A week is a long time in Ecoacoustics? (Working title)

Intro

Biodiversity is crucial for the wellbeing of the planet and its inhabitants, but it is critically threatened by a number of drivers. For this reason, wildlife monitoring is of pivotal importance, if we are to understand the population dynamics and health of certain species. Unfortunately, most of the commonly used monitoring methods have distinct drawbacks that can affect the reliability of data and the amount of data collected, for effort put in.

Recently there has been an expansion of studies into ecoacoustics, the branch of monitoring that utilises sound as a proxy for environmental health and as an indication of which species are present in an area. This method has the potential to collect more data, with less effort, and is far less invasive than other strategies. For many species though, there are no specific guidelines on maximising success of an acoustic approach and there are limited tools available to aid classification of sounds.

Few acoustic studies on rodents have taken place and little knowledge has been generated on how an acoustic approach to their conservation could work. Recently, the BTO (British Trust for Ornithology) created an extensive reference library of rodent calls to act as a classification tool, in order to assist in the identification of acoustic events (BTO 2022). If rodent ecoacoustic monitoring is enhanced, it could provide an extra form of monitoring available to ecologists and conservations, to protect threatened species, whilst being non-invasive and less laborious. This library is a key step in making ecoacoustics easily applicable for rodent monitoring.

Hazel dormouse are a protected species in the UK (Wildlife and Countryside Act 1981) because their numbers have dropped by 51% since 2000 (PTES 2019) and they have become locally extinct in 17 counties. The key drivers of this trend have been loss and fragmentation of natural habitat and structural connectivity degradation (Mortelliti et al. 2010). Typical dormice surveys include nest box searches, footprint tunnels and nut hunts, which are often laborious and require greater manpower. They are therefore a species that would benefit from extra monitoring across the British Isles, particularly via ecoacoustics, as they are nocturnal.

Our study aimed to understand how long a surveyor could expect to survey an area using passive acoustics approaches in order to be confident they have allowed time to detect a dormouse.

Methods

To understand the potential for acoustics to improve ease of dormouse detection further, we recorded in areas known to harbour dormouse populations, to discover how much effort needs to go into ecoacoustic monitoring. We set out to record dormouse activity in two areas of the Arnside and Silverdale Area of Outstanding Natural Beauty; Gait Barrows National Nature Reserve managed by Natural England, and Eaves Wood owned by the National Trust.

Dormice have been absent from South Cumbria for many years and as part of the Back on our Map (BOOM) reintroduction scheme run by the People's Trust for Endangered Species (PTES), dormice were reintroduced to Gait Barrows in 2021, and Eves Wood in 2022. Traditional surveys of nest boxes were conducted in each year to confirm the populations have become successfully established. This project provided an ideal opportunity to test the utility of acoustic recorders for supporting dormouse monitoring and focused on those areas where releases had taken place. In addition, we were also able to deploy recorders adjacent to the cages in which the dormice were initially kept on site, which also provided supplementary food for them at the time of release.

We used two types of acoustic recorders, the low-cost AudioMoth (Hill et al 2018), and the SongMeter MiniBat available from Wildlife Acoustics. The SongMeter MiniBat (SMMB) recorders are triggered by sounds in ultrasonic frequencies, whereas the AudioMoths were scheduled to record for 1 minute in every 3. Recorders were placed within 1m of nest boxes over three 2-week periods, spending 2 weeks in Gait Barrows and 4 in Eaves Wood. A large number of AudioMoths were available and were used to test the distances at which calls could be detected from the cages, and to sample a variety of habitats in each site. However, unfortunately AudioMoths did not appear suitable to detect dormice, failing to detect the majority of calls that were recorded by the SMMB when both were placed next to the release cages. Thus, the remainder of this article focuses on the results we gained from analysis of the data collected using SMMB recorders.

After our data was collected, we sent the files through the BTO pipeline to classify them, as this software can sort rodent sounds based on the species type. The software classes each sound and gives a probability value for the classification. For each location we then took the sound files with greater than 50% probability of being a dormouse.

Recent studies by Newson at BTO, remarked on how similar Brown Rat and Dormouse calls are and the potential for misclassification. For this reason, we manually checked 20% of files that were classified as brown rats, at a range on probabilities (Low, medium, high) and as a consequence all calls that were manually checked were considered to in fact be dormice.

After finding all our dormouse calls, we calculated the time-to-detection, for each recording device, on each night of the study. That is, how long each device had to wait before hearing a dormouse call. We also compiled temperature and rainfall data for each night of recording.

We added our data into a single species model previously used by Henry et al (2019), to analyse how long a surveyor would have to record for to hear a dormouse, assuming the species was present in the area. The model was initially created to use multispecies bird data, to predict occupancy and detection rates but we modified it to utilise time-to-detection data for one species, across multiple sites.

Result and Discussion

To be confident of detecting dormice using passive acoustic recorders, we recommend recording for at least 5 nights. If dormice are not detected within this period, our study suggests it is unlikely they are making use of that specific location. The likelihood of detecting a dormouse was also influenced by temperature and rainfall. Not surprisingly, higher average precipitation does decrease detection probability, but if recording is sustained for a week, the cumulative probability of detection remains above 80%. Temperature was expected to reflect any seasonal differences in activity, possibly peaking on the warmest nights, but in fact our analysis suggested increasing temperatures slightly decreased the time to detection. Even so, surveys under all modelled temperatures tended to 100% detection probability after a week.

Reclassifying calls that had been automatically assigned as rats instead of dormice had a relatively small impact overall, reducing time-to-detection under optimal conditions, and also slightly strengthening the effect of environmental conditions.

This case study provides new evidence to suggest dormouse acoustic surveys are a viable monitoring method; and in particular clarifies the degree of survey effort practitioners would expect to apply when planning a survey. Unfortunately, the lack of detections by AudioMoths meant we could not assess the distance over which calls could be detected. Nevertheless, acoustic detection is likely to be restricted to within 1-2m and therefore practitioners will still need to use their judgement to assess which habitats to target. For dormice, dense vegetation cover and a proximity to sources of food such as hazel and bramble are often preferred, but using acoustics it may be possible to explore their use of other habitats too.

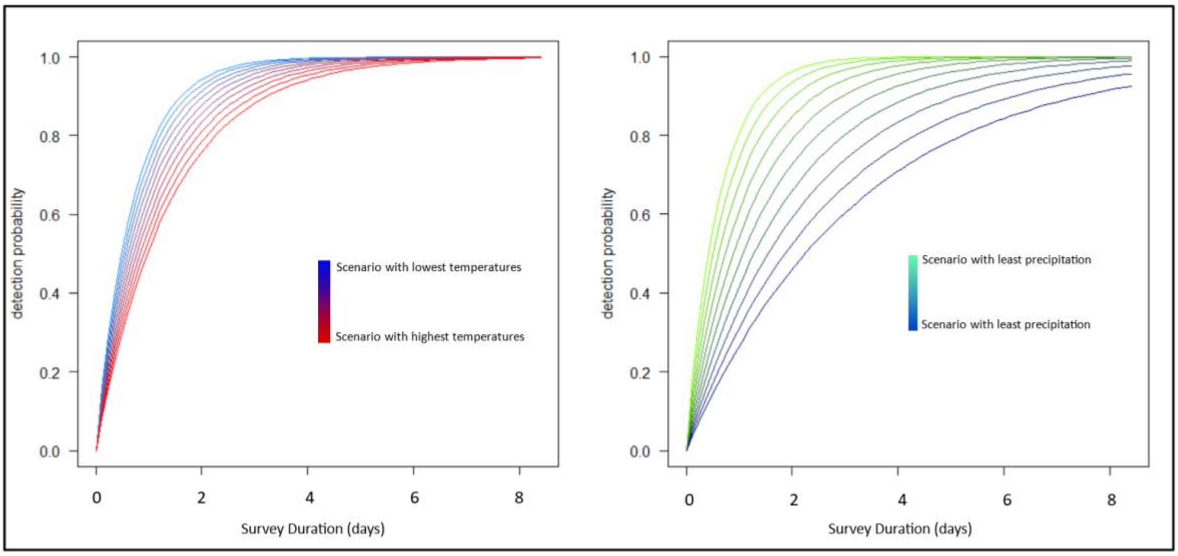

Figure 1a-b: Graphs showing detection probability with increasing recording time, across a range of scenarios, involving changing temperature (a) and precipitation (b)