THE UNIVERSITY of York

DEPARTMENT OF BIOLOGY
Wentworth Road York YO10 5YW U K

Nancy Irwin

Direct Facsimile: (01904) 32 85 05
E-Mail: nancy.irwin@york.ac.uk

Interim report: Year 2
PTES Improving ground vegetation for bats in urban spaces.

Rationale for study (reminder)

Many bat species prefer to forage along hedges, tree rows and water bodies where insect abundance is higher. These habitat features are generally less available in the landscape, and are difficult to create for bats, especially in urban landscapes. Instead, it may be possible to increase the abundance of insects, and hence the foraging potential for bats, by improving the ground vegetation especially next to edge habitat (e.g. treelines or hedgerows) or in the undergrowth beneath trees.

The main aims of the project were:

1. Document how effectively bats use an urban landscape, explicitly the city of York, for foraging (collect the first all night and seasonal monitoring data in York).
2. Document more specifically how the green spaces in York (parks, gardens & cycle paths) are used by bats.
3. Improve the ground vegetation of green spaces in the city by delaying mowing and planting wildflowers (in collaboration with partner organisations).
4. Monitor the efficacy of these improvements on the flora and the nocturnal insects (in collaboration with partner organisations).
5. Monitor if bats are more efficient at foraging insects in response to these improvements (measuring feeding buzzes per minute).
6. Monitor if these improvements have differential effects on different species of bat present.
7. Monitor if these improvements increase bat activity generally.

Summary of achievements in the previous report (2011) (verbatim).

In 2011 we recorded 506 full nights of bat activity that represented 56,652 individual bat passes by 5 species. Activity in a single night could reach a 1000 bat passes. These passes are represented by *Pipistrellus pipistrellus*, *Pipistrellus pygmaeus*, *Pipistrellus nathusii*, *Nyctalus noctula*, and *Myotis mystacinus/brandtii*. *P. nathusii* was recorded in York for the first time, only 3 years ago, it now seems to be relatively common. Rarer bats that we will focus more on next year once we have more recordings are *Myotis alcathoe* (at 4 sites) and *Barbastella barbastellus* from a single site. The *B. barbastellus* calls are unlikely to be confused with any other species but this surprising result has lead us to assess if the calls could be social calls from a *Myotis* sp. *Myotis daubentoni* is also present in the city but hasn't been classified to species in the recordings. It is therefore likely that they are present in the dataset but so far only identifiable to genus level.

Although analysis has not been completed to date, the initial trend seems to be that improving vegetation increased diversity of bat species at a site and decreased activity of *Pipistrellus pipistrellus*. Bats use sites at different times of the night. We also noted that cutting grass at sites massively changed the species diversity and number of bats on the site the following night and subsequent days after. These anecdotal observations suggest that bats are able to change their habitat feeding sites to make use of new or changed habitats. These data will be analysed more fully over the next few months, as there are many statistical issues to deal with, non-poisson distributed data, autocorrelation, weather variables, etc. [Alas the PhD student working on this project has left permanently, see General Issues/Changes to the Project section, so no further analysis has been carried out yet]

General issues/changes to the project (since last interim report)

Our PhD student unfortunately withdrew from the project in May 2012. This was a sudden and unexpected departure; we therefore had to hire a field technician to complete the placement of the bat detectors during our summer absence (June to August). Dr. Missa personally manned the detectors the rest of the time, from May into June and Sept to October. Other staff members of the University of York agreed to place detectors in their garden and collate and store the data for this period. We therefore were able to conduct both the short/long vegetation comparison and the structured garden sampling projects that have resulted in some 280,000 audio files to analyse from 2012 alone. This is a 5-fold increase on the previous year and brings the total number of bat files to some 336,000 calls (a dataset 12-fold larger than has ever previously been published). The sheer volume of data has become an issue to store and requires a lot of time to upload on computers and is currently our main bottleneck that we are working through.

We have had no further security problems for the detectors this year. However, repeated floods in York cut us off from accessing some sites, and we have experienced many problems with the batteries this year. Batteries were replaced by the manufacturer but this lost us time and data as we discovered which units were not working properly. Due to the increase in bat activity we bought larger memory cards again this year. We were also able to place temperature data loggers in each site.

We currently have 3 honours project student tasked with analysing the datasets, and they are making good progress. Their final reports are due in April 2012. The three projects are:

1) Bat activity in short/long vegetation sites.

This student will analyse all the audio files collected this year (247,579 files) in the short/long vegetation comparison. The following temporal trends will be examined: When is bat activity highest in the night (after dusk, before dawn?), during the season (which month?) and is this related to the weather at the time. The main spatial trends examined will of course be to verify the preliminary results found last year, which suggested that sites with taller vegetation had a higher diversity of bats and a lower abundance of Common Pipistrelle compared to sites with shorter vegetation.

2) Bat activity in private gardens.

This student will analyse the audio files collected in nine private gardens in the city of York (32,308 files) from May to October 2012 (each garden being monitored for approximately 7 consecutive nights every three weeks). The student will attempt to find variables in the nearby environment (building density, amount of green spaces, trees, …) that may help explain why some private gardens are more often visited by bats than others. Temporal trends through the night and the season will also be looked at.

3) Insect and plant biodiversity in short/long vegetation sites (prior and after mowing).

This student has collected over the summer insects present in the ground vegetation using a standardised protocol with a D-Vac (a vacuum machine that sucks up arthropods) in all the sites (and subsites) that were monitored for bat activity (though not in private gardens). The vegetation was also censused by quadrats to quantify its plant diversity and species composition. In most locations, the student was able to get samples in each site prior and subsequently to being mowed or grazed. The student has completed sorting about half of the samples so far. The first impression is that short vegetation sites are heavily dominated by springtails and mites (which are not eaten by bats) while long vegetation sites are less heavily dominated and show a wider diversity of arthropods. The student should soon be able to determine whether the arthropod composition in the long vegetation subsites changes markedly after mowing or grazing.

Achievements in this report (2012)

In 2012, we continued monitoring bat activity in the city of York with a view to confirm or refine the results obtained the previous year. Two separate but complementary projects were pursued. The first project continued to investigate the benefit for bats of improving the ground vegetation near tree rows in public green spaces. A total of eight sites were monitored (each with one subsite overlooking short vegetation and another subsite overlooking vegetation left to grow for part of the season), some of which were in the same general location as last year (Figure 1). The second project monitored bat activity among nine private gardens spread across the city to gauge the value of private gardens for bats in comparison to larger green spaces.

Bat activity next to short/long ground vegetation

We monitored bat activity on a total of 1,189 full nights across 16 observation sites (8 locations x 2 subsites) in the city of York and recorded a total of 247,579 audio files (bat passes). Each site was usually monitored for 7 nights in a row every fortnight from late April to mid-October, which lead to an average of 74 nights being monitored per site with little variation (min 67 nights , max 81 nights) between sites.

The identification of the bat species represented in these audio files is still underway, so only preliminary findings based on the number of audio files recorded are presented here (Table1). Averaged across all sites, 208 passes (audio files) were recorded per night, but this hides huge variations; a single night could generate as many as 4,575 audio files, others none at all. Some sites generated far more audio files (e.g. Bishopthorpe Crematorium grounds: 774 files per night across the entire season) than others (e.g. Rawcliffe left-aside: 30 files per night across the entire season). In 6 of the 8 locations monitored, there was more bat activity next to short vegetation than next to tall vegetation. Most of this bat activity is likely to be from *Pipistrellus pipistrellus*, the Common pipistrelle, which would confirm the findings from last year. The two locations which showed the opposite trend, Clifton Banks and Walmgate, may do so for different reasons. The subsite overlooking long vegetation at Clifton Banks was right by the river Ouse and may have picked up a lot of Daubenton's "patrolling" along the river. The subsite overlooking "long" vegetation at Walmgate, was grazed by sheep fairly early in the season, which may have changed the attractiveness of the site compared to the attracted short subsite for part of the season. Further analysis at the species level should reveal if the long vegetation were used by a greater diversity of bats (as suggested in last year's result).

Each site surveyed showed tremendous variation in bat activity through the season, but there is no general pattern emerging, each site seeming to peak at different times (Figure 2). What is even more surprising is that the two subsites (short and long vegetation) at a given location often depart markedly from each other in their temporal patterns. For instance on the City Walls, the short vegetation subsite has a clear peak in late May to early June, whereas the long vegetation subsite has a peak in mid-August. Another example, in Little Hobmoor, the short vegetation subsite has a peak in bat activity late in the season around the beginning of October, whereas the long vegetation subsite has a peak at the beginning of July. Variation is also extremely high from one night to the next, where it is not unusual for the number of bat passes one night to differ by an order of 10 (higher or lower) from the previous night (Figure 3). Furthermore, the number of passes recorded nightly in one subsite does not seem to be correlated at all to those of the other subsite (tested for Bishopthorpe but not shown), which would suggest that weather does not play a major role in this variation. All in all these very preliminary results suggest that bat activity in a specific location is very stochastic and that bats are not "faithful" to a site but change often their foraging grounds.

Bat Activity in private gardens

We monitored bat activity on a total of 386 full nights across 9 private gardens in the city of York and recorded a total of 32,308 audio files (bat passes). Each site was usually monitored for 7 nights in a row every three weeks from May to mid-October, which led to an average of 43 nights being monitored per site (the minimum being 31 nights, and the maximum 52 nights) (Table 2).

Averaged across all private gardens, 84 passes (audio files) were recorded per night, but again there was huge variation; a single night could generate as many as 1,505 audio files, others none at all (Figure 4). And some sites generated far more audio files (e.g. garden 1: 230 files per night across the entire season) than others (e.g. garden 6: 16 files per night across the entire season). All in all, a private garden seems to attract about 2.5 times less bat activity than a large green space (average bat activity in private gardens 83.7 passes / night, average bat activity in large green spaces 208 passes / night). Interestingly, the private garden with the highest bat activity (garden 1 with 230 files per night across the entire season) was immediately adjacent to a large green space, the Greater Hobmoor. If proximity to large green spaces is confirmed (after proper analysis) to affect the level of bat activity measured in private gardens, the difference between private gardens and large green spaces may end up being more pronounced than the 2.5 factor as suggested above. When the files are identified to species, we will also be in a position to check whether bat activity in private gardens is primarily dominated by the Common and Soprano pipistrelles (as we expect) and whether rarer bat species are only ever found in large green spaces.

Testing the species identification obtained through the automatic software.

Occasionally the batcorder software identifies species that do not occur within the UK, e.g. *Miniopterus schreibersii.* However, we can see from the call and the manufacturer's literature that this misidentification is common for *P. pipistrellus* social calls, we therefore have to be vigilant in our acceptance of unusual assignments. We assessed more carefully the rare species records from 2011 i.e. those assigned to *Myotis alcathoe* and these turned out to be *Pipistrellus pipistrellus* social calls. We have therefore decided to conduct a double blind study with a panel of experienced bat echolocation experts to test species assignment calls. The batcorder gives a confidence of assignment to the bat species identified. We will therefore extract data that has different confidence limits of assignment for the same species, and for several species and also include samples of all "rare" calls. We will then be able to quantify the error of assignment of the software.

Table 1: Bat passes (audio files) recorded in each location next to short and long vegetation over the entire season (late April to mid-October).

Location	Short Vegetation	Long Vegetation
Bishopthorpe	**773.6 passes / night** 56,471 passes / 73 nights	**87.3 passes / night** 6,113 passes / 70 nights
Bootham	**377.8 passes / night** 26,450 passes / 70 nights	**41.9 passes / night** 3,188 passes / 76 nights
City Walls	**300.3 passes / night** 24,321 passes / 81 nights	**194.6 passes / night** 14,013 passes / 72 nights
Clifton Banks	**231.6 passes / night** 17,600 passes / 76 nights	**625.8 passes / night** 41,928 passes / 67 nights
Little Hobmoor	**191.4 passes / night** 14,738 passes / 77 nights	**74.7 passes / night** 5,531 passes / 74 nights
Poppleton	**194.6 passes / night** 14,598 passes / 75 nights	**108.4 passes / night** 8,674 passes / 80 nights
Rawcliffe	**43.9 passes / night** 3,509 passes / 80 nights	**29.5 passes / night** 2,213 passes / 75 nights
Walmgate	**42.7 passes / night** 3,162 passes / 74 nights	**73.5 passes / night** 5,070 passes / 69 nights

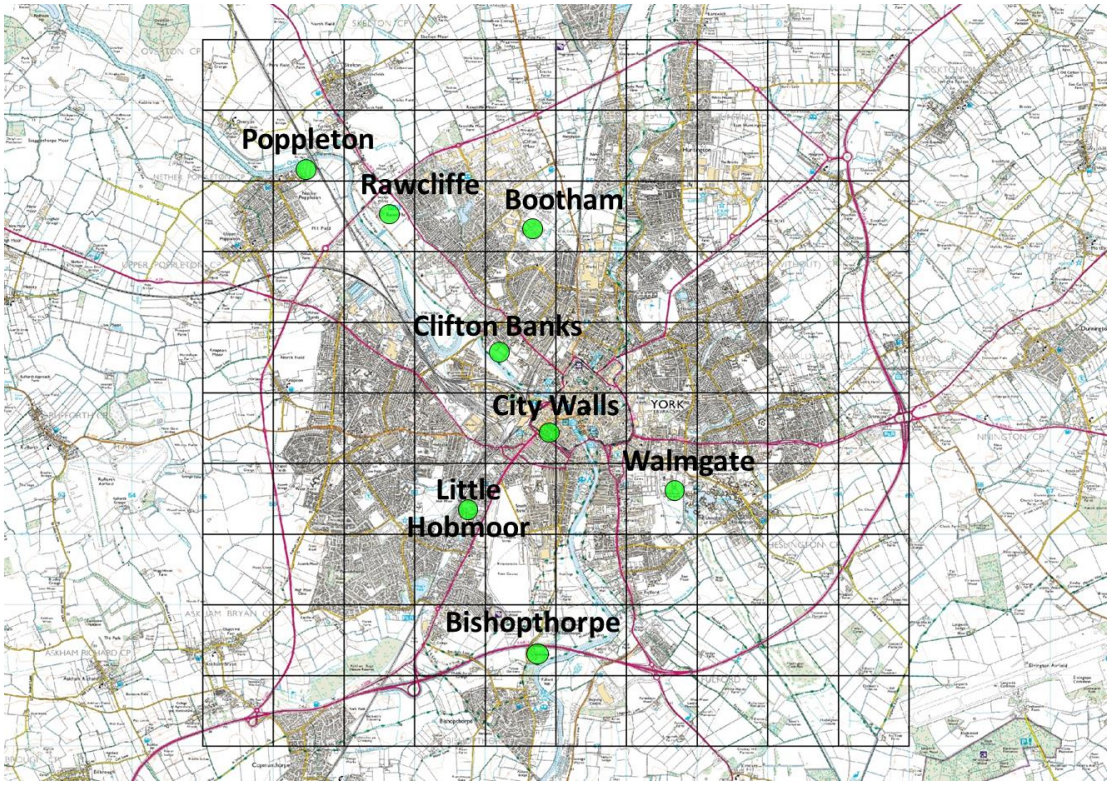

Figure 1: Distribution map of all public green spaces that were monitored in 2012 to study whether the height of the ground vegetation impacted bat activity.

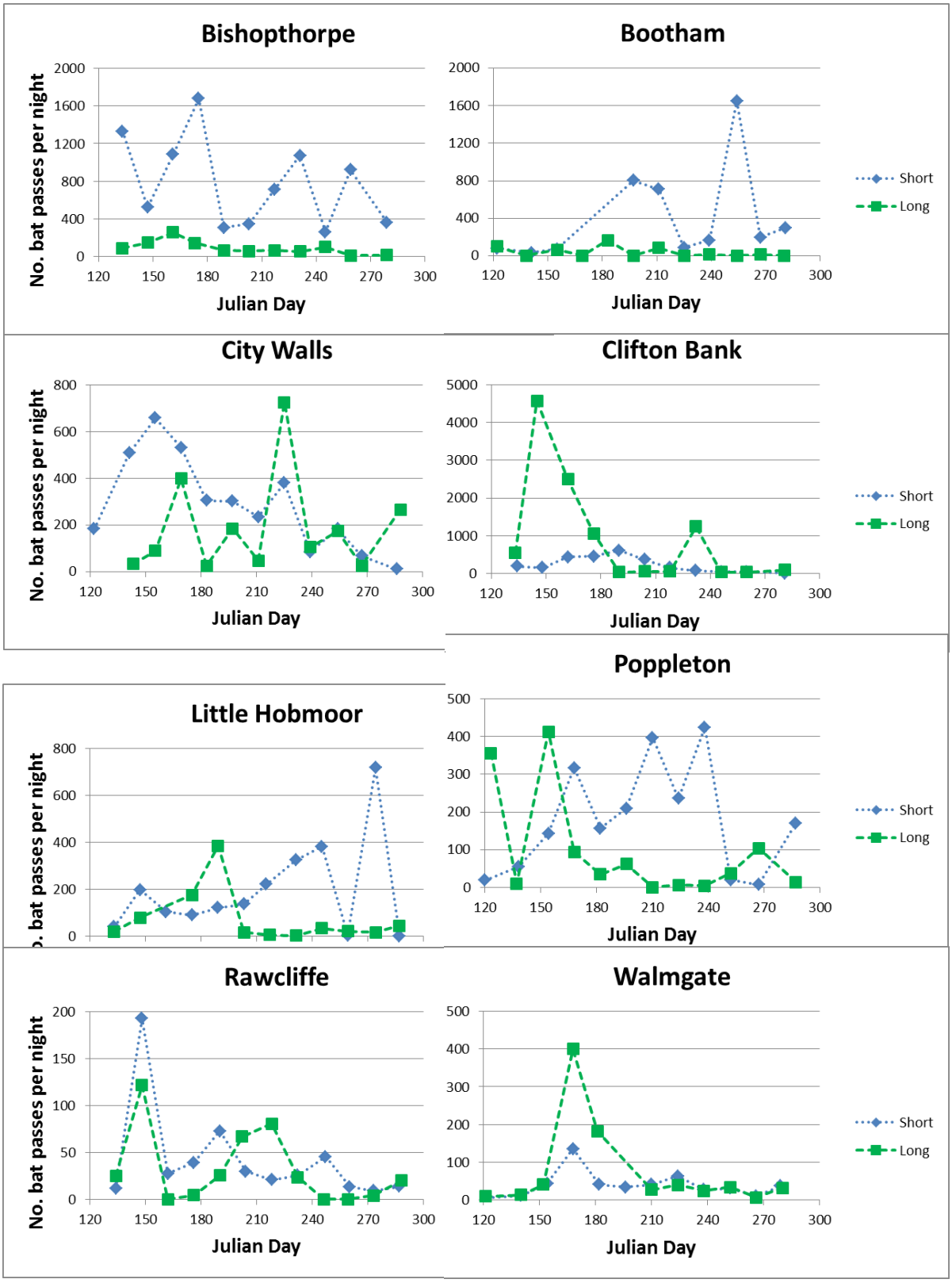

Figure 2: Temporal variation in the number of bat passes recorded per night across the season (May to mid-October) in the eight sites were short vegetation was compared to long vegetation.

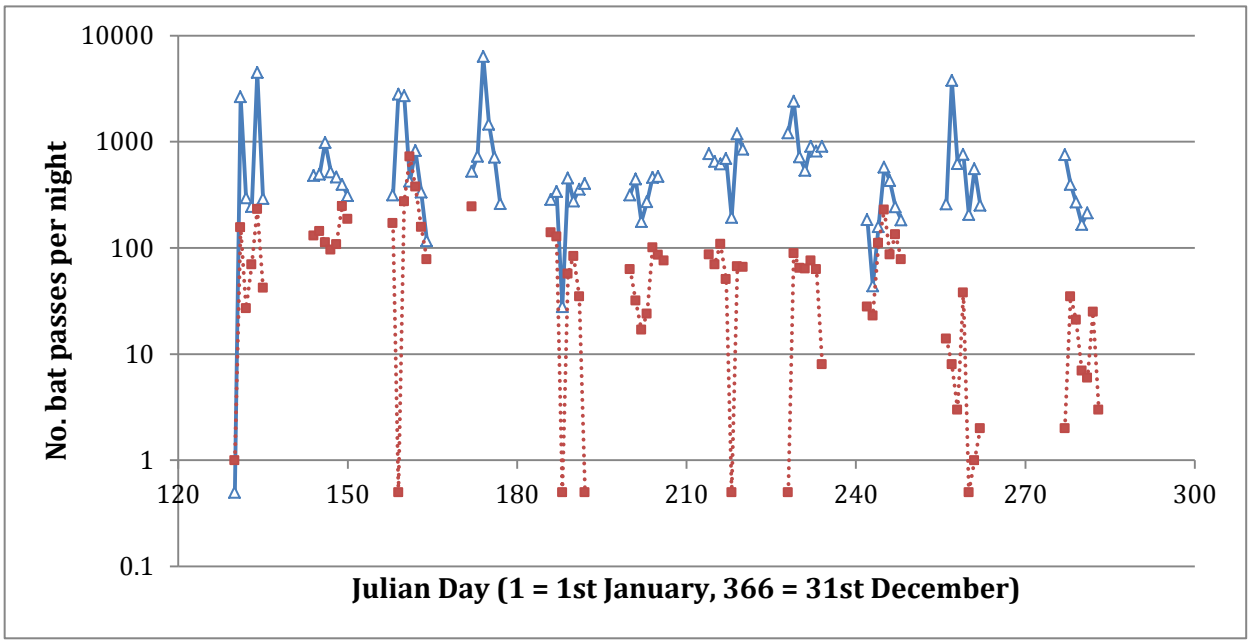

Figure 3: Comparison between nightly bat activity at Bishopthorpe Crematorium between the short vegetation (red square, dotted line) and long vegetation (blue hollow triangle, continuous line) subsites. Numbers are consistently higher in the short vegetation subsite but vary considerably from one night to the next (note the logarithmic scale).

Table 2: Bat passes (audio files) recorded in nine private gardens over the entire season (May to mid-October).

Garden	Total	Average
1	9,429 passes / 41 nights	**230 passes / night**
2	887 passes / 47 nights	**18.9 passes / night**
3	3,360 passes / 35 nights	**96 passes / night**
4	2,728 passes / 50 nights	**54. 6 passes / night**
5	883 passes / 31 nights	**28.5 passes / night**
6	543 passes / 35 nights	**15.5 passes / night**
7	6,508 passes / 49 nights	**132.8 passes / night**
8	6,002 passes / 46 nights	**130.5 passes / night**
9	1,968 passes / 52 nights	**37.8 passes / night**
OVERALL	**32,308 passes / 386 nights**	**83.7 passes / night**

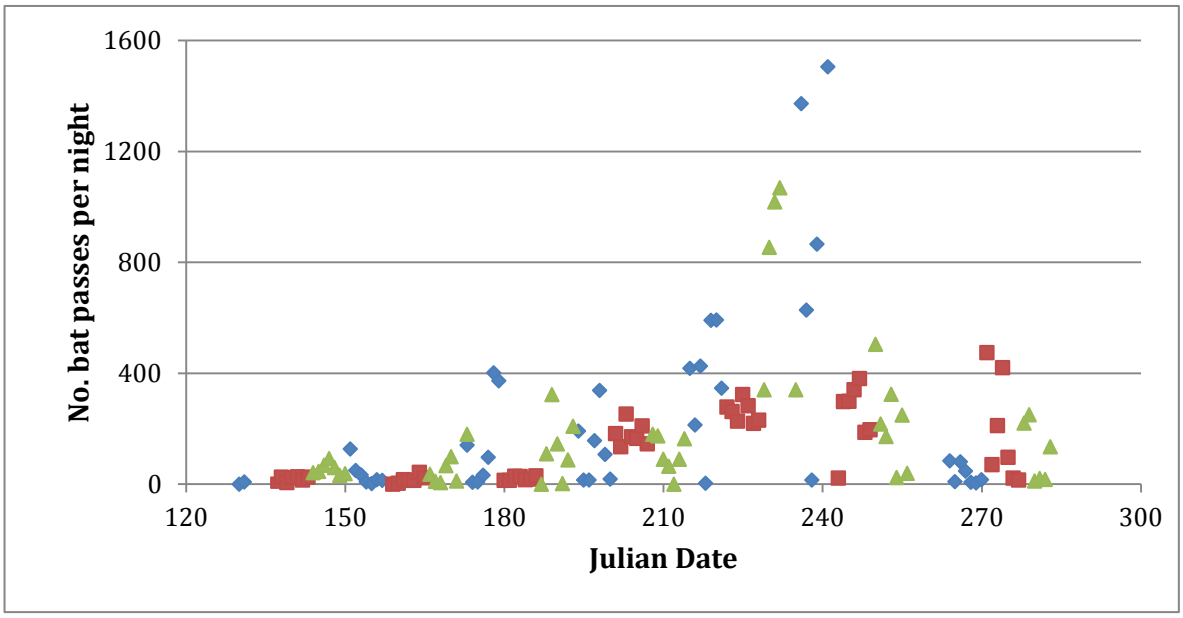

Figure 4: Bat activity in 3 different private gardens. There is both inter-garden differences in abundance and seasonal differences. Different colours represent different gardens (red square = 6, green triangle = 7, blue diamond = 1).