Bat Boxes at Priory Country Park

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In 2009 Danny began a bat box project at Priory Country Park in Bedford with two aims: to provide roosting places for bats which could be monitored, and to compare the effectiveness of two designs of wooden bat box. The two designs of box were both devised by bat groups, and both were intended to be cheap, easy to construct and install, and easy to monitor. The box designed by the Gwent Bat Group[1] is a variant of the familiar cuboidal box designed by Bob Stebbings and Sheila Walsh[6], but with a wedge shape intended to deter birds from nesting because it lacks a horizontal floor on which a nest can be constructed. Like the Stebbings box, it allows the bats to gain access through a slot at the base through which the bats can be seen by careful examination from ground level, using a torch. The box designed by Shirley Thompson of the Kent Bat Group[1,4] is different in that the roosting space consists of two vertical slots with no floor at all. It is impossible for birds to build a nest in it, and it can be monitored from the ground in the same way as the Gwent bat boxes. The different size and shape of the roosting cavities in the two designs was expected to be the factor which might lead to different levels of bat use, and possibly to use by different species of bat. Priory CP was known to have at least five species of bat (Common Pipistrelle, Soprano Pipistrelle, Noctule, Daubenton's Bat and Brown Long-Eared Bat), with the possibly of a sixth species, Leisler's Bat. Since the project began, there have also been records of Nathusius' Pipistrelle and Serotine flying in the Country Park.

A Gwent box (left) and a Kent box on the same tree.
Photo: Danny Fellman

Installation and monitoring

Boxes were installed in March and April 2009 at a spread of locations around the main lake. Locations were chosen according to the availability of suitable trees to support the boxes and by the presence of at least partial canopy cover. The boxes were installed in pairs, usually on the same tree but occasionally on adjacent trees. Kent boxes were given letters A-J and Gwent boxes were numbered 1-10. Box heights ranged from 1.5 m. to 4.2 m (median 3.3. m.). The Gwent and Kent box making up a pair were, as nearly as possible, at the same height as each other. The orientations of the boxes were randomised so that there was no consistent pattern which might favour one box type.

Monitoring of boxes was carried out at intervals of between two and four weeks. After slightly more frequent monitoring between May 2009 and the end of 2010, a regular pattern of four week intervals was adopted. The boxes were examined for the presence of bats by shining a torch from directly below so that any bats in the box could be seen. The species and number of bats was recorded and, from the beginning of 2010, which of the two slots in a Kent box the bats were occupying. On some occasions, bats were photographed, but disturbance was kept to a minimum. It should be noted that, under current Natural England licensing regulations, both use of a torch and photography of roosting bats require a licence. The box designs did not allow the boxes to be opened and the bats were not removed from the boxes or handled. This meant that the sex and age of the bats could not be recorded, and it was not possible to confirm the species identification by looking at features not visible from below the box.

Bats in the boxes

Bats quickly began to use the boxes. Nine out the ten Kent boxes were used during 2009, but only one Gwent box was used in this time. Five of the ten Gwent boxes had been used by the end of 2011, and by 2012, the tenth Kent box had been used. With one exception, all bats found in the boxes were pipistrelles. On the basis of facial colouration they appeared to be Common Pipistrelles (Soprano Pipistrelles have paler faces than Common Pipistrelles). This cannot be taken as certain identification, because variability within species means that the two species are difficult to distinguish reliably from any single visible feature[4]. Both species (identified with the aid of bat detectors) are regularly found flying in the Country Park, and Soprano Pipistrelles have been found roosting in a small building close by.

Table 1 shows the number of occasions on which bats were found in the Kent boxes in each year. The number of surveys was not the same in each year, with a higher frequency of surveys in 2009 and 2010 than in succeeding years. In 2009, surveys began in late May; in all other years they were spread through the year from January to December.

Table 1. **Times each Kent box was used in each year**

Location	2009	2010	2011	2012	2013	2014	Total
A/1	2	1	3	2	3		11
B/2	5	1	2	3	2	3	16
C/3	7	6	8	11	11	5	48
D/4	3	2	2	3	2	6	18
E/5	1	3	2	1	1		8
F/6	3	6	5	3	6	4	27
G/7	6	5	5	4	5	6	31
H/8	8	8	6	3	7	3	35
I/9				3			3
J/10	2	6	2	2	2	3	17
Total	33	38	35	36	39	30	214
Surveys	14	19	13	14	13	13	

Box C is the most frequently used box. Seven of the boxes were used in every year, and two others were used in every year except 2014. Box I was used only in 2012. *Table 2* shows the number of occasions on which bats were found in the Gwent boxes. Bats have never been found in boxes 2, 4, 6, 8 and 10.

Table 2. **Times each Gwent box was used in each year**

Location	2009	2010	2011	2012	2013	2014	Total
A/1		1					1
C/3			1	1			2
E/5	1						1
G/7		1	3	3	2	3	12
I/9		1					1
Total	1	3	4	4	2	3	17
Surveys	14	19	13	14	13	13	

The different frequency of use of the two box designs is dramatic. In every pair of boxes, the Kent box was used more frequently than the Gwent, making a statistical test unnecessary. The probability of this occurring by chance with ten matched pairs is less than 0.002[2]. The maximum number of bats found on one occasion is also greater for the Kent box (nine) than for the Gwent box (four). Other species may have different preferences, but since only Common Pipistrelles appear to roost in the boxes at Priory Country Park (with two exceptions – see below), this could not be tested. One possible factor in this could be competition with nesting birds. Although both designs of bat boxes are intended to discourage birds, there were frequently birds' nests found in Gwent boxes, but never in Kent boxes.

Additional boxes were installed in the Country Park between May 2009 and September 2013. These consisted of a further 16 Kent boxes, and boxes of three other designs. All of the Kent boxes have a 15 mm. wide front slot and a 20 mm. wide back slot. The Super-Kent ("Clark Kent") box is similar to the Kent box, but with three rather than two slots. Ten of these were installed with various arrangements of 15 mm., 20 mm. and 25 mm. slots. Some

A Super-Kent box with anti-woodpecker metal covering (left) and a CJM box (right)
Photo: Danny Fellman

of the Kent and Super-Kent boxes had a metal covering over the front to prevent woodpecker damage. Two further boxes were of the CJM type, designed by Colin Morris of the Vincent Wildlife Trust[7]. These have three or four slots, of various widths, arranged at 90° to the back of the box. The final four (MOT) boxes were of an elongated cuboidal shape and were designed by Martin O'Connor.

Table 3 summarises the features, number and use by bats of all the 52 boxes in the Country Park. All types of box have been used, but further assessment of designs is not possible at present because the number of MOT and CJM boxes is too small for meaningful comparisons. Eight of the Super-Kent boxes have been in place for little more than a year, and further data will be needed before they can be compared with the Kent boxes.

Table 3. **The five bat box designs used in Priory CP**

Box type	Features	Number present	Number used by bats
Gwent	Single chamber, wedge shape	10	5
MOT	Single chamber, elongated shape	4	1
Kent	Two slots, 15 mm. and 20 mm.	26†	22
Super-Kent	Three slots, widths from 15-25 mm.	10	10
CJM	3or 4 slots at 90° to back plate	2	2

† *Because two boxes became damaged or inaccessible to survey, there were never more than 24 Kent boxes at any one time, although 26 different locations had Kent boxes over the six year period.*

Seasonal pattern of use

The number of boxes used tends to peak in spring and autumn. Detailed comparison between years is complicated by the increase in the number of boxes of different designs since the project began, but the figures for 2014 show the typical pattern. *Figure 1* shows the number of boxes occupied with clear peaks in spring (week 12) and autumn (week 45). The pattern in the total number of bats is less clearly marked (*Figure 2*) because bats in summer are more likely to be in groups than bats in spring or autumn. It is noticeable that few bats were found in week 28 (early July), when females are normally in large maternity roosts while giving birth and feeding infants. The boxes are not suitable for use as maternity roosts because they offer too little space and are probably not sufficiently warm, but they clearly offer useful transitional roosts in spring and autumn. It may be that the few bats in the boxes in midsummer are males, but this could not be tested because the bats were not accessible for close examination in the hand.

Figure 1. **The number of boxes with bats on each survey in 2014**

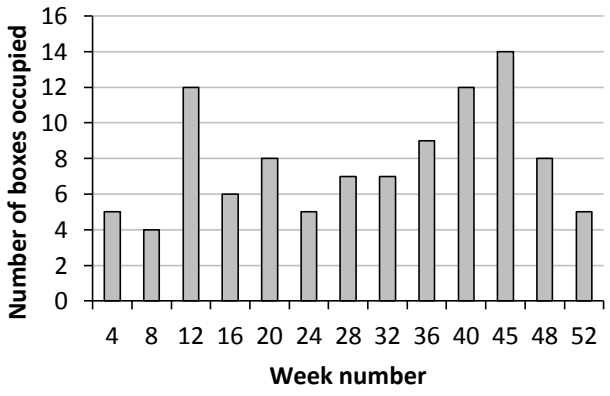
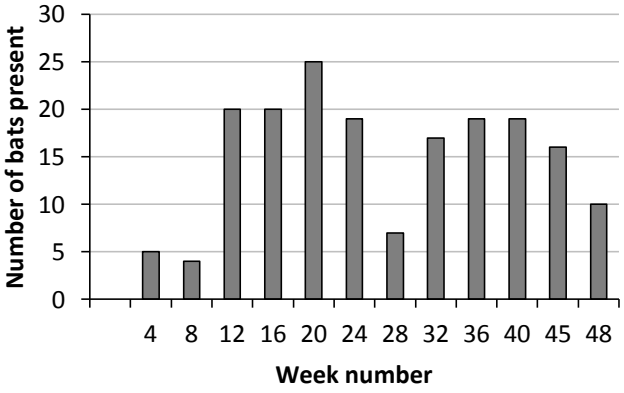


Figure 2. **The number of bats found on each survey in 2014**



Slot selection by bats

The Kent boxes offer bats a choice between a 15 mm. slot and a 20 mm. slot, and initially it appeared that bats preferred the wider back slot. Since each box consists of a pair of slots in the same location, all the data from 2010 to 2014 were analysed using Wilcoxon's test for matched pairs. Records for 2009 did not include which slot contained the bats and these were therefore excluded from analysis.

There is a significant difference (p<0.05) in the total number of bats found in the back slots and the front slots, but not in the number of occasions on which bats were found. This suggests that the difference is at least partly caused by groups of bats showing a preference for the back slot which, being wider, offers more space. The number of occasions on which more than one bat was found in the back slot was significantly greater than for the front slot (p=0.05), supporting this interpretation. On the other hand, there was no significant difference in the number of occasions a single bat was found in the back slot and the front slot. Bats roosting alone seemed to show no preference.

Table 4. **Usage of the front and back slots of Kent bat boxes 2010-2014**

	Back (20mm.)	Front (15 mm.)	All
Number of bats found in slots	305	117	422
Maximum number of bats per slot	9	3	9
Mean number of bats per slot (when bats present)	1.9	1.2	1.6
Total number of occasions bats found	161	98	259
Total number of occasions more than one bat in a slot	67	17	84
Total number of occasions one bat in a slot	94	81	175

Five Common Pipistrelles in the back slot of a Kent box, seen from below. *Photo: Danny Fellman*

Caution is needed in interpreting slot preferences because the back slots are not only wider than the front slots but also longer, and probably better protected against temperature changes and disturbance. Testing the contributions of each of these factors would need boxes with reversed slots (15 mm. at the back, 20 mm. at the front), and the use of data loggers in the boxes to record temperature.

Furthermore, there seems to be seasonal variation. If data for the three winter months (December, January and February) and the three summer months (June, July and August) are tested separately, the significant preference for back slots in summer ($p<0.02$) is replaced by a significant preference for the front slot in winter ($p<0.05$). Fewer bats are found in winter, and the maximum number in one slot was three, compared with a maximum of five in one slot in summer. In spring and autumn there is a transition between the summer and winter preferences. The highest numbers of bats are found in spring and autumn, but larger groups (up to nine bats) are always in the back slots.

Use of the boxes by other bat species

In May 2013 a number of relatively large bat droppings were found below one of the Kent boxes. No bat was present, and it was not possible to identify the species which had left them. Possibilities include Brown Long-Eared Bat or Natterer's Bat, but all that can be said for certain is that a box was used by a non-pipistrelle species.

In October 2014 a Barbastelle was found in a Kent box. This species had not previously been recorded in the Country Park. There are reports from Worcestershire of Barbastelles using Kent boxes[3] but this was the first report of Barbastelles using a Kent bat box in this region.

A Barbastelle in a Kent box. *Photo: Danny Fellman*

The regular monitoring of these boxes has provided a great deal of useful information. We have not heard of another bat box project which involves regular checks of the boxes in winter, and such checks at Priory Country Park have established that some use of the boxes continues throughout the year, but with peaks of activity in spring and autumn. The preferential selection of the wider back slots in summer, and of the narrower front slots in winter seems to be related to the size of the group of bats found together. The boxes are not used as maternity roosts, but are used by groups of up to nine bats in spring and autumn as well as by smaller numbers in summer and winter. At this site, use of the boxes is dominated by Common Pipistrelles, with occasional use by at least one other species. The Bat Group would be interested to hear of other sites in the county with numbers of bat boxes where monitoring is possible but not carried out at present.

Acknowledgements
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References:
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