Shadows, Undercurrents and the Aliveness Machines

Jon Pigott and Antony Lyons

Introduction: Resident in Expanded Ecologies

The River Torridge catchment (Devon, South West UK) is a picturesque and serene wooded river valley setting, with a largely undeveloped estuary coastal zone. It has been selected as one of six sites in England to be designated a UNESCO Biosphere Reserve. Beneath this seemingly idyllic surface however, there exist some serious ecological health issues that are being actively addressed by the reserve's operational staff. Key indicators of declining health include the freshwater pearl-mussel, whose habitat lies within the gravel-beds of the river. This shellfish species is rare in the UK, and noted for its longevity and high sensitivity to water quality. An individual's age can be determined by counting the annual growth rings on the shell. In the River Torridge, the local population has not reproduced for over fifty years. Thus, unless the water quality and habitat conditions can become conducive to reproduction again, the concern is that the freshwater mussel will become locally extinct.

This situation is symptomatic of a loss of biodiversity, both within the catchment and more widely, with marked declines also observed in salmon and bat populations.[i] Adding extra complexity is the fact that the life cycles of the salmon and mussel are intimately connected, and both are negatively impacted by the increasing build-up of waterborne silt and mud, with associated high levels of turbidity. These species are bio-indicators; they are the 'canaries in the coalmine' – warning of larger shifts at play, and of knock-on effects on wider ecological systems, as well as on the local rural economy through tourism and leisure fisheries. The

pervasive damage to ecosystems, such as the Torridge, from agro-chemicals and soil run-off caused by land use practices can be gradual and cumulative, occurring at landscape, regional and global scales.

<FIGURE 1.1 HERE>

Title: River Torridge Fieldwork Attribution: Antony Lyons

<FIGURE 1.2 HERE>

Title: River Torridge Estuary Attribution: Antony Lyons

Monitoring and data harvesting may reveal specific trends - at least to a technical audience of conservationists and environmental governance agencies. For the most part, however, the chronic accumulation of pollution impact proceeds beyond the radar of human perception and the need for significant changes to land-use and catchment management is difficult to express politically and culturally. *Shadows and Undercurrents* was the name we gave to our rural eco-art project in the catchment of the River Torridge,[ii] which sought to respond to some of these challenges. In the project, we explored methods that may help generate a deeper awareness, empathy and understanding of the co-dependency of the hidden processes and flows. The situation called for a questioning of the status – both material and conceptual – of the many 'actors' involved (Latour 2005). For us, this included contemplation of water as a participant in the mesh of activity.

In this chapter, we draw on a range of theoretical positions including the thinking of PAR scholar Peter Reason, media theorist Jussi Parikka, STS scholar John Law and philosopher Felix Guattari to discuss our work and to explore concepts of water's participation in the blurred world of

environmental and media ecologies that the *Aliveness Machines*, (sculptures created as part of *Shadows and Undercurrents)*, speak to and for. In the following sections, we first discuss the project in general terms before exploring some of the conceptual frameworks on which we drew. We then outline some of the technical and practical aspects of the creative making process, as situated in an experimental laboratory context. Finally, we reflect on the project overall and particularly how it might be seen as one that invited the participation of non-humans, via aspects of both practice as research (PaR),[iii] and Participatory Action Research (PAR).

<FIGURE 1.3 HERE>

Title: Ultrasonics workshop with school Attribution: Jon Pigott

The Project

As artists-in-residence over a period of 18 months, we engaged with the site, the local communities and with innovative data-gathering techniques, aiming to respond to, and reveal, unseen processes. These creative approaches involved extensive exploratory fieldwork, participatory workshops and sound walks with school groups whereby, through the use of sensitive microphones and hydrophones, the human participants were enabled to extend their sensory awareness into hidden aspects of the environment. The culmination of this 'slow-art residency' project was an immersive, scenographic installation space, assembled around the *Aliveness Machines* – a pair of kinetic sculptural works activated by the 'data' gathered. Through this sculptural animation, emergent sound effects, and play of light and shadow, we attempted to amplify the changing levels, and complexity, of what were identified as some key hidden

ecological processes in the field area. The installation was exhibited at the end of the project at the Appledore Arts Festival located within the Biosphere Reserve.

The *Shadows and Undercurrents* installation brought together some of our efforts to encounter and communicate hidden aspects of the local ecological mesh, or *umwelt* (von Uexküll 2010).[iv] As a practical experiment, we explored a pathway towards a new conception of an integrated ecological-health indicator, and towards a poetic synthesis of vital signs suggestive of the locality's ecological aliveness. From its earliest uses, the word *ecology* has reached beyond biological and environmental sciences, to cultural studies, sociology and politics. Current expanded meanings include 'ecologies of place' (Thrift 1999), and 'ecologies of mind' (Bateson 1972), which entails the acknowledgement of both rational conscious and creative unconscious forms of knowing. There is also the notion of 'media ecologies' (see Parikka 2012, Parikka and Hertz 2012), which addresses our increasingly electronically mediated lifestyles in ways that go beyond the human, extending to the material and even to the geological aspects of media technologies. Parikka suggests that such technologies, often highly refined and deeply integrated into human lifestyles, can be explored in ways other than through their typically screen based human interface (Parikka 2012: 429). Behind their screens, these devices are assemblages of manufactured materials, as well as minerals, such as coltan and gold, which have accumulated over geological time before being folded into human communication and information structures.

The intersections of these expanded notions of ecology informed the creative collaborative project,[v] which was situated within environmental and site-specific art, geopoetics, and deep mapping.[vi] Although we had a range of objectives, a crucial aspect of the project in relation to

this collection was its character as an extended durational investigation of the landscape, through slow attunement and creative 'listening'. This process involved a distillation of a rhizomic mesh of conversations and encounters, embracing place identity, species, technology and communication. Bat-activity from the shadows, and river pollution parameters from the undercurrents, were the key data-streams that we chose to work with, revealing aspects of non-human realms through the kinetic, sculptural *Aliveness Machines* operating in response to live and recorded data-flows. In this way our experiment was founded on a very limited set of data flows, but also introduced a multi-sensorial information-rich space for embodied human response, or affect. With the *Aliveness Machines* we aimed to raise interest, and questions, around both the ecological vitality of this bioregion *and* the means by which we come to measure and understand it. Our creative collaboration therefore necessarily involved two interwoven perspectives: one emerging from a fusion of 'intimate' environmental sciences and intermedia installation, the other from a concern with tools of measurement explored through the context of kinetic sound art.

<FIGURE 1.4 HERE>

Title: In the River Torridge Attribution: Antony Lyons

Paradoxes and Intimacies of knowledge

Working between technologically enabled approaches/methods, and an embodied connection to the 'natural' ecology and environment of the Torridge catchment, exposed a tension. The problem is neatly summarised by Timothy Morton in a lecture titled *This Is Not My Beautiful Biosphere*:

> The dilemma of an ecological era is that the era is at once the product of massively increased knowledge, but also that this knowledge is itself a product of a planetary-scale imagination that has already profoundly damaged the earth (Morton 2012, n.p.).

The 'massively increased knowledge' that Morton describes enables the technological intervention into, and measurement of, the ordinarily less accessible environmental bio-web, thus deepening our understanding of the natural processes and systems at play. It also suggests the contemporary possibility (or fiction) of living at arm's length from 'nature', in contexts ranging from virtual software worlds and 'second-lives' to urban 'bubble' arcades; environments which contribute to conditions such as 'nature deficit disorder' (see Louv 2005). Despite this sense of disconnect, we humans remain multi-sensorial beings, experiencing the intimate, haptic sensation of rain on our skin, or the floodwaters lapping around our feet. However, it is generally thought to be impossible to directly feel climate change, or the slow gradual ecocidal decline in global biodiversity.

Roger Malina (2009a, p. 184) highlights such concerns in his thoughts on 'intimate science' and the 'hard humanities'. Malina considers issues relating to the fact that as a scientist, almost none of the information about the world that he studies is captured by his 'naked senses'. Instead, he develops an understanding of the world through an intimacy with his scientific instruments, inventing new words to describe new phenomena and knowing intuitively when his 'instrument is hallucinating' (2009a, p. 184). Such intimacy, however, is not in the daily experience of most people. He outlines developments that address this issue, including the work of practitioners such as sound-artist David Dunn, who harnesses environmental data-flows for cultural purposes,

‘coupling the virtual world to the physical, making [data] intimate, sensual and intuitive’. (Malina 2009b, n.p.). In this presentation Malina also discusses the role of ‘micro science’, embedding technological mediation into everyday life creating the possibility of ‘open observatories’ for local and community knowledge and data-acquisition. An example of this approach, within the context of social science, is the *Morris Justice Project*, set up by members of the Public Science Project in New York City (Stoudt and Torre 2014). Here, participatory data gathering methods were used to map events and activities regarding the New York Police Departments use of stop and frisk measures. The data gathered by communities around the city was used to communicate issues, raise questions and challenge policy with regard to discriminatory policing and effective and efficient crime prevention. The project shows the potential of the ‘open observatory’ within a socio-political context. The approach was one we were keen to deploy in the socio-ecological context of the River Torridge catchment.

Our leaning towards an open source, demystifying and participatory approach to instrumentation and data handling nurtures an ‘intimacy’ with science-based technology and resonates with wider accounts of participatory research, including Reason’s model of ‘participation as education and transformation’, which seeks to challenge powerful groups in society monopolizing ‘the production and use of knowledge for their own benefit’ (Reason 2005, p.38). Much of the technology that enabled our project, particularly in the data acquisition stages, came from and was supported by an open source culture. The term ‘open source’, often associated with computer coding but equally applicable to a broad spectrum of technologies, describes the way in which all information necessary for the use, modification, adaption and application of a technology is freely available. This provides the basis for self-organising communities and groups of participants of all abilities who share tips, information and concepts for the use and

application of technologies (see DiBona *et al*. 1999). Such relationships exist in contrast to the hierarchical paradigms of technology corporations guarding 'intellectual property' for profit and market domination.

<FIGURE 1.5 HERE>

Title: Hacking a bat-detector Attribution: Antony Lyons

To further draw out links with participatory research methods, we see our experimental work as fusing creative science and science-based creativity, thus utilising what Reason calls an 'active science', an approach which 'integrates all forms of knowing – immediate acquaintance, aesthetic expression, informative statements, practical competence – in […] inquiry and education process' (Reason 2005, p.38). The *Aliveness Machines* represent an attempt to make and present something sensual and intuitive from ecological data streams by reflecting notions of open technologies and tools of observation. Within the mix, we integrated objects, materials and mechanisms that could manifest data in ways that are performative, sensuous and atmospheric, and are subjective and personal whilst also being informative. We sought to render detectable what is largely undetectable to our senses, by augmenting technologies and hacking readymade objects into assemblages capable of evoking resonant and richly metaphorical associations (described in more detail below). For us, these were 'provocative prototypes' that tested and demonstrated a proof of concept, encompassing fieldwork and technological sensors, through to gallery installation and audience. [vii] At the same time, our assemblages operated as entities that were reflective of the relationship between creativity, technology and ecology. Mediated by digital technology and data, our installation space was scenographic; to produce it, we created a stage with props, robotic actors, projections and soundscapes. There was a mycelial, or rhizomic,

strategy in operation; a proposition that through the noise of such a multiplicity of stimuli there could emerge some intrigue, enchantment and emotional reconnection to the more-than-human realms, or ecologies.

Data Harvesting, Translations, Engagement

It is worthwhile now briefly to consider some of the technical detail of the project within the context of non-human participation. Data harvesting for the *Aliveness Machines* was facilitated by the placement of small wireless microprocessor devices (using *XBee* and *Arduino* technology) in the field. These had the inbuilt capability to record a range of parameters including light, temperature and humidity. Transmission of periodically sampled values took place over a linked/mesh network to the nearest internet connection, relayed to a dedicated online server, as well as creating an archived log. An initial challenge was how to adapt this technology to monitor the levels of silt pollution (or turbidity) of the river, and the activity of the bat population in the area. Measuring the river turbidity involved a reasonably simple appropriation of the wireless sensor's light-detecting capabilities. The murkier the river water, the less light is able to pass through it. Thus, a light sensor (in this case a light-dependent resistor) makes for an effective monitor. Sensing the more-than-human realm evidenced by the ultrasonic frequencies of bat-calls was achieved by hacking the output of a basic heterodyne bat detector (the Magenta 4) onto the XBee wireless detectors input. This set-up enabled the 35Khz-and-above frequency range of the Pipistrelle bat call and the 80Khz-and-above call of the Horseshoe bat, for example, to be converted into a set of data, representing bat-activity that was sensible to humans who are unable to hear anything outside of a 20Khz frequency band.

These approaches to sensing variations in river-pollution and detecting bat activity are not particularly new in a monitoring context. Environmental agencies and wildlife groups use similar methods for their sampling and monitoring surveys. What made the project novel, from a technological and participatory point of view, was that the sensing was being achieved through relatively low cost and easily available means, and through the support of an open-source culture of sharing knowledge and resources. Furthermore, the data was live and accessible via the internet, reflecting an open observatory and micro science approach. Through the workshops that we facilitated as part of the project, school groups were able to monitor and and work with these data feeds, and become familiar with the technology and its placement in the environment. For us, the designing, making and testing of elements of the data-sensing technology also provided another perspective on the relationalities involved. Hands-on involvement in the encounters between the technological and environmental realms, and the ways in which these exchanges were translated into data, led us to a deeper acknowledgement of the agency of non-human participants within the project.

<FIGURE 1.6 HERE>

Title: Online schools-based sensor data Attribution: Antony Lyons

Mitchell Akiyama (2014) writes that digital technologies, and a general increase in the amount of data available, have influenced the rise in data sonification as creative practice since around the 1960s. He emphasises a growing concern at this time with bureaucracy and the rise of an information society, as being concurrent with early examples of this mode of practice. With the modern availability of open source-type programming packages such as Processing and

Max/MSP, along with easily available rich site summary (RSS) feeds of data via the internet, as well as other developments such as wireless connectivity, creating digital visualisations and sonifications from data clearly offers a fertile territory for creative practice. Noortje Marres notes, however, that there are potential problems with public engagement through ubiquitous data streams creating a kind of 'informational citizenship' (2012, p. 5). She describes this as a form of public participation that makes impossible demands on people, insisting they take interest in complex issues that have little relevance to their everyday lives (ibid.).

Marres instead develops the idea of 'material participation' as a form of public participation that is enacted with materials and objects and as something that can work alongside and complement 'informational citizenship' (2012, p. 5). She explores this through empirical examples relating to sustainable living with a focus on action and impact rather than just understanding and knowledge. For us, the situated field-experience of the project residency, and the material complexity of the natural environment with which we were working, warranted more than a purely digital, screen-based visualisation or loudspeaker-based sonification of any data taken from the field. Uncritical data visualisation practices have been challenged by Robert Kosara (2010) and others. Embracing complexity and paradox, we developed the *Aliveness Machines* to critically and imaginatively intervene with the data flows, whilst exposing the dynamics of some local ecological processes. Through sculptural animation, mechanical sound events, light and shadow, we thus blurred the boundaries between technological and environmental ecologies.

<FIGURE 1.7 HERE>

Title: 'Bat-wheel' Aliveness Machine (detail) Attribution: Antony Lyons

The Aliveness Machines

In a productive sense, the project involved the construction of two kinetic sculptural works as centrepieces to the installation space. The first such *Aliveness Machine* was created in response to the activity of selected bat populations in the Biosphere Reserve. This device that harks back to early cinematic contraptions such as the *Zoetrope* (whose name means *'wheel of life'*). Our 'bat-wheel' was a clear acrylic disk with an embedded sequence of silhouettes of a bat in flight. When rotated by a motor, with a synchronised strobe light, the flickering shadows of the flying bat are projected onto a screen. Another cinematic, audio-visual component was added, akin to a *Mutoscope* (an early cinematic device), which, through its simple flick-book style animation, contributes a further mechanical flapping sound. The spinning of the wheel and associated sounds of the mechanism were triggered by the bat activity recorded and fed from the field via the wireless sensor devices. The exposed mechanisms and technologies of the bat-projecting wheel served to reveal the assemblage nature of the technological mediation that was at work between a living bat in the field and the immersive installation, whilst also allowing for a poetic and human connection to the source of the data. The connection was reinforced by referencing the wings of a flying bat, as well as alluding to the chatter of old film projectors, exhibiting another layer of association with silent-era vampire films. This intimacy between technology and atmospherics, data and environment would have been very difficult to achieve through a purely screen-based visualisation output.

<FIGURE 1.8 HERE>

Title: 'Bat-wheel' Aliveness Machine (detail) Attribution: Antony Lyons

The second *Aliveness Machine* was developed to reflect the turbidity/silt levels in the hidden depths of the river. It also used an interplay of light and mechanical sound sources to represent activity and flux in the natural environment. Light was a particularly appropriate medium with which to work, as it was the cloudiness of the water and its propensity to pass light that was being measured by the sensors situated in the field. To pursue this theme a bundle of reflective steel ribbons was suspended inside a cylindrical cage formed from hundreds of fishing lines illuminated from below by a bright light. When the river was clear, the associated data stream activated a blade-less fan, which in turn excited the steel ribbons causing chaotic patterns of light, reflecting and diffracting on and through the translucent fishing line. Each of the steel bands was also attached to a contact microphone so that when it was excited a mid-frequency rumble became audible, reminiscent of underwater sonics. This water-pollution-focused *Aliveness Machine* was also partnered by a bolt-on data activated fishing reel mechanism, which further augmented the soundscape through its characteristic clicking sound. On one of our field outings, we had taken a canoe trip along the river, viewing the landscape from a vantage point usually only enjoyed by the resident wildlife and the occasional fisherman. During this trip the sound of fishing reels merged seamlessly with the background soundscape of the river. The inclusion of these relational installation elements can be seen as eco-metaphorical. We aimed to echo elements of the river's soundscape as well as poetically reflecting how clear water can equate to good levels of fish stock, thus having a beneficial effect on the local economically important angling activities.

<FIGURE 1.9 HERE>

Title: 'Pollution Column' Aliveness Machine (detail) Attribution: Antony Lyons

Theoretical reflections

The kinetic, optical and sonic nature of the *Aliveness Machines* within the immersive *Shadows and Undercurrents* scenographic installation was, in part, designed to make manifest the material complexity of both the ecology of the Biosphere Reserve's environment and the technological assemblages used to measure and monitor it. Neither of these two complexities, it was felt, were really fully described by, or usefully reduced to simple 'data'. John Law provides some useful understanding in this regard when, in a discussion of what may be considered part of the standard scientific method, he states that 'the materiality of the process gets deleted' (2004, p20). Laboratory and field based experiments typically involve a rich interplay of a myriad of animal, mineral, plant and human entities, which are capable of throwing up ever-surprising streams of events. Law's point is that typically much of this interesting activity is subsequently deleted in what is ultimately published in the form of papers, spreadsheets and graphs. Further to this, Law explores the role of the very objects and technologies that are used to measure and monitor the more-than-human world around us. These measurement or 'inscription' devices as Law refers to them (2004, p. 29), so central to the harvesting and extraction of data, are themselves material complexities and assemblages of human and non-human agencies. The complex nature of these devices and processes however is typically hidden away, physically obscured inside a case or box, hiding all the inter-dependant relationships of the various components. Law describes the process of obscuring the complex relationships involved in producing data, whether through relying on written numbers and text or through the use of neatly hidden technologies, as a 'hinterland of scientific routinisation' (Law 2004, p. 35) and through the idea of the 'black box' (2004, p.34), a term with its origins in military systems design.

Similar themes to this are also present in Jussi Parikka's (2012) writings within the field of media archaeology, an area that takes an interest in the material make up of media technologies. Devices such as computers and smartphones that are readily associated with, and folded into, a textual and cultural domain of human meaning and commerce are, according to Parikka, also part of a non-human history of 'media-natures' (2012, p. 97). He suggests that these can be viewed as one big chemical reaction involving glass plates, gutta percha, shellac, silicon, copper and all other manner of minerals and component parts that happen to be available from the natural, material environment. By viewing the machines that we use to communicate, measure and record the world around us in terms of their components and material make-up, media and other technologies can be placed in a geological or geophysical context just as much as a human one. From this perspective, media history reaches back beyond any human history.

Our experimental efforts led us to the realisation that the material complexity of our *Aliveness Machines*, and the methods by which they operated, were important and active participants in the project. The bats and suspended particles in the water also contributed their part to the creative outcome and hence to everything that was ultimately communicated to our audiences. Whilst at an early design stage the *Aliveness Machines* had been conceived of without the input of these non-human participants, through iterative development of the project, room was created to – potentially – allow the voices of both our human collaborators and the beyond-human entities to be heard. The appropriated technologies and materials, and the unpredictable and unfamiliar (to us) worlds of bats and water were as equally responsible for the creative outcome as we were. Yet we had not been able to design the project entirely from its inception with these co-producers

in the way that a fully participatory project might have aspired to do, by allowing participants to lead and design as well as partake in research (Banks and Manners 2012, p. 8). The fact that the artist residency was happening at all was tied to different, quite anthropocentric ecologies of arts and regional development funding, educational upskilling agendas and many planning meetings over coffee etc. However, our creative method, based on slow, deep-mapping and careful listening to the landscape, did help us to take our cues from, and reflect on, what we encountered beyond the human realm.

Feminist STS scholar Karen Barad offers some insight that for us resonate with the creative processes behind the *Aliveness Machine* elements. In a discussion on the use of piezo-electric transducers and ultrasonography within medical applications, Barad explores the relationship between the 'material and the discursive', something central to her notion of 'agential realism' (2007, p. 191). Ultrasonography, and the mechanism through which ultrasound is transduced and used within a medical context, clearly has interesting parallels to the detection of bats via their use of ultrasound for navigation and hunting. Barad describes similar technologies to those that we deployed in the North Devon Biosphere Reserve as devices for 'making and remaking boundaries […] between human and non human, living and non living, visible and invisible' (2007, p. 201). Other observations by Barad reflect on the interplay between the science, technology and creative practice of the *Shadows and Undercurrents* project, while also reinforcing some of the points made by Law:

> Apparatuses are not pre-existing or fixed entities; they are themselves constituted through particular practices that are perpetually open to

> rearrangements, re- articulations and other re-workings. This is part of the creativity and difficulty of doing science (2007, p. 203).

The practicalities of our creative residency raised our awareness of these theoretical positions as we worked in the field with sensing and measuring technologies designed to operate across widely available platforms of digital media, drawing together a web of environmental and technological interactions. Issues of river access, fishing seasons, power supplies, dead batteries, mud, wireless ranges, web connectivity and waterproofing were just some of the challenges encountered in any one day. It became clear that the artistic outcome from the project would need to reflect this material complexity and the tenuous nature of the influences that led to what would ultimately become regarded simply as 'data'.

<FIGURE 1.10 HERE>

Title: 'Pollution Column' Aliveness Machine (detail) Attribution: Simon Warner

The particular data we were keen to explore, relating to bats and river pollution, emerged from a sequence of countless translations between one material substrate and another. Ultrasound bouncing between trees and insects became electromagnetic waves, binary numbers, mechanical force and flickering shadow. Clouds of mud and microscopic particles in the riverbed became a factor in natural light levels, a voltage level held on a on a server, the clicking of a fishing reel. Many of these translations were carried out by manufactured socio-technological black boxes such as bat detectors, silicon chips and internet service providers. Further down the line more translations were enacted by our *Aliveness Machines*. Through their assemblage aesthetic of exposed mechanics, localised light sources and sounding materials, the aim is that the *Aliveness*

Machines draw attention to the process of translation rather than hide it away behind some kind of screen or inside a sleek black box. In this way the *Aliveness Machines* are able to raise questions around both the state of ecological vitality *and* the means by which we may come to measure and understand it. Over the course of the project it became clear that the role of the creative visualisation and sonification of environmental data extended across the entire operation of sensor design and placement in the field through to the creation of the interplay of movement, light and sound to describe something of the data stream and its origins within the context of a scenographic immersive installation.

More than human: water as participant

In addressing ideas of expanded ecologies, Guattari's (2000) concept of 'the three ecologies' represents an enduring and overarching context for our creative efforts. His argument was that it is only through broadening our view of the meshes of the ecologies of the environmental, social and mental that we can bring about the necessary shifts away from destabilisation of our planetary life support capabilities, and away from destructive resource-depletion. For example, he writes:

> Wherever we turn, there is the same nagging paradox: on the one hand, the continuous development of new techno scientific means to potentially resolve the dominant ecological issues and restate socially useful activities on the surface of the planet, and, on the other hand the inability of organised social forces and constituted subjective formations to take hold of these resources in order to make them work (Guattari 2000, p. 31).

Here, Guattari provided one articulation of some ideas that are becoming increasingly relevant today, especially through transdisciplinary and interdisciplinary research, across fields of socially

engaged and participatory art-practice, human geography, place-research, ecological sustainability and health and well being. Many such approaches can be considered *geopoetic* - embracing diverse contacts with a locality, blending ecological perspectives with poetic imaginaries; entering 'a mental space where conjecture and imaginative play are needful and legitimate' (McKay 2011, p. 10). In framing our exploratory thinking, we drew on a wide breadth of modes of re-imagining ecological relationships and possibilities. In *The Spell of the Sensuous*, anthropologist-magician David Abram speculates that 'despite all the mechanical artifacts that now surround us, the world in which we find ourselves before we set out to calculate and measure is not an inert or mechanical object, but a living field, an open and dynamic landscape subject to its own moods and metamorphoses' (1997, p. 32). Based on research amongst traditional medicine people and shamans, Abram explores the need for 'boundary keepers' who are 'the intermediaries between the human community and the more-than-human community' (2006, n.p.). He asks, 'Look at the river. Do you know how the river feels whenever the salmon returns to its waters?' (ibid.).

In the spirit of this, and as an extension of our *Shadows and Undercurrents* explorations of place, we were invited to co-design an intensive workshop as part of the *In conversation with…* project (discussed in more detail by Bastian and Heddon in this volume). This project looked at the possibility of more-than-human participatory research and the focus for the workshops was participation *with* an element – in our case water. A key text for discussion during the workshop was Illich's (1985) 'H2O and the Waters of Forgetfulness', amongst others. This work describes the shift away from a holistic relationship with water towards the contemporary prevalent and narrow view of this life-giving substance as simply a utilitarian chemical compound. It prompted us to consider the intrinsic 'aliveness' of water, or a river, or an ecological zone. In challenging

anthropocentrism and the division of the world into living and non-living, into 'animal, vegetable or mineral' we began to speculate on how we might 'speak' to a river, or for a river, or even as a river. Our bodies are more than 70% water. It is alive within us. Where then do we draw the line between 'alive' and 'inert'? Like the river, which has no definable boundary, could our bodies also be considered to merge with the 'outer' world in a continuum? Leonardo da Vinci reflects this sentiment when he noted '…as from the said pool of blood proceed the veins which spread their branches through the human body, in just the same manner the ocean fills the body of the earth with an infinite number of veins of water' (in Keele 1983, p. 80).

The group of participating academic researchers set out to examine the co-production of knowledge, expanding beyond the human realm to include the voices, needs and agencies of non-humans. The workshop's initial aim, or thought experiment, was to explore the possibilities and obstacles of including water as a participant in the research process. However, in this case, it was the whole River Torridge catchment that gradually emerged as the participatory entity. One of the activities was a trip, by small boat, along the estuary and river during which we attempted, with the aid of data from salinity meters, to gauge the hidden, shifting boundary of salt-water and freshwater. How separate are these water 'bodies'? Where does the river end, and the sea begin? In the liminal setting of the tidal estuary zone, does the river lose its identity in meeting the sea? Our exploratory encounters also included the visceral experience of the elusiveness of the waterbody at its boggy headwater regions. Here, we were left with a sense of water as all-pervasive within the hollows, pores and microscopic rivulets of the land, also present in much deeper veins as hydrothermal flows, echoing the nature of water and circulation in living organisms, human and non-human. Through a number of such embodied and immersive experiences, including full immersion through swimming, there emerged responses that

considered ‘the complex webs of relationality between the river, the area’s geomorphology and the many human and non-human beings that made their life-ways through and with the river’ (Bastian, 2013).

Conclusion

Whitelaw describes data as ‘a set of measurements extracted from the flux of the real [that] are abstract, blank, meaningless’ (2008, n.p.). Our sculptural assemblages and immersive installation space sought to bring the real back into play, returning channels of information to material activity and agency. This is reflective of the fact that in the narrative of this project, our starting point was not simply the data, and our aims not just data-visualisation or representation. Our creative, situated experience and critical engagement involved wider questions and challenges relating to our sense of place in a field of nature-culture tensions. These included: how to both query and translate the (largely) hidden state of health and well-being of the local ecological mesh of human and non-human interactions; issues of harnessing creative science and science-based creativity to enhance human connections to ecological processes; and how to explore, through experimentation, the coupling of the virtual world with the physical, attempting to make data flows sensuous, intimate and atmospheric. In attending to these challenges through participatory methods we developed tactics and technologies with the support of open source communities and made systems that were themselves open source in terms of both their technical assembly and the accessibility of the data that they produced. With the sculptural *Aliveness Machines* we explored how non-human ‘technological’ participants contributed to the creative translation of some dynamics within the natural environment. These technological arrangements were ultimately intended to communicate the behaviours of bats and water, two vitally important non-human participants within the project. Through the involvement of participant groups, we

attempted to facilitate a wider community awareness of, and conversation with, the ongoing monitoring and stewardship of the ecological processes in which we are embedded.

References

Abram, D., 1997. *The spell of the sensuous: Perception and language in a more-than-human world.* New York: Vintage Books.

Abram, D. 2006. The ecology of magic: An interview with David Abram [online] . Available from: www.scottlondon.com/interviews/abram.html [Accessed 16 May 2016).

Akiyama, M., 2014. Dataffect: Numerical epistemology and the art of data sonification. *Leonardo Music Journal*, 24, 29-32.

Banks, S., and Manners, P., 2012. *Community based participatory research: A guide to ethical principles and practice* [online]. Durham: Durham University. Available from: https://www.dur.ac.uk/resources/beacon/CBPREthicsGuidewebNovember20121.pdf [Accessed 16 May 2016].

Barad, K., 2007. *Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning*. Durham: Duke University Press.

Bastian, M., 2013. *Conversations with the elements* [online]. Available from: http://www.morethanhumanresearch.com/conversations-with-the-elements.html [Accessed 19 May 2016].

Bateson, G., 1972. *Steps to an ecology of mind: Collected essays in anthropology, psychiatry, evolution, and epistemology*. Chicago: University Of Chicago Press.

Biggs, I., 2010. Deep Mappings/Spectral Traces: a partial view [unpublished]. Keynote paper for the "Mapping Spectral Traces" symposium, Virginia Tech, USA, 13 October.

DiBona, C., *et al*., eds., 1999. *Open sources: voices from the open source revolution*. Sebastopol, CA: O'Reilly.

Guattari, F., 2000. *The three ecologies*. London and New York: Continuum.

Illich, I., 1985. *H2O and the waters of forgetfulness*. Dallas: Dallas Institute of Humanities & Culture.

Keele, K., 1983. *Leonardo DaVinci's Elements of the science of man*. New York and London: Academic Press Inc.

Kosara, R., 2010. *The visualization cargo cult* [online]. Available from: https://eagereyes.org/criticism/the-visualization-cargo-cult [Accessed 15 May 2016).

Latour, B., 2005. *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford: Oxford UP.

Law, J., 2004. *After method: Mess in social science research*. New York: Routledge.

Leopold, A., 1948. *A sand county almanac.* Oxford: Oxford University Press.

Louv, R., 2005. *Last child in the woods: Saving our children from nature-deficit disorder*. Chapel Hill, NC: Algonquin Books of Chapel Hill.

Malina, R.F., 2009a. Intimate science and hard humanities. *Leonardo*, 42 (3), 184.

Malina, R.F. 2009b. *Making science intimate: The scientific method as a territory for artistic experimentation* [online]. Available from: http://www.diatrope.com/rfm/docs/Imagen_09.pdf [Accessed 15 May 2016].

Marres, N., 2012. *Material participation: Technology, the environment and everyday publics*. Basingstoke: Palgrave Macmillan.

McKay, D., 2011. *The shell of the tortoise: Four essays & an assemblage*. Kentville, NS: Gaspereau Press.

Morton, T., 2012. *This Is Not My Beautiful Biosphere (video)* [online]. Available from: http://ecologywithoutnature.blogspot.co.uk/2012/10/this-is-not-my-beautiful-biosphere-video.html [Accessed 20 September 2015].

North Devon biosphere review [online] Available from http://www.northdevonbiosphere.org.uk/review-report.html [Accessed 18 May 2016]

Parikka, J., 2012. New materialism as media theory: Media natures and dirty matter. *Communication and Critical/Cultural Studies*, 9 (1), 95-100.

Parikka, J., and Hertz, G., 2012. Zombie media: Circuit bending media archaeology into an art method. *Leonardo*, 45 (5), 424–430.

Reason, P., 2005. Living as part of the whole: The implications of participation. *Journal of Curriculum and Pedagogy*, 2 (2), 35-41.

Stoudt, B.G., and Torre, M.E., 2014. The Morris Justice project: participatory action research [online]. *Sage Cases in Methodology*, London: Sage. Available from: http://dx.doi.org/10.4135/9781446273050145353 58 [Accessed 18 May 2016]

Thrift, N., 1999. Steps to an ecology of place. *In:* D. Massey, J. Allen, and P. Sarre, eds., *Human geography today*, Cambridge: Polity Press, 295–323.

von Uexküll, J. 2010. *A foray into the worlds of animals and humans*. Minneapolis and London: University of Minnesota Press.

Whitelaw, M., 2008. Art against information: Case studies in data practice. *The Fibreculture Journal* [online] 11. Available from: http://eleven.fibreculturejournal.org/fcj-067-art-against-information-case-studies-in-data-practice/ [Accessed 31 March 2015].

Endnotes

[i] For example, in the periodic review of the Biosphere Reserve, the authors state that 'UK populations of the greater horseshoe bat have fallen by 90% in the last 50 years' (2015, p. 47).
[ii] This was commissioned as part of a wider project called Confluence, whose broad aims were to involve local communities, creative practitioners and novel digital technologies in order to observe, measure and communicate aspects of the natural ecology of the UNESCO Biosphere Reserve.
[iii] An institutional term for creative research enquiry and critical reflection, leading to a durable record of new knowledge or substantial new insights.
[iv] In 1909 Jacob von Uexküll theorised that organisms have different '*umwelten*', even while sharing the same environment. *Umwelt* theory states that the mind and the world are inseparable, because it is the mind that interprets the world for the organism. The small fraction of the world that an animal is able to detect is its *umwelt*. The bigger, fuller reality he termed the *umgebung*.
[v] Core functional collaborators included the Biosphere Reserve Team, the IDAT unit of University Of Plymouth and David Brinicombe, a local enthusiast engaged in bat observation and recording.
[vi] Deep mapping is described by artist Iain Biggs as aiming 'to challenge the official management of memory that fixes the value and uses of places' (2010, n.p.).
[vii] It is important to note that the preparatory data-harvesting efforts were aimed at both demonstrating proof-of-concept in sensor-design, and gathering a limited data-set for demonstration purposes; we were not aiming, under the circumstances, to collect scientifically robust data - though this is certainly one possible future trajectory for our explorations.