Calls from the Wild: Engaging Citizen Scientists with Animal Sounds

Abstract
Sound allows people to intimately relate to nature. When people search for wildlife they often rely on their expert knowledge to recognise animal calls. The process of learning these calls involves social engagement and repeated identification in situ. Rare, cryptic, and migratory animals, however, are difficult to hear when people are only at a given location for minutes or hours. This makes many species difficult to study on a large scale, further confounded because human presence may disturb individual animals and reduce their likelihood of detection.

Acoustic monitoring has great potential to engage people with animal calls. It can reveal hidden subtleties of animal lives over long periods. Here, we explore new ways to engage people with natural sounds. We begin with an exploration of the artefacts and practices of birdwatchers, and then online citizen scientists (voluntary contributors to scientific research). Next, we discuss how these practices can extend to co-design user interfaces for people to listen to calls from the wild and make ecological discoveries.

Author Keywords
Citizen science; sound; acoustics; bioacoustics; design; participation design; crowdsourcing.

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Figure 1: A group of birders participating in an annual Twitch-a-thon event, and competing with other teams to find the most species of birds over a 24-hour period. This team from Southern Queensland is part of an annual fundraising event for their regional BirdLife Australia group and Birds Queensland.

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**ACM Classification Keywords**  
H.5.5; H.5.2; H.5.3; H.5.m; I.5.2

**Introduction**  
As evening approaches, cricket chirps fill the air. Eventually these calls progress to a steady drone. Then this nocturne is joined by night-active birds, frogs, and mammals. Dawn approaches and the crescendo of the morning chorus of bird-song begins. Avid birdwatchers, or birders, are well aware of this cycle and often search for species by ear before sunrise, giving them the best chance of hearing the most species (Figure 1).

Venturing outdoors is the primary way people interact with natural sounds and many tools, or artefacts, enhance this experience (Figure 2). This paper explores the micro-cultures that are intimately engaged with the sounds of nature, as well as the artefacts used by these groups, so as to inform the design of online citizen science projects focused on finding animals by sound. Recorded sound holds great promise for capturing information about species; however, online citizen science projects involving review of audio recordings have had limited success. Such projects often lack sustained participation and have a low proportion of data processed by citizens, relative to projects involving image classification [1].

Understanding how to design interactions with recorded sound makes such citizen science more enjoyable and compelling. This paper is based upon observation of birder practices over 20 years by the first author, with organizations such as Point Blue Conservation Science, Cornell Lab of Ornithology and BirdLife Australia. This experience has been synthesised to suggest paths forward that ensure existing birder knowledge will not be lost when designing new ways for citizen science to incorporate analysis of acoustic data digitally.

**Culture & Artefacts**  
The largest group of people to take notice of natural sounds is birders. Serious birders often plan travels based on regional areas with high bird diversity, and technology development has enabled people to easily share such information with community members (e.g. online through Eremaea eBird).

People search for birds, or go ‘birding’, to venture outdoors, socialize, become part of a community, learn about birds, and/or help research efforts [2]. The learning process is substantially expedited for a novice birder when they are able to join experienced birders who can point out key characteristics that lead to accurate identifications. New birders initially develop recognition of physical features of a bird, such as body shape, plumage colours, and relative size. They also quickly learn the importance of behavioural and contextual information, such as expected habitat or seasonal changes in plumage, and/or location. Casual birders who transition to more serious birding train their ears to always be aware of calls from the wild, which allows them to rapidly locate and identify unseen individuals of potentially noteworthy species. Acoustic species identification can be challenging because each species, and in some cases each individual, may have many calls (Figure 3), several of which are deceptively similar to the calls of other species. Learning habitats, distribution, and calls of species is a substantial time investment, and birders use many artefacts to aid in acquiring this knowledge.
Prior to computer and mobile technologies being widely available, printed field guides and commercial recordings were the primary artefacts used by birders. Field guides and recordings are sometimes converted to a single mobile application (e.g., The Michael Morcombe eGuide to Australian Birds). These mobile ‘apps’ are advantageous because they often include a wider variety of calls for each species than was previously available (e.g. call types or regional variation), they’re intuitively organized and readily accessible, and they now include visual representations of sound (as waveforms or spectrograms). Despite the versatility of these technologies, traditional field guide books are still essential, particularly for those birders not interested in apps or not technologically savvy. Electronic guides are also limited to use in regions with reliable access to electricity, and in some cases internet.

Birders may be inclined to play calls in the field to confirm identification, to bring a bird closer, or to elicit a reaction from nearby species. Such practices are often discouraged, though the overall impact on birds when people partake in such behaviours is poorly understood. Overall, these artefacts have allowed birders to engage with nature more directly than was possible with separate books and acoustic recordings.

Recently, a few apps have been developed to automatically recognize bird calls detected by mobile devices. These programs are prone to misidentification of birds with the confounding effects of distance of call, call variability, background noise, microphone quality, and variation in audio formats. There is, however, the potential that such applications may improve as techniques advance and additional acoustic data are acquired over time.

Online Citizen Science & Sound
Strategies of both birders and online citizen scientists deserve careful consideration in terms of developing new ways for citizen scientists to interact with acoustics. Birders may not be the most likely group to listen to acoustics via a computer, given their love of the outdoors. It is still worthwhile, however, to involve birders in the design process to ensure that their effective field practices and artefact-use are translated appropriately to an online project.

Only a handful of online project engage citizen scientists with recorded sound, and these projects have limited uptake. Whale FM and Bat Detectives, both of which involve animal sound classification from spectrograms and sound playback, have relatively low levels of public engagement compared to projects that task citizen scientists to classify objects from astronomy and wildlife photographs [1]. Whether citizen scientists and ecologists collaboratively designed any aspects of these projects is unclear, given the lack of articles about the design process. Project evaluations and scientific findings, however, are regularly published (see https://www.zooniverse.org/about/publications).

The Xeno-Canto project, by contrast, engages citizen scientists to not only explore, upload, and classify bird calls worldwide as a collaborative community, but also allows members to be directly involved in the website improvement process (e.g. http://www.xeno-canto.org/article/194) and enables both citizen scientists and ecologists to share ecological findings (see http://www.xeno-canto.org/articles). Xeno-Canto, however, has only been used to a limited extent in Australia, and reasons for this are unclear and deserve consideration.
Citizen scientists are driven to participate in online projects, using computers and mobile devices, for a wide variety of reasons. Examining successful image-based projects may offer design techniques that translate well to sound-based projects. DigiVol, which digitizes museum collections [3], and Snapshot Serengeti, which processes images of Africa [4], are two such examples. Citizen scientists participate in DigiVol as a means to contribute to science [Flemons, personal communication], while Snapshot Serengeti participants not only analyse records, but later use results as a teaching tool in coursework [4]. Integrating effective birder and online citizen scientist techniques is likely to increase interest in projects focused on acoustics.

Future Citizen Science with Sound
Acoustics have only minimally been considered in the Computer Human Interaction and citizen science fields, and both birding and online citizen scientists should be included in the design process of future online projects. Such strategies will ensure that species, tasks, and questions are of interest to citizen scientists and of importance to ecologists, which is likely to promote sustained interest and participation (Figure 4). Particular consideration should be given to translating practices of birding groups to online projects. Such projects, for example, should establish a community and enable a way for citizen scientists to track findings [2]. Reviewing audio data from nature with standard spectrograms is often difficult and time consuming, potentially explaining the low participation [1], so new and efficient ways for citizen scientists to learn calls and explore sound data are required. Providing broad environmental context, such as pictures of habitats and animals, species distribution information, and insights from experts is also likely to increase project appeal.

This will allow citizens to answer critical questions relating to animal behaviour, migratory patterns, or finding endangered species through sound.

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References