To Catch a Cicada: A Case of Expert Listeners in a 'Little Science' Community

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Abstract

This paper examines the role of tacit knowledge and embodied sonic skills involved in catching cicadas (*Cicadoidea* Latreille in the order Hemiptera) for scientific study in Australia. Cicada researchers rely on identifying the unique "call patterns" of male cicadas to locate populations and track individuals to net. Drawing on an ethnographic study of the authors' own practices as cicada researchers, we demonstrate that cicada-catching involves tacit and embodied skills that are mastered in a community of practice that has a local epistemology centred on sonic skills for the multimodal production of knowledge. Through analysing their own cicada-hunting fieldwork, the authors demonstrate how sonic skills, as a form of active embodied knowing, enable the production of scientific knowledge.

Keywords: Cicadas, Sonic Skills, Tacit knowledge, Scientific communities, Citizen Science, Entomology

Introduction

Cicadas are a hallmark of the Australian summer soundscape. During the warmer months, it is common to see media outlets discussing the remarkable volume of sound generated by cicadas, often with headline-grabbing comparisons made to aircraft noise, rock concerts, or combustion engines.[1] But despite both their summertime ubiquity and vocality, relatively little is known in precise scientific detail about the cicada species which populate Australia. Perhaps the best example of this relative paucity of knowledge is the fact that even the exact number of species in Australia is unknown. Experts estimate that there are as many as 500-800 species (Corbin and Corbin, 2022; Emery, 2020), perhaps far more, which remain scientifically undescribed. This acts as a 'taxonomic impediment' (Taylor, 1983) to conservation in that unknown species cannot be protected (Sands, 2018; Foley, 2023). Partly this lack of knowledge is due to a lack of funding – cicadas do not pollinate, nor do they typically suit the needs of biotech research – but it is also due to the simple fact that cicadas are typically very difficult to catch. Not only are individual specimens wary and elusive; but they emerge in their adult stage either in such small numbers that are hard to detect at all, or otherwise, they emerge *en masse* in such large numbers that it makes identifying particular individuals within the surrounding cacophony remarkably challenging. Furthermore, many cicada species emerge only in highly localised remote regions and do so only opportunistically (and therefore unpredictably) during certain favourable conditions and survive for merely 1-3 weeks above ground.

The authors of this paper are members of a small amateur cicada research community – what we will refer to as the 'cicada hunting community' for reasons outlined later in the article – in Victoria and New South Wales, Australia. In what follows, we describe our own practices in the field. Our main goal is to explain in detail how cicada-catching involves tacit and embodied skills that are mastered in a community of practice that has a local epistemology that centres around sonic skills for the multimodal production of knowledge. Such an account of these scientific practices is currently missing from the literature as scientific papers documenting the identification of new cicada species focus on taxonomic details and song descriptions but do not outline the methods by which they are tracked and captured (e.g., Moulds, 1988; 2012; cf. Lorimer, 2008 on the challenges of documenting field skills). Popular works for lay audiences are available (e.g., Emery, 2020), but focus on species identification and general education on the superfamily. A more thorough account of the actual practice of catching a cicada is warranted for several reasons.

Firstly, there is an interest in Science and Technology Studies (STS) and philosophy of science around the tacit dimensions of knowledge (Polanyi, 1966) and local epistemologies (Longino, 2002). These are the ways in which scientific knowledge is produced in particular communities of practice and situated in particular material conditions. Since the 'practice turn' in science studies (Soler et al., 2014), and the move away from idealised conceptions of science towards what Latour (1987) called "science in action", theorists are increasingly interested in the scientific practices – tacit, material, and psycho-social – and what scientists actually *do*. Longino (1990, 2002) has argued, 'knowledge-productive practices' – involving material and intellectual elements – take place within a context of inquiry and how scientific findings are produced in contexts by social communities working together. Chang (2022: 18) has recently stressed that we should not think of scientific knowledge as primarily propositional, instead "active knowledge is at the core of scientific knowledge": it is in knowing for example, how to build a model, conduct an assay, make an observation by manipulating an instrument, or engage with a theory. Reasoning and observation are social processes, and so cognitive ethnographies of these practices can help deepen our understanding of science itself (Alač and Hutchins, 2004; Latour, 1987; Nersessian, 2005; Nersessian and MacLeod, 2022; Solberg, 2021). Currently, these details are overlooked in the etymological literature on cicadas which focuses on taxonomical details. Our paper addresses these omissions by providing details of the various steps in which cicada hunters proceed from making initial observations, through catching a specimen, and up to the final stages of research including documenting known species in new locations or describing a new species.

Turnhout and Halffman (2024) have discussed the benefits of combining an 'emic' perspective – the insider's viewpoint – with ideas drawn from STS and other theoretical resources. Our analysis draws on our experience as members of the cicada hunter community with differing levels of expertise. With one exception, we are all family members, a father, his two adult children, each who has been hunting cicadas for scientific research purposes since they were children, and their spouses. Each of us holds PhD qualifications, though none in entomology (two in philosophy and the remainder in different scientific fields). Three of our members each have over 30 years' experience, two have around 10 years each, and the most recent member is a novice who has only been on a few fieldtrips and is still yet to net a specimen by themselves unaided. We utilise ideas and methods drawn from cognitive ethnography (Hutchins, 1995) that are focused on the "multisensoriality aspects of experience, perception, knowledge, and practice" (Pink, 2015: xi). In particular, we adopted an apprenticeship method (Downey et al., 2015) in which the relative inexperience of some members of the team was an 'ideal site' from which to draw out a variety of key intertwined social and cognitive features that would have otherwise been opaque. In doing so, we demonstrate that cicada research is novel compared to similar kinds of entomological research, such as lepidoptery. This is due in part to the particularities of the lifecycle of the cicada but more importantly it is due to the place and significance of 'sonic skills' involved in knowledge production (Bijsterveld, 2019). To successfully catch an individual cicada requires a range of learned cognitive practices – patterned habits of embodied activity involved in knowledge making (Menary, 2018; Roepstorff et al., 2010; Solberg, 2021).

A second key contribution of this paper is the documenting of novel sonic skills. Skilled perception in scientific inquiry requires extensive learning (Goldstone and Byrge, 2015). Much work on skilled perception and embodiment in science focuses on the visual domain (e.g., Alač and Hutchins, 2004; Goodwin, 1994). Focusing on auditory perception is important to show that other senses are also crucial in how we engage with the world in scientific reasoning in specific contexts (Supper, 2016). Bruyninckx and Supper (2016, 2021) have documented the increasing interest in the auditory aspects of tacit knowledge in scientific communities. Interest in these 'sonic methodologies' looks at the ways in which sound technologies are used in complex contexts. For example, how geologists can make inferences about subterranean phenomena, such as underground oceans (Bijsterveld, 2019), the development and refinement of recording apparatus in tracking and documenting birdsong (Bruyninckx, 2018; Hunter, 2023; Lorimer, 2008), and ultrasound equipment in bat detection (Mason and Hope, 2014). A second area of interest in sonic methodologies that overlaps with the former set of concerns, but which is in some ways distinct, are the material practices of expert listening, such as bodily skills – following Bijsterveld (2019) we refer to these as 'sonic skills'.

With some notable exceptions, such as the aforementioned work on birdsong, much work on sonic methodologies in STS tends to focus on lab work and on recording devices or other equipment rather than fieldwork (Bruyninckx and Supper, 2016, 2021). When cicada hunting in the field, the hunters rely almost solely on their auditory senses for triangulating and identifying specimens. Furthermore, unlike listening for birdsong, skilled listening is only one step in taxonomical identification. Sonic skills in cicada hunting are not an end in themselves but a means to an ends – viz., the aim is not just to be able to identify by sound differing species but also to be able to locate them by sound sufficiently to get close enough to catch them. Phenological knowledge of local and regional cicadas (what to expect where and when, aided by studies of stored museum specimens, publications, and social media) must be combined with skilled auditory perceptual capacities. One "must listen with one's whole body" (Supper, 2016: 76) in order to identify species based solely on their distinct call patterns (what we call discernment) and triangulate individual cicadas against the sonic barrage of a chorus centre – where large numbers of cicadas make overlapping call patterns as a form of sonic camouflage or perhaps mating frenzy – so that it can then be captured for taxonomical identification and documentation. As we will show, this is a very challenging task and leads to features of sonic skills and social practices which are different from other cases of sonic skills in the literature. Combined with our focus on local epistemologies, the challenges and context give rise to, as Hunter (2023: 6) puts it, "particular, skilled bodies embedded in particular, complex places that produce ecological knowledge".

The paper is structured as follows: In next section we outline the main factors that make cicada hunting in Australia particularly noteworthy in comparison to other parts of the world and to other methods in entomological research. Then we move on to detail how cicada hunters choose an area of interest and begin a hunt – particularly the emphasis on searching for interesting call patterns. This is followed by an account of the sonic skills: how hunters triangulate individual cicadas by their call pattern. Once an individual cicada has been triangulated, the final stage of a hunt is the netting of the target specimen. This is a challenging affair and often ends in failure. If a hunt is successful, then the experts engage in identification and analysis. Finally, we discuss how the identification process is coordinated in the community and provide details on how this information is utilised – including the laborious nature of discovering and describing new species.

Cicadas in Australia

Species of cicadas are found on every continent with the exception of Antarctica. Where cicadas are found, they are often found in large – and loud – numbers. The reason for this is that cicadas spend most of their lives underground, only coming above ground at the end of their lifecycle to mate and, as a result, they typically emerge with synchroneity from egg batches in order to ensure their brief time above ground (typically in the scale of a few weeks) corresponds with the maximum number of other individuals from their species to optimise successful reproduction. The "call" or "song" of males is primarily used to locate potential mates and so during this time famously large numbers can be heard in a restricted location, or smaller numbers of males may produce short calls while moving frequently.

Despite their emergence numbers and their widespread distribution as a superfamily, cicadas are heavily localised when it comes to global species distribution. North America has enormous emergences of individual cicadas known as "periodical" cicadas which emerge in 13- or 17-year rotations that are predictable and loud enough to justify the existence of websites to assist in planning outdoor activities (such as weddings and graduations) during these years (Cooley et al., 2009). Though both extremely numerous and disruptive, periodical cicadas are made up of only seven species of the *Magicicada* genus.[2] Across the Atlantic, Europe as a whole contains only 53 species, and the British Isles is home to only a single species (*Cicadetta montana*) which has not been recorded since the 1990's (Pons, 2020). It is estimated that Australia has around 500-800 described species and likely more than double that number of undescribed species (Corbin and Corbin, 2022; Emery, 2020). Because of its long continental isolation and diverse habitat, Australia also has uniquely unusual species such as *Tettigarcta crinita,* the Alpine Hairy cicada which is uncharacteristically nocturnal, exothermic, and emerges in atypically cool climates and seasons (Moulds, 2005). This makes Australia particularly interesting as a cicada environment, especially now that areas rich in cicada fossils have been documented (Moulds et al., 2022). Our collective understanding and knowledge of cicada species in North America is rather extensive, in contrast, we have a limited and slowly expanding knowledge of the species which inhabit Australia.

Whilst the disparity in global species numbers is a contributing factor in our relative understanding of the cicada species in any environment, a larger factor here is funding and limited expertise. Australia has numerous small, inconspicuous, and quiet species that without prior knowledge are generally unknown and go unobserved to most people. Many Australians think that there are very few species of cicada and that they are mostly large, all roughly the same size and shape, altering only in colour and not sound.[3] The number is far greater, with the actual number only an estimate, as there is no 'official' count or central database which precisely tracks described numbers[4]. Furthermore, considering already described species, there is much of their ecology that we are still unsure about. For instance, the conditions and drivers for emergence patterns and geographical distribution of species are relatively unknown except for some plant preferences and climate. Whilst our understanding of Australian cicadas is increasing, especially with the increase in citizen science submissions to online biodiversity repositories, there are two further challenges.

Firstly, the cicada hunting community is almost entirely amateur – there are no researchers who are primarily employed by universities or other institutions to conduct specific research into cicadas (as opposed to invertebrates as a whole). One likely reason for this lack of institutional backing is that cicadas have no commercial implications and so there is little capital reward and therefore funding motivation for this research. The cicada hunting community is consequently an example of 'little science' as opposed to 'big science' (Solla Price, 1963). Researchers conduct their investigation with little funding, resources, or time, and this obviously greatly curtails the extent of scientific work they can engage in. These issues present challenges that place a heavy burden on members of the community. There are, however, other forms of motivation driving this research. The authors of this paper can attest to the joy of discovery (also see Ellis, 2011), the challenge of the hunt and the feeling of relief and reward with a catch, even the competitive drive between members of the team.[5] Since many of the team members are related, and many members began searching for cicadas as children, this competitive edge is often explicit. Nevertheless, conducting scientific inquiry on a shoestring budget also necessitates a number of interesting innovations, such as engaging in citizen science (Emery, 2020; Greenville and Emery, 2016) and the utilisation of social media.

The second major reason why we know so little about Australian cicadas is because, taken as a whole, they are quite simply elusive, ephemeral as adults, unpredictable regarding emergences, difficult to catch, and inhabit terrain that is often hard to access. Therefore, they are difficult to document and study.[6] This difficulty is perhaps best seen by contrasting cicada hunting to other kinds of entomological field research. For instance, lepidopterologists can use seasonal flowering patterns to inform them of where to look for particular butterfly species (e.g., Finch et al., 2021). In contrast, cicada emergences do not pattern with floral emergences, but rather with altering combinations of elements such as warmth, plant sap flow, and rain. So, knowledge about possible plant or bushland preferences are not always accurate determinants to pin down precise emergence times or locations and instead physical field time is required to confirm emergences (often informed by stored specimens or internet postings). The outcome of this is that cicada research involves substantial travel as well as time and capital (see, Corbin and Corbin, 2022). Entomologists in several other specialisation areas are able to use pheromones or floral odour blends as lures for certain insect species, notably moths and butterflies as well as many beetle species, as well as passive traps such as the malaise trap (e.g., see Kristensen et al., 2015); but these are not viable strategies in cicada research. There is only one lure that can attract cicadas and that is 'light trapping', where a powerful light or series of lights is placed on a large white sheet. The bright lights at night can be an insect attractant, as can be seen at any park or other location which has night-time lighting. Light trapping is a common tactic for many invertebrate species (e.g., Rice et al., 2017). However, not all cicada species or cicada sexes will come to light and, depending on weather conditions and moonlight, those that do will not come reliably. We do not often use light trapping in our own fieldwork as it is rarely effective (one typically spends their night shifting through the thousands of moths and other insects that all attracted to the light trap) and only where incidental lighting is found in a target location (for instance in public restrooms, parks, or reserves) rather than intentionally brought and set up lights.

Cicada research is consequently a 'manual' and often opportunistic affair, in that it depends on the active, embodied, and tacit skills of the cicada researcher themselves rather than on abstract technological or propositional knowledge-based collection strategies. This is a process best categorised in hunting terms where the individual perception and stalking skills of a researcher become paramount in the research process (Corbin and Corbin, 2022; see also Lorimer, 2008 for further discussion of field researchers self-ascribing their work as 'hunting'). In what follows, we outline this hunting process to elucidate and document the tacit knowledge involved in answering the question: 'how do you catch a cicada?'

Establishing an area of interest and beginning the 'hunt'

Cicadas only emerge above ground for short periods of time each year in the final stage of their life cycle. In Australia (unlike the 'periodical' cicadas of North America) they are not known to emerge in predictable or consistent patterns. This presents the first and most obvious challenge for the researcher, with long-term dedication needed for repeated field studies and collection. Long fieldwork hours are also demanded in the harsh conditions of the Australian bush, where summertime temperatures frequently reach 40 degrees Celsius, and researchers must be mindful of snakes and a range of biting insects. In other words, cicada researchers need to be very dedicated to their work. The second challenge is that most Australian cicada species are very small (<30mm long) and well camouflaged, making them challenging to visually locate (see figure 1). Despite the often large emission of calls – both in terms of numbers of calling cicadas (referred to as 'chorus centres'[7] (Williams & Simon, 1995)) and overall audio volume – they can also be very hard to pinpoint aurally without substantial training and experience. This is perhaps unsurprising, as cicada songs, in addition to acting as a mating call, are likely to have evolved under selection for their ability to deter predators, due both to simply their volume (Smith and Langley, 1978) and for their effect of auditorily "masking" an individual and blending their call into a chorus preventing effective triangulation[8] (Shieh et al., 2012; Ishimaru et al., 2022). Combined, this presents researchers with a challenging epistemic environment. Yet, despite these difficulties, the cicada hunting community successfully locates populations of unique cicada species and effectively tracks, catches, and studies individual specimens in preparation for taxonomic description.

To begin, cicada researchers need to identify a location to target a range of cicadas or specific species. We approach this in several ways. Firstly, one can visit local State museums or the Australian National Insect Collection (ANIC; Canberra) to check labels on stored specimens to provide a previously successful time and location. Secondly, we use a citizen science app, iNaturalist, which allows for crowdsourcing and massive collaboration in the collection of data. Members of the public with this app can take photos and audio recordings of natural phenomena they deem to be of interest but do not necessarily know what it is. Other users of the app can then provide species details. Users of the app gain points for original posts and for providing labels and information on other posts. Gamification as a way of motivating participation in citizen science projects has been examined in a number of contexts (e.g., Bowser et al., 2013). Given that iNaturalist has over 1.4 million users globally, and Australia is one of the largest contributors with over 1.6 million observations made by over 27,000 users (Mesaglio and Callaghan, 2021), the platform is proving to be useful for the collection of data points. Our team uses the iNaturalist app to obtain information on phenology, locations, species, and audio recordings. This sometimes involves contact with the original poster on the app to secure specimens and recordings or gather more specific details for site visits – especially if the sighting was off-road

Figure 1. An example of cicada camouflage.

and deeper into the bush. By using iNaturalist, we are able to collate observations over a much greater distance and area than could be physical covered by the few team members in the limited time they have. Thirdly, researchers may follow tips from other general entomologists or park rangers.[9] Finally and most commonly, we may simply drive around in heavily bushed areas, heathland, desert, or undisturbed riparian tracts along watercourses (typically next to or near national park or public land) slowly with the window open listening carefully (Corbin and Corbin, 2022). This final approach may be conducted at intervals in a target area that has been productive in previous years, or this could be a new and unknown area which is being surveyed for the first time.

Regardless of how the area is selected, the first step in catching a cicada is almost always *hearing* a cicada.[10] Cicadas produce songs made up of repeating call patterns which are specific to their species. Song therefore provides an alternative basis for scientific research practice to those commonly used for other invertebrates. Cicada researchers must travel large distances either by car or by foot, simply listening until they hear a cicada which is novel or worth the effort to catch as a locational record. This entails that acquiring and mastering sonic skills are crucial for cicada hunting.

Since cicadas are often very hard to catch, substantial time is invested in catching them once a population has been found. Consequently, one of the first questions a cicada hunter must ask themselves on hearing a call is how much time to invest attempting to locate and catch the cicada they hear. Therefore, one has to listen and see if it is "interesting", by which we mean whether it is the call of a new or little-known species, a known species but in an unusual area, or perhaps simply of interest to the cicada hunter. Bijsterveld (2019) labels this the 'why' mode of listening – the purpose of listening. In turn, these motivations, combined with training, shape the hunter's auditory attentional patterns and allows for greater discrimination and parsing of the perceptual array (Goldstone and Bryge, 2015).

Only male cicadas sing or call,[11] so initially the cicada researcher is limited to tracking males. Their call is produced by timbals, a membranous structure containing 'ribs', which are bent and buckled at high frequencies by muscles (Fonesca, 2013). Timbals may be exposed (Subfamily *Cicadettini* Buckton) or covered (Subfamily *Cicadinae* Latreille). On the underside of the abdomen are opercula, colloquially referred to as 'drums'[10], and together with rhythmically flexing the corrugated structures of cicada abdomens which act as a resonance chamber, all contribute to vibrating the air rapidly and amplifying the sound significantly (Pringle, 1954; Young and Bennet-Clark, 1995; Ewart and Popple, 2001). Knowledge of the bioacoustics of how cicadas produce their call pattern is crucial since it is these features that differentiate them from the calls of other insects in the bush. Cicadas of many species are attracted to the songs of their own species, and males are stimulated to call by increasing temperature in the mornings and by the calls of other males. For those species, this creates 'chorus centres' of dense population of potential mates (Williams and Simon, 1995). These chorus centres often overlap, with multiple species calling in the same place at the same time. This requires the hunter to be able to specifically focus their hearing on the single target species. We refer to the ability of a cicada hunter to identify a cicada species based solely on the call pattern as 'discernment'.

All cicada call patterns are unique to their species, and therefore a species can be identified by its call alone. Consequently, to judge if a species is "interesting" or not, significant numbers of cicada calls must be recognisable to the researcher. Cicada hunters must learn, memorise, and recognise songs for the cicadas that are common in their region and their interests. Like other scientific communities in which listening practices are crucial, for example in ornithology (Bruyninckx, 2018; Hunter, 2023; Lorimer, 2008) and in hospitals (Bijsterveld, 2019), agents must master the terminology, coding schemes, thought styles, strategies, and practices that have been devised to delineate the objects of inquiry (also see Goodwin, 1994; Latour, 1987). To assist cicada hunters in the learning of calling songs, descriptive and recognisable terms are documented in written resources, covering the volume, pitch, dynamics, frequency and duration, and the tone, e.g., 'metallic', 'yodelling', 'rattle', or 'syncopated'.

Additionally, for non-verbal communication of cicada call patterns (particularly important in the field during a hunt), cicada hunters engage in a form of 'data karaoke' (Supper, 2016) – using onomatopoeia for phonetic imitation, e.g., "Clip-clop", "buzz", "tick", "zip", "zop", etc. 0.[11] Not only can this be for communicating between team members on a particular hunt, it can also act as a form 'instructional nudge' (Sutton, 2007) in which a hunter tries to direct and steer their own auditory perception and acts as a memory aid. Visual representations of the calling songs are also used as 'sound diagrams' (Bruyninckx, 2018) for educational and communicative purposes, for example the use of dots, lines, and squiggles accompanied by descriptive words such as "ee-ay", "orrr", "shic", and "dee" (see Figure 2) and the more conventional waveform plots of spectrogram (Emery et al., 2015). It is also useful in learning and teaching call patterns to compare them to known sounds. For example, the pattern of the Floury Baker (*Aleeta curvicosta*) could be communicated to a novice by likening it to the sound of maracas shaking and getting increasingly louder, or – as appropriate to the intended audience – it could also be likened to the gradually increasing speed of clapping given by the crowd at a cricket match as the bowler runs up to deliver their ball.

Even for experienced cicada hunters, the identification of calls can be difficult and confusing. This is particularly the case for the members of the team who started hunting for cicadas as adults. At the start of a new season, they will point in the direction of a 'cicada' call only to receive the disparaging news that it is a cricket, katydid, or other non-cicada species. As with many other cases of sonic skills and auditory perceptual learning (e.g., Bijsterveld, 2019; Bruyninckx, 2018; Goldstone and Byrge, 2015; Lorimer, 2008; Irvine, 2018; Roepstorff et al., 2010), the learning and memorisation of cicada songs is possible through repeated exposure to them. By learning a variety of call songs and having points of comparison, differences become apparent. Once trained to recognise a cicada call, a bias is developed whereby people become attuned to its presence and in fact become practised to hear it over the ambient soundscape.

In the field, researchers often use recording devices to not only document cicada calls but

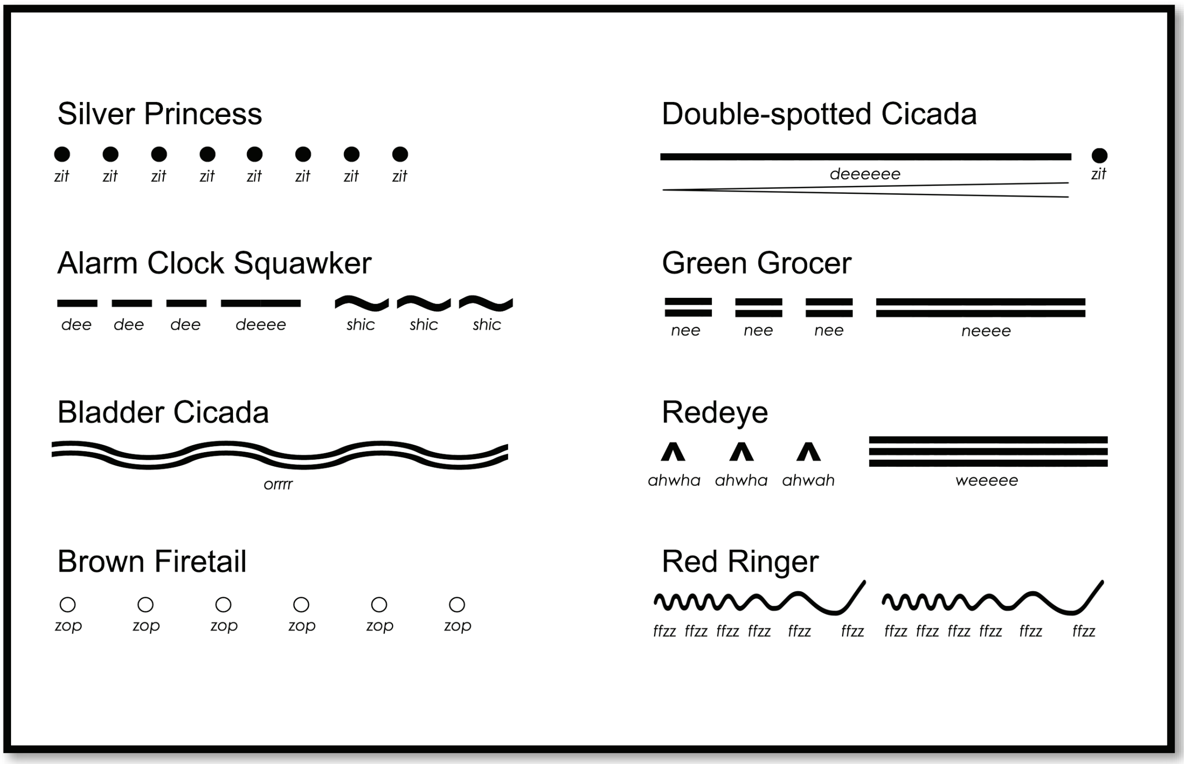

Figure 2. A selection of visual representations of cicada call patters, reproduced with permission from Emery (2020).

also to share amongst each other to confirm the species origin of a call. Improvements in the portability, durability, and fidelity of recording equipment has increased the extent to which recordings are seen as a crucial tool in the arsenal of the researcher (Vallee, 2018). As Bruyninckx (2018) notes in the case of the science of birdsong, improvements in both recording equipment and analytical techniques, such as spectrograms, were a major driver in the field in coming to terms with the complexity of the phenomena of bird song. Some practitioners even went as far as comparing spectrograms to the invention of the microscope (see Bruyninckx, 2018:123 for discussion). For cicada research, these inventions have altered publication practices about what details are included in scientific publications. Between cicada seasons, due to lack of regular 'practise' in the off season, hunters do forget some of the call patterns and a simple refresher by listening to a recording is often sufficient to "jog" the lost memory. Playback of recordings in the field may also be used to encourage otherwise silent males to sing. Lorimer (2008) and Hunter (2023) have documented the use of recordings to elicit a response in the fieldwork involving birdsong to varying levels of moderate-to-high success – they can be used as a lure in some cases but can also confuse other fieldworkers. But in our work with cicadas, the success rate is much lower. If cicadas are not calling then a hunter is typically standing still and merely waiting, so playback is only attempted in the absence of an alternative. While songs identify species, they do not provide any other information on morphology or behavioural ecology to aid capture for descriptions, which is why they are only the first step in a larger process. Sonic skills are needed to move from identifying a species to locating a specific individual within a group of the same species that can then be stalked and captured.

Once a researcher has established an area of interest, they need to stalk a call and get closer to an individual cicada. Cicadas range from as little as 10 mm in forewing length (for example, *Punia minima*) to 70 mm (such as *Thopha saccata* with a total wingspan of up to 200 mm). However, typically, larger cicadas are not as "interesting" from a research perspective as smaller ones, the reason being that larger cicadas are louder and therefore more noticeable, are easier to see and catch and so naturally, much more is known about them. Unsurprisingly, larger cicada species produce the loudest sound, which is multiplied by their en masse emergences in chorus centres. Larger cicadas also survive for longer periods of 3-8 weeks as adults (e.g., 'bladder cicadas' and 'black princes') compared with 1-2 weeks for many smaller species. As well as their diminutive size, many cicada species spend their adult lives high in trees. For these and other reasons (thick surrounding brush or dense host plant, dynamic with frequent movement, predator avoidance strategies, etc.), cicadas are extremely difficult to locate simply by relying on eyesight and so the cicada researcher must rely on their auditory perception. This is the case in initially identifying population centres, but also in tracking individual cicadas. Without these auditory signals the researcher would not be able to begin stalking towards a position cued by the call of a target species.

Expert Auditory Perception, Triangulation, and Netting

Once a hunter has identified a target location and species, they must then identify a target individual that they can then stalk, triangulate, visually identify, and ultimately net. This process starts with a range of interconnected sonic skills.

Adult male cicadas are primarily singing to attract females to mate. For the larger species, females fly to the males in response to their singing. More typically for smaller species, males move constantly and sing at rest or call when in flight, waiting to hear wing flicking from resident females that signal their readiness to copulate. As such, males typically move frequently, flying from tree-to-tree or branch-to-branch listening for a response from a potential mate. This frequent movement means that the researcher does not have boundless time to hear, visually identify, get close to, then swing a net and catch a cicada.[12] Researchers must move quickly if they are to locate and catch an individual.[13] Cicadas have good eyesight, and sense movement or vibrations, so they are aware of threats in their environment. And this is an important point of difference with some other forms of fieldwork in which the researcher will aim to achieve a form of neutrality (cf., Alcayna-Stevens, 2016). Cicada researchers are hunters and so we do not see ourselves as neutral observers and are not trying to get cicadas to habituate to us, we recognise that we are predators and relate to them as such. Fast, jittery, or obvious movement will elicit a threat response and the cicada will either fly away, drop to the ground pretending to be dead, walkaround the other side of a tree away hiding from the hunter, or simply stop singing and remain still. The researcher quickly learns these behavioural idiosyncrasies and adjusts their approach and capture technique to counter. Mason and Hope describe this as 'attunement' – an "embodied sensitivity to particular non-human differences" in movement (Mason and Hope, 2014: 108). They argue that this is essential for certain forms of scientific fieldwork. We see examples of this in our own fieldwork: when hunting in the early morning before the day warms up and cicadas are only starting to sing, they are typically on the sunny side of trees and shrubs to warm up faster. Similarly, in windy weather cicadas will move around plants to have the branch they are sitting on to protect against winds. Because of these environmental factors and behaviours, hunters must also be listening for the 'dulling' of a call, indicating that a cicada has hidden itself behind a physical structure out of direct sight. As such, the hunter-hunted relationship is one in which, rather than being a neutral observer, the cicada researcher enters into the world of meaning of the cicada (also see Alcayna-Stevens, 2016).

Large emergences of cicadas create a cacophony,[14] which is both an effective species attractant and a deterrent for predators. This has three main outcomes. Firstly, the chances of mating are maximised. Secondly, the sheer volume and combination of large numbers of individuals generating calls can cause auditory discomfort and even pain – the threshold for pain in humans is around 120 decibels, and over 90 decibels can cause damage following extended exposure (Rodaway, 1993). Several species of cicada can generate volume of these intensities (e.g., *Thopha saccata* and *Cyclochila australasiae*). The cicada's own hearing organs (their 'ears', technically termed tympana) collapse to protect it from the damage that would otherwise be caused from the decibel level they achieve (Hennig et al., 1994). Thirdly, cicada chorus can resonate, disorientate, and mask the call signature of a specific individual. If one individual cicada is calling, it is not overly challenging for a cicada hunter to track. If many are calling, it is far more difficult to isolate any one individual. In this way, chorus centres act as sonic camouflage. Although a chorus makes a population much more obvious, it masks the individuals within it in much the same way that certain fish are simultaneously more visible yet more protected from predation while within a school. However, cicadas in populations are constantly moving (particularly for smaller species) to counter competing sounds that may detract from mating signals, many co-locating cicada species either call sequentially, call at different times of the day, or cluster together to avoid confusing signals. Awareness of this and other behavioural traits which impact song production is crucial knowledge for cicada hunters[15]. But, without a specific target one cannot reliably track an individual and get close enough to visually identify and ultimately net it, much like sharks and other aquatic predators are challenged by schooling fish (Neill and Cullen, 1974). In these instances, it can be difficult to determine the number of cicadas calling. There could be one very loud cicada, or several added together in synchrony. Or simultaneous but staggered and not in sync. Thus, one of the main sonic skills cicada hunters must learn is the ability to disambiguate call patterns and pick out particular individuals. The ability to determine patterns is what we refer to as discernment, and the ability to pick out a single cicada among many, or to identify the number of cicadas calling in a given location, we refer to as enumeration.

Discernment and enumeration are a rarefied form of resolving the challenge of 'auditory scene analysis' (Bregman, 1994). Auditory scene analysis, often colloquially referred to as the 'cocktail party problem', is a common challenge that all humans face in any environment in which they are listening to a specific sound amidst the surrounding other auditory phenomena, for example listening to a conversation amongst loud background chatter.

I.e., it is the task of focusing on a certain set of auditory events (streaming) and disambiguating them against the noise of the background. Some sonic environments have a very poor noise-to-signal ratio (lo-fi soundscape), others have a much better ratio (hi fi soundscape) (Rodaway, 1993; Schafer, 1977). We can easily intuit the difference by thinking about trying to listen to a conversation in a quiet room with one other person (a hi-fi soundscape) compared to carrying on the same conversation on a busy street or in a busy café (a lo-fi soundscape). Much greater effort must be put into streaming in a lo-fi soundscape. Cicada hunters are sometimes confronted with extremely lo-fi soundscapes – the walls of noise produced by chorus centres or other cicada species – and so discernment and enumeration can be very taxing.

It is important to note that enumeration is not merely "counting by ear", as Lorimer (2008: 390) puts it, by which one is taking an individual call as a data point for a census. Rather, through enumeration, the hunter is aiming to estimate the number of calling insects in the same location so that they can then go about isolating and picking out a single individual – which is a much more complex task. The key element in enumeration as a sonic skill draws on the call pattern – that each species has a distinctive rhythm and duration to their call based on the bioacoustics of the insect. This can be used to parse overlapping but nonsynchronous calls. The hunter can begin to try and localise this individual and triangulate their location. This involves sophisticated abilities in spatial hearing (Blauert, 1996). It is important to note that although cicada hunters need to be careful in their movements in the bush, not only because of snakes and other hazards of the Australian bush, but lest the hunter scare off their target. As such, movement is also a crucial part of skilled listening. Cicada hunters are not passively listening but actively engaging with the environment. Despret (2013) notes that field reports rarely mention the body of the scientist. But in cicada hunting the embodied aspect of sensing is crucial: they are "listening with their whole body" (Supper, 2016: 76). By moving, we alter the signals in the call patterns – by tilting or turning the head, taking hats off, cupping the ear to improve directional sound isolation, waiting for breezes or unrelated noises to stop, standing taller or squatting down, and moving to different locations whilst stalking (also see Lorimer, 2008). By actively probing the local sonic environment in this way, cicada hunters make it much easier to enumerate and triangulate: establishing the direction of differing individuals which are making call patterns from differing directions. Once relatively sure of the cicada's position, hunters can then proceed to close in on the target individual. The composite of these sonic skills, the mental library of call patterns, forms of embodiment, and particular patterned practices that govern their interplay can be considered a community of practice with a 'local epistemology' – a particular active way of knowing (Chang, 2022; Longino, 2002). For cicada hunting, it is important to emphasise that the local epistemology is centred around knowing how to listen (also see Bijsterveld, 2019; Bruyninckx and Supper, 2021). Not only being able to identify an animal by their call, often in the challenging epistemic conditions of lo fi soundscapes, but also the ability to estimate the number of individuals making a call so that one can be triangulated. This gives cicada hunting a unique sonic methodology tied to the particular material, social, and cognitive conditions in which they are emplaced (also see Hunter, 2023).

Given that cicada hunting is very challenging, we sometimes work together to spot the target once we have established the potential location of an individual. When working together, there can be a division of labour to have a greater chance of catching a cicada. These collaborations are organised spontaneously based on where particular members of the team are in relation to the target. But tasks are also sometimes delegated based on a person's abilities. For example, one member of our team is particularly deft at catching cicadas with her hands. So, in cases where a net cannot be used, she is often called upon to take the lead. In other cases, when stalking a target together, this involves hunters moving quietly and slowly around different sides of trees and shrubs, standing still when the cicada is silent, and communicating to one another through hand signals such as pointing towards the cicada or raising a hand to halt movement.

But whilst being able to pinpoint the location of a particular individual in challenging circumstances might be an impressive auditory feat, we must place this epistemic activity within in its context: the primary goal is to catch a cicada. Knowing how to hear a cicada is embedded within what Chang (2022: 16) calls the wider 'epistemic activity' – "a system of practice is a network of activities that function coherently together" in the acquisition, assessment, and use of knowledge towards a goal – in this case of being able to catch a cicada. As Bijsterveld (2019) notes, we can differentiate between several distinct 'modes of listening': the why, the how, and the what. The how, or way of listening, is both analytic (in terms of breaking down the sonic information into finer details of species type, and individual location from the wall of noise), but is also interactive insofar that triangulation requires that cicada hunters move through the environment and manipulate the sound source to establish location in acute spatial hearing. The why, the purpose, of sonic skills in cicada hunting is ultimately to be able to pinpoint and triangulate an individual specimen.

The effective use of a butterfly net combined with several connecting aluminium poles, sometimes extending to three or four metres in length, can be critical to a successful catch for cicadas that are flighty or typically occur in tree canopies. When it comes to swinging a net to catch an individual on a tree or shrub, some members of a team will act as spotters. If the primary hunter with the net misses (a frustratingly frequent occurrence), the spotters help to see where the individual flies to and lands. On occasions where a cicada is resting in a fork of a branch or protected by numerous lateral branches, a second person will attempt to coax a cicada to fly from a tree into a nearby open net, by using a pole or second net to touch the branch the cicada is resting on and spook it. The addition of a second net may also increase the chance the cicada will take off and fly into the net. With every extension pole added, the harder it becomes to control due to weight, gravity, and inertial resistance from the pivot point, requiring more upper body strength. Some members of our team are much more adept at this, but divisions of labour are not always straightforward because there is a competitiveness between members to be the one who makes the successful catch. Attempting to catch a cicada several metres above ground in a tree canopy requires patience, stability, and strength to guide the net between branches to not disturb the cicada and prevent the net from sudden movements due to snagging the netting on twigs or unexpected wind gusts. In addition to physical prowess, using a net is a cognitively demanding skill requiring a wide body of species-knowledge. Depending on the species, particular cicadas will behave differently to threats – and humans trying to put them in a net certainly counts in this category. When one tries to get a cicada, knowing the behaviour pattern is important for a successful catch. Some species, such as the 'Smokey Buzzer', *Myopsalta waterhousei*, or 'bladder cicada', *Cystosoma saundersi*, will often drop at the sight of a net and feign death. Species commonly found in heath, shrub, or grassland communities, such as *Diemeniana euronotiana,* often do not fly far before landing again and can be tracked by eye in some instances. Others, such as *Yoyetta grandis*, will more typically fly to a nearby tree. Other species do not fly away and stay in the tree they are in; *Auscala spinosa* ("creaking branch cicada") will often hide themselves in the grooves of their favoured ironbark trees, making net capture almost impossible. Other species, such as *Atrapsalta furcilla*, will often simply walk around the branch, while *Chelapsalta puer*, will remain stationary in the midst of their *Cassinia* host plant, leaving a net to bounce away unproductively. Mastering and appreciating these idiosyncratic behaviours is not propositional but is instead learned through much gruelling trial-and-error on behalf of novices, with many hunts ending in frustrating failure. This is where the active knowledge and motivations of cicada hunting goes beyond the joy of recognition present in other forms of naturalist communities (Ellis, 2011) and into the thrill (and frustrations) of the hunt.

The cicada behaviour and position on vegetation also lends itself to the method of approaching it with a net. Oftentimes a cicada resting on a tree trunk or primary branch can be coaxed into an open net by using the round metal frame to slowly slide up under the cicada before sweeping the net away from the tree as the cicada takes flight. By contrast, cicadas resting on thin branches of trees, shrubs or grasses can be caught by quickly sweeping the net in a smooth motion that often captures both the cicada and vegetative material as collateral. In either case, both methods require consideration of several factors pre- and post-netting of cicadas. Firstly, the direction of the net should consider wind direction and, where possible, position the open face of the net to the prevailing wind. This ensures that the net remains open to increase the likelihood of the cicada been caught or blown into the base of the net, making it less likely to quickly escape. A net position with the wind effectively creates a mesh barrier that a cicada may contact and then fly away from. Secondly, consideration must be given to the vegetation surrounding the cicada and the risk of snagging, ripping, or damaging the net if attempting to sweep catch. Some woody shrubs and herbaceous plants have spines or thorns that will rip the mesh net rendering it useless. Finally, regardless of how a cicada is first netted, once ensnared the hunter must then continue to sweep the net away from vegetation with force to ensure the cicada is 'pushed' to the bottom of the net before turning the poles in their hands through 90° to fold the net over itself around metal frame to prevent the cicada escaping. This action is difficult when using multiple poles or in strong winds, but continually sweeping the net back and forth while trying to fold the mesh over the frame should eventually be successful. A less skilful but effective technique is to swing the sweeping net straight down onto open ground and then holding up the base of the net to trap the cicada by encouraging it to fly vertically. A field diary with entries outlining details of daily catches is an integral reference to the actual specimens captured, seen, or recorded.

Identification and describing new species

If the hunters are successful in making a catch, then the next step is to go about identifying what it is that we have caught. Since members of many cicada genera are morphologically similar, song provides the initial evidence that a particular cicada is different from other like species. For description, a minimum of six males (singing the same song and providing a verified series to accommodate variations across the species and confirm distributions) and several females are usually needed. We often consult with one another through discussions either in person or via apps and photo-sharing sites, where photos or recordings of the individual and/or its song may be uploaded to enlist the help of those who are more experienced, to postulate its novelty. While it is possible to determine some species from photos or song recordings online, the actual specimen(s) is crucial for definitive identification. One exciting prospect is if it is a new species – this what drives members of the team to spend the many hours in the hot Australian bush being bitten by mosquitoes and leeches. If it is a putative new species, then the next possibility becomes one of taxonomic description after a series has been collected, dissected, and compared against extant described species. When new specimens are captured, live individuals may be photographed. Then the three right legs may be removed and placed into absolute ethanol for later DNA isolation and analysis, before the specimens may be pinned and "spread" and dried for around a week. Meanwhile, labels containing details of location (with GPS), date and plant data (and perhaps catalogue numbers) are prepared and attached to each specimen for later reference. Specimens are then stored in insect- and rodent-proof drawers or containers prior to additional photography for publication.

A key element of this descriptive process is the establishment of converging lines of evidence (Hacking, 1984) that are robust in Wimsatt's (2007) sense: i.e., the evidence is drawn from measurement methods and procedures that involve differing modalities and techniques (also see Chang, 2004, 2022). Once sufficient individuals are available, and this may take many seasons (where seasons are years of emergences), then holotypes are described before these and paratypes are deposited in appropriate collections and catalogued (especially those holotypes and paratypes in museums) for future reference and to reduce risk of loss. Catching mating couples is particularly valuable to ensure the identity of females, since mating is species-specific and females are harder to find as they do not sing. Females often exhibit significant sexual dimorphism in colour and traits (i.e., look very different to males of the same species) and even have physical differences between specimens.[16]

Historically, cicada publications did not include song analyses as appropriate field equipment was not available or cumbersome (e.g., Moulds, 1988). However, as more versatile, reliable, and sensitive technology allows more precision and clarity in the field, song recordings of the males are becoming increasingly analysed for inclusion in recent descriptions (e.g., Emery et al., 2015). The changing publication practices here speak to the increasing and central role of sound and listening in this specific branch of entomological research (also see Vallee, 2018). Song was highly likely used to find the species in the first instance and is species-specific, thus offering a complementary taxonomic characteristic for species differentiation. A series also provides the range of measures and morphological variations to give greater accuracy and rigour to descriptions as well as covering species phenology. As such, here we have a case in which sound is not relegated or secondary to visual information, but is a primary source in the production of scientific knowledge (also see Bijsterveld, 2019).

In addition to analysis of the song characteristics, the other species-determining properties of the specimens are investigated. These include the song-making apparatus, the timbals and opercula, and the genitalia for mating. These are examined, often dissected, and drawn or photographed along with various views of the holotype male and paratype female (at least dorsal and ventral views of spread specimens). All aspects such as colour, shape, and size of the body parts of the male and female specimens are described (body, wings, legs, and genitalia) and linear measures of body, wings, and widths of head, thorax, and abdomen, across the series is included to establish species characteristics according to prescribed nomenclature and methodology (e.g., Moulds, 2005; International Commission on Zoological Nomenclature, 1999). Also included in the description are features which distinguish the new species (*species nova; sp.nov.*) from others in the same genus. Advances in geospatial technologies – geographic information systems – have transformed practices in insect ecology and made recording, storing, and computing of geospatial data (Liebhold et al., 1993). Modern taxonomical papers are able to more precisely provide GPS plots of where specimens have been found (distribution), and these are presented alongside photos of the habitat and any particulars of plant preferences. Ultimately, morphological features are used to create a dichotomous key to enable a stepwise approach to identification of a cicada's species in a family or genus. Authors select a name for the species and give reasons for their selection (etymology).[17] Then they apply to register the name and species on "The Official Registry of Zoological Nomenclature" (https://zoobank.org/) to obtain a catalogue number which is included in the paper. Following submission, peer review, emendation and acceptance, the description of the new species can be published in the journal.

All of this takes quite some time. For example, Emery and colleagues (2019) recently revised the genus *Yoyetta* Moulds and described eight new species. It took the authors' team over 15 years to catch and record the requisite number of individuals in this case and another 3 years to fully produce the final draft. This demonstrates the scale of time and effort which can be required to achieve and complete this kind of 'little science' research without major funding. However, sufficient specimens and recordings may be obtained in a single productive season if only one new species is to be described. Since authors are writing papers in their spare time (not part of their paid job), it may take 1-2 years to get the description published; longer as exemplified above, if more species are included. But the effort is required to document our precious biodiversity, especially in an era of declining insect numbers in many parts of the world (Didham et al., 2020). A love of nature, being out in the Australian bush (despite the mosquitos and flies), the joy of recognising a call pattern, the friendly rivalry between ourselves and other members of the wider cicada research community, and the thrill of identifying a new species all motivate us to put in this work in the field.

Conclusion

Cicada hunting provides us with a novel case demonstrating the central role of sound and practices of listening in the life sciences, and "the auditory dimensions of making knowledge" (Bijsterveld, 2019: 1). Hunting cicadas is primarily based on the central idea of the call pattern – that each species has a distinctive song – and this guides a range of sonic skills: being able to not only identify species by their song (discernment), but also estimate how many individuals are making a call (enumeration). This is crucial because cicadas use sonic camouflage in chorus centers to disorientate and conceal their location. By enumerating a call pattern, an expert cicada hunter can pick out a single individual and then begin to triangulate them by dynamically moving through the bush. Cicada hunters are not passive observers, but rather listen with their whole bodies, stalking their target, and aiming to catch them in a net for documentation. Cicada hunting fieldwork is gruelling and challenging and often ends in failure, but members of the team are motivated by the thrill of the hunt, the joy of identification, and the possibility of discovering new species. Following the capture of a series of individuals and the recording of their calls from several locations, the process of specimen preparation, storage, and sampling for downstream investigation all are directed to the description and curation of the new species for future reference and conservation. Our account shows that active knowledge embedded in a community of practice is required for producing a taxonomical scientific paper. As the vital starting point, the importance of the call pattern to all that follows in this endeavour, cannot be over-emphasized. Drawing on an ethnographic study of the authors' own practices as cicada hunters, our paper contributes to ongoing discussions in STS scholarship regarding the multimodal production of knowledge in scientific communities.

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NOTES

1 For example, *The Sydney Morning Herald:* some cicadas reach "the level of sound a jet makes taking off." https://www.smh.com.au/environment/conservation/as-loud-as-a-jet-taking-off-why-do-cicadas-sing-at-dusk-20211101-p594xe.html (accessed May 17, 2024).

2 It is only these seven species which emerge in precise, predictable broods every 13 or 17 years. Most species do not follow predictable emergence patterns. The emergence patterns involving prime numbers has been debated heavily both in philosophy of science – about whether it constitutes a genuine mathematical explanation – and in philosophy of mathematics – about whether it supports a naturalist-realist position (e.g., Bangu, 2012; Craver and Povich, 2017; Lange, 2013).

3 Anecdotally, multiple members of this team thought this before becoming involved in cicada research.

4 For the most complete current catalogue, see; https://dr-pop.net/cicadas.htm (accessed May 17, 2024).

5 This competitive drive is also found in the iNaturalist community, which contains leaderboards and other gamified ways of measuring success relative to other members. We discuss this in more detail below.

6 Unless otherwise indicated, all subsequent statements in the paper refer exclusively to Australian cicada species.

7 Most entomologists are experts in a specific taxon. One of the present authors knows a great deal about cicadas for example, but practically nothing about jewel beetles. However, he does know a jewel beetle expert, so when he comes across a jewel beetle population he will pass on that information. In a similar fashion, cicada hunters often receive 'tips' of potential locations where "cicadas" (very rarely precise species) have been heard. There is also the exchange of specimens between experts from differing entomological research communities, especially for description or curation.

8 We have added the caveat here of 'almost always' because it is the case that sometimes, despite their camouflage, individual cicadas can be spotted by scanning visually. Cicadas will sometimes go silent (especially if they are wary of a predator) and females do not call. It is also the case that sometimes the best opportunity to catch cicadas is when they initially emerge from the ground in their nymph stage and before they fully transition into adults and begin calling. But this requires having prior knowledge of suspected emergence patterns – both in terms of seasons and locations, But also in terms of potential environmental triggers, such as climate factors.

9 Females of certain species do make audible sound by wing clapping, hitting her wings against her abdomen likely to signify her presence to a potential mate. However, this is typically very low in volume and could not be relied upon to identify population centres or track individuals as songs are.

10 This colloquial reference can be somewhat confusing as the hearing organ of a cicada is termed the tympanum, literally "drum" in Latin and similar in form and function to the human 'ear *drum*'.

11 See also, https://dr-pop.net/ (accessed May 17, 2024)

12 An exception to this rule is when a mate is found, and male cicadas lose their wariness in the "heat of the moment".

13 There are a few notable exceptions here. Some species have a 'courtship' calling song that is slightly different to the normal song, since this can be identified by the researcher in that the cicada may not necessarily fly away immediately. Some species also have an evening/dusk calling song - e.g., the floury baker and double spotted cicada. The differing call patterns in a singular species based on environmental effects adds to the complexity of the skilled auditory task.

14 American species have been surveyed for over 100 years with Andrews estimating in 1921 that there were upward of 100,000 individuals per acre. In 1937 this number was increased to 1,394,000 per acre (Andrews, 1921; Andrews, 1937). However, no data is available on Australian species. But given the higher diversity and number of species in Australia, we expect it to be different with substantial geographic and temporal variability.

15 Interestingly, this knowledge may be used to one's advantage against wary male cicadas which call in flight, as the hunter may remain stationary and use timed finger snaps or tongue "clicks" to emulate the female wing flicks and attract the flying male to land nearby.

16 A good example of this is the Golden Twanger which has a green morph and a yellow morph.

17 In the cicada hunting community, there are three differing naming systems employed – each suited to varying research interests and requirements. Firstly, there is scientific name. For example, Pauropsalta mneme. The Latin signifier is the standard way of labelling species in Linnaeus taxonomy and allows scientists to place species in clades – diagrams that depict evolutionary branches and determine higher taxonomic properties, such as genus, family, etc. Secondly, there is a taxonomic numbering system, a method originally developed for cataloguing undescribed cicadas numerically for quick reference and organisation (Moss and Popple, 2000). This designation system is used to catalogue and organise specimens in physical and online inventories such as the Web Guide to the Cicadas of Australia (https://dr-pop.net/cicada-list.htm, accessed May 17, 2024) run by Dr. Lindsay Popple. Lastly, there is the common or colloquial name, many of these are extremely colourful and descriptive. For example, the 'Black Prince', 'Greengrocer', 'Floury Baker', 'Masked Devil', or 'Alarm Clock Squawker'. The common name is often used for engagement with the public given that this is the name most widely used. All described cicadas will have one of each of these names.