Going for a Song (Cheap & Cheep)

A low-cost protocol for studying birdsong

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1 | Summary

This project shows how students can develop a wide range of research skills by using smartphones and free apps to investigate whether noise pollution alters the amplitude or frequency of birdsong.

- **Keywords:** birdsong, amplitude, frequency, house sparrow *(Passer domesticus)*, noise pollution, urban, rural
- **Disciplines:** biology, physics
- **Age level of students:** 16-18 years (also suitable for the 14-16 age group)
- **Android apps:** iRig Recorder, FreequenSee, Sound Meter, UK Birds Sounds
- **iOS apps:** iRig Recorder, Decibel Meter, British Birds Lite
- **Further software:** Audacity® freeware

2 | Conceptual introduction

Birds sing to communicate. In particular, male songbirds sing to attract females and to deter male competitors. Each songbird species has its own signature tune.

Several research studies, including studies on blackbirds, great tits, song sparrows and nightingales, have concluded that songbirds in urban areas are challenged by noise pollution. These studies indicate that songbirds compensate to get themselves heard above urban noise pollution by singing at either a higher amplitude (louder) or at a higher frequency (higher pitch) than members of the same species in rural areas where noise pollution is lower.

In the Going for a Song project, students carry out their own investigations of the effect of noise pollution on birdsong using smartphones and free apps.

3 | What the students do

Present the students with a challenge: to investigate whether noise pollution alters the amplitude or the frequency of birdsong.

Introduce the conceptual background and the available Android/iOS apps, and explain how free software (Audacity®) can be used to analyse birdsong. Audacity® is an open-source, cross-platform software for recording and editing sounds.

The students make preliminary recordings using their smartphones and apps at two locations (one urban, one rural) to help them choose one bird species suitable for the study and the length of recording. Bird species can be identified by their songs with the UK Birds Sounds (Android) or the British Birds Lite (iOS) apps. The Sound Meter app (Android) or the Decibel Meter app (iOS) can be used to record the noise level in decibels. iRig Recorder (Android/iOS) can be used to record bird songs for later analysis using Audacity®. FreequenSee is an alternative recording app (Android).

During preliminary investigations, the students are reminded that they must consider how they can make valid comparisons between the urban and rural sites. The variable under investigation is the level of noise pollution. All other variables must be controlled as far as possible to ensure fair testing. Sufficient recordings must be made at each site to ensure data reliability. The students report their preliminary findings to the supervising teacher, including variables which they have identified as requiring control and the importance of controlling these variables.

The students are encouraged to consider any other variables they have not considered, using the following list as a guide: Species of bird, time of year, time of day, weather conditions, type of habitat, recording distance from birds, number of birds recorded at one time (for species, which flock), presence of other songbird species during recording.

The students adjust their methods accordingly. They carry out twenty final recordings at each site over a period of two weeks and analyse the collected data using Audacity®.

The students evaluate their data and draw conclusions regarding the effect of noise pollution on the amplitude and frequency of the birdsong.

FIG.1 **Male house sparrows *(Passer domesticus)* chirp to attract mates** Source: wikipedia CCA, Adamo

What the students did (as an example project)

The students used Android apps. Preliminary investigations were carried out to help identify a suitable songbird for study (using UK Birds Sounds) and to help find two contrasting

FIG.2 **Students used Android apps to record noise pollution and birdsong**

FIG.3 **A hawthorn hedgerow provides cover for house sparrows**

locations with significantly different levels of noise pollution (using Sound Meter). The bird species chosen for investigation must be present in approximately equal numbers at both sites.

The students chose to investigate the songs of house sparrows. They worked in pairs to record male house sparrows (FIG. 1) at two different locations — an urban hawthorn hedgerow beside a busy main road (FIG. 2) and a rural hawthorn hedgerow in a country lane (FIG. 3). Recordings were made 1.5 metres away from the hedgerow. One student recorded the background noise level amplitude (in decibels) using Sound Meter, and the second student recorded the birdsong using iRig Recorder.

Twenty iRig and Sound Meter recordings were made at each location (rural and urban) at approximately the same time of day (14.00–16.00 hours) at the same time of year (first two weeks in March 2014) on days with similar weather conditions. Only flocks with similar bird numbers were recorded (approximately ten birds). Each recording lasted one minute. The mean noise level recorded using Sound Meter was 43 dB at the rural sites and 70 dB at the urban sites. The iRig recordings were downloaded into Audacity® and viewed as spectrograms (FIG. 4 and 5).

The students noted that the highest-frequency recordings at the urban sites were caused by road traffic. Choosing to focus on ten recordings, students questioned whether the average number of house sparrow chirps differed between the two sites. They used the Audacity® recordings to count the number of chirps of the house sparrows within ten-second intervals, from 20 to 30-second intervals for rural recordings and for ten-second intervals in between road traffic for urban recordings (FIG. 6). They found that the average number of house sparrow chirps varied considerably at both sites (between five and 20 chirps) but that the mean number of chirps per ten seconds taken over ten sites from each location was remarkably similar (approximately 13 chirps per ten seconds).

FIG.4 **An example of an iRig app recording at a rural site, imported into Audacity®**

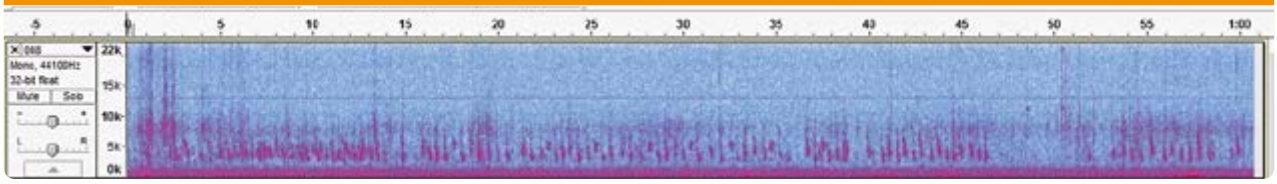


FIG.5 **An example of an iRig app recording at an urban site, imported into Audacity®**

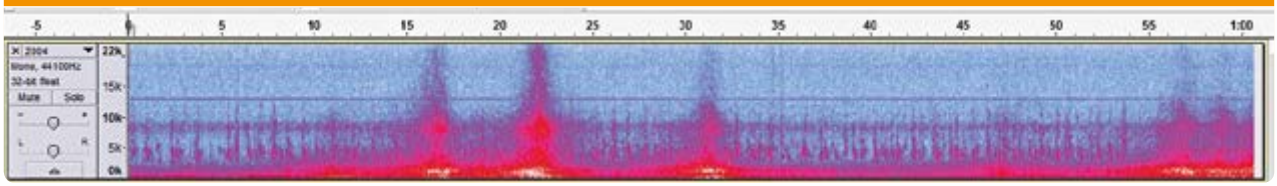
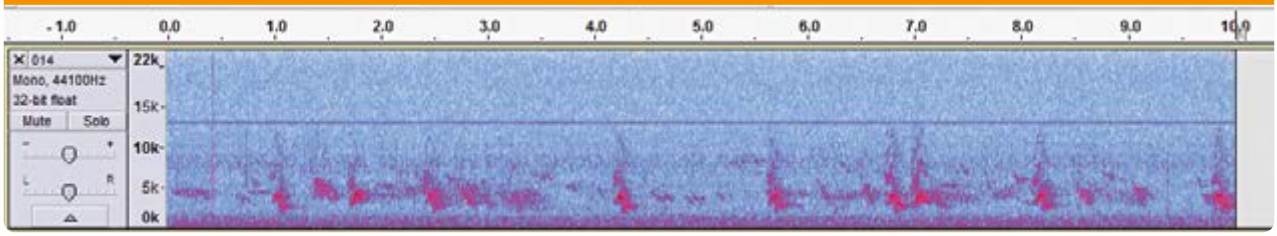


FIG.6 House sparrow *(Passer domesticus)* chirps over ten seconds (typical recording)



The students concluded that there was no evidence that house sparrows chirp at a different frequency (in Hertz), amplitude (in decibels) or recurrence (chirps per second) at urban sites compared to rural sites. They concluded that the intermittent noise pollution caused by road traffic occurs at a much higher frequency and amplitude than the chirps of house sparrows. Any attempt by birds to compete would not only be futile, but also would waste the birds' energy.

4 | Cooperation option

Passer domesticus (the house sparrow) is the most widely distributed species of wild bird. This species is native to Europe and most of Asia. Human activities have introduced this species into Australia, Africa, North America and South America, whether deliberately or accidentally. Consequently, it is an ideal subject for studies to compare data on the same species in different countries, opening up exciting possibilities for international comparisons and project extension. Alternatively, the general protocol could be adapted to study any songbird species.

5 | Conclusion

Presenting students with a simple challenge (to investigate the effect of noise pollution on the amplitude or frequency of birdsong) helped students to develop a wide range of research skills using smartphones and freely available apps. The students gained the following skills from participating in this project:

- Experience of gathering "real" data in the field using smartphones as a tool.
- Appreciation of the importance of controlling variables for fair testing when gathering data to compare two different situations (in this case, for valid comparison of house sparrow birdsong in urban versus rural areas).
- Decision-making skills in planning experimental design and in gathering data.
- Decision-making skills in analysing and evaluating data.
- An understanding of the tentative nature of science (see under "Personal experience").
- Knowledge of how to identify birds from their songs.
- Increased familiarity with the local environment and its wildlife.
- A broader interest in the species of bird being studied and environmental issues. In studying the birdsong of house sparrows, the students wanted to find out more about why birds sing, why males sing more than females, why house sparrows are in decline in the UK (an estimated 71% decline in UK numbers between 1977 and 2008), whether this is a universal phenomenon and what they can do as individuals to encourage house sparrows in their own gardens.

Personal experience

An appropriate risk assessment must be completed before students carry out fieldwork (an exemplar is available at www.science-on-stage.de/istage2-downloads).

Having been introduced to background research on the effect of noise pollution on birdsong, students may be disappointed if their results do not fit in with the findings of other researchers. However, this is an excellent opportunity to discuss the tentative nature of science and opens up debate on why students' results may be different from published studies. For example, students may consider the effects of different forms of noise pollution (in terms of both amplitude and frequency) and the fact that the published research applied to one species of bird may not necessarily apply to another species. They can find out how the data gathering in published studies may be more sophisticated.

Colleagues from Cyprus (Anna Maria Pavlou) and Poland (Maria Dobkowska) trialled preliminary recordings and have made several helpful suggestions for future investigations. The bird species under investigation must be chosen carefully, as some species are wary of humans and will fly off unless the students making the recordings approach them quietly or under cover. The sound quality could be improved by fixing a cheap directional microphone to the smartphone with a boom attached.

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