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Monitoring ecological change in UK woodlands and rivers: an exploration of the relational geographies of citizen science

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Abstract

The adoption of citizen science methodologies by environmental organisations and ecologists entrusts the task of collecting ecological data to non-experts operating at a local scale. This presents individuals and communities with opportunities to monitor ecological change and contribute to local environmental management. Little is known about why volunteers choose to participate in burgeoning contemporary citizen science research initiatives, the aim of this paper is thus to explore volunteer motivation for involvement in two environmental citizen science initiatives, based in the United Kingdom. It contributes towards understandings of the socio-geographical influences that act upon participation in environmental citizen science. It is proposed within this paper that affective connections with local geographies provide a conceptual framework for understanding citizen science motivations. The paper discusses the main themes emerging from site-based, in-depth interviews with twenty-two citizen science participants in various UK locations. The study revealed that early affective bonds formed with ecological spaces endured throughout life courses, while citizen science participation offered a means by which to remain connected to local environments. The paper reflects on the endurance of affective environmental bonds and their manifestation within the expressed motivations for citizen science participation, which emerged as fulfilling a compulsion to observe ecological surroundings; a desire to participate in environmental research and a commitment to protecting local environments. The paper proposes that citizen science participation offers a framework to connect to and protect local and global affinity spaces, while assisting in monitoring global environmental change.

Introduction

Environmental organisations and scientists from numerous disciplines have worked with volunteer ecological data collectors for over a century (Cohn 2008), while citizen sciences' roots can be traced back 'to the very beginnings of science itself' (Silvertown 2009, 467). Within the present day, assisted by global communication technologies, citizen science has 'dramatically expanded' becoming a 'fundamental part of scientific practice' (Lewenstein 2016, 1). Citizen science data now results in 'legitimate, publishable research' (Gura 2013, 259) and some insist it is influential enough to constitute a distinct discipline (Jordan et al 2015) advocating for the field's institutionalisation, through Citizen Science Centres, which would enable wider scientific, social and environmental impacts of citizen science (Bonney et al 2014).

Citizen science methodologies are used in many scientific fields, including health and computer science. This paper focuses specifically on ecological studies, which constitute most citizen science endeavours (Kobori et al 2016). Ecological observation has been a leisure activity since at least the 18th-century (Tuan 1976). In the UK, recording ecology became an important volunteering activity during the mid 20th-century, advanced through natural history societies and volunteer-run *Biological Recording Centres* (Pocock et al 2015). Such monitoring projects are often regarded precursory to modern citizen science (Miller-Rushing et al 2012), while the present-day phenomenon arises within a 'perfect storm' (Catlin-Groves 2012, 1) involving global communication technology (Dickinson et al 2013), data uploading platforms, social networks and international research councils' current emphasis upon research impact. A 'realisation among professional scientists that the public represent a free source of labour, skills, computational power and even finance' (Silvertown 2009, 467) arguably also contributes to the field's growth. Despite citizen sciences'

popularity and vibrant discussions concerning data usage (see Cohn 2008; Kummer et al 2016; Lukyanenko et al 2016; Roy et al 2016; Salk et al 2017), project volunteer motivations are little understood (Mahr et al forthcoming), providing a rationale for this study.

Contemporary debates surround nomenclature used to describe the phenomenon, with some viewing citizen science as a problematic term, not least given its associations with the loaded term ‘citizenship’ (Ceccaroni et al 2017). Over the past decade, suggestions for alternative terms have included, public participation in scientific research (Haywood and Besley 2014; Shirk et al 2012); participatory science; community science or crowd sourced science (Lewenstein 2016). Within conservation biology and ecology, activities now classified as citizen science were traditionally referred to as ‘voluntary biological monitoring’ (Lawrence 2006), while citizen scientists were considered ‘volunteer naturalists’ (Ellis and Waterton 2004). Recently, Eitzel et al (2017) has argued that terminology adopted to describe activities should be project context specific. In considering this, ‘citizen science’ is used here, given its general acceptance amongst those involved in this study and increasingly common usage.

Much existing research concerning the effects of citizen science participation upon volunteers is aimed at providing guidance for those leading citizen science projects (Dickinson et al 2013). The nature of volunteer involvement in citizen science has thus far been represented in participation typologies (Haklay 2013; Wiggins and Crowston 2011), with emphasis placed upon co-productive participation models (Cornwell and Campbell 2012). A recent UK-based online-survey of 147 citizen science participants (Geoghegan et al 2016) revealed that most participants were motivated by the altruistic drivers of ‘helping wildlife’ and ‘contributing to science’, while responses to the survey’s open-ended question indicated emotional attachment also acted as an intrinsic motivator. Yet, no evidence is provided concerning what

respondents were emotionally attached to. Furthermore, pre-defined categories used to identify motivations fail to capture the possible complexity and multiplicity of motivations, while the study's brevity neglects exploration of the values and meanings underpinning motives. In contrast, Busch's (2013) autobiographical anthology documents her lived experiences of monitoring bats, eels, eagles, coyotes and tree disease, enabling appreciation of embodied, contextual meanings and subjectivities brought to ecological monitoring. Yet, in contrast to Geoghegan et al (2016), the anthologies focus is not explicitly participant motivation, resulting in ambiguity. There is a need for further explorations of environmental citizen science motivations (Mahr et al forthcoming), particularly in terms of explorations of the affective dimensions of citizen science experiences (Larson et al 2016).

Emotional spatiality and citizen science

Currently, very little consideration is given to the issue of emotional spatiality in relation to citizen science. The affective turn within geography (Anderson and Smith 2001; Anderson and Harrison 2010; Bondi 2005; Bondi et al 2005; McCormack 2003) offers a means to explore citizen science motivations. Ecological monitoring, a process that involves an intense focusing upon ecological objects and issues, brings our attention to the 'affective forces of lifeworlds' (McCormack 2017, 2), brought into focus through the tactile, sensual, embodied nature of citizen science experiences. The precedence, in terms of acknowledging individual values and actions and the emotional meanings of human interactions with the environment, lies in the work of humanistic geographers of the 1970s (Bondi 2005; Cox 2013) who, taking inspiration from phenomenology and existentialism, explored 'the essences of human experience of place and space' (Simonsen 2012, 15). Notably, Tuan's phenomenological explorations concerned how "affective ties" were formed through coupling 'sentiment with place', whereby one's surroundings provide 'sensory stimuli' that shape our 'joys and ideals'

(1976, 113). Responses to ‘potentially infinite’ stimuli are shaped by biological, social and cultural factors, operating within a spatial-temporal context. These ties are ‘manifestations of the human love of place’, a phenomenon that Tuan called ‘topophilia’ a concept concerned with

fleeting visual pleasure; the sensual delight of physical contact; the fondness for place because it is familiar, because it is home and incarnates the past, because it evokes pride of ownership or of creation; joy in things because of animal health and vitality (1976, 247).

Tuan recognised how ecological observation became a fashionable leisure pursuit amongst wealthy Europeans in the late 18th and early 19th-century and argued that, when combined with ‘scientific curiosity’, topophilia is ‘richly informed by the reality of environment’ (1976, 124).

Yet despite these early insights, humanistic geography has been critiqued during the past 20 years for its perceived anthropomorphism and normativity. Instead, anti/ post-humanistic perspectives, characterised by a focus upon assemblages, materiality and the non-human/ more-than-human, have taken a stronghold (Simonsen 2012). Non-representational theories (Anderson and Harrison 2010) and relational understandings (Harvey 1996; Ingold 2011; Latour 2011; Massey 2005; Schatzki 2010) drew attention to “relational bodies” and the fact that: ‘the root of action is to be conceived less in terms of willpower or cognitive deliberation’, as humanistic geographers had proposed, ‘and more via embodied and environmental affordances, dispositions and habits’ (Anderson and Harrison 2010, 7).

Concurrently, the emergence of studies of emotional spatiality (Anderson and Harrison 2010; Bondi 2005; Cox 2013; Simonsen 2012) acknowledged emotions as situated not only within

bodies, as humanistic geographers had emphasised (Bondi 2005), but as flows between people and places (Bondi et al 2005), leading to experiential research approaches and relational understandings of people and places (Bondi et al 2005, 2) enabling the comprehension of dynamic affective spaces ‘in which we are emotionally in touch - open to the world and its “affect”’ (Simonsen 2012, 17-18). As such, academics began to draw attention to the affective forces at play within and between encounters of the self and environment (Wylie 2009), focusing upon, for example, the therapeutic affect of certain landscapes, such as shorelines and forests (Conradson 2005). The notion of affect (Thrift 2004), considered as ‘a prepersonal intensity corresponding to the passage from one experiential state of the body to another and implying an augmentation or diminution in the body's capacity to act’ (Deleuze and Guattari 1987, xvii) places a focus upon intersubjective and embodied encounters, between humans, non-humans and to occurrences as events shaping the self and places, both of which are in a state of constant flux and becoming (Schatzki 2010).

Recently, however, Simonsen has called for re-acknowledgement of the everyday life worlds of humans and associated human intentionality and agency that humanistic geographers brought into focus, in the face of what she calls the ‘excesses of posthumanism’ (2012, 10). Simonsen proposes a ‘new humanism’, which gives credence to the meanings of the lived experiences of humans to those living them. Human agency is re-characterised ‘not as an essential characteristic of the rational subject, but as contingent capacities for reflexivity, creative disclosure and transformation.’ (2012, 15). According to Simonsen, a new humanistic perspective takes ‘seriously bodily experiences and emotions’ (2012, 15), incorporating ‘experiential dimensions of everyday life’ (2012, 10), while avoiding ‘rationalist and self-righteous claims of the old’ humanism (2012, 10). The new humanist

perspective provides ‘a grounding for meaning in lived experience’ (2012, 15) within unique space-times. Simonsen argues that it is ‘moving bodies’, which inhabit space that are both shaped by and help space take shape, inhabiting space is about both ‘finding our way’ and how we come to ‘feel at home’ (2012, 16).

Here Simonsen (2012) echoes Ingold’s (1993) dwelling perspective and notion of wayfaring (2010, 2011). Ingold theorises that humans are wayfarers who, upon paths, make their knowledge, in the sense of ‘making their way in the world’ (Ingold 2010, 122), coming to know as they go along, becoming wiser as they traverse their paths, while unconcerned by the notion of a final destination. Through dwelling within landscapes as wayfarers, Ingold argues, ‘the landscape becomes a part of us, just as we are part of it’ (2011, 154). These insights offer a useful framing for understandings of the motivations of citizen science, which emerge from this study as grounded within affective connections to ecologies of place.

A situated exploration of citizen science motivations

Inspired by a new humanistic perspective, which proposes that meanings are constituted through practice (Simonsen 2007) this study adopted a situated approach, which would provide insights into the reasons and interests underpinning citizen science motivations in site-specific contexts. In doing so, the study took ‘seriously everyday embodied experiences, emotions and human agency’ (Simonsen 2012, 12). It focused upon two environmental citizen science initiatives. The first was a nationwide phenology project, known as *Track-a-Tree* (<http://trackatree.bio.ed.ac.uk/>), run by the *University of Edinburgh* and supported by *The Woodland Trust*. The second case was a regional project (*London Rivers*), coordinated by *the Zoological Society of London (ZSL)* (<https://www.zsl.org/conservation/regions/uk-europe/londons-rivers>). The research methodology involved in-depth interviews with 12

individuals participating in *Track-a-Tree* and ten from *London Rivers*. Where possible, each interview involved a visit to each monitoring site, contextualising insights into citizen science motivations.

Ethnographic methods were adopted to actively engage participants from citizen science projects involved in the study in a reflexive process (Hertz 1997). Photo-elicitation has the potential to evoke feelings and memories (Harper 2002) and was used to gain insights into the temporal dimensions of experiences. Participants were asked to bring any photographs or materials that were significant to their citizen science activities to interviews and to provide their reflections upon these. To gain in-depth insights into participant's motivations, while not predetermining what made experiences meaningful, each interview addressed several key themes. These included: participant's backgrounds and interests; attending to the experience itself; the personal effects of participation; effects on those around them; implications for the local environment and the wider scientific field. Interviews lasted between 30 and 80 minutes, averaging one-hour in length. Typically, one to two hours was spent visiting each monitoring site.

Interviews were analysed using a narrative analysis technique, which involved uncovering significant themes emerging from interview transcripts through attentiveness to the poetic structures of participant's language. The approach, introduced by Riessman (1990 1993), synthesises principles from social science research with those from linguistics (Gee 1991). The approach gives credence to respondent's subjectivity and voice (Hertz 1997) by paying close attention to how things are said, as well as to what is said. The technique enables deconstruction and interpretation of 'ambiguous representations' of everyday life within 'talk, text, interaction, and interpretation' (Riessman 1993, 8). A ten-stage process, based

upon Riessman's (1993) approach was developed (Dunkley, 2018), to attend to each of the 22 interview transcripts. This process involved transcribing each interview verbatim from audio file; locating words emphasised by participants through, for example, changes in tone or pitch and noting grammatical choices. This made it possible to decipher where line-breaks occurred within the speech. During a repeated listening to audio files, the transcripts were further divided into four-line stanzas. Following this, the transcripts main strophes and parts were located. The next stage involved looking for the 'psychological subject' within the speech, together with literary device, adverb and metaphor use. Each stanza, part and strophe was given a title in the transcript. These titles were then copied to a one-page document providing a thematic overview that enabled analysis of commonalities and differences amongst participant's motivations and synthesis of consistencies in expressed motivations within the transcripts.

Environmental citizen science projects

The first project understudy (*Track-a-Tree*) was established by biological scientists at the *University of Edinburgh* in 2014. Developed as a response to a gap within scientific literature, the project records relative geographical variations in woodland tree phenology across the UK and in relation to climatic shifts. The project organisers utilise this national dataset to make predictions concerning how different woodland communities might respond to future climatic changes. This scientist-led project requires participants to visit ancient woodlands in spring to monitor budburst and first-leaf in selected oak, birch and beech trees, as well as their understory flowers. Participants input results into an online portal (<http://trackatree.bio.ed.ac.uk/>) (figure one). The second project, *London Rivers*, was also established in 2014. It implements the *Anglers' Riverfly Monitoring Initiative (RMI)* methodology (<http://www.riverflies.org/rp-riverfly-monitoring-initiative>), which monitors

freshwater invertebrates through kick-sampling. The RMI score determines the river health and enables pollution event detection. The project occurs on the Crane (*Citizen Crane*) and Hogsmill rivers (*Hogsmill monitoring project*), both river Thames tributaries in West London. *Citizen Crane* operates 11 monitoring sites along the river (figure two), while five sites are monitored on the Hogsmill (figure three). Though *London Rivers* is managed by ZSL, it is a collective endeavour involving local interest groups, including ‘Friends’ organisations, such as the *Friends of the River Crane Environment*, as well as resident’s associations and conservation trusts. *Citizen Crane* was funded by *Thames Water* in response to a major pollution incident at Heathrow Airport in 2011.

Insert here: Figure 1. Budburst for Sessile Oak (Source: Track-a-Tree website).

Insert here: Figure 2. River Crane Monitoring sites (Source: Citizen Crane report 2015).

Insert here: Figure 3. Hogsmill Monitoring sites (Source: Hogsmill forum RMI Update 2015).

The twenty-two study participants responded to a request, received via an email from project organisers, a social media post or for the *Hogsmill project*, an annual volunteer forum. Over half the research participants were over 60 years-old (13 participants) and the study involved eight females and 14 males. Over half of participants (12) were retired, while the remaining 10 were in fulltime employment. Most participants (14) lived in urban areas, while four resided in suburbs and four were rural dwellers. The results and discussion section presents individual narratives that explore the role of affective connections to ecologies, initially experienced in childhood, within present-day motivations for citizen science. Following

analysis of all participants' early childhood ecological experiences, the paper focuses upon 10 individuals: market researcher Charles and retired market researcher Rosie, former engineer Victoria, academics Thomas and Joshua and retired academic Cerys, environmental activist Scarlett, student volunteer coordinator Owen, landscape coordinator Molly and accountant, Joseph. The 10 individual narratives are chosen to exemplify the main motivational factors that emerged from the 22 interviews. Most participants were recruited to both projects directly through existing affiliations to organisers or a local Friends group. A smaller number of participants chanced upon the projects on the internet or through word of mouth. Study findings should therefore be interpreted in the context of the recruitment approach, which could mean that participants profiles are reflective of the recruitment approach taken. Participants names have been changed within this paper using a random name generator.

Results and Discussion

This section provides a situated understanding of the three most prominent citizen science motivations to emerge from this study (*fulfilling a compulsion to observe ecological surroundings; a desire to participate in environmental research and a commitment to protecting local environments*) within the context of early childhood encounters with ecology. These three themes emerged from the 10-stage poetic structure narrative analysis process, which cumulated in emergent theme summaries for each of the 22 interview transcripts. Themes were not pre-determined, but emerged from the transcripts through an interpretive process (Riessman 1993). A count of the most prominent themes within each summary was then carried out, as a means of identifying the three main motivations discussed here, as summarised in Figure Four. The 10 narratives illustrate how embodied childhood encounters led to lifelong affective affinities to ecological settings through play, exploration and observation. They also revealed that early affective ties to local environments

have repercussions for choices concerning the environments that participants attended to in later life and influenced motivations for citizen science. This relationship is illustrated in figure four, which shows both total references to childhood edgeland encounters amongst all 22 participants, as well as the number of participants who identified with the three main motivations.

Insert here: Figure 4. Edgelands encountered during childhood and citizen science motivations in working life and retirement (*Counts based upon references within all 22 narratives and are not mutually exclusive).

Childhood informal encounters with edgelands

Tuan (1976) argues that childhood practices are steered by cultural values that affect the child's capacity to sense. Early experiences of ecology thus inform affective affinities to ecological settings, providing the grounding for sentimental attachment to place, informing capacities to sense one's surroundings in later life. 21 of 22 participants highlighted that they had initially established affective connections with their environments through sensory engagement with edgelands, including nearby parks, gardens and countryside during childhood. These edgelands (Farley and Roberts 2012) can be conceptualised as the spatially marginal, yet socially significant places that enable people living in towns and cities to encounter ecological features. In figure four, participant's childhood 'edgeland' encounters are categorised into four distinct areas:

- a) *'the nearby wild'*, activities included growing plants in gardens and allotments and vicarious outdoor experiences, for instance, reading or watching environmental television programmes;

- b) *'Further afield'*, involving free-walking into surrounding countryside, through fields, moors, paths and woodlands;
- c) *'Organised activities'*, involving interacting with plants and animals through, for example, arranged pursuits in urban parks or commons and;
- d) *'Blue spaces'*, interactions included, rock-pooling on beaches or river-dipping.

In stressing the significance of edgeland encounter spots, participants reveal themselves as wayfaring beings (Ingold 2011). The key age for child-edgeland memorable encounters appeared to be seven or eight years-old, a time when, arguably a child possesses an 'openness to the world', vivid in colour and experienced as 'an enveloping penetrating presence, a force' (Tuan 1976, 56). These edgelands may be interpreted as knots (Ingold 2011) that participants journeyed beyond yet remained bound to through memories. Memories work with 'the material traces they encounter' (Jones 2015, 11) and perform 'the foundational function of becoming' (Jones 2015, 12). Our present-day emotions are thus 'never free of the past but are instead always re-encountered' (Bondi 2005, 12). In recalling early embodied, often solitary, investigations of spaces on neighbourhood margins as underpinning their desire to become involved in citizen science, study participants appear to be involved in a process of recalling their childhood geographies, walking 'in memory's shadow' into 'spaces for reverie' (Lorimer 2014, 598).

Fulfilling a compulsion to observe ecological surroundings

Individuals may seek out 'emotional gains' of proximity 'to other ecologies and rhythms of life' enabling them to 'gain distance from everyday routines whilst perhaps also experiencing renewed energy and finding different perspectives upon our circumstances' (Conradson 2005, 103). People have been found to use the ecology of places, such as parks or favourite places, 'self-consciously in an effort to work upon their emotions' (Conradson 2005, 108). Some

study participants were motivated to conduct ecological monitoring because of a desire to connect affectively to a such an ecology of place. For example, retired market researcher Rosie, describes herself as having an ‘obsession with nature’. She participates in five ecological citizen science projects, including *Track-a-Tree* and for the past 20-years, has recorded weather conditions and ‘interesting’ environmental observations ‘from the window’ at home in a personal ‘nature diary’. *On discovering "Nature's Calendar", a citizen science project run by the Woodland Trust, which involves observing seasonal change, she stated it “seemed only sensible” to “write in their diary as well”*. Rosie is unsure of the direct origins of her interest in citizen science, yet she has: ‘always been like it, even as a child’. She describes how ‘from eight to 15, I lived in the centre, and I mean the centre of Birmingham, with no garden’. During this time, Rosie established ‘the Bird Watching League, with a friend’ and she would travel by bus to ‘a riding school about 12 miles outside Birmingham’ where she would muck-out horses in exchange for riding lessons. She regards these early experiences to be ‘all bound up with the same kind of inner fire’ as her contemporary citizen science activities.

As Bondi et al state ‘emotional geographies of our lives are dynamic, transformed by our procession through childhood, adolescence, middle and old age’ (2005, 1). As Rosie moves from reflecting upon childhood to present day, observing ecology emerges as central to her wellbeing. Rosie, who has osteoporosis states ‘your needs through life change’. In childhood, ecological observation was a coping strategy for urban pressures while, in later life, when there are ‘all sorts of outside influences over, which you have no control’, Rosie describes ecological observation as a deeply satisfying activity that offers ‘a way of dealing with the things in life that are perhaps more difficult’. She describes citizen science metaphorically as her ‘safety valve’ that gives her a ‘deep pleasure and takes your mind totally off any

difficulties that you might be having in your life'. Citizen science offers Rosie, a means of connecting to her environment despite declining mobility. Tuan argues that as people age, 'the future shrinks, so does the spatial horizon and the old can become emotionally involved with immediate events and objects in a way that is reminiscent of a child' (1976, 57-58) and as Rosie faces geographical restrictions due to old age, her situation appears to mimic her childhood experiences. Within this context, ecological observation appears to enable continued enjoyment of her environment in the absence of somatic engagement. To this end, she states:

as your physical capabilities get less, you tend to home in on the things you can still do. And observing and logging things, is something you can do, even if perhaps you can't ride [horses] any more. Or you can't do the physical things. You can still do things you enjoy, but in a more passive sense.

Like Rosie, Victoria a retired engineer living in Derbyshire, identifies with the obsessive phenologist image. She recalled being told that "'To be a phenologist, you have to be a little bit obsessive-compulsive and like to see things over a period of time and feel you're making a difference to history if you like, by keeping these records"''. Victoria also feels participation benefits her mental wellbeing. She states 'looking out for spring plants' through Track-a-Tree is 'a sort of mental healer', because it presents a means 'to get outdoors'. Recounting her involvement in citizen science, while caring for her father, who was suffering with Alzheimer's Disease, she states:

it was a good excuse to say, "oh well if I've got to do it every week, whatever the weather, that will be my time for getting out". So yes, it did help, to sort of set aside that bit of time for yourself, in your own interests. It's always good.

As for Rosie, in later life, getting out into the woodlands through citizen science appears to facilitate emotional expression for Victoria (Milligan et al 2005). Citizen science offers both Victoria and Rosie, a means of connecting to ecology despite declining mobility. In doing so, both women avoid becoming prisoners of space (Rowles 1978) finding means of continued access to those spaces found to be restorative from an early age.

Thomas, a radiography lecturer, who lives in rural Kent and is about to retire also echoed this notion. Like Rosie and Victoria, he feels ecological observation is an ‘innate’ characteristic, it is how his *‘persona’* is ‘orientated’. He has been interested in ecological observation since childhood and has a home weather station and telescope from which he observes the sky in ‘minus temperatures’, a relic of his ‘first hobby’ astronomy at aged five, which he attributed to his father, a WWII navigator. Thomas describes ecological observation as ‘a hobby I’ve always had, even as a kid. I like watching birds and looking at things and going over to farms and looking at animals and stuff’. Like Rosie, Thomas grew up in a city and his interest in ecology stems from interactions with city edgelands, specifically a 50-acre park that he visited regularly. He recounts: ‘you’d go literally a quarter of a mile and you’re up into open fields. So...yeah, that was a catalyst [for ecological monitoring] back in the sixties’. Thomas states, hobbies ‘come and go depending on your obligations in life’ and being an ‘empty nester’, near retirement provides him with space to indulge his childhood interests again. *Track-a-Tree* yields opportunity to learn about identifying trees for the first time since his school years. He also feels it beneficial to his mental wellbeing, describing citizen science as a *‘de-stressor’* that allows ‘unwinding...if you’re uptight about things’, enabling ‘pleasure, freedom, open air, fresh air, not being told off by anybody, you know, getting away from work’. For these individuals, participating in citizen science, as other activities that involve spending time in ‘scenic natural surroundings’ and ‘ecology of place that differed from that

of their home environments' (Conradson 2005, 103) is an escape from the pressures of modern life.

Desire to participate in environmental research

Tuan suggested science and associated taxonomies are 'cocoons that humans have woven in order to feel at home in nature' (1976, 13), while Irwin (1995) argued that citizen science constitutes the democratisation of science, introducing increased uncertainty by drawing upon local, situated knowledge and multiple voices, providing reflexivity within science-informed policy decision-making. Citizen Science researchers have noted that a desire to contribute to scientific research can motivate participants (Geoghegan et al 2016). Participants who had had a career or were currently involve in research often expressed a desire to participate in environmental research. For example, retired university lecturer and keen horse-rider, from rural South Wales Cerys, described her decision to participate in *Track-a-Tree* as driven by '*being supportive*' of 'a well constructed PhD project' concerning trees. Cerys explained that she has been fond of trees since childhood. She was home schooled until the age of nine and, as part of this, most afternoons involved 'nature walks' in the bluebell woods behind her home, during which her mother would point-out different kinds of trees. In discussing her interest in woodlands, Cerys describes these experiences as giving her a 'childhood pattern' upon which her current interests are based. Due to her horse-riding hobby, Cerys visits the tree she tracked daily. Since retirement, Cerys had relinquished many of her voluntary roles, yet she continued to participate in citizen science as she perceived it to be a valuable and non-time consuming activity, given her combined riding activities. She was also concerned about the disconnect between science and society, particularly amongst younger generations. Cerys had tried to encourage her friends with grandchildren to become involved in *Track-a-Tree*, as

she believed citizen science enables young people to ‘play’ with science and is a means by which they ‘learn to love science’.

Conversely, Joshua’s desire to participate in environmental research through *Citizen Crane* was driven more by self-interest and his interest in environmental issues, which he feels can be traced ‘as far back as playing Pooh-sticks with my Dad at the village river’. Joshua states he has ‘always had that inherent interest in the environment’ leading to a degree and research career. In the present day, as a university lecturer, whose research concerns water ecology, his participation was bound to his ‘professional identity’. Joshua, who is in his thirties, became involved in *Citizen Crane* to provide student volunteers with work placement activities. The *London Rivers* project, of which *Citizen Crane* is part, invites participants to use collected data. Joshua monitors a site near his university campus to ensure the long-term dataset, which he desires access to for research purposes, is robust. He rationalises his interest by stating ‘I love data and recognise it’s such a valuable thing to have. So, I’m happy’. His interest is ‘cynically...almost entirely purely academic’. *Citizen Crane* provides Joshua access to:

a network of people, with a passion for collecting data, on a scale that I could never achieve, and I could be a part of it without any sort of funding requirements on me.

Charles, a market researcher and self-professed ‘data geek’ in his fifties, also participates in *Track-a-Tree* because of a ‘love’ of data, which forms a ‘synergistic’ relationship with his ‘love of nature’, initially experienced in childhood in a village on the edge of Nottingham, within a ‘country-focused’ family. Citizen science provides Charles with the opportunity to

‘actually see more things and understand more aspects of nature’. He values the ‘focus’ and ‘purpose’ that citizen science gives his woodland walks and visits to ‘the countryside’.

In contrast to Cerys, Joshua and Charles, Scarlett was specifically interested in participating in environmental research through *Track-a-Tree* because she ‘loves trees’ and has ‘been campaigning quite a bit on climate [change]’, an issue that she feels ‘very concerned about’. Scarlett is in her seventies and lived in Whitechapel, London for most of her adult life. Originally from the Chiltern Hills, she moved to the edge of the Clough Valley, on the outskirts of Hebden Bridge (Yorkshire) five-years ago to ‘get out into the country, because’, she states, ‘I grew up in the country and the natural world is a major interest of mine’. Scarlett tracks ten trees, a process that involves ‘scrambling’, ‘slivering’ and ‘skidding’ along the Clough Valley steep. As Blicharska and Mikusiński state, ‘for local people’ as well as being aesthetically valuable, individuals perceive trees ‘emotionally’ (2014, 1561). Such perceptions connect with ‘personal sentiments’ and a ‘sense of place’ for Scarlett who possesses an affinity with trees having made them her home during protests in Newbury and Lancashire. She regularly climbs the trees around her home, as a means of knowing them and expresses concern for their health. For instance, when an ash tree she is monitoring started ‘falling to bits’, her worries led to even closer observation to ensure its health.

As Irwin states, ‘the environment...sits in both public and private space; it challenges us in terms of public policy but also raises personal questions of a profound and ethical kind’ (1995, 179). Like Charles, Scarlett appears to use *Track-a-Tree* to participate in environmental research but also for her own purposes. For Scarlett, contributing to phenology research appears to be a means of familiarising herself and becoming ‘at home’ within her locale. Observing the trees in the valley surrounding her home enables her to ‘get to know the

area a bit better’, to ‘get a bit grounded’ in her new home, to which she had no prior connection. Scarlett appears to seek ‘a greater sensitivity to cues in the environment and a greater capacity to respond to these cues with judgement and precision’ (Ingold 2011, 161). She realises she will come to ‘know and enact a [her] world from inhabiting it’ (Anderson and Harrison 2010, 9). Scarlet appreciates that scientific data collection, through training the ‘senses, dispositions and expectations’, enables individuals to ‘initiate, imitate and elaborate skilled lines of action’ (Anderson and Harrison 2010, 9), which can facilitate processes of becoming ‘attuned to’ novel surroundings. Citizen science thus offers a means by which to ‘dwell in’ place (Ingold 1993) in a wayfaring sense (Ingold 2011) for Scarlet, as she orientates herself within the forest around her home in order to feel at home (Simonsen 2012).

Commitment to protecting local environments

Several authors have discussed citizen science as enabler of community empowerment in response to environmental threats (Cooper 2016), particularly in instances where causes are external and relate to environmental justice (Vitos et al 2013). As well as enabling participants to form environmental connections, many participants believed they were protecting ‘*their*’ local place and enabled responses to immediate ecological threats through citizen science. For example, *Track-a-Tree* enabled participants to report suspected tree disease to the *Forestry Commission*. Similarly, participants in the *London Rivers* project regularly reported pollution incidents to the *Environment Agency* and *Thames Water*.

Participating in *Citizen Crane* appeals to Joseph, who describes ‘animals and the natural world’, as ‘a lifelong interest’, due to a fascination with the action below the water’s surface and a desire to protect his local environment. Like several participating in the *London Rivers*

project, Joseph grew up near his monitoring site and is involved in local voluntary groups, including as volunteer manager for the *London Wildlife Trust* nature reserve neighbouring the river. He has lived in Hayes, West London, since he was three-years-old and the river and nearby grassland were his childhood playground. The ‘emotions of childhood’ become ‘imprinted onto whatever landscape they are acted out in’ (Jones 2005, 215) and Joseph accredits play within this local environment during his youth as central to the fact that, now in his fifties, he seeks to protect the space.

Joseph’s curiosity about the river ecosystem draws upon his longstanding connection to it. The opportunity that *Citizen Crane* provides to perceive and connect with the usually hidden aspects of the environment is part of participations appeal. He states ‘having been roaming over those fields since I was old enough to be let out on my own, and that was five or six...in those days... I just wanted to know more about what the actual food chain was affected by’. Scientific observations obtained through wading into the river to conduct regular kick-sampling provides Joseph with another way of sensing his local environment, enabling him to know the complexity of the river’s ecosystem. The practice of immersing himself in the river through citizen science appears to be an activity given meaning through connecting this practice to an emerging perception of the otherness of invertebrates (Simonsen 2007), enabling him to know his place anew.

In addition to knowing the river at a deeper level, Joseph believes citizen science provides data to ensure community-participation in river management. He contributes to several local ecological monitoring surveys established when ‘the developers wanted to do a development on the open spaces’ neighbouring the river. Joseph had seen what he perceived to be negative effects of imposed river management as a seven-year-old, when a decision had been taken to

dredge the river. He explains the significance of monitoring to local environmental protection:

the monitoring gives you the information to say ‘no you can’t develop there because there are rare bat species, there are rare plant species...There are things that need protecting over here’. If you don’t have that information, somebody’ll just go, ‘well you don’t want it built near you then, do you? That’s ‘not in my backyard’. Whereas if you can actually put information out there and say ‘well, so and so and so lives here, and needs protection...or need protecting under the Wildlife Act’, you’re much better informed and you’ve got a much better argument. You need the back up evidence, to back up your arguments.

Similarly, for Owen and Molly, citizen science constituted a form of environmental action, yet for these individuals it was by mechanism of involving their families, communities or students. For example, participating in *Track-a-Tree* offers Owen, a University volunteering officer, an opportunity to engage student groups in tracking ten trees locally. He contextualises this activity within broader conservation and management efforts for a regularly visited woodland. For Owen, citizen science provides a system of ‘small, achievable tasks’ in which to involve student volunteers, while contributing to ‘wider [scientific] projects’. *Track-a-Tree* is valuable as a process, emphasised by the fact that unlike Charles, Owen possesses little desire to be involved in data analysis.

Molly, a University Biodiversity and Landscape officer, also uses citizen science to engage students, staff and local communities in volunteering for the *Hogsmill monitoring project*. Molly was raised in central London. She explains that, although she had few opportunities to

interact with the outdoors, she grew up reading books about outdoor adventures. She states, 'as a child, you grab onto those kind of worlds, and the experience that they're having, experience it, vicariously'. She pursued a career in ecology, to do 'something' she 'loves'. Molly's participation in citizen science is driven by a desire to enable others to engage with environmental action. She recognises the value of citizen science in terms of providing 'opportunities for students to really experience biodiversity...especially for those who want to get into conservation as a job'. She also became involved in citizen science and shared the experience with others because she felt that participation could lead to wider behaviour changes. She states:

it also shows them, there's a much bigger world out there, where we can have an impact – even if it's a small impact, like volunteering... And the way we actually treat our waterways are quite deplorable, in some instances. And it's just when we're out, we have an ability to change that. And I think we need to get into people's heads, at a point where, they're not just able to be influenced, but they're going to a point in their lives where they can influence others. And it's trying to capture that, kind of little seed of passion, that they may have and like grow it, to a point where, for them it's completely normal that, they know there's misconnections going into the river, and they know there's things we can do to try and stop it and they can then spread that information out further...as you get older and you can impart more information and do it in a much more assured way. I think you have then more of a chance, of potentially changing the minds of family members and their friends.

Molly uses the metaphor 'seeds of passion' to express how she feels participants might become involved in environmental monitoring and stresses that nurturing these 'seeds' may

have further repercussions for those who students interact with during everyday life. Her narrative confirms Dickinson et al's assertion that citizen science can be perceived as a 'sharable public good' (2012, 291), in that her motivation is inspired by both a desire to positively influence life courses of students, as well as to solve 'deplorable' river pollution. As Tuan states: 'wherever we can point to human beings, there we point to somebody's home' (1976, 114) and for these individuals, a desire to protect one's home is a key driver behind citizen science participation. Simonsen draws upon Lefebvre stating that spatiality can be given a 'critical edge by telling us how this lived space involves participation, conflict and the appropriation of space for creative, generative, bodily practices' (2012, 16). Participation in citizen science, when considered as such can be thought of as a means of being critical of current environmental practice and seeking to enact change.

Conclusions

This paper drew upon understandings of emotional spatiality to illuminate the under-explored area of citizen science motivations. The study explored the narratives of 10 citizen science participants providing contextually meaningful insights into the role of citizen science within their everyday lives. Participant motivations were not considered in isolation, nor by using pre-defined motivations, such as the desire to gain new skills to enhance personal employability (POST 2014), to interact with scientists, to boost one's scientific knowledge (Dickinson et al 2012) or social capital (Dickinson et al 2013). Instead, citizen science emerges from this in-depth, qualitative study as an embodied ecological experience, to which affective ties between the self and the environment, established initially within childhood, underpinned motivations. The three main reasons for engaging with the two projects explored emerge as: fulfilling a compulsion to observe ecological surroundings; a desire to participate

in environmental research and a commitment to protecting local environments. Rather than seeking to make generalised claims concerning the diverse field of citizen science, the analytical approach employed within this study provided an in-depth insight into the experiences of 10 participants. A perceived limitation of this study may thus be that it does not make generalisations concerning all participants' motivations.

Within each participant narrative the desire to become involved in such embodied experiences was rooted in environmental affinities first experienced in childhood. As Bondi et al state 'embodied emotions are intricately connected to specific sites and contexts' (2005, 3) and the child is arguably particularly open to experiencing the world through embodied action. Tuan argued that 'Nature yields delectable sensations to the child, with his openness of mind, carelessness of person and lack of concern for the accepted canons of beauty' (1976, 96). Ecological relationality established through childhood interactions with *edgelands* (Farley and Roberts 2012) of neighbourhoods, towns and cities had far reaching implications for participant's life courses. Figure four attempts to demonstrate the edgeland spatial contexts encountered by all 22 participants' in childhood. Citizen science offers a means of continual interaction with and enjoyment of these marginal spaces, due to the visceral, embodied nature of such encounters. It enables Joseph and Joshua to wade into rivers and Scarlett and Thomas opportunity to become closer to new trees. Citizen science promotes multisensory enjoyment of ecology, enabling participants to 'be yielding and careless like a child', slipping 'into old clothes' to experience the 'meld of physical sensations' (Tuan 1976, 96) that such experiences provide. Emotional spatialities (Bondi et al 2005) of citizen science motivations emerge from this paper as significant, allowing for a reconceptualisation of citizen science as an activity, beyond its political, technological, or knowledge generating capacity that sustains affective connections to ecological surroundings.

Several participants stated that volunteering for citizen science was connected to a compulsion to observe ecological surroundings. In addition, doing so appeared to have benefits for participant's health and mental wellbeing. Just over half the study participants were over 60 years-old, which meant many had navigated difficult life events. For example, dealing with personal ill-health or caring for elderly relatives or spouses. Commitment to citizen science provided several participants with time to re-establish human-ecology connections. For study participants Rosie, Victoria and Thomas, a compulsion to monitor ecology was a particularly relevant motivation, all of whom discussed using citizen science to enhance their experiences of being outdoors and of the mental wellbeing benefits it provided. In later life, access to edgeland environments emerge from this study as restorative, in their capacity to relieve stress (Milligan et al 2005) and draw individuals 'away from internal ruminations' (Conradson 2005, 109). Citizen science enables participant to avoid the 'loss of past geographical selves' (Jones 2005, 217), through remembering and recording ecologies around them in an act of reverie (Philo 2003). Childhood places and experiences may then be lost in time, but through the close observation involved in citizen science, the joy of ecological connection can be maintained in space, even when mobility issues or life commitments form a barrier, as they did for Rosie and Victoria.

Such findings contest the notions of scientific practice upon which citizen science rests (Lewenstein 2016), pointing instead to the significance of participants' intentionally harnessing projects for their own purposes. This has important implications for citizen science as a field, introducing a need for greater consideration of the ethical implications of project closure and continuances upon participants. Citizen science appears to provide a

means of remaining connected and engaged in local ecological spaces, particularly for older participants. This is especially significant given that older people ‘often feel marginalized in public spaces’, resulting in ‘reduced activity patterns and emotional detachment from familiar places and neighborhoods’ (Milligan et al 2005, 61). The study thus has important implications for how we understand the agency that individuals exert in finding ways to remain attached to valued places (Conradson 2005). The links between ecological observation through citizen science (as a passive, though prolonged activity) and mental health benefits have not been fully explored, offering fruitful ground for further research.

A desire to participate in environmental research was also a motivator for several individuals. Crucially, however, it emerges from this study that, as well as an altruistic motivation to contribute to scientific research (Geoghegan et al 2016), participants also sought to participate in scientific data collection for their own purposes. Each participant had unique reasons for valuing the scientific research to which they contributed data. Cerys, for example, felt it was important to assist a doctoral student in carrying out their thesis through *Track-a-Tree*, while Joshua wanted access to *London Rivers* project data for his own research purposes. In addition, Charles wanted to be involved in the data analytical process as he found it enjoyable, while Scarlett’s motivations related to a lifelong commitment to global activism. She saw citizen science as a means of environmental action, as well as a way of connecting to her local place.

A third and final driver behind citizen science participation was a commitment to protect local environments. For those of working age, this motivation often interrelated with work roles, while those in retirement were wholly community-focused. Unlike in the United

Kingdom, in the early 20th-century ‘when adaptive response of the inhabitants to industrial pollution was to develop the institution of cozy chamber concerts and afternoon teas behind drawn blinds’ (Tuan 1976, 66), citizen science enables people to be attentive to and find solutions to local environmental concerns through scientific data collection. Through the *London Rivers* project, participants turned their attention towards often-polluted rivers running through their neighbourhoods. Citizen science is seen by participants, including Joseph, as a means of environmental action, enabling him to protect the environment that has been his lifelong home, while Owen and Molly’s narratives show that citizen science motivations can be difficult to isolate, relating to both work and community roles, as well as deriving personal benefits.

Making typically invisible aspects of local space visible, as citizen science does, provides participants with another means of sensing their world. Citizen science appeals to participants because of its potential to enhance their sense of place (Blicharska and Mikusiński 2014), enabling them to feel increasingly connected to or ‘grounded’ within the spaces in which they dwell (Ingold 1993). Voluntary scientific research emerges from this study as a means by which to bond and retain commitments to the local non-human world. The notion that connecting to local environments through citizen science can help people settle within and remain committed to place has important implications for understanding citizen science motivations. It also enhances understanding of the role of citizen science within society. Citizen science not only presents an important evolution for scientific research, but considering the phenomenon through the lens of emotional spatiality, it emerges as appropriate by participants to fulfil a range of personal, social and environmental goals. Citizen science may thus be considered a process employed by the wayfarer ‘who, in following a path of life, negotiates or improvises a passage as he goes along’ (Ingold 2010,

134). Like the wayfarer, participants within this study were less concerned with a final destination (scientific outcomes) and more attuned to the process of sensing, learning and becoming attuned to the environments that they explored through citizen science, as they went along. For it was this process that they found enjoyable, therapeutic and restorative, enabling them to continually engage with ecological surroundings valued since childhood. As such, attending to issues of human agency and intentionality (Simonson 2012) within the citizen science process, enables an appreciation of how participants intentionally harness citizen science to continue to engage with the emotional geographies (Bondi 2005) of their childhood experiences. Simultaneously, it is also possible to appreciate how affective geographies (Thrift 2004) exerted a draw upon participants motivating them to seek both a greater understanding of and to protect their environments.

The participant in citizen science, as wayfarer, ‘draws a tale from impressions in the ground’, they seek a knowledge that ‘is not classification but storied, not totalising and synoptic but open ended and exploratory’ (Ingold 2010, 135). Though citizen science organisers might be concerned primarily with the large data sets that projects create, for those who gather it, the river, tree/forest is storied and for the participant, as wayfarer, gathering knowledge is part of their ‘own development and maturation as an embodied being’ (Ingold 2010, 136). Citizen science offers an opportunity for participants to embrace those affective spaces (Simonsen 2012) to which they are emotionally connected on paths that they navigate.

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