Parkhurst Forest Selective Harvesting: Measured Impact on Bat Habitat Use

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Abstract
This paper describes the results of monitoring bat activity within an area of hardwood forest known to have a very high presence of the Western Barbastelle bat before, during and after selective stem harvesting. Changes in bat habitat use during the different time periods are assessed and discussed. This work was carried out under Forestry Commission England permit 02348/2018.

Habitat Context
The Parkhurst Forest is located on the Isle of Wight and lies approximately half way between Cowes and Newport (grid reference SZ 474 896). The forest is one of the oldest in the UK (Chatters 1993), and activities within the forest have been varied including a royal hunting ground in medieval times, large coppiced areas supporting local laundry and brick making kilns in the 19th century, to the multi-purpose mixed woodland of today. In particular there are large areas of semi-natural ancient woodland (predominately oak) dating back to pre-Napoleonic times. A significant difference between Parkhurst Forest and the other local forests of the same era is the lack of intensive woodland management, which has resulted in a significant number of "poor quality" trees (dead, bent, leaning, split, etc.) which would have normally been removed (Forestry Commission, 2007). This lack of 'tidying' has provided the ideal background environment for woodland bat species such as the Western Barbastelle bat which are wholly dependent on tree splits and lifted bark for roosting sites. The forest is an unusual mix of both semi-ancient woodland and stands of commercial species such as spruce, larch and pine, and is surrounded on the majority of its perimeter with grazing pasture; see the aerial view of forest landscape context in Figure 1. This unusual composition of tree species, surrounding pasture and the internal networks of road, track, ride and streams has the potential to support a very wide range of bat species. The Parkhurst Forest site was first recognised to be of particular importance as a bat habitat by Davidson-Watts in 2008 when radio tracking activities resulted in the discovery of the largest known Western Barbastelle maternity roost in the UK (115+ bats) (Davidson-Watts, 2008). The area where the selective harvesting took place is shown in Figure 2, and is known to be one of the most active areas within the forest for a wide range bats (Whitehurst, 2016). The harvested area is classified as native and honorary broadleaf, and the planting years recorded as 1500-1911, and the harvesting has been carried out in line with Forestry Commission England's Isle of Wight Forest Plan objectives (Forestry Commission England 2017):

- Maintain and increase the native composition of ancient seminatural woodland.
- Initiate restoration of planted ancient woodland sites to native and honorary native woodland.
- Maintain and enhance the favourable conservation status of nationally important wildlife sites.
- Maintain and enhance where possible the recreational capacity of the woodland.
- Maintain and increase the species and age diversity of the woodland.
- Provide a regular supply of quality timber to support local employment and local timber processing industries.

The Parkhurst Forest site and surrounding farmland supports 16 bat species in total. Within the harvested area the main species known to be present are:

- Pipistrellus pipistrellus (P.pip)
- Barbastella barbastellus (B.bar)
- Eptesicus serotinus (E.ser)
- Nyctalus noctula (N.noc)
- Myotis mystacinus (M.mys)
- Myotis nattereri (M.nat)
- Pipistrellus pygmaeus (P.pyg)
- Plecotus auritus (Pl.aur)

In addition, there is significant acoustic evidence that points to a local colony of Myotis alcathoe in the Marks Corner area. Each species makes use of specific space volumes within the forest consistent with established behaviours. For example, the Pipistrelle family are mostly found foraging in the high canopy gaps and open rides, whereas the Barbastelles are more usually found foraging in the region above the understory but beneath the canopy. In terms of roost site presence, the Barbastelle, Noctule and Myotis bats are exclusively tree roosting species in this area, the other species present are known to use house and outbuilding roosts in significant numbers (however, this does not rule them out from using tree roosts).

Harvesting Approach

The harvesting approach being adopted was one of selective felling, effectively thinning the canopy and in some cases creating new clearings or extending existing clearings. This is considered a sensitive form of woodland harvesting and was adopted in the knowledge of the significant bat presence. Prior to harvest a number of trees were marked to be left where they presented significant roost site value to Barbastelle bats (principally split and lifted bark). Additional surveys were carried out on those trees to be felled where there may have been roost potential missed by the ground based visual survey.

Survey Protocol

The bat survey protocol adopted for this work was based on a call density principle, i.e. the activity metric is the echolocation calls per unit time measured over a fixed transect carried out in a fixed target time period and walked at constant speed. The fixed transect means that any spatially driven variation is minimized, and the fixed time period ensures that the call density metric is not distorted by very local peaks in activity within the transect.

Echolocation calls were recorded using an Elekon Batlogger and the calls analysed manually using Bat Explorer 2. The transect was planned based on the area of the Forest being harvested and the typical detection range of the Batlogger to ensure that all the harvested area was covered by the survey.

The survey was initiated on the first bat recording or 15 minutes post local sunset time if no bats had emerged by then. For each survey carried out, the number of individual echolocation calls recorded for each species was determined by manual inspection and then the total divided by the actual duration of the survey in minutes to give a call density measure in terms of echolocation calls per survey minute. Whilst this is not an absolute measure of bat activity, it does enable the relative activity across the different surveys carried out to this survey protocol to be directly compared.

Surveys were carried out during the season of harvesting itself, and then in the directly subsequent season over the equivalent time period to assess the post-harvest impact and potentially look for any seasonal shifts in activity without the harvest disturbance.

Results

Results are presented here for two species, P.pip and B.bar during the following periods:

- The month before harvest was started
- The month in which harvest took place
- The equivalent time period before harvest in the following season
- The equivalent time period to the harvest period in the following season

A summary of the season 1 results (which was when the harvest took place) is given in figures 3-5. Paying particular attention to the P.pip results, you can see subjectively in the graphical data that the average and peak activity has actually increased in the harvesting period. However, when reviewing the equivalent data for the B.bar, *there is a significant and sudden drop in activity over the same period; indeed there are several surveys where no Barbastelles were recorded at all*. This is born out in the calculated average activity for each of the species during the different periods:

- Pre-harvest: P.pip – 6.2 calls/minute
- Harvest: P.pip – 9.0 calls/minute
- Pre-harvest: B.bar – 2.4 calls/minute
- Harvest: B.bar – 0.5 calls/minute

Potential reasons for the differences are covered in the results discussion.

The survey results for the equivalent periods in the second season are given in figures 6-8. In this instance, without the harvesting disturbance, the activity of the P.pip species remains virtually constant over both time periods. The B.bar activity shows a slight drop in the average activity during the equivalent harvest period, but there is no re-occurrence of the sudden drop in activity noted in the previous season when harvesting started. The calculated average activity for season 2 is as follows:

- Pre-harvest: P.pip – 14.7 calls/minute
- Harvest: P.pip – 13.7 calls/minute
- Pre-harvest: B.bar – 2.3 calls/minute
- Harvest: B.bar – 1.6 calls/minute

Results Discussion

The rapid drop in B.bar activity during season 1 and the start of the harvest period does appear to be linked, indicating a disturbance of the locally roosting B.bar. The disturbance is unlikely to be roost loss, but possibly the local habitat disruption and displacement of their food source (primarily lepidoptera). At the same time, the opening up of the canopy has introduced additional foraging opportunity for the P.pip species, as indicated by the significant increase (45%) in activity measured during the harvest period.

The repeat of the surveys in season 2 indicated that the P.pip activity was significantly higher (237%) than the previous year. This suggests that increased openness in the canopy has indeed provided a sustainable improvement in the foraging opportunities for this species. This is also borne out by the visual observation and clustering of the bat passes in the clearing and open canopy areas. The initial B.bar activity was essential similar to the previous season; a positive sign that the harvesting had not caused a permanent loss of foraging habitat. In addition, the average activity only reduced by 30% over the equivalent period in season 1 where the activity reduced by 80%. Whilst a seasonal shift in the B.bar activity cannot be excluded, the profound B.bar activity drop during the season 1 harvest period cannot realistically be excluded as related to the harvesting activity. It is more likely that the regular Barbastelle “roost hopping” habit has resulted in the variations seen in season 2.

There were some seasonal differences; season 1 was a wetter period, with a sudden temperature drop during the harvest period. However, this temperature drop did not seem to influence the P.pip species activity, and it is known from previous work (Whitehurst 2016) that the B.bar species will regularly forage in temperatures as low as 5°C. It is therefore unlikely that this was a key driver in the reduced B.bar activity observed in the season 1 harvest period.

Conclusions

The conclusion of this survey activity is that the harvesting activity did present a disruption to the local B.bar population during the period of the harvest. However, this disruption has been temporary, and within the limitations of this survey, the B.bar activity has recovered to the recorded pre-harvest levels in the season following the harvest. It is likely in this case that the Barbastelle “roost hopping” strategy, combined with the widespread availability of alternative roosts in the Parkhurst Forest has enabled the Barbastelles to overcome the disruption.

The P.pip species appears to have benefited greatly from the harvesting activity due to opening up of the canopy, thus providing a significantly improved foraging habitat.

The M.mys, M.nat and E.ser species present also appeared to have benefited from the more open habitat, but the number of records was too small to present a fully quantitative picture of activity change. An increase in Pl.aur activity was also noted, but the records were in areas least impacted by the harvesting

activities. It is likely the increase in records was due to the increased sampling effort achieved in season 2, rather than any habitat change.

Overall, the selective felling approach appears to be a good solution to maintaining bat foraging habitat at the same time as effectively harvesting high value hardwood timber. Success of the technique in this case appears to be related to there being alternative roost/foraging locations available within the local landscape context, and the attention to detail in avoiding the felling of a number of stems with roost potential within the harvesting area.

References

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Acknowledgements

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Figures

Figure 1 Parkhurst Forest Landscape Context

Denotes Harvested Area

Figure 2 Harvest Area and Previously Recorded Bat Activity

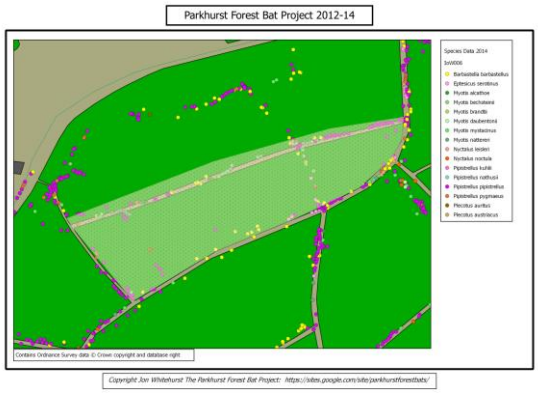

Figure 3 Season 1: Pipistrellus pipistrellus Activity

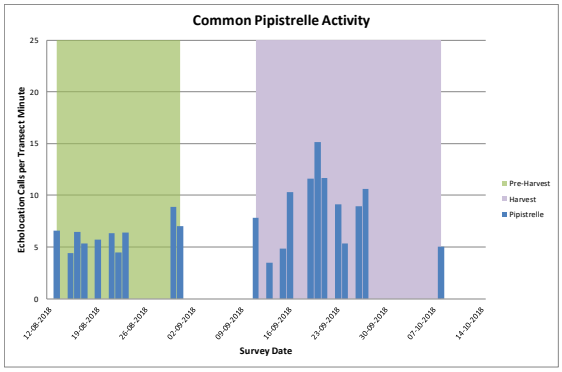

Figure 4 Season 1: Barbastella barbastellus Activity

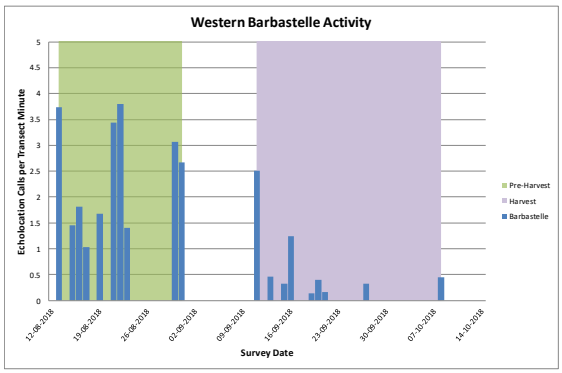

Figure 5 Season 1: Survey Sunset Temperature

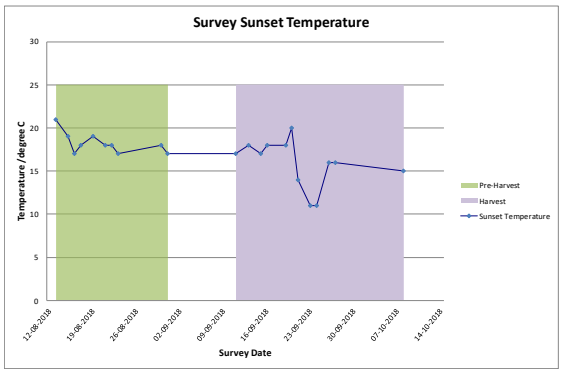

Figure 6 Season 2: Pipistrellus pipistrellus Activity

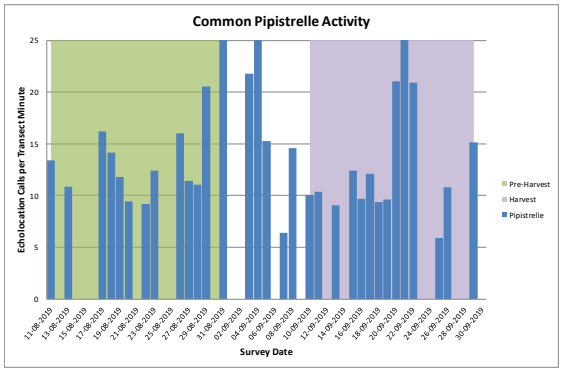

Figure 7 Season 2: Barbastella barbastellus Activity

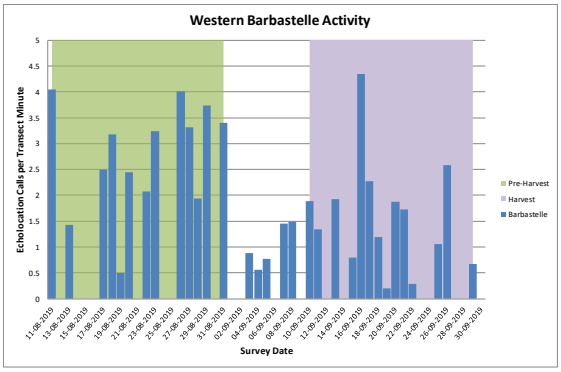

Figure 8 Season 2: Survey Sunset Temperature