from bats can be seen throughout the church: staining/bleaching from bat droppings/urine on floor tiles, walls (including wall paintings), pews, ledger stones, brasses, wall memorials and the organ pipes. At the time of the visual inspection, fresh Natterer's-type droppings were concentrated at the west end of the south aisle with some also at the corners of the east end of the south aisle (R2, Figure 7). During the 2017 Light Touch Survey visual inspection, droppings were evident at these locations as well as concentrations at the west end of the nave and east and west ends of the north aisle (R2, Figure 7). The distribution of droppings indicated roost presence along the nave ridge (R1, Figure 7) and at the ends of both aisles, with some more minor roosts likely to be present along the northern side of the south aisle, southern side of the north aisle, west end of the nave and porch roof void. There are confirmed (Zeale *et al.* 2014 and Packman *et al.* 2015) access points at the east end of the north aisle, northern side of the nave (particularly at the west end) and west end of the south aisle. There is potential further access along the lengths of the aisles and nave; the building appears to be quite 'bat-porous'.

The church representatives described concerns about bat droppings and urine (and the substantial cleaning burden they create) and damage to furnishings, artefacts, memorials and the organ. Of particular concern is droppings and urine staining to the wall paintings (located at the east end of the nave and north wall of the north aisle).

Measures taken to date to try to manage the impact of bats on the church include plastic sheet coverings, cleaning, light deterrent trials (Zeale *et al.* 2014, see 2.2.3) 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 (especially with regards to the wall paintings, which cannot easily be protected) 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 7. Visual inspection results from Light Touch Survey 25/09/17, updated 07/05/19 (annotated on plan in blue). Plan not to scale. Rx indicates roost locations (see main text and 2017 Bat Roost Visit Report Form, Appendix 1).



4.2. Bat activity surveys

Species in tables/figures/text reported as:

- *P.pip = Pipistrellus pipistrellus* (common pipistrelle)
- *P.pyg* = *Pipistrellus pygmaeus* (soprano pipistrelle)
- *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 (all species) was recorded during the August dusk emergence survey (when juveniles would have been volant), with a total count of 63 bats leaving the church. The highest count for Natterer's bats was 38 (7th May) and for brown long-eared bats (roosting in the chancel roof void) was 24 (27th August). Common pipistrelle numbers peaked at 10 (27th August) and the highest soprano pipistrelle count was 7 (21st June), giving a total of four species recorded using the church during the surveys (see Tables 3-6). Natterer's bat numbers were noticeably low during the June (dawn) survey, with just three individuals counted.

Most emergence (and re-entry) for Natterer's bats (and for pipistrelle species accessing the church interior) was at eaves level at the east end of the north aisle (Figures 8 & 10). Small numbers of Natterer's bats also exited from the west end of the nave (and one from the west end of the north aisle). Individual pipistrelles also exited/entered the building at other points along the north aisle, west end of the south aisle and west end of the nave (south side), but at least some of these appeared to be external roosts only (i.e. without the bats passing from/to the interior of the church). Almost all of the brown long-eared bats emerged from a vent high up on the east gable end of the chancel (see Figures 8 & 10), with small numbers occasionally also emerging from the south and north sides of the chancel roof.

There are many different roost areas that have been identified in the church over the multiple years of study (see Figures 7 & 9). During the 2019 activity surveys, Natterer's bats (and the occasional common pipistrelle) were mostly roosting at the western end of the south aisle (north wall, roosts D & E in Figures 9 & 11), although droppings also indicated roosting activity further east of this location (roost C in Figure 9). Small numbers of soprano pipistrelles were observed using roosts at the east end of the south aisle (north and south walls, roosts A & B in Figures 9 & 11). It is also thought that some of the pipistrelles at the church are roosting externally, as noted above. The brown long-eared bat roost is located in the chancel roof void (without access to the church interior, roost F in Figure 9, see also Figure 10).



Species	es Emergence Re-en		Time of first	Time of last	Total
			exit/entry	exit/entry	
P.pip	1	0	20:42	20:42	1
M.nat	38	0	20:38	21:36	38
P.aur	1	0	20:48	20:48	1
Bat sp.	2	3*	20:45	21:33	2
				Total	42

Table 3. Emergence/re-entry counts by species for the dusk survey on 7th May 2019.

*3 re-entered at the end of the survey – no further bats emerged so not deducted from the total

Table 4. Eme	rgence/re-entry co	ounts by species	for the dusk surve	y on 8 th July 2019.
--------------	--------------------	------------------	--------------------	---------------------------------

Species	Species Emergence Re-entry		Time of first	Time of last	Total
			exit/entry	exit/entry	
P.pip	2	0	21:37	21:40	2
M.nat	16	0	22:15	22:34	16
P.aur	20	5	21:43	22:49	15
P.pyg	3	0	21:36	21:40	3
				Total	36

Table 5. Emergence/re-entry counts by species for the dusk survey on 27th August 2019.

Species	Species Emergence Re-entry T		Time of first	Time of last	Total	
			exit/entry	exit/entry		
P.pip	10	0	20:08	20:53	10	
M.nat	22	0	20:40	21:02	22	
P.pyg	6	0	19:59	20:13	6	
P.aur	24	0	20:19	20:50	24	
Bat sp.	1	0	20:08	20:08	1	
				Total	63	

Table 6. Emergence/re-entry counts by species for the dawn survey on 21st June 2019.

Species	Emergence Re-entry		Time of first	Time of last	Total
			exit/entry	exit/entry	
P.pip	1*	2	02:59	03:54	2
M.nat	3	5	02:49	03:20	3**
P.pyg	n/a	7	03:26	04:15	7
P.aur	n/a	16	03:37	04:04	16
				Total	29

*Emergence before re-entries

**Counted as 3 total (minimum) as 1 of the 3 emergences was before any re-entries.





Figure 8. Results from the bat activity surveys (dusk 7th May, 8th July and 27th August 2019 and dawn 21st June 2019) shown on a plan of the church (Nicholas Warns Architects): emergence (blue circle & arrow)/re-entry (red circle and arrow) locations, species and numbers.





Figure 9. Roost locations (labelled A-F) 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 (C) or through internal and external simultaneous observations confirming bats were likely to be roosting externally i.e. re-entering from the outside but not passing through to the building's interior. Note this is not a comprehensive record of all roosts – only those that were evident during the 2019 activity surveys. Information overlaid on church plan by Nicholas Warns Architects.





Figure 10. Annotated photo of the northern elevation of the church (with parts labelled) showing main access point and roost location for brown long-eared bats (roost F in text & Figure 9) and main access point into/from the church interior for Natterer's bats.





Figure 11. Annotated infrared photos showing interior roost locations during 2019 bat activity surveys (all in south aisle). Roost labels (A, B, D & E) as in text and Figure 9.



5. Discussion

The data show that Holy Trinity is home to medium-sized maternity colonies of brown long-eared bat and Natterer's bat. For the Natterer's bats however, the picture is a little complex, with the pattern observed in 2014 repeated in 2019: the Natterer's bat colony was present in early May (when numbers were highest, 38), but had disappeared by the time of the June survey (leaving only three individuals) only to return again in July (16) and present still in August (22). So clearly there is another maternity roost used by the colony, particularly at the point of giving birth (late May/early June for Natterer's bats) and raising their young, dependent pups. The impact of bats on the church has not been as severe in more recent years – perhaps coinciding with this shift to using at least one other maternity roost (the pattern we observed in 2014 and 2019 was not reported by Zeale *et al.* (2014) from surveys prior to 2014).

The Natterer's bat colony at the church has been significantly larger in the relatively recent past, with 96 recorded by Philip Parker Associates in August 2013 and Zeale *et al.* (2014) reporting the colony size to be 60-80 Natterer's bats (2011-2013). Our peak count for brown long-eared bats was 24 in August (2019), compared to Philip Parker Associates' count of 37 in August 2013.

The status of the pipistrelle roosts at the church is somewhat ambiguous. Mostly small numbers only (1-3) of common and soprano pipistrelles were recorded during the surveys, with the exception of the June survey when seven soprano pipistrelles were counted and then in August, six soprano pipistrelles and 10 common pipistrelles were present. Given the late season peak in numbers and range of roost locations used at any one time throughout the building (including a number of roosts suspected to be exterior roosts only), this probably does not represent a maternity roost for either species (more likely multiple day roosts). Philip Parker Associates recorded similar pipistrelle numbers in August 2013 (four common pipistrelles and seven soprano pipistrelles).

In 2019 at least, interior roosts were concentrated in the south aisle roof area. For Natterer's bats, these were at the western end (north wall, although droppings indicated another roost further to the east) and for pipistrelles these were mostly at the eastern end (north and south walls). The brown long-eared bat roost in the chancel roof void does not impact on the church, as the roost is 'self-contained' with no direct access into the church interior.

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 still significant (and particularly of concern with regards to the wall paintings), 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 maternity colony 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 1st November 2019 (attended by PCC member Joanne Wyatt, Churchwarden Jamie Plummer, Bats in Churches Engagement Officer Diana Spencer and Ecologist C. Packman), management options and proposals were discussed and an approach agreed.

The church architects, Nicholas Warns Architects, and the Norwich Diocesan Advisory Committee (DAC) will need to be consulted about the proposed management plan. The proposed works *may* fall under List A and List B works which can be carried out without a Faculty, but (for List B) would still need written approval from the Archdeacon.

The proposed management approach is as follows (refer to Figure 12 for church plan annotated to show locations of proposed interventions and Figure 13 for images illustrating some of the proposed measures):

Rafter bat boxes x4 (see Figure 14 for generic rafter bat box design)

- Rafter bat boxes to be built-in at the east and west ends of the north and south aisles. These correspond with (current/past) confirmed access locations and/or are in close proximity to known roost locations.
- The north aisle rafter boxes 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 and as one of the northerly boxes would be positioned at the major entry point into the church, this is particularly important).
- Small 'no-glow' infrared cameras to be fitted at the entrance to each rafter bat box to enable monitoring of use.
- Phased approach: boxes built-in during late August/early September (originally proposed for spring 2020 but not possible due to Covid-19 restrictions). The boxes will connect-up to the interior entry points but with an access slot (initially) to allow bats to pass through into the church interior while becoming familiar with (and being encouraged into) the new roost provision. This should increase the likelihood of uptake and decrease the risk of bats abandoning the church completely when the interior access points are blocked.



- If the results from Year 1 monitoring are positive, the access slots from the rafter bat boxes can be fitted with a one-way excluder (allowing bats to pass from the church interior to the outside) in spring Year 2 (bats need to be active/out of hibernation to ensure individuals are not trapped inside and to allow monitoring).
- Insertion of the wooden slot cut-outs, to complete the blocking of access through to church interior, should be designed-in during Year 1 construction to allow ecologist to complete this once one-way excluders are no longer required and these points can be permanently blocked.

Exterior bat box

• Large wooden crevice-style bat box (painted black) to be positioned on the nave clerestory wall, south side, west end (this is a discrete location, high up and at the 'rear' of the church).

Blocking & one-way excluders

- Blocking of alternative access points into the church interior along the eaves of the north and south aisles (other than the access points at the locations of the rafter bat boxes and one-way excluders) and the nave (particularly the north side, west end).
- Blocking would be carried out from the inside, to allow retention of the (suspected) exterior pipistrelle roosts at eaves level.
- Consideration will need to be given to suitable blocking materials, ventilation etc.
- Blocking along the aisles may be achievable by ladder (or mobile scaffold tower).
- Blocking along the nave would require a cherry picker for access.
- Fitting of one-way excluders at 3-5 access locations along the eaves of the north and south aisles and nave (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 (and should be factored into contingency costings).

Access to existing exterior church roost retained

• Access to the existing exterior pipistrelle roosts (at eaves of nave and aisles), brown long-eared bat maternity roost (in the chancel roof void) and porch roof void to be retained.

Monitoring methods

• As the Natterer's bats at this church, unusually, have a number of alternative roosts beyond the church, including a linked maternity roost (used for giving birth and early stages of raising pups) at an unknown location, **radio-tracking** would be very beneficial here, allowing the colony to be monitored (which otherwise may not be



possible if the bats leave in response to blocking, which is more likely at this church, with the higher usage of alternative roosts). Without radio-tracking it may not be possible to assess if Favourable Conservation Status (see footnote on page 10 for definition) has been maintained. Radio-tagging should be undertaken several days prior to Year 2 blocking-up of rafter bat box access to the interior (second week of May 2021).

- **Ringing** this will enable long-term monitoring of the bat population at the church. Ringing 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. Assessing Favourable Conservation Status requires an understanding of longer-term population dynamics, which can only really be meaningfully achieved with ringing. Ringing 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.

In addition to the measures proposed above, it would be worth investigating if there is potential to enhance roosting opportunities for bats in the Hockham Block of Thetford Forest e.g. bat boxes (design suitable for use by Natterer's bats and pipistrelles) erected on trees. Radio-tracking by Packman *et al.* (2015) revealed a number of tree roosts used by the church Natterer's bat colony in the Thetford Forest Hockham Block. 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 pipistrelles are known to use woodland bat boxes.





Figure 12. Annotated church plan (Nicholas Warns Architects) showing locations of the proposed management interventions (and roosts to be retained/not affected).





Figure 13. Photos/illustrations of proposed measures.





Figure 14. Rafter bat box design (generic), C. Packman.



Summary of roost options provided/retained:

- Four interior rafter bat boxes (one at each end of south aisle, unheated, and one at each end of north aisle, heated). Fitted with roost cameras.
- One exterior bat box at rear of church (south nave, clerestory wall).
- Access to/roosts in chancel roof void (brown long-eared bat), aisle and nave eaves (pipistrelles) and porch roof void retained.
- Explore potential for roost enhancements (bat boxes) in nearby woodlands (Hockham Block of Thetford Forest).

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)							
*Installation of south nave clerestory exterior bat box							
*Blocking of eaves north and south aisles and nave &							
fitting of one-way excluders							
Visual inspections, bat activity survey monitoring (can							
be done with social-distancing protocols)							
*Ringing session							
*Additional blocking, if required (subject to findings							
from monitoring)							
Investigate options for woodland bat boxes (Thetford							
Forest Hockham Block)							

*These activities cannot be done at the current time (02.06.2020) as social-distancing is not possible

Table 8. Year 2 (2021) schedule of works.

Activity	Apr	May	Jun	Jul	Aug	Sep
Trapping, radio-tagging & ringing						
Radio-tracking						
Blocking/one-way excluders fitted to rafter bat box						
interior access slots- 2 days post-tagging						
Visual inspections, bat activity survey monitoring						
Additional ringing session						
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 Holy Trinity, Great Hockham. Additional monitoring through annual trapping 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 longerterm 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 <u>https://cdn.bats.org.uk/pdf/Resources/Core_Sustenance_Zones_Explained_04.02.1</u> 6.pdf?mtime=20190219173135&focal=none
- Halsey, R. (2019) Statement of Significance for Holy Trinity Church, Great Hockham, 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: <u>https://research.historicengland.org.uk/Report.aspx?i=15751&ru=%2fResults.aspx</u> <u>%3fp%3d1%26n%3d10%26rn%3d106%26ry%3d2015%26ns%3d1</u>
- 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: <u>http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=N</u> <u>one&Completed=2&ProjectID=17863</u>



Appendix 1: Bat Roost Visit Report Form, Sept 2017

'Bats in Churches Heritage Lottery Fund Heritage Grant Bat Roost Visit Report Form' – completed 25th September 2017.

Submitted 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. Northern elevation.



Photo 2. Southern elevation.





Photo 3. Nave interior (from west end facing east), with large medieval wall painting on eastern nave wall (above chancel arch).



Photo 4. Chancel interior (facing east). Brown long-eared bat maternity roost in the above roof void.





Photo 5. South aisle (from west facing east).



Photo 6. North aisle (from east facing west, wall paintings visible on north wall).





Photo 7. From south aisle looking across nave to north aisle (organ at west end).



Photo 8. North aisle (east end) major Natterer's bat access point into/from church interior (circled in red, damage to wall from water ingress).





Photo 9. East end of north aisle – major Natterer's bat access circled in red.



Photo 10. Brown long-eared bat access to/from chancel roof void (east end of chancel).





Photo 11. Bat urine staining on organ pipes.



Photo 12. Staining on wall painting (nave east wall, above chancel arch).





Photo 13. Bat droppings on wall.



Photo 14. Bat urine bleaching on pews.





Photo 15. Bat droppings and urine staining on wall memorial.

Appendix 4: Budget/estimated costs

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