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ORIGINAL ARTICLE

Access restrictions at internal entrances to lesser horseshoe bat (*Rhinolophus hipposideros*) roosts within large buildings can protect their populations

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ABSTRACT

Lesser horseshoe bat (*Rhinolophus hipposideros*) roost access points with large dimensions (cross-section area of 0.25 m^2 or more) are frequently used to facilitate pre-emergence flight behaviour. However, when these access points are the only barrier between the external environment and the internal roost, they may also let in light, wind, rain, and other animals. These variables may result in altered roost microclimate and/or predation causing population declines. If extreme, they may cause roost abandonment or eviction by other bats, pigeons (*Columba livia domestica*), jackdaws (*Coloeus monedula*) or owls. We studied the effect of additional physical measures between the external entrance and the roosting area (either an internal barrier or an entrance tunnel) on seven lesser horseshoe bat colonies. Lesser horseshoe populations subsequently increased as a result of successfully excluding either pigeons, jackdaws or greater horseshoe bats (*Rhinolophus ferrumequinum*). Different designs were used depending on the physical characteristics of each roost, and the problem species present. The materials and dimensions associated with each design are provided, so that they can be replicated elsewhere.

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INTRODUCTION

United Kingdom (UK) lesser horseshoe bats (*Rhinolophus hipposideros*) historically roosted throughout the year in caves. This behaviour persists in the southern parts of its global range. Within the UK, caves continue to be used for winter hibernation. However, most summer roosts are now found within buildings (Schofield, 2025). In any year, seven different roost types (day, night, feeding, transitional, maternity, hibernation, satellite) can be used by a bat colony (Collins, 2023). Mating roosts are also important for horseshoe bats, with lesser horseshoe bats thought to use the same mating system as greater horseshoe bats (*Rhinolophus ferrumequinum*) (described by Rossiter *et al.,* 2000) (R. Ransome pers. comm.). Different temperature and humidity roost regimen are required at different times over a year (Ransome, 1998; Downs and Wells, 2021). Roost access points large enough to allow bats to fly through are a requirement for horseshoe bats, since they are unable to gain entry/exit by crawling through crevices (Reason and Wray, 2023).

Schofield (2008, 2025) recommends that a lesser horseshoe bat roost access should ideally provide a cross-sectional area of 0.25 m^2, either square-shaped or rectangular with a minimum height of 0.2 m. This area allows many bats to enter or exit at any one time (Schofield, 2025), and avoids an external bottleneck which could expose bats to predation (Schofield, 1996). However, such dimensions may also let in light, wind, rain, and other animals including predatory birds such as owls (Downs and Wells, 2021). Schofield (2008, 2025) describes how the use of sheet metal can deter predators, and how a hopper/turnstile style entrance can be used to successfully prevent wind/rain/light ingress and deter nesting birds (notably jackdaws, *Coloeus monedula*). Successful barn owl (*Tyto alba*) roost exclusion is described in more detail by Bollo Palacios *et al.,* (2023). Additionally, the provision of a second roost entrance is sensible, in case the main entrance is targeted by predators or becomes blocked (Schofield, 2025). However, these measures are not sufficient to exclude greater horseshoe bats, which can negatively influence lesser horseshoe maternity colonies (Wright *et al.,* 2026) and displace them from their roosts

(Ransome, 2023). Although smaller external roost entrances may achieve this, they also have the potential to cause external bottlenecks during pre-emergence flight behaviour and whenever multiple bats return to roost at the same time. This could increase predation risk (Schofield, 1996), which would increase with increasing colony size.

Smaller internal lesser horseshoe bat roost entrances can exclude greater horseshoe bats. There has been discussion concerning external roost access dimensions (Mitchell-Jones, 2004; Mitchell-Jones and McLeish, 2004; Schofield, 2008, 2025; Reason and Wray, 2023), but not internal ones apart from tunnel access dimensions (Gunnell *et al.*, 2013).

Norberg and Rayner (1987) define bat manoeuvrability as the space required to alter a flight path when flying at a constant speed, and bat agility as a measure of the ease or rapidity with which a flight path can be altered. Ransome (1990) discusses these with reference to bat morphology, concluding that a broad-winged, low wing-loaded bat (such as a lesser horseshoe) would be both highly manoeuvrable, and show low-speed agility. Lesser horseshoe bats are a bat species with one of the smaller wingspans: Dietz (2007) measured the wingspan of 37 lesser horseshoe bats and found it to be between 22.7 – 26.5cm. This species is able to fly through narrow internal spaces and small gaps (R. Ransome pers. comm.). Relatively small differences in behaviour can facilitate the coexistence of different horseshoe bat species (Jiang *et al.,* 2013), hence we predict this ability is significant in allowing coexistence with the much larger greater horseshoe bats (wingspan 33.0-39.5cm) which have reduced manoeuvrability in favour of fast and economic commuting flight over longer distances (Dietz, Dietz and Siemers, 2006).

When exiting a roost lesser horseshoe bats often repeatedly fly out and back in through a roost exit point before leaving to forage (Schofield, 2025). The reasons for this pre-emergence flight behaviour remain unclear, and it may serve multiple purposes including light sampling (Gaisler, 1963: Voûte, Sluiter and Grimm, 1974; Erkert, 1982, Schofield, 2025) and socialising (Andrews and Andrews, 2016; Andrews, Hodnett and Andrews, 2017).

The importance of having large roost entrances which open directly into their foraging habitat was considered by Schofield (1996). He considered that a large opening was necessary for pre-emergence flight behaviour to occur. This study aims to determine the impact of entrance size on roost populations located well within buildings. Our survey studies at various lesser horseshoe bat roosts in different buildings and locations have shown other key considerations that can impinge upon the best entrance size at a specific site. It is impossible to investigate these key factors using standard scientific procedures. Ecological investigations involve too many variables that cannot be controlled. Instead, we used seven lesser horseshoe roost sites, in some cases over decades, to compare population outcomes.

MATERIALS AND METHODS

We surveyed seven sites located in the south-west of England or south Wales (Fig. 1) where a lesser horseshoe bat roost was present. Sites 1 and 5 each contained two surveyed roosts (situated approximately 10m and 150m apart from each other respectively), whereas all the other sites contained one. The separate roosts from Sites 1 and 5 are described as 'a' and 'b' within Tables 1, 2 and 3. The Site 2 'a' and 'b' relate to two different roost entrances to the same roost. Apart from Site 2 (a purpose-built bat house), roosts were all located within established buildings and all but one were subject to modification between 1996 and 2015 (Table 1). Modification primarily resulted from either development (Sites 1, 2 and 6) or conservation actions (Sites 3, 4 and 5). At Site 1 (a stable block), it was possible to monitor roost accesses associated with pre- and post-development roosts, described as 'old' and 'new' respectively within Tables 1,2 and 3.

Fig. 1 - The location of the seven study sites within Great Britain.

Sites 1, 2, 5b and 7 each supported two roost accesses (with different characteristics and dimensions) approximately 10m, 5m (Fig. 2), 15m and 1m (Supplementary Material (SM) Fig. 1) apart respectively. Site 3 had multiple external roost accesses (those used were north facing close to a vegetated bank), whereas Sites 4, 5a and 6 only one.

New roost accesses at Sites 1, 2a and 5a used an external baffle (Figs. 3 & 4, SM Figs. 1-2, Table 2). Site 2 also contained two sets of two Schwegler 1 FE bat access panels (Site 2b), installed at approximately 3 m high at each top corner of the north facing wall. One of each set of panels was installed in the internal wall, and the other opposite on the external wall (separated by approximately 10 cm of cavity wall, Fig. 4). At Site 3 (Woodchester Mansion) a small access point (Table 3) was installed in 1996 to exclude greater horseshoe bats; these had previously gained access and ejected the lesser horseshoe bats (R. Ransome pers. comm.). Sites 3 and 5b contain maternity colonies of both greater and lesser

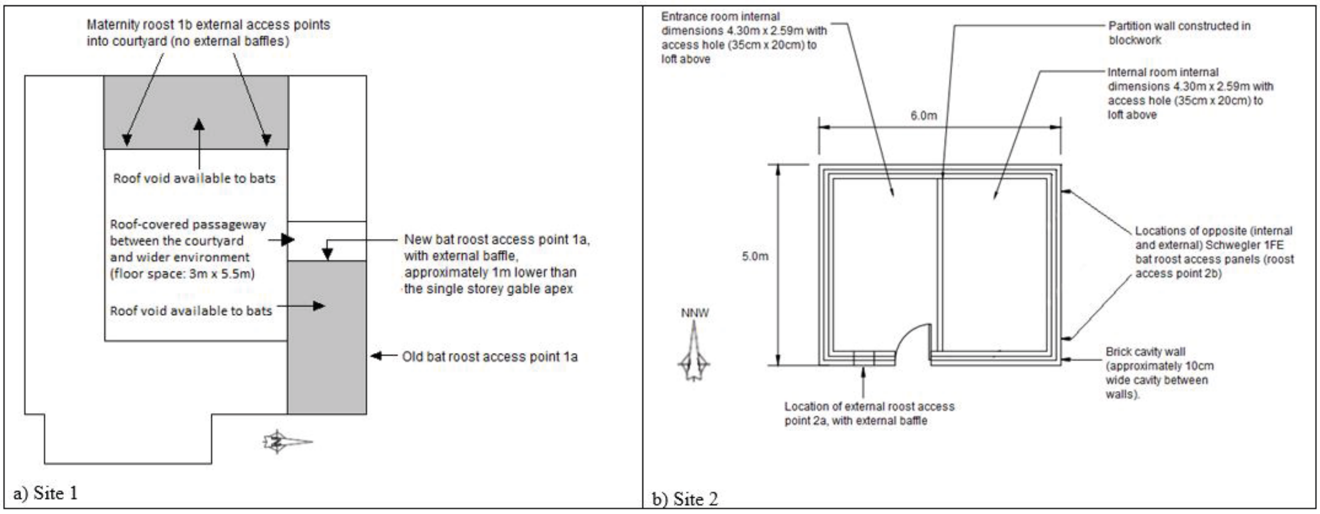

Fig. 2 - Sites 1 (a) and 2 (b) plan views.

horseshoe bats.

Site 4 is a church containing a lesser horseshoe bat maternity roost in a roof void above the nave. The bats emerge from this roost into the church tower via a narrow access (Table 3) before flying up the tower and emerging externally at the top. In 1996 the current external roost access door was installed.

Site 5 is a building complex consisting of a manor house and outbuildings. During the winter of 1997/98 a cottage terrace was reroofed and a purpose-built lesser horseshoe bat access was installed, designed to prevent corvid entry (Table 1). Prior to the works a small number (9) of lesser horseshoe bats (Table 3) was recorded. In 2013 (following building deterioration) the maternity colony moved to a separate building approximately 150m away (Site 5b), with larger (non-bespoke) roost access points (Table 1).

Site 6 was an abandoned granite cottage where the existing lesser horseshoe bat maternity roost access was via an open door and windows that had lost their glazing. A missing loft hatch allowed bat access into the roof space. During renovation works in the winter of 2000/01 a bespoke lesser horseshoe bat roost access was installed (Table 1) and smooth plastic was placed on the floor of the access in order to provide a slippery surface to deter corvids (particularly jackdaws), which were the primary concern at this site.

Site 7 is an occupied 16th century farmhouse containing a lesser horseshoe maternity roost with no associated renovation. It consists of a cellar/boiler room with large external roost accesses (Table 1, Fig. 3). It also has a plastic pipe connecting the cellar/boiler room with an area underneath the house (Fig. 4). The pipe is thought to have been originally installed for ventilation purposes.

Dimensions (Figs. 3 & 4) and photographs (SM Figs. 1 & 2) of the internal and external roost accesses described above are provided. Where relevant (i.e. excepting Sites 5b and 7), roost count monitoring (via emergence counts and/or internal inspection) occurred at intervals within 1-30 years after the creation of new roost entrances (Table 3). In the case of Sites 1, 2, 5, 6 and 7 monitoring was done via the use of one surveyor at each external roost access supported by a bat detector (usually either a Pettersson D240x (time expansion x10, manually activated storage time of 1.7 secs, Pettersson Elektronik AB, Sweden) or an Elekon Batlogger M (Elekon AG, Switzerland)), manually counting out the number of emerging bats. The Site 7 bat emergence was also filmed due to challenges in producing an accurate count from large entrances which the bats move in and out at speed. In the case of Sites 3 and 4 (internal and external roost access respectively), roost counts were done by remotely counting emerging bats via an infra-red camera connected to a screen. Tally counters (Sites 1 and 2) and a Psion personal digital assistant (Psion PLC, UK) (Sites 3 and 4) were used to help count emerging bats. Sites 1 and 2 were subject to fewer roost count monitoring visits (12-14, Table 3) than Sites 3, 4, 5, 6 and 7 (Table 3, minimum of 27 visits per site).

Counting of emerging bats began approximately half an hour before sunset and continued until at least 5 minutes had passed without any emerging bats after the main emergence period.

RESULTS

All six modified lesser horseshoe roosts continue to be used after the works. Moreover, increases in colony size ranged from 18% to over 4,900% (Table 3), although there was variability in both monitoring length (1-29 years) and monitoring timing between sites. Emergence count increased at all seven roosts. At four of the sites (Sites 3, 4, 6 and 7) external and/or internal roost access dimensions were narrower than the bat wingspan (Table 1).

With the exception of Site 2b, a significant amount of pre-emergence flight behaviour still occurred at all sites, and no predation was observed as a result of reducing the size of roost access points. Site 2b represented the smallest external access (designed specifically for vesper bats), hence it was notable that lesser horseshoe bats used it at all. With regard to Site 3, it is notable that the lesser and greater horseshoe bats externally emerge from separate areas of the building.

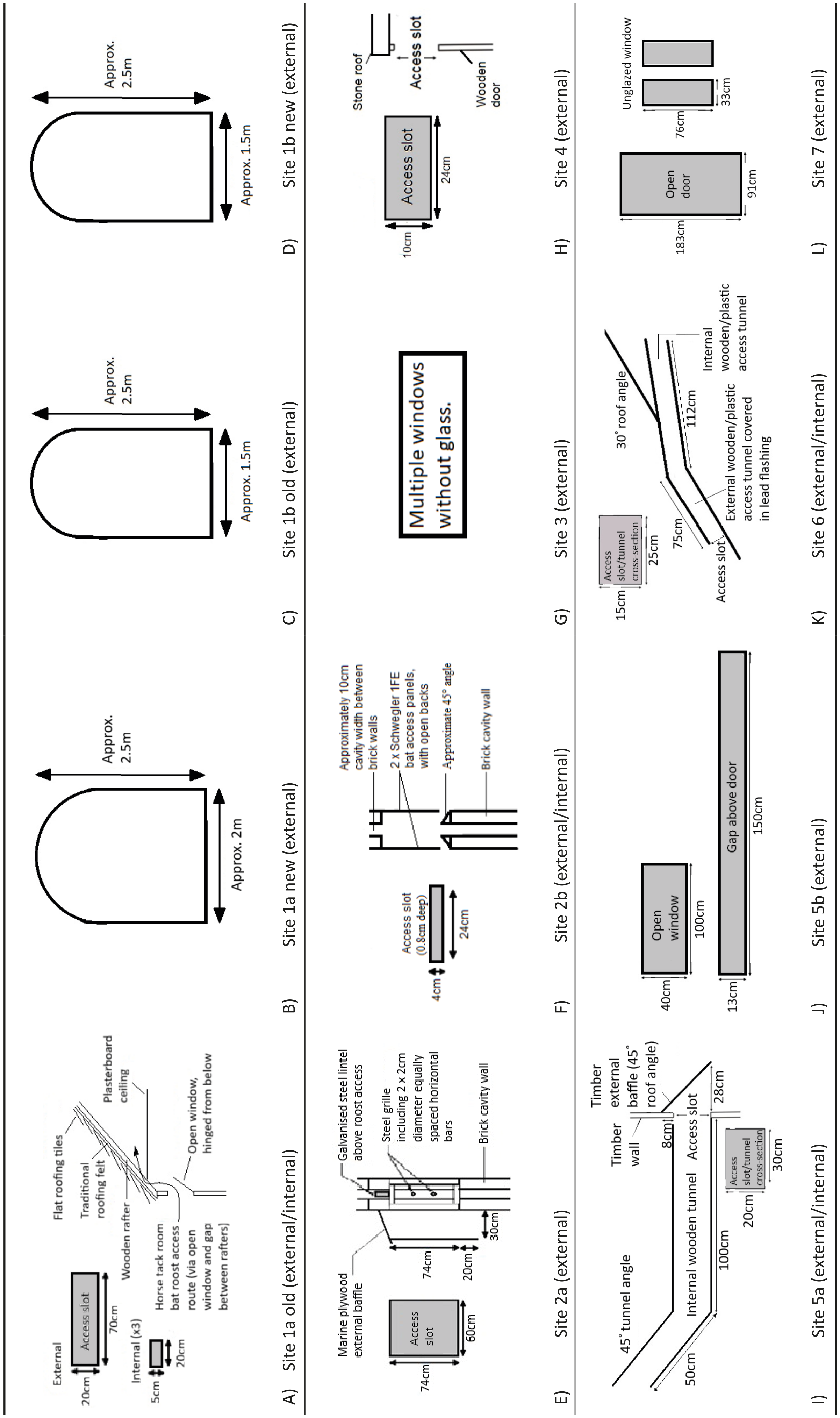

Fig. 3 - Predominantly external roost access dimensions with confirmed lesser horseshoe bat use.

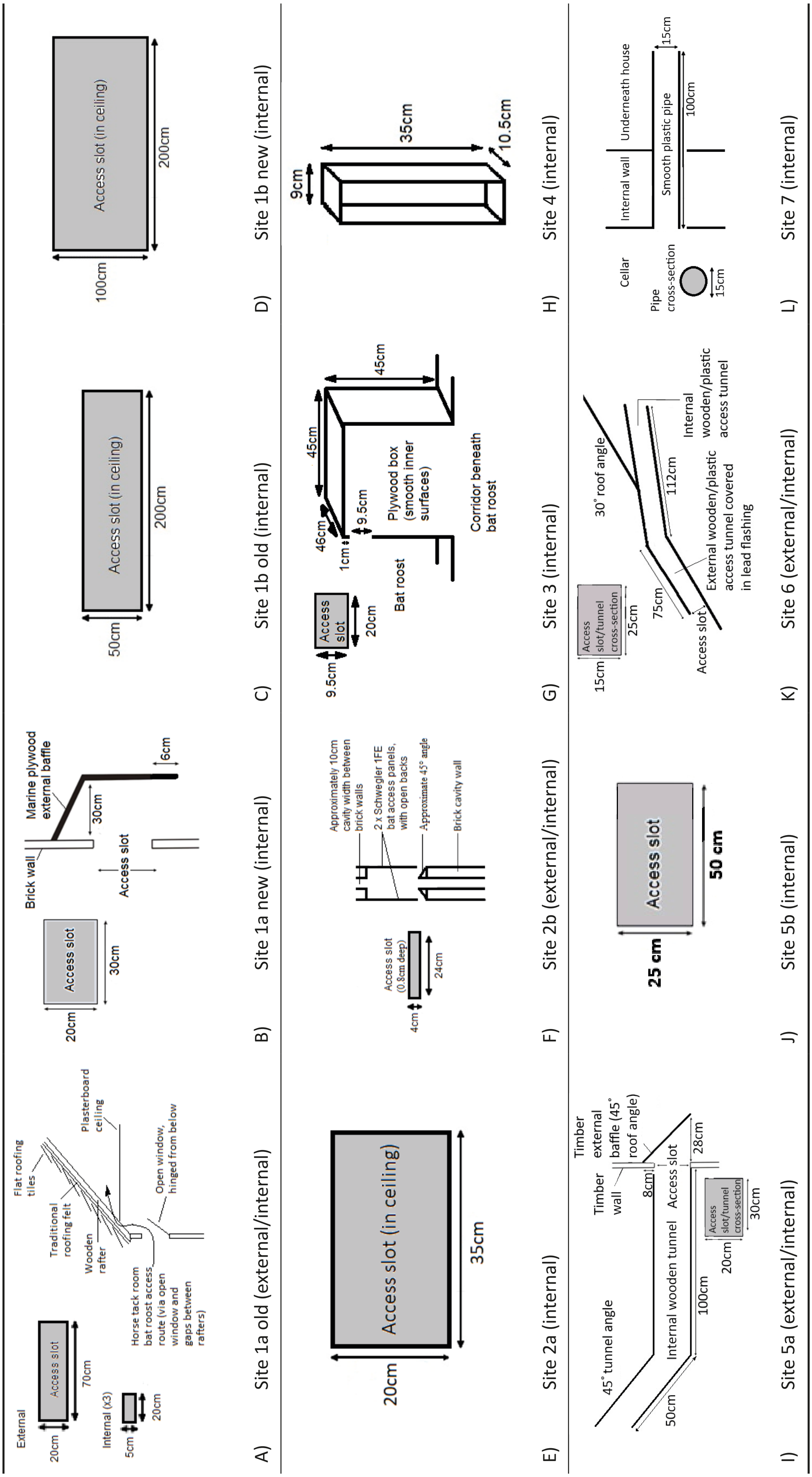

Fig. 4 - Predominantly internal roost access dimensions with confirmed lesser horseshoe bat use.

Table 1 - Study site summary

Site	**External roost access dimensions (length x height)**	**Internal roost access dimensions (length x height)**	**Roost type**	**Problematic species**	**Problematic species resolution with internal barrier**
1a old (Victorian stable block)	70cm x 20cm (open window)	3 gaps 20cm x 5cm (between plasterboard ceiling and roof rafters)	Hibernation/ transitional	None	N/A – roost access no longer present.
1a new (Victorian stable block)	Approx 2.5m high x 2m wide (covered porch)	30cm x 20cm (with external baffle)	Possible maternity	None	N/A
1b old (Victorian stable block)	Approx 2.5m high x 1.5m wide (porch)	0.5m x 2m (hole in ceiling)	Maternity	None	N/A – roost access no longer present.
1b new (Victorian stable block)	Approx 2.5m high x 1.5m wide (porch)	1m x 2m (hole in ceiling)	Maternity	None	N/A
2a (purpose-built bat house)	60cm x 75cm (with external baffle)	35cm x 20cm (hole in ceiling)	Maternity	Pigeons	Partially
2b (purpose-built bat house)	24cm x 4cm (x2)	35cm x 20cm (hole in ceiling)	Maternity	Pigeons	Partially
3(partially completed mansion)	Open windows of various dimensions.	20cm x 9.5cm	Maternity	Greater horseshoe bats	Yes
4 (church)	24cm x 10cm (x 2cm deep)	9cm x 35cm (x 10.5cm deep)	Maternity	Jackdaws	Partially
5a 17th century terrace outbuilding to country house	30cm x 20cm (with external baffle and internal tunnel). Pre-1997 renovation: holes in roof slates	No additional internal roost access.	Maternity	Greater horseshoe bats Jackdaws	Yes
5b 18th century stable block to country house	100cm x 40cm (open window), and 150cm x 13cm (above doorway).	50cm x 25cm (hole in internal wall)	Maternity	Greater horseshoe bats	N/A
6 Old granite built cottage	25cm x 15cm (with internal and external tunnel). Pre 2001 renovation: unglazed windows and an open door with loft hatch missing.	No additional internal roost access.	Maternity	Jackdaws	Yes
7 16th century farmhouse	91cm x 183cm (open doorway), and 33cm x 76cm (x2, unglazed window). Both provide access to a cellar with boiler.	1m long (15cm diameter) smooth plastic pipe leading from the cellar boiler room maternity roost area to an area underneath the house.	Maternity	Greater horseshoe bats	Probable (not possible to check the area underneath the house).

Three of the sites contained external baffles (Sites 1, 2 and 5, Table 2). The largest of these baffles (Site 2) failed to prevent entry by problematic species, whereas the other two appeared to be successful. However, Site 2 did succeed in problematic species exclusion with the creation of a smaller internal roost access due to an internal barrier (Table 1). Internal barriers were also successfully used at Sites 3, 4 and 7 (Table 1). Problematic species successfully excluded included greater horseshoe bats (Sites 3, 5a and (probably) 7), pigeons (*Columba livia domestica*) (Site 2 (partially)) and jackdaws (Sites 4 (partially), 5a and 6). Partial success resulted from problematic species being excluded by an internal barrier but not an external one.

DISCUSSION

Although lesser horseshoe bat numbers increased at all of the sites post-modification (Table 3), additional variables influencing population changes and ranges make it difficult to quantify the extent to which this was a result of internal barriers. These variables include roost temperature (Ransome, 1998), roost availability (Reason and Wray, 2023), roost fidelity (Lewis, 1995), climate change (Festa *et al.,* 2023, Andrews *et al.,* 2024), landscape change (Ransome, 1997), predation (Speakman, 1991; Hernández-Brito *et al.,* 2018), prey availability (Ransome, 1997), development type (Reason and Wray, 2023), extent of disturbance/habituation (Luo, Siemers and Koselj, 2015), and population size (Bat Conservation Trust, 2025). The national UK population monitoring shows a country-wide increase during the majority of the period covered by this study (Bat Conservation Trust, 2025). Drawing conclusions is also not helped by the fact that monitoring visits were not always carried out at the same times each year (Table 3). Regardless of these confounding variables, lesser horseshoe bat numbers increased and entry by problematic species was prevented.

Manoeuvrability

This study highlights that lesser horseshoe bats are sufficiently manoeuvrable to fly through gaps narrower than their wingspan (horizontally), which is at least partially dependant on the amount of space either side of the gap. The internal roost access dimensions for Sites 1a (new), 1b, 2, 5a, 5b are wider than their wingspan, whereas the dimensions for Sites 1a (old), 3, 4, 6, and 7 are not (Table 1). In order to move through these holes at the first three of these sites, the bats hover in front of them before partly closing their wings and diving through. At Site 3, this is aided by the fact that the roost access hole has a narrow depth (i.e. thickness of wood: 0.5cm), and the box is spacious enough (SM Fig. 2g) to allow bats to fly vertically to enter, and 'drop' through when they exit. The box lid is only about 1cm above the top of the roost access hole, and it has smooth inner surfaces. Both of these characteristics may contribute to the successful exclusion of greater horseshoe bats. Over 60 years of observation at this site suggest that greater horseshoe bats find it easier to fly through a narrow space when dropping down rather than flying up towards it (R. Ransome pers. comm.).

Sites 2 (1FE bat access panel use), 4 (internal access), 6 (access tunnel) and 7 (internal pipe) provide additional information on how lesser horseshoe bats can navigate through small spaces. During approximately 5 minutes of monitoring by one of the authors (ND) on 24-06-2022, 20 lesser horseshoe bats were observed to fly through the Site 4 internal roost access hole. Of those, only one was observed to turn 90° in order to fly through the hole with wings outstretched. All the other bats closed their wings close to their bodies, and travelled through using momentum. At both Sites 6 and 7, the length of the roost access tunnel and internal plastic pipe respectively means that lesser horseshoe bats cannot use momentum to move through, and must actively fly with their wings partially drawn in to their bodies. The distance and/or smooth plastic makes it impossible for a bat to gain access via hanging from the ceiling and they are not able to crawl through.

External baffles

Well-designed external baffles both allowed lesser horseshoe bat access and excluded problematic species at two of the sites (Table 2). Hence external baffles should be used at roosts with a single small opening.

Roost exit choice

At two of the sites (1 and 2), bats from the same roost flew through one larger (Sites 1b old and 2a) and one smaller (Sites 1a new and 2b) external roost access point on the same evening (July 2015 and July 2020 respectively, Table 3). This suggests that active selection for a certain roost access size is done by individual bats rather than the whole colony. In July, females may be non-breeding, pregnant or lactating. Their status is known to affect emergence timing probably via flight performance capabilities and predation risk (Jones and Rydell, 1994). The presence of even a single greater horseshoe can cause lesser horseshoes a lot of emergence disturbance (Ransome, 2023). Hence a range of separate roost exit locations (such as those provided by Sites 1, 5 and especially Site 3) may be critical for the coexistence of the two species within the same building. Comparable location suitability (e.g. close proximity to vegetation, north or east facing to avoid setting sunlight) could assist in avoiding inter-specific competition.

Predation

No lesser horseshoe bat predation was actually observed in this study as a result of creating small exit holes. If there was an increase in predation, it may have been outweighed by the benefits of excluding unwanted species from the roost. However, further work on this topic is needed, particularly taking into account recent evidence of brown rat (*Rattus norvegicus*) bat predation (Gloza-Rausch, Bergmann and Knörnschild, 2025).

The presence of a small internal roost entrance is likely to slow down roost exit/entry. Although probably safer than a small external roost entrance, there is still a risk of predation if predators are able to gain internal access (Bollo Palacios *et al.,* 2023). For lesser horseshoe bats, these negatives should be balanced against the positive of being able to exclude greater horseshoe bats, which are known to have displaced several UK lesser horseshoe bat maternity

Table 2 - External baffle dimensions.

Site	Height of boarding parallel to roost exit hole (cm)	Width of boarding parallel to roost exit hole (cm)	Parallel distance from roost exit hole (cm)	Distance extending below bottom of roost exit hole (cm)	Problematic species excluded?
Site 1a new	26	30	30	6	Yes
Site 2	75	60	30	20	No
Site 5a	39.6 (45° angle)	30	28 (bottom of exit hole)	0	Yes

roosts (Ransome, 2023). It is therefore probable that any site where both species of horseshoe bat coexist requires bespoke management to succeed. Further evidence for this is provided by the fact the greater and lesser horseshoe bat maternity colonies seem able to co-exist within Site 5b, albeit without any explanatory evidence to date. It should be noted that within both the UK and the European Union, a relevant Statutory Nature Conservation Body licence is required (under the 'Conservation of Habitats and Species Regulations 2017 (as amended)' legislation) before excluding any species of bat from an existing roost (Reason and Wray, 2023).

Inter-specific competition

Both greater and lesser horseshoe bats require flight access into their roosts (Marnell and Presetnik, 2010), in addition to specific environmental conditions (Ransome 1998, 2023). There is therefore potential for inter-specific competition for roost sites in landscapes where they are in short supply. For this reason, lesser horseshoe bat competitor exclusion may have more of an impact at or near the edge of their range (such as the UK). At one UK artificially heated underground summer roost for both species, a single greater horseshoe bat regularly chased exiting lesser horseshoe bats at dusk. The lesser horseshoes waited until the greater horseshoe had left before emerging (A. Pinch pers. comm.).

The success of the Site 3 lesser horseshoe bat internal roost access is reinforced by the fact that there is still roosting conflict between lesser and greater horseshoe bats at this site. The creation of a winter hibernaculum for greater horseshoe bats from two underground storage tunnels resulted in up to 180 lesser horseshoe bats using it for over 15 years in the absence of cattle-grazing overwinter. The introduction of winter grazing resulted in greater horseshoe bats largely displacing lesser horseshoe bats over several years (R. Ransome pers. comm.).

An increased knowledge of the interspecific interactions between greater and lesser horseshoe bats would be beneficial. Regardless, it is clear from Sites 5b and 7 that the two species can co-exist within the same roost, at least to some degree. Greater horseshoe bats are a rarer species in Britain than lesser horseshoe bats (Mathews *et al.*, 2018), hence in some circumstances it may be appropriate to prioritise their conservation.

Socialising

In the case of Sites 1, 3 and 4, a smaller roost access leads to a larger covered space (a covered porch, several internal rooms, and a church tower respectively), from which bats can undertake pre-emergence flight behaviour and enter/exit the roost without risk of either an internal or external bottleneck occurring. This arrangement promotes socialising (Andrews, Hodnett and Andrews, 2017), reduces predation risk and allows earlier emergence relative to sunset. Bats emerging directly into vegetative cover can do so up to an hour earlier than similar roosts in the locality lacking such cover (Schofield, 2008). Emergence times after sunset (Table 3) compared favourably with the published mean (29 mins (Downs *et al*., 2016a)) and median (31 mins (Jones and Rydell, 1994)) for this species. Although Sites 2, 5a, 5b, 6 and 7 suggest that emergence into a larger covered space is not strictly necessary, it is recommended as a best practice approach pending further research. The primary reason for pre-emergence flight behaviour may be socialising rather than light sampling (Andrews and Andrews, 2016; Downs *et al.*, 2016b; Andrews, Hodnett and Andrews, 2017). Dunbar (1993) supports the hypothesis that oral communication (ultrasound social calls) is necessary in a large group of mammals that habitually live in the dark. Given that in some roosts lesser horseshoe bats can both determine the outside light level without going outside and socialise in internal areas that are completely dark before emerging to forage (M. Andrews pers. comm.), it is possible that predation risk around the roost entrance can be reduced by other aspects of roost design.

CONCLUSIONS

- Lesser horseshoe bat use continued at all of the sites post-modification, with all populations increasing. No evidence of increased predation was observed as a result of reduced roost entrance sizes.
- Greater and lesser horseshoe bats can have successful maternity colonies within the same building when provided with separate roost spaces, external roost accesses (openings should be provided on north or east-facing sides to avoid light from the setting sun) and internal roost accesses.
- A smaller lesser horseshoe bat internal roost access (for protection) should ideally be used in combination with a larger external access (or suitable internal area) for pre-emergence flight behaviour (similar to Site 3). If this is not possible due to limited space, consider installing a tunnel similar to those used at Sites 5a and 6.

Table 3 - Site Monitoring

Site	Monitoring period (years)	Date of roost access creation	Initial roost count (individual bats, with date)	Maximum recorded roost access use (individual bats, with date)	Monitoring visits (numbers per year)	Minimum percentage increase (%) using max. counts	Example first emergence time (sunset time in bold)
1a old	2006-2007 (2)	Unknown	2 (November 2006)	2 (plus approx. 4m^2 covered by droppings to a depth of 0.5cm). (November 2006)	Internal inspection. 2006 (1), 2007 (1)	N/A	Not recorded
1a new	2008-2015 (8)	March 2008	1 (August 2008)	>100 (July 2015)	Emergence and/or internal inspection. 2008 (2), 2009 (3), 2013 (4), 2015 (1).	4,900+ (from 1a old)	21:36 (**21:24**) 09/06/2008
1b old	2007-2013 (7)	Unknown	47 (October 2007), 124 (June 2008)	167 (June 2009)	Emergence 2008 (2), 2009 (2), 2013 (1).	N/A	17:55 (**18:03**) 22/10/2007
1b new	2015 (1)	Between June 2013 and July 2015	197 (July 2015)	197 (July 2015)	Emergence 2015 (1)	18 (from 1b old)	21:24 (**21:07**) 28/07/2015
2a	2015-2021 (7)	March 2014	Droppings only (June 2015)/ 1 (November 2017)	12 (July 2020)	Emergence and/or internal inspection. 2015 (1), 2016 (1), 2017 (1), 2018 (1), 2019 (1), 2020 (5), 2021 (4).	1,100	21:34 (**21:27**) 09/07/2020
2b	2015-2021 (7)	March 2014	Droppings only (June 2015)/ 1 (November 2017)	4 (July 2020)	See 2a.	300	21:40 (**21:27**) 09/07/2020
3	1996-2025 (30)	1996	Approximately 150 (1996)	478 (August 2019)	Weekly emergence counts (May-October) from 1996.	218.7	21:20 (**21:30**) 20/06/2021
4	1996-2025 (30)	1996	Approximately 40 (1996)	371 (June 2020)	Two or three annual counts for the last (approx.) 20 years (up to and including 2025) for the UK National Bat Monitoring Program.	827.5	21:38 (**21:27**) 10/06/2022
5a	1997-2025 (29)	1998	9 (25/09/1997)	160 (13/06/2008)	Two annual counts for the UK National Bat Monitoring Program (1999 – 2025). 1999 counts: 16 & 28.	1,678	21:45 **(21:42)** 26/06/2023

Table 3 continuation - Site Monitoring

Site	Monitoring period (years)	Date of roost access creation	Initial roost count (individual bats, with date)	Maximum recorded roost access use (individual bats, with date)	Monitoring visits (numbers per year)	Minimum percentage increase (%) using max. counts	Example first emergence time (sunset time in bold)
5b	2021-2025 (5)	N/A	N/A	98 lesser horseshoes and 19 greater horseshoes (10/06/2024)	Two annual counts for the UK National Bat Monitoring Program (2019 – 2025).	N/A	21.40 (**21:29**) 10/06/2024 First emergence of greater horseshoe: 21:55
6	2000- 2025 (26)	2001	119 (01/08/ 2000)	419 (11/06/2014), but then an unexplained subsequent decline to 94 (June 2024).	Initially annual (2000-2004), and subsequently two annual counts for the UK National Bat Monitoring Program (2005 – 2025).	252	21:15 (**21:42**) 23/06/2023
7	1996 -2025 (30)	N/A	Unknown (small non-breeding roost in 1996)	Approximately 100 (June 2024)	Annually most years between 1996 – 2025.	N/A	Approx. 20 minutes after sunset.

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