Maximising occupation of bat boxes in an ancient woodland in Buckinghamshire: a summary of recent research

Hannah Bilston

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Senior Ecologist Hannah Bilston has been conducting research with the North Bucks Bat Group in Finemere Wood in Buckinghamshire. She has been examining the way specialist woodland bats use bat boxes in an ancient woodland setting. Bat box monitoring has been undertaken in the wood for the last 10 years and Hannah has been involved since 2008. Her work has been observational and experimental and interestingly what she has seen doesn't coincide with the existing literature and some commonly held beliefs about using bat boxes.

The emerging results of this research may be of value in informing the positioning of bat boxes in woodland to improve the chance of them being used by certain species.

A summary of the recent history of research at Finemere Wood is presented below, including key findings. The article also identifies some potential factors for consideration when installing bat boxes in woodland settings.

The study site

Finemere Wood is 10 km northeast of Aylesbury in Buckinghamshire. It is an ancient oak /ash woodland with a hazel coppice and field maple understorey (Figure 1). The reserve is owned and managed by the Buckinghamshire, Berkshire and Oxfordshire Wildlife Trust (BBOWT) http://www.bbowt.org.uk/reserves/finemere-wood The 47 hectare woodland has been notified as a Site of Special Scientific Interest (SSSI) for the presence of important butterfly populations that rely on woodland habitats, including the endangered black hairstreak and vulnerable wood white[1].

Figure 1. Finemere wood

Long-term monitoring of woodland bat populations using bat boxes

The bat boxes in Finemere have been monitored since they were erected in 2003 and found to be regularly used, primarily by maternity roosts of brown long-eared bats and Natterer's bats (Figure 2).

[1] The black hairstreak butterfly is classed as Endangered according to Butterfly Conservations Red Data Book Status http://butterfly-conservation.org/files/red-list.pdf and also receives partial protection under the Wildlife and Countryside Act 1981 (for sale only). The wood white butterfly is classed as Vulnerable according to Butterfly Conservations Red Data Book Status and it is also partially protected under the Wildlife and Countryside Act 1981 (for sale only).

Figure 2. Maternity roost of Natterer's in a Schwegler 2FN bat box

Hannah's MSc research built on previous MSc research conducted by Matthew Dodds of the NBBG (Dodds, 2008). Both pieces of research have found a significant relationship between the occupation rate of bat boxes and bat box location. For instance, the bat boxes with the highest occupation rates were located in areas of the woodland that had more mature coppice with mature standard trees. This pattern of occupation has been observed in five other woods in Buckinghamshire and Oxfordshire (Dodds, 2008). There are several reasons why bats may be selecting boxes in this habitat type. The shade the coppice casts over the box could prevent the black box heating up and becoming too hot for bats in the summer maternity season. In addition Russo *et al.,* 2007 found that bats emerge from tree roosts earlier where the roost is covered overhead by the canopy. This observed behaviour could be a predator avoidance mechanism as the canopy provides bats with cover and potentially protection from predation. There were also statistically significant higher occupation rates in boxes closer to water-bodies. The bats may be selecting the boxes that are close to water so they have less far to travel to drink and to forage. Brown long-eared bats, in particular, have been found to forage closer to their roosts and are known to select roost sites within or very close to good foraging habitat (Entwistle *et al.*, 1997). Occupation rates were also higher in bat boxes positioned closer to one another and/or closer to a known tree roost. Other studies have also shown that bats prefer to roost within areas with high roost density (Kalcounis-Rüppell *et al.* 2005). The brown long-eared bats and Natterer's bats that use the boxes as maternity roosts have been found to switch roosts very regularly, switching every 3-5 days (Smith and Racey 2005; Fuhrmann and Seitz 1992). Having alternative roost sites close to each other would enable easy switching which could be particularly important when a bat is carrying a pup.

In addition to habitat variables, Hannah's MSc research also measured internal temperature and humidity in the bat boxes using sensors. This enabled comparison of the internal box environment and the box occupation rate, to assess whether bats selected bat boxes with particular microclimates. Boxes located in more mature coppice habitat, which casts a shade over the bat box, had more stable temperature regimes. Conversely, bat boxes in recently coppiced habitats exhibited much larger temperature ranges (Figure 3). Daytime temperature was significantly higher than in the shaded boxes due to the effects of direct sunlight; summertime temperatures recorded in bat boxes in young coppice or along open woodland rides peaked at over 38^{o}C. Recorded night time temperatures were also typically lower in recent coppice than in the boxes in the mature coppice habitat.

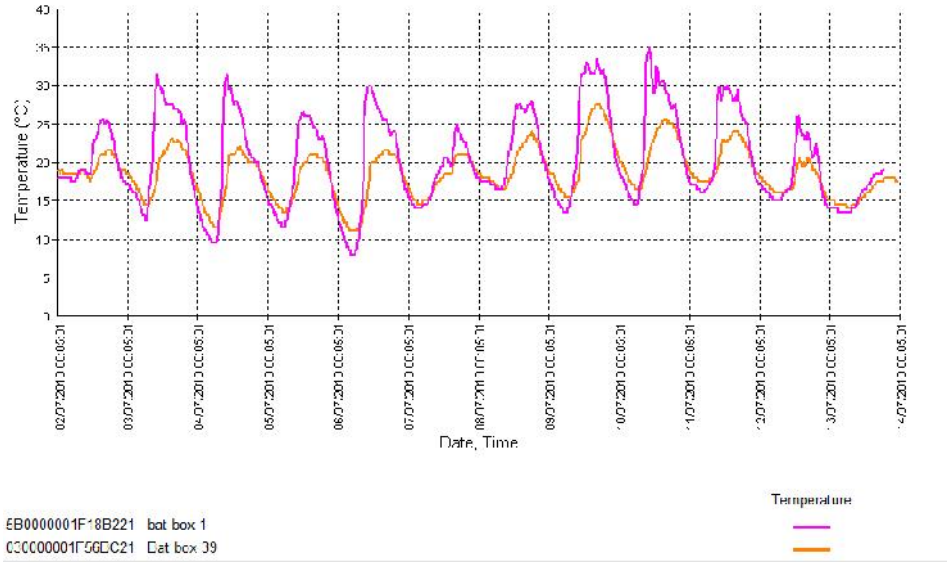

Figure 3. Temperature regimes of a bat box in an area of newly coppiced habitat (Bat Box 1), compared with a bat box in an area of mature coppice (Bat Box 39)

The installation of sensors also enabled the detection of bat occupation, using temperature change as an indicator. The presence of a maternity roost of bats typically increased the internal temperature of a bat box by between 5 and 15°C (Figure 4). It was hypothesised that boxes receiving sunlight for most of the day might get too hot for tolerable maternity roost conditions, leading to lower occupation rates. The humidity within bat boxes in sunlight was also found to be lower compared to boxes in shaded habitats. This was also considered to potentially contribute to the lower occupation rates observed.

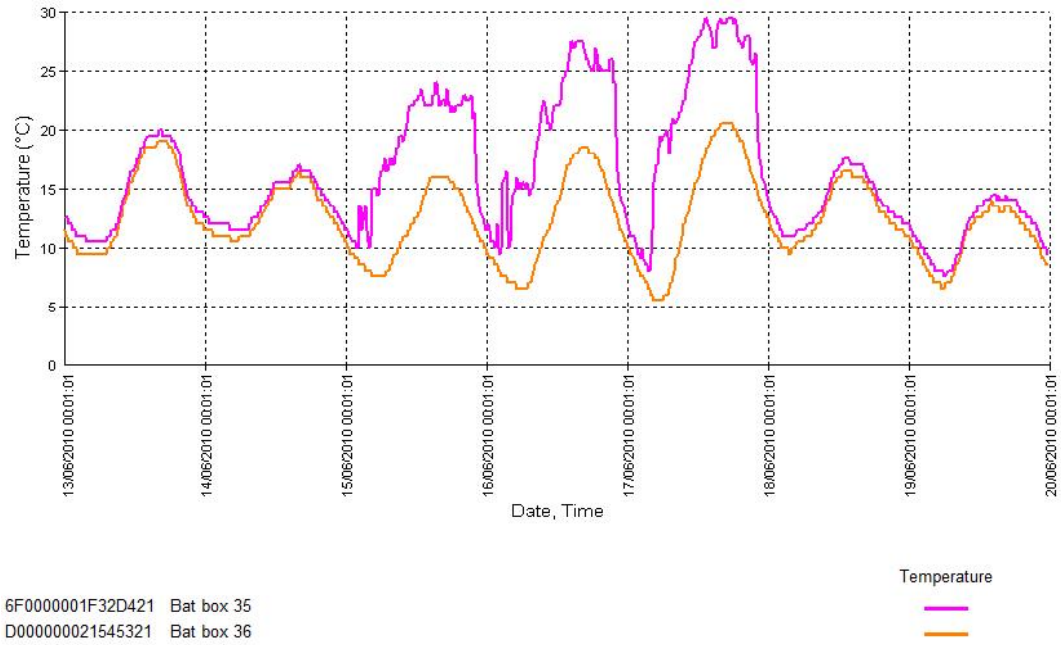

Figure 4: Comparison of two bat boxes in mature coppice habitat showing similar temperature regimes until Box 35 is occupied by a maternity roost from 15/06/2010 until 18/06/2010 when the temperature in the occupied boxes increases by approximately 10°C

Hannah's MSc research also investigated preferences for bat box type by erecting a set of five different bat boxes on single trees. Fourteen trees, within one of the oldest parts of the woodland with very mature coppice were selected for the experiment (Figure 5). The five different bat box types that were tested included four Schwegler boxes (2F, 2FN, 1FS, 1FF) and a wooden apex

box. Over the two year study period it was found that the occupation rates of maternity roosts of brown long-eared and Natterer's bats was significantly higher in the largest bat box available (the Schwegler 1FS). A full article regarding the bat box type research conducted by Hannah and the NBBG was published in Conservation Evidence (2013, Volume: 10): http://www.conservationevidence.com/individual-study/4028 which includes details of how aspect was considered for bat box positioning.

Figure 5. Five different bat boxes erected around a tree

Research in 2013: Maximising occupation rates of bat boxes by maternity roosts of woodland bats

Throughout 2013 BSG Ecology sponsored Hannah to continue her research into woodland bat use of bat boxes. The aims for the 2013 season were:

- To investigate methods of modification to exclude birds from the 1FS and 2FN bat boxes during the bird nesting season.
- To assess whether there is a statistically significance difference in occupation rates of maternity roosts in bat boxes affixed to trees in higher or lower positions.
- To assess whether there are species preferences in occupation according to the height of the bat box.

2013 Methods

Over winter 2012-2013 the bat box experiment was set up in the wood. The two bat box types that had been found to have the highest occupation rates (the Schwegler 1FS and 2FN) were used. Half of the bat boxes were modified using expanding foam to restrict the size of the entrance and the internal area available to nesting birds. The intention was to make the boxes less favourable to cavity-nesting birds while still permitting bats to roost within the box. Half of the bat boxes were left unmodified.

Figure 5. Matthew Dodds modifying a Schwegler 2FN bat box

A total of 27 trees were selected for the experiment; 14 from the existing transect in which the bat box type experiment was conducted and a new transect of 13 trees in another area of the wood with a similar structure with mature trees and mature coppice. Boxes were erected at two different heights with one box positioned at approximately 3.5m and one at approximately 6m height above ground level. The boxes were checked on a monthly basis and the presence or absence of bats was recorded.

2013 Results

The first year results of the bird exclusion experiments were positive, with the exclusion measures working 100% of the time in both types of bat boxes (Schwegler 1FS and 2FN). Bat occupation rates of the favoured bat boxes (the Schwegler 1FS) were higher in the modified boxes during the bird nesting season than they had been in previous years.

From an analysis of the first year of results there does not appear to be a significant difference between occupation rates of bat boxes at different heights. As an aside, however, a noctule bat was recorded within a bat box positioned at a height of 6m in September 2013. This is the first recording of this species in a box at Finemere.

Consideration of factors for effective bat box placement

From the studies carried out since 2008, some factors relating to placement can be identified that could usefully be given consideration when planning bat box erection in deciduous coppice woodlands. They are relevant to brown long-eared and Natterer's bats but may also be of use in informing placement in situations involving other woodland species. Interestingly the findings at Finemere do not accord with previously published research and comment on use of bat boxes in woodlands. Other studies have suggested that there is little use in erecting bat boxes in deciduous woodlands that have abundant natural roosting opportunities for bats and instead effort should focus on coniferous woodlands (Altringham and Bullock 1988; Boyd and Stebbings 1989; Benzal 1990). Studies have also suggested Boxes should be erected to receive full sunlight for all or part of the day (Stebbings and Walsh 1988; Entwistle *et al.* 2001; Bat Conservation Trust 2003; Northumberland Wildlife Trust 2005) and should be erected with good flight paths e.g. on woodland glades and open rides (Bat Conservation Trust 2003; Northumberland Wildlife Trust 2005). At Finemere and other deciduous woodlands in Buckinghamshire and Oxfordshire NBBG and Oxfordshire Bat Group research shows that bat boxes are used despite alternative natural roosts being abundant. It is important that before a bat box scheme is initiated, the objectives are clear and target species are identified and so the scheme can be designed for the species. When designing a bat box scheme to attract woodland specialist bats it is worth considering the following:

- Placing bat boxes at varying heights (3m – 6m) appears to increase attractiveness to a wider range of bat species.
- Place bat boxes approximately 20 m apart from each other.
- Select habitats such as mature coppice which would shade the box from the sun for the majority of the day.
- In woodlands that are managed on rotation, for instance through coppicing, erection of bat boxes in different woodland compartments may allow bats to move into more optimal habitat after areas have recently been managed.
- If bat boxes are to be regularly monitored it is recommended that either the 2FN or the 1FS bat box are utilised. The boxes should be modified prior to erection to prevent birds from using them. For more information on box modification please contact Hannah Bilston.

Future research

The bat box monitoring will continue until 2015 to assess whether a difference in occupation over a two year study period is observed.

The NBBG has found multiple roosts in natural cavities, and there are opportunities to fit temperature and humidity sensors into these tree roosts in 2014 to assess and compare the environmental conditions within tree roosts and boxes. The data collected from the sensors could allow the frequency of use of tree roosts to be assessed. Information from the modification experiments might be useful in informing future bat box design.

In August 2014 Hannah Bilston and Mathew Dodds will be running a bat box training day in conjunction with the BCT. This will involve a theory session and a practical session in Finemere Wood where participants will be able to learn more about the project and get to handle bats (provided they have had their rabies vaccinations).

If you would like more information about this research or the bat box training day please contact Hannah Bilston: h.bilston@bsg-ecology.com

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