

## Exclusion of barn owls *Tyto alba* from a greater horseshoe bat *Rhinolophus ferrumequinum* roost in Devon, UK.

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### SUMMARY

The greater horseshoe bat *Rhinolophus ferrumequinum* is a rare species in the UK that relies heavily on undisturbed stone buildings in which to breed. Barn owls *Tyto alba* are also a protected species that roost and raise their broods in similar places. This overlap in roosting requirements can lead to barn owls moving into buildings containing well-established greater horseshoe bat maternity colonies. This in turn could result in disturbance and abandonment of the building by the bats. Such an event occurred at one of the largest greater horseshoe bat roosts in the UK in 2018 when the colony deserted the roost after barn owls moved in. We describe measures used to exclude the owls while retaining access for the bats, to encourage the colony to return. The suite of modifications consisted primarily of wooden baffles and smooth surfaces on the entrances and doorways. Monitoring showed that the interventions were effective in excluding barn owls whilst allowing bats to access the building. Exclusion of the owls resulted in the return of the greater horseshoe bat colony in similar numbers to 2017 when owls were absent (2022: 92% of the adults) and breeding resumed (2022: 93% of the juveniles in 2017). This paper is the first to evaluate the before and after effects of protecting a bat roost from disturbance or predation by other species.

### BACKGROUND

The greater horseshoe bat was once found across southern Britain from south-east England to western Wales. Its population underwent a major decline in the 20<sup>th</sup> century due to the loss of suitable roosting sites and a reduction in insect availability linked to agricultural practices and habitat loss (Stebbins 1988, Hutson & Mickleburgh 2001, Ransome & Jones 2008). It is now one of the rarest bats in the UK and protected at a European level as an Annex II species under the Habitats Directive (European Commission Directive 92/43/EEC), as well as at national level under Schedule 5 of the Wildlife and Countryside Act (1981). These bats are highly selective in their choice of breeding roost sites, usually favouring stone buildings with slate roofs and large openings allowing access to the site.

Barn owls, like greater horseshoe bats, are nocturnal hunters that frequently use old agricultural buildings for day roosting and nesting. The UK population of barn owls suffered a decline for similar reasons to the greater horseshoe bat but has been recovering in part due to legal protection (Schedule 1 of the Wildlife and Countryside Act (1981)) which gives them special protection during the breeding season.

The overlap in breeding sites and diurnal activity between these two species can lead to conservation conflict if the same building is being used. Evidence of successful mitigation is scarce and there have been no studies evaluating the before and after effects of protecting bat roosts from disturbance or predation (Collins *et al.* 2020,

Berthinussen *et al.* 2021, Wright *et al.* 2022, Zingg *et al.* 2022).

High Marks Barn is a 19<sup>th</sup> century building with stone walls and a slate roof located in Devon, south-west England, (Fig.1), and designated as a Site of Special Scientific Interest (SSSI) because of its maternity colony of greater horseshoe bats. Vincent Wildlife Trust (VWT) acquired the barn in 1997 and carried out a series of repairs to ensure the building was weather-tight for the bat colony (Wright *et al.* 2022). In July 1997, 37 greater horseshoe bats were recorded, and numbers increased yearly, reaching a maximum of 825 adults and 360 pups in July 2017, making it one of the largest greater horseshoe bat maternity colonies in the UK at that time. However, no bats were recorded in July 2018.



Figure 1: High Marks Barn and location.

In the winter of 2018/19, a barn owl was observed inside the building along with barn owl droppings, pellets and feathers, and the bats remained absent despite usually hibernating in there. Dissection of approximately 200 barn owl pellets revealed evidence of a single greater horseshoe bat, suggesting that the absence of bats was caused by the threat of predation. Without intervention, it was judged that the presence and threat of predation by barn owls would have resulted in the continued loss of an important greater horseshoe bat roost. Given that effective mitigation for the loss of barn owl breeding sites can be provided in the form of nest boxes, VWT decided to exclude these birds from the site. The aim of the intervention tested here was to determine whether measures to exclude barn owls would result in bats returning to the roost and the resumption of breeding.

### ACTION

In January 2020, VWT modified two bat entrances and two internal doorways in the barn. The works were carried out in winter to avoid disturbing the barn owls during the breeding season and to give them time to find a new nesting site. To mitigate for the barn owl exclusion, a barn owl box was installed on a large hedgerow tree nearby, but this was rapidly used by jackdaws. However, other natural and man-made nesting sites are abundant in the area.

The modifications were designed to be effective and simple, with materials that could be easily sourced and replicated or customised to different scenarios. The designs were based on similar historical modifications used in other VWT horseshoe bat roosts, which have been effective at excluding predators without negatively impacting the bat population (unpublished data).

### Modification to entrances

Two bat entrances are present in the building. Entrance A (Figure 2) had a metal door on the bottom part and a grill at the top. The bars on the grill were 15 cm apart, which was large enough for the barn owls to access the building. Entrance B (Figure 3) is a long rectangular opening (279 cm x 27 cm) in the barn porch that provided space for bats to fly within the building prior to their emergence.

**Entrance A:** The grille that formed the top half of the door was removed and replaced by a 9 mm exterior grade plywood sheet supported on a frame made of 25 mm x 50 mm tanalised treated timber. A custom-made metal tip tray was fitted on the plywood (Figure 2) which tilts when the weight of an owl or other animal is on it, temporarily closing the opening. The default position of the tray allows the bats to fly through the opening without touching it. The dimensions of the opening were customised for greater horseshoe bats (390 mm x

190 mm). A plywood and timber baffle was fitted to the front of the tip tray to reduce light spill, rain and wind.



**Figure 2:** Entrance A with light baffle (1) and tip tray (2). The tip tray is a tilting tray made of 3mm thick aluminium, attached with hinges to a vertical metal sheet that forms a frame around the opening where the tray sits. The vertical metal surface (666 mm x 538 mm) and tray (390 mm x 170 mm) are smooth and prevented owls or other predators gripping the surface. Doorway A with baffles (3) and dimensions (4). Two wooden baffles were fitted on each doorway, attached to opposite sites and parallel between them, mounted on hinges to allow for human access.

**Entrance B:** A galvanised steel sheet (1.2 mm thick, 50 cm width) was attached below the opening on the outside, covering the whole length of the entrance (Figure 3). This provided a smooth surface that prevented owls and other potential predators from gripping or perching. A box made of 9 mm exterior grade plywood sheet and 25 mm x 50 mm tanalised treated timber with an open bottom was attached at the top of the entrance, on the external side, covering the whole length of the gap. The gap between the box and the wall is 38 cm, which is 10 cm wider than the widest point on the entrance (16 cm - 27 cm). The box is designed to prevent owls from flying directly into the barn, as any attempt to do so beneath the box would cause the birds to stall in flight. The steel sheet should prevent them gaining any purchase to crawl up into the building.

### Modifications to internal doorways

There are two doorways in the barn connecting room C, where the greater horseshoe bats typically breed, with the bat access points in rooms A and B. Both were modified with two plywood baffles each, attached on the left and right side of the doorway, parallel to each other and overlapping in the middle (Figure 2 & 3). The gaps left between baffles were considered large enough for the bats to access the building with ease whilst discouraging the barn owls. See Figure 2 & 3 for dimensions. The baffles were attached on hinges to allow human access and tower bolts were used to keep them in place.



**Figure 3:** Entrance B (1) with baffle and metal tray (2) fitted as an anti-gripping surface to prevent owls perching. Doorway B with baffles (3) and dimensions (4).

### Pre-intervention monitoring

The greater horseshoe colony at this site has been monitored yearly since 2000, following the emergence roost count methodology for the National Bat Monitoring Programme (NBMP, Bat Conservation Trust). Bats are counted twice in July as they leave the roost at sunset. Internal inspections were carried out after the emergence count in summer 2018 revealed the absence of bats.

All owl pellets were collected when visiting the roost to determine whether owls were regularly using the barn. In June 2019, two Browning trail cameras were deployed for six weeks in front of both entrances to record owl activity. Two Song Meter SM2 bat detectors were deployed inside the barn on 1 June 2019, which recorded bat calls for 10 and 26 days respectively. Recordings were analysed using Kaleidoscope Pro software (version 3.1.1; Bats of Europe classifier version 3.0.0; Wildlife Acoustics, Maynard, Massachusetts, USA).

### Post-intervention monitoring

The trail cameras recorded video footage to ascertain whether barn owls were entering the roost after the entrance modifications. Visual inspections for bats and owls were carried out throughout 2020 and 2021 and annual summer emergence counts were carried out in July 2020, 2021 and 2022, as part of the National Bat Monitoring Programme (NBMP - Bat Conservation Trust).

An Anabat SD1 (Titley Scientific) bat detector was deployed with an external 12V 110Ah battery to record bat activity from September 2020 to March 2021 inside room A. Recordings were analysed using Kaleidoscope Pro.

### Costs

Costs were incurred in 2019-2020. All materials were readily available at hardware stores, with the exception of the tip tray, which was manufactured by a metal engineering company and cost £77.40. All other materials cost £312. A barn owl box was purchased from the Barn Owl Trust (£95). The modifications took two full days to complete (in January 2020) by a team of four individuals with basic building repair skills.

### CONSEQUENCES

The footage from the trail cameras deployed prior to interventions confirmed the presence of barn owls breeding inside the building – barn owl chicks calling could be heard on the footage. The owls were recorded using entrances A and B before modifications. Pellets, owl droppings and feathers were present throughout the building, indicating the owls were using all rooms.

No bats were recorded during the annual summer emergence count carried out in July 2019 when the pair of barn owls was nesting in the building. Greater horseshoe bats, however, were recorded flying inside the barn at night on one trail camera, in the presence of owls.

Following the modifications, the barn owls were recorded attempting to but failing to enter the building through entrance B (Figure 4). The trail camera recording entrance A had no footage of the owls. The internal trail camera and building inspections confirmed no owl presence (e.g., video footage, pellets, feathers) inside the building since the interventions took place in January 2020.

A maximum of 825 adult greater horseshoe bats emerged in July 2017 when 360 juvenile greater horseshoe bats were observed inside the roost (Figure 5). Barn owls were present in 2018 and 2019 resulting in the absence of bats before the modifications took place in January 2020. In July 2022, 755 adult greater horseshoe bats emerged from both entrances (92% recovery of the count before barn owls moved in), and 335 juveniles were

recorded in the roost which is 25 fewer than the highest count in 2017 (see Figure 5).

Bats have been using both entrances and internal doorways. We did not record the number of bats using each entrance before the roost was deserted but bats preferred emerging via entrance B and this is still the case (only 74 out of 353 bats emerged via entrance A on 31/08/2022).

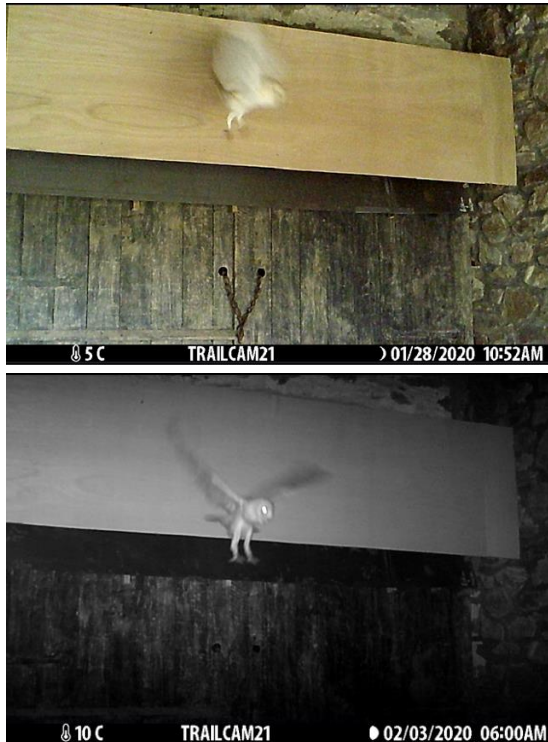


Figure 4. A. Barn owl attempting to access through entrance B on different days.

## DISCUSSION

The modifications undertaken at High Marks Barn resulted in the immediate removal of owl disturbance and showed how the incursion of a predatory species into a nationally important bat roost can be prevented. Bats returned in small numbers eight months after the interventions had been installed and eventually resumed breeding and hibernating inside the barn 18 months after the barn owls had been excluded.

The combination of interventions to the external entrances were successful at excluding the owls whilst allowing the bats inside the building. However, we did not test modifications individually or add modifications in a staged manner to ascertain what the simplest method could have been, as the priority was to ensure the rapid exclusion of barn owls. The non-grip metal surfaces or the baffles at both external entrances may have sufficed, but it was considered more efficient to install the full implementations to avoid any further adjustments.

The modifications made to the internal doorways have not been put to test at present as they were installed to safeguard the main breeding room in case the owls managed to access the building. Hibernation counts are carried out annually in winter and will provide opportunities to check for any signs of predators and inform on the success of the internal baffles in the future.

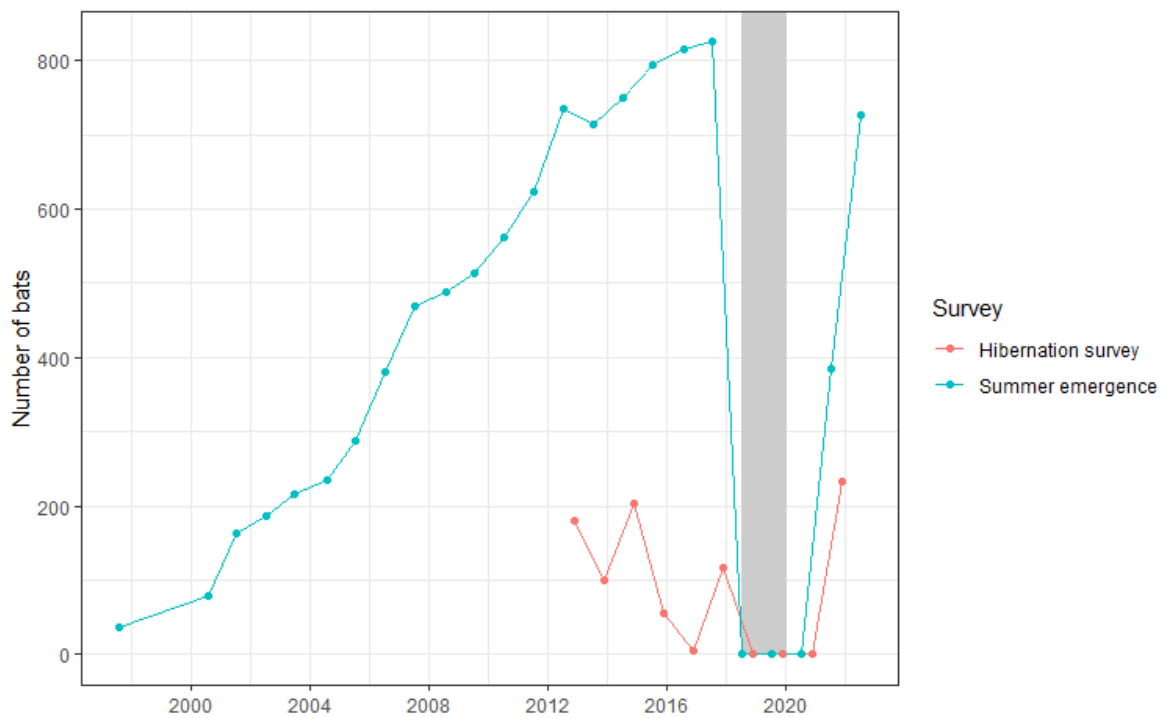


Figure 5. Maximum number of greater horseshoe bats counted during summer emergence surveys (blue) and internal hibernation counts (red) at High Marks Barn as part of the National Bat Monitoring Programme from 2000 - 2022. The grey band shows when barn owls were present.

The relevant Statutory Nature Conservation Organisation permission may also be needed in the UK. The timing of any construction work/modifications is also important to minimise disruption to the predatory species and any other species that may be present. In this case, all works were carried out under a Natural England conservation licence and a consent to work on a SSSI was obtained. The owl exclusion was carried out in January, before barn owl nesting season (March-August) and the owl box was installed at the same time. The owl box has not been successful yet, probably due to a combination of other species occupying it first and the abundance of natural and other man-made barn owl nesting sites in the area.

The designs described in this study can be customised and adapted to suit other roost sites and bat species and modified to suit different roost entrances and buildings. In addition, potential avian and mammalian predators use buildings in different ways and have their own access requirements. Hence, modifications need to fit both the predator and bat species in question to successfully safeguard roosts from predators without having a negative impact on the bats or contravening the protected status of the predator.

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#### REFERENCES

- Berthinussen A., Richardson O.C. & Altringham J.D. (2021) *Bat Conservation: Global Evidence for the Effects of Interventions*. Conservation Evidence Series Synopses. University of Cambridge, Cambridge.
- Collins J.H., Ross A.J., Ferguson J.A., Williams C.A. & Langton S.D. (2020) The implementation and effectiveness of bat roost mitigation and compensation measures for *Pipistrellus* and *Myotis spp.* and brown long-eared bat (*Plecotus auritus*) included in building development projects completed between 2006 and 2014 in England and Wales. *Conservation Evidence*, **17**, 19-26.
- Hutson A.M. & Mickleburgh S. P. (2001) *Microchiropteran bats: global status survey and conservation action plan*. IUCN.
- Ransome R. & Jones G. (2008) Greater horseshoe bat (*Rhinolophus ferrumequinum*). Pages 298-306 in: S. Harris & D.W Yalden.. *Mammals of the British Isles: Handbook, 4th edition*, The Mammal Society, Southampton.
- Stebbing R.E. (1988) *The conservation of European bats*. Christopher Helm Pub Limited. London.
- Wright P.G.R., Kitching T., Hannify R., Bollo Palacios M., McAney K. & Schofield H. (2022) Effect of roost management types on populations trends of *Rhinolophus hipposideros* and *Rhinolophus ferrumequinum* in Britain and Ireland. *Conservation Evidence*, **19**, 21-26. doi: 10.52201/CEJ19BUJS9747
- Zingg P.E., von Weissenfluh U. & Schaub M. (2022) A small, heated roost facilitates nursery establishment and increases the size of a lesser horseshoe bat (*Rhinolophus hipposideros*) colony in the northern Swiss Alps. *Conservation Evidence*, **19**, 27-34. doi: 10.11609/jott.8140.15.1.22548-22550

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