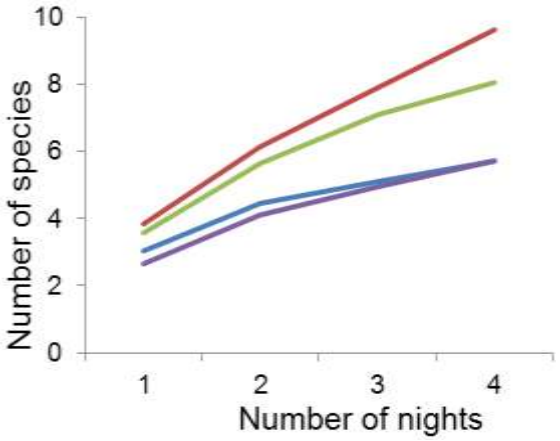
Piloting an approach for increasing the level of surveillance for bats in Norfolk

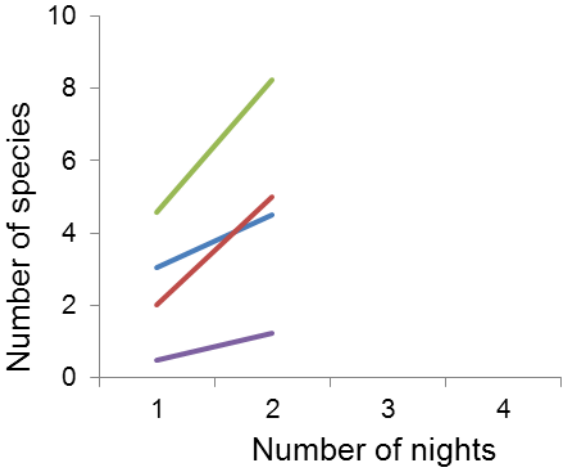
Survey effort

Small-scale field trials were carried out in September 2012 at five sites, to help provide an informed decision on the survey effort required to give a good idea of the species present. Currently we are considering that each 'Bat Monitoring Centre' has a single detector in 2013, so survey effort is limited to increasing the number of nights of recording at a site, rather than being able to have multiple detectors at a site. However, as part of the small-scale trial, we wanted to see the variability in species detected on different detectors at different points in the same 1-km square.

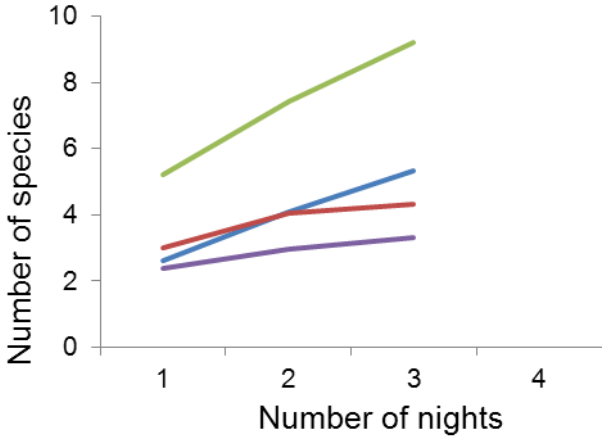
Bramerton (OS grid TG3005)



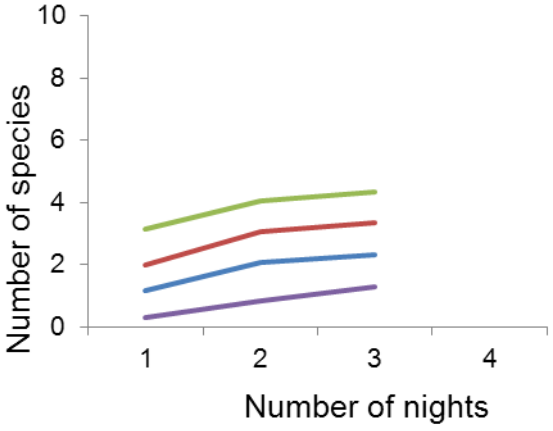
High Ash Farm, Caistor St Edmunds (OS grid TG2403)



Dinosaur Park, Lenwade (OS grid TG117)



Mousehold Heath, Norwich (OS grid TG2410)



The Rabbit Enclosure, UEA, Norwich (OS grid TG1906)

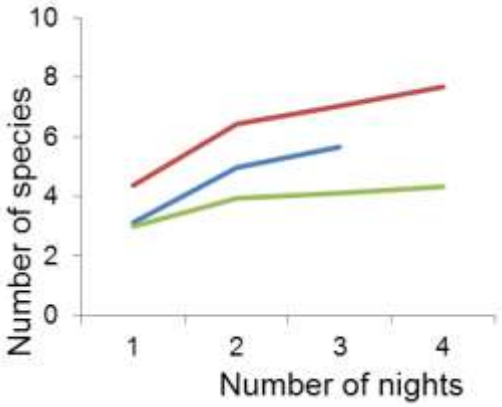
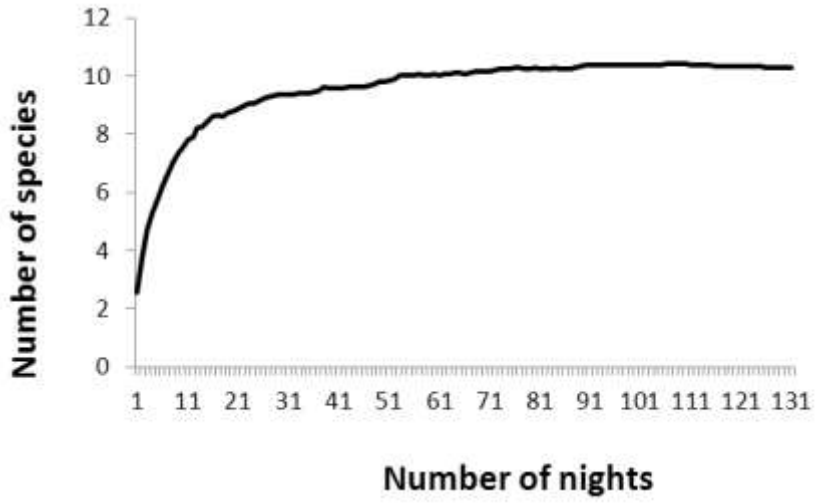


Figure 1. Number of species recorded with an increasing number of nights of recording at five study sites in September 2012. Bootstrapping (199 samples) of the species recorded by each detector and sites across visits, was used to produce species accumulation curves that are not dependent on the order of the visits. Each line on the graph is a single detector.

From Figure 1 it is clear that there is a big increase in the number of species recorded when two compared to one visit is carried out, but that the number of species continues to increase with three and four visits to a site. There is also ni some cases considerable variation in the number of species recorded by different detectors placed at different points within a 1-km square, suggesting that bats are using particular micro-habitats within the square for foraging or commuting.

To get an idea of the number of visits that would be required to detect all species present over a season, we looked at the species accumulation curve for a single rural site in Hapton, Norfolk, where a detector is put out each night where the temperature is not predicted to fall below 7^{o}C. We focus here on data collected across 131 nights between April and September 2011. Over this period, a total of 10 bat species were recorded.

A) 131 nights



B) 13 nights

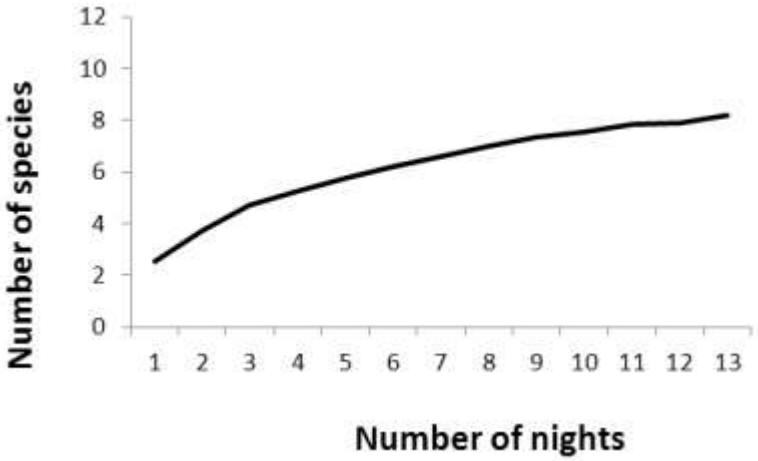


Figure 2. Number of species recorded with an increasing number of nights of recording at a single rural long-term monitoring site in Hapton, Norfolk (OS grid TM1797). We focus here on species recorded between April and September 2011 across 131 nights of recording. As in Figure 2, bootstrapping (199 samples) was used to produce species accumulation curves that are not dependent on the order of the visits. We show a figure for all nights and for visual purposes a separate figure for 13 nights of recording.

Whilst this is for a single site only, Figure 2 suggests that about 70 visits may be required to detect all the bat species that could be detected at a site over a season. However, it is clear that several of these species occur at very low densities or rarely use the site. We can see this by re-running the above analyses for each species separately, to determine the expected number of nights required to detect each species (see Table 1).

It is clear that a compromise is needed between trying to detect as many species as possible, but is not so limiting to restrict coverage to a small number of sites. Figure 4 shows the relationship between the number of visits to a site and number of sites that can be surveyed in a given year given ten detectors, and assuming that it is possible to put a detector out for 3 days / week and a more optimistic 4 days /week between April and September.

Species	**Expected number of nights to detect species**
Common Pipistrelle	1
Soprano Pipistrelle	2
Natterer's	3
Noctule	9
Barbastelle	14
Daubenton's	15
Nathusius' Pipistrelle	17
Brown long-eared	34
Brandt's / Whiskered	57
Serotine	64

Table 1. Expected number of nights required to detect each species detected at a long-term rural monitoring site in Hapton, Norfolk (OS grid TM1797).

Considering that the rate of increase of new species detected is greatest across the first three visits (shown in Figure 2), and the rapid fall off in number of sites that can be surveyed with an increasing number of visits (shown in Figure 3), we suggest that three visits are made to each site. We accept that by doing this, species at very low density or that rarely use a site will be missed by the survey.

Because of the micro-scale variation in the number of species recorded by different detectors placed at different points within a 1-km square observed in Figure 1, we suggest that three different points within the 1-km^2 are chosen for survey in a given year. The longer term aim will be to survey the same three points in subsequent years.

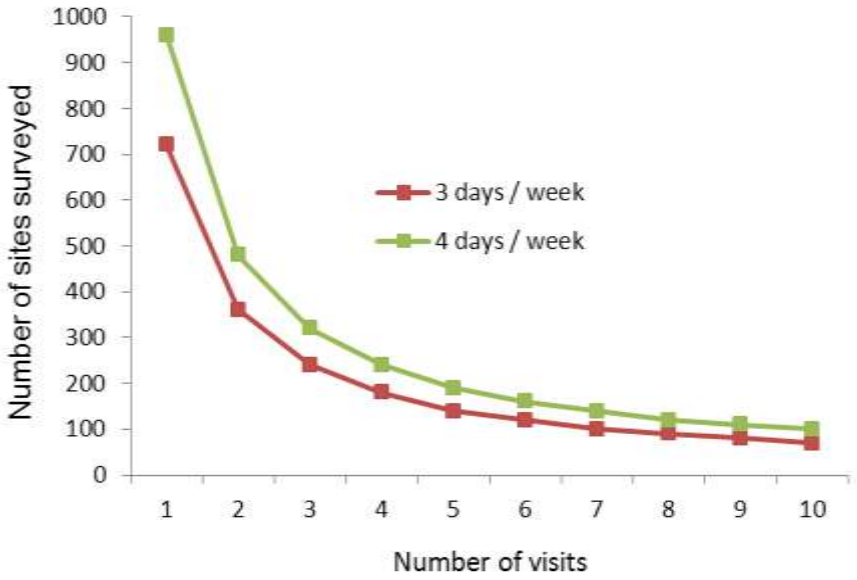


Figure 3. Relationship between the number of sites that are possible to survey given a specified number of visits to each site. This assumes that ten detectors (note the project has 18 detectors) are put out for 3 days / week (or a more optimistic 4 days /week) between April and September.