



Telling times: More-than-human temporalities in beekeeping[☆]

Catherine Phillips

School of Geography, University of Melbourne, 221 Bouverie St, Carlton, VIC 3053, Australia



ARTICLE INFO

Keywords:
Time
Temporality
Honey bee
Beekeeping
Australia

ABSTRACT

In this paper, I build on insights from temporal studies and more-than-human geographies to argue that there is need to delve more deeply into how, by whom, and to what ends the times in which we live become told. Empirically, the practice of beekeeping provides orientation for exploring intertwining temporalities and timescales as more-than-human accomplishments. Drawing on ethnographic research undertaken in Australia, three accounts are developed: the catastrophic futures related to calls to ‘save the bees’; intimate, embodied tempos and negotiated timings of visiting a hive; and seasonal cycles and rhythms beyond but integral to the life of a colony. Employing the concept of ‘telling times’ enables a gathering of these three accounts and highlights not only the eco-social significance of the current times, but the ways in which time becomes experienced, shared, and resonates through more-than-human practices of time- and world-making.

1. Introduction

We live in telling times. What is done, thought, accomplished in the now matters in significant ways, only some of which may be understood or understandable. Advisories of these vital ecosocial times may be found in (among other things) the proposal of the Anthropocene as a new age (Crutzen and Stoermer, 2000), the impending disaster symbolised by the Doomsday Clock (Mecklin, 2018), or the indication of massive biodiversity loss through warnings of a ‘Sixth Extinction’ (Leakey and Lewin, 1996). These are attempts to register shifts in how worlds become, and end. Each provides provocation to rethink and remake worldly relations, among humanity and nonhuman others in ways that might allow for mutual survival or even thriving; however, each also suggests that time is running out for such action. Whether or not such symbols and namings move us, they point to the significance of what Adam (2000) calls a ‘temporal gaze’ – a means of examining worlds through time and temporality.

How might one respond to the demand for ‘stories (and theories) that are just big enough to gather up the complexities and keep the edges open and greedy for surprising new and old connections’ (Haraway, 2016: 160)? To begin with, I argue we need to consider temporality in our accounts of the ‘complexity of specific culture-nature intersections in their in/visible and im/material expressions’ (Adam et al., 1997: 81). Narratives of particular sites and encounters not only convey temporality but also generate temporal affects (Crang, 1994). ‘Telling times’, then, points to the significance current ecosocial

relations but also the importance of examining lived narratives of temporality. We need, in other words, to explore how and by whom the times in which we live become told.

What might it mean to understand time telling as more-than-human accomplishment? What might such tellings of time reveal about the significance of the times in which we live, whomever ‘we’ are? Which tellings of time come to matter? To attend these questions, I explore the intertwining of multiple temporalities and timescales through attention to one more-than-human practice: beekeeping. In doing so, this paper takes up recent calls to better attend gaps in exploring temporalities of more-than-human world-making (Bastian, 2012; Jones, 2011), and to demonstrate how situated accounts of intimate human-nonhuman relations stretch beyond the spacetimes of their immediacy (see Fitz-Henry, 2017; Phillips, 2017). Through detailing beekeeping, a patterning of lived temporalities emerges – refrains told, remade, reiterated through negotiated practice. Further, how time comes to be understood and experienced is shown to radiate. The times told through this paper travel not only with bees and keepers, but resound in wider worlds swayed through tales of catastrophe and loss, practice and co-ordinated tempos, encounters and seasonality. In highlighting multiple, entwined more-than-human temporalities, the case of beekeeping also helps reveal how select tellings of time both emerge from and remake worlds. In addition to demonstrating the complications of more-than-human temporal experiences, then, this paper gestures to how different senses of time and temporality become conveyed, coordinated, and contested. Such temporal accounts inform practices and the pivotal era

* Submission declaration: This article has not been published previously, is not under consideration for publication elsewhere, and its publication is approved by the author. The research occurred under ethical approvals from the University of Wollongong, Western Sydney University, and University of Melbourne.

E-mail address: cphillips2@unimelb.edu.au.

in which we live in ways often unrecognised.

After outlining the paper's conceptual framing for considering multispecies accounts of temporality and a short section on the context and methods of the research, this paper proceeds through three accounts of temporality that inform contemporary beekeeping. The first of these sections interprets recent projected catastrophic futures of bee loss, and the project of 'saving the bees'. While seemingly distinct from more experiential accounts that orient the next sections, there is no doubt that the anticipated loss of bees echoes through beekeeping worlds. The next segment outlines beekeeping through the tempos, sequencing, and timings of intimate encounters of visiting with bees in hives. While keeping the hive in view, the penultimate section focuses on relations beyond the hive found in the cycles, durations, and disruptions of seasonality. These three explorations of temporal dynamics are not intended to convey a linear or scalar account of beekeeping – moving from intimate relations to a global debate, for example. As narrative fragments oriented around temporal experiences, each telling punctures, runs alongside, and/or interweaves among others, through practice and, as such, should be read through each other. Finally, the conclusion reflects upon what insights might be gained through more-than-human time telling.

2. Thinking toward multispecies time tellings

Recent social studies of beekeeping offer important insights into the complexities of the practice (Adams, 2018; Moore and Kosut, 2013; Phillips, 2014) and the politics of knowledge involved in related ecological damage and extinctions (Lezaun, 2011; Lehébel-Péron et al., 2016; Maderson and Wynne-Jones, 2016; Watson and Stallins, 2016). There are also indications of how important temporalities can be in beekeeping. In their account of urban beekeeping in New York, Moore and Kosut (2013, 92) observe that beekeeping involves a 'responsible performance of [human] mind/body and bee' such that apiarists must attune to the 'affective buzz' of bees. This is suggestive of the key role that coordinating human and bee temporalities plays in the practice. Further, these authors argue that beekeeping might be understood as a method of 'striving to coexist in common worlds' (2013, 89), an observation that implies a concern for bee lives and futures shared with humans. Temporality also plays a role in which expertise becomes recognised through its enrolment in standard lab protocols for testing toxicity for bees (Kleinman and Suryanarayanan, 2013); in which flora is accessible and, therefore, how and when economic precarity is experienced by industry (Durant, 2019); and in how bees become mobilised within cultural discourses, for example as industrious 'busy' creatures to be emulated (Preston, 2006). However, thus far, attention to temporalities of human-bee relations and their importance to beekeeping practice tends to be implicit. This article begins to redress this.

In this paper, temporality is taken as embodied and enacted, emergent through and with practice. Time, in this view, becomes through lived, situated experiences that take shape in particular expressions of time. Edensor and Holloway (2008) point to such relations in their exploration of a coach tour through polyrhythmia, eurythmia, and arrhythmia – types of rhythms that 'order and disorder experiential terrains and mesh with subjective apprehensions wherein time can appear to drag, speed up, or feel at odds with habitually placed rhythms' (484). In this way, time becomes something done and experienced differently, undermining assumptions about the possibilities of a universal or singular temporal order. Time may be experienced as a finite, measured resource such that one 'has time' or not, but this is far from the only way time becomes lived, felt, and/or told.

Ingold's (2000) explanation of times through a consideration of music is helpful. Time emerges, he argues, through activity; the musicians play sequences of notes at particular tempos, which must coordinate or resonate among themselves but also with others (the conductor and audience, the instruments, ideas of what the piece should be, etc.). Time here is not only lived, but lived through practice and as

collectives. Ingold's emphasis on repetition as productive of spacetimes echoes Lefebvre's articulation of rhythmanalysis, in which spacetimes are understood to take shape through the relations of 'slow or fast, syncopated or continuous, interfering or distinct' rhythms (2004: 69). Tsing (2015) takes the music analogy further writing of revelation found in learning to listen for polyphony. In this learning, Tsing 'was forced to pick out separate, simultaneous melodies and to listen for the moments of harmony and dissonance they created' and, she argues that '[t]his kind of noticing is just what is needed to appreciate the multiple temporal rhythms and trajectories of the assemblage' (24, original emphasis). Such accounts indicate the multiplicity and complexity needed in developing accounts of more-than-human temporality, but how and who/what tells time in the polyphony remains somewhat obscured.

The idea that time is experienced and made through diverse and imbricated relations and, further, that such relations are more-than-human, is beginning to gain attention (see Bastian, 2012; Brice, 2014; Gan, 2017; Neimanis and Walker, 2014). Power (2009), for instance, considers how the temporalities of possums influence dynamics of human efforts of home-making. In a different vein, Jones' (2011) study of tidal rhythms, explains an interest in 'natural' rhythms with two important caveats: first, that such times require analysis to grasp the world's polyrhythmicity; and second, that natural rhythms point to nature not as opposite but as condition of culture. How such natural temporalities coexist with other times has proven of interest for recent more-than-human studies as investigations into seasonality. Krause's (2013) exploration of the seasonal liveliness of a river demonstrates that 'these rhythms emerge from the interplay of various fluctuating phenomena, including the calendar and weather, but also electricity prices and human activities'. Times, and worlds, are not necessarily comprised of or with social or natural temporalities, but rather complex intertwinnings and foldings. Moreover, time itself might be understood not only as lived but as dynamic in its polyrhythmic tellings. Rethinking time this way provides opportunity to consider how seemingly discordant temporalities and time scales co-exist. As I illustrate, urgent pleas to 'save the bees' in the face of fears of extinction and lost food security can (and do) co-exist with intimate tempos and seasonal coordinations of beekeeping.

Recent work also challenges assumptions about nature's pace always being 'slow' (Bastian, 2012; Jones, 2011; Neimanis, 2018). One approach has been to suggest that in fact, nature's quickening pace makes humans too slow when it comes to environmental crises. While it is not unreasonable to argue that humans are responding too slowly to the many ecosocial crises we face today, this approach retains a problematic dualism between nature and culture as well as an underlying sense of a singular natural temporality. A different approach, and one taken herein, involves critically attending to the complex interplay of temporalities through empirical enquiry. We might note, for instance, the slow and fast as well as the immediacy and hauntings evident in the violences of extinctions, hazardous waste, or oceanic pollution (Adam, 1998; Neimanis, 2018; Phillips, 2017; Van Dooren, 2014). Or the cycles, durations, and tempos involved in maintaining plants (Jones and Cloke, 2002), producing wine (Brice, 2014), or caring for soil (Puig de la Bellacasa, 2015). In addition to detailing complex relations, more-than-human accounts reveal other possibilities through their telling, signalling what figures might serve as inspiration for alternative senses of time (Bastian, 2012) or questioning conceptual and methodological habits through attention to non-linear, relational experiences of time (Bawaka et al., 2017). As these examples suggest, accounts of multispecies co-constitutions of time offer a means to disrupt notions of unitary natural time and straightforward accounts of ecosocial challenges.

Diversifying and 'thickening' accounts of times and temporalities provides opportunity to gain new insight into 'small kingdoms of worldliness' (Lorimer, 2009: 273; see also Phillips and Atchison, 2018). As this paper will show, examining more-than-human temporalities

provides means to more deeply explore the experiences and negotiations involved in practices, and provides another means of considering the ethico-political implications involved. How beekeepers and bees live, learn, and tell time in multiple ways suggests the polyphony mentioned by Ingold (2000) and Tsing (2015). Held alongside this notion of polyphony, the concept of resonance (and dissonance) might reflect the imbricated processes of living temporalities, sharing such experiences through tellings of time, and making such tellings matter more widely. In the following sections, I offer partial, situated accounts of living and telling more-than-human temporalities that I hope find resonance through and beyond their particularity. In this way, the paper not only reports but participates in telling times.

3. Exploring Australian beekeeping

Australia provides a fascinating location for exploring beekeeping practices for several reasons, three of which are particularly relevant here. First, Australian beekeeping is experiencing a declining commercial sector with simultaneous growth in (especially urban) hobbyist numbers (ABARES, 2016). Second, there is an absence of documented mass bee losses and of *Varroa destructor*, a parasitic mite held at least partially responsible for world-wide bee declines and considered “the most serious threat to apiculture globally” (UNEP, 2010). And third, distinctive spatiotemporal patterns shape Australian practice including irregular blossoming of key species, a relatively long season, and ongoing challenges of dealing with changing land management and climate change (Sommerville, 2010; ABARES, 2016). These three aspects – ambivalent numbers, continuing absences, and erratic spatiotemporal patterning – point to the unique and compelling worlds of Australian beekeeping.¹ Each of these aspects suggest the need to explore beekeeping beyond its economic and productive aspects, and provides indication that attention to time may offer useful insights into beekeeping as it is currently known, felt, and reproduced.

This research took an ethnographic approach to learn about beekeeping. To allow for varied spaces, times, and activities, fieldwork was undertaken throughout the year and involved three methods. Firstly, interviews with 42 beekeepers (24 hobbyist and 18 commercial) and five government officers were completed during 2011–2014 and 2015–2018. The first period, as part of a larger study, concentrated on commercial beekeepers – defined by governmental documents as full-time apiarists with 400 hives or more (see ABARES, 2016). Distinctions made in statistics and in interviews prompted a second project to consider the practices of hobbyist beekeepers, especially those practicing within urban contexts.² Discussions with both commercial and hobbyist beekeepers covered a range of themes: details about their hives and resourcing; learning processes; materials and techniques; joys and challenges; and, opinions about related governance and the future of beekeeping. Secondly, the interviews were complemented by ‘go-along’ (Kusenbach, 2018) activities, such as examining hives and extracting honey, ranging in duration from about an hour to several days. This method proved particularly useful in building understanding of lived experience. It also allowed other-than-human roles to come to the fore,

¹ An exploration of the ecosocial history of Australian beekeeping is beyond the scope of this paper. However, it is notable that honeybees became established as part of pursuits of settler agriculture (Hopkins, 1886) and later developments of industrial agriculture. This history is carried through generations of practice.

² Pseudonyms have been assigned to quoted beekeepers. Each is also labelled either commercial (full-time, 400 hives or more) or hobbyist (part-time, 50 hives or less), reflecting governmental distinctions and common descriptors. Though this provides a sense of participants it can also obscure nuances within a complex community of practice. As examples, hobbyists may sell products or act as full-time swarm collector in season; many beekeepers undertake other activities – running clubs, mentoring, brokering, etc.; and several positions exist between ‘hobbyist’ and ‘commercial’.

sparking new conversations (see Hitchings and Jones, 2004). And thirdly, in both periods of research, participant observation involved attending various meetings, events, field-days, and training. This combination of interviews, go-alongs, and participant observation provides rich data on the experiences, valuations, practices, places, and temporalities of Australian beekeeping.

4. A time of crisis, or urgent mandates to ‘save the bees’

‘No bees = No food’ (see Fig. 1) declares the mudflap on the beekeeper’s truck I hop into to learn about how honeybees³ are moved in commercial production in Australia (see Phillips, 2014). At the end of my visit, which covered over 24 h together in or around that truck, I am gifted my own set. I do not own a vehicle so their intended function is lost but they are an excellent reminder of our discussions and that experience – part of an archive of affective objects. The mudflap was used by the Crop Pollination Association of Australia to raise awareness of the importance of bees in assuring human food security. Its exhortation is clear: save the bees! In this telling of impending catastrophe, bees condition human survival – particularly as pollinators. Humans may shape bees’ possibilities of living – particularly through colonial dispersals, industrial agriculture, habitat destruction, and anthropogenic environmental change. But, we are told, bees would not leave this world alone. Our fate follows theirs: ‘no bees, no food’.



Fig. 1. Promotional object. Photo by author.

The plea of the mudflap builds upon a crisis narrative that has come to dominate discussions of bees, even though bee losses experienced around the world remain undocumented in Australia. Chris (longterm hobbyist, club organiser) points to the importance of this narrative:

Why did people get interested in bees in the last 10 years? The main reason is because of the threat of bees overseas, and that's picked up in the press. So, people have become interested in bees here [in Australia] to save bees.

As Chris indicates, the anxiety over bee losses, and the accompanying drive to save the bees, becomes felt even in places yet to live such losses. The narrative compels action. Cameron (short-term beekeeper, working toward commercial) reiterated this point, explaining:

The whole CCD [colony collapse disorder] phenomenon, you know what I mean, that media is transpiring here. So, I do get people wanting to save the bees. Some people want to keep hives, but also I get calls about swarms, where people say, ‘given bees are in decline, I don't want to call a pest controller I'll call a beekeeper [to remove a

³ In deference to the stories being told, throughout this paper I use the colloquial honeybee rather than the scientific term ‘honey bees’.

swarm]’.

Swarming – the process of forming a new colony – is further explored in section five, but here offers a connection to a sense of crisis, and the mandate to save bees. The threat of this looming future, heralded by the mudflap, resonates.

I contend that paying attention to the framing of time involved with this crisis narrative helps reveal the ways in which bee existence and interaction are becoming understood, and the inclusions and exclusions involved. In other words, to understand contemporary beekeeping and the challenges facing people and bees it is vital to explore how times become known and told.

In 2006 beekeepers in the United States began noticing that colonies of bees were disappearing, and the cause was unclear. It was a troubling mystery. Bees’ products – honey, wax, venom – provide significant benefits for humans, but the most valued service they provide is pollination; of the 100 crop species estimated to provide 90% of the food worldwide, 71 are estimated to be least partially bee-pollinated and honeybees remain the most commonly managed pollinator (UNEP, 2010: 1).⁴ Without honeybees, human food security would be at risk. This says nothing of ecological consequences, erosion of longstanding and diverse roles in human culture, or the emotional toll such losses might incur (Hung et al., 2018; Mathews, 2010; Preston, 2006). Losing bees would be tragic – in ecological, economic, cultural, and moral terms. In the aftermath of the alert, it was revealed that US beekeepers were not alone in their losses.⁵ Concern mounted.

In her consideration of the implications of ‘colony collapse disorder’, as the US losses came to be known, Mathews (2010) coined the term ‘planetary collapse disorder’, pointing to and reiterating the ominous tale being told. In addition to the particularities of these bee deaths, these losses were understood to signal a broader warning. Honeybees, it turned out, were not the only bees, the only pollinators, or the only insects disappearing (Hallman et al., 2017; IPBES, 2016). Though evidence on many insects is limited, it is expected that bees, butterflies, and other invertebrate pollinators will make up the majority of future biodiversity loss (FAO, 2018; IPBES, 2016). Public commentaries on the catastrophe of ‘insectageddon’ (see Monbiot, 2017) echo this idea that such losses point to fundamental ecological and agricultural breakdown.⁶ With this repeated framing, bee/pollinator/insect loss becomes a crisis.

The sense of urgency and need for action are made clear by the many campaigns, news stories, governance measures, films, and promotional objects (like the mudflap). The message transmitting is: we must save the bees, to save ourselves, now. But this ‘now’ is conditioned by assumptions about the past and concerns for the future. In the past, it is assumed, bee lives were not so precarious or at least pollination (and therefore human lives) were less at risk. The hope for the future, then, becomes a return to a time when this present disruption is resolved and the norm re-established. There is a sense of a future rushing toward the present, inhabiting it, reshaping it, demanding action before it becomes

⁴ Of the estimated 20,000 bee species, approximately 0.1% are actively managed as pollinators (vanEngelsdorp and Meixner, 2010).

⁵ Though falling short of increasing pollination demands, hive numbers worldwide are estimated to have increased overall since 1961 (Aizen and Harder, 2009). However, total hive estimates ignore death rates, and in some locales problems are serious. Unmanaged colonies have largely disappeared in places inhabited by the parasitic mite *Varroa destructor*, while managed hives experience significantly higher winter die-off (Kraus and Page, 1995; Jaffé et al., 2010). And bees continue to be stressed and killed through aspects of industrial agrifood, including chemical use (EFSA, 2014; Godfray et al., 2014). No single cause has been determined for increased honeybee death rates worldwide; rather, it seems to be interactions of pests and diseases, limited genetic diversity, and stressors of agrifood production (chemical exposure, poor nutrition, mismanagement) (Potts et al., 2010).

⁶ For recent debates on the subject in conservation science see Thomas et al. (2019) and Forister et al. (2019).

‘too late’. During this time of anticipating loss, what is decided and done makes all the difference. Anderson (2010) has highlighted anticipatory action as precautionary, pre-empting, and/or preparatory, suggesting activities are undertaken to create an interval in time to deal with futures-yet-to-come. Even as bees and people are living amid losses – projected and real – the message is reiterated. The seeming inevitable future of a world of ‘no bees, no food’ might be avoided or even rolled back, we are told, if we act in time. Within this defined crisis, there is a linear understanding of time such that ‘time is divisible into a static past, a given present, and a predictable future’ (Grosz, 1999: 9).

Anticipating the ecosocial disaster of pollinator loss not only shows the future as something that can be enacted in the present, it supports particular pursuits and materialisations of envisioned worlds. In general terms, arguments for particular solutions may favour sustainability measures, like planning bee-friendly flora or transitions to multifunctional agriculture (IPBES, 2016), or may endorse techno-scientific innovation such as manufacturing drones capable of pollination (Chechetka et al., 2017; Chen et al., 2017). Commenting on the situation in Australia, Cameron argued for different strategies. First, he indicated, echoing governmental and industry messages, that it is a parasitic mite that threatens bees and beekeeping futures:

It’s really interesting, everyone thinks that bees in Australia are declining, but it’s not. But it’s good for me, ‘cause people think that and they’re naturally going to want to save the bees. Which is good, but. ... You know, bees are fantastic. It’s good, wanting to save bees. But saving our bees is going to be, going back to *Varroa* mite, preventing that from coming here. That’s gonna be saving the bees.

In this way, the particular threat to bees (and corresponding solutions) may be differently defined, but the sense of urgency to ‘save the bees’ remains. As a discourse, this implies the future is catastrophic, unless humanity can lead the world out of this mess.

It is worth pausing to consider the gains and loses made through viewing the future only through a lens of catastrophe, and through addressing crisis only through asking how to halt its progression. Tsing (2015: 19) argues that ‘neither tales of progress nor of ruin tell us how to think about collaborative survival.’ Heeding this warning, we might work to admit tellings of times of crisis into collective stories, but that need not mean being confined to such tales. What might other reckonings and renderings of time reveal? This question might be posed about bees and beekeeping, but also in relation to many identified crises from climate change to food security. In the next sections, I take up this question by moving toward more intimate accounts of beekeeping, first by considering the tempos and rhythms involved in visiting bees in a hive, and then by moving beyond the hive to examine bee-human negotiations of seasonal cycles.

5. At the hive: visiting bees, coordinating rhythms

Observing. I am told over and over again that it is the key to beekeeping. Knowing when to intervene, or not. A lot of beekeeping is about timing it seems – discerning and becoming part of a shared rhythm. The best time, I have been taught, is a clear, warm, not-too-windy day. Then I still have to discern if the time is right. Watching, listening, smelling. Are the bees up for a visit? Are they calm and happy? Hungry, queen-less, diseased? Bees signal with their flight patterns and buzzing; quick, erratic, high, loud warnings. Sluggishness would be troubling, silence devastating. Is the hive entrance busy with bees carrying heavy loads? Is there a sour smell, or that wondrous scent of warm wax, propolis, and honey? With a sense of bees’ movements and mood, things can proceed. I light a smoker in case the bees get grumpy and I need to delay attack, then pull a veil over my head. Watching, listening, smelling, I move closer. I try not to disrupt the workings of the colony too much. Opening the hive takes focus – on what is happening, on the state of the colony, on pollen and honey

stores, on interacting with bees. Masses of fuzzy bodies wiggling and wagging, being born and giving care, returning with pollen and nectar, going about their lives. I become rapt, almost immersed in another world. For a moment. And more. Watching, listening, smelling (see Fig. 2). But there are practical issues when keeping bees, and that means getting on with it. Drawing on previous experience, using diverse resources but especially previous interactions with beekeepers and bees, I continue to learn the ‘art of noticing’ (Tsing, 2015). The colony tells me whether it is time not just to visit, but to intervene.



Fig. 2. Visits with bees, outside and inside hives. Photos by author.

The physical and emotional work of beekeeping means becoming attuned to hives over time, altering one’s rhythms to coordinate with those of bees, and feeling how one is altered through repeated encounters. The opening paragraph of this section is based on my own experiences with beekeeping. Among other things, it points to the need for attentiveness to hive rhythms, the possibilities of immersion and lost time, and a shared interest in honey and/or pollen that requires negotiation. This section elaborates each of these aspects of beekeeping encounters.

5.1. Feeling hive tempos, getting in tune

Several beekeepers I interviewed spoke about slowing down – slowing their bodies, focusing on bees, and enjoying the distance from monitored and measured times. Though their contexts and scale-of-operations differ, commercial and hobbyist beekeepers mentioned this slowing and its associations to peace, calm, mindfulness, and connection to natural cycles as motivations for continuing to keep bees. For example, Jack (long-term commercial beekeeper and bee broker) explained that his favourite part of his job is ‘When I’ve got time to just go out and observe. A nice, sunny day when the blossoms’ full out, and the aroma’s in the air, and the bees are coming... That’s a good day.’ This desire for a slower tempo and for time to observe is not just about beekeeper enjoyment, but about doing beekeeping well. Speaking about

what makes a ‘good beekeeper’, Daphne (long-term hobbyist), for instance, indicated that lessons about slowing down and patience were key:

... the biggest thing is being patient. It’s not something you can do in a hurry. I find it a bit frustrating, because I am, I am a terribly impatient person... But to have to slow myself down for the bees is good really. It’s taken me a while to think that I can go slower.

Beekeeping, for Daphne, means mediating tendencies to hurry.

Through tending to bees and learning their rhythms she is learning that she ‘can go slower’, to do beekeeping well but also in ways that benefit other aspects of her life.

In addition to demands to slow down, for some practitioners, time itself recedes in beekeeping. This is reflected in my own account when I note becoming rapt and moments drawing out. Other fascinated beekeepers, both commercial and hobbyist, indicate that they can become lost in their attention to bees. For them, time stops, passes without notice, or becomes consumed. In conversation, two long-term commercial beekeepers reflected:

Alex: I love it, but not to the extent that [Simon] does. I really do enjoy the bees. I like working out in the bush, in the open. But I also enjoy working when we’re pulling the hives apart, and actually working with the bees themselves. But, [turning to Simon] you’re just obsessed.

Simon: Yeah [pleased, rueful smile], it’s a bit time consuming.

Commenting upon the intrigue of bees and her own awe of bees, Valerie (long-term hobbyist and broker) revealed:

I think we don’t respect bees enough for what they do. The incredible taking of pollen, and the nectar and creating honey. I just think that’s unbelievable. So, there’s a bit of awe I guess. ... It’s just fascinating. I could just, you could just open a hive, just have it open

all the time and be looking at stuff. [We (names deleted)] get quite carried away actually sometimes when we're doing that.

Though her fascination creates a desire to keep a hive 'open all the time and be looking at stuff', she can get 'carried away' so her enthusiasm must be moderated. Continuous observations can be difficult, even dangerous, for bees. The respect Valerie advocates means not only slowing movements but also not overstaying one's welcome. It is a compelling world that can provoke pauses as well as demanding action. Valerie continued by explaining that, 'when they've had enough, the bees say "Come on! Move on! Close up the hive." The bees, then, remind her of the time. They tell her 'time's up', at least until the next time.

Part of this fascination of beekeepers comes with watching bees resting, playing, and (mostly) working. In my note and the photos above, the initial glimpse into a hive reveals thousands of vibrating, bumping, flitting bees involved in colony life. During their lifetime, worker bees take on a series of tasks based on age – moving from cleaning when they are a few hours old, through nursing, cooking, constructing, and guarding, until they begin foraging in their early 20s (days not years). But bees tell it is time to change jobs by more than age; timing these moves is about the condition of the hive and its residents. Though the progressive task schedule suggests a regularised timeline, the specifics of any bee's progression and any colony's workforce composition relates to hormone levels, which shift with weather, nutrition, colony age profile, genetics, and season (Huang and Robinson, 1996). All the activity discovered beneath a hive roof also involves bees sharing news about food, tasks, their queen, and general hive living. Bees bump, stroke, joggle, dance, dart, among other things. The directions, tempos, and durations of their moves convey much of the goings on (Seeley, 2009). Opening a hive also alters the conditions of the colony, so a beekeeper must be careful about their timing, making efforts to work with the colony's tempos and timings.

Other beekeepers echoed the need for patience for and respect of hive rhythms. Belinda (longterm hobbyist), for example, explained how she thinks of beekeeping:

It's almost a meditative practice. You can kind of be in tune with them and you can open the hive mindfully and not get stung at all and observe things that you wouldn't have observed otherwise. ... the other way that bees teach you mindfulness is when they do get aggressive ... There's a bee inside your suit, you've got your hands full, you've got your hive open, gloves and stuff everywhere. You know it's going to take you 10 min to pack it all up before you can walk away to open your suit and let that bee out. And the bee's getting more and more agitated and stressed. And you can hear it, you can feel it crawling around in your ear, and near your eye. ... Nothing else teaches you mindfulness like a bee in your suit!

As Belinda suggests, beekeeping is not always smooth. Beekeeping can be 'a meditative practice' helping a beekeeper connect with and learn about the colony, but one must also protect oneself and the bees when encounters become dangerous. Though distinct from moments of fascination, here too, 10 min can feel like an eternity. As Valerie and Belinda indicate, it is not just slowing down that matters. Becoming 'in tune' may mean slowing or expedience. Coordinating multiple temporalities and remaining open to what is needed in any one moment is part of beekeeping well.

5.2. Storing for the future, or time to harvest?

Another important way in which negotiating bee times manifests is in considering when, or if, to take honey from the colony. Honey is, for

bees, key to survival. Stored pollen provides bees with protein but honey is their primary energy source. Foragers, in the last stage of their life, find and collect pollen and nectar for the colony (Huang and Robinson, 1996). Once a bee's stomach is full, she delivers its contents to the hive and returns to foraging. Through repeated regurgitation among worker bees inside the hive, the nectar is transformed and evaporated until it is stored in a cell. Further moisture reduction may be achieved as the bees fan their wings. Honey is then sealed (or capped) by 'construction' worker bees, who make and shape wax into comb. All of this honey-making and -storing suggests planning for the future of the colony. The honey remains stored until bees need to eat it, or until a beekeeper takes it for their own use.

The crafting of honey by bees for their own sustenance is an undertaking that humans benefit from (or exploit) as harvester. Kevin (long-term commercial) recollects his choice to leave a full box of honey for bees working an area that later became surrounded by flood:

But that's a beekeeping technique. There's a lot of people that would just take the honey off, usually because they're running low on money. They say, 'Right, I need the money. I need it now. I'm taking it off.' And then something happens, and there's no honey left so all the bees might die. Whereas, as much as I am trying to look at the business, I try to keep the bees first.

His bees survived the unexpected, he clarified, because a future risk was anticipated and short-term gain was refused in favour of long-term success. His distinction disrupts unitary assumptions about commercial practice (that it is only about quick production), and points to the importance of temporal considerations: if and when honey is removed; long- and short-term concern.

The idea that healthy bees should come first resounded through this research and, as Kevin suggests, much of this has to do with temporal coordination. Questions relating to honey taking revolved around how long bees needed to endure without new food sources – when flora might flower, when to supplement feed, when to move hives. This question of 'when' had significant influence on the life and death of bees, and on the success of beekeepers. For some concerned with short-term gain, learning bee tempos might enable pushing bees hard to produce large quantities quickly but for most the desire to share time with bees ran deeper. As Chris reiterated, 'You've got to make sure that you learn beekeeping and do what's right for the bees, and the honey will follow.' This prioritisation of proper beekeeping, in combination with repeated assertion that for each teaspoon of honey twelve forager bees have laboured their lifetimes, points to a sense of responsibility. It also demonstrates recognition of differences in the duration and rhythms of bee and human lifetimes.

The sensory and affective impact of beekeeping can be overwhelming – fascination, fear, love, anxiety, desire are all part of the transformative encounters that can happen through visiting with bees. Moore and Kosut (2013) explain that good beekeeping involves feeling bees' 'affective buzz', a sense built through gestures and reverberations, made but not necessarily heard or understood by all those involved. This echoes Lefebvre's notion that through experience capacities to register everyday rhythms may enter 'into the lived'; though that does not mean it enters into the known' (2004: 77). Further, the potential for moments of enchantment to prompt ethico-political engagement has been explored in more-than-human studies (Bennett, 2010). Building on these insights, this section illustrates that to understand beekeeping requires attention to involved temporalities. The sequencing, timing, and pacing of checking hives matters because it has implications for bees and their time reckoning as well as for what the relations among bees and humans produces. Too long, too fast, too disruptive and bees begin to think it is time to defend the hive rather than getting on with

their lives. And bees certainly tell beekeepers when dissonance registers. To achieve honey-making, pollination, or even just healthy hives in beekeeping there is a need for human and bee tellings of time to coordinate, to sync, even if this is always incomplete. Over time, with repeated encounters and the development of routines, the capacities of practitioners to attune, to tell times together, can be enhanced. However, the worlds of any particular hive, and its products, do not end with the combined labour of specific colonies and beekeepers. Rather, broader rhythms and histories live within such intimate encounters. The next section explores seasonality as part of the polyrhythmic tales of beekeeping, an aspect that moves us beyond the hive.

6. Beyond the hive: learning seasonal cycles and dynamism

Attuning to the rhythms of seasonal changes, growth patterns, and circadian cycles within beekeeping was considered by beekeepers to make felt both the persistence and the dynamism of broader environments. Connecting with ecological temporalities was part of the appeal of beekeeping. Belinda, reflecting on the cycles involved in her practice, explained:

If you're in tune with your bees, you connect with this seasonal cycle of things. It's very subtle. You wouldn't necessarily notice otherwise. So, you're really aware of your environment. There's just a lovely seasonal cycle of beekeeping, like swarming in the spring and building boxes and harvesting the honey in the autumn and then wintering down. It kind of marks the season when it's those times of the year. I think that's one of the greatest gifts of beekeeping.

Belinda's appreciation for the 'seasonal cycle of things' and the increased noticing of environmental shifts was reiterated by many of the beekeepers with whom I spent time. Two of the significant ways this manifested orient around seasonality as related to tree rhythms, particularly the availability of pollen and nectar, and to the growth and contraction of colonies in terms of swarming.

6.1. Getting into the flows of trees

Ensuring bees have access to nectar flows is vital for healthy hives and beekeeping success. Daphne, for instance, articulated a need to 'know flora' that was confirmed by others. She explained:

You do have to check that there is flora around for them. These days, it doesn't matter where you are, whether you're in the city or coming out into the suburbs, a lot of gardens are disappearing. Like I said, when I first brought the hives here, I made sure that there was something around. It's the next-door neighbour's garden probably that kept them going rather than mine.

Although her own garden could not support her hives alone, in combination with other resources in the neighbourhood Daphne's beekeeping has thrived. Chris reiterated the need to learn surrounding places and seasonal variations, stating:

I think what it does is, it makes you more aware of the living world. Particularly, it's highly dependent on the weather. So, you've got to be looking out at the weather... I think definitely for me, it makes me more aware of nature. Trees, you've got to look at trees.

For both Daphne and Chris, among others, beekeeping entangles with the rhythms and times of plants.

Flowering frequencies, durations, and intensities vary with species, and with each species' reactions to climatic factors. In Australia, Eucalypts serve as the main flora for commercial honey production and though they can offer abundant flows, they are also erratic; blossoming relates more to rainfall events than to seasonal cycles, and involves time scales ranging from one to five years (Sommerville, 2010). This is distinct from other places, like North America and Tasmania. Lincoln (long-term commercial) explained the significance: 'beekeeping over

there [Tasmania] is different to over here [mainland Australia]. Totally different. There, you can put the clock just about to the time and date when the honey flow starts and finishes. And usually you get a heavy honey flow and a quick flow'. Available nectar also varies with tree age and abiotic factors, and some Australian beekeepers have observed long-term declines in nectar production (Britchnell and Gibson, 2008). Moreover, ensuring access to nectar flow is not enough; instead, overlapping flows at the right times are necessary to support a colony's lifecycle. Commercial beekeepers move their hives to different sites to ensure nectar and pollen access (see Phillips, 2014), while hobbyists' hives mostly remain static. This difference means that the focus differs – one across a series of sites and landscapes, another on one place – but for both, an understanding of plant seasonality is necessary. The seasonality of beekeeping, therefore, is experienced differently based on colony needs, flora, place, and practice.

The 'angiosperm-insect alliance' developed long before human-bee relations (Clark, 2013). Concerns about disruption within the rhythms of this relation – such as those raised by the adaptation of different species to climate change – further complicate matters. Belinda affirmed:

Climate change affects bees massively. I mean, if you talk to beekeepers about climate change, because they all will tell you, years ago we always used to get the best honey... I mean, it affects the bees in that it affects their nutrition. Things don't flower at the right time, when they're supposed to. It rains when things are blossoming and they [bees] can't get out to forage. If the system's kind of out of whack, bees aren't getting the nutrition that they need in their hives.

Beekeepers and bees rely upon flora – remnant, weedy, cultivated, conserved – all a result of complex pasts of floral capacities and distributions as well as human land management and planting preferences. Decreasing availability and accessibility of floral resources leads to precarity for beekeepers (Durant, 2019), and for bees. Current efforts to engage publics in planting bee-friendly flora and disputes over access to state forest for apiaries (compare EPA, 2007; DEPI, 2013) suggest this kind of reliance, though ongoing planting and land histories remain largely unspoken. And emergent floral landscapes – cultivated and otherwise – are just one aspect of the complex seasonal cycles (and their disruption) lived through beekeeping.

6.2. Time to move, and 'swarm-watch'

Another way in which seasonality comes to matter in beekeeping temporalities involves swarming – when some bees from one colony separate to form a new colony (see Fig. 3, bottom right). Swarming is taken most commonly as a sign of spring, as Belinda notes above, but it can occur anytime when weather is warm, food sources plentiful, and a healthy colony becomes too cramped. This abundance and excess prompts about half of an established colony to depart with their queen to form a cluster nearby, leaving remaining bees behind. Though those leaving have agreed it is time to move, they have not yet decided where to live. Emerging from the cluster, scouts, among the eldest in the hive, explore the area for potential new homes. When a scout returns to the swarm, she dances – through her movements she shares information about the direction, distance, and quality of her preferred site. Followers of the dance will then visit the site to evaluate it themselves, and if they are convinced, they return to the swarm and dance for that site. Once the number of sites has been whittled down and enough bees agree, the swarm will fly *en masse* to their new place and begin settling in.⁷ As swarming demonstrates, rhythms of communication and coordination of timing are key to colony survival.

⁷ This process was repeatedly elaborated by beekeepers based on their own observations, readings, or mentoring by other beekeepers. For a scientific exploration of swarming and bee cognition see Seeley (2009).



Fig. 3. Watching for and finding swarming, photos by author.

Attending to the timing of swarming is part of beekeeping. Speaking of seeing a swarm emerge, beekeepers used words like ‘amazing’, ‘fantastic’, and ‘cool’, always suggesting a sense of excitement. It was considered a privilege to catch swarming in process – to witness a humming, shifting cloud of bees fly off and later resolve as a vibrating, semi-settled cluster. Commercial producers mentioned ongoing tweaks to their swarm management techniques, but for hobbyists a stronger debate about whether (and how) swarms should be managed was ongoing. Chris divulged:

Some people say they’re natural beekeepers because they don’t manage the bees as much as what I would manage them. For example, controlling swarming. So, they don’t worry about swarming because it’s natural to let bees swarm. Whereas I would say because you live in a city, you’ve got a responsibility perhaps to stop the swarms going into buildings.

As hobbyist beekeeping grows in popularity especially in urban locations, and as worry over loss of insects and biosecurity concerns grow, management of swarms is increasingly endorsed; collection and management of swarms is recommended, for instance, by governmental agents to limit public risk especially in urban areas (see [DPI, 2000](#)).

‘Swarm-watch’ was what Quinton (long-time hobbyist) called swarming season – a time each year when he said he was ‘run off his feet’ trying to keep up with his own hives as well as all of the requests for removal. Beekeepers like Quinton, reflecting on spring tasks, recommended being ready to collect unexpected swarms, suggesting a season of anticipation involving preparation for not-always-predictable colony timings. To manage swarming in one’s own hives means attempting to interrupt colony division and spread. To delay swarming,

beekeepers cited increasing the frequency of their hive checks and removing queen cells (see [Fig. 3](#), top right). But, they explained, removing queen cells is no guarantee against swarming, and it can be risky; construction of cells for queens signals either imminent swarming or a failing queen and reading things wrong can be disastrous for the colony. To disrupt the swarming cycle, rather than just delay it, beekeepers recommended either providing more space in the hive to allow growth or splitting the hive – i.e., creating an artificial swarm. Even with such measures, however, swarming can happen.

In addition to watching one’s own hives, beekeepers like Quinton often engaged in swarm collection. Stories of swarm collection included tales of easily removing swarms with a strong rap on a tree branch with bees dropping smoothly into a waiting box but also of prolonged affairs involving removals from inside walls, heritage tree hollows, chimneys, compost bins, and even a fire hydrant. The docility of swarming bees and the marvel of collecting beekeepers does not always translate into how bee swarms are publicly received, particularly if swarms crossover into ‘human’ places like shops, streets, pools, or yards. Beekeepers relayed stories of responses involving thrill and support but also fear and avoidance until swarms were removed or killed (see [Fig. 3](#), left, for example of posted warning in public park of colony swarming scheduled for collection). Human schedules and expectations of timely accommodation can conflict with leaving bees to their own devices, or waiting for solutions other than extermination.

While swarm-watch season can be busy, unpredictable, even tense, most beekeepers indicated they enjoy collecting swarms. In fact, swarms often offered inspiration; swarms provided the initial colony for most of the beekeepers with whom I spoke and provided a means of increasing the numbers of the hives they had or could share with others.

In this way, swarm-watch serves the practice of beekeeping by ensuring friendly relations with neighbours and by providing the basis for sharing the practice. There was also a sense of doing something good for the bees collected as swarms. Henry (short-term hobbyist) explained:

I've been starting to collect swarms and I think there's a tremendous satisfaction where you can rescue some bees that were either going to be poisoned or sprayed or in some way killed through ignorance or just through convenience. But to save some bees, relocate them to someone who is going to look after them, so that they prosper and then multiply at some stage in the future. Now that, to me is, if you're getting involved with bees to help save the bees, what better way of doing it? – saving swarms from certain death.

Henry's comment suggests a disjunct between the time-spaces of swarms and those of humans such that bees would lose their futures due to a public's lack of understanding or inconvenience. In this way, he, among others, understood swarm collection as work to ensure bees can thrive, with someone who cares for them. This is quite an intimate, imminent sense of 'saving the bees' compared with that explored in section four. Swarming has previously been characterised as a 'time of anxiety' due to a suggestion that beekeepers worry about the loss of productivity should swarming occur (Green and Gim, 2014). This desire for uninterrupted production – whether for honey or pollination – may be part of the concern; however, as Henry, Chris, and Daphne articulate, there is much more going on.

In beekeeping, then, the marking of a season is demonstrably less a calendar reference than recognition of a polyrhythmic confluence. Olwig's (2005: 260) observation about farming (in the global North) is suggestive:

it is not particularly helpful to calculate the spring growing season as beginning on 21 March ... phenomenon such as the sprouting of leaves are more realistic indicators of spring because seasonal transition involves a highly irregular, complex process of inter-related climatic, geologic, floral, faunal, and social change, and the ability to read all the signs of this change correctly can spell agricultural success or failure.

Seasonality, then, is a patterning of multiple rhythms. The cycles and times of the colony are individual and collective; bees communicate with each other through chemical receptors and gestures, negotiate timing of activities such as swarming, and coordinate with seasonal variations. Bees experience and tell time, for themselves and in ways that keepers must learn and accommodate to maintain the shared practice of beekeeping. There are also interruptions and disruptions in seasonal patterns, such as those of irregular nectar flows or unexpected swarms, that require continual attendance. Several of the comments from beekeepers may seem to reinforce a division of 'social' or 'natural' temporality; however, as recent works on agricultural seasonality remind, dissonance need not be read as dualism (Brice, 2014; Krause, 2013; Whitehouse, 2017). Holding calendar indicators or production timelines alongside other ways of telling times provides valuable insights into how seasonality becomes registered (as well as how beekeeping gets done).

7. Telling times, finding resonance

It may be through loss, through catastrophe-in-progress, that bees – and beekeeping – are coming into focus worldwide. Honeybees are becoming a symbol of ecological and agricultural vulnerability, and their long, intimate history with humans may make the warning they proffer of shared, troubled futures take hold in ways other crises would not. There is a risk that care for, about, with honeybees might obscure other creatures and worlds worthy of consideration; however, their figuration as omen might also prompt deeper questions and thoughtful action. Further, as this paper demonstrates, such anticipations of loss

and urgencies to act refract only part of how tellings of time manifest and influence. Thinking further about ways of reckoning, experiencing, and coordinating time through more-than-human practices demonstrates a diversity of experience and narratives that refuses any sense of singular, unitary, or universal accounts of time or temporality.

This paper has explored the phenomenon of beekeeping as emerging from and reiterating interplays of temporal rhythms and time framings. A moment's pleasure, a lifetime of labour; expected sequences and surprising variations; negotiations of long- and short-term; tempos of disruption and timings of flow; repeating cycles, erratic eruptions – each of these (among others) has featured. Recognising the temporalities of nonhumans, such as bees, is just a small step to gaining insight into their worlds. This paper illustrates some ways in which honeybees tell of the tempos and timings of their lives and deaths. The time tellings provided also indicate temporal interactions of bees and keepers – efforts to negotiate, manage, coordinate as part of keepers' aims to find resonance. These multiple temporalities of practice are not experienced in isolation or linearly, there are interruptions, complex harmonies, staccato notes, as well as driving beats in the polyphony. Beekeeping times also reach beyond immediate encounters, carrying legacies and futures. Which times become lived and shared (or not) has practical, affective, and ethico-political implications. Only some tellings of times resound, while others stutter, fall silent, haunt. Whether and how telling of times of crisis, of intimate immersion, of cyclical coordination (among others) become experienced and find resonance matters a great deal.

As part of an endeavour to understand contemporary ecosocial challenges, analyses need to delve more deeply into questions of how and what we tell ourselves and others about time. In framing this paper through 'telling times', I have aimed to highlight three things: first, the variety of ways in which time becomes experienced, understood, and shared in more-than-human terms; second, the act of sharing through accounts in which we all – including myself as a researcher – attempt to tell of things, including times, that matter and that find resonance; and third, the significance of the times in which we live, and which we remake with others. Thinking time in a more-than-human mode reveals the value of a temporal approach involving varied spans, scales, and rhythms. It also indicates that collective understandings of forms and relevance of time emerge, with and without engagements with humans. Developing more-than-human accounts of how times become, how temporalities are experienced, and multiple tellings of time, I argue, is fundamental to understanding and responding to the telling times in which we live.

Acknowledgements

My deepest thanks to all the beekeepers and bees who shared their times and places with me for this research. My gratitude also to the special issue editors for the invitation to join the publication, and the participants in the 'Rethinking Time and Temporality' workshop for thoughtful, provocative discussions about time. Final thanks to Lesley Head, David Bissell, the anonymous reviewers, and the handling editor for offering constructive comments about the thinking and writing of this article.

References

- ABARES (Australian Bureau of Agricultural and Resource Economics and Sciences), 2016. Australian Honey Bee Industry: 2014–2015 Survey Results. Commonwealth of Australia, Canberra.
- Adam, B., 1998. Timescapes of Modernity: The Environment and Invisible Hazards. Routledge, London.
- Adam, B., 2000. The temporal gaze: the challenge for social theory in the context of GM food. *Br. J. Sociology* 51, 125–142.
- Adam, B., Geißler, K., Held, M., Kümmeler, K., Schneider, M., 1997. Time for the environment: The Tutzing time ecology project. *Time Soc.* 6 (1), 73–84.
- Adams, E., 2018. How to become a beekeeper; learning and skill in managing honeybees. *Cultural Geographies* 25 (1), 31–47.

- Aizen, M.A., Harder, L.D., 2009. The global stock of domesticated honey bees is growing slower than agricultural demand for pollination. *Curr. Biol.* 19 (11), 915–918.
- Anderson, B., 2010. Preemption, precaution, preparedness: Anticipatory action and future geographies. *Prog. Hum. Geogr.* 34 (6), 777–798.
- Bastian, M., 2012. Fatally confused: telling the time in the midst of ecological crises. *Environ. Philosophy* 9 (1), 23–48.
- Bawaka Country, including Burarrwanga, L., Ganambarr, R., Ganambarr-Stubbs, M., Ganambarr, B., Maymuru, D., Wrights, S., Suchet-Pearson, S., Sweeney, J., 2017. Co-becoming time/s. In: Thorpe, J., Lavau, S., Sandberg, L.A., (Eds.) *Methodological Challenges in Nature-Culture and Environmental History Research*. Routledge, New York, pp. 81–92.
- Bennett, J., 2010. *Vibrant Matter: A Political Ecology of Things*. Duke University Press.
- Brice, J., 2014. Attending to grape vines: perceptual practices, planty agencies and multiple temporalities in Australian viticulture. *Social & Cultural Geography* 15 (8), 942–965.
- Britchnell, M., Gibson, M., 2008. Flowering Ecology of Honey-Producing Flora in South East Australia. RIRDC report. ACT: Commonwealth of Australia, Barton.
- Chechetka, S., Yu, Y., Tange, M., Miyako, E., 2017. Materially engineered artificial pollinators. *Chem* 2 (2), 224–239.
- Chen, Y., Wang, H., Helbling, E., Jafferis, N., Zufferry, R., Ong, A., Ma, K., Gravish, N., Chirattananon, P., Kovac, M., Wood, R., 2017. A biological inspired, flapping-wing, hybrid aerial-aquatic microrobot. *Sci. Robotics* 2 (11). <https://doi.org/10.1126/scirobotics.aao5619>.
- Clark, N., 2013. Mobile life: biosecurity practices and insect globalization. *Sci. Culture* 22 (1), 16–37.
- Crang, M., 1994. Spacing times, telling times and narrating the past. *Time & Soc.* 3 (1), 29–45.
- Crutzen, P., Stoermer, E., 2000. The ‘Anthropocene’. *Global Change Newsletter* 41, 17–18.
- DEPI (Department of Environment and Primary Industries), 2013. Beekeeping on Public Land. www.dse.vic.gov.au/forests/forest-products-firewood/beekeeping-on-public-land.
- DPI (Department of Primary Industry – New South Wales), 2000. Bee Swarms and their Control. Agnote DAI/125. NSW Agriculture, Orange, NSW.
- Durant, J., 2019. Where have all the flowers gone? Honey bee declines and exclusions from floral resources. *J. Rural Stud.* 65, 161–171.
- Edensor, T., Holloway, J., 2008. Rhythmanalysing the coach tour: The Ring of Kerry, Ireland. *Trans. Inst. Br. Geographers* 33 (4), 483–501.
- EFSA (European Food Safety Authority), 2014. Towards an Integrated Environmental Risk Assessment of Multiple Stressors on Bees: Review of Research Projects in Europe, Knowledge Gaps and Recommendations. EFSA, J12, 3594.
- EPA (Environmental Protection Agency), 2007. Operational Policy: Managing Beekeeping on EPA Managed Lands. Queensland Government, Brisbane.
- FAO (Food and Agriculture Organisation), 2018. Why Bees Matter: The Importance of Bees and Other Pollinators for Food and Agriculture. FAO, Rome. www.fao.org/3/I9527EN/19527en.PDF.
- Fitz-Henry, E., 2017. Multiple temporalities and the nonhuman other. *Environ. Humanities* 9 (1), 1–17.
- Forister, M.L., Pelton, E.M., Black, S.H., 2019. Declines in insect abundance and diversity. *Conservation Sci. Pract* e80.
- Gan, E., 2017. Timing rice: an inquiry into more-than-human temporalities of the Anthropocene. *New Formations* 92 (92), 87–101.
- Godfray, H., et al., 2014. A restatement of the natural science evidence base concerning neonicotinoid insecticides and insect pollinators. *Proc. Royal Soc. B: Biol. Sci.* 281.
- Green, K., Ginn, F., 2014. The smell of selfless love: Sharing vulnerability with bees in alternative apiculture. *Environ. Humanities* 4 (1), 149–170.
- Grosz, E., 1999. *Becomings: Explorations in Time, Memory, and Futures*. Cornell University Press, New York.
- Hallman, C., Sorg, M., Jongejans, E., Siepel, H., Hofland, N., Schwan, H., Stenman, W., Muller, A., Sumser, H., Horren, T., Goulson, D., de Kroon, H., 2017. More than 75 percent decline over 27 years in total flying insect biomass in protected areas. *PlosOne*. <https://doi.org/10.1371/journal.pone.0185809>.
- Haraway, D., 2016. *Staying with the Trouble: Making Kin in the Chthulucene*. Duke University Press, Durham.
- Hitchings, R., Jones, V., 2004. Living with plants and the exploration of botanical encounter within human geographic research practice. *Ethics, Place Environ.* 7, 3–18.
- Hopkins, I., 1886. *Illustrated Australasian Bee Manual*. I Hopkins, Auckland.
- Huang, Z.Y., Robinson, G.E., 1996. Regulation of honey bee division of labor by colony age demography. *Behav. Ecol. Sociobiol.* 39 (3), 147–158.
- Hung, Keng-Lou James, Kingston, Jennifer M., Albrecht, Matthias, Holway, David A., Kohn, Joshua R., 2018. The worldwide importance of honey bees as pollinators in natural habitats. *Proc. R. Soc. B* 285 (1870), 20172140. <https://doi.org/10.1098/rspb.2017.2140>.
- Ingold, T., 2000. *The Perception of the Environment. Essays in Livelihood, Dwelling and Skill*. Routledge, London.
- IPBES (Inter-governmental Science-Policy Platform on Biodiversity and Ecosystem Services), 2016. The Assessment Report on Pollinators, Pollination and Food Production. IPBES, Bonn.
- Jaffé, R., Dietemann, V., Allsopp, M.H., Costa, C., Crewe, R.M., Dall'olio, R., De La Rúa, P., ElNiweiri, M.A., Fries, I., Kezic, N., Meusel, M.S., Paxton, R.J., Shaibi, T., Stolle, E., Moritz, R.F., 2010. Estimating the density of honeybee colonies across their natural range to fill the gap in pollinator decline censuses. *Conserv. Biol.* 24 (2), 583–593.
- Jones, O., Cloke, P., 2002. *Tree Cultures: The Place of Trees and Trees in their Place*. Berg, Oxford.
- Jones, O., 2011. Lunar-solar rhythmpatterns: towards the material cultures of tides. *Environ. Planning A* 43 (10), 2285–2303.
- Kleinman, D., Suryanarayanan, S., 2013. Dying bees and the social production of ignorance. *Sci. Technol. Human Values* 38 (4), 492–517.
- Kraus, B., Page, R.E., 1995. Effect of Varroa jacobsoni (Mesostigmata: Varroidae) on feral Apis mellifera (Hymenoptera: Apidae) in California. *Environ. Entomol.* 24, 1473–1480.
- Krause, F., 2013. Seasons as rhythms on the Kemi River in Finnish Lapland. *Ethnos* 78(1), 23–46.
- Kusenbach, M., 2018. In: Flick, U. (Ed.), *The SAGE Handbook of Qualitative Data Collection*. Sage, London, pp. 344–361.
- Leakey, R., Lewin, R., 1996. *The Sixth Extinction: Biodiversity and its Survival*. Weidenfeld & Nicholson, London.
- Lefebvre, H., 2004. *Rhythmanalysis: Space, Time and Everyday Life*, trans. Elden, S. & Moore, G. Continuum, New York.
- Lehbel-Péron, A., Sidaway, P., Dounias, E., Schatz, B., 2016. Attuning local and scientific knowledge in the context of global change. *J. Rural Stud.* 44, 132–142.
- Lezaun, J., 2011. Bees, beekeepers, and bureaucrats: parasitism and the politics of transgenic life. *Environ. Planning D* 29 (4), 738–756.
- Lorimer, H., 2009. Caught in the nick of time: archives and fieldwork. *The Handbook of Qualitative Methods in Human Geography* 248–273.
- Maderson, S., Wynne-Jones, S., 2016. Beekeepers' knowledges and participation in pollinator conservation policy. *J. Rural Stud.* 45, 88–98.
- Mathews, F., 2010. Planetary collapse disorder: the honeybee as portent of the limits of the ethical. *Environ. Ethics* 32, 353–367.
- Mecklin, J. (Ed.), 2018. *2018 Doomsday Clock Statement*, Bulletin of the Atomic Scientists. Science and Security Board, Chicago.
- Monbiot, G., 2017. Insectageddon: farming is more catastrophic than climate breakdown. *The Guardian*. 20 Oct. www.theguardian.com/commentisfree/2017/oct/20/insectageddon-farming-catastrophe-climate-breakdown-insect-populations.
- Moore, L., Kosut, M., 2013. *Buzz: Urban Beekeeping and the Power of the Bee*. NYU Press.
- Neimanis, A., Walker, R.L., 2014. Weathering: Climate change and the ‘thick time’ of transcorporeality. *Hypatia* 29 (3), 558–575.
- Neimanis, A., 2018. Queer times and chemical weapons, suspended in the Gotland Deep. *J. Contemp. Archaeology* 5, 66–78.
- Olwig, K.R., 2005. Liminality, seasonality and landscape. *Landscape Res.* 30 (2), 259–271.
- Phillips, C., 2014. Following beekeeping: more-than-human practice in agrifood. *J. Rural Stud.* 36, 149–159.
- Phillips, C., 2017. Ghostly encounters: Dealing with ghost gear in the Gulf of Carpentaria. *Geoforum* 78, 33–42.
- Phillips, C., Atchison, J., 2018. Seeing the trees for the (urban) forest. *Austr. Geogr.* <https://doi.org/10.1080/00049182.2018.1505285>. In press.
- Potts, S., Biesmeijer, J., Schweiger, O., Kunin, W., 2010. Global pollinator declines: trends, impacts and drivers. *Trends Ecol. Evol.* 25 (6), 345–353.
- Power, E., 2009. Domestic temporalities: nature times in the house-as-home. *Geoforum* 40 (6), 1024–1032.
- Preston, C., 2006. *Bee. Reaktion*, London.
- Puig de la Bellacasa, M., 2015. Making time for soil: Technoscientific futurity and the pace of care. *Soc. Stud. Sci.* 45 (5), 691–716.
- Seeley, T.D., 2009. *The Wisdom of the Hive: the Social Physiology of Honey Bee Colonies*. Harvard University Press.
- Sommerville, D., 2010. *Forestry Plantations and Honeybees*. Pub10/076. Commonwealth of Australia, Canberra.
- Thomas, C.D., Jones, T.H., Hartley, S.E., 2019. “Insectageddon”: A call for more robust data and rigorous analyses. *Glob. Change Biol.* 25, 1891–1892.
- Tsing, A., 2015. *The Mushroom at the End of the World*. Princeton University Press, Princeton.
- UNEP (United Nations Environment Program), 2010. *Emerging Issues: Global Honey Bee Colony Disorder and Other Threats to Insect Pollinators*. UNEP, Nairobi.
- VanDooren, T., 2014. *Flight Ways: Life and Loss at the Edge of Extinction*. Columbia University Press, New York.
- vanEngelsdorp, D., Meixner, M., 2010. A historical review of managed honey bee populations in Europe and the United States and the factors that may affect them. *J. Invertebr. Pathol.* 103, 580–595.
- Watson, K., Stallins, J.A., 2016. Honey bees and colony collapse disorder: A pluralistic reframing. *Geography Compass* 10 (5), 222–236.
- Whitehouse, A., 2017. Loudly sing cuckoo: More-than-human seasonalities in Britain. *The Sociological Rev.* 65 (1suppl), 171–187.