Sylvan Sounds:
Connecting with the Forest through Listening and Sound Visualisation

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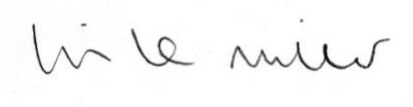
Author's Declaration:

This thesis represents partial submission for the degree of Doctor of Philosophy at the Royal College of Art. I confirm that the work presented here is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

During the period of registered study in which this thesis was prepared I have not been registered for any other academic award or qualification. The material included in this thesis has not been submitted wholly or in part for any academic award or qualification other than that for which it is now submitted.



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Abstract

Human-induced climate and ecological breakdown is radically changing the conditions of the surface of the Earth, affecting the capacity for life to flourish. This thesis developed from a drive to engage with the ecological crisis within my art practice. I do this through reconnecting to trees and forests in my home country whilst asking the question: within the current crisis of ecological breakdown, how can listening and sound visualisation enhance human connection with forests?

The practice-based research for my thesis combines listening, field recording and sound visualisation to create audio-visual installations. I track the evolution and development of my interdisciplinary making methodology, by tackling four secondary questions:
How can listening to the sounds made by trees reconnect humans to the forest?
What might sylvan soundscapes contribute to the field of ecological sound art?
How can I use sound visualisation to deepen my understanding of sylvan soundscapes and the experience of listening in forests?
How might exhibiting field recordings and sound diagrams as audio-visual installations change perspectives of sylvan sounds and how might this be affected by the exhibition setting?

I use listening as a method to engage with the woodland environment and field recording to gather sounds of sylvan processes. I explore unnoticed and inaudible sounds made by, and within, trees such as susurrations, transpiration, and recycling of tree matter.

The five study sites within UK forests are: Clocaenog Forest (Denbighshire, N Wales), the forest of Mar and Spittal of Glenshee (Cairngorms National Park, NE Scotland), Scott's Wood (Helford River, Cornwall, SW England), Caledonian Forest (Glen Affric, Highlands, NW Scotland), and Blackheath Forest (Surrey, SE England).

Through sound visualisation I analyse my field recordings to reveal the hidden sonic depths of the sylvan forest. The resulting diagrammatical and audio-visual artworks provide audiences with alternative avenues of engagement with, and perspectives of, trees and woodlands.

My work references contemporary theorists from the fields of communication and listening theory (Lisbeth Lipari, Pauline Oliveros and Salomé Voegelin), political and ecological philosophy (Jane Bennett and Timothy Morton), anthropology (Tim Ingold and Anna Tsing), soundscape ecology (Bernie Krause), and indigenous knowledge (Robin Wall Kimmerer and Dylan Robinson). I synthesise these theories with my own forest listening and sound visualisation practice, alongside the work of ecological sound artists and visual artists with sound diagramming practices. I argue that multi-modal listening generates alternative perspectives to consider the forest not as an ecosystem service (for use and exploitation by humans) but as a community of vibrant, interconnected, multi-species beings, worthy of attention and auditory focus.

Given our expanding knowledge of ecological breakdown, research such as this comes at a time when reconnecting humans with our more-than-human companion species – trees – has never been more critical. This thesis seeks to highlight alternative perspectives of the sounds of trees and facilitate awareness of our complicated relationship with the sylvan forest.

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1. Introductory Chapter

1.1 Personal ecological disconnect

At 20 years old I moved to the city to study visual art. Fourteen years on, my art practice specialised in exploring the listening experience through visualising music. Despite professional success in this field, it felt there was something lacking. Lacking in the sense that through the artwork, I may be contributing to a small extent to the field of experimental music but mostly to the commercial art market. Alongside this feeling of emptiness was a linked feeling that my adult life as a city dweller had uncoupled me from ecological environments, or 'nature'. I grew up on my grandad's tree nursery in Northumberland, UK. My family had a deep connection to the land through gardening, forest rambling and mountaineering. These formative experiences with ecosystems and biodiversity embedded a strong sense of place and belonging with my home landscape. After fourteen years in the city, it wasn't so much that immersing myself in 'nature' might benefit my mental health and wellbeing, it was more that by failing to participate in the multispecies world, I was failing to engage with the most important issue facing humanity – climate and ecological breakdown. That by not engaging, I was in fact part of the problem. My nostalgia for my rural upbringing is not a substitute for my lack of direct knowledge of environmental decline, for example, how Ash Dieback or Dutch Elm Disease have changed and continue to change the British landscape within my lifetime. I have not experienced the loss of these species as I have not maintained my connection to the landscape. I align with environmental philosopher Glenn Albrecht when he concludes that as we become less ecologically attuned and aware then we "may be unable to respond to the enormous risks posed by ecosystem distress syndromes and climate change."[1]

Reorienting behaviour and thinking towards the climate and ecological crisis can feel complicated and overwhelming. Might my skills and experience as an artist help me through these emotions? Experts in the fields of ecological philosophy and anthropology suggest that:

[1] Glenn Albrecht, *Earth Emotions: New Words for a New World* (Ithaca: Cornell University Press, 2019), p. 76.

artists are producers of meaning;[2] they help give form and voice to feelings,[3] concepts and events that might otherwise feel indescribable or appear unseeable; that artworks can both offer solace and heighten discomfort, thus enabling us to understand our surroundings in a different way;[4] and that these new insights can lead us to question our perception of environments and therefore our pre-established notions of our reality.[5] For me, art provides guidance and resilience to navigate difficult feelings and concepts, and offers glimmers of understanding and possible routes forward. Therefore, as an artist, could I use my practice, and in particular my specialism in sound visualisation, to engage with the climate and ecological crisis by embarking on a journey of reconnection with ecological environments?

1.2 Western ecological disconnect

My personal feelings of disconnect are not unique to me, but a reasonable response to a global predicament. The terminology used to discuss ecological environments shows the dysfunctional relationship between humans and the physical world. 'Nature' is defined as: "The phenomena of the physical world collectively; *esp*. plants, animals, and other features and products of the earth itself, as opposed to humans and human creations."[6] The term 'nature' is used to separate all nonhuman life from human, and 'culture' or 'civilisation' are human constructs in which the physical world is controlled. For me, this division is problematic because humans are living beings, part of the physical world and therefore part of 'nature'. By creating this divide, the physical world, or 'nature', has become a resource to be controlled, extracted, and commodified. This is exemplified by the Western practice of describing the enormous benefits of plants and trees as 'services': supporting services (photosynthesis, pollination, soil formation, and nutrient recycling); provisioning services (supplies of timber, drinking water, and food); regulating services (carbon sequestration, water purification, groundwater recharge, flood protection and climate regulation); and cultural services (spiritual enrichment, cognitive development, recreation, aesthetic

[2] Rebecca Solnit, *Hope in the Dark: Untold Histories, Wild Possibilities* (Edinburgh: Canongate Books, 2016), p. 100.
[3] Tim Ingold, *The Perception of the Environment: Essays on Livelihood, Dwelling and Skill* (London; New York: Routledge, Taylor & Francis Group, 2011), p. 23.
[4] Albrecht, p. 45.
[5] Timothy Morton, *The Ecological Thought* (Cambridge, Mass: Harvard University Press, 2010), p. 8.
[6] 'Nature', *Oxford English Dictionary [Online]* <https://www.oed.com/view/Entry/125353?rskey=FVADCi&result=1#eid> [accessed 30 March 2023].

experiences, heritage and creative inspiration). These life-sustaining and life-enhancing properties of trees and plants are called ecosystem services, defined and termed by the Millennium Ecosystem Assessment in 2005.[7]

In place of the commonly used 'nature', the eco-philosopher David Abram suggests the term 'more-than-human'. Adopted by theorists and activists, more-than-human shows how humans are no more than a subset of 'nature' and therefore we need a humbler approach to the more-than-human world. He argues that the unnecessary Western division is detrimental to our experience of the world. He states: "by insisting that the river has no real voice and that the ground itself is mute, we stifle our direct experience."[8] Here, Abram's ecological position aligns with Albrecht's in that they regard direct experience between humans and more-than-humans as a reciprocal relationship. Abram warns, "[i]f we do not soon remember ourselves to our sensuous surroundings, if we do not reclaim our solidarity with the other sensibilities that inhabit and constitute those surroundings, then the cost of our human commonality may be our common extinction."[9] All 'nature' – human, plant, animal, rain, temperature, and soil – each affect one another. We are nurtured when the world around us flourishes, and if we cease to care for the Earth then it is unable to care for us.

Originating from North America, Abram shed his Western mindset of domination and developed the premise of "a world of multiple intelligences" in which "everything is an experiencing form".[10] He spent prolonged periods living with indigenous peoples in Nepal, Indonesia and the Americas, learning traditional ecological knowledge. In Bali, Abram experienced how the indigenous community listened and attuned to the presences that surrounded and influenced their daily lives considering not only the animals and plants, but also the rivers, rains, stones, mountains and the forest itself to be sensuous and alive.[11]

1.3 Indigenous ecological connection

Respect and care for land are the guiding principles of Potawatomi nation citizen Robin Wall Kimmerer who practices the traditions and customs of her ancestral heritage. She considers it

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[7] Millennium Ecosystem Assessment, *Ecosystems and Human Well-Being: Synthesis* (Washington, DC: Island Press, 2005), pp. 8, 53, 40.

[8] David Abram, *The Spell of the Sensuous: Perception and Language in a More-than-Human World* (New York: Pantheon Books, 1996), p. 157.

[9] Abram, p. 161.

[10] Ibid., p. 16.

[11] Ibid., p. 15, 18, 19.

our responsibility to "find ways to enter into reciprocity with the more-than-human world", suggesting this can be done through gratitude, ceremony, land stewardship, science, art, and everyday acts of practical reverence.[12] She lives with the Onondaga people in upstate New York, where she is the director of the Center for Native Peoples and the Environment, at the State University of New York College of Environmental Science and Forestry. She follows the Onondaga traditional beliefs that: "in return for the gifts of Mother Earth, human people have responsibility for caring for the nonhuman people".[13] Kimmerer would like an alternative pronoun for plants and animals which would help us think of them as persons (he/she) rather than objects (it). In her indigenous Anishinaabe language, 'aki' refers to 'land' and 'bimaadiziaki' is a 'living being of the earth'. Drawing from these words, she suggests 'ki' as a more-than-human pronoun, for example, "ki is giving us maple syrup this spring time" and 'kin' for their collective pronoun, as in: "kin are flying south for the winter."[14] This language change suggests a path towards non-hierarchical communion with plant and animal beings.

To shed light on why the worldview of indigenous peoples is more attuned to the physical world than the Western mindset, I turn to author and integrator Jeremy Lent. In *The Patterning Instinct*, he describes indigenous communities in Australia, Alaska, North America and South India, who have maintained the perspective of their hunter-gatherer ancestors that the more-than-human world is a benevolent parent, provider and sustainer. From this mindset comes the guiding principle of indigenous communities that everything is connected. In return for the gifts of Mother Earth, they care for and respect their environment as if it were a nurturing member of their own ancestral family. According to Lent, this worldview developed because of the limitless bounty of the more-than-human world at their disposal. In comparison, more highly populated civilisations exhausted the wild gifts of the earth and turned to agriculture, thereby changing their ideology to one of control and commodification of the physical world as a resource. Food, clothing, materials and medicine were no longer gifts from the forest, they were grown and owned by humans. This mindset was cemented further into Western culture via the Christian doctrine of humankind's 'dominion over nature', and then further still during the European Scientific Revolution of

[12] Robin Wall Kimmerer, *Braiding Sweetgrass* (Minneapolis: Milkweed Editions, 2013), p. 190.
[13] Kimmerer, p. 319.
[14] Krista Tippett, 'Robin Wall Kimmerer: The Intelligence of Plants'', On Being with Krista Tippett <https://onbeing.org/programs/robin-wall-kimmerer-the-intelligence-of-plants-2022/> [accessed 3 April 2023].

the late Middle Ages which declared 'nature as machine'. These concepts ingrained in the Western mindset the separation of humans from nonhumans.[15]

However, hunter-gatherer culture is not a perfectly sustainable model. Lent identifies a dichotomy: unrestricted access to Mother Earth's gifts "caused mass extinctions of megafauna in each new region [hunter-gatherers] discovered."[16] Although a return to the hunter-gatherer model is not a solution to the current ecological crisis, today's indigenous peoples exemplify how to live reciprocally with the more-than-human world. The 2019 biodiversity report issued by the United Nations (UN) shows that flora and fauna "extinction rates are significantly less or absent where traditional indigenous people have control of the land."[17] It is clear from this evidence that Western culture has much to learn from indigenous cultures. The people who have held fast to the worldview of connection, respect and care towards the more-than-human have retained the aspects of the hunter-gatherer mindset that are essential for the on-going survival of humans and all life.

For me, the indigenous worldview provides a better model than the Western mindset in that it maintains a balance of kinship with land. When learning from indigenous cultures, it is crucial to understand my position as a white Westerner and avoid the extractive mindset of my own heritage. To assist with this adjustment, I am guided by the writing of Stó:lõ First Nations scholar Dylan Robinson. He criticises the historical and on-going settler activity of extracting indigenous music and listening practices, and assimilating them into composition and performance, as their own. Robinson contends: "one cannot simply select and add noncolonial, feminist, queer, or black listening filters in order to listen otherwise. This reductive approach… fails to recognize that to apply a form of Indigenous listening would also constitute appropriation."[18] He calls this 'hungry listening'. Robinson challenges the presumption of Western settlers to consume knowledge and culture as shallow because it takes no account of place. He states "[i]ndigenous methodologies are located in a deeply embodied/experiential relationship to culture and place"[19] and criticises what it might mean

[15] Jeremy R. Lent, *The Patterning Instinct: A Cultural History of Humanity's Search for Meaning* (Amherst, New York: Prometheus Books, 2017).
[16] Lent, p. 292.
[17] Wahinkpe Topa and Darcia Narvaez, *Restoring the Kinship Worldview: Indigenous Voices Introduce 28 Precepts for Rebalancing Life on Planet Earth* (Berkeley, California: North Atlantic Books, 2022), p. 61.
[18] Dylan Robinson, *Hungry Listening: Resonant Theory for Indigenous Sound Studies* (Minneapolis: University of Minnesota Press, 2020), p. 51.
[19] Robinson, p. 247.

to absorb these methods without the lived experience of the land and heritage within which they are practiced.

I do not intend to appropriate the environmental sounds, ceremonies, rituals, songs, or music of indigenous, or any other culture, in my research. I seek to reconnect with the landscape of my homeland, and in doing this, I wish to draw inspiration from indigenous knowledge where it is offered and shared. An example of this knowledge sharing comes from Wahinkpe Topa (Oglala Lakota Tribe) who maintains that the:

> 'Indigenous worldview' does not belong to a race or group of people, but indigenous cultures who still hold on to their traditional place-based knowledge are the wisdom keepers of this original Nature-based worldview. All people are indigenous to Earth and have the right and the responsibility to practice and teach indigenous worldview precepts.[20]

A Westerner learning respectfully from indigenous cultures is exemplified by Monica Gagliano, the world's leading researcher into plant bioacoustics. The fascinating aspect of Gagliano's research into plant hearing and sonic communication, is that she attributes the catalyst for her initial research to communicating with plants through dreams. She learned this practice whilst living with the Shipibo tribespeople in the Amazon lowlands of Peru. Indigenous knowledge led Gagliano to her scientific finding. As a result, she argues for living in communion with plants, stating that they "are not property to be owned. They need not custodianship, but a commitment to a nonhierarchical respect, a space of communion in which we come to understand the world and take the pathway toward understanding each other."[21] Following Gagliano, I would like to recalibrate my Western mindset and reconnect with the landscapes of my own homeland. I wish to draw inspiration respectfully from indigenous cultures where that knowledge is offered, taking care not to appropriate their practices verbatim, but to be inspired by them to change my actions within the world. In doing this, I hope to move towards communion and kinship with nonhuman beings, and value them for their gifts and intrinsic worth, on which our very survival depends.

1.4 Ecology, biodiversity and woodlands in the UK

[20] Topa and Narvaez, pp. 4–5.

[21] Monica Gagliano, *Thus Spoke the Plant* (Berkeley, California: North Atlantic Books, 2018), p. 36.

Having confirmed the need to reconnect with the physical world, the next choice was, which ecological environment should I engage with and where? There were compelling reasons for choosing to base my studies in the UK. One was the ambition of reconnecting with my local landscape in the place that I call home. Another was to restrict my ecological footprint, and a third was to acknowledge the environmental failings of my own country. Our national parks ranked by the International Union for Conservation are a shameful V in comparison to most of the worlds national parks at I or II,[22] we fall far short of our own targets for new woodlands,[23] the most recent State of Nature Report reveals that worldwide "the UK has some of the lowest amounts of biodiversity remaining",[24] and in the 2019 Biodiversity Loss report, of the 240 countries assessed, the UK came 228th.[25] I believe we must first look to restore our own ecosystems and landscapes before criticising other nations such as Brazil and Indonesia, for not preserving and valuing their own. Environmental Journalist George Monbiot supports this position, arguing: "We should continue to mobilise against the destruction of the world's great habitats, and its terrifying implications. But the most persuasive argument we can make is to show we mean it, by restoring our own lost wonders."[26] The lost wonders that Monbiot refers to are Britain's former temperate rainforests. Britain's west coast has the perfect wet and rainy weather conditions for temperate rainforests to thrive. Today, only fragmented pockets remain, but up to 20% of Britain has the right conditions to support them.[27] Guy Shrubsole, author of *Britain's Lost Temperate Rainforests*, gives some context: "today we only have around 13 percent of woodland cover left in Britain, and less than 1 percent of that is temperate rainforest."[28] Globally, temperate rainforests are under threat and according to Shrubsole, Britain's wet

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[22] George Monbiot, 'Rewilding Will Make Britain a Rainforest Nation Again', *Guardian*, 25 September 2019 <https://www.theguardian.com/commentisfree/2019/sep/25/rewilding-britains-rainforest-planting-trees?utm_term=RWRpdG9yaWFsX0dyZWVuTGlnaHQtMTkwOTI3&utm_source=esp&utm_medium=Email&utm_campaign=GreenLight&CMP=greenlight_email> [accessed 3 October 2019].

[23] Fiona Harvey, 'Tree-Planting in England Falls 71% Short of Government Target', *Guardian*, 13 June 2019 <https://www.theguardian.com/environment/2019/jun/13/tree-planting-in-england-falls-72-short-of-government-target> [accessed 20 July 2022].

[24] Josh Davis, 'UK Has "led the World" in Destroying the Natural Environment', *Natural History Museum*, 26 September 2020 <https://www.nhm.ac.uk/discover/news/2020/september/uk-has-led-the-world-in-destroying-the-natural-environment.html> [accessed 20 July 2022].

[25] RSPB, *Biodiversity Loss*, 2019 <https://www.rspb.org.uk/globalassets/downloads/projects/48398rspb-biodivesity-intactness-index-summary-report-v5-1-1.pdf> [accessed 20 July 2022].

[26] Monbiot, 'Rewilding Will Make Britain a Rainforest Nation Again'.

[27] Guy Shrubsole, 'About This Project', *Lost Rainforests of Britain*, 2021 <https://lostrainforestsofbritain.org/2021/03/16/about/> [accessed 16 February 2023].

[28] Richard Collett, 'Mapping the Rainforests of Britain', *Atlas Obscura*, 1 November 2021 <https://www.atlasobscura.com/articles/mapping-britain-endangered-rainforests> [accessed 20 July 2022].

conditions provide a globally significant habitat for them.[29] The need to restore the state of UK forests feels even more pressing when considering the vital role of trees in combatting climate breakdown – from carbon sequestration to combatting flooding, desertification, and extreme weather.[30]

A brief history of woodlands in the UK shows that ecological disconnect and its links to climate and ecological breakdown are not just a contemporary phenomenon. Instead, they stem from a gradual deterioration of people's relationship with land due to social, political and economic factors, that track the change from needing to maintain a flourishing relationship with woodlands for human livelihoods to decoupling from mutually beneficial relationship as new demands changed the way people lived and what they needed to survive. Britain's woodlands date back just 12,500 years to when it was still linked to the Continent. Before this Britain was largely treeless. At the end of the last Ice Age, 42 species of trees and shrubs migrated across what would become the southern North Sea and the English Channel. These are considered our 'native' species. By 8,000 years ago, when sea level rise cut Britain off from the Continent, most of the country was covered in diverse mosaics of these tree species. These woodlands are known as Wildwoods.[31] Humans first major impact on Wildwoods in Britain was about 6,000 years ago when woodland was cleared for agriculture. Agriculture stimulated population growth, which, with the introduction of metal tools in the Bronze Age, accelerated woodland clearance so that by the beginning of the Iron Age (about 2,500 years ago) only 50% of all woodland remained. This trend of population growth and woodland clearance continued. By 1086 the Domesday Book recorded that just 15% of England was wooded. Throughout the late Middle Ages and into the Early Modern period woodland cover remained at roughly 10%.[32] This was because these woodlands and wooded pastures were heavily managed to benefit trees and wildlife as these ecosystems were integral to the rural economy. It is perhaps this moment that the popular imagination considers the reciprocal relationship between people and woodland to be at its greatest, when skills like coppicing and pollarding benefited both woodland and human in equal measure. It is worth remembering though that at this moment only 10% of ancient woodland in the UK remained

[29] Collett.
[30] The Woodland Trust, 'How Trees Fight Climate Change' <https://www.woodlandtrust.org.uk/trees-woods-and-wildlife/british-trees/how-trees-fight-climate-change/> [accessed 15 November 2022].
[31] Oliver Rackham, 'Wildwood and Prehistoric Beginnings', in *Trees and Woodland in the British Landscape* (London: Phoenix Press, 2001), pp. 26–38.
[32] Oliver Rackham, 'Outline of Woodland History', in *Woodlands* (London: William Collins, 2015), pp. 51–61.

and that woodland was heavily managed.[33] Following the Industrial Revolution, populations migrated from the countryside to industrial cities and the widespread use of wood for building and burning was replaced with wrought iron, steel and coal. This decoupling of people from land was accompanied by large-scale destruction of ancient woodland for agriculture. The demands for timber during the First World War left UK woodlands severely depleted. In 1919, woodland cover was reduced to just 5% and so the state-owned Forestry Commission was created to increase and manage UK woodlands.[34]

A 2021 report showed that woodland cover in the UK has increased to 13.2%, however only half of this is native tree species, and the other half is non-native commercial conifer plantations, which are biodiversity deserts.[35] Early Forestry Commission practices were criticised for replacing heathland, ancient woodlands, moorlands and peatland with single species conifer monocultures. In 2019 the Forestry Commission became Forestry England and Forestry Research in which its new aim is "to maintain and enhance England's forests for people and wildlife; planting a range of species to create forests resilient to climate change and tree disease."[36]

This history shows that woodlands are ever changing and evolving and that there is no sylvan utopia of wildwood tree cover to return to as the time of highest tree-human connection was when tree cover was at 10% and it was all heavily managed.

This contemporary and historical review of British biodiversity and forestry convinced me that I wanted to re-engage with the living and life-giving woodland ecosystems of the UK. Through my art practice I wish to learn about them and from them. I want to celebrate their current existence and be prepared for an uncertain future in which climate chaos and ecological collapse increasingly impact all life – both human and non-human.

1.5 Art, ecology and woodlands

The timeliness of my investigation is part of a growing response within the artworld to climate concerns. The recent surge in public concern for the climate and ecological crisis,

[33] Ancient woodland is considered woodland that has remained unchanged since 1600.

[34] Oliver Rackham, *Woodlands* (London: William Collins, 2015), p. 59.

[35] C Reid and others, *State of the UK's Woods and Trees 2021* (Woodland Trust, 2021), p. 12.

[36] 'History of Britain's Forests and Woodlands: 100 Years of the Forestry Commission', *BBC Countryfile*, 19 September 2019 <https://www.countryfile.com/wildlife/trees-plants/history-of-britains-forests-and-woodlands-celebrating-100-years-of-the-forestry-commission> [accessed 28 November 2023].

evidenced by the creation of grassroots environmental movements such as Extinction Rebellion and Fridays for Future in 2018, and Just Stop Oil in 2022, is reflected in the rise in exhibitions at established galleries with explicitly ecological themes. In London alone, four exhibitions since 2019 have focused on human entanglement with, and dependency on the physical world. First, *Eco-visionaries – Confronting a Planet in a State of Emergency* at the Royal Academy (2019-20) examined the damaging impact of modern human life on the Earth and how art, design and architecture might reframe our relationship with the physical world. Second, *The Botanical Mind – Art, Mysticism and the Cosmic Tree* at Camden Arts Centre (2020) explored the significance of plants to human life, culture, consciousness and spirituality. Third, *Rooted Beings* at the Wellcome Collection (2022) invited reflection on what we might learn from plants and fungi covering themes from plant behaviour to colonialism and indigenous knowledge. And fourth, *Our Time on Earth* at the Barbican (2022) asked us to consider anew our place in the delicate balance of our shared ecosystem. Public interest and awareness of the value of trees is also strong, with four museum exhibitions with a woodland focus since 2017 in Europe: *Disappearing Legacies: The World as Forest* at the Zoological Museum (Hamburg, Germany, 2017-18); *Into the Woods: Trees in Photography* at the Victoria and Albert Museum (London, UK, 2017-18); *Trees* at Foundation Cartier pour l'Art Contemporain (Paris, France, 2019-20); and *Among the Trees* (Hayward Gallery, Southbank Centre, London, UK, 2020).

This volume of artistic response to the climate and ecological crisis plus the acknowledgment of the value of trees within the era of the Anthropocene shows the timeliness of this thesis. The topic of trees and forests has become high on the agenda of how we might mitigate against the climate crisis. This number of exhibitions suggests that artists and artworks have an important part to play in raising awareness, offering alternative perspectives and helping people navigate feelings of hope and despair as we journey through changing and troubling times.

In the past 30 years, the ground-breaking research of Suzanne Simard, Professor of Forest Ecology at British Columbia University, has brought pioneering discoveries in plant communication and intelligence into public consciousness. Simard's work on tree interaction and communication via tree root and fungal networks has led to the recognition of Mother Trees, highly connected hub trees that connect the flow of information and resources in forests, known as the wood wide web. Her research shows how complex sylvan-fungal relationships contribute to forest resilience and adaptability with far-reaching implications for

managing and protecting forests from human inflicted harm such as clear-cutting forestry practices and global heating.[37] Her discoveries and the rocky path to finally being given recognition in her field have inspired and been retold in multiple genres including: international bestselling non-fiction *The Hidden Life of Trees* by Peter Wohlleben; landmark natural history BBC series *Green Planet* presented by David Attenborough; science fiction blockbuster *Avatar* by James Cameron; and Pulitzer Prize winning literary fiction *The Overstory* by Richard Power. *The Overstory* asks difficult questions of its characters and readers such as: "What does it mean, to learn that trees turn out to be social beings, networked together underground, cooperating and coordinating their behaviors with one another?" and "What is it in us human beings that has led us to believe that we are separate from and sovereign over all the rest of creation?".[38] Power's fiction asks us to consider the world from the trees' point of view – to empathise with the tree. This is testament to the role of creative arts to nurture ecological awareness and connection.

1.6 Chapter outline and questions

The primary question of this thesis developed from the drive to address climate and ecological breakdown within my art practice through reconnecting to trees and forests in my home country: Within the current crisis of ecological breakdown, how can listening and sound visualisation enhance human connection with forests?

The practice-based research for the thesis combines listening, field recording and sound visualisation to create audio-visual installations. Over four chapters, I track the evolution and development of this interdisciplinary making methodology.

I began my journey of forest reengagement by asking: How can listening to the sounds made by trees reconnect humans to the forest? I travelled to forests throughout mainland UK listening and field recording. I particularly wanted to attune to the more subtle sounds in the

[37] Simard Suzanne, 'About Suzanne', 2023 <https://suzannesimard.com/about/?doing_wp_cron=1690450887.9808630943298339843750> [accessed 28 November 2023].
[38] Megan Mulligan, 'Q&A: 2019 Fiction Winner Richard Powers', *The Pulitzer Prizes*, 2019 <https://www.pulitzer.org/article/qa-2019-fiction-winner-richard-powers#:~:text=Richard%20Powers%20won%20the%202019,the%20humans%20living%20amongst%20them.%22> [accessed 28 November 2023].

forest, made by trees, without knowing whether it was even possible. Chapter two follows this journey. It is a record of my personal response to the forest soundscape and what I learnt about trees and forests and, as a result, also about myself. It proved to be a journey of reconnection and learning, in an unexpected way. The joy of listening to hidden sylvan processes and interconnections collided with uncomfortable experiences of not fully understanding what I was hearing and the confrontation of human entanglement and complication. I analyse my listening experiences through communication and listening theory (Lisbeth Lipari, Brendon LaBelle, Pauline Oliveros and Salomé Voegelin), political and ecological philosophy (Jane Bennett and Timothy Morton), and anthropology (Tim Ingold and Anna Tsing) and I conclude that participation with nonhumans is an integral part of my journey of reconnection.

The five forests and the dates that I visited were: Clocaenog Forest in North Wales on 5 April 2018, Mar Lodge Estate in the Cairngorms National Park, Northeast Scotland on 8 June 2018, Scott's Wood on the Helford River, Southwest England on 18 August 2018, Caledonian Forest in Northwest Scotland on 3 and 5 April 2019, and Blackheath Common in Southeast England on 8 May and 7 June 2019.

In April 2018 I was staying in my family home near the Welsh border. Having learnt to love the hills of north Wales as a teenager, I was eager to revisit this location and experiment with a microphone and portable field recorder in a familiar landscape. On the edge of Clocaenog forest the sound of oak leaves caught my attention and went on to inform the direction of my entire listening journey. The next three locations were all opportunities to learn. I wanted to engage with experts in their respective fields, about the practice of listening, the equipment in field recording, and being an active participant in woodland ecological work. In June 2018 I spent a week in the Cairngorms National Park with the Murmurations Gathering of Listeners. Here, the experts in listening and field recording were the sound artist Jez Riley French and the award-winning natural history field recordist Chris Watson. I travelled to Mar Lodge each day, following the waymarked trails in the National Nature Reserve, listening and experimenting with field recording equipment. In August 2018 Alex Metcalf, the inventor of the Tree Listening Device, invited me to Cornwall to demonstrate it in his home landscape. Here, Alex and I spent time in Scott's Wood on the banks of the Helford River listening to the sounds of transpiration using his equipment. This was a unique opportunity to encounter the Helford River, a location I did not know well, through the perspective of a local. In April 2019 I volunteered with Trees for Life, a rewilding charity based in the Scottish Highlands. Trees for Life appealed to me because their guiding philosophy is rewilding both places and

people. Active participation in the rewilding process is key to their land regeneration model. I was also keen to revisit Scotland, having lived there as a young professional and spent time camping and working in the highlands. The fifth location, Blackheath Common, arose as I was invited to be a featured artist with Surrey Hills Arts for the 2019-20 programme. I was delighted to work closely with Ali Clarke, the program manager. Together we selected a site ideal for my listening activities with the object of developing an artwork for the organisation. I am aware that these five locations are all varying degrees of rural and semi-rural. I accept that in terms of tree cover, London can in fact be defined as a forest, and I could have used it as a study site. However, throughout this research journey, the more I visited and learnt about woodlands, the more I came to realise that there is no location in the UK, rural or urban, that is unmanaged, unaltered or unaffected by human intervention.

My initial plan was to visualise the field recordings made during my listening experiences as this is my established artistic skill set. However, before I could begin that process, there was unanticipated interest in the field recordings themselves, resulting in three presentations of my sylvan soundscapes. I then conducted a review of field recordists and ecological sound art to help position sylvan soundscapes within the field. This research evolved into chapter three, in which I wanted to know: What might sylvan soundscapes contribute to the field of ecological sound art? This chapter is a record of my field recordings as audio artworks and a review of artworks in the field of forest and tree sound works.

I anticipated using sound visualisation as a making methodology at the outset of this research. In chapter four I analyse three of my sound visualisation artworks-in-progress, each of which explores a different aspect of my sylvan field recordings via the practice of diagramming. The first uses a flow diagram technique to compare multiple sylvan field recordings to establish a more thorough definition of the dendrophony that differentiates it from a sylvan sound. The second uses a Venn diagram technique to explore the relationships between dendrophony (trees sounds), geophony (earth sounds) and biophony (animal sounds). The third diagram is a forensic listening analysis of creaking pine trees to explore the listening experience within the forest. The field of sound visualisation is explored by comparing my visual works-in-progress with the diagrammatical methods embedded in artworks by Christine Sun Kim, Jorinde Voigt and Lawrence Abu Hamdan. These diagrammatical artworks are important examples of unique perspectives on listening and sound perception, although none of these artists work with ecological sound. Throughout this chapter I seek to

answer the question: How can I use sound visualisation to deepen my understanding of sylvan soundscapes and the experience of listening in forests? I discover that explorative diagramming generates idea development and facilitates a journey to new knowledge about sylvan soundscapes and the dendrophony.

When presenting my sylvan soundscapes and making my sound visualisations, I realised that the full potential of the practice was to exhibit them together. Chapter five tracks the development of the audio-visual installation *Forest Listening*. This artwork combines the field recording *Rainstorm Inside Forest Earth* with its corresponding sound visualisations, a set of diagrams which expand on the spectrogram.
As audio-visual artwork was a new presentation method for me, I wanted to know: How might exhibiting field recordings and sound diagrams as audio-visual installations change perspectives of sylvan sounds and how might this be affected by the exhibition setting? Within the chapter I discuss the exhibition of *Forest Listening* in three locations – an outdoor courtyard, an indoor gallery, and a woodland. Each site required a unique site-responsive install, which in turn altered the listening experience. Through the iterative presentation of this artwork, I explore alternative ways to access the listening experience, using the visual to listen both with and beyond the auditory. Exhibiting in the woodland created an opportunity to return to the forest setting, respond to it, draw attention to it, encourage people to actively engage with it, and to think about it from a new perspective.

The sixth and final chapter draws my journey of forest reconnection through practice-based research to a momentary close. I consider the successes and limitations of my methods, summarise my findings, outline my original contribution to knowledge, and suggest future avenues and projects for further investigation generated directly from the outcomes, making and thinking completed during this thesis.

2. Listening for Sylvan Sounds

2.1 Introduction

In this chapter I explore listening as a method of multi-species reconnection. I show how the practice of listening led me to focus on the sounds of trees amongst more prominent sounds of the forest, via the attunement theory of Lisbeth Lipari, the listening practice of Pauline Oliveros and the listening theory of Salomé Voegelin and Brendon LaBelle. I explore how listening revealed the inner workings of trees and discuss these findings in relation to three theoretical concepts: Timothy Morton's 'mesh'; Jane Bennett's 'vibrant assemblage'; and Anna Tsing's 'polyphony'. I describe how listening to sylvan sounds enabled me to embrace Lisbeth Lipari's notion of 'not understanding' and Tim Ingold's theory of 'complication'. Through these experiences I consider the development of my listening practice as I begin to understand the difficulties of my ecological entanglement and the necessity of my participation with nonhumans to continue my journey of reconnection.

In 2018 and 2019 I made field trips to UK forests to listen and make field recordings, which resulted in my study *Searching for Sylvan Sounds.*[39] Throughout this chapter, I explore six listening experiences from this study. Of these sylvan sounds, three are external and three are internal. The external sounds were gathered using a stereo pair of omni microphones that record everything in the surrounding air that a human ear might hear. These recordings are: *Oak Leaves,* dry oak leaves clattering in the wind; *Chestnut Grove Rainstorm,* sweet chestnut trees in a rainstorm; and *Burning Logs*, logs burning in a mountain bothy stove during a rainstorm. Of the three internal sylvan sound recordings, two were gathered using contact microphones that record vibrations inside solid sylvan material. These are the sounds of *Fallen Pine Needles*, wood ants building a nest in fallen pine needles and *Decaying Birch Log,* carpenter ants building a nest in a water-saturated birch log. The third internal sylvan

[39] I call my listening and field recording a practice of sound 'gathering' to reference a transitory 'bringing together'. I reject 'collecting' (due to its links to 'accumulation'), and 'archiving' (due to its links to historical preservation of documents or records). *Searching for sylvan sounds* has the opposite intentions from colonial botanical collections and archives whose aims were to acquire, conquer and exploit. For more information on decolonialising collections see Alexandre Antonelli, 'Director of Science at Kew: It's Time to Decolonise Botanical Collections', *The Conversation,* 19 June 2020. < https://theconversation.com/director-of-science-at-kew-its-time-to-decolonise-botanical-collections-141070> [accessed 27 October 2022]. For an analysis of decolonialising research methods see Max Liboiron, *Pollution is Colonialism* (Durham and London: Duke University Press, 2021).

sound is *Transpiration*, transpiration in the trunk of an ash tree. This was recorded with a highly sensitive recording device that amplifies sound by 400 times, making internal tree sounds audible to the human ear. Field recording equipment provided acoustic access beyond the capacity of the human ear (and became important for close analysis of soundscapes in chapters three, four and five).

Throughout the chapter I invite the reader to listen to the field recordings made during my listening experiences. Each of the six field recordings are labelled with the corresponding location, date, and short description of the listening situation to orientate the reader.

This chapter explores the question: How can listening to the sounds made by trees reconnect humans to the forest?

2.2 Attuning to the forest

I propose listening as a method of engagement with the forest to re-calibrate my relationship with the physical world and begin to navigate my response to the crisis of climate and ecological breakdown. I hope listening might lead me to reconnect with, and attune to, forest life. From this I might become more aware of what the earth needs from me, how to be grateful, respectful, and reciprocal.

What would it mean, to become attuned to the forest? To 'attune' is to bring into accord or harmony.[40] There is an openness and a willingness to this state of being as well as a desire to work, live or simply be, in agreement, in accord, in resonance, or as one. I believe engaging in focused listening could create the conditions for re-tuning to landscape as listening requires the type of open-minded receptiveness needed for this task. Professor of Communication Lisbeth Lipari uses listening as an ethical practice and way of being in the world that attends to a more attuned relationship with the nonhuman. She insists that this is not ordinary listening, but "a kind of listening attuned, with great sensitivity, to the sounds of

[40] 'Attune', *Oxford English Dictionary [Online]* <https://www.oed.com/view/Entry/12954?rskey=kpFH7f&result=2&isAdvanced=false#eid> [accessed 25 October 2022].

alterity and the willingness to be transformed."[41] There is a sonic focus to Lipari's "ethics of attunement" as she believes listening generates "an awareness of and attention to the harmonic interconnectivity of all beings and objects."[42]

A practical application of Lipari's sonic ethical attunement is the practice of Deep Listening, created by the pioneering composer Pauline Oliveros. Deep Listening engages not just the ears, but the whole body, grounding the listener through active engagement with sound, paying attention to multiple sounds simultaneously, without filtering, considering how they interrelate with each other and with the listener. This practice triggers changes in awareness and forges intimate connections between the listener, other living beings and the surrounding environment. Oliveros wrote: "Ideas, feelings and memories are triggered by sounds. If you are too narrow in your awareness of sounds, you are likely to be disconnected from your environment"[43]. If this is the case, then the reverse should also be true, that through listening deeply to the environment, connections can be forged.
The objective of Deep Listening is to "shine attention upon what is usually not given the aural spotlight."[44] Salomé Voegelin aligns with this objective. She argues for actively listening out for subtle sounds smothered by more dominant sounds not because they are quiet, but because they are deemed insignificant. Her listening practice:

> hears the in-between and does not only listen to what is audible but lends its ear also to the inaudible, which often does not lack in decibels, in sonic intensity, but in the ability to be heard and counted among what makes a valid sound.[45]

Voegelin's approach to the practice of listening to the in-between, is similar to Brendon LaBelle's approach to listening for the 'overheard'. Listening for subtle sounds can often result in a lingering sense of there being more to a soundscape, perhaps an excess of sound, a background noise, or an extra push of energy. LaBelle calls these subtle sounds the

[41] Lisbeth Lipari, *Listening, Thinking, Being: Toward an Ethics of Attunement* (Pennsylvania: Pennsylvania State University Press, 2014), p. 183.
[42] Lipari, pp. 2–3.
[43] Pauline Oliveros, *Deep Listening: A Composer's Sound Practice* (New York: iUniverse, 2005), p. xxv.
[44] Miya Masaoka, 'From the Ordinary to the Extraordinary: Plants and Deep Listening'', in *Anthology of Essays on Deep Listening*, ed. by Monique Buzzarté, Tom Bickley, and Pauline Oliveros (Kingston, NY: Deep Listening Publications, 2012), pp. 65–74 (p. 68).
[45] Salomé Voegelin, *The Political Possibility of Sound: Fragments of Listening* (New York; London: Bloomsbury Academic, 2019), p. 64.

'overheard'.[46] Through overhearing LaBelle says the listener can develop new practices of care and much-needed skills for being attentive.[47] He states, "listening is marked by its capacity to instil sensitivity for what goes unheard". [48] LaBelle's focused listening practice differs from Voegelin's wide-ranging listening, as he concentrates on human voices that go unheard. With this focus he challenges notions of politics and power through listening in, towards and with people who struggle to find a voice. [49]

Voegelin's and LaBelle's listening concerns are who or what is being given the auditory spotlight and who or what is being side-lined. Applied to my own forest focus, what might be the sonic in-between that gets lost amongst other more prominent forest sounds such as wind, rain, birds, dogs, human voices, or machinery? As I begin to listen to forest landscapes, what sounds might make themselves heard that would usually be missed, ignored or hidden? And could listening to the sonic subtleties of the forest lead to novel understandings of its inner workings, thereby enhancing my attunement?

***Oak Leaves* field recording**

Clocaenog Forest, Denbighshire, North Wales

5 April 2018

Clocaenog Forest is a 40 square mile high lying conifer plantation bordering Conway and Denbighshire in north Wales. Planting began in 1905 on heather moorland and hill farmland, with a complete replantation in 1930s by the Forestry Commission after the forest was raised during the First World War to make wooden props for trenches and coal mines.[50] Since 2013 it has been controlled by Natural Resources Wales as a commercial enterprise. Sitka Spruce is the predominant species grown for timber, but dispersed stands of Norway spruce, larch and pine have created a habitat for red squirrels. This small population of red squirrels is a high priority for the forest's management plan, which includes reducing broadleaved trees such as oak and beech to remove food sources preferred by grey squirrels.[51] Other uses of the

[46] Brandon LaBelle, *Sonic Agency: Sound and Emergent Forms of Resistance*, Goldsmiths Press Sonic Series (London: Goldsmiths Press, 2018), p. 60.

[47] LaBelle, p. 87.

[48] LaBelle, p. 24.

[49] Ibid., pp. 25-26.

[50] Natural Resources Wales, 'Clocaenog Forest – Pincyn Llys, near Ruthin' 27 November 2023 <https://naturalresources.wales/days-out/places-to-visit/north-east-wales/clocaenog-forest-pincyn-llys/?lang=en> [accessed 29 November 2023].

[51] Clocaenog Red Squirrels Trust, 'About Clocaenog Forest' <https://clocaenog-rst.org/clocaenog-forest/#1589292948204-5a706453-0b8f> [accessed 29 November 2023].

forest are for power generation and recreation activities. In 2005 the construction of 27 turbines began for the Clocaenog Forest Wind Farm. Walking trails and mountain biking tracks draw in families for day trips who describe the forest as a 'best kept secret' and a 'hidden gem' of north Wales with reviews often praising its peaceful atmosphere.[52]
In April 2018, I visited the forest on a bright and crisp spring day. As I paused and listened to the forest, the lack of sound, especially the lack of bird song and insect buzzing, made me aware of the near silence of the plantation. The only noticeable sounds were trickling rivulets. The rows of commercial conifers and clearly marked tracks felt functional, uniform and lacking in intrigue. Their lifelessness deadened my curiosity. A feeling grew that this wasn't quite the sylvan connection that I had hoped for. Towards the end of the day, down a farm track on the northeast side of the forest, I noticed the sound of dry oak leaves. A gentle breeze jostled them with an audible crackle - the most interesting sonic texture I'd heard all day. I could hear a stream and sheep in the valley below and pheasants in the farm above. Ordinarily, leaf susurrations might be ignored, with the stream, sheep, and pheasants drawing my ear, but focused listening led me to notice the rustling leaves. Although my listening practice is without expectation or intention of hearing specific sounds, the process of listening changed my experience within woodlands from this first trip to Clocaenog.

***Chestnut Grove Rainstorm* field recording**

Blackheath Common, Surrey, Southeast England

7 June 2019

Blackheath Common is a mere 0.5 square miles yet has many managing parties and stakeholders: Waverly Borough Council, the Albury Estate, the National Trust, Surrey Heathland Project, the Amphibian and Reptile Conservation Trust, and the residents of the village of Blackheath. It sits within the Surrey Hills Area of Outstanding Natural Beauty, and the Wealden Greensand National Character Area. It is a mosaic of mature birch and pine woodland, with areas of open heathland consisting of heather, bracken, bilberry, grass and gorse. It is very dry with no streams or open water. The soil is light and sandy. Where brown earth soils have developed to the west and south of the site and around the village, there are large areas of broadleaf deciduous woodland comprised of sweet chestnut, oak and beech.

[52] Skip and Jump, 'How to Explore Clocaenog Forest in North Wales' 21 September 2020 <https://skipandjump.co.uk/clocaenog-forest-in-north-wales/> [accessed 29 November 2023].
Clued in with Kids, 'Our peaceful Family Woodland Walk through Clocaenog Forest', 26 July 2021 <https://www.cluedinwithkids.co.uk/a-hidden-gem-our-peaceful-family-woodland-walk-through-clocaenog-forest/> [accessed 29 November 2023].

Some notable veteran trees (a large oak and a holly) on the north boundary are valued for their cultural significance and host valuable lichen communities. The high point of the common is the War Memorial to the north of the site.[53]

In the Neolithic or Bronze Age early farmers cleared the wooded area of Blackheath Common through a combination of grazing, cultivation and fire, resulting in very infertile, acid soils. Evidence on the heath of early prehistoric activity such as neolithic flints and Bronze Age burials, have led Surrey County Council to identify Blackheath as an area of considerable archaeological potential.[54] It remained as open heathland for grazing, cutting and burning right up until the Second World War. From 1940 to 1944 the common was used as a military camp, after which grazing animals were excluded from the site and some tree growth returned. Conifers were planted in Blackheath in the mid-19th century for timber and rural use, and after the Second World War these self-seeded to cover a substantial area of the common.[55]

Blackheath Common heathland is a habitat for birds such as Nightjar, Woodlark and Dartford Warbler, as well as specialist butterflies, beetles, bees and other invertebrates. The rare sand lizard has been successfully introduced, and because of this, the site is designated an SSSI (since 1987). Part of this remit it to maintain specific areas of the common as heathland, and consequently, self-seeded pine and birch are removed to prevent them reverting to woodlands. Also removed are invasive exotic species such as Rhododendron, laurel, and American rum cherry which carry fungus-like pathogens and are harmful to native fauna.[56]

There is a thriving local volunteer network and a programme of events on the common. The many public footpaths and bridleways are highly valued for rambling, dog walking, horse riding, cycling, jogging and wildlife watching. Visitors are encouraged to stay on paths and control dogs, especially during bird breeding season.[57]

In 2019-20 I was a featured artist with Surrey Hills Arts. In May and June 2019, I travelled to Blackheath Common in the Surrey Hills to listen and gather field recordings. I worked closely with Ali Clarke, the program manager of Surrey Hills Arts to select a site for my

[53] Footprint Ecology, *Blackheath Management Plan 2015-2024* (Waverley: Waverley Borough Council, 2015), p. 4 <https://www.footprint-ecology.co.uk/reports/Underhill-Day%20J.%20and%20King%20M.%20-%202015%20-%20Blackheath%20Management%20Plan.pdf> [accessed 11 December 2023].
[54] Footprint Ecology, p. 24.
[55] Ibid., p. 12.
[56] Ibid., p. 14.
[57] Ibid., p. 14.

listening activities, from which I would make an artwork for the organisation. Ali Clarke began working for Surrey Arts in 2000 as the Visual Art Development Officer. In 2013, she approached the Director of Surrey Hills and the Head of Surrey Arts to propose that they shared funding her role so she could deliver an arts programme across the Surrey Hills. Surrey Hills Arts thus incorporates the key aims of these two partners: to deliver quality art projects with meaningful engagement and impactful outcomes; to nurture the experimentation, growth and development of artists; to have an environmentally conscious approach to projects and places of work; and to maintain a collaborative and inclusive working relationship with artists, partners and communities.[58]
Ali nurtures the development of artists who respond to landscape. Since 2017 she has offered opportunities to students at University for the Creative Arts and placements to PhD students at the Techne doctoral training partnership (which is my connection with Surrey Hills Arts). Ali commented that the PhD placements have been a very successful partnership: "It really adds to our programme to have an individual who delves deeper into an aspect of the landscape. We all learn from the process."[59] Ali works entirely with outdoor artworks and is motivated by how these attract visitors into the Surrey Hills. Most of the works that she commissions are temporary and leave the landscape as it was found.[60]

In the summer of 2019, I made multiple trips to Blackheath Common. It rained every time. Sheltering beneath sweet chestnut trees, I listened to the rain falling on their leaves and the forest floor. Lush foliage provided many surfaces for rain to collide with and bird chirrups sounded closer and more intense. Their calls seemed to bounce off the rain-soaked leaves. It was rare to meet other humans; only the hardiest dog walkers marched past. Who could blame them? Why would anyone linger here in the rain? Yet I was surprised to find the experience of listening to rain-soaked leaves was rewarding. Before my forest-listening journey began, I might have actively avoided this situation and missed these sounds, leaving them unheard. On previous woodland trips, walking, cycling or picnicking with friends, my intention would have been to invigorate and recharge my lungs, legs, and eyes. My ears would have a rest from city noise, but they would be filled with conversation. Plus, these leisure activities would be for my own benefit, with the forest used as an aesthetic backdrop, an ecosystem service. Immediately space was created in which I could notice the subtler

[58] Ali Clarke, email to Liz K Miller, 1 September 2023.
[59] Clarke.
[60] Ibid.

acoustic textures of trees. The examples of listening in Clocaenog Forest and Blackheath Common were times when I paid special attention to leaves: in the former, dry oak leaves, and in the latter, wet chestnut leaves. This was the start of my search for sylvan sounds, and led to deeper listening investigations: if this subtle sound was revealed by simply focusing my ears, what might I be able to hear if I used specialist field recording equipment to hear inside trees?

2.3 Listening inside trees – the interconnected

Fallen Pine Needles **field recording**
Mar Lodge, Cairngorms National Park, Aberdeenshire, Northeast Scotland
8 June 2018

Mar Lodge is a 113 square mile estate in the Cairngorms National Park in the Scottish Highlands. The estate encompasses ancient pine forests, heather moorland, juniper scrubs, blanket bogs, and highland plateau. The estate is a flagship area for British wildlife conservation. It was awarded Nature Reserve Status in 2017 and more then 80% of its land is covered by European Conservation designations. Iconic wildlife found at Mar Lodge includes golden eagles, capercaillie, snow bunting and dotterel. Areas of the ancient Caledonian pine forest support animals and birds which are rare or absent across Britain such as red squirrels, wood ants, pine martens, black grouse, treecreeper, redstart and crossbill.[61] However, when National Trust for Scotland began managing the estate in 1995 the native Caledonian pinewoods were in very poor condition.[62] The dense Caledonian Forest which covered much of the Scottish Highlands in Roman times was reduced to an all-time low by the 18th century. Following the trajectory of UK forestry outlined in chapter one, a pivotal moment for Scottish woodlands was the Highland clearances. This was the forced eviction of tenants living in the Highlands and western islands of Scotland from 1780 to 1855. Landowners removed tenants from the land to introduce the lucrative enterprises of pastoral sheep farming and deer stalking. The cultural consequences were the destruction of the traditional clan society, rural depopulation of the highlands, and emigration from Scotland.

[61] Rewilding Britain, 'Mar Lodge Rewilding Project', 2023 <https://www.rewildingbritain.org.uk/rewilding-projects/mar-lodge> [accessed 29 November 2023].
[62] National Trust for Scotland, 'Mar Lodge Estate' <https://s3-eu-west-1.amazonaws.com/ws-nts/Production/assets/downloads/DL-MarLodge_4.18_v2.pdf?mtime=20180417103355> [accessed 29 November 2023].

The ecological consequence was the destruction of ancient Caledonian forest in pursuit of economic gain. The world wars both took a heavy toll on the remaining woodland as timber was needed for allied trenches. Today only 1% of native pinewoods remain in locations either too remote for human settlements or too inaccessible for grazing.[63] The regeneration of the Caledonian pinewood in the Mar Lodge Estate began with the National Trust for Scotland's intensive deer culling programme which enabled natural regeneration to begin. According to Rewilding Britain the results have been outstanding, with 3.2 square miles of natural regeneration of pinewood, juniper, birch and willow well underway.[64] This has occurred in spite of much resistance from traditional deer stalking managers.[65]
In June 2018 I spent a week in the Cairngorms National Park with the Murmurations Gathering of Listeners, learning from experts in field recording (Jez Riley French and Chris Watson), the local landscape (artist Gill Russell), and sound art (Heather Ross and Kaffe Matthews). All these artists intend to raise awareness of sites through engaging with landscape through the senses. I implemented my new listening and field recording skills, whilst exploring the trails in Mar Lodge, experimenting with hydrophones and contact microphones made by French.

On one trail side a Scots pine sapling, not a meter tall, had shed a thin blanket of needles around its base, within which was a colony of wood ants. Gently, I buried a contact microphone just beneath the surface and listened as the ants scurried over and around it. Contact microphones pick up the smallest of vibrations enabling the human ear to hear the most delicate of sounds. About the size of a plastic bottle top, this could be inserted into the nest with only a moment's disruption and removed without any damage. Through this small piece of equipment, I could hear the tapping of tiny ant feet scuttling about the nest. A world of secret ant activity was revealed.

Wood ants depend upon conifers' spiny, narrow needles to build their ant hills.[66] This sonic microcosm highlights a specific problem concerning biodiversity within the Cairngorms

[63] The Scottish History Society, 'The Highland Clearances', 2016 <https://scottishhistorysociety.com/the-highland-clearances/> [accessed 29 November 2023].
Trees for Life, 'Deforestation in Scotland', 2023 <https://treesforlife.org.uk/into-the-forest/habitats-and-ecology/human-impacts/deforestation/> [accessed 29 November 2023].
[64] Rewilding Britain, 'Mar Lodge Rewilding Project' [accessed 29 November 2023].
[65] Susan Wright, Peter Cairns, and Nick Underdown, *Scotland: A Rewilding Journey* (Kingussie: SCOTLAND: The Big Picture, 2021), p. 185.
[66] Peter Wohlleben, *The Hidden Life of Trees* (London: William Collins, 2017), p. 220.

National Park. A biodiversity study in the Cairngorms, found that woodlands are a rich habitat supporting 39 percent of important species, on just 17 percent of the land, whereas moorland is a poor habitat, supporting only 3 percent of important species, on a huge 42 percent of the land.[67] The study showed that woodlands were thirteen times richer in biodiversity than moorland, emphasising how vital forests are for biodiversity. The Cairngorms is regarded as a beacon of hope and pride for British ecology, as it is Britain's largest National Nature Reserve, and "one of the most important areas for nature conservation in the British Isles."[68] But even within this landscape, rich woodland habitat needs to be greatly expanded to increase and support biodiversity.

***Decaying Birch Log* field recording**

Caledonian Forest, Glen Affric, Highlands, Northwest Scotland

5 April 2019

In April 2019 I volunteered with Trees for Life, a rewilding charity based in the Scottish Highlands. I chose to volunteer in their Glen Affric National Nature Reserve site to learn about rewilding and the history of the Scottish landscape. Glen Affric is owned by Forestry and Land Scotland (68 sq. miles), the National Trust for Scotland (14 sq. miles), and four private landowners (who hold small parcels). In accordance with the Scottish Outdoor Access Code, there is a right of responsible access to most of the land in the glen for pursuits such as walking and camping. Glen Affric contains the largest untouched woodland area in Britain and is one of our precious fragments of temperate rainforest.[69] Trees for Life's goal is to rewild the length of the River Affric watershed, creating a native forest corridor – the Caledonian Forest – stretching twenty-five miles.[70]

Rewilding is a world-wide science of ecological recovery. It seeks to restore ecosystems to a point where self-willed ecological processes can evolve their own balance of biodiversity. Where appropriate, missing mega-fauna are introduced to shape the landscape in a manner than mimics historical native animal records. Rewilding learns from the past whist being resolutely future focused. Rewilding is both radical and new.[71] It challenges the notion of

[67] Philip Shaw and D. B. A. Thompson, *The Nature of the Cairngorms: Diversity in a Changing Environment* (Edinburgh: Stationery Office, Scottish Natural Heritage, 2006), p. 444.

[68] National Trust for Scotland, 'About This Place', *Mar Lodge Estate National Nature Reserve* <https://www.nts.org.uk/visit/places/mar-lodge-estate> [accessed 20 October 2022].

[69] George Monbiot, *Feral: Rewilding the Land, the Sea, and Human Life* (London: Penguin Books, 2014), pp. 146–47.

[70] Monbiot, *Feral*, p.151.

[71] The term rewilding was coined in America in 1992 by the founder of The Rewilding Institute, Dave Foreman.

preserving an ecological baseline, which in Europe was set in the pre-industrial revolution mid 19th century. It sets the intention of creating a new conservation mindset for the 21st century in which ecosystems are invigorated, not saved. As a new scientific method within wildlife conservation and ecology, it is evolving differently according to the needs of specific locations and local mindsets. In the Oostvaardersplassen rewilding project in the Netherlands, over the course of its 30-year evolution, significant revelations have caused ecologists and conservationists to re-examine a fundamental principle of forest science. They discovered that natural vegetation in Europe was not necessarily closed canopy forest, but patchy mosaics of scrub, groves, grasslands and woodlands. This was caused in part by free roaming grazing animals. Dense woodlands that are celebrated and conserved, such as Bialowieza in Poland and Belarus may be the outcome of human intervention such as herbivore extinctions rather than remnants of primeval forest.[72]

Practical and scientific evidence suggests that rewilding acts as a nature-based solution to contemporary climate challenges such as flood management, carbon sequestration, control of invasive species and soil degradation. Some leading rewilders believe that rewilding can aid social challenges like rural depopulation, public health issues, and contribute to nature-based economies through eco-tourism.[73]

As a radical, new, and developing science, rewilding can be unsettling and politically controversial, especially so in the UK. In 2014 George Monbiot propelled rewilding into the mainstream with his book *Feral: Rewilding the Land, Sea and Human Life.* However, his critique of upland sheep farming in Wales was considered a direct attack on the culture, way of life and language of upland Welsh hill farmers by a middle-class English outsider. Consequently, rewilding became a toxic subject in parts of Wales and in 2019 Rewilding Britain (an organisation co-founded by Monbiot), eventually pulled out of the 'Summit to Sea' rewilding project in Wales.[74] A more recent example is in 2022 when The National Trust was accused of 're-enacting the Highland clearances' with their rewilding drive in which tenant farmers claimed highly productive land was being taken from them for tree-planting.[75] These examples show how vital public understanding and support is to

[72] Paul Jepson and Cain Blythe, *Rewilding: The Radical New Science of Ecological Recovery* (London: Icon, 2020), pp. 27, 56, 57.

[73] Jepson and Blythe, p. 8.

[74] Ibid., p. 104.

[75] Olivia Rudgard and Emma Gatten, 'National Trust 'Re-enacting Highland Clearances' with Rewilding Drive', *The Telegraph*, 31 July 2022 <https://www.telegraph.co.uk/news/2022/07/31/national-trust-re-enacting-highland-clearances-rewilding-drive/> [accessed 11 December 2023].

implementing new conservation and land use practices for the benefit of both ecology and people, especially if those changes are as radical and novel as rewilding proposals.

I chose to learn about rewilding with Trees for Life as they offer the opportunity to volunteer under the instruction of rewilding guides. Through this volunteering model, they create direct public engagement with rewilding. According to leading rewilding scientists, Trees for Life (as part of Scotland: The Bigger Picture) has managed to communicate rewilding as hope for the future. In their words, it is "an alternative to the relentless communication of facts that foretell an ecological and climate emergency and the failure of others to do the right thing."[76] As a result 76% of Scots in 2020 were in support of rewilding.[77] Although some of the criticisms levelled at rewilding such as land grabbing, undermining agricultural livelihoods and neo-colonial practices of dispossession[78] have not been levelled at Trees for Life, it is important to acknowledge that the current ecological condition of the Scottish Highlands is a direct result of the Highland clearances, which led to removal of native woodland for sheep grazing, and the resulting rural depopulation, which created the current disconnection from forest ecology as traditional relationships with land were forcibly uprooted and terminated. Susan Wright and Peter Cairns note how the term 'wild' is problematic in Scotland, as wild land is associated with the absence of people caused by the clearances. They say: "This notion has persisted through the last two centuries and has become the foundation for some of the suspicion surrounding rewilding that people may feel."[79] However they maintain that wild places don't mean the absence of people: "The true wild is where natural processes flourish, where ecosystems are working in all their colourful complexity to give life to the land and everything on it, including us."[80] In Scotland, rewilding includes building a relationship between people and land.[81]

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[76] Jepson and Blythe, p. 113.

[77] Rewilding Britain, 'Three-Quarters of Scots Support Rewilding, Says New Research' 17 February 2021 <https://www.rewildingbritain.org.uk/press-hub/three-quarters-of-scots-support-rewilding-says-new-research#:~:text=A%20new%20opinion%20poll%20shows,–%20with%20just%207%25%20opposed.> [accessed 11 December 2023].

[78] Jepson and Blythe, p. 154.

[79] Wright, Cairns, and Underdown, p. 155.

[80] Ibid., p. 39.

[81] The only other alternative that I could find in 2018-19 for my own personal engagement with rewilding in the UK would have been a rewilding safari or glamping at the Knepp Estate in Sussex. This is a flagship rewilding project for the UK, accompanied by the best-selling book *Wilding* (2018) by Isabella Tree, one of the owners of the 5.5 sq. miles estate. However, the eco-tourism on offer here didn't provide the same depth of opportunity as Trees for Life.

On the slopes of Glen Affric, a fallen birch tree lay amongst thick, mossy undergrowth. Its decomposing trunk was saturated with moisture from snowfall the previous day. Peeking under a section of bark I found another ants' nest – carpenter ants. I placed my contact microphone underneath the bark, expecting to hear the same delicate tapping as from the wood ants. The tapping was there, but to my surprise there was another sound – a rubbery squeak. Carpenter ants live in forests, building nests inside dead, damp wood. They chew out galleries with their mandibles, not consuming the wood, like termites, but hollowing out sections of trees in which their colonies can live, aiding forest decomposition. Perhaps this squeak was the sound of ants chewing moist wood matter?[82]

Dead trees are just as vital for the forest ecosystem as living trees, as forester Peter Wohlleben explains:

> As soon as the snapped trunk hits the ground, the tree and its root system become the site of a culinary relay race for thousands of species of fungi and insects. Each is specialised for a particular stage of the decomposition process and for a particular part of the tree.[83]

As woodland declines, so too do their interdependent species. Citing a biological conservation study, George Monbiot warns of the danger of losing essential woodlands: "around 40 per cent of the creatures that have become extinct in Britain since 1800 lived in woodlands, and two-fifths of those needed mature trees and dead timber to survive."[84]

In Mar Lodge and the Caledonian Forest I was listening to ants but I was also listening to trees. The woody matter of the pine needles and water-saturated birch logs were as much an

[82] A potential answer to this question arose during a conversation with acoustic ecologist and ant specialist Lisa Schonberg, and biologist and author David George Haskell, at the World Forum for Acoustic Ecology on 24 March 2023, just three weeks before the submission of this thesis. Schonberg's expert opinion was that the ant's squeaking was most likely stridulations, but she would need to see the ants to be sure. Stridulations are vibrations used by ants as a communication device. If this is indeed the sound within my recording, this sound would not be created by interaction with wood. However, in Haskell's keynote presentation he discussed how "the properties of the environment shape the evolution of communicative sound in all animal species." The three of us discussed how the sylvan material architecture of the ant colony might have a relationship with their stridulations. For example, might the moist wood structure muffle the high frequency of the stridulations therefore allowing them to communicate without detection from predators? This discussion at the tail end of my research will influence future directions for investigations into the symbiotic relationships between ants and sylvan materials. David George Haskell, 'Sounds Wild and Broken', in *Listening Pasts Listening Futures* (presented at the World Forum for Acoustic Ecology, Atlantic Center for the Arts, 2023).

[83] Wohlleben, p. 133.

[84] Monbiot, *Feral*, p. 225. Citing, Clive Hambler, Peter A. Henderson, and Martin R. Speight, 'Extinction Rates, Extinction-Prone Habitats, and Indicator Groups in Britain and at Larger Scales', *Biological Conservation*, 144.2 (2011), 713–21 <https://doi.org/10.1016/j.biocon.2010.09.004>.

active element of creating these soundscapes as the wood ants and the carpenter ants. These sounds could not exist without either ants or trees. It is their combination and interaction that creates the sound.

Listening revealed to me the symbiotic relationship between ants and trees. In *The Ecological Thought*, Timothy Morton explores the interconnected relationships between humans and everything else. He calls this interconnectedness of the living and non-living "the mesh".[85] For Morton, 'mesh' is the perfect term as it has so many subtleties of meaning: "holes in a network and threading between them. It suggests both hardness and delicacy. It has uses in biology, mathematics, and engineering and in weaving and computing… It has antecedents in mask and mass, suggesting both density and deception…" and an entangled situation "of constraining or restricting forces or circumstances; a snare."[86] For me the 'mesh' encompasses the emotional and practical complication of our complicity and culpability in climate and ecological breakdown. The mesh means we are all in the together. We are all caught in the net, the network of interconnection. Whether we come from ecology, arts or activism, finance, politics or industry, we are all implicated, responsible and impacted. For Morton, the 'mesh' is infinite in scale, size, detail and connections, in which every being is interacting and nothing is static.[87] Understanding the world from an ecological perspective is becoming aware of a "vast, sprawling mesh of interconnection without a definite center or edge. It is radical intimacy, coexistence with other beings, sentient and otherwise".[88] Mindful that many of these interconnections remain hidden to us, Lipari emphasises that human independence is an illusion: "When we fail to see these interconnections, we fail to listen. When we fail to listen, we fail to respond. We turn away."[89] By listening, responding, and turning towards the forest, interconnections revealed themselves. Through listening I understand the mesh of the forest a little better.

The political theorist and philosopher, Jane Bennett, is another advocate for developing a greater awareness of the interconnectedness of all things. For Bennett, 'all things' means encouraging awareness of the agency of nonhuman beings, in particular matter itself. Bennett

[85] Morton, *The Ecological Thought*, p. 28.
[86] Ibid., p.28.
[87] Ibid., p. 30.
[88] Morton, *The Ecological Thought*, p. 8.
[89] Lipari, p. 216.

states her ambition is to "encourage more intelligent and sustainable engagements with vibrant matter and lively things."[90] She asserts that it is necessary to rewrite the "grammar that assigns activity to people and passivity to things".[91] Bennett's call to redistribute value to vibrant matter comes from a position of ecological ethics. She hopes that: "it can inspire a greater sense of the extent to which all bodies are kin in the sense of inextricably enmeshed in a dense network of relations."[92] Here, Bennett aligns with Kimmerer's desire for a greater kinship between humans and nonhumans, as well as Morton's vast ecological 'mesh'.

Bennett employs Bruno Latour's term 'actant' which describes a human or nonhuman source of action that can "make a difference, produce effects, [and] alter the course of events."[93] Each actant is interdependent. "Its efficacy or agency always depends on the collaboration, cooperation, or interactive interference of many bodies and forces."[94] Developing this notion further still, Bennett draws on the concept of 'assemblage' by Gilles Deleuze and Félix Guatarri. Here, diverse elements and vibrant materials group together in living systems, with power distributed across and throughout the mass, each member-actant of the collective a part of the assemblage and yet maintaining its own independent pulse.[95] Together the wood ants and pine needles form what Bennett would call a 'vibrant assemblage'; carpenter ants and birch log form another. Ants need sylvan material to build nests. Trees need ant colonies to assist in the process of decomposition and nutrient recycling.

Bennett omits sonic examples of vibrant matter and vibrant assemblages, but as the very essence of sound is matter vibrating, it has important potential for exploring the agency of nonhuman beings. She does however admit the need for novel avenues of perception, calling for: "new procedures, technologies, and regimes of perception that enable us to consult nonhumans more closely, or to listen and respond more carefully to their outbreaks, objections, testimonies, and propositions."[96]

Through listening, sylvan materials reveal themselves to be vibrant, ever changing and in process, capable of affecting change and altering the course of the flourishing of life – both human and nonhuman.

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[90] Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Durham: Duke University Press, 2010), p. viii.
[91] Bennett., p. 119.
[92] Ibid., p. 13.
[93] Ibid., p. viii.
[94] Ibid., p. 21.
[95] Ibid., pp. 23-24.
[96] Ibid., p. 108.

To expand the concept of the assemblage into the sonic, I turn to Anthropologist Anna Tsing. In *The Mushroom at the End of the World*, Tsing looks for life in the ruins of the Anthropocene. She explores human-forest connection, interaction and participation via the global commodity of Matsatuke mushrooms. While Bennett's focus is on the vibrant assemblages of matter, Tsing attends to multispecies interactions – how humans, mushrooms and forests participate in world making. Tsing uses listening to attune to land-based assemblages. She claims: "if we want to know what makes places livable we should be studying polyphonic assemblages, gatherings of ways of being."[97]

Tsing draws polyphony from its musical origin in which autonomous melodies intertwine, and combines it with assemblage in the context of place or landscape. The polyphonic assemblage is the open-ended gathering, temporal rhythm, and patterns of unintended coordination that is the gift of the sonic landscape. Attending to the polyphonic assemblage is to feel alive in the landscape. Tsing suggests:

> to appreciate polyphony one must listen both to the separate melody lines and their coming together in unexpected moments of harmony or dissonance. In just this way, to appreciate the assemblage, one must attend to its separate ways of being at the same time as watching how they come together in sporadic but consequential coordinations.[98]

She continues, in contrast to the repeatability of composed music, "the polyphony of the assemblage shifts as conditions change."[99] The elegance of the polyphony is that it highlights not only the moments of interconnection but values the separateness of each element within the assemblage. Morton reinforces this notion: "Ecological awareness gives you a world in which everything is relevant to everything else, but is also really unique and vivid and distinct at the very same time."[100]

Listening to the tapping and squeaking of carpenter ants building a nest in decaying birch logs was my introduction to the sylvan polyphony. Attuning to the forest through listening revealed aspects of species interconnection. The process of attunement involves not only learning about the forest but is also about personal rebalance. How might listening to the sylvan polyphony contribute to mindset change?

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[97] Anna Lowenhaupt Tsing, *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins* (Princeton: University Press, 2015), p. 157.
[98] Tsing, p. 158.
[99] Ibid., p.158
[100] Timothy Morton, *Being Ecological* (London: Penguin Books, 2018), p. 88.

2.4 Listening inside trees – the unknown

***Transpiration* field recording**
Scott's Wood, Helford River, Lizard Peninsula, Cornwall, Southwest England
18 August 2018

The Helford River on the Lizard Peninsula in Cornwall is a rare example of where ancient oak woodland meets the sea. This special landscape was much studied by the late professor of woodland ecology Oliver Rackham. In Rackham's posthumously published 'The Ancient Woods of the Helford River', he focuses on 25 ancient woods totalling just under 1 square mile in West Cornwall, most of which are on the banks of the Helford River. Rackham describes how these ancient woodlands would be made up of *coppices* and *wood-pasture.* Coppicing is when native trees, such as oak, are cut at the stump but instead of dying they re-sprout and the stump becomes a permanent base called a stool. This method of cutting and re-growth yields successive crops of *poles*, which after centuries of the practice, stools can grow to a giant size of 3 or more metres in diameter.[101] Wood-pasture is a landscape that is formed when low levels of grazing animals like cattle or sheep are allowed to roam and feed in woodlands. According to Rackham, historical references to sheep or cattle feeding in woods in fact means wood-pasture.[102] In wood-pastures trees are widely spaced with grass and heather growing between them. They were often cut high enough above animal browsing to allow for re-growth. This is known as *pollarding* and such trees can be especially valuable for conservation as they are home to rare lichens, bats and insects.[103]
The author of 'The Lost Rainforests of Britain', Guy Shrubsole bestows further value on the Helford River woodlands, showing that this special location hosts a remaining fragment of UK temperate rainforest, and that it is part of the 20% of Britain that could potentially support temperate rainforest ecosystems.[104]

In August 2018 I travelled to the Helford River in Cornwall to meet designer Alex Metcalf, the inventor of the Tree Listening Device, unaware of the immense importance of the Helford

[101] Oliver Rackham, *The Ancient Woods of the Helford River*, ed. by David R. Morfitt (Dorset: Little Toller Books, 2019), p. 25.
[102] Rackham, *The Ancient Woods of the Helford River*, p. 27.
[103] Ibid., p.27
[104] Guy Shrubsole, *The Lost Rainforests of Britain* (London: William Collins, 2022), pp. 74, 90.

River that was about to be unveiled following the publication of 'The Ancient Woods of the Helford River' in 2019 and 'The Lost Rainforests of Britain' in 2022. Our listening destination was Scott's Wood on the north bank of the river next to Scott's Quay. The ancient woodlands that Rackham explores in such depth are privately owned. The advantage of this was that this saved them from 20th century forestry practices.[105] The disadvantage is the lack of public access. However, Scott's Quay, Scott's wood and the farmland around it, have a different narrative. Scott's Quay was built in the early 1800s by Charles Scott who owned the manor house, farmland and mines of the Trewadreva estate. He planted the beeches, oaks, ash and sweet chestnut of Scott's Wood. In the 1930s the land, with the Quay, was bought by Mrs Hext who created a public right of access through the land to the creek frontage. She created a permanent covenant to the National Trust preventing any development on the land, now called Goongillings. The current owners, Charles and Barbara Pugh, came to Goongillings in 1954. They uphold the National Trust covenant and have begun conservation-minded farming practices, such as allowing pastures to revert to meadows and encouraging wildlife diversity. They created a public path round the edge of the farm, along the creek, and through the woods.[106]

Collaborating with Metcalf, who is a local of the Helford River, and visiting the woodland with him, enabled me to access Scott's Wood. Without his place-based knowledge of the site, I would not have known it was possible to visit this part of the river and its surrounding woodland. Scott's Wood is not ancient woodland as it was planted in 1800s, but it is in a special part of the country with the right conditions for significant temperate forest regeneration and the local landowner's commitment towards more ecologically restorative farming methods, as well as a commitment to maintaining historical public access on their land.

In Scott's Wood an ash tree hugged the grassy hill as it rose away from the river. The mature ash leant into the sloping field caused by a lifetime of buffeting by coastal wind. It was a warm but blustery summer's day. Metcalf's Tree Listening Device amplifies sound by 400 times, making it possible to hear vibrations inside trees. The device looks like a cone or miniature trumpet, that when pressed against the ash trunk, revealed two sounds. One was a

[105] Rackham, *The Ancient Woods of the Helford River*, p. 23.
[106] Information obtained from a placard on Scott's Quay. Charles and Barbara Pugh, 'Some Historical Notes for Visitors' [accessed 19 August 2018].

light crackling pop, its delicacy dancing away from the ear, escaping the listening grasp. This was transpiration – the process of water travelling up the tree from roots to leaves through microscopic xylem vessels beneath the bark. The more dominant sound was a bass-y grumble, the sonic texture of a boiling pot of gravel, caused by the wind pushing the tree. I could see skinnier branches jostling in the wind, but it was through listening that I could hear movement within its trunk.

In 2007 Metcalf took his device to Steven Jensen, a specialist in water cavitation at Royal Botanical Gardens Kew, to identify the popping sound. Metcalf learnt from Jensen that water travels up trees through xylem tubes. These tubes are not one continuous straw but are interlinked with valves. The valves have small air pockets in which air spins, known as cavitation, and it is this that creates a popping sound.[107] Despite Metcalf's explanation of the sound of transpiration, I still felt mystified. Metcalf tours his Tree Listening installation, in which small microphones hang under trees' canopies, so visitors can listen to transpiration in situ. He admitted that while most people find it fascinating, some are sceptical. The sound of transpiration is new and strange, and visitors to the installation have no way of checking its authenticity. In place of scepticism, I embraced the un-knowing.

Lisbeth Lipari values how sound reveals novel experiences, stating that listening "requires an encounter with the unknown; listening draws forth something hidden, bringing something new to the world."[108] The experience of listening to transpiration was an instance of encountering the unknown, a previously hidden living process, which even Jensen, who knew it existed, had never heard before using the Tree Listening Device.[109] The sceptics who doubted the validity of the sound were experiencing, as Lipari argues, what happens "when our world changes, when we are drawn beyond the limits of our subjective understanding and knowing – when what we thought we knew or understood… changes."[110] This echoes Pauline Oliveros' explication of the word deep: "Deep has to do with complexity and boundaries, or edges beyond ordinary or habitual understandings… A subject that is "too deep" surpasses one's present understanding or has too many unknown parts to grasp easily."[111]

[107] Alex Metcalf, interview by Liz K Miller, (Cornwall, UK, 18 August 2018).
[108] Lipari, p. 199.
[109] Metcalf.
[110] Lipari, p. 188.
[111] Pauline Oliveros, *Deep Listening: A Composer's Sound Practice* (New York: iUniverse, 2005), p. xxiii.

Although much of my practice is about listening, I am new to both phonography – the audio recording of the everyday[112], and dendrology – the scientific study of trees. The perspective of a neophyte is an advantage, as I can approach these fields with fresh, open ears. Being a receptive listener facilitates changes in perspective and worldview as Lipari postulates:

> It's not about the acquisition of facts or information – our world doesn't necessarily change with new information. Our world only changes when there is a kind of decentring involved, when we come to question…our old views and certainties about the world.[113]

A pertinent example of decentring an established worldview, is provided by Wohlleben. He criticises how the explanation of water transportation from tree roots to leaves is often summarised by capillary action, osmosis and transpiration. He demonstrates that these descriptions are an over-simplification and in fact the process is far from fully understood. To summarise his argument: the annual time of greatest water pressure (and therefore water movement) in trees, is in the spring before leaves open. If the tree is bare, transpiration (leaves breathing out water vapour and in turn drawing further water up the tree) cannot be occurring. Capillary action (the surface of a liquid rising up against the edges of the vessel in which it is contained) has a maximum rise of 3 feet – far short of the height of a mature tree. And osmosis (water flowing through cells to equalise sugar content) only occurs in roots and leaves, not in tree trunks. To compound this lack of knowledge, Wohlleben cites a study in which scientists in Switzerland listened to trees at night, hearing what they thought might be carbon dioxide bubbles in xylem tubes.[114] His conclusion completely dismantles this previously held theory: "Bubbles in the pipes? That means the supposedly continuous column of water is interrupted thousands of times. And if that is the case, transpiration, cohesion, and capillary action contribute very little to water transport."[115] This misunderstanding of water transportation in trees, impels scientists to listen more closely, inquire more deeply, and question their "already well-formed understandings of the world."[116]

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[112] Field recording can also be referred to as phonography. This term echoes photography and expands out of the acoustic ecology and naturalism constraints of the term field recording. For my purposes these two terms are interchangeable.

[113] Lipari, p. 188.

[114] Kathy Steppe, 'Low-Decibel Ultrasonic Acoustic Emissions Are Temperature-Induced and Probably Have No Biotic Origin', *New Phytologist*, 183 (2009), 928–31.

[115] Wohlleben, pp. 56, 59.

[116] Lipari, p. 8.

Audio-enhancing equipment reveals resonances usually hidden from humans. This extends the listening potential and creates possibilities to perceive and experience the un-hearable. The ash trunk appeared solid and silent, yet the Tree Listening Device opened a sonic window into its inner processes. This experience decentred my prior knowledge of trees, providing the opportunity to listen from a non-anthropocentric point-of ear. When I began my search for sylvan sounds, I mistook my drive for reconnection with the forest for a thirst for new knowledge. Despite this epistemophilia, my experiences of sylvan listening, have led me to value not always fully comprehending what I am hearing. Lipari makes a compelling argument for embracing this: "there is great strength in not understanding – in giving up our convictions and certainties to let understanding evolve."[117] Partial knowledge can generate curiosity and excitement over a mystery unsolved.

2.5 Complicated listening

***Burning Logs* field recording**

Caledonian Forest, Glen Affric, Highlands, Northwest Scotland

3 April 2019

During my field trip to the Caledonian Forest, I planned to visit and listen to a famous elm tree. This elm was the sole survivor of Dutch elm disease in Glen Affric. This now infamous tree disease is a fungus spread by the elm bark beetle. Over the past 40 years it has killed millions of elm trees in the UK, changing the landscape forever and continuing to spread.[118] On the planned day of visiting the elm tree an unforgiving rainstorm set in. Although I was well accustomed to recording in rainy conditions, this was extreme enough to make me feel unsafe. Soaked through, I retreated to the bothy. I lit a fire in the stove in the drying outhouse. The wind howled outside, and the rain beat on the tin roof, whilst the fire brought me back to life and comforted me. In the darkness my senses became attuned to the sound of the flames, the rain and the wind. I could hear changes in the environment, the storm swelling and ebbing, the fire dimming and then the sounds of me re-stoking it. During this time of focused listening, I began to distinguish the details of the sound, like the difference between a raindrop down the stove pipe and the crackle of a log sparking.

[117] Lipari, p. 139.

[118] The Woodland Trust, 'Dutch Elm Disease' <www.woodlandtrust.org.uk/trees-woods-and-wildlife/tree-pests-and-diseases/key-tree-pests-and-diseases/dutch-elm-disease/> [accessed 14 September 2022].

Despite feeling revived and safe, this situation made me uneasy. As mentioned previously, my trip to Glen Affric was with Trees for Life, a charity with the highest credentials in sustainable forestry practice and land regeneration. The bothy belonged to Trees for Life and the wood provided to burn would undoubtedly have been sustainably collected. My research is premised on respect and celebration of trees and yet, here I was, consuming and destroying wood.

Within my listening practice I choose not to ignore or deny complications, but to expose and acknowledge them. I follow Tim Ingold's interpretation of the term 'complicate' meaning 'folded together'.[119] The prefix 'com' stems from the Latin for 'with'[120] and the meaning of 'plicate' is folded or pleated.[121] For Ingold, the 'com' in complicate means "we join with things in their passage through time, going along together with them, working with them, and suffering with them."[122] The listening experience inside the bothy in Glen Affric crumpled me together with the wood, juxtaposing an enchanting sylvan soundscape with my awkward ethical entanglement in its creation.

Ingold favours 'complicate' over 'assemblage'. In his challenge of 'assemblage', Ingold states that in Deleuze and Guattari's native French, the term they used was 'agencement', which translates as 'arrangement' or 'fitting together'. For Ingold, Bennett's use of the term assemblage describes "an arrangement of things, a layout."[123] He suggests, instead of arranging elements together in the assemblage, to complicate is a braiding of elements which better describes thinking through interconnectivity. For me, what is useful about the term complicate, is that it implies ambivalence. As Morton reminds us "[i]nterconnectedness isn't snug and cozy."[124] My efforts to attune myself to the sounds of the forest are simultaneously grounding and unsettling. I acknowledge the complications of my listening practice, both ecologically positive (reconnecting to land), and negative (consuming wood).

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[119] 'Complicate', *Oxford English Dictionary [Online]* <https://www.oed.com/view/Entry/37705?rskey=qKdPNr&result=2&isAdvanced=false#eid> [accessed 25 October 2022].

[120] 'With', *Oxford English Dictionary [Online]* <https://www.oed.com/view/Entry/34948#eid9209081> [accessed 25 October 2022].

[121] 'Plicate', *Oxford English Dictionary [Online]* <https://www.oed.com/view/Entry/145816?rskey=FujUVV&result=1&isAdvanced=false#eid> [accessed 25 October 2022].

[122] Tim Ingold, 'In the Gathering Shadows of Material Things', in *Exploring Materiality and Connectivity in Anthropology and Beyond*, ed. by Marlen Elders, Martin Saxer, and Philipp Schorch (London: UCL Press, 2020), pp. 17–35 (p. 24).

[123] Ingold, 'In the Gathering Shadows of Material Things', p. 20.

[124] Morton, *The Ecological Thought*, p. 31.

Ingold equates complicating, braiding or folding together, to the act of gathering: "what makes a gathering more than the mere juxtaposition of elements is the drawing together of the pathways along which its constituents have come into being".[125] He uses the example of a stone wall, where stones are not separate elements stacked next to one another but gathered together, each with a story of how it arrived and settled. Further to this, the stones are not the only element in the gathering of the wall, "lichens, moss, plants and animals both large and small are folded together, or complicated, in the gathering, becoming part of each other's stories."[126] Searching for sylvan sounds has proved to be a fusion of disparate elements: spending time listening to trees (ethical); learning about tree diseases, ant behaviour and rewilding (new knowledge); traveling to forests (environmental costs of fuel); recording equipment (materials extraction); and making a wood fire (personal consumption). These elements, both ecologically positive and negative gather together to form the narrative of my complication with trees. Which leads me to consider: does the process of reconnection with forests outweigh the ecological costs of taking part in that process?

Instinctively, I feel that it is necessary to show up, that reconnecting with landscape is an embodied experience. My instinct is supported by both Ingold and Kimmerer. Ingold argues: "Knowledge of the world is gained by moving about in it, exploring it, attending to it… acquiring the skills for direct perceptual engagement with its constituents, human and non-human, animate and inanimate."[127] In other words, learning about the world means physically engaging with the world. One of Kimmerer's guiding ecological principles is developing a relationship with landscape. She insists:

> Restoring land without restoring relationship is an empty exercise. It is relationship that will endure and relationship that will sustain the restored land. Therefore, reconnecting people and the landscape is as essential as reestablishing proper hydrology or cleaning up contaminants.[128]

Listening to the forest is my method of engaging with the multi-species world. Being physically present enables me to develop a relationship with trees and learn a better way to respond to what is needed from me. This is what Voegelin might call an "ethics of

[125] Ingold, 'In the Gathering Shadows of Material Things', p. 24.
[126] Ibid., p. 25.
[127] Ingold, *The Perception of the Environment*, p. 55.
[128] Kimmerer, p. 338.

participation"[129] in which through listening I am creating opportunities for engagement, sense making and perception change. As a human, I am both an active participant of, and responsible for, the Earth. My listening practice is, in the words of Donna Haraway, a way of "cultivating response-ability" for the multi-species Earth.[130]

2.6 Listening positionality

The journey of reconnection to my homeland is further complicated by what my research has taught me about learning from indigenous cultures, specifically their reciprocal relationship between land and people. Robinson's request to "listen in relation with their knowledge systems"[131] is crucial to a visitor and newcomer to indigenous culture, such as myself. This task entails a shift in mindset that Robinson helps to facilitate. He poses that a difficult yet necessary effort for this endeavour is to recognise listening positionality – the privileges, abilities, habits and biases of the listener. Disrupting my habits and biases are at the heart of my listening practice as I devote attention to the unheard sounds of the forest. Along this journey I've been surprised by finding sylvan-animal interconnection, confronted and confused by not fully understanding the sounds I discovered, and forced to wrestle with my listening complication. But what of my privilege and ability?

I am middle class, white, educated, and able-bodied, born and brought up in the UK – the fifth richest country in the world. Engaging with this study as a PhD candidate has provided three further privileges: dedicated time for listening field trips; funding from my PhD consortium; and connections that the PhD platform enabled me to make. These are specifically, Surrey Hills Arts for Blackheath Forest, designer Alex Metcalf for Scott's Wood, the Murmurations gathering of listeners for Forest of Mar, and Trees for Life for Caledonian Forest. Above all, my most essential privilege was an upbringing that gave me the opportunity to experience mountains, forests, walking tracks, moors, downs, peat bogs, camping, river swimming and exploring, with knowledge and support to guide me. This journey of reconnection begins with an incredibly lucky foundation.

Bearing in mind the formative experience of my childhood, an unexpected insight arose during my search for sylvan sounds. When listening in relation with indigenous knowledge

[129] Voegelin, *The Political Possibility of Sound*, p. 36.

[130] Donna Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham: Duke University Press, 2016), pp. 34, 130.

[131] Robinson, p. 51.

systems, Robinson suggests engaging in 'guest listening' in which each listening experience is an act of "entering into a *sound territory.*"[132] Whilst listening in forests, I have had a growing realisation of being a guest in my own homeland. My listening practice has revealed that I have been an inattentive guest for most of my life. Through listening, I am beginning to cultivate a deeper understanding of my native landscape.

I regard my practice as curious listening. This approach is not a mission to find answers, facts or solutions that, as a member of a dominant species, I might manipulate to my advantage. Soundscapes are not mine to control, but moments in which I can participate, perhaps not fully understand but nonetheless, value for their uniqueness. Tsing emphasises how important curiosity is for the process of connection: "Without meaning to, most of us learn to ignore the multi-species worlds around us. Projects for re-building curiosity… are essential work for living with others."[133]

Searching for Sylvan Sounds is a method of engaging with the multi-species world around me. The choice of the word 'for' in the title, is selected for its meaning to do something 'on behalf of' another being.[134] A gift to that being. I offer trees the gift of my listening time and energy in thanks for all the gifts they willingly give – shelter from the rain, cooling on a hot day, their stabilising presence, the oxygen I breath, the visual splendour of greenery and flowers, and the fruit I eat. Of the many forest sounds that ask for my attention, it is sylvan sounds to which I devote my focus and curiosity.

2.7 Conclusion

Listening to sylvan sounds enabled two paths of reconnection to the forest landscape.

First, listening revealed hidden and unnoticed sylvan treasures, such as materiality, interior activity and multi-species symbiosis that would be otherwise be ignored, filtered out or hidden. That inside seemly solid and silent sylvan matter is a vibrant world of interconnected beings and processes.

Second, listening generated a personal response to sylvan sounds. That instead of finding answers and accumulating knowledge, embracing not-understanding is part of the process of

[132] Robinson, p. 53.

[133] Tsing, pp. 281–82.

[134] 'Behalf', *Oxford English Dictionary [Online]* <https://www.oed.com/view/Entry/17187?redirectedFrom=behalf#eid> [accessed 25 October 2022].

reconnection to nonhuman landscapes. Also, acknowledging that my ecological efforts can still contribute to sylvan destruction and that this complication is something I must stay with and not deny within my art practice and research, as without participation, reconnection cannot begin.

Listening with open-minded curiosity is not a finalised method but an iterative practice and process. Listening forced me to slow down and re-consider forest landscapes that I thought I knew, yet through close listening, an entirely novel sonic perspective revealed itself. Audio-enhancing field recording equipment provided access to acoustic resonances beyond the hearing-range of the human ear, allowing exploration of a wider range of sylvan sounds inside trees.
There are myriad sylvan sounds that I have not yet experienced such as pinecones splitting open, tree roots creaking or a range of sylvan susurrations. These are potential areas of further study which could lead to insights on tree fruits, roots and leaves, their interconnections and processes.

This chapter has been a practical response to my disconnect from the earth within the overwhelming force of ecological breakdown. Through searching for, and listening to sylvan sounds, I have sought a path towards reconnection with the organic landscapes of my homeland. How might I expand on this highly personal experience? How might I present sylvan soundscapes to others and to what field might they contribute?

In chapter two I consider making public my field recordings and how sylvan soundscapes might contribute to ecological sound art. I compare the iterative performances and presentations of my sound work, *Listening to Sylvan Sounds*, with contemporary sound works that also explore the forest soundscape through an ecological lens.

3. Presenting Sylvan Soundscapes

3.1 Introduction

The previous chapter explored listening as a method for attuning to the forest in this time of climate and ecological breakdown. It explored how listening to the sounds made by trees might reconnect humans to the forest. Listening to sylvan sounds, and gathering field recordings, enabled two paths of reconnection: unnoticed sylvan treasures revealed themselves, such as materiality, interior activity and multi-species symbiosis; and personal responses to sylvan sounds were generated through first, embracing not-understanding and second, acknowledging that despite my efforts, it was impossible to completely avoid contributing to sylvan destruction.

This chapter is generated from invitations to present my gathering of sylvan soundscapes. In response to interest in my field recordings, I wanted to know if listening to the sounds made by trees was a new area of study within ecological sound art. The chapter compares the iterative performances and presentations of my sound work, *Listening to Sylvan Sounds*, with contemporary sound works that also explore the forest soundscape through an ecological lens. The three presentations of *Listening to Sylvan Sounds* are:

1. A radio broadcast on *Radiophrenia* selected for their series exploring current trends in sound and transmission arts on 15 November 2020. (Pre-recorded and designed as an audio-only experience).
2. A live sound event for the publication launch of *I am Listening to You*, broadcast from the Gunnersbury Triangle in West London on 17 August 2020. (Streamed online due to Covid-19 social distancing restrictions).
3. A live sound event on a cliff top at the *Listening to Field, Body and Voice* Summer School in Bude, Cornwall on 12 June 2019. (Outdoors)

Chapter three considers the question: What might sylvan soundscapes contribute to ecological sound art? Before exploring this question, I briefly outline two areas of study. The first is a methodological positioning: Why make field recordings? And what are the issues with field recording? The second is a review of sound works by renowned field recordists to position the making-public of my recordings in the wider field.

3.2 Field recording

Field recording was an essential tool for my deeper sonic engagement with woodlands as the combination of microphones and recording device enabled greater amplification of sounds. My position is supported by three experts in technology and sound. Oliveros noted, "The microphone and tape recorder became extensions of my body and amplified my hearing."[135] Sociology professor Jennifer Gabrys describes the world of sensors as amplified connections that reveal undetectable phenomena and create opportunities for alternative encounters, engagements and relations.[136] Late scholar of digital technologies and environmental issues Karen Bakker outlined how human physiology (and psyche) potentially limits our capacity to listen to the multispecies world around us. Her research into the field of bioacoustics[137] and eco-acoustics[138] (also sometimes called to acoustic ecology[139] and soundscape studies[140]) suggested that digital technology creates opportunities to listen more deeply to the nonhuman world, and in doing so, revive connections with our multispecies kin.[141]

When listening in woodlands, I used four microphones: omni microphones (in the open air); hydrophones (in water); and contact microphones and the Tree Listening Device (inside solid matter).[142] This combination enabled a range of internal and external sylvan listening

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[135] Pauline Oliveros and others, *Sounding the Margins: Collected Writings 1992-2009*, ed. by Lawton Hall (New York: Deep Listening Publications, 2010), p. 213.

[136] Jennifer Gabrys, *How to Do Things with Sensors* (Minneapolis London: University of Minnesota Press, 2019), pp. 1, 54, 56.

[137] Bioacoustics is the scientific study of sounds made by non-human animals. See, N. H. Fletcher, 'Animal Bioacoustics', in *Springer Handbook of Acoustics*, ed. by Thomas D. Rossing (New York: Springer, 2007), pp. 785–804.

[138] Eco-acoustics is the scientific study of sounds generated by entire landscapes. See, Barry Traux and Gary W. Barrett, 'Soundscape in a Context of Acoustic and Landscape Ecology', *Landscape Ecology*, 26.9 (2011), p. 1201. And Bernie Krause and Almo Farina, 'Using Ecoacoustic Methods to Survey the Impacts of Climate Change on Biodiversity', *Biological Conservation*, 195 (2016), 245–54 (p. 245) <https://doi.org/10.1016/j.biocon.2016.01.013>.

[139] Acoustic ecology is the study of the social, cultural, ecological and aesthetic aspects of the sonic environment, approaching the discipline from an anthropological perspective. See, World Forum for Acoustic Ecology, *About the WFAE*, 2021 <https://www.wfae.net/about.html> [accessed 12 April 2022], R. Murray Schafer, *The Soundscape: Our Sonic Environment and the Tuning of the World* (Rochester, Vermont: Destiny Books, 1994), p. 7, and Barry Traux, *The World Soundscape Project's Handbook for Acoustic Ecology* (Vancouver, B.C: ARC Publications, 1978).

[140] Cities also have soundscapes. When created, the term *soundscape* was first applied to urban sound. See, Michael Southworth, 'The Sonic Environment of Cities', *Environment and Behavior*, 1.1 (1969), 49–70.

[141] Karen Bakker, *The Sounds of Life: How Digital Technology Is Bringing Us Closer to the Worlds of Animals and Plants* (Princeton Oxford: Princeton University Press, 2022), p. 2.

[142] The Listening Device could be made from an accelerometer that measures extremely fine vibrations. I would like to thank Eric Leonardson, Peter Cusack and Budhaditya Chattopadhyay for a wonderfully informative discussion about the potential creation method of Alex Metcalf's invention at the Beyond Listening conference (Budapest, 21 – 25 November 2023).

perspectives.[143] At times the surrounding noise was muffled but audible and at times it was eliminated. My intention was to amplify some sylvan sounds, but not erase others. The amplified sounds could be uncomfortable (the intense grumbling of the tree movement in the *Transpiration* recording), confusing (the pop of transpiration), or surprising (the squeak of ants). Field recording equipment enabled a listening experience beyond my human hearing range. Extended listening sharpened my senses and attuned me to sylvan activity I had previously neither heard nor considered. Thus began the process of considering woodlands from a more-than-human perspective.

A second reason for recording in all the above scenarios was because I wanted to be able to listen back in the studio, and in doing so understand the recordings on a deeper level. This stance is supported by sound scholar Mark Peter Wright, who notes that by listening again and again to recordings, it is possible to begin asking how listening changes.[144] In the studio I analyse the decisions I had made in the field and consider how my perception of my field recordings changes with each re-listen. Omni microphones record 360 degrees of sound in an environment, so when listening back to *Rainstorm in a Chestnut Grove* I noticed extra technological sounds like planes and trains. And when listening back to *Burning Logs* I noticed the sounds of me restoking the fire. In the field I focused on signal sounds (rain hitting leaves and burning logs) but the recordings made me aware of my own human presence in the environment – the train that brought me to Blackheath Common, and my active participation in the burning wood.[145]

In the previous chapter I discussed ecological complications and privileges embedded within the act of listening. These are equally implicated in the act of field recording. Wright notes that field recording evolved from ethnomusicology and wildlife sound recording and from these practices it inherited the myth of recordist as sound preserver and saviour, as well as the falsehood of technological objectivity and neutrality. These myths portray the recordist as

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[143] Omni microphones recorded *Oak Leaves*, *Rainstorm in a Chestnut Grove*, *Burning Logs* and *Creaking Pines* from the open air. Contact microphones recorded inside *Fallen Pine Needles* and a *Decaying Birch Log.* The Tree Listening Device augmented the sounds of *Transpiration* and trunk movement inside an ash tree. Hydrophones recorded a *Rainstorm inside Forest Earth* and a *Rainstorm Inside a Forest Puddle*.

[144] Mark Peter Wright, *Listening after Nature: Field Recording, Ecology, Critical Practice* (New York: Bloomsbury Academic, 2022), p. 153.

[145] In chapters four and five I describe how my nine field recordings became vital for deeper exploration and analysis of sylvan soundscapes in my sound diagramming practice, and even more vital when I came to exhibit my sound diagrams as audio-visual installations, where the presence of the original soundscape alongside the visual imagery created from it was an essential aspect of the multi-modal artwork.

neutral witness which is often considered justification for recording and collecting sound. Wright argues that: "Listening and sound are full of complex erasures and violations that leave field recording in no better position than any other creative modality."[146] Field recording evolved in the colonisers' tool kit, with recordists documenting and archiving the banned and silenced songs of displaced indigenous peoples in USA.[147] Yet the legacy of these recordings is recoded as a practice of "archival conservation and the white savior recordist."[148] The conservation and preservation of animal sounds and ecological soundscapes, often a motivating force within bioacoustics and acoustic ecology, can also be considered, Wright argues, as a form of mining nonhuman sounds for capital across arts and culture.[149] The fact that animals and plants lack consent, does not mean that they have no rights.[150] Recordists may be benefiting financially or professionally from their recordings, but in what capacity is that benefit being returned to the landscape? Composer and sound ecologist Hildegard Westerkamp highlights the danger of recording enchanting sounds that carry little meaning beyond being captivating.[151] Further challenges of the sound saviour myth from Wright are that nothing lasts forever, certainly not sonic media which can be degraded, lost or corrupted,[152] and that field recording is not an objective historically factual document. It is a version of events created by the recordist in which what is edited out is as important as what is left in. The human recordist holds all the decision-making power in an unequal balance with the nonhuman being recorded. Wright states: "This is not an argument against conservation but an acknowledgement that all histories, whether analogue or digital, are formed upon partial truths; decisions and agendas, fallibilities, and fragments."[153] One final point that I will draw from Wright is the extensive consumption of natural resources that are used in constructing microphones, portable recording devices, headphones, laptops for sound analysis, and cloud storage, to name just a few essential digital devices used within field recording.[154] I touched on this topic while discussing my complicated listening practice

[146] Wright, p. 10.
[147] Ibid., pp. 14–15.
[148] Ibid., p. 16.
[149] Ibid., p. 45.
[150] Ibid., p. 43.
[151] Hildegard Westerkamp, 'Speaking from Inside the Soundscape', in *The Book of Music and Nature: An Anthology of Sounds, Words, Thoughts*, ed. by David Rothenberg and Marta Ulvaeus (Middletown, CT: Wesleyan University Press, 2001), pp. 143–52 (p. 149).
[152] Wright, p. 46.
[153] Ibid., p. 47.
[154] Ibid., pp. 117–19.

but it is worth highlighting it again as it emphasises how both listening and field recording are not ecologically neutral but in fact are as entangled in the extraction and consumption of materials as any other artistic process.
Considering these ethical and ecological complications, Wright proposes that instead of simply not recording, an opportunity is created here to acknowledge the blind spots and erasures of field recording and sonic media. New possibilities arise here for artistic sonic exploration into the process and action of field recording which could include an acknowledgment within sound works of the actions and the presence of the field recordist.[155]

The nine field recordings that I chose to include in this research all amplified the sounds of trees, and through them I learnt about woodlands and trees and my relationship with woodlands and trees. I chose to focus on trees after identifying an omission within the field of soundscape ecology.[156] Soundscape ecology identifies soundscapes from three acoustic sources: geophony, biophony and anthropophony. Geophony is earth sounds such as wind, rain and thunder. Biophony is the sounds of birds and non-human animals. Anthropophony is all sounds created by humans including speech, industry and music. However, within this terminology there is no category for the sounds of plant and tree life. Botanical and sylvan species are living, and so not geophony, but neither are they animals, birds or insects, so they are not biophony either. This omission is the sonic equivalent to plant blindness, the human inability to notice plants, recognise their role on earth, and believe them to be inferior to animals.[157] Remembering Voegelin and LaBelle's writing concerning the power of listening out for the inaudible and underheard, and my intention to reconnect with the forest through listening to its in-between sounds, my listening studies led me to identify that the most vital part of the forest, its living support system and network – the trees – are omitted from the lexicon and categorisation of the types of sounds that can be heard, studied, listened to, and learned from within soundscape ecology.

[155] Wright, p.41.

[156] The focus of soundscape ecology is all sounds heard at a location including animal sounds, the sounds of geological forces and human sounds. Here, less focus is placed on the impact of sound *on* humans, and more on the study of the soundscape itself, its processes and functioning, *without* human interaction, influence or impact. See, Bryan C. Pijanowski and others, 'Soundscape Ecology: The Science of Sound in the Landscape', *BioScience*, 61.3 (2011), 203–16 (p. 204) <https://doi.org/10.1525/bio.2011.61.3.6>.

[157] Ainara Achurra, 'Plant Blindness: A Focus on Its Biological Basis', *Frontiers in Education*, 7 (2022) <https://doi.org/10.3389/feduc.2022.963448>.

Animal soundscapes are the focus of the founder of soundscape ecology, Bernie Krause's phonographic research. As such, it is logical that he would organise all other sounds into categories that are not animal. It was savvy to create two other categories – human sounds and earth sounds – that are broad enough to encompass all sounds not made by animals. I understand Krause's inclination to consider trees as geophony,[158] as they are not animals, and the most common sounds associated with trees are when their leaves vibrate from wind movement or rain bombardment. However, I argue that when the wind blows or the rain falls in a forest, it is in fact not the rain or the wind that we are hearing, but the tree leaves. When a musician beats a drum, we do not hear 'the beat of a person', we hear 'the beat of a drum'. So too in the forest. The wind and rain are the forces that generate sound, but the sounds themselves come from the vibrations and movements of the tree materials – leaf, branch and bark.[159] As a result of wanting to rectify the omission of tree sounds within soundscape ecology, to describe the sounds made by trees I use the term *dendrophony*. Dendron, meaning tree, follows the Greek etymology of bio (life), geo (earth) and anthropo (human) as used by Krause.[160] Although I came to the term dendrophony independently in 2018, others have similarly used it to describe their work thinking about the sound of trees with examples between 2015 to 2022 including classical composition inspired by trees, audio and VR compositions created from sylvan sonic data, and interpreting the stories of trees within eco-critical walking practices.[161]

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[158] I am grateful to Krause for discussing my suggestion for developments within soundscape ecology with openness and generosity. He wrote to me: "...you are right about the sound of trees which become a gray [sic] area. If I needed to make a choice, the internally created signature of a tree would probably be considered a geophonic resonance since is it not created by something that could commonly be deemed an animal organism... However, I'm not certain about that, myself. Perhaps, it needs a transitionally descriptive word to make more clear the indistinct lines." Bernie Krause, email to Liz K Miller, 26 July 2019.

[159] The example of the wind and the rain highlight how tree sounds are often dependent on their relationship to geophonic forces. A key aspect of my sylvan listening practice is the relational quality of tree sounds which I explore in more detail in chapter four.

[160] *Sylvan soundscapes*, the thesis title, uses the term sylvan, meaning forests, woods and trees in Latin. This term is used to describe my audio gathering process, as some of the soundscapes I record are not strictly made by trees but are closely linked to trees and certainly recorded within woods and forests. I explore the difference between sylvan sounds and the dendrophony in chapter four.

[161] I list five examples of the uses of dendrophony by others. This list is not exhaustive. 1. A classical composition expressing the essence of a tree throughout changing seasons. (Marcus Hatfield, 2015) 2. A virtual, audio-visual tree that grows in response to real-time recorded tree sounds (Krzysztof Krzysztof, 2016). 3. 'Ex Arboris' described as a 'dendrophony for string quartet' (Carmine-Emanuele Cella, 2015). 4. Tiziano Fratus wrote that a dendrophony is "a composition achieved by recording the sounds and noises of a tree, sometimes in different atmospheric conditions, mixed and possibly accompanied by or inserted into music composed for the occasion." Tiziano Fratus, 'Walking Roots: Knitting Past and Future through Italy's Woods' in *Italy and the Environmental Humanities: Landscapes, Natures, Ecologies*, ed. by Serenella Iovino, Enrico Cesaretti, and Elena Past (Charlottesville: University of Virginia Press, 2018), pp. 235–241 (p. 237). 5. Fratus' description was discussed by Paolo Saporito for interpreting tree sounds into tree stories – dendrophonies into dendrostories –

Having chosen to conduct a close study of nine sylvan soundscapes, this meant choosing not to use recordings with a watery focus, an animal focus, or a human focus. The unused recordings are digitally stored for future artistic studies with alternative focuses. As Wright reminds us: "Waste is… a decision-making problem for any recordist. Sonic detritus, so often consigned to digital trash, is reclaimed as part of a critical field recording practice."[162]

Within my selection of nine field recordings, I notice that I have been seduced by one of the dangers of field recording: "the aesthetics of sublime sound objects."[163] Following Bruno Latour's conundrum of negotiating matters of concern with matters of fact, Wright queries how recordists might balance "sound's powerful ambiguity" with "the geopolitical context of its making."[164] Whilst rustling oak leaves attract my attention, I ignore the controversial wind turbines at Cloceanog Forest; when being surprised by the sound of ants in a decaying birch log, I'm not attending to the politics of rewilding sites; and when being confounded by the sound of transpiration I don't address the issue of privately owned land on the Helford River containing the precious fragments of UK rainforest. The complications of my own actions and presence rise to the surface when listening to burning logs, but without context even this soundscape is simply a sonically enchanting atmosphere. This is a study of my personal connecting and learning experience through sylvan sounds that spark my imagination, confusion and wonder. This has necessitated excluding other important aspects of sites such as their political complications. This point returns to the question, how has my listening changed? Perhaps my future listening studies could embrace, in the words of Wright, "the absurd and monstrous, flawed and fragile"[165] as there is an abundance of this within UK forestry practice.

Sound creates knowledge about objects and bodies, by rendering them as dynamic, in process and in motion.[166] According to Peter Cusack, sound, and field recording in particular, enables "subjective engagement and intuitive understanding" of an event or place as it can "transmit a

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within eco-critical walking practices. Paolo Saporito, 'Walking: Ecocritical Encounters with Storied Matter', in *Italy and the Ecological Imagination: Ecocritical Theories and Practices*, ed. by Damiano Benvegnù and Matteo Gilebbi (Delaware: Vernon Press, 2022), pp. 71–88 (p. 78).

[162] Wright, p. 137.

[163] Ibid., p. 138.

[164] Ibid, pp. 138–39.

[165] Ibid, p. 154.

[166] Salomé Voegelin, *Listening to Noise and Silence: Towards a Philosophy of Sound Art* (New York: Continuum, 2010), p. 11. LaBelle, p. 32.

powerful sense of spatiality, atmosphere and timing."[167] For Voegelin, sound reveals the unseen complexity of the world, highlighting "the minor, the supressed, the hidden and the ignored"[168] which offers a new perspective on the world.[169] As such, sound is a generator of non-visual experiences[170] with the capacity to create sensory knowledge.[171] This sonic sensory stimulus can be an affective trigger for strong emotions and feelings[172] as it has the capacity to disturb and unsettle,[173] as well as enchant and enliven. For Michael Gallagher sound doesn't need to convey meaning to have affect. For example, bird song is enjoyable despite not understanding what the bird is communicating, and the brilliance of a composer is irrelevant if the playing of loud music is unwanted or disturbing.[174] Sylvan sounds taught me about the interrelationships between trees, forest animals and earthly elements, revealing how sylvan matter is just as much an active sonic element of the forest as animals or precipitation. The sounds in this study also had a powerful decentring emotional effect. As Wright reminds us, hope for the future, that finds flight in the practice of field recording, requires paying attention to the obscure, the inaudible, and the unrecognisable, and that this field "is felt and full of friction and unease."[175] Friction and unease played out in my listening in two ways – I was forced to alter my mindset to embrace partial understanding, allowing the unsettling process to generate curiosity whilst resisting the urge to strive for definite answers, and I was forced to acknowledge uncomfortable ecological implications embedded within my listening activities.

3.3 Field recordists

This review compares the presentation of *Listening to Sylvan Sounds* with selected sound works by six renowned field recordists who create rich and illuminating portraits of

[167] Peter Cusack, 'Field Recording as Sonic Journalism', in *On Listening*, ed. by Angus Carlyle and Cathy Lane (Axminster, Devon: Uniformbooks, 2013), pp. 25–29 (p. 26).
[168] Voegelin, *The Political Possibility of Sound*, p. 31.
[169] Ibid., p. 108.
[170] LaBelle, p. 32.
[171] Voegelin, *Listening to Noise and Silence*, pp. 177–78.
[172] Ibid., p. 177.
[173] David Toop, *Sinister Resonance: The Mediumship of the Listener* (New York: Continuum, 2010), p. xiv.
[174] Michael Gallagher, 'Listening, Meaning and Power', in *On Listening*, ed. by Angus Carlyle and Cathy Lane (Axminster, Devon: Uniformbooks, 2013), pp. 41–44 (pp. 42–43).
[175] Wright, p. 155.

environments, locations, and spaces – Peter Cusack, Jana Winderen, Leah Barclay, Chris Watson, Hildegard Westerkamp and Annea Lockwood.

Through the audio topography of oceans, rivers, glaciers, seas and shores, Jana Winderen researches the hidden sonic depths of aquatic environments revealing complex and strange unseen worlds. Her immersive multi-channel sound installations and concerts provide insight into places and creatures which humans find both physically and aurally difficult to access, shining an aural spotlight on aquatic species some of which have existed for millions of years longer than humans. Winderen notes that listening to the subtle sounds of ice or the smallest creatures "gives you access to another dimension… one that you are not used to having to understand."[176] As such, Winderen's compositions are a parallel study to my own exploration of underheard sylvan sounds with similar ecological intentions of attracting attention to vulnerable and essential ecological spaces. Her compositions are layered and complex. They feel abstracted and other-worldly, leading to imaginative wonderings as to what exactly might be sounding, and how (as do my own field recordings). She described her method of composition to me as telling stories through soundscape composition.[177] Grounded in scientific knowledge about aquatic ecology, Winderen imagines future scenarios in which water landscapes have evolved due to on-going change and destruction by humans.[178] Winderen's sonic presentations differ from my own, in that she composes with sound, and I compose with the visual. I present field recordings as individual soundscapes and they are the catalysts for my visual artworks.

Spring Bloom in the Marginal Ice Zone (2018) is a 35-minute composition created from field recordings from the Barents Sea, of plankton blooming, sea ice shifting and cracking, and animals that all depend on the spring bloom, such as seals, whales, saithe, crustaceans and cod. The marginal ice zone is an ecologically vulnerable border between sea ice and open sea. In springtime, the phytoplankton bloom in this zone creates the most valuable CO^2 sink in our biosphere.[179] I experienced this as an audience member in a darkened venue which contributed to an immersive sonic experience.[180] However, for the presentation of my own

[176] *In the Field: The Art of Field Recording*, ed. by Cathy Lane and Angus Carlyle (Axminster: Uniformbooks, 2014), p. 151.
[177] Jana Winderen, interview by Liz K Miller, 18 September 2019.
[178] Winderen.
[179] Jana Winderen, 'Sprint Bloom in the Marginal Ice Zone' November 2018 <https://janawinderen.com/releases/spring-bloom-in-the-marginal-ice-zone> [accessed 11 December 2023].
[180] Recorded performance 'Music and Other Living Creatures', 15 September 2019, Café OTO, London, and live performance 'Touch Presents', 28 September 2019, Café OTO, London.

sound works, I wanted to return to the outside environment to see if there could be an element of audience attunement to landscape through listening to the recordings, just as I had felt attuned whilst making them.

Leah Barclay is a composer, sound artist and researcher whose environmental sound compositions draw attention to fragile ecosystems and changing climates. Barclay incorporates a variety of techniques including of field recording, live streaming, immersive sound diffusion and data sonification.[181] Since 2012 Barclay has used her Sonic Ecologies framework, a multi-platform approach in which a single project can result in a variety of outcomes such as live performances, interactive installations, sound maps, site-specific interventions, publications, community engagement, and documentaries.[182] During this time, her practice shifted from composing music in response to the environment to designing participatory projects that encourage community listening and "inspire connection with major ecosystems across our planet through sound."[183] These projects span the fields of both arts and sciences and enable Barclay to position acoustic ecology as an interdisciplinary field that can inspire climate action and help us understand the complexities of changing environments. Barclay's projects explore environments from subtropical cloud forests, and pacific islands, to temperate desserts, and aquatic ecosystems. Three examples are *The Dam(n) Project* (2011-present), *River Listening* (2014-present) and *Sonic Reef* (2017-present). *The Dam(n) Project* is a sound work composed from field recordings of the Narmada River in North India and the songs and stories of local people, protesting peacefully against the damning of the river by hydroelectric companies. *River Listening* and *Sonic Reef* are art-science projects that measure the health and biodiversity of aquatic ecosystems, and aim to connect communities, and enable audiences to learn about, river systems and the Great Barrier Reef. This is done through field recording workshops, and audio walks that combine field recordings, live feeds from hydrophones, interviews and soundscape compositions.

An aspect of Barclay's work that resonates with my own research is her use of field recording and listening to connect people with place so that we might understand and value our precious and changing landscapes. The difference between our working methods is that she

[181] Leah Barclay, 'Biography' <http://leahbarclay.com/biography/> [accessed 11 December 2023].

[182] Leah Barclay, 'River Listening', in *Environmental Sound Artists: In Their Own Words*, ed. by Frederick W. Bianchi and V. J. Manzo (New York: Oxford University Press, 2016), pp. 69–76 (pp. 70–71).

[183] Leah Barclay, 'Acoustic Ecology and Ecological Sound Art: Listening to Changing Ecosystems', in *Sound, Media, Ecology*, ed. by Milena Droumeva and Randolph Jordan (Switzerland: Palgrave Macmillan, 2019), pp. 153–77 (p. 155).

has developed her Sonic Ecologies Framework into a community-based practice over 11 years post PhD, whereas my own listening, field recording and sound diagramming practice is in the early stages of development, meaning that currently it is still a very personal endeavour.

Peter Cusack is a field recordist, researcher and musician, with particular interest in how sound communicates a sense of place. In *Sounds from Dangerous Places* (2006-12) he explores sites affected by serious environmental damage or change, such as the Bibi Heybat oil fields in Azerbaijan, which are heavily polluted with devastating consequences for the local population. Cusack highlights the danger for local inhabitants "who have no option to leave or through the location's role in geopolitical power structures."[184] Listening to *Sounds from Dangerous Places Vol. 2 (Caspian Oil and UK Sites)*, I am mesmerised by the rhythmic nodding-donkeys, melodic motor chugs and clinking chains, in line with Voegelin who comments: "A lot of these sounds are terribly beautiful, not dangerous at all."[185] Here, it's worth remembering Westerkamp's warning: "How do we avoid the very real danger of simply creating… one more CD with yet more amazing sounds?"[186] Cusack deliberately creates a disconnect between beguiling soundscapes and their troubling context.[187] The field recordings are presented alongside documentary style photographs and text, the product of extensive research. Cusack calls his multi-modal method of audio-visual presentation sonic-journalism.[188] Through this technique Cusack draws an audience in with beguiling sounds whilst also challenging them to learn about the context of the sound-making environment. Like Cusack, the presentations of my field recordings include context. However, while his document the dangerous conditions in which others are forced to live, mine are introspective, inviting the audience to share my reflections of, and discoveries made, on my listening journey. A further similarity is the presentation of short, un-layered sound samples. I feel that for Cusack's work, this emphasises his documentary style, whereas I use it to emphasise each separate listening moment, not as a composition, but as one of a group of individual learning experiences, all subtly different. (Furthermore, we both use images, but whilst Cusack's are

[184] Peter Cusack, 'What Can We Learn of Dangerous Places by Listening to Their Sounds? <https://sounds-from-dangerous-places.org/about> [accessed 11 December 2023].
[185] Voegelin, *Listening to Noise and Silence*, p. 159.
[186] Westerkamp, 'Speaking from Inside the Soundscape', p. 149.
[187] *Autumn Leaves: Sound and the Environment in Artistic Practice*, ed. by Angus Carlyle (Paris, France: Association Double-Entendre in association with CRISAP, 2007), p. 81.
[188] Cusack, pp. 25–26.

documentary photographs, mine are sound diagrams created from my field recordings. This aspect of my work will be discussed in chapter five.)

In the following review of sound works by Hildegard Westerkamp, Annea Lockwood and Chris Watson, I focus on their use of voice, as a useful comparison with the spoken word element of my own presentations.

Hildegard Westerkamp is a renowned composer, acoustic ecologist and radio artist. Her compositions combine and manipulate field recordings, instrumentation and voice. *Kits Beach Soundwalk* (1989) is a well-known example of the field recordist-composer drawing attention to their presence in the field through narration layered over soundscape.[189] Westerkamp's narration reflects on the content of the field recording, her responses to the soundscape and how she is manipulating it. This positions the composer as a listener, revealing a personal reaction and interaction with sound and place. Westerkamp uses her voice as an act of presence and self-expression. She notes: "I was literally trying to find my own voice, as a composer, as an artist and as a woman".[190] Her use of personal narration has a bearing on my presentations of *Listening to Sylvan Sounds*, as narration and reflection became important for two reasons. First, they provided context. Second, I used them to communicate knowledge gained and the ethical and emotional effects of the listening process. This intention aligns with Westerkamp's position on the essential role of acoustic ecologists which is to provide the listener with the recordist's perspective and context. She states: "If we put out recordings without contextual information, then what are they? What is the message?"[191] As previously discussed, field recording with ecological intentions, carries a responsibility to acknowledge relationship with the environment and the recordist's position within it. This creates an opportunity to share context and ethical reflections, and in doing so offers a new perspective. In the words of philosopher Alva Noë, this is a 'contract opportunity'. He states: "works of art don't just present themselves as obscure and out of focus. They also, I think, are required… to give you the resources that you require to make sense of them. Works of art, then, are contract opportunities to move from not seeing, to

[189] Iain Findlay-Walsh, 'Sonic Autoethnographies: Personal Listening as Compositional Context', *Organised Sound*, 23.1 (2017), 121–30. See also, Salomé Voegelin, *Listening to Noise and Silence: Towards a Philosophy of Sound Art* (New York: Continuum, 2010), p. 32-39.
[190] Lane and Carlyle, p. 113.
[191] Ibid., p. 116.

seeing, or from not getting it, to getting it."[192] The narrative style of both *Kits Beach Soundwalk* and *Listening to Sylvan Sounds* enact Noë's 'contract opportunity' by giving the audience the resources necessary to understand them.

The complexity and richness of waterways are the central interest of the composer and sound artist Annea Lockwood[193] in *A Sound Map of the Danube* (2005). This sound work is constructed from field recordings made between 2001 and 2004 at 80 sites along the entire length of the river from source to sea. Lockwood recorded sounds both human and nonhuman above and below the water. As well as trickles, gushes and torrents, she includes sheep, birdsong, vehicles, footsteps, swimmers and church bells. She interviewed people she met along the way asking them 'what does the river mean to you?' Woven into the composition are the distinct voices and native languages of a fisherman, a river pilot, a restauranteur, a ranger, and an archivist. Lockwood notes: "This is a river which has had a profound effect on its peoples for millennia and has shaped borders and histories repeatedly."[194] Lockwood is interested in the draw of rivers on the human psyche, how they provide livelihoods and a sense of identity for those who live and work there. She reflects: "my strong feeling is that the Danube is alive, shaped by gradient, soil and rock conditions, climate, and animal as well as human action, but as powerfully, the river is a shaper of the land around it and of the human societies along its banks."[195]

A Sound Map of the Danube is nearly 3 hours in length and presented as a surround sound installation. It is supported by: a map detailing the circumstances of each recording site; a booklet of her interviews translated into English; and stones collected from the river. Visitors are encouraged to touch the stones as "handling them gives people direct tactile contact with the river's geological nature."[196] Lockwood uses sound to immerse the listener in "the full sensory life [of] a river".[197] She does this with the intention of activating "a desire to cherish the rivers which nourish us."[198] Lockwood and I share the intention of communicating the

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[192] Alva Noë, 'Is It Bad If Art Is Boring?', *National Public Radio*, 11 December 2015 <https://www.npr.org/sections/13.7/2015/12/11/459323426/is-it-bad-if-art-is-boring> [accessed 11 December 2023].

[193] Annea Lockwood, 'Sound Mapping the Danube River from the Black Forest to the Black Sea: Progress Report, 2001—2003', *Soundscape: The Journal of Acoustic Ecology*, 5.11 (2004), 32–34 (p. 32).

[194] Lockwood, 'Sound Mapping', p. 33.

[195] Annea Lockwood, 'What Is a River?', *Soundscape: The Journal of Acoustic Ecology*, 7.1 (2007), 43–44 (p. 44).

[196] Lockwood, 'What Is a River?', p. 43.

[197] Ibid., p. 44.

[198] Ibid., p. 44.

value of ecological spaces through audio sensory experience and the use of the spoken word to convey personal connection and interaction. For Lockwood, the purpose of the spoken word is in communicating the memories and personal accounts of others, whereas I use my own voice to share my journey of relationship building with woodlands in my country.

Chris Watson is a wildlife sound recordist and composer specialising in animals in remote habitats. His spatial sound installations evoke a strong sense of place and his field recordings are renowned for their use by the BBC Natural History Unit.[199]
Watson was generous with his expertise during the Murmurations gathering in the Cairngorms which I attended in 2018. He shared two ways in which he records, having physically removed himself from the recording site. The first was the technique of leaving a recording device out overnight to record the dawn chorus without human disturbance. The second was to record owls roosting without disturbing them, by extending a long cable back to his car, from where we could hear them as if we were sitting right next to them. In contrast to Watson, I prefer to be present during listening and recording sessions to acknowledge my participation in them.
Knowing the remote recording techniques used by Watson, listening to *In the Studio - Green Planet* was of great interest. The radio programme takes the listener behind the scenes of the BBC's *Green Planet* presented by David Attenburgh. *Green Planet* intends to communicate an experience the world from the plant's perspective in five challenging environments across the world: tropical, aquatic, seasonal, desert and human. A key moment during the radio programme is when Watson is attempting to record transpiration inside a Balsa tree in the Costa Rican rainforest with an electronic stethoscope. The scripted content is interrupted to reveal a clip of Watson voicing his emotional response to the field recording task. This includes fear of venomous snakes that live in undergrowth and pain when he is bitten by a bullet ant. When the stethoscope reveals nothing he says "Well that was a disappointment" with an embarrassed laugh.[200] He relays that this means the story of the Balsa can't be included in the programme, commenting "So frustrating! This feels like a really good opportunity… I can only think the trees haven't read the script".[201] Watson's personal

[199] Chris Watson, 'biography' <https://chriswatson.net> [accessed 12 December 2023].
[200] 'Green Planet', dir. by Sarah Blunt, *In the Studio* (BBC World Service, 2022) <https://www.bbc.co.uk/programmes/w3ct1tfb> [accessed 12 December 2023].
[201] 'Green Planet'.

narration is a window into the field craft of recording. His spontaneity and vulnerability are in sharp contrast to the highly polished and scripted BBC documentary format.
This style of behind-the-scenes programme lifts the veil of the field recordists craft, allowing the audience to share in their errors and misfires, expectations and frustrations. In this moment the field recordist is placed in the centre of the recording. In contrast to that style of radio programme, my presentations are scripted, and inevitably lack the spontaneity evident in Watson's recording. But in both cases, the inclusion of the recordist's voice and responses to the environment, a richer sense of place is achieved.

My work shares the central aspect of these renowned field recording sound works in that they all draw attention to ecological spaces that are enriching, life-giving, underheard, threatened, abandoned or inaccessible. I share the focus of micro and hidden sounds with Winderen, without her layering and composition (these I implement in the visual element of my practice). With Cusack, I share the presentation of individual, un-layered sound segments. With Barclay, I share the goal of connection with place, although her focus is on the process of community engagement and mine is focused personal connection. I share the use of narrative voice with the selected works by Lockwood, Westerkamp and Watson, although the way the voice is used differs greatly. Lockwood communicates the voices and stories of others, Watson's voice is a spontaneous reaction communicating the difficulties of field craft, and Westerkamp (whose narrative style is closest to my own) narrates the listener through the sound environment employing audio manipulation to take the listener on a sonic journey.

3.4 Ecological sound art with a forest focus

Jonathan Gilmurray's 2018 thesis *Ecology and Environmentalism in Contemporary Sound Art*, proposes a definition-in-progress for ecological sound art:

> Ecological sound art is a modern, ecologically-concerned movement within sound art, comprising works whose form, content or subject matter demonstrate an active engagement with contemporary ecological issues. Works of ecological sound art tend to reflect the artist's own ecological concerns, and exhibit an inherent ecocentrism in conception and realisation…[202]

[202] Jonathan Gilmurray, 'Ecology and Environmentalism in Contemporary Sound Art' (PhD, University of the Arts London, 2018), p. 172.

In his analysis of ecological sound art, Gilmurray observes how artworks in this newly defined field often exhibit one or more of seven characteristics. These are:

1. The use of listening as a pathway towards greater ecological understanding.
2. The promotion of an ecological mode of listening.
3. A prioritisation of listening over sounding.
4. The use of sounding as a metaphor for ecological coexistence.
5. A form that functions as an ecosystem.
6. A blend of art with science, and of ecology with environmentalism.
7. A combination of the educational with the philosophical.[203]

My review of sound art, focusing on forests and woodlands from the past 30 years, reveals a number of sound works that create immersive sonic experiences from within forest landscapes. They highlight ecological and environmental concerns such as habitat loss, biodiversity extinction, clear cut logging and the effects of the oil industry. Many of these sound works fall into the categories of both ecological sound art and soundscape ecology.[204]

Five works explore these issues by presenting soundscapes of rich biodiversity undisturbed by human activity. They showcase the concerns and characteristics of ecological sound art and the holistic approach of soundscape ecology.

Hildegard Westerkamp's *Beneath the Forest Floor* (1992) blends and layers recordings from old-growth rainforests in Vancouver Island's Carmanah Valley, "half of which has already been destroyed by clear-cut logging."[205] The composition takes the listener on a sonic journey through the forest revealing the musicality of the biophony, geophony and potentially, the dendrophony.

David Monacchi's *Fragments of Extinction* (2002-present) is an on-going environmental sound art project exploring the sonic complexity of the three remaining intact equatorial rainforests. This interdisciplinary project includes making *sound documentaries* of habitats under threat of extinction, as well as creating *eco-acoustic compositions* with the field

[203] Gilmurray, p. 172-173.

[204] The sound works discussed in this chapter by Westercamp, Monacchi, Quinn, Barclay, Lopez, Nieto, Dunn and Newton, are also analysed by Gilmurray in his thesis. Whilst Gilmurray considers their contribution to ecological sound art, my analysis asks how these sound works incorporate and highlight the sounds of trees.

[205] Hildegard Westerkamp, *Transformations* (Montreal: Empreintes DIGITALes, 1996), p. 25.

recordings. Monacchi's patented *bio-acoustic theatre* provides audiences with an immersive sound experience combining the audio of his recordings and compositions with visual spectrogram analysis.

Forests: A Book of Hours (1999) takes the listener on a fictional journey through tropical forest landscapes that composer and sound designer Douglas Quinn worked in during the 1990s. These include endangered and disappearing habitats in Madagascar, Kenya and Brazil. Quinn's overlapping and intersecting field recordings create soundscapes of places both real and imagined leading the listener from pre-dawn until night. The three-part composition combines unedited field recording, processed soundscapes, human voice and electronic instrumentation.

Leah Barclay made *Rainforest Listening* (2015-present) in partnership with the Rainforest Foundation as an engagement tool for the NGO whose mission is to protect tropical rainforests. It enables listeners to hear the biodiversity of the Amazon rainforest through a mobile phone app as they walk through iconic urban spaces.

Francisco Lopez's *La Selva* (1998) blends field recordings from a Costa Rican tropical rainforest throughout a day cycle during the rainy season. Within this sonic composition, Lopez represents the acoustic fabric of the rainforest. He considers the geophony just as important as the biophony. Most striking is Lopez's attention to plants. In the linear notes of the CD he states: "[plants] are also living organisms… what we call the sound of rain or wind we could better call the sound of plant leaves and branches."[206] On close listening to *La Selva*, the vast majority of what I could hear was biophony and geophony. I identify two delicate moments that frame the composition, in which water droplets falling onto leaves are given audio space. Apart from these two moments, the dendrophony remains largely unheard. Despite Lopez' written assertion on the importance of plant sounds, I did not hear this reflected in the audio.

All these sound works move away from the single-species bio-acoustic model towards the more holistic approach of soundscape ecology. Throughout, I identify a lack of focus on trees. Westerkamp's *Beneath the Forest Floor* might include the sound of creaking trees, but not in any focus. Lopez' *La Selva* makes a claim for the special status of plants yet the sound work does not highlight the dendrophony in any depth or detail. I intend to amplify sylvan

[206] Francisco López, *Environmental Sound Matter*, La Selva: Sound Environments from a Neotropical Rain Forest (Netherlands: V2, 1998) <http://www.franciscolopez.net/env.html> [accessed 12 April 2022].

sounds amongst the forest biophony and geophony, not by eliminating other forest sounds or isolating the dendrophony, but by augmenting it.

3.5 Sylvan soundscapes with a tree focus

My radio broadcast *Listening to Sylvan Sounds* explores the act and art of listening to trees. Section one explores external sylvan sounds, audible to the human ear, yet easily passed by: *Oak Leaves* and *Creaking Pines* (Blackheath Forest, Surrey, Southeast England, 8 May 2019).
Section two delves into internal sylvan sounds made inside tree matter, too quiet to fall within the range of human hearing: wood ants nesting in *Fallen Pine Needles*; carpenter ants burrowing in *Decaying Birch Log*; and *Transpiration*.
Section three reveals underground sylvan sounds inaccessible to humans: *Rainstorm Inside Forest Earth* (Spittal of Glenshee, Braemar, Cairngorms National Park, Scotland, 8 June 2018); *Rainstorm Inside a Forest Puddle* (Blackheath Forest, Surrey, Southeast England, 7 June 2019); and creaking tree roots inside a sand dune. I selected the soundscapes from my listening and field recording practice *Searching for Sylvan Sounds* with one exception. The creaking tree roots were recorded by Jo Langton as part of her soundscape composition *Sand Creep* for the 2018 *Terror on Tour* conference in Geneva. I interviewed Langton and with her permission, selected elements from *Sand Creep* that were relevant to my project for the broadcast.

A strong motivation for undertaking this work was to gain greater ecological connection, learning and understanding. But how to communicate this to my listening audience in the broadcast? I decided to present a commentary providing context and offering my own reflections alongside the unaltered soundscapes.
I introduce the soundscape of Scots pine trees creaking as the wind pushes them back and forth, rubbing their water-saturated barks against one-another. I allow the sound to breathe long enough for the listener to immerse themselves with the soundscape, then I say alongside the audio: “I hung… tiny omni microphones… right next to where the trees touched, so the creak is amplified. This… sound… would normally be hidden amongst the other sounds… birds… wind, and… planes going overhead to Gatwick airport.”[207]

[207] Liz K Miller, Appendix A p. 173.

Here, I'm encouraging a more focused listening experience, to highlight aspects of the forest previously passed by, directing attention towards the sounds of trees. I delve further, expressing a desire to listen beyond the purely human perspective: "If I could explore the sounds within trees, sounds… just beyond the range of human hearing, what might that reveal?"[208] I use questioning to intrigue the listener, then play unusual and unexpected sounds, such as transpiration, piquing their curiosity – what made that sound? I then guide them through the experiential listening journey to answer the question. This expansion of the audience's sonic understanding aligns with the first of Gilmurray's criteria for ecological sound art: "The use of listening as pathway towards greater ecological understanding" [209] Heuristic listening and learning is encouraged by the introduction of brief slivers of my own thoughts and the specific conditions in which the recordings were made. My short musings guide the listener towards a better ecological understanding through the sounds.

I offer the listener an alternative perspective of a common sonic experience. I introduce the first rain in months hitting the dry forest earth during a summer heatwave in the Forest of Mar by saying: "the recording is from a perspective that humans don't normally experience – from beneath the forest floor."[210] And when discussing the sounds of a rainstorm from the perspective of inside a forest puddle, I comment: "a non-human perspective can completely change a soundscape."[211]

This shifting of audio perspective enables an alternative avenue for sonic engagement with the forest ecosystem, as novel experiences encourage imagination outside the limitations of the human body to inhabit areas normally beyond access. I present a sonic experience of hearing rain from beneath the ground in both drought and deluge. This also fulfils Gilmurray's first characteristic of ecological sound art, an "experiential means of learning more about the functioning of the earth's natural ecosystems". [212]

When listening to my field recordings, I expected to be able to differentiate clearly between dendrophony, biophony and geophony. However, the deeper I listened, the more blurred the boundaries of the sound sources became. In the broadcast I highlight this discovery via the soundscape of nesting wood ants: "…the sound is hard to categorize: are we listening to the

[208] Miller, Appendix A p. 174.
[209] Gilmurray, p. 172.
[210] Miller, Appendix A p. 175.
[211] Miller, Appendix A p. 175.
[212] Gilmurray, p. 172.

biophony of the wood ants? Or the dendrophony of the pine needles? Or both? The sound can't exist without either wood ants or pine needles."[213] This interconnection of sound sources, brings us to the second characteristic of Gilmurray's ecological sound art:

> The promotion of an ecological mode of listening… in which our focus is moved away from isolated objects or things in favour of the dynamics of ecological processes, interactions and interrelationships, and which thus facilitates a deeper, experiential awareness of the principles of the interconnected ecosystem.[214]

Close listening to the dendrophony reveals interactions and interrelationships within the forest network. I explore this in the broadcast by comparing the sounds of wood ants nesting in dry pine needles, with carpenter ants nesting in sodden birch logs. I describe the curiously different sounds made by the two ant colonies, by pointing out that the difference in sound might come from the different sylvan species that the ants were recycling: "The carpenter ants and the wood ants use different sylvan species – pine and birch – and different sylvan materials – needles and trunk – resulting in completely different sylvan sounds."[215]
Here, I lead the listener away from the isolated soundscapes of biophony, geophony and dendrophony by introducing sounds created in partnership by these various forest elements. This corresponds to the dynamics of ecological process in Gilmurray's second characteristic of ecological sound art.

I explore this notion further through the soundscape of transpiration. I interview Alex Metcalf, who created a device to listen to transpiration. He describes two sounds present in the transpiration recording. The first is a low grumbling sound: "…the tree is… picking up vibrations, not just from the wind moving the branches… it's also… from the ground and then travelling up. So, you've got a lot of low frequency grumbling…"[216] I respond by emphasising the collaboration of forest elements to create this sound: "This is geophony in concert with dendrophony – the wind moving the tree to create the grumbling sound."[217] Alex then describes the second sound – a pop:

> …a kind of rice crispy crackly pop, that is the water as it travels up the xylem tubes… The xylem tubes are not one continuous column… they are interlinked and have valves,

[213] Miller, Appendix A p. 174.
[214] Gilmurray, p. 172.
[215] Miller, Appendix A p. 174.
[216] Alex Metcalf, Appendix A p. 175.
[217] Miller, Appendix A p. 175.

> and when water enters into an airfield pocket it spins, which is a cavitation, that cavitation creates a pop.[218]

I comment on the two sounds together, describing the grumble and pop as a "dendrophony duo. Two different sounds created by movement of water and wind inside this ash tree."[219] Here, several elements create each sound: wind and tree create the grumble; and water, air, and xylem vessels create the pop. The soundscape that Metcalf describes as transpiration is in fact multiple movements within the ash tree, the flow of water upwards and the sway of the tree sideways. This demonstrates how *Listening to Sylvan Sounds* facilitates a deeper awareness of the interconnected forest ecosystem, exemplifying Gilmurray's second characteristic of ecological sound art.

To recap, soundscape ecology is the study of all sounds within an environment and how they interact with one another. Krause exemplifies this in his *acoustic niche hypothesis*, introduced in 1987.[220] It hypothesizes that species within an acoustic community have evolved to avoid frequency overlap within their sound making, and where frequencies do overlap, temporal differences are utilised. This model helps ecologists understand how "species enter into competition or avoid competition during their acoustic performances."[221] In any given habitat, each species has adapted its own sonic bandwidth to be heard and identified amongst the soundings of other species. Ever the musician, Krause likened this organisation of animal sounds to instruments in an orchestra: "In biomes rich with density and diversity of creature voices, organisms evolve to acoustically structure their signals in special relationships to one another—cooperative or competitive—much like an orchestral ensemble."[222] This led to an alternate, more musical, name for this phenomenon: "the great animal orchestra".[223] This theory is evidence of Krause's approach to his field recording as "an ecological mode of listening" in which "our focus is moved away from isolated objects or things in favour of the dynamics of ecological processes, interactions and

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[218] Metcalf, Appendix A p. 175.
[219] Miller, Appendix A p. 175.
[220] Bernie Krause, 'Bioacoustics: Habitat Ambience and Ecological Balance', *Whole Earth Review*, 57.Winter (1987), 14–17.
[221] Bernie Krause and Almo Farina, 'Using Ecoacoustic Methods to Survey the Impacts of Climate Change on Biodiversity', *Biological Conservation*, 195 (2016), 245–54 (p. 247) <https://doi.org/10.1016/j.biocon.2016.01.013>.
[222] Bernie Krause, *The Great Animal Orchestra: Finding the Origins of Music in the World's Wild Places* (London: Profile Books, 2013), p. 97.
[223] Krause, *The Great Animal Orchestra*, p. 10.

interrelationships"[224], placing his work within the second characteristic of Gilmurray's ecological sound art.

The cooperative or competitive acoustic space that Krause describes within the biophony of landscape changes when listening to the dendrophony. Dendrophony soundscapes reveal blending, slippages and interconnection between the sound-makers of dendrophony, biophony, and geophony. Including the dendrophony in the sounds within a forest landscape reveals that acoustic textures are interdependent: wind is silent without leaves; ants need pine needles or decaying birch logs; and water transportation requires xylem vessels. The sounds of trees might be considered incidental vibrations and not as insistent as the vocalisations of communicating animals, however, they are the soundings out into the world of the presence of living beings. Furthermore, these sounds are a harmonious collaboration between animal and tree, earthly force and tree. They are not in competition with each other for acoustic space, they are not even cooperating to allow sufficient bandwidth for each other, they are in fact sounding in harmony, as one, combining to create an audio presence in the acoustic envelope of the forest. Close listening to the polyphony of sylvan sounds reveals the essential support network that trees provide within the forest and the interconnected mesh of the biophony, geophony and dendrophony, growing, decomposing, recycling, living, and dying together.

3.6 Sylvan soundscapes and human impact

The Sound of Light in Trees (2006) by sound artist David Dunn is an important example of Gilmurray's sixth characteristic of ecological sound art: "A blend of art with science, and of ecology with environmentalism."[225] This soundscape composition compiles multiple field recordings made inside piñon pine trees, a two-needle conifer common in the Southwestern United States. Dunn's custom-built vibration transducer picks up extremely low amplitude vibrations made across the outer bark (the phloem layer) and the inner xylem (the cambium layer) of piñon pines. These internal tree sounds are of bark beetles, primarily the piñon Engraver Beetle, and are beyond the lower range of both human hearing and conventional air microphones. Dunn's piñon soundscape highlights "the rich acoustical behaviour of a single

[224] Gilmurray, p. 172.
[225] Gilmurray, p. 173.

species of small insect" and suggests "how sound is a much more important aspect of how it organizes its world, and interacts with its surrounding ecosystem, than previously suspected."[226]

This sound work has significant impact as a cross-disciplinary project between art and science. Engraver Beetles attack damaged and drought-stressed trees. Dunn's specially made recording equipment detects the many stages of beetle attack and infestations of piñon trees. Previously, only chemical analysis had explored this field. Dunn achieved a personal goal by creating a piece of sound art that contributed to bio-acoustics:

> One of my underlying intentions has been to create a true synthesis of art and science where my field studies of these insects and tree interiors through sound monitoring could not only yield fascinating sound art sources but some novel scientific insights along the way.[227]

Dunn's novel insight was this: beetles that attack conifers could be alerted to the susceptibility of trees to an infestation by the ultrasounds of their drought-stressed cavitation. When a tree's water transport system becomes dehydrated, small vacuum bubbles form in their vascular conduits. These air bubbles then implode with such force that they release both light and ultrasound signals.

The work's title refers to the light and ultrasound signal produced by trees during cavitation, leading me to expect this to be a pertinent example of an artwork that explores a sylvan sound impacted by humans. This work is a soundscape from inside trees that are undergoing significant damage due to human-caused global heating and climate chaos. Well-hydrated trees have in-built defence systems which reduce the resin flow that invading beetles require, and they form isolated tissue wounds that deprive invading beetles of nutrition. Unfortunately, these defence mechanisms "are very susceptible to variations in temperature and available moisture."[228] Human-caused global heating and the resulting rising levels of drought in the Northern New Mexico region limit the trees' natural capacity to defend themselves, resulting in extraordinarily high levels of beetle infestations in piñon pines.

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[226] David Dunn, 'The Sound of Light in Trees: The Acoustic Ecology of Pinyon Pines', *Acoustic Ecology Institute*, 2001 <http://aeinews.org/aeiarchive/dunn/solitnotes.html> [accessed 13 April 2022].
[227] Dunn.
[228] David Dunn and James P. Crutchfield, *Insects, Trees, and Climate: The Bioacoustic Ecology of Deforestation and Entomogenic Climate Change* (Santa Fe: Santa Fe Institute, 6 February 2008), p. 5 <http://arxiv.org/abs/q-bio/0612019> [accessed 2 November 2020].

The title turned out to be misleading because in fact the soundscape composition is made up almost entirely of the vocalisations of infesting beetles. *The Sound of Light in Trees* primarily explores the bioacoustics of beetles, with few, if any, sounds of tree cavitation. Which is not to downplay the crucial importance of trees in the study. A key finding of the scientific research was: "The phloem and cambium layers of pinion trees are an amazingly effective medium for acoustic communication."[229] In fact the trees were the vessel which enabled the sounds of the beetles to be heard. Dunn's acknowledgment of the importance of the dendrophony within the scientific research is evident: "the diverse sounds made by the pinion engraver beetles appear to effectively match the combination of cellulose, fluids, and air that comprise these tissue layers." [230] The value of the dendrophony is more implicit than explicit within the study, as his final conclusions make clear: "These observations suggest that these insects have a more sophisticated social organization than previously suspected—one that requires ongoing communication through sound and substrate vibration."[231] Dunn's work is an important contribution to the artistic bio-acoustic exploration of the sounds made by animals, and it adds to knowledge about the survival of the piñon tree species, but it is not a dedicated investigation of the sounds made by trees.

Studying *The Sound of Light in Trees* highlighted the issue of ecological soundscapes impacted by human caused climate breakdown. Within my own sound presentations, how might I address the complicated impact of my human actions on sylvan sounds? In conversation with sound artist Jez Riley French, he commented: "to realise the potential of listening to natural environments we need to be both attracted to and frightened by it."[232] Reflecting on the need to investigate sylvan sounds that move away from the notion of the idealised, untouched forest landscape, and more towards human impact on trees I realised that in fact I had begun accidentally to explore this subject. I was invited to perform *Listening to Sylvan Sounds* for the launch of the publication *I am Listening to You* on 17th October 2020 (online due to Covid-19).[233] The final field recording I played during this performance was the soundscape *Burning Logs*. Within this presentation, I provided brief explanations for the

[229] Dunn and Crutchfield, p. 9.
[230] Ibid., p.10.
[231] Ibid., p.10.
[232] Jez Riley French, email to Liz K Miller, 24 June 2019.
[233] A publication to archive the responses of participants to the Techne Conflux / GeoHumanities Summer School 'Listening: Field, Voice, Body' that took place in Bude, Cornwall, 7 – 13 July 2019 <https://listeningsummerschool.info> [accessed 13 April 2022].

context of the recordings and my reflections alongside the soundscapes. I explained my choice for the inclusion of this field recording:

> Previously we have been listening to the forest itself: the sound of growth and life of creaking pine trees; the sounds of decomposition and reuse of tree matter by ants; and the sounds of rain nurturing the foundations of the forest floor. But this sound of the stove is about me, personally, and how I interact with trees. In this recording my interaction was through burning the wood. This is still a sylvan sound, but perhaps a negative one, in which I am interrupting the natural cycle of the forest and destroying trees for my own benefit.[234]

Here, I departed from the notion of the sylvan soundscape unimpacted by human presence. I confessed to intervening in the landscape. Including the field recording of the fire in this event was an important step towards addressing human-affected sylvan sounds within my sound performances. I contextualised this decision by saying:

> Natural ecosystems, like forests, are being destroyed so quickly, that I believe we need to find ways to reconnect with them and help us value them. And for me, listening to all these different sylvan sounds has helped me to do that. I feel like I'm beginning a journey to reattune myself to the forest landscape through sound.[235]

The inclusion of a human-disturbed sylvan sound as well as my contextualisation and reflections demonstrate Gilmurray's seventh characteristic of ecological sound art:

> In their engagement with contemporary ecological issues, works of ecological sound art frequently combine the investigative, informative or educational with the emotive or philosophical, thus leaving audiences with both an enhanced understanding of contemporary ecological issues, and the emotional urge to do something about them.[236]

I explicitly connected sylvan sounds to the effects of humans on forest landscapes. This highlighted the impossibility of untangling our everyday actions from negative environmental consequences. Acknowledging my interconnections with the forest, both positive and negative, are part of the process of attunement and reconnection.

A sound work which highlights the violent effects of human activity on forest environments on a much larger scale than my personal example, is Mikel R. Nieto's *Dark Sound* (2016). His album makes sudden cuts between field recordings of the Ecuadorian rainforest: frogs, insects, birds and underwater creatures in one moment; and engines, pumps, generators and

[234] Miller, Appendix B p. 178.
[235] Miller, Appendix B p. 178.
[236] Gilmurray p. 173.

drills in the next. The sound work and accompanying book explore the destructive effects of the oil industry upon the rainforest and its human inhabitants. Nieto juxtaposes pristine soundscapes of biophony and geophony against industrial sounds of the anthropophony. This approach pits negative associations of the human-caused anthropophony, against the unspoilt animal vocalisations of the biophony.

Whilst Nieto includes the sounds of machinery to show human destruction of the rainforest, there are acoustic ecologists whose aim is to preserve and celebrate soundscapes devoid of human sound. In Schafer's much-cited *Tuning of the World* he sets up the political task of cleaning up the polluted soundscape to make room for 'natural' silence once again.[237] Although originally published in 1977, Schafer's thesis of human 'noise' as damaging and the absence of human sound as the ideal, is still highly influential in contemporary soundscape discourse and research. An example is the 2009 publication *One Square Inch of Silence* by celebrated acoustic ecologist Gordon Hempton with its subheading: *One Man's Search for Natural Silence in a Noisy World.*[238] Following Schafer, Krause edits out human sounds from his soundscape presentations (although he does use them to illustrate their negative effects within his ecological soundscape analysis). He makes hours of recordings in order to eliminate sections of anthropophony from the final edit. He explains this practice as such:

> When I first began recording in the late 1960s, I could record for ten hours and be able to capture one hour of useable material for production of an album or a museum exhibit. Now, as a result of diminishing wild habitats, pollution, global warming, and human noise, that ratio has shifted to roughly one thousand hours of recording for every hour of usable material.[239]

Whilst his aim is to provide the listener with a sonic experience devoid of human sound, this comment shows how Krause uses the prevalence of human sound as a measure of declining habitat health.

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[237] R. Murray Schafer, *The Soundscape: Our Sonic Environment and the Tuning of the World* (Rochester, Vermont: Destiny Books, 1994).
[238] Gordon Hempton and John Grossmann, *One Square Inch of Silence: One Man's Search for Natural Silence in a Noisy World* (New York: Free Press, 2009).
[239] Bernie Krause and others, *Bernie Krause and United Visual Artists - The Great Animal Orchestra* (Paris: Fondation Cartier pour l'art contemporain, 2019), pp. 81–82.

Sound theorist Marie Thompson sets up a compelling argument against the Schaferian claim of human-made 'noise' as bad and silence as good, of which I select three points: she identifies inconsistencies in Schafer's condemnation of human noise, as he places value in the technological sounds of steam trains[240]; she contests that Schafer's acoustic ecology "leaves little space for noise to play a beneficial or positively productive role within the soundscape"[241]; and she highlights how "Schaferian politics of silence fails to link exposure to noise to other socio-political struggles, of which it may be considered symptomatic."[242] On my journey listening for sylvan sounds, I came to realise that my own counter to the goal of recording soundscapes devoid of human-made sound is that a purist stance is impossible. For example, Hempton defends his square inch of silence in the Hoh Forest in Northwest America by calling out airlines that disturb the peace by flying over the Olympic National Park. Yet in his career as an acoustic ecologist Hempton has recorded in remote locations around the world. If he flew to those locations, might he not have disturbed the silence somewhere else? I support Hempton's valuable ecological work protecting the Hoh National Park from the sounds of unwanted plane traffic, yet I must acknowledge that human actions and their associated sounds are entangled and complicated. I am becoming increasingly aware of this complication in my own listening research and practice.

The Underground Sound Project (May 2022 to May 2023) by Nikki Lindt is an interactive public art installation in New York. Multi-media artist Lindt invites visitors on a sound walk around Prospect Park in Brooklyn, with additional access to the trail online. She recorded sounds in parks in New York City and rural Cherry Valley, using contact microphones, hydrophones and geophones. The artwork focuses on sound worlds underneath soil, below plants, within bodies of water such as streams, lakes, rain showers and snowstorms, and most interesting to me, inside trees. On the website listeners can hear inside an oak tree above a subway, a maple in sapping season, a pine tree in spring, and pine in snow. These sylvan sound samples reveal movement inside trees as well as resonant vibrating through them, such as subway trains. As such it exhibits Gilmurray's second characteristic of ecological sound art: "The promotion of an ecological mode of listening"[243] in which sonic interactions and

[240] Marie Suzanne Thompson, 'Beyond Unwanted Sound Noise, Affect and Aesthetic Moralism' (Newcastle University, 2014), p. 137.
[241] Thompson, p. 149.
[242] Ibid., p.154.
[243] Gilmurray, p. 172.

interrelationships are revealed between the dendrophony (tree cavitation), the geophony (wind vibrating the tree), and the anthropophony (subway trains). This is an artwork attuned to and celebrating its location. This audio portrait of New York parks embraces the positive interplay between trees, topography, seasons, and human interconnection (bikes, walkers, and subway trains).
In the online version of the artwork, each sound extract begins with the above ground audio recording, accompanied by a corresponding video. The audio then switches below ground in the exact same location. The video signposts this change by reflecting a mirror image of the landscape below. The visual cue is an effective signpost for the change in listening position. What Lindt achieves with this technique is the relationship between the above ground and below ground soundscape. The contrasts are stark. Riotous bird song above ground becomes muffled rumbles beneath; and silent snowscape above becomes cavernous dripping and creaking beneath. The listening position is guided by the visual.

In the field of ecological sound art, the recognition of human sound as part of the rich tapestry of ecological sound is evident in works such as Lindt's *Underground Sound Project.* Meanwhile in the field of soundscape ecology, Stuart Gage considers human vocalisations to be part of the biophony and suggests the term technophony for sounds produced by machinery and technology.[244] I also include anthropogenic sounds of the technophony such as train hoots and passing aeroplanes within my sound works. Therefore, while my research uses the terminology of soundscape ecology as a foundation, my inclusion of the anthropophony, or technophony, also positions the work under the umbrella of Barclay's contemporary definition of acoustic ecology, which she describes as a "socially engaged, accessible, interdisciplinary field that can inspire communities across the world to listen to the environment… through various artistic and scientific approaches."[245]

3.7 Presenting sylvan soundscapes outside

Adrian Newton's *Heartwood* (2014) is a site-specific sound work focusing on ash dieback disease affecting trees on the South Dorset Ridgeway in the UK. Ash dieback is caused by a

[244] Josh Dzieza, 'Scientists Are Recording the Sound of the Whole Planet', *The Verge*, 28 August 2014 <https://www.theverge.com/2014/8/28/6071399/scientists-are-recording-the-sound-of-the-whole-planet> [accessed 13 April 2022].
[245] Barclay, 'Acoustic Ecology and Ecological Sound Art: Listening to Changing Ecosystems', p. 158.

fungus, benign in its native Asia, but a serious disease for European ash, causing widespread damage to populations when it emerged 30 years ago. It is projected to kill up to 80% of British ash trees, devastating forest landscapes and threatening biodiversity that depends on them.[246]

Heartwood is a celebration of the cultural and ecological importance of ash trees in the rural landscape. Newton recorded the ultrasonic acoustic emissions (20-2000 kHz) of ash during a summer drought. He used ultrasound detectors, conversion circuits and an array of other sensors to make audible sounds normally beyond human hearing. Audiences heard these sounds change in response to variations in wind, rain and sunlight. The sonic installation was exhibited around an ash tree on the Ridgeway with sensors detecting and responding to human presence, enabling audience interaction. A composition for woodwind trio and community choir was performed under the canopy of the tree completed the artwork.[247]

Heartwood shares some characteristics with my event *Listening to Sylvan Sounds,* performed on a coastal cliff top in Bude, Cornwall on 12th July 2019 for the *Listening to Field, Body and Voice* Summer School[248]. The seven soundscapes I played at the event were: *Rainstorm Inside Forest Earth*; *Rainstorm Inside a Forest Puddle*; *Transpiration*; *Creaking Pines*; *Decaying Birch Log*; *Fallen Pine Needles*; and *Burning Logs*.

I chose as a backdrop the least distracting view which was a grassy hill rising to the horizon about 300 meters away. I positioned the listeners in a semi-circle with benches around the edges and blankets in the centre providing options for lying or sitting. Stereo speakers set 1.5 meters apart, faced the group. The event lasted 45 minutes, in which time the dusk descended, providing a sense of the passage of time. My sylvan soundscapes played alongside the sound events occurring in real time at the location: the distant crashing and pulsing of waves, seagulls squawking overhead, and passers-by walking their dogs up the coastal path. The new sounds mingled and merged with the pre-recorded soundscapes, creating moments of uncertainty as to whether a sound had come from the speakers or the

[246] The Woodland Trust, 'Adapting to Ash Dieback – The Woodland Trust's View', *Position Statement,* 2019 <https://www.woodlandtrust.org.uk/media/45328/ash-dieback-position-statement.pdf> [accessed 13 April 2022].

[247] Adrian Newton, 'Heartwood 2014' <http://nemeton.org.uk/heartwood-2014/> [accessed 13 April 2022].

[248] In 2018 and 2019 I was a member the research group *Listening to Field, Body and Voice*. This was an interdisciplinary team of academics and doctoral students spanning geography, sound, movement and word, funded by Techne DTP and hosted by The Centre for Geohumities Royal Holloway. After multiple research events during the year, we consolidated our time working together with a summer school in Bude, Cornwall, from 7 to 13 July 2019. <www.listeningsummerschool.info> [accessed 13 April 2022].

current environment. This sound event was audio only, providing an opportunity to test presentation of my sylvan soundscapes without any visual prompt or attempt to direct attention other than the speaker placement.

The common characteristics of *Heartwood* and the Bude performance of *Listening to Sylvan Sounds* are several: the use of sounds gathered from trees in Britain; the focus on the internal dendrophony; the ecological intention of raising awareness and reconnection with trees through sound; and the outdoor performance.
The difference is Newton's use of additional aural and physical stimuli in the form of composition, performance and interaction. Within *Heartwood,* textures of the dendrophony are layered and blended into a composition. It is possible to identify the creaking and scraping of tree movement, as well as the crackling and popping of cavitation. Other more abstracted sounds can be guessed at, such as the rattling and rustling of leaves, a thundering grumble which could also be flowing water, and low tapping or knocking. The music provided a ritualistic ceremony in celebration of ash trees to engage the audience; and interaction was made possible by the soundscape responding to environmental conditions and human presence. In contrast, I deliberately pared back additional stimuli to create a deep listening experience of audio immersion allowing audience imagination to explore the sound. I played the eight soundscapes sequentially with a pause in between each track to allow the audience an aural reset.

After the *Listening to Sylvan Sounds* performance, the audience discussed their responses. A notable reaction resulted directly from the set up and location. The group discussed the mysteriousness of hearing soundscapes that they could not see (acousmatic sounds) and how this led to individual imaginative play about the origin of the sounds. For example "the scuttling one became the sounds that the clouds make as they go overhead, and that creaky one was exactly the rhythm [of the] three wind turbines on the hill" and the "rumble was really working with the way this little clover was trembling in the breeze".[249] In the absence of presented visuals, the audience still sought out visual stimuli to accompany what they were hearing, resulting in augmented attention and awareness of the surrounding environment. Within this event I trialled the change of location from the traditional interior space of a performance venue into the open air. This small gesture revealed that the visual perception of

[249] Participant B, Appendix C p. 179.

the audience members was very active during the listening experience, which opened an interesting avenue to trial the inclusion of a visual element to sonic experiences and events.

The effective use of the visual in Lindt's *Underground Sound Project*, and the audience response to the outdoor performance of *Listening to Sylvan Sounds* made me consider, as an audio-visual artist, how might I incorporate the visual within my listening sound works? What form might this take? How might the visual alter the listening experience? Might a deeper understanding of my sylvan field recordings emerge during the process of making visuals from the soundscapes?

3.8 Conclusion

The forest soundscape is explored in many works of ecological sound art. Focus is often on the whole acoustic fabric with biophony and geophony as predominant sound sources, as shown in the sound works of Westerkamp, Lopez, Monacchi, Barclay and Quinn, whereas the sound work of Nieto contrasts the organic sounds of biophony and geophony with the human sounds of anthropophony and technophony. Some sound works focus on trees, for example Dunn's *The Sound of Light in Trees.* This project highlights the plight of piñon pines yet omits sounds of the dendrophony. Instead, it is biophony focused. Although the plight of the pines is exacerbated by human-caused climate chaos, the human is not present in this sound work. Within my presentation of *Burning Logs* the damage caused by human interaction with sylvan species is more explicit, not in the large-scale destructive manner of Nieto, but on a smaller scale and in a more personally entangled manner. Newton's *Heartwood* dedicates attention to ash trees, thereby aligning with my own sylvan focus, with the key difference being that *Heartwood* is highly performative and interactive whereas *Listening to Sylvan Sounds* is a deep listening experience.

There is little focus on tree soundscapes within ecological sound art and where it does occur more emphasis is placed on the technophony of human destruction, scientific collaboration, and the performative, interactive approach than that of the deep listening experience. Promoting the immersive practice of deep listening is the key experiential aspect of my *Listening to Sylvan Sounds* artworks. It enables engagement with the sounds themselves, leading to imaginative visual experimentation and resulting in augmented attention and

awareness of the surrounding environment. Lindt's *Underground Sound Project* shows how the visual can guide a listener through a sound experience as they move position from the above ground anthropocentric to the unfamiliar below ground. Lindt's sound work welcomes human-made sound into the whole acoustic envelope, acknowledging our interconnected being in the world. I find my own listening practice drawing increasingly closer to this perspective.

The ecologically mindful listening method I use within my field recording practice revealed complex ethical entanglements of being a human in a world in which the need to use and consume wood is part of the process of living. Acknowledging that my interconnections with the forest, are of necessity, both creative and destructive, are part of the process of re-attunement and reconnection. Much ecological sound art appears to deny the artist's involvement in ecological destruction for example not acknowledging the air miles travelled to make recordings in remote locations or criticising the 'noise' from air and road traffic whilst conveniently ignoring one's own personal contribution to that noise and pollution. Of the sound works analysed in this chapter the exception is the book accompanying Nieto's *Dark Sound* which invites contemplation of creative conflict by stating "[b]y buying this book you are contributing to the destruction of the planet."[250] When making artworks (and simply living in the world), I must accept responsibility that however much positive good my artworks or actions may do, the negative impact can never be completely eradicated.

A key finding is the profoundly relational quality of the dendrophony. Trees are vehicles or vessels for many of the sounds that have been classified as biophony and geophony, such as bark beetles, woodpeckers, carpenter ants, wind, rain and even transpiring water. Wind and rain are only heard in the forest when they impact or are in friction with sylvan material such as leaves or the earth. In the following chapter I expand on this finding as I consider how the visual might enable deeper analysis of sylvan soundscapes.

In chapter four I analyse three sound visualisation artworks-in-progress, each of which explores a different aspect of my sylvan field recordings via the practice of diagramming. I use the diagram to investigate: the difference between sylvan sounds and the dendrophony;

[250] Gruen Rekorder, 'Dark Sound - Mikel R. Nieto' <https://www.gruenrekorder.de/?page_id=15050> [accessed 5 April 2023].

the relationships and interconnections between dendrophony, biophony and geophony; and the personal experience of listening in the forest.

I review the field of sound visualisation by comparing my sound diagrams with the diagrammatical methods embedded in artworks of three contemporary artists, who each present a uniquely individual perspective on listening and sound perception.

4. Visualising Sylvan Soundscapes

4.1 Introduction

In the previous chapter I investigated whether listening to the sounds made by trees was a new area of study within ecological sound art and what sylvan soundscapes might contribute to this field. I found that mine is the first explicitly dedicated study of tree sounds with a listening focus. A key finding was the profoundly relational quality of the dendrophony. In this chapter I examine this finding more deeply.

I analyse three of my sound visualisation artworks-in-progress, each of which explores a different aspect of my sylvan field recordings via the practice of diagramming. The first uses a flow diagram technique to compare multiple sylvan field recordings to establish a more thorough definition of the dendrophony that differentiates it from a sylvan sound. The second uses a Venn diagram technique to explore the relationships between dendrophony, geophony and biophony. The third diagram is a forensic listening analysis of creaking pine trees to explore the listening experience within the forest. Each of these sound visualisation artworks are fragments of my diagramming process, ever incomplete and in progress. They reveal a relay of thought generation and development in which each diagram leads to new ideas and new diagrams. They are my playful struggle with exploring sound and the listening experience.

The field of sound visualisation is explored by comparing my visual works-in-progress with the diagrammatical methods embedded in artworks by Christine Sun Kim, Jorinde Voigt and Lawrence Abu Hamdan. These artists work in fields other than ecological sound, enabling me to harness their unique perspectives to provide valuable insight into the possibilities of the diagram to understand and express more deeply the highly personal experience of listening and sounding.

Throughout this chapter I pose the question: How can I use sound visualisation to deepen my understanding of sylvan soundscapes and the experience of listening in forests?

4.2 The visual and the listening experience

I have found that the visual can enhance the listening experience by highlighting previously unnoticed sonic details and providing alternative perspectives through which to consider familiar sound through a new lens. I explored this premise in previous art projects, such as the set of artworks titled *Circular Scores* (2018) (Fig. 1). For these works I created a sound visualisation system that used repetitive pattern within pre-composed music to generate new score. These highly visual graphic notations were read and interpreted by musicians with performances ranging from visual art contexts such as the London Design Festival (2017) (Fig. 2) to music events such as the Huddersfield Contemporary Music Festival (2018) and hybrid events such as the Seeing Sound Symposium at Bath Spa University (2018). The aim of the artwork was to break down the hierarchy between the performer of the music (who reads and interprets the notation), and the audience (who traditionally listens without reference to the score), thereby enhancing listener engagement with the music and shifting towards a more interactive and agential relationship between the audience, visual score and sound. The visual aesthetics of my novel scoring system generated curiosity and audience interest in attempting to follow along with the performed music. When the original composition was performed from my notation, as opposed to a new interpretation, audiences could follow the *Circular Score* with only basic instructions, even those untrained in the traditional stave musical scoring system.

The *Circular Score* notation system was a novel visual investigation of music and provided an alternative avenue for audience engagement with musical performance. I used the substantial heritage of alternative graphic notation as the foundation for the research and development of this project. In the post war period, experimental composers began to dismantle classical music score to create graphic notation which contained greater scope for performer interpretation and invention. Notable pioneering examples include Earle Brown's *December 1952* (1952) and Cornelius Cardew's *Treatise* (1963-67). Philosopher Christoph Cox notes that this expansion of the visual form of music renders it more than purely functional as "the visual score becomes an element in its own right and approaches the condition of visual art."[251] *Circular Score* was approached from the visual art perspective as an exploration of audiences' audio-visual listening experiences.

[251] Christoph Cox, *Sonic Flux: Sound, Art, and Metaphysics* (Chicago: The University of Chicago Press, 2018), p. 63.

Whilst my sound visualisation practice within this thesis draws from my previous graphic notation artworks, the artworks developed for this practice-based research differ in two ways from the extensively explored theme of graphic notation. Instead of visualising music I am visualising ecological sound and instead of creating performable notation from ecological imagery I am creating imagery in response to ecological sound with diagramming as my analytical tool. In this way my sound diagramming practice differs significantly in method and intention from sound performance and data sonification artworks such as Miya Masaoka's *Pieces for Plants* (2000 – 2012), Bartholomäus Traubeck's *Years* (2011), Daniel Jones and James Bulley's *Living Symphonies* (2014), Susan Stenger's *Sound Strata of Coastal Northumberland* (2015), and Tim Collins' and Reiko Goto's *Eden 3* (2016).

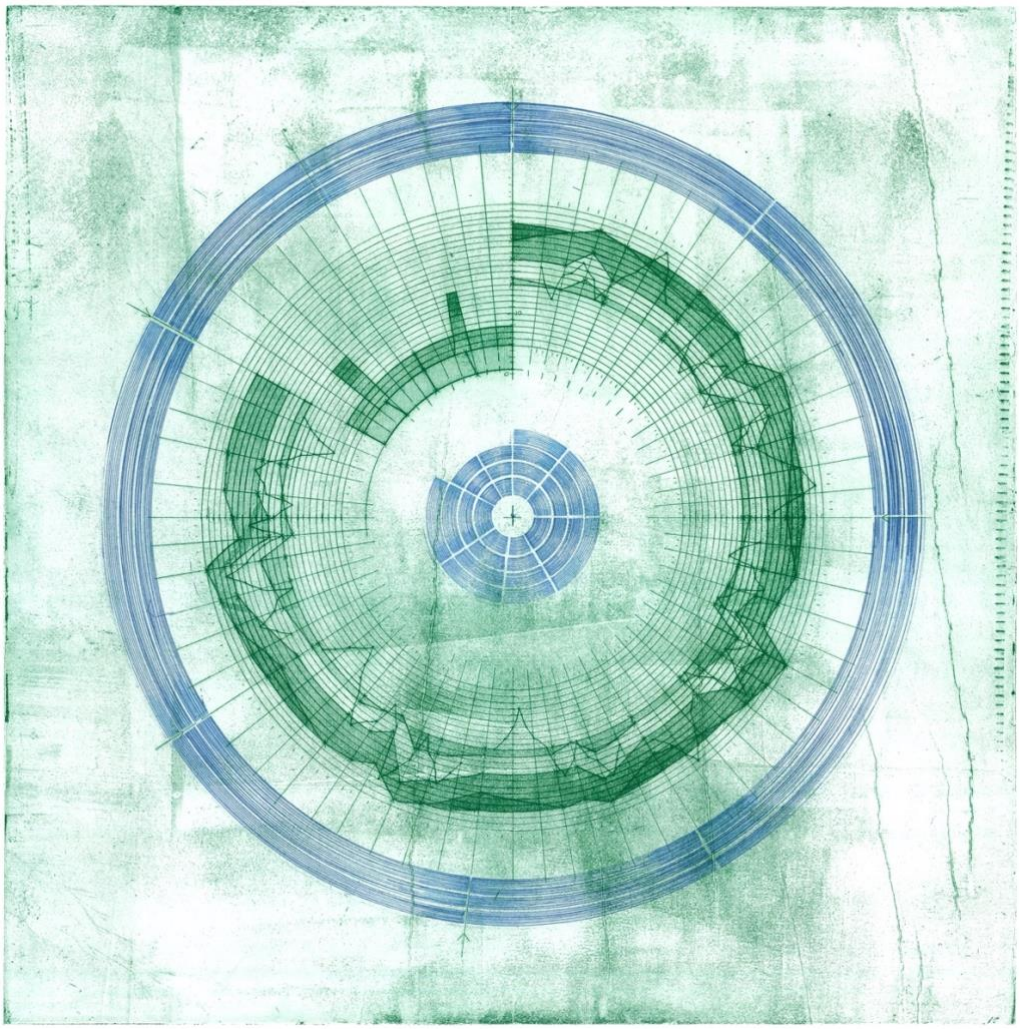

Figure 1: *Circular Score #5*, 2017. Etching 50 x 50 cm.

Figure 2: *Circular Scores* performed by Ponciano Almeida, 16 September 2017, Well Gallery, London College of Communication, London, UK, for 2017 London Design Festival.

4.3 Diagramming as an epistemic tool

As I search for deeper understanding of my gathering of sylvan sounds, could diagramming be an epistemic tool that might assist my knowledge generation of soundscapes? If the term epistemic is defined as 'of or relating to knowledge',[252] then an 'epistemic tool' could be described as a device or implement that relates to knowledge, a tool for knowledge generation even. In a 2019 research seminar, the history of philosophy professor Christoph Lüthy, discusses how an 'epistemic image' might be an aid to understanding where words fail. His case study in the seminar is the diagram, which he defines as 'one of the most basic and visually least appealing 'epistemic images'.'[253] Although Lüthy argues the case of diagrams as successful epistemic tools, he refers to their aesthetic as 'a few lines and their relation.'[254] I agree with the former while entirely disagreeing with the latter as I will argue throughout this chapter, lines and their relation can indeed be deeply visually

[252] 'Epistemic', *Oxford English Dictionary [Online]* <https://www.oed.com/view/Entry/63541?rskey=DoAyjI&result=1#eid> [accessed 31 January 2023].
[253] Christoph Lüthy, 'Epistemic Imagery and Their Functions: The Case of Diagrams' (presented at the Research Seminar, Bibliotheca Hertziana: Max Planck Institut, 2019) <https://www.biblhertz.it/2877802/epistemic-imagery-and-their-functions-the-case-of-diagrams> [accessed 30 January 2023].
[254] Lüthy.

appealing and in that very appeal contribute as a tool for new understanding and knowledge.

The painter Frances Bacon defines a diagram or graph using vivid visual metaphors:

> …it is as if a Sahara, a zone of the Sahara, were suddenly inserted into the head: it is as if a piece of rhinoceros skin, viewed under a microscope, were stretched over it; it is as if the two halves of the head were split open by an ocean; it is as if the unit of measure were changed, and micrometric, or even cosmic, units were substituted for the figurative unit. A Sahara a rhinoceros skin: such is the suddenly outstretched diagram.[255]

My interpretation of this rich and complex description exposes many qualities within diagramming methods. I will take each of Bacon's metaphors in turn. 1. The Sahara: a diagram can take a vast, magnificent yet harsh expanse of space (or concept) and condense it into a compact area. The unforgiving whole ceases to be overwhelming as its essence is captured in a more manageable unit. 2. The rhinoceros skin: a small section of an intricate idea can be considered under intense micro-level scrutiny, manipulated to enable focus on details and paradoxically to appreciate the wider picture. 3. The ocean splitting open the head: the diagramming mechanism is itself an evolving technique. It can be broken apart or dismantled via visual analysis. 4. The micrometric and the cosmic: scale within a diagram can be expanded and contracted to allow elasticity within the examination process. Bacon's definition of the diagram provides a method of analysis that is changeable, expandable, contractable and fluid. It enables the exploration of an idea, concept or experience to be considered as a whole, or in detail, with variable proportions and from alternative perspectives. I see implied in Bacon's examples the ability of diagrams to both simplify vastly complex subjects and conversely reveal complexity in seemingly simple subjects. In short, the diagramming process acts as a catalyst for thought generation and creates new pathways towards understanding and novel discovery.

Novel discovery from a diagram is most enjoyable when a viewer is provided with ample guidance and information but is allowed to follow their own path through the diagram and use their imagination to draw their own interpretations and conclusions. For Edward Tufte, professor of statistical evidence and information design at Yale, within a diagram "control of

[255] Frances Bacon quoted in Gilles Deleuze, *Francis Bacon: The Logic of Sensation*, trans. by Daniel W. Smith (London: Continuum, 2003), p. 100.

information is given over to viewers"[256] as the viewer can "…reason about an array of data at their own pace and in their own manner. Visual displays of information encourage a diversity of individual viewer styles and rates of editing, personalizing, reasoning, and understanding."[257] If Tufte makes the case for viewer-led diagram interpretation, I prefer more of a balance between the three elements: maker, viewer, and diagram itself – a sympoetic process of creating meaning and understanding together.[258] The maker gains new insights and discoveries through making and the viewer gains new insights and discoveries through visual interpretation. The diagramming process is a heuristic journey for both maker and viewer.

I find the information graphics of designers such as Stefanie Posavec or the maps and flow charts by painter Loren Monk highly absorbing. However, within my own practice I do not strive to make information graphics, maps or charts, in which the diagram is a functional communication tool such as *statistical* diagrams like those used to map Covid-19 rates, outbreaks and R numbers, or *explanatory* diagrams like how to assemble flat-pack-furniture instructions.[259] Instead, my diagramming practice is experimental, exploratory and open-ended, allowing ideas and thoughts, sometimes unexpected and surprising, to rise up to the surface. In this chapter, my use of the term diagram refers to exploratory diagrams.

Diagramming differs from both mapping and cartography[260]. Tim Ingold identifies that although the intended aim of a map is to represent reality both comprehensively and precisely, in fact it can never reflect the true experience of being in the world as "the world of our experience is a world suspended in movement, that is continually coming into being as we – through our own movement – contribute to its formation. In the cartographic world, by contrast, all is still and silent."[261] A map fixes elements by pinning them down, whereas the function of a diagram is to move an idea forward continuously. If you can pin down a diagram and the outcome is certain then it is no longer a diagram, it has become a map. The art historian Simon O'Sullivan describes the diagram as "a map that is always open to

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[256] Edward R. Tufte, *Envisioning Information* (Cheshire, Connecticut: Graphics Press, 1990), p. 50.
[257] Tufte, p. 31.
[258] Sympoesis meaning 'making together' is termed by M. Beth Dempster and discussed by Donna Haraway. Haraway, pp. 33, 58, 125.
[259] Arthur Lockwood, *Diagrams: A Visual Survey of Graphs, Maps, Charts and Diagrams for the Graphic Designer.* (London: Studio Vista, 1969).
[260] Cartography is the drawing of charts or maps. 'Cartography', *Oxford English Dictionary [Online]* <https://www.oed.com/view/Entry/28306?redirectedFrom=cartography#eid> [accessed 31 January 2023].
[261] Ingold, *The Perception of the Environment*, p. 242.

revision"[262]. This notion opens up the idea of a changeable and ever-evolving map. However, a diagram adds a layer of complexity to a map because it can never be fixed, it is not attempting to suspend a moment of experience. Instead, diagramming is an ever-in-motion experience, leading both the maker and the viewer through the mental terrain of an idea. A diagram can disorientate pre-conceived notions, reinterpret events, and generate novel experiences and thought patterns. The etymology of the verb *to diagram* stems from the Greek *dia* meaning 'through', leading to *diagraphein* meaning 'to mark out by lines'[263] therefore to diagram is to work through something, such as a concept, using drawn marks and lines.

I use diagramming to focus my listening, with visual investigation of soundscapes involving repetitive listening to field recordings in the studio. This detaches the sound from the original embodied experience, enabling me to analyse soundscapes without the bodily distractions present when listening in the field. This use of repetition aligns with the attunement exercises used within Oliveros' Deep Listening practice. For Oliveros: "Each repetition of an exercise invites the possibility of new understanding and the development of listening as a desirable practice or tool for living, learning and creative work."[264] Continuous re-listening to recordings reveals details missed whilst listening in the field and enables close analysis, as with each fresh listening, further sonic textures and sound events become apparent. This process is mirrored in the iterative re-drawing of diagrams showing the interconnections of the re-listening and re-drawing methods within my practice.

The diagrams made for this practice-based research are not intended as score or notation. Sonic scores and notation systems are intended as guides or prompts for action, performance or musical response.[265] Sound artist Jez Riley French's scores are "prompts towards a performance or an act of listening".[266] *Score for Listening #80* (2016) guides sonic output in a musical context, in which performed sounds emerge in response to textural photographic

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[262] Simon O'Sullivan, 'On the Diagram (and a Practice of Diagrammatics)', in *Situational Diagram*, ed. by Karin Schneider, Begum Yasar, and Dominique Lévy (presented at the Exhibition Situational Diagram, New York: Dominique Lévy, 2016), pp. 13–25 (p. 20).
[263] 'Diagram', *Oxford English Dictionary [Online]* <https://www.oed.com/view/Entry/51854#eid6917316> [accessed 31 January 2023].
[264] Oliveros, p. 1.
[265] John Bingham-Hall, 'What Kind of Thing Is a Score?', *Theatrum Mundi*, 2019 <https://theatrum-mundi.org/library/what-kind-of-thing-is-a-score/> [accessed 9 April 2020].
[266] Jez Riley French, email to Liz K Miller, 24 June 2019.

images, described by French as gestures, mixed with the local soundscape. David Dunn's graphic score *Purposeful Listening in Complex States of Time* (1997-98) doesn't instruct sonic output. Instead, it guides a solo listener's perceptual focus towards the surrounding soundscape as well as their own body. Both artworks are intended to enhance the listening experience by using the visual score (in diagrammatical or photographic form) as instructions for how to listen. In contrast, my diagrams are not visual listening instructions, rather they are a visual exploration of sound intended to spark alternative perspectives of sonic elements noticeable within the sylvan soundscape, but they do not instruct specific listening or sound-making actions.

4.4 Sylvan sounds diagram

The sylvan sounds diagram compares seven of my *Listening to Sylvan Sounds* field recordings, to identify the unique qualities of each, and the connections between them to help define what constitutes a sylvan sound (Fig. 3). The seven sounds compared are: *Oak Leaves*; *Creaking Pines*; *Transpiration*; *Decaying Birch Logs*; *Fallen Pine Needles*; *Rainstorm Inside Forest Earth*; and *Rainstorm Inside a Forest Puddle.* I approached this comparison from four perspectives: 1. The position of the listener – from where was I making the field recording? 2. Tree matter – what part of the tree made a sound? 3. Cycles of growth and life – what stage of the tree life cycle made a sound? 4. The importance of water in sylvan soundscapes – does the sound event reveal water changing state?

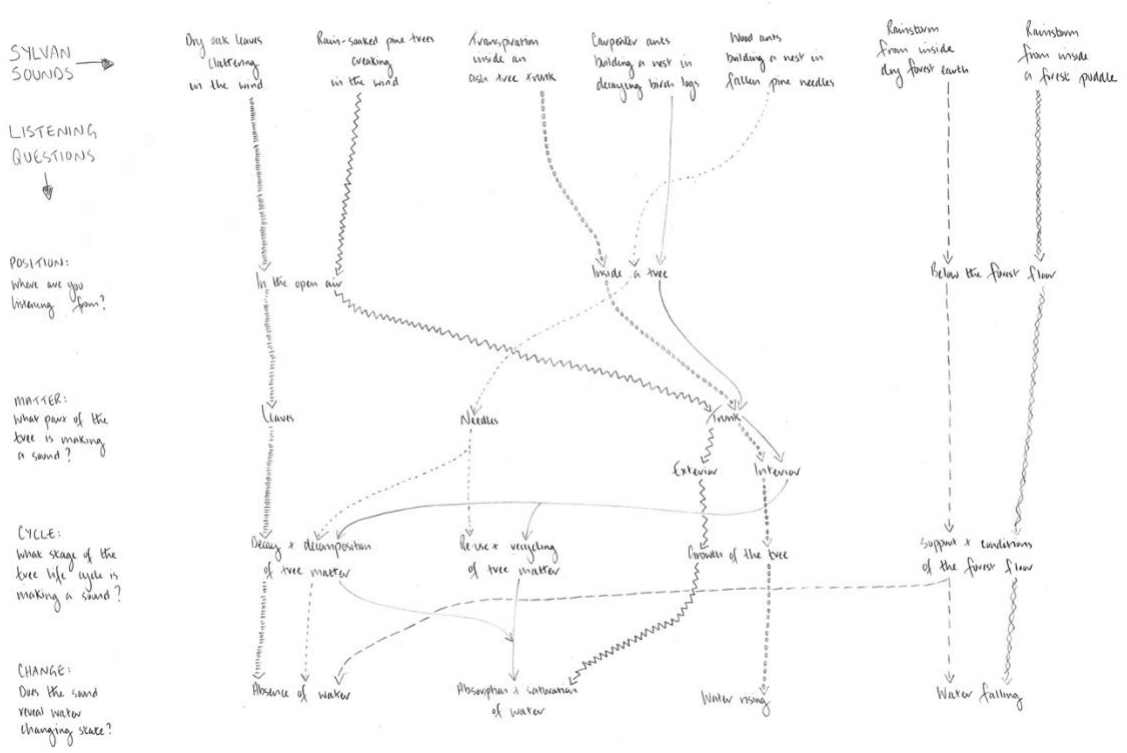

Figure 3: *Sylvan Sounds Diagram*, 2020. Pencil on paper, 60 x 80 cm.

Each sylvan sound has its own unique hand-drawn quality of line, so the viewer can visually track which sounds link to ‘listening from inside a tree’ or ‘the decay and decomposition of tree matter’ for example. I used the technique of a traditional flow diagram without restricting the flow to one direction. Viewers can follow the path of *Creaking Pines* to the ‘trunk’ as the site of sound making, then identify other sounds coming from the ‘trunk’ such as *Transpiration* or *Decaying Birch Logs* and choose to change course and follow their unique lines in a different direction (Fig. 4). The viewer can make their own discoveries at their own pace.

Figure 4: *Sylvan Sounds Diagram*, detail view, 2020. Pencil on paper.

Making the diagram enabled my own discovery. During the diagramming process, I began to determine the difference between a sylvan sound and the dendrophony, two terms that I had thus far been using interchangeably. The sylvan sounds diagram includes the soundscapes *Rainstorm Inside Forest Earth* and *Rainstorm Inside a Forest Puddle*. These two soundscapes were recorded in forests, yet do not include any sounds made specifically by trees. The etymology of dendron comes from a straight translation of the Greek word for tree, hence the dendrophony, however, the definition of sylvan, from the Latin *silva* meaning wood or forest, has evolved to mean 'a being of the woods', and 'relating to, or characteristic of a wood or woods'.[267] Therefore, the two soundscapes of rainstorms are correctly classified as sylvan sounds as they were recorded within woodlands, but they are not dendrophony as the sounds were not made specifically by trees. The diagram revealed this by showing a clear lack of linkages between the two rainstorm soundscapes and other five, with only one thread connecting *Rainstorm Inside Forest Earth* to the 'absence of water' section.

The sylvan sounds diagram was remade multiple times as I experimented with how hand drawn techniques and digital design programs altered the diagrammatical tempo and flow, both in terms of making and viewing (Figs. 5 – 9). This iterative process resulted in additions,

[267] 'Sylvan', *Oxford English Dictionary [Online]* <https://www.oed.com/view/Entry/196168?redirectedFrom=sylvan#eid> [accessed 31 January 2023].

deletions, and modifications. For example, how might text be used most affectively to address the themes and questions?[268] Changes were made whilst maintaining the flow diagram aesthetic, its multi-directional quality allowing both maker and viewer to explore multiple threads of the diagram simultaneously, as opposed to the uni-directionality of textual analysis. Constant revision of the diagram altered my perspective of the soundscapes and drove growth and movement of ideas. This process echoes O'Sullivan's observations that contemporary art diagramming, "moves things on" and "set[s] things in motion", by "demand[ing] ever more interpretations" and calling for "interaction".[269] Making the sylvan sound diagram is an ongoing activity, and although diagrammatic artworks are continuously made throughout this process, they are never the completed outcome, as there can never be a final diagram. Extra soundscapes or further listening questions can always be added, as well as redesigning the diagram to reveal further insights.

Currently I am considering three further additions and expansions of this diagram. The first is to include further sylvan sounds, specifically complicated sounds such as *Burning Logs* or field recordings yet to be gathered such as the sound of a monoculture of eucalyptus trees.[270] The second is to include the geographical location of the field recordings to help ground the diagrammatical study within a physical space. The third is to expand the range of listening questions such as which sylvan sounds are interconnected with biophony or geophony? This final question I decided to explore through a different diagram, one dedicated to the dendrophony alone.

[268] For a poetic analysis of the relationship between semantics and graphic form see: Johanna Drucker, *Diagrammatic Writing* (Banff: Banff Art Centre, 2013).
[269] O'Sullivan, pp. 14, 16.
[270] A valid sylvan sound of leaf susurrations yet one with negative impacts on the earth due to soil nutrient depletion and water over-consumption if planted in unsuitable areas. Mekonnen Daba, 'The Eucalyptus Dilemma: The Pursuit for Socio-Economic Benefit versus Environmental Impacts of Eucalyptus in Ethiopia', *Journal of Natural Sciences Research*, 6.19 (2016), 127–37 <https://core.ac.uk/download/pdf/234656667.pdf> [accessed 25 January 2023].

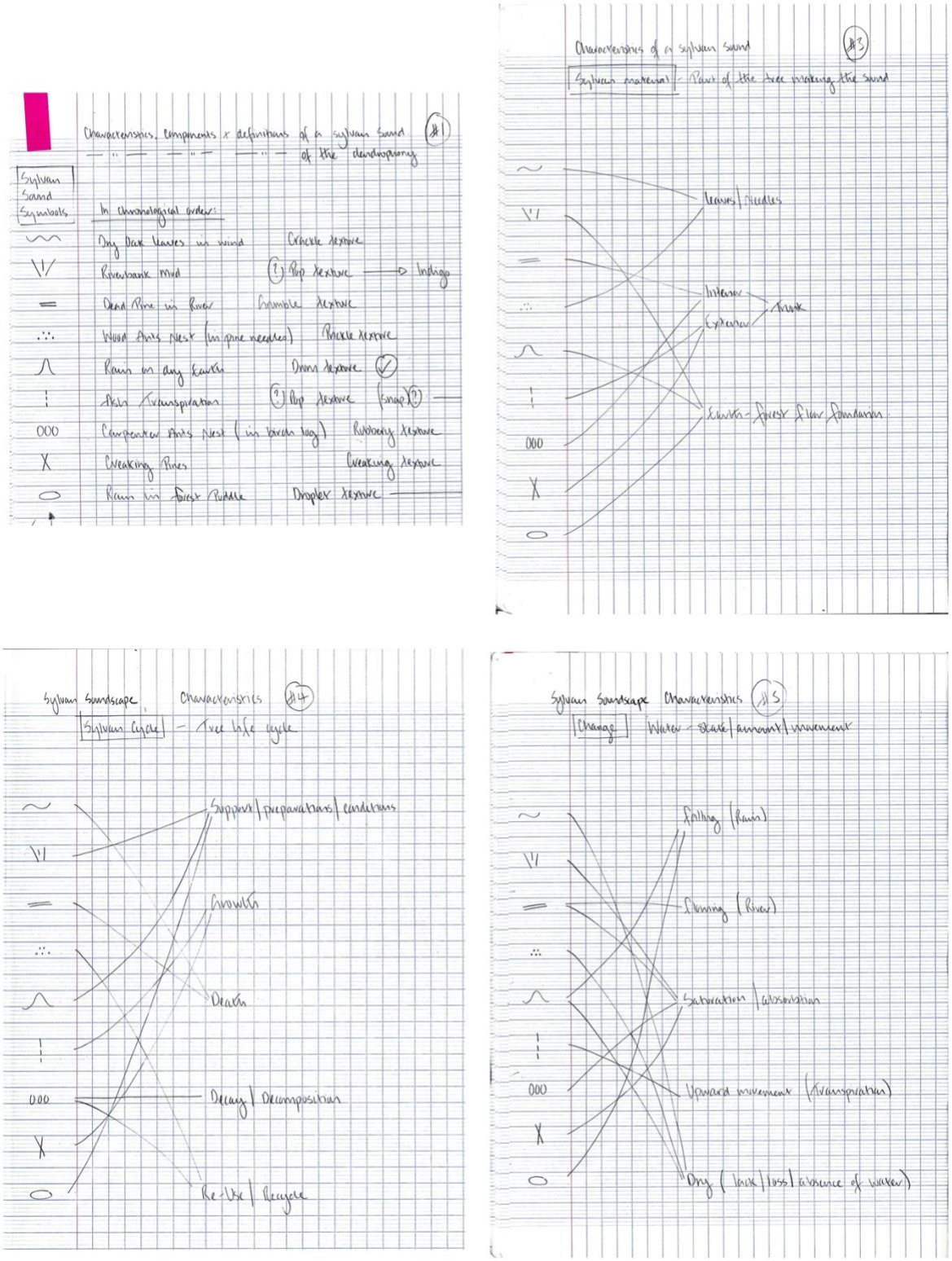

Figure 5: *Sylvan Sounds Diagram*, work in progress, 2020. Pencil on graph paper, each 23 x 32 cm.

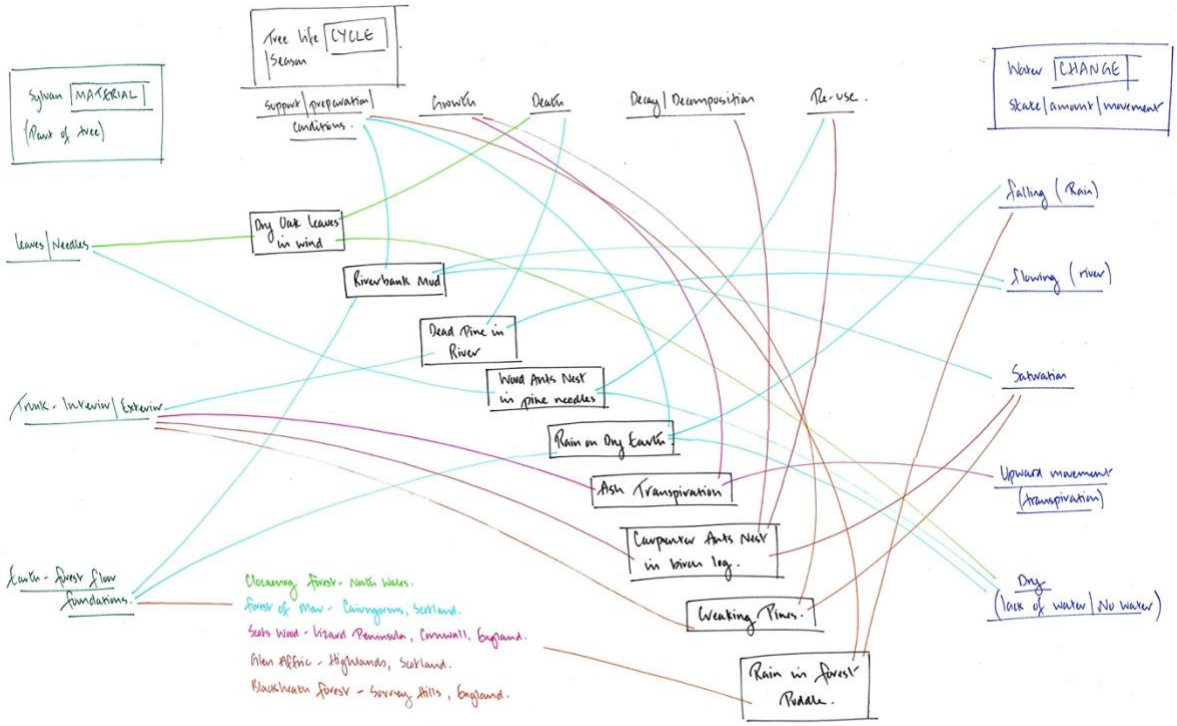

Figure 6: *Sylvan Sounds Diagram*, work in progress, 2020. Pen on paper, 59.4 x 84.1 cm.

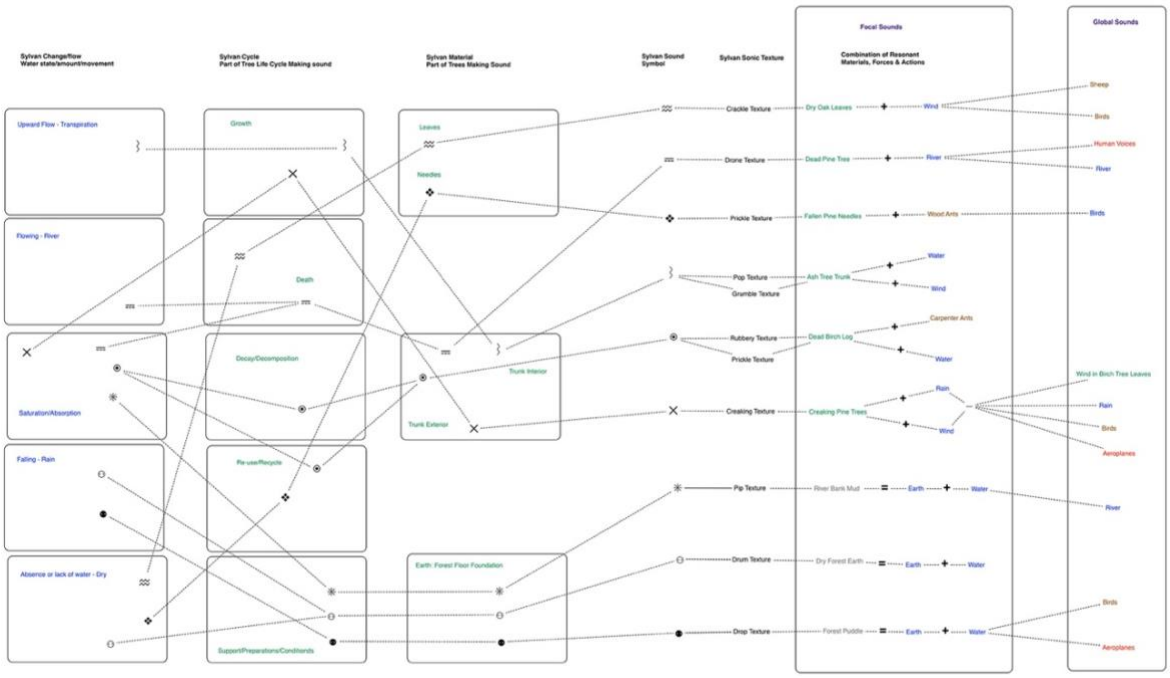

Figure 7: *Sylvan Sounds Diagram*, work in progress, 2020. Digital image.

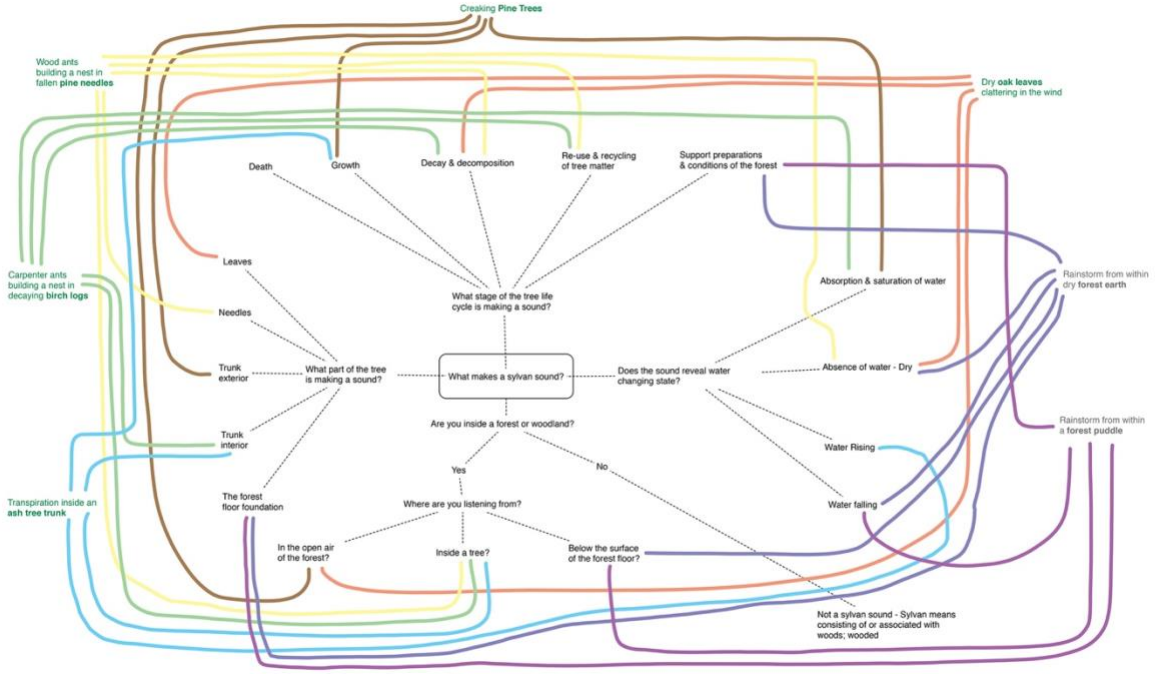

Figure 8: *Sylvan Sounds Diagram*, work in progress, 2020. Digital image.

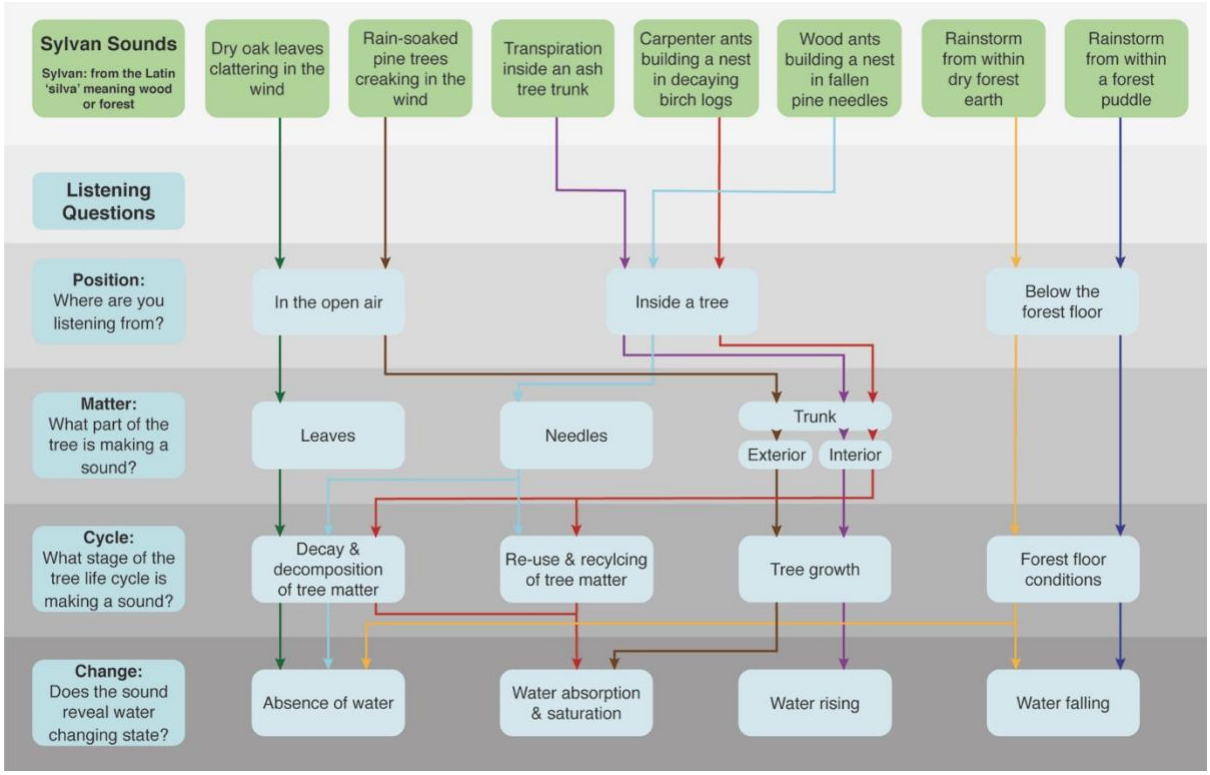

Figure 9: *Sylvan Sounds Diagram*, work in progress, 2020. Digital image.

4.5 Dendrophony diagram

In chapter three I discussed the finding that the dendrophony is often a result of vibrational relationships between tree matter and earthly elements, or tree matter and animals. As a visual thinker, I was aware of the limitations of the linear, uni-directionality of text to explore a subject with such an abundance of overlaps. The multi-directional property of a diagram enables several dendrophony events to be investigated simultaneously.
I began by making a legend to reduce text within the diagram (Fig. 10). In the process I discerned the need for two symbols for *Transpiration* as this soundscape included two sounds – the sound of transpiration and the sound of the trunk moving in the wind. The Venn diagram was the obvious choice for showing overlaps and commonalities (Fig. 11). The outer circle of the Venn diagram is labelled 'sounds of the dendrophony' as every sound is this diagram includes tree matter – oak leaves, pine trunks, ash trunks, pine needles and birch logs. The two inner circles are labelled 'sounds of the biophony' and 'sounds of the geophony'. Each one of the dendrophony symbols sits inside one of these two inner circles as every dendrophony sound vibrates in collaboration with either geophony or biophony. The sound of *Decaying Birch Logs* is the only sound that sits within the overlap of both circles as it is a sound made with the combined presence of birch logs (dendrophony), water (geophony) and ants (biophony). Three more inner circles, marked with dotted lines encircle clusters of sounds made by water, wind and ants, with the symbol for *Creaking Pines* nestling in the overlap between wind and water as this sound is created by the dendrophony of the tree trunks as well as the two geophonic forces of wind and rain. What is clear from making this diagram is the profoundly relational quality of dendrophony, geophony and biophony.

This simple diagram (still a work-in-progress) would benefit from the addition of colour to reveal in greater contrast the overlaps between these soundscapes. It could also be expanded to include recordings of the dendrophony by other phonographers, such as sound designer Jo Langton's creaking tree roots,[271] or sounds from the British Library archive such as pinecones cracking open by Kyle Turner.[272] Alternatively, this diagram could be used to explore the crossovers between the biophony and the anthrophony, as some argue, such as

[271] Jo Langton, 'Sand Creep' (presented at the Conference Terror on Tour, Geneva: Haute Ecole d'Art et de Design, 2018) <https://terrorontour2018.weebly.com/conference.html> [accessed 30 January 2023].
[272] Kyle Turner, *Pinecone Splitting Open*, Soundscapes (Loire, France, 1998), British Library, W1CDR0001238 <https://sounds.bl.uk/Environment/Soundscapes/022M-W1CDR0001238-2100V0> [accessed 30 January 2023].

Traux and Barclay, that sounds made by human voices should be included within biophony. This then leads to where the technophony might be placed within this diagram? Krause also notes that "when viruses let go from a surface they've been attached to, they create a detectable sonic spike—a sharp, quick change in amplitude measurable by only the most sensitive instruments"[273] As viruses are unable to reproduce independently or survive outside of living host cells, they might also need their own classification, however, might their reliance on living cells link their sounds to the biophony? Also, should the sounds of plants be included in the biophony or dendrophony, or in fact do they need their own category? The dendrophony diagram could be expanded to explore these complicated questions. As the parameters required by the diagram expand, the ability of a Venn diagram to show complex relationships comes into its own.

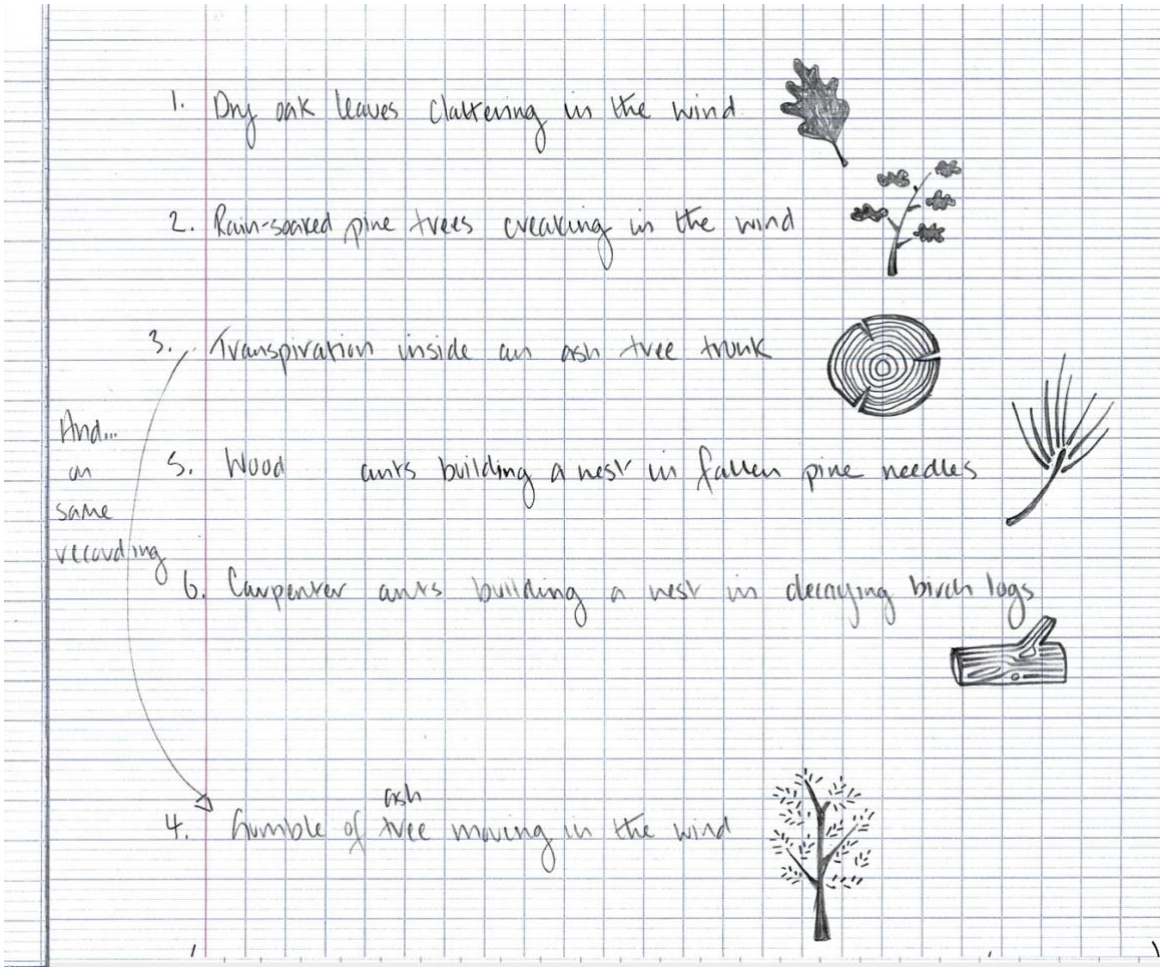

Figure 10: *Dendrophony Diagram*, 2020. Pencil on graph paper, 23 x 23 cm.

[273] Krause, *The Great Animal Orchestra*, pp. 110–11.

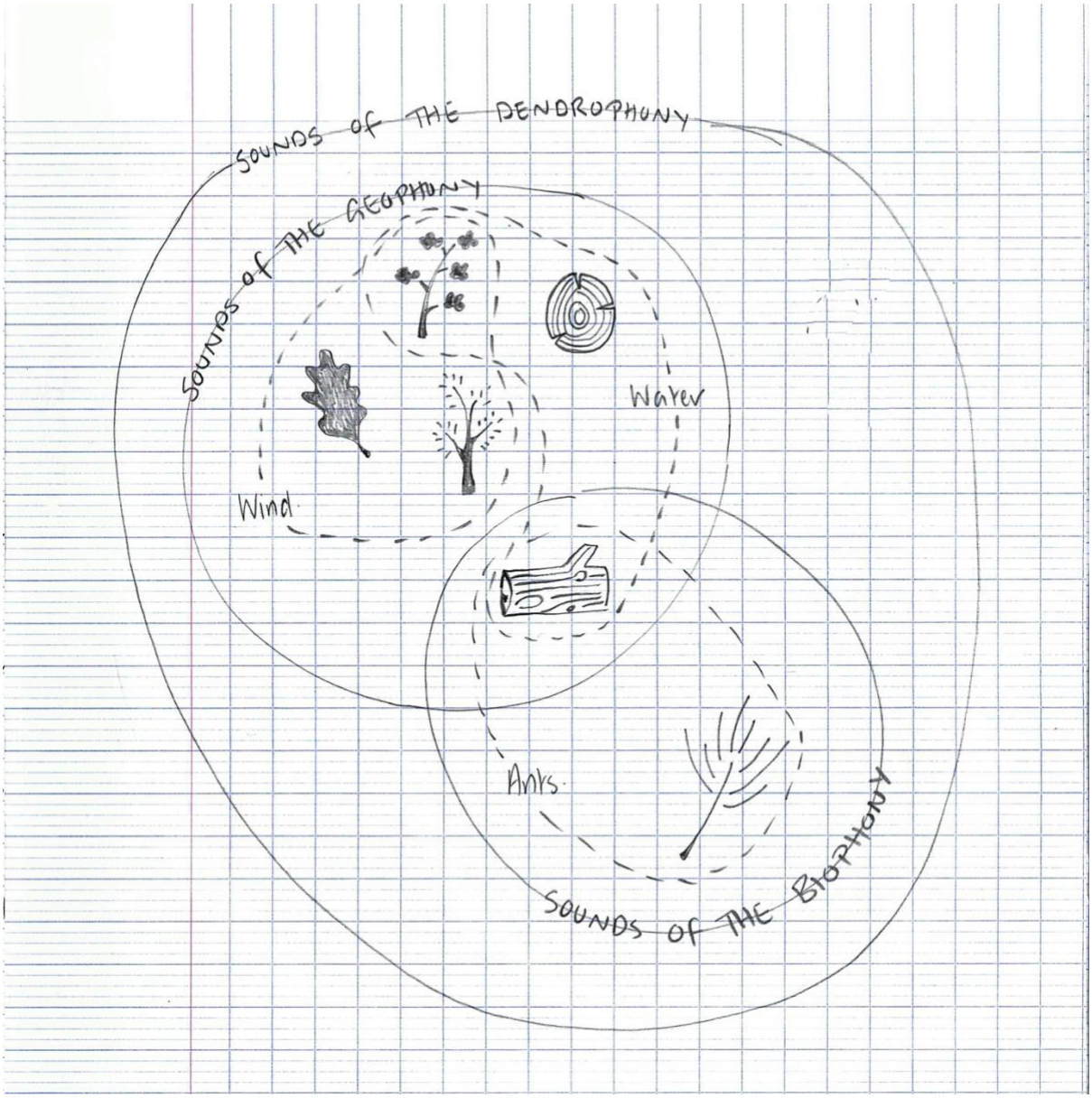

Figure 11: *Dendrophony Diagram*, 2020. Pencil on graph paper, 20 x 20 cm.

4.6 Waiting diagram

The waiting diagram is an exploration of the field recording *Creaking Pines* (analysed in detail in chapter three). Instead of focusing on the source or character of this sylvan sound, this diagram explores the experience of anticipating the moment when the trees creaked. Each creak was marked with a line on the diagram. Each line acted as a reward for my anticipation and listening focus. This developed into a long thin diagram with the lines no more than 5 cm in height and a total length of 20 meters, sketched in the first instance in 20 separate strips of paper each one meter long and then remade on two ten-meter strips for the

group exhibition *Unruly Encounters* at Southwark Park Galleries, 19th and 20th March 2022 (Figs. 12 – 14). Following Bacon's notion of the scalable quality of a diagram and the changeable units of measurement, the waiting diagram stretches out the listening experience identifying and plotting each moment of creaking sound, visually recording its fleeting presence.

This method of sketching my listening experience prior to analysing it aligns with O'Sullivan's thoughts on diagrammatical drawing: "A diagram, especially as drawing, often leads ahead of conceptual thought."[274] The waiting diagram is a tool for considering my perception of the soundscape and my listening experience, as well as the beginnings of a visual artwork. As such, this diagramming method is both the instrument and object of my research. O'Sullivan also describes the diagram as an experimental strategy to generate "the unknown from within the known, the unseen from within the seen."[275] Whilst I agree with this method of generation, in my case, it is the production of the unheard from within the heard rather than the unseen from within the seen.

The drawn or sketched element of my diagramming practice is particularly relevant. A sketch is a rough drawing, a preliminary study, or a tentative draft. These descriptions indicate a work in progress, unfinished and full of possibilities, as yet unresolved and ripe for revisions. It is an open-ended form which prompts the viewer regarding the sketch to contemplate what might come next – the future of this work hangs in the air. When exhibiting or presenting my diagrams I often use the term 'sound sketching'. This description of my process indicates the incompleteness of the visual, and values the changing character of a sketch, never perfected, always a trial of an idea that leads to further work, part of a gathering of notes and experiments. I aim to reflect in my sketching process, the impermanent quality of sound, described by Labelle as a "fleeting and punctuated event… of transience and transition."[276] As such my sound sketches are a form of visual phonography, that, following Voegelin's description of sound, "read as passing reflections, fleeting and ephemeral"[277].
In *I swear I saw this*, a book about anthropologists' field notes and drawings, Michael Taussig examines what it is to draw. He notes that to draw is to "apply pen to paper" as well

[274] O'Sullivan, p. 21.
[275] Ibid., p. 17.
[276] LaBelle, p. 96.
[277] Voegelin, *Listening to Noise and Silence*, p. 36.

as “pull on some thread” or the act of drawing “water from a well”. He talks about being “drawn along” and gives the examples of “I was drawn to her” and, “[h]e was drawn to the scene of the crime”. For Taussig, ‘[d]rawing is… a depicting, a hauling, an unravelling, and being impelled toward something or somebody.”[278] Taussig’s insights illuminate how drawing is an integral aspect of my research process. From the sounds that first capture my attention through to how I unravel sonic experiences through drawing. The waiting diagram is an example of how I draw on my listening experiences through the process of drawing.

A further area worth considering within my diagramming practice is Oliveros’ notion of focal and global attention. Focal attention “produces clear detail limited to the object” and has been the focus of my diagramming so far. Global attention is “diffuse and continually expanding to take in the whole of the space/time continuum of sound”.[279] Within *Creaking Pines*, the creak first drew my attention, however by shifting from focal to global attention, other sounds reveal themselves to be present alongside the creak, such as birds, planes, and wind. Parallel to the terms focal and global is the distinction between signal and noise, for which Christoph Cox has an apt definition. He thinks of “noise as the ground ‘the continuous acoustic flow’ that provides the condition of possibility for every articulate sound, as that from which all speech, music and signal emerge, and to which they return.”[280] If the creak is the signal sound that emerges from the ground noise of the forest, what might happen if I broaden my listening scope and include the sound of the wind in the diagram? Each time the wind picks up it can be heard in the susurrations of the nearby birch leaves. An intensification of birch leaf rustling is often followed by a creak of the pine trees suggesting that the two sounds are related. The creak follows the susurrations. The signal emerges from the noise. As I am also present during the field recording, my breath and small movements must also be part the ground noise. What might a diagram reveal that included the ground noises of wind, planes, birds, and the rustlings of my own movements? Further diagrammatical investigation could explore the relationship between focal and global sounds (signal and noise) within my gathering of sylvan field recordings.

[278] Michael Taussig, *I Swear I Saw This: Drawings in Fieldwork Notebooks, Namely My Own* (Chicago: University of Chicago Press, 2011), p. xii.
[279] Oliveros, p. 13.
[280] Cox, p. 119.

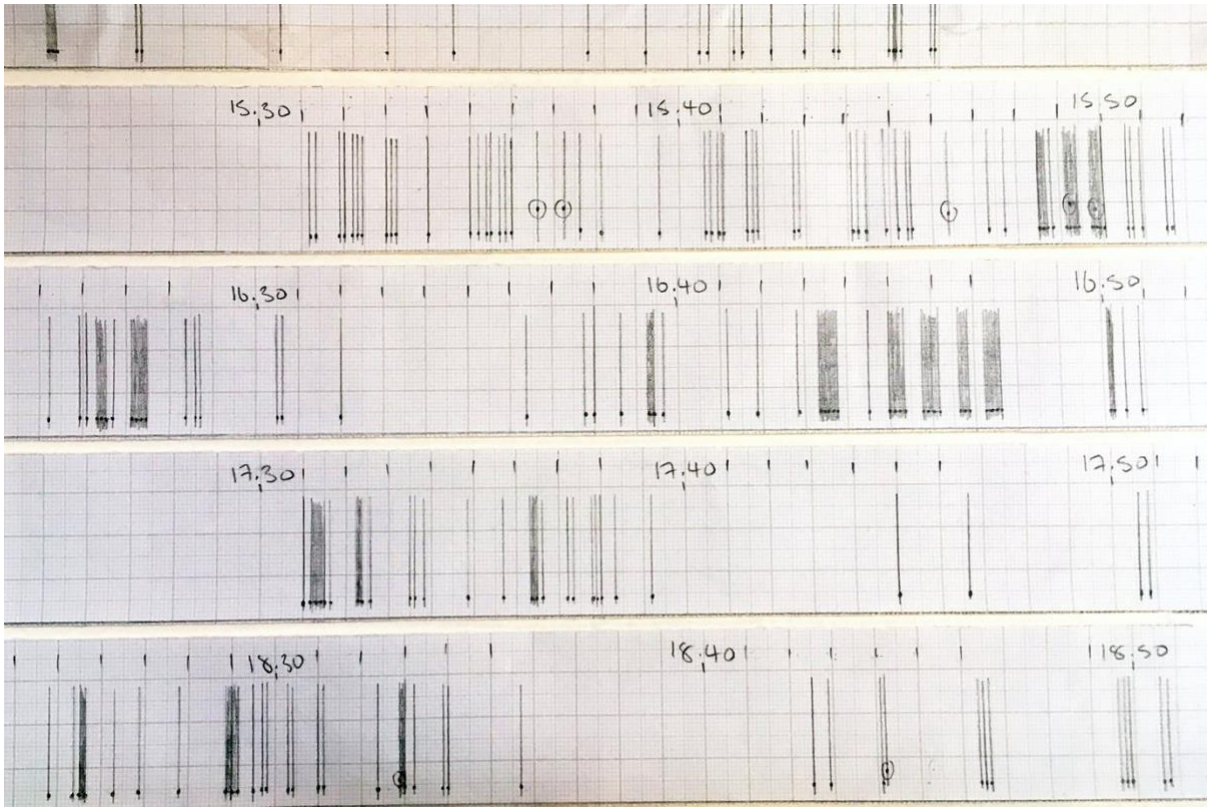

Figure 12: *Waiting Diagram*, work in progress, 2020. Pencil on paper, 59.4 x 84.1 cm.

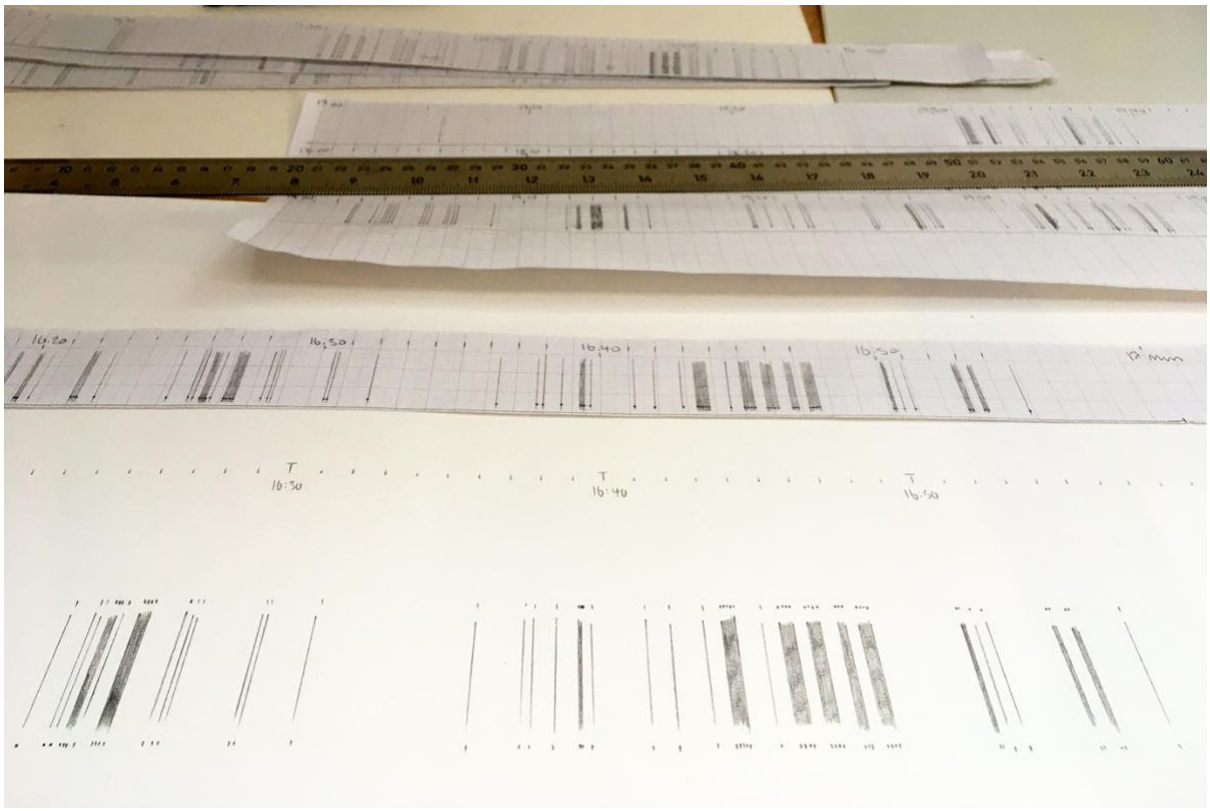

Figure 13: *Waiting Diagram*, work in progress, 2020. Pencil on paper, 59.4 x 84.1 cm.

Figure 14: *Waiting Diagram* exhibited as *Listening for the Creak*, 2020. Pencil on paper, 30 x 200 cm. Unruly Encounters, Southwark Park Galleries, London, 19 – 20 March 2022.

4.7 Jorinde Voigt – diagramming sound and beyond

Jorinde Voigt's work explores diverse cultural and natural phenomena such as eagle flight, couples kissing or explosions. Mathematical precision is evident in her highly detailed drawings which include pencil and painted mark-making, line work, written information and numerical calculations. Rather than being restrictive, Voigt's algorithms are scaffolding from which her diagrams can unfold, propelling a visual sequence of reactions to branch and fan out in organic patterns reminiscent of swirling river eddies or the murmuration of flocking starlings. Each image is one stage in a cycle of perpetual growth of scale and complexity, the outcome of one informing the next. Consequently, Voigt's artworks are far more open to personal interpretation than mere explanatory diagrams, as the art historian Franz W Kaiser notes: "Voigt's algorithms permit a certain degree of openness, which implies a measure of unpredictability"[281] These qualities invite viewers towards deeply subjective and imaginative interpretations of the concepts and events explored.

[281] Jorinde Voigt and Franz-W. Kaiser, *Jorinde Voigt: Ludwig Van Beethoven Sonatas 1-32*, ed. by David Nolan (Hatje Cantz, 2015), p. 8.

Voigt prefers to describe her works-on-paper as score or notation rather than drawings, influenced by her classical music training. She describes how music notation informs the aesthetics and intentions of her artworks:

> By implementing all the elements I was familiar with from classical-music scores, I was finally able to both describe and play with attitudes. This musical factor that found its way into my work in this manner allowed me to make everything I perceived a component of this notation process.[282]

She thinks of her score not only in relation to music but also in its more expansive mode as "instructions for the imagination".[283] In performances of works such as *2 küssen sich / 2 People Kissing*[284] Voigt's diagrams function as score, as instructions for actions. However, more pertinent to my research are her diagrams which explore phenomena from alternative perspectives. One example is Voigt's extensive thirty-two-part study of *Ludwig van Beethoven Sonatas 1-32* (2015), in which she visualises the musical expression, experienced and notated, by Beethoven whilst composing the music between 1795 and 1822. Voigt uses the intonation and dynamics of the original score, such as *forte (f), pianissimo (pp)* and *crescendo (cres.),* to create a new diagram expressing the emotional spectrum of the composition (Fig. 15).

In contrast to traditional stave music, Voigt's diagramming process is not linear. The physicality of the making process is recorded in her images as it's possible to see how she uses her entire body span to create each artwork. Voigt's fine strokes, dotted lines, arrows and compass rings are applied with equal measures of exactitude and lightness alongside text and numbers reminiscent of the graphic scores of György Ligeti's *Artikulation* (1958) or Robert Moran's *Sketch for a Tragic One-Act Opera* (1965). Her handwriting provides scale for the immense size of the drawings, making the text impossible to read in a publication and ensuring a much more satisfying study of the work in person. In a reproduction (such as in this thesis) the text becomes illegible, and the image abstracted to resemble natural formations such as constellations or shells. Due to their excessive intricacy, these exploratory drawings are somewhat indecipherable. Even after reading her detailed accompanying descriptions, I still can't fully comprehend all the connections within the imagery, although I

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[282] Wolfgang Astelbauer and Stephanie Damianitsch, *Jorinde Voigt - Now*, ed. by Julia Klüser and Hans-Peter Wipplinger (Köln: Walther Koenig, 2016), p. 249.
[283] Astelbauer and Damianitsch, p. 249.
[284] Performed at the group exhibition *Tales from the Travel Journal Vol.I* at Contemporary Art Centre Vilnius, Lithuania in 2006, and led to a series of fourteen drawings.

enjoy trying. Art historian Peter Lodermeyer notes that although "[w]e may grapple with works by [Voigt] for a long time and never come to a conclusion", the experience is one of enrichment not frustration.[285] For me, the joy of Voigt's diagrams is being involved in the meaning-making process. For Voigt, her artworks "explore what is imaginable and the way that perception functions. The discoveries you make in this process change you… At any rate, they change me."[286] The statement shows the power of the diagramming process. It is a journey for both maker and viewer in which events and concepts can be considered from alternative perspectives and new understanding can be approached with open-mindedness and acceptance of never fully comprehending but appreciating the process all the same.

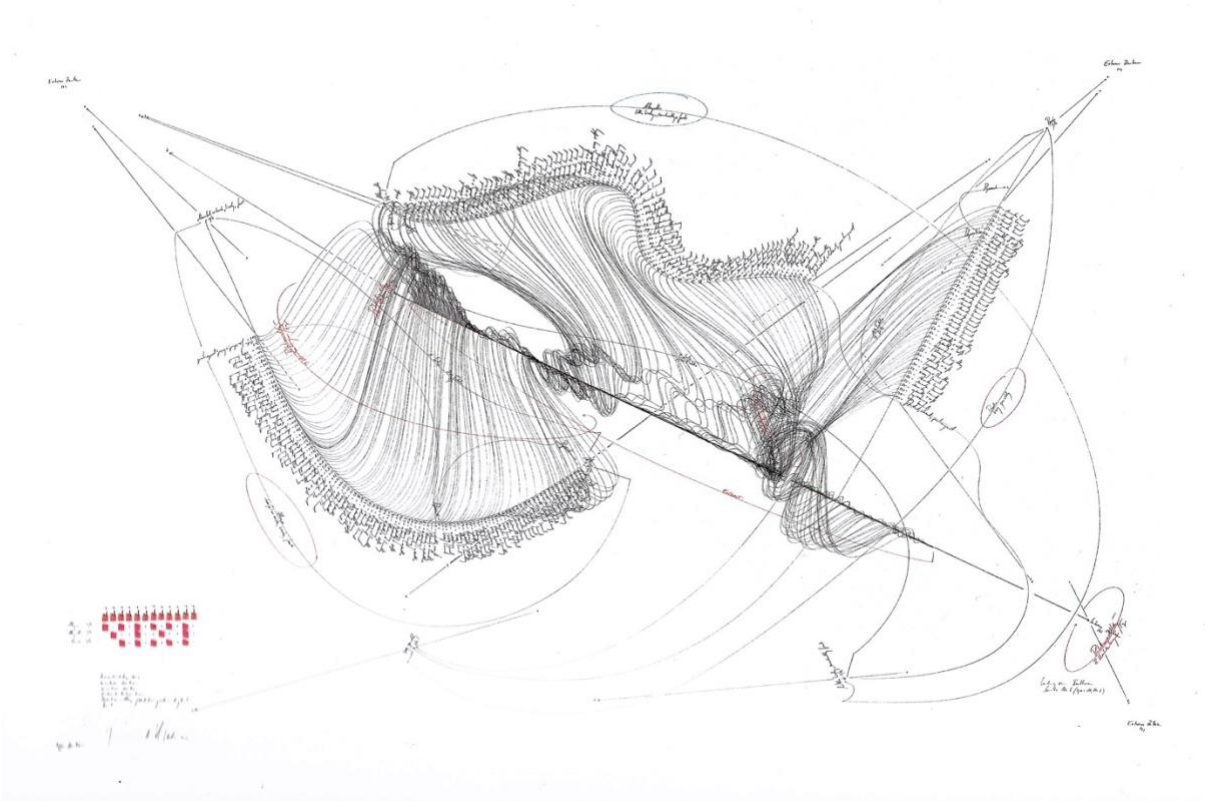

Figure 15: Jorinde Voigt, *Ludwig van Beethoven Sonata no.6 (Opus 10, no.2)*, 2012. Ink and pencil on paper, 86.5 x 140 cm. Used with permission of © DACS 2023.

[285] *Re/pro/Ducing Complexity: Nelleke Beltjens, Hedwig Brouckaert, Jorinde Voigt*, ed. by Peter Lodermeyer (Bonn: GlobalArtAffairs, 2013), p. 58.
[286] *Personal Structures: Time, Space, Existence*, ed. by Peter Lodermeyer, Sarah Gold, and Karlyn De Jongh (Cologne: DuMont, 2009), p. 297.

4.8 Christine Sun Kim – diagramming sound from a deaf perspective

Christine Sun Kim's drawings, installations, videos and performances explore the politics of listening, sound and voice from the personal perspective of a Deaf person.[287] The visual language of Kim's artwork combines aspects of music notation, American Sign Language (ASL) and body language to present her own visual experience of sound. Kim's diagrammatic images direct attention to what is frequently overlooked – the experience of a Deaf person navigating a hearing world. Her emotions and responses to often-infuriating everyday experiences are explored with wit and playful sarcasm through to pointed institutional critique in artworks such as *Degrees of my Deaf Rage in the Art World* (2018) (Fig. 16). This chart visualises six occasions within which her professional interactions with art institutions have insighted what she calls 'Deaf Rage'. The hand-drawn charcoal diagrams are bold in style and content. Mistakes are crossed out or only partially rubbed away and all-caps titles clearly state the cause of each angle of rage, such as 45 degrees of 'ACUTE RAGE' at the 'GUGGENHEM ACCESSABILITY MANAGER' and 360 degrees of 'FULL ON RAGE' at 'MUSEUMS WITH ZERO DEAF PROGRAMMING'.

[287] I follow Kim's lead of capitalising the word Deaf as she considers it as a culture unto itself, like American (where she was born) or German (where she currently lives).

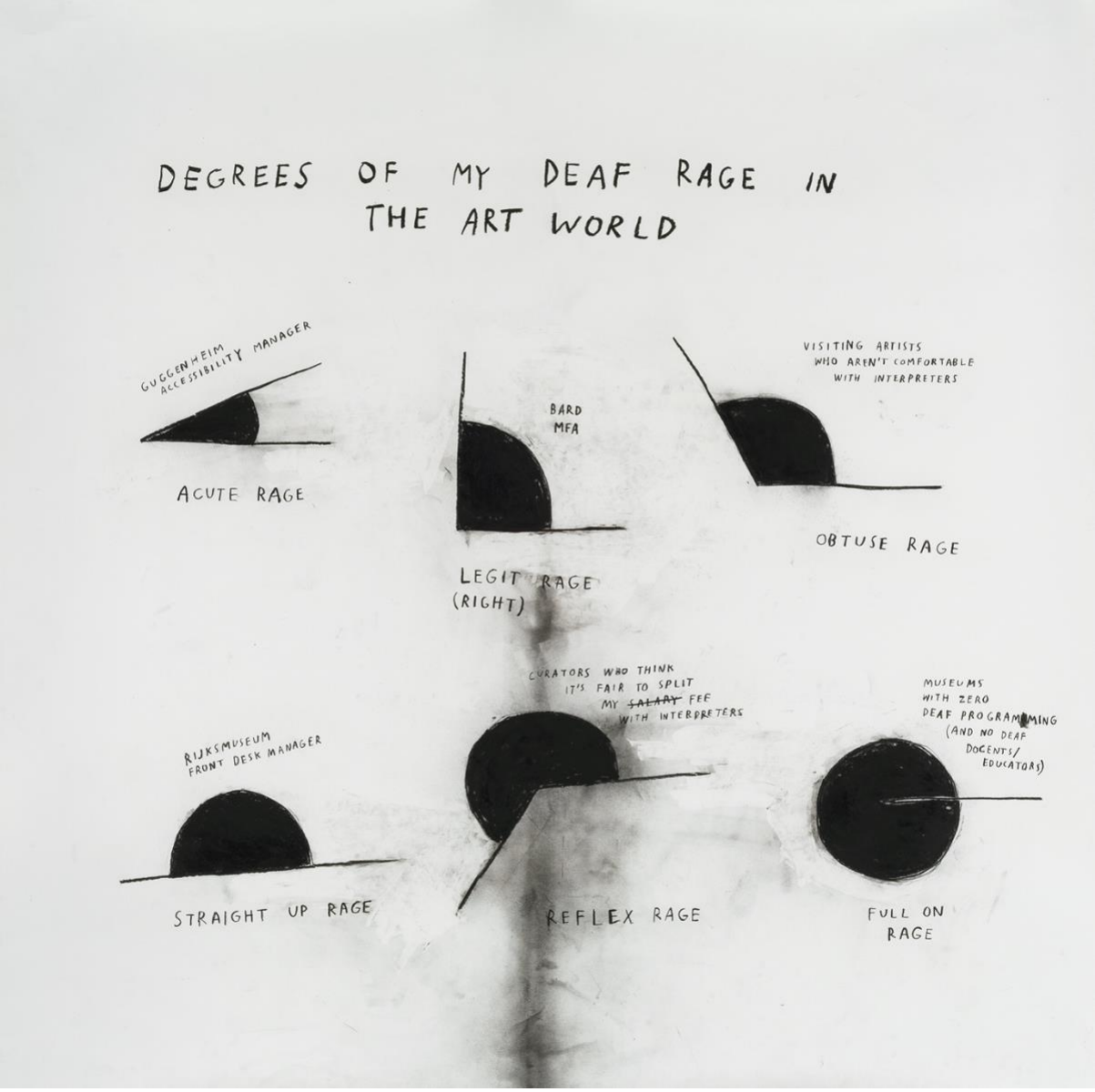

Figure 16: Christine Sun Kim, *Degrees of my Deaf Rage in the Art World*, 2018. Charcoal and oil pastel on paper, 126 x 126 cm. Courtesy of the Artist and François Ghebaly Gallery. Photograph: Yang Hat

Her choice to use diagrammatical techniques, such as angles or pie charts, is a carefully selected communication tool. To reach a wide audience of hearing people she states that she selects "a format that people can easily understand. It's like mathematical angles. How much rage do I have? You can see it in the size of the angle."[288] For Henriette Huldisch, the curator of Kim's 2020 solo exhibition *Off the Charts*, what's witty about Kim's artwork is the

[288] Lucy Martirosyan, 'Transcript: Artist Christine Sun Kim on "Deaf Rage", the Super Bowl and the Power of Sound', *The World*, 13 February 2020 <https://theworld.org/stories/2020-02-13/transcript-artist-christine-sun-kim-deaf-rage-super-bowl-and-power-sound> [accessed 19 January 2023].

"absurdity in expressing a very personal decision in a diagrammatic pie chart form."[289] For example in *Why my Hearing Daughter Signs* (2020) (Fig. 17) the largest portion of the pie chart is labelled 'BECAUSE IT WOULD BE LAME IF HER DAD HAD TO INTERPRET FOR US'. I find the humour in Kim's artworks an effective technique for addressing the often-insulting way she is treated, such as her 'REFLEX RAGE' (225 degrees out of 360) at 'CURATORS WHO THINK IT'S FAIR TO SPLIT MY FEE WITH INTERPRETERS.' These issues are both political and highly personal. Kim emphasises the importance of the humour in her diagrams, stating: "If I were just mad without the humor, I think it might be uncomfortable and people would leave. They wouldn't do the complex contemplative work that I want them to do."[290] Kim's deadpan humour allows her to shine a light on unaddressed issues for Deaf people but with a lightness of touch that makes the viewer immediately understand her perspective.

[289] Lucy Martirosyan, 'Artist Christine Sun Kim on "Deaf Rage", the Super Bowl and the Power of Sound', *The World*, 13 February 2020 <https://theworld.org/stories/2020-02-11/artist-christine-sun-kim-deaf-rage-super-bowl-and-power-sound> [accessed 19 January 2023].

[290] Janelle Zara, 'She's Creating Her Own Language: Christine Sun Kim's Unique Sound Art', *Guardian*, 24 March 2022 <https://www.theguardian.com/artanddesign/2022/mar/24/christine-sun-kim-unique-sound-art-queens-museum> [accessed 19 January 2023].

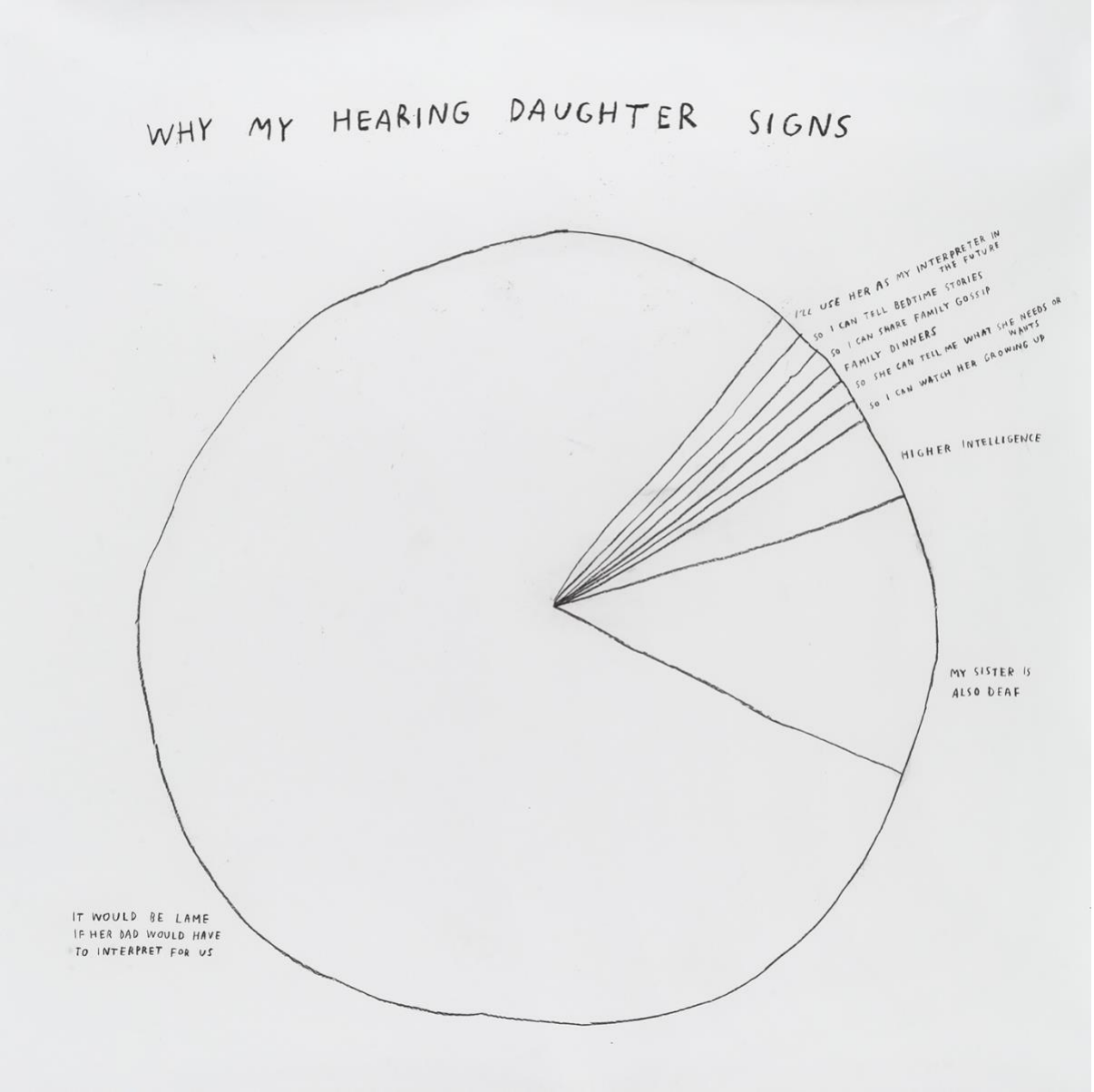

Figure 17: Christine Sun Kim, *Why My Hearing Daughter Signs*, 2018. Charcoal on paper, 126 x 126 cm. Courtesy of the Artist and François Ghebaly Gallery. Photograph: Yang Hat

Kim often combines the written coding systems of ASL and musical notation as she finds they use similar forms of bar line staves, symbols and notes. In her 2015 TED Talk she describes how, "[b]oth ASL and music are somewhat 'closed' – unless you have training, it's hard to understand either of them."[291] Despite their closed nature, Kim combines these systems of visualising sound to create a language that conveys her ideas and stories, such as in her series *Scores and Transcripts.* In one example, *Pianoiss . . . issmo (Worse Finish)* (2013) (Fig. 18), she employs the musical symbol '*p*' (shorthand for *piano*) which instructs a

[291] Christine Sun Kim, 'Gallery: Beautiful Drawings Show the Music of Sign Language', *Ideas.Ted.Com Art + Design*, 11 December 2015 <https://ideas.ted.com/gallery-beautiful-drawings-show-the-music-of-sign-language/> [accessed 1 February 2023].

musician to play quietly, with *pp* meaning slightly quieter down to *ppp* meaning very quiet. Kim uses this symbol to explore how deafness is often associated with silence. She identifies that "when I started employing sound in my art I saw how little I actually knew about silence… you could never get to the point of complete silence. Silence is an obscure sound."[292] Within *Pianoiss . . . issmo (Worse Finish)* a cascade of ever-quietening *p* instructions indicate that true silence is never reached. It is an example of an ever-expanding diagram in which Kim has created an algorithm for ever more quiet sound-making that could spill out of the confines of the paper and continue ad infinitum. For Kim this is a comment on her own choice to be silent. She questions why she should have to make noise in the world just to appease hearing people, commenting: "[i]n my feminist utopia, my own language would be good enough"[293]

[292] Kim.

[293] *The Feminist Utopia Project: Fifty-Seven Visions of a Wildly Better Future*, ed. by Alexandra Brodsky and Rachel Kauder-Nalebuff (New York City: The Feminist Press, at the City University of New York, 2015), p. 35.

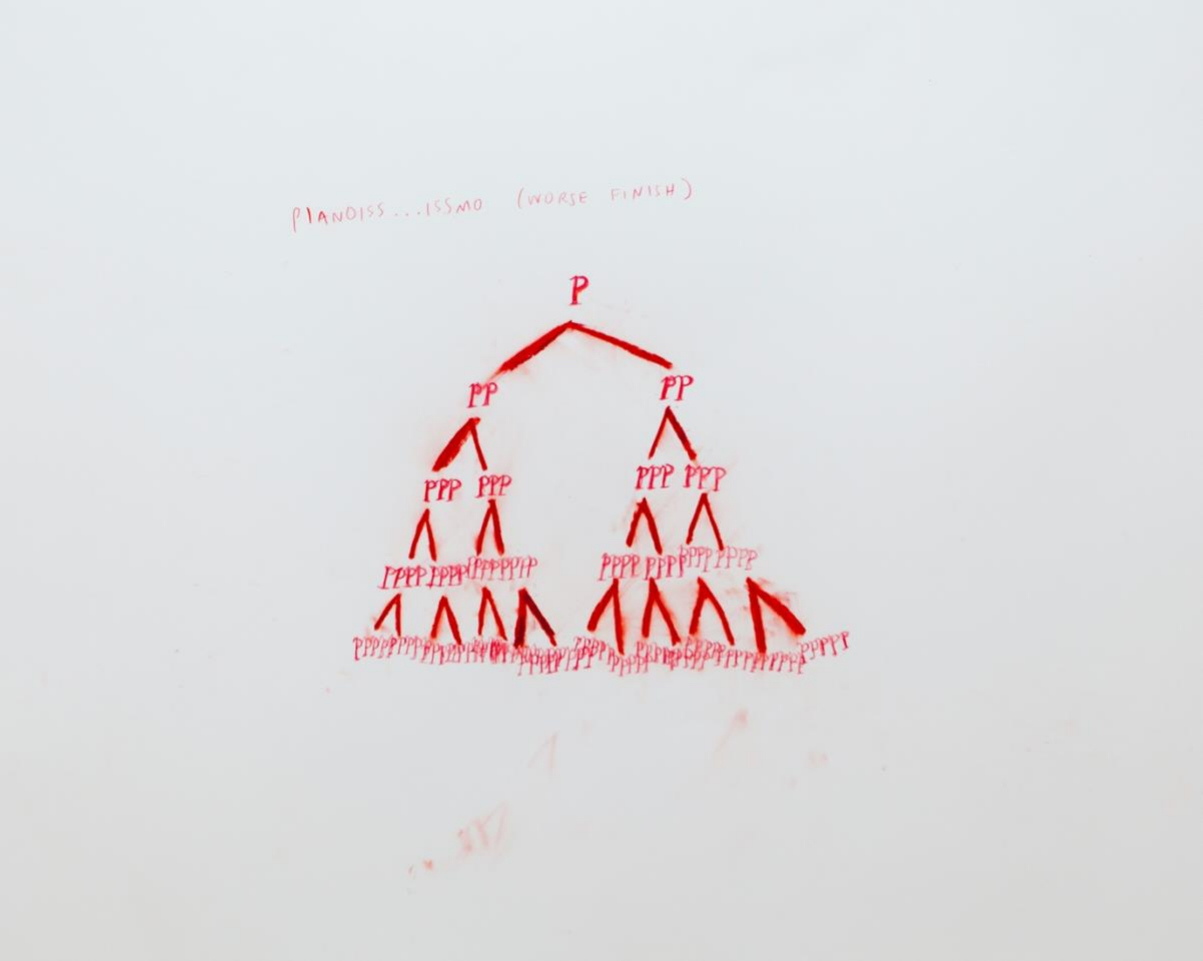

Figure 18: *Christine Sun Kim, Pianoiss . . . issmo (Worse Finish),* 2012. Transcript, pastel and pencil on paper. Courtesy of the Artist and François Ghebaly Gallery. Photograph: Erica Leone

Communication is an essential aspect of Kim's art practice as she says she "cannot afford to be misunderstood."[294] Through her artwork she has created a growing platform for the visibility of the Deaf community. She states: "I'm forcing our place into the histories of art and humanity by creating work. The more I create, the more we appear in history and the more the Deaf voice is represented."[295] This representation offers those unfamiliar with the issues faced by the Deaf community a gateway to understand Kim's perspective on sound, listening and simply being in the world.

4.9 Lawrence Abu Hamdan – diagramming a politics of listening

[294] Ann Friedman, 'Christine Sun Kim: On What Listening Looks Like', *The Gentlewoman,* 2021 <https://thegentlewoman.co.uk/library/christine-sun-kim> [accessed 19 January 2023].
[295] Emily McDermott, 'How I Became an Artist: Christine Sun Kim', *Art Basel*, 2022 <https://www.artbasel.com/stories/how-i-became-an-artist--christine-sun-kim?lang=en> [accessed 19 January 2023].

Through his artwork, Lawrence Abu Hamdan investigates the politics of sound and listening, particularly the role of voice within human rights and the law. His highly researched artworks range from audio-visual installations to lectures, text, performances and audio archives. An artwork of particular relevance to the practice of diagramming is *Conflicted Phenomes* (2012), a series of diagrams created by Abu Hamdan in collaboration with graphic designer Janna Ullrich, as well as specialist forensic audiologists and nine Somali asylum seekers, whose applications to the Dutch authorities were rejected due to failing a voice analysis test that assesses language and accents. Since 2001, the voice recognition technology called LADO (Language Analysis for the Determination of Origin) has been used in Western countries to determine the validity of asylum claimants without identity documents by testing if the accent of the applicant matches their stated country and place of origin. Abu Hamdan gathered this group resulting in an artwork that reveals the unjust and prevalent practice of denying legitimate claims of asylum from the results of this blunt test. The accent test is largely unknown outside this specialist field, with results often hinging on a couple of words, and asylum seekers unable to challenge the results. For Abu Hamdan, the artwork "is a way of disseminating its existence" and "offer[ing] the rejected/silenced asylum seeker[s] an alternative and non-vocal mode of contestation."[296]

The Somali community are particularly disadvantaged by this system of testing. The test wrongly finds the majority of Somalian asylum applicants to be from a small northern region designated as safe and habitable, and as a result their claims are rejected. Abu Hamdan's artwork counters these results by showing how 40 years of constant migration, war and crisis have impacted the language, accents and very way of life of Somalians, rendering the continued use of the LADO accent test ineffective and unjust.

Conflicted Phenomes has two parts. The first is an exceptionally detailed digital print (Figs. 19 – 20) that tracks six historical events that have affected the movement, dialect and accent of nine Somali asylum seekers since the Somali language was first written in 1972. These events are: the forced integration program of 1974; the Ethio-Somali war in 1977; the Northern civil war in 1988; the Southern clan war and famine in 1991; famines in the Southern and coastal regions in 1992, 1995 and 1996; and the 2011 famine in central and Southern Somalia. These events conspired to force internal migration throughout the country.

[296] Lawrence Abu Hamdan, 'Conflicted Phonemes', *The System of Systems*, October 2017 <https://systemofsystems.eu/research/conflicted-phonemes> [accessed 23 January 2023].

Abu Hamdan describes how designating Somalians accents as simply Northern, Southern or Coastal, as the British and Dutch governments have done, is hugely problematic:

> there has been so much movement, even if not in this generation, in the generation proceeding it… what we end up with is every kind of possibility of a speaking voice of the people who have lived through these times, and moved through and up and down the country.[297]

The infographic design of the digital print is integral to revealing the complexity of Somalian accents. The symbols representing how the accents are evolving increase in complexity and number as the component parts of each accent varies and multiplies. The lines that flow from each individually textured event to the following one alter in quality and colour to indicate the change that the accent is going through. With careful study, each component part of the diagram can be read, analysed, followed and ultimately understood. Abu Hamdan's diagram reveals complexity in a system which the LADO test has simplified to the extent of distorting the truth of the situation. He explains:

> Usually maps are abstracts, they reduce the complexity of the issue to a digestible form, yet here we felt it was important to rather show how complex the situation in Somalia is and how consequently irreducible the voices and biographies of those who are fleeing from conflict and famine.[298]

Abu Hamdan refers to this artwork as a map to call out the poor mapping practice of the Dutch authorities who divided Somalian asylum seekers into three geographical areas – North, South and Coastal – and allocated accents to each location. In contrast the *Conflicted Phenomes* map reveals the complexity of voices as they bleed through boundaries drawn on a map in a distant country. This shows the impossibility of reducing a person's voice to a simple passport-like test that attempts to fix a person and the people they interact with to one place.

[297] *Conflicted Phonemes Walkthrough*, dir. by Lawrence Abu Hamdan, Infrasonica's 4th Wave The Sonic Image, 2021 <https://vimeo.com/537496912> [accessed 24 January 2023].
[298] Abu Hamdan, 'Conflicted Phonemes'.

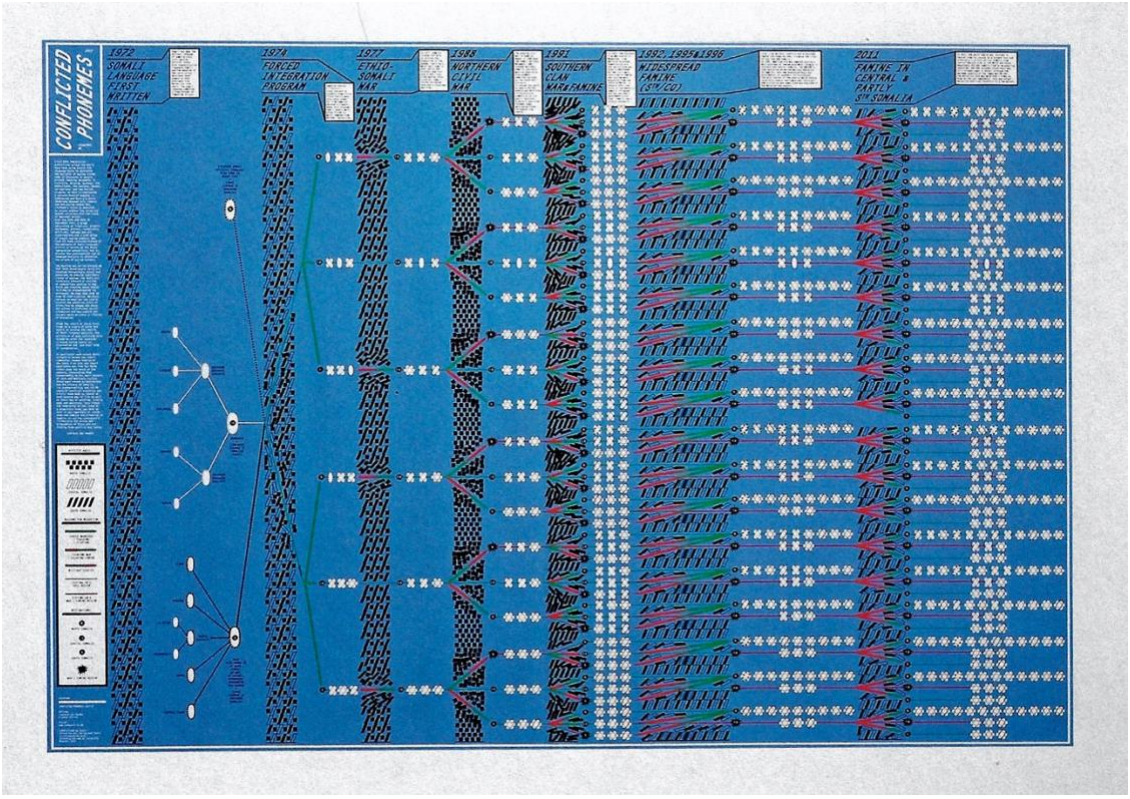

Figure 19: Lawrence Abu Hamdan, installation view, *Conflicted Phenomes*, 2012, hybrID, Kunsthaus Hamberg, Germany, 2019. Courtesy of the artist, mor Charpentier, and Sfeir-Semler Gallery Beirut/Hamburg.

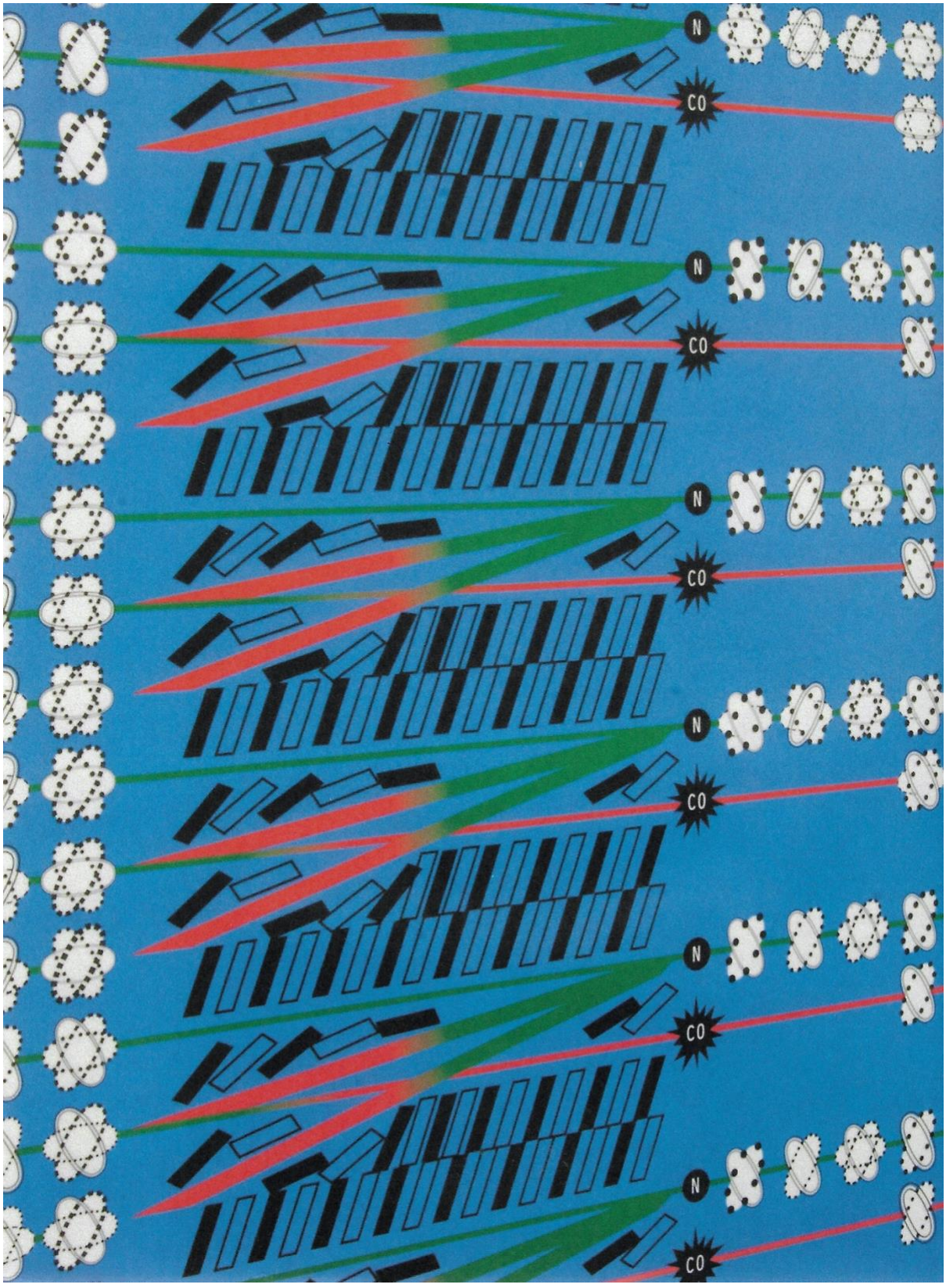

Figure 20: Lawrence Abu Hamdan, detail view, *Conflicted Phenomes*, 2012, hybrID, Kunsthaus Hamberg, Germany, 2019. Courtesy of the artist, mor Charpentier, and Sfeir-Semler Gallery Beirut/Hamburg.

The second part of the artwork is individual maps for each of the nine asylum seekers (Fig. 21). They show the status of each applicant and the words for which he was rejected. A dot in the middle of the map represents the individual person. Multiple dots encircle the individual representing everybody they currently speak to with lines joining the individual and their interlocuters, each with a differing pattern to show the many and varied accents that the individual interacts with daily. The centre of these maps where the lines all connect with the individual is dense, showing in diagrammatical form the many influences on applicants' accents.

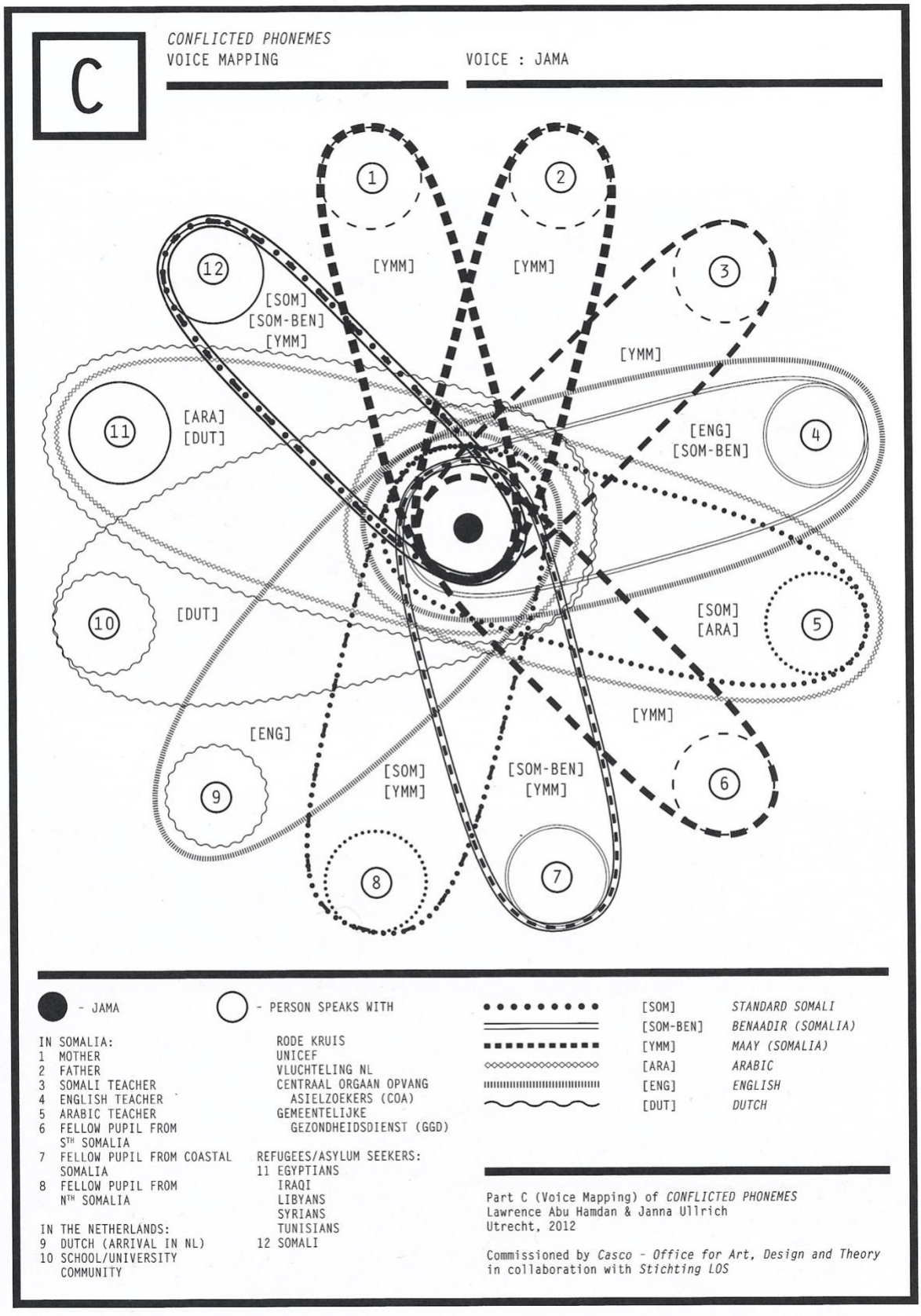

Figure 21: Lawrence Abu Hamdan, detail view, *Conflicted Phenomes*, 2012, hybrID, Kunsthaus Hamberg, Germany, 2019. Courtesy of the artist, mor Charpentier, and Sfeir-Semler Gallery Beirut/Hamburg.

Abu Hamdan calls for 'a politics of listening' which "moves away from the classic notions of advocacy and of giving people a voice. It is not a call for free speech."[299] Instead, he argues for an "intervention into, and a reorganisation of, the forms of listening to speech itself."[300] The asylum seekers had their right to silence removed by the Dutch authorities. They were required to speak for their asylum applications to be considered, but the way they spoke was used in evidence against them. *Conflicted Phenomes* is a graphic work instead of a sound work as this purely visual format respects the Somalians' right to silence. Through diagramming, the Somalians' voices are represented in all their complexity.

Whilst respecting Abu Hamdan's use of the term map, I also consider *Conflicted Phenomes* to be diagrams. By following and interpreting the visual symbols, lines, marks and text, viewers gain insight into asylum seekers' accents through Somalian historical and political events, and by considering the individual's daily interactions. Through the diagram we come to understand the unjust use of the LADO test. Abu Hamdan also hopes that once we are aware of this policy "we might reflect on what our own hybrid accents say about our place of birth, how we change and adapt our voices in different social situations and how complex our accents would be after a lifetime of migration."[301] This diagram is an epistemic tool – a catalyst for thought generation not only about the unjust barriers that Somalian asylum seekers face but also about voice itself. It led me to reflect on the un-place-ability of my own accent (a mix of growing up in Northumberland and Wirral, then living in Scotland and London as an adult) and how this had led me to describe my accent as Northern mongrel. These diagrams are a path towards new understanding of Somali asylum seekers and beyond.

4.10 What diagrams reveal about sound and listening

The artworks discussed by Jorinde Voigt, Christine Sun Kim and Lawrence Abu Hamdan use diagramming to offer alternative perspectives of sound. Voigt represents her personal interpretation of the emotional expression encoded within Beethoven sonatas. Kim communicates the everyday experience of a Deaf person functioning in a hearing world. Abu

[299] Lawrence Abu Hamdan, 'Aural Contract: Towards a Politics of Listening', in *What Now? The Politics of Listening*, ed. by Anne Barlow (London: Black Dog Publishing, 2016), pp. 38–47 (p. 46).
[300] Abu Hamdan, 'Aural Contract: Towards a Politics of Listening', p. 46.
[301] Abu Hamdan, 'Conflicted Phonemes'.

Hamdan reveals the plight of Somalian refugees applying for asylum in the Netherlands because of misinterpretation of their accents.
Kim and Abu Hamdan each convey a clear perspective of sound and silence. Kim chooses to communicate not with her voice but through her movement and expressions, in other words, through the visual. Her diagrammatical artworks reveal her experience and perspective of sound whilst maintaining her choice to be vocally silent. The Somalian asylum seekers in Abu Hamdan's diagram had their voices misrepresented and used against them. Abu Hamdan respected their right to silence by communicating the story of their unique voices visually. Diagrams are used by both artists as highly effective communication tools to highlight under-heard and under-represented perspectives of listening, voice and silence.
In contrast Voigt does not intend to communicate a specific sonic perspective. Instead, she uses the diagramming processes to explore a concept, not knowing where it will take her, and allowing the viewer to draw their own conclusions from the images she makes.
The three diagrammatical works-in-progress that I made in response to my gathering of sylvan sounds align more with Voigt's method. I use the diagramming process to deconstruct each soundscape, analyse the fragmented parts, and re-form my perception of the sounds as the diagram's form takes shape. This technique could be likened to the practice of dividing music up into sections to learn to play a piece fluently from muscle memory. However, closer to this research is the notion of the organic cycle in which component parts are constantly being broken down and reconstructed to create new living forms in an on-going cycle of decomposition and re-composition.

Just as Kim and Abu Hamdan represent under-heard experiences of voice and silence, I too wish to expand the sylvan sonic experience by drawing attention towards the hidden and unnoticed sounds made by and with trees. My diagrams, like Voigt's, are investigative, generative and open-ended. They are artefacts generated from sound: holding pens for ideas; spaces for visually working through challenges; and methods of processing the intangibility of the audio experience. Through visual diagramming I seek alternative ways to listen both with and beyond the auditory.

The aesthetic appeal of diagrams aids curiosity by compelling viewers to revisit, discovering further elements at each return. As such they are a useful visual tool for the micro-analysis of sound. There is much to discover within soundscapes, as demonstrated by forensic linguist

Peter French who once listened to a single word for three days.[302] A diagram provides ample scope, flexibility and adaptability to offer space for this level of forensic exploration. This aligns with Tufte's argument that: "the… reason for displays that portray complexity and intricacy is that the worlds we seek to understand are complex and intricate."[303]
The artworks discussed in this chapter each present complex events in their own visually appealing way. Voigt's hand-drawn images show a highly skilled draughtsperson's attention to detail and precision. In contrast, Kim's images appear deceptively simple with their smudgy charcoal aesthetic, yet they convey deeply perceptive ideas about sound and communication. Equally, the digital design from Janna Ullrich for *Conflicted Phenomes*, uses a visually intriguing variety of lines, textures and symbols to communicate intricate content with highly successful aesthetic effect. All three artworks include text that requires careful consideration.

When making the sylvan sounds diagram, I experimented with both digital and hand-drawn techniques. Here, I discovered that hand-drawn methods are better suited to my making practice. Returning to O'Sullivan's notion that sketching by hand drives conceptual insight and Taussig's argument that drawing leads to an unravelling of ideas, I find that when drawing, the physical marks made by my hand feel like a more personal expression, and the slow development of thought when drawing, allows ideas to percolate and flourish.

4.11 Conclusion

Analysis of the artworks of Jorinde Voigt, Christine Sun Kim and Lawrence Abu Hamdan, alongside my own works-in-progress show how diagramming is a highly effective method for exploring un-represented aspects of sound and alternative perspectives of silence and the listening experience. The visual artworks analysed have proved successful for: expressing a personal relationship with sound and silence (Kim); drawing attention to the harmful misinterpretation of voice (Abu Hamdan); speculating as to the emotional experience of another when writing music (Voigt); deconstructing an ecological soundscape to identify links and sonic overlaps (sylvan sounds and dendrophony diagrams); and exploring a

[302] Abu Hamdan, 'Aural Contract: Towards a Politics of Listening', p. 40.
[303] Tufte, p. 51.

listening event with the hand, ears, pencil and paper before academic analysis (waiting diagram).

Several discoveries were made during my initial phase of diagramming. First, the iterative re-designing of the sylvan soundscapes diagram led towards better clarification and definition between sylvan sounds and the dendrophony. Second, diagramming the dendrophony uncovered relationships and interconnections between the dendrophony, biophony and geophony. Third, the waiting diagram showed the value of a sketch to interpret and unravel the listening experience ahead of analytical investigation and revealed the diagramming method to be both the instrument and object of my research. These analyses revealed that the process of explorative diagramming drives growth and development of ideas and facilitates the journey to new knowledge about sylvan soundscapes. As such the diagrammatic process led to several potential avenues for further investigation. The sylvan sounds diagram could expand to include complicated sylvan sounds and geographical location. The dendrophony diagram could expand to include the anthropophony, technophony, sounds of plants or even viruses. Further diagrammatical investigations could explore focal and global attention, or noise and signal sounds within my gathering of sylvan soundscapes.

The diagrammatical process discussed in this chapter embodies a thinking-through-making methodology that enables me to develop ideas and analyse sonic experiences through artworks that are open to revision and expansion.[304] In the following chapter I draw one diagram to a momentary close by exhibiting it as a finished artwork. The act of marking it as complete enabled the artwork to develop in an unexpected way. It led to the combination of the field recording *Rainstorm Inside Forest Earth* with its corresponding sound visualisation and their exhibition as a single audio-visual installation, *Forest Listening*. I discuss the exhibition of *Forest Listening* in three locations – an outdoor courtyard, an indoor gallery, and a woodland – with how each unique site-responsive install altered the listening experience.

[304] Exhibiting the waiting diagram as *Listening for the Creak* at Unruly Encounters was a group exhibition with fellow PhD students at the Royal College of Art. It was an opportunity to share work-in-progress with my research peers. Despite exhibition of this diagram, I still consider it open to revision and expansion.

5. Exhibiting Audio-Visual Sylvan Soundscapes

5.1 Introduction

In the preceding chapter I analysed three of my sound visualisation artworks-in-progress, each of which explored a different aspect of sylvan field recordings via the practice of diagramming. I used a flow diagram to compare multiple sylvan field recordings to establish a more thorough definition of the dendrophony that differentiates it from a sylvan sound. I used a Venn diagram to explore the relationships between dendrophony, geophony and biophony. I used diagramming to analyse the soundscape *Creaking Pines* and through this explored the listening experience within the forest. I compared these diagrams with the diagrammatical methods embedded in artworks by Christine Sun Kim, Jorinde Voigt and Lawrence Abu Hamdan. Throughout the chapter I asked: How can I use sound visualisation to deepen my understanding of sylvan soundscapes and the experience of listening in forests? I discovered that explorative diagramming generates idea development and leads to new knowledge about sylvan soundscapes and the dendrophony.

The artworks in the previous chapter by Kim, Abu Hamdan and Voigt consider sound through the lens of music, silence, voice, emotion and personal perspective. None focus on ecological soundscapes. This chapter builds on my sound diagram analyses, beginning with two sound artists previously discussed – Bernie Krause and David Monacchi. Both have a dedicated ecological agenda embedded within their sound practices and both use the spectrogram, a digitally rendered form of sound diagramming, to expand the listening experience. I have chosen to focus on the sound works of Krause and Monacchi as they work with the key themes of this chapter: diagramming ecological soundscapes and exhibiting audio-visual installations which combine field recordings with their corresponding sound visualisations.

This chapter focuses on an artwork which combines the field recording *Rainstorm Inside Forest Earth* with its corresponding sound visualisation, a diagrammatical investigation that expands on the form of a spectrogram. I combined these two elements to make the audio-visual installation *Forest Listening* which was exhibited in three locations – an outdoor courtyard, an indoor gallery, and a woodland. Each location required a unique site-responsive

install, which in turn altered the listening experience. Through the iterative presentation of this artwork, I explore alternative ways to use the visual to listen both with and beyond the auditory.

Throughout this chapter I ask: How might exhibiting field recordings and sound diagrams as audio-visual installations change perspectives of sylvan sounds and how might this be affected by the exhibition setting?

5.2 David Monacchi and Bernie Krause – diagramming ecological soundscapes

Concern for ecological environments underpins the sound practices of Monacchi and Krause. In a collaborative essay for the publication *Eco Acoustics: The Ecological Role of Sounds*, they describe the inspiration for each of their independent soundscape practices as the sounds of living organisms emanating from natural habitats.[305] Their particular focus is human impact on the biosphere in the form of deforestation, overexploitation of ecosystems, pollution and invasion of non-native species. Monacchi states his life's work is invested in raising public awareness of "the most silent catastrophe of our times: the Sixth Mass Extinction" in which an "estimated 8.7 million living species are going extinct."[306] Krause and Monacchi both aim to link the humanities with science through cross-disciplinary acoustic ecology and engage with non-specialist audiences through contemporary art practice.

To do this, they present visual information alongside sound works. These supporting visuals are in the form of spectrograms – digital rendering of sound in which time runs along the horizonal X axis from left to right, and frequency up the vertical Y axis with lower pitched frequencies at the bottom up to higher pitched frequencies at the top of the image. In their publications and presentations, spectrograms are presented as annotated still images (Fig. 22). In exhibitions, such as Monacchi's *Fragments of Extinction* (2002 onwards) (Fig. 23) and Krause's installation at the Horniman Museum in London (2015), the spectrogram unfolds in real-time, synchronised with the soundscape, so that the vocalisations of the birds, animals, and insects can be visually identified alongside their corresponding sounds. Sound is the

[305] David Monacchi and Bernie Krause, 'Ecoacoustics and Its Expression through the Voice of the Arts: An Essay', in *Ecoacoustics: The Ecological Role of Sounds*, ed. by Almo Farina and Stuart H Gage (New Jersey: John Wiley & Sons, 2017), pp. 297–312 (p. 298).

[306] *Environmental Sound Artists: In Their Own Words*, ed. by Frederick W. Bianchi and V. J. Manzo (New York: Oxford University Press, 2016), p. 159.

primary element in Krause's exhibitions, with visuals providing a supporting role, thereby "turning a century of tradition upside down", where sound would have traditionally acted as supporting material within visual museum exhibits and films.[307] For Monacchi, the visuals of a spectrogram allow audiences to access the details of a soundscape, such as "the cycles and sound signatures in the macro-temporal domain; the interspecies niche segregation dynamics; the microcosm of the subtle sound gestures and narrow frequency textures of insects."[308] Monacchi's understanding of the structured and balanced soundscapes of undisturbed, intact ecosystems, was confirmed when he read about Krause's Acoustic Niche Hypothesis,[309] a theory that relies on spectrogram analysis to evidence biophonic niche segregation in ecological environments. As such, their practices are linked both by subject matter and intent, as well as by their use of the spectrogram to support and evidence their ecological message.

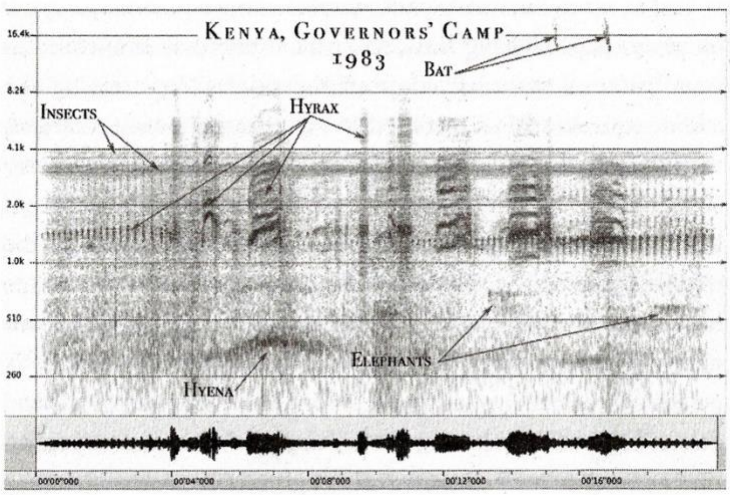

Figure 22: Bernie Krause, Kenya, *Governor's Camp*, 1983. Annotated spectrogram. Used with permission of Bernie Krause.

[307] Monacchi and Krause, p. 304.

[308] David Monacchi, 'Fragments of Extinction: A Periphonic Audio-Video Concert Based on 3D Ambisonics Field Recordings of Primary Rainforest Ecosystems' (presented at the EAA Joint Symposium on Auralization and Ambisonics, Berlin, Germany, 2014), p. 3.

[309] Bianchi and Manzo, p. 161.

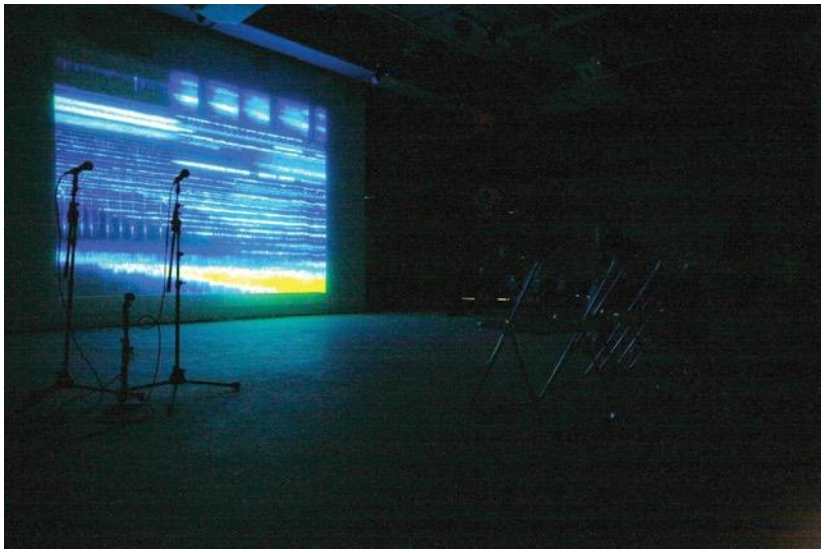

Figure 23: David Monacchi, *Fragments of Extinction*, 2006. Eight-channel surround sound installation with streaming spectrogram projection. 6–14 October 2006, 3LD Art Gallery, New York. Used with permission of 3LD Art and Technology Center.

A spectrogram reveals the structure of sound in visual form. This could be applied to any sound such as a field recording, music or a spoken interview. Spectrograms can be analysed in micro detail and if required, edited. Both Monacchi and Krause liken the spectrogram to musical notation with Monacchi describing it as a "score of the soundscape"[310] and Krause stating: "I dared to think of the spectrograms as contemporary graphic musical scores—not that different from those written by the Canadian composer R. Murray Schafer."[311] Krause and Monacchi have both come to acoustic ecology as highly successful musicians and so it is understandable they should link spectrograms to score. However, coming from visual arts, I have an alternative perspective as I see scores as the precursors and generators of sound, in the way that a musical score leads and guides players. For me, a spectrogram is different. It is a visual interpretation of sound and as such the sound comes first and the spectrogram follows. I prefer to regard the spectrogram as a diagram, a visual interpretation of sound that can generate new knowledge and understanding.

Krause and Monacchi use the spectrogram to communicate their vital eco-acoustic findings and (particularly Krause) for scientific analysis of eco-acoustic data. These uses of the spectrogram place it in the category of an explanatory diagram in which it represents with precision the sonic structure of soundscapes. Here, the diagram is excellent for communication and scientific analyses as it reveals and confirms ecosystem health and

[310] Bianchi and Manzo, p. 164.
[311] Krause, *The Great Animal Orchestra*, p. 87.

decline. The combination of field recordings with a visual support of the spectrogram is used with great effect to engage the public in immersive exhibition experiences and communicate vital knowledge about threatened ecosystems.

The spectrogram is clearly an extremely useful tool for analysing soundscapes, however I pose that the diagrammatical capacity of the spectrogram might be explored further by expanding its use from the explanatory into the realm of the exploratory. To this end, I intend to use the spectrogram in a different way. What new understanding of soundscapes can I achieve through using the spectrogram as an exploratory diagrammatical tool? In what ways are the component parts of a spectrogram – frequency, time and volume dynamics – limiting, and can they be expanded or changed? What might be the effect of converting the digital format of a spectrogram into a hand-drawn analogue format? Is the immersive effect of a real-time spectrogram lost if it is not moving, and might still images of a spectrogram be equally as immersive?

To answer these questions, I track the making process of a sound diagram through to completed artwork and its changes over several exhibitions.

5.3 Diagramming an alternative perspective of forest rain

Rainstorm Inside Forest Earth is an audio record of the first rain in months hitting the forest floor during the 2018 summer heatwave in the Forest of Mar in the Scottish Cairngorms. It reveals a perspective of a rainstorm that humans don't normally experience. Listeners are surrounded by the sounds of raindrops vibrating against dry earth particles, revealing materials in different states, liquid water and solid earth, colliding together. The recording was gathered by burying two hydrophones (microphones that can be submerged in water) just beneath the surface of the earth with the rain hitting them from above. This shift alters the listening position from the human above-ground to a worm or tree root's sensation below-ground. The field recording enables imagination of the embodied experience of a rainstorm from a non-human perspective. By placing hydrophones inside forest earth, the soundscape was restricted and consequently the signal sound of rainfall was augmented. This decision enabled me to use the spectrogram, back in the studio, for close analysis of the frequency of the rain drops as they hit the ground (Fig. 24). The first stage in this analysis was to re-make the spectrogram, changing it from a digital rendering to a hand-drawn diagram. I retained its

form but incorporated my own interpretation of sonic textures that visually echoed the patterns of rain on a windowpane (Fig. 25).

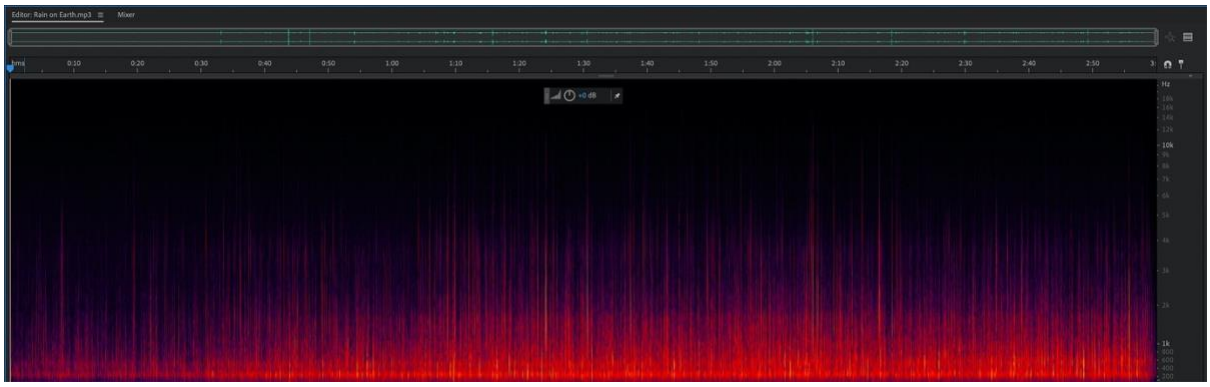

Figure 24: *Rainstorm Inside Forest Earth,* 2018. Digital spectrogram.

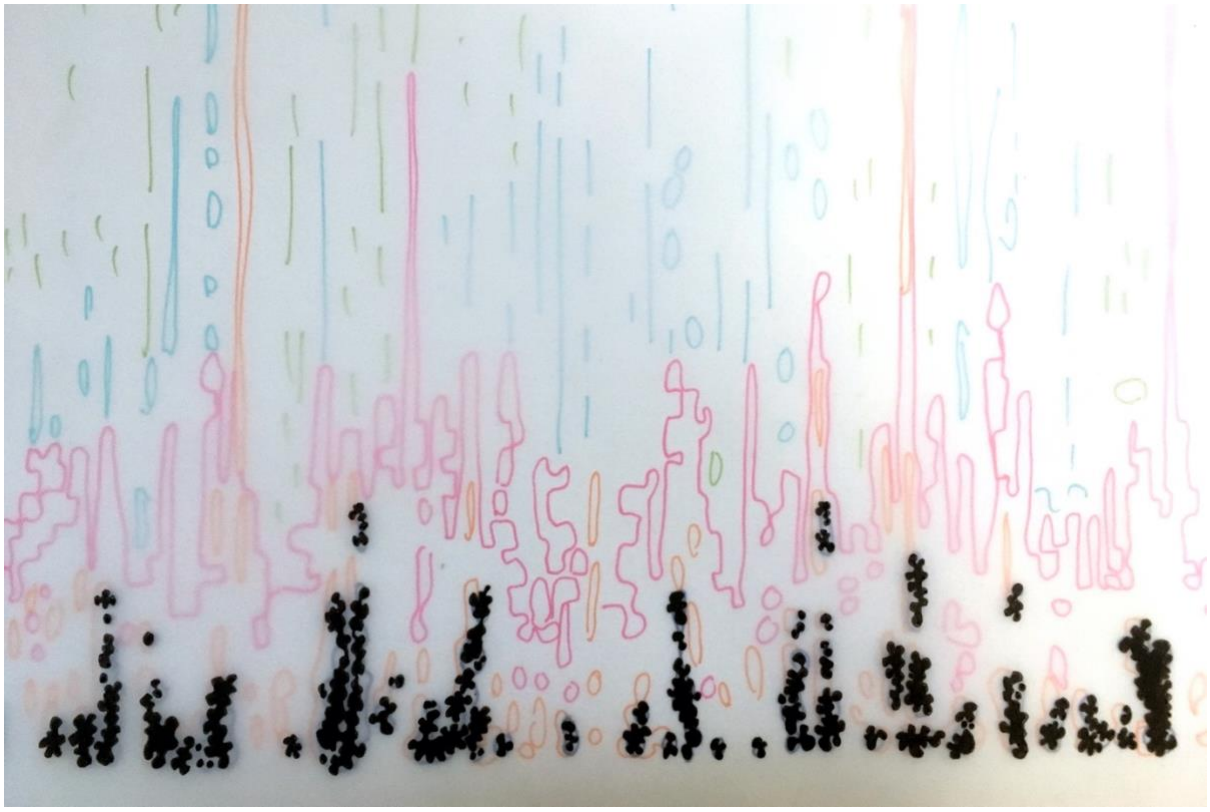

Figure 25: *Rainstorm Inside Forest Earth*, work in progress, 2018. Pen on tracing paper, 59.4 x 84.1 cm.

Analysing sound through imagery is complicated. Equally complicated is writing about sound, which is the specialism of Salomé Voegelin. She uses the visual medium of text to reveal hidden aspects of sound. She proposes writing about sound as "an experiment, a suggestion, a provocation"[312] that encourages contemplation and engagement with sound from a new perspective. She invites the reader to treat her writing as "a generative

[312] Salomé Voegelin, *Sonic Possible Worlds: Hearing the Continuum of Sound* (New York: Bloomsbury Academic, 2014), p. 4.

interpretation"[313] so that the reader's imagination is triggered towards sounds remembered and sounds yet to be heard. Similarly, my diagrams are a prompt to listen with, or through, the visual. As such, my artistic intention aligns with Voegelin's aim for her sonic writing practice which is "a sonico-visual understanding of the world that knows its surface but also appreciates the hidden mobility beneath".[314] Voegelin's sonic writing and my sound diagramming are both transformation processes in which textual and visual artefacts are produced from sound to promote greater awareness of its depths. The composer John Cage identified the importance of transformation within the artistic process: "the inspired conversion of sound to image from one medium to another, or ideas from mind to page – ultimate expressions far more resounding than the original sources from which they spring."[315]

However, sensory transformation as artistic method is potentially problematic. A critique of sensory transformation is posed by Tess Takahashi in her paper examining the quietest areas in the US, in which audio data is represented as graphic visualisations. She identifies the advantage of data visualisation to condense the overwhelming amount of 'Big Data' into an image that can be understood at a glance, whilst also critiquing the authority of this method which selects only the information it deems important. She sets out the problem thus: "Visual measurements of sound volume… strip away the less quantifiable aspects of tone, resonance, accent, and musicality… The individuality, intermittence, and confusion of an all-enveloping soundscape are exchanged for epistemological clarity on the level of the visual."[316]

Takahashi warns that the clarity of data visualisation methods, loses the embodied sensorial experience inherent in sound, and reminds us that the organising principles of the predominant data visualisation methods reinforce the dominant "already powerful audible, meaningful, and legitimate views of the world."[317] With this critique she advocates recognising what goes unrepresented and what is left behind within data visualisation methods and imagery. Takahashi's critique applies to visualisations that replace the original soundscapes with visual representations. In contrast, my diagrams expand the listening experience. Just as Voegelin's visual text is a prompt to consider aspects of sound more

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[313] Voegelin, *Sonic Possible Worlds*, p. 3.

[314] Ibid., p. 5.

[315] John Cage speaking with Bernie Krause at Skywalker Sound soundscape conference, California, 1989. Krause and others, p. 33.

[316] Tess Takahashi, 'Data Visualization as Documentary Form: The Murmur of Digital Magnitude', *Discourse*, 39.3 (2017), 376-396, (p. 378).

[317] Takahashi, p. 381.

easily overlooked, my diagrams seek to draw out unnoticed fragments of sound and make these more accessible. By focusing on the less noticeable edges of soundscapes, my diagramming process aligns with Takahashi's advocation for recognising sounds that are unrepresented and left behind. For example, exploring the sonic detail of *Rain Inside Forest Earth* doesn't have the melodic allure of birdsong, or the excitement of thunder, yet it has its own value. On a philosophical level it contributes to the shift in perspective towards the experience of the non-human (and on a practical level it enables close examination of the soundscape without the discomfort of being wet, cold and muddy).

5.4 Expanding out of the digital spectrogram

The digital spectrogram format is ideal for analysing and communicating sonic data. Krause and Monacchi both use it to great effect within exhibitions for communication of eco-acoustic findings. However, I find the digital aesthetic of this diagramming format does not foster personal connection. I feel that I gain a deeper connection with the personalities of Voigt and Kim through their drawing styles. I want this level of personal connection in my work. I am not just communicating information; I am offering up my perspective of sound. For this reason, I translated the digital spectrogram into analogue handmade diagrams. As mentioned in the previous chapter, drawing by hand slows down the making process, allowing ideas to percolate and flourish. One such idea emerged whilst hand-drawing my *Rainstorm Inside Forest Earth* diagram. The idea was to draw four diagrams each corresponding to a different decibel range. In doing this I could explore the volume dynamics of the soundscape in greater details without losing the depiction of sound texture, frequency and time (Figs. 26 – 29). I chose to omit all measurements from the x and y axes to distance the diagram from a graph with boundaries. During recording, volume was amplified by the hydrophones to levels audible to the human ear, making a measurable decibel level redundant. Following John Drever's premise of *aural diversity* in which "every human hears differently",[318] the four volume levels of the diagrams are about perception and reception, not defined measurements.

[318] John Levack Drever and Andrew Hugill, 'Aural Diversity', 2019 <http://auraldiversity.org/index.html> [accessed 9 March 2020].

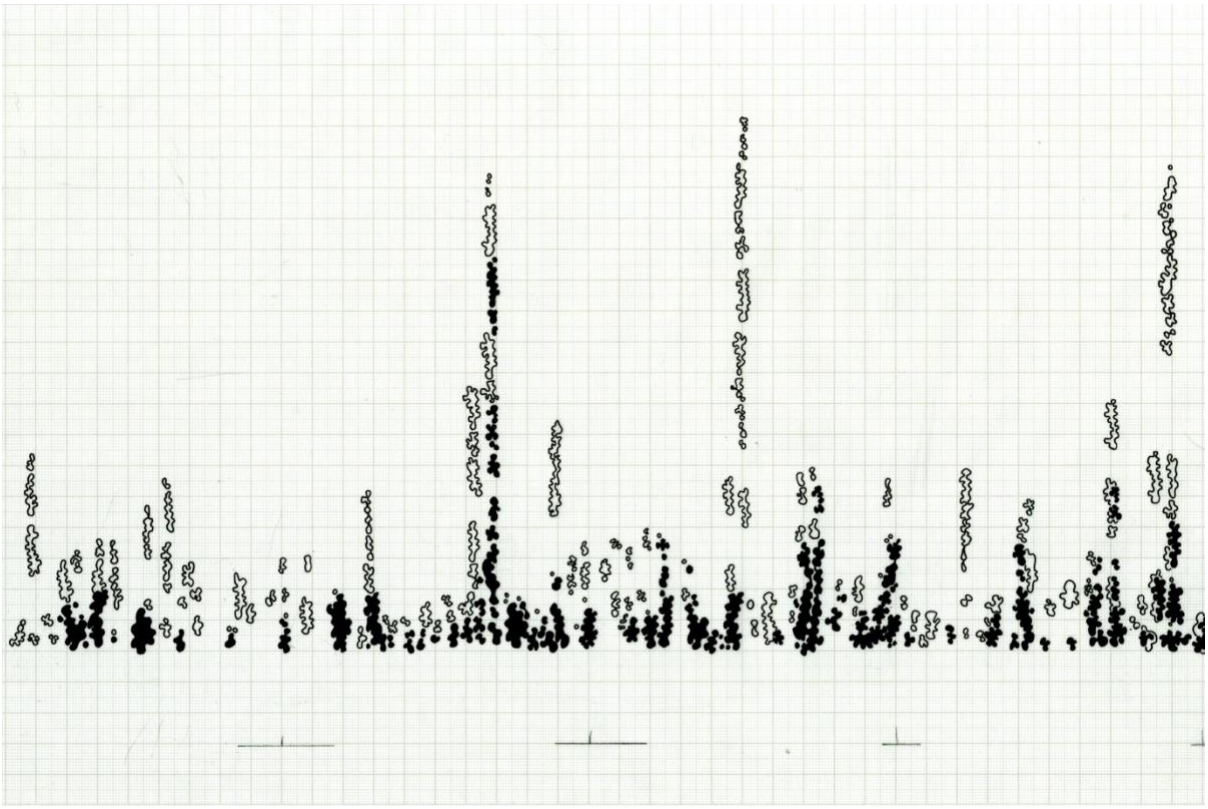

Figure 26: *Rainstorm Inside Forest Earth Diagram #1*, detail view, 2018. Pen on tracing and graph paper, 59.4 x 84.1 cm.

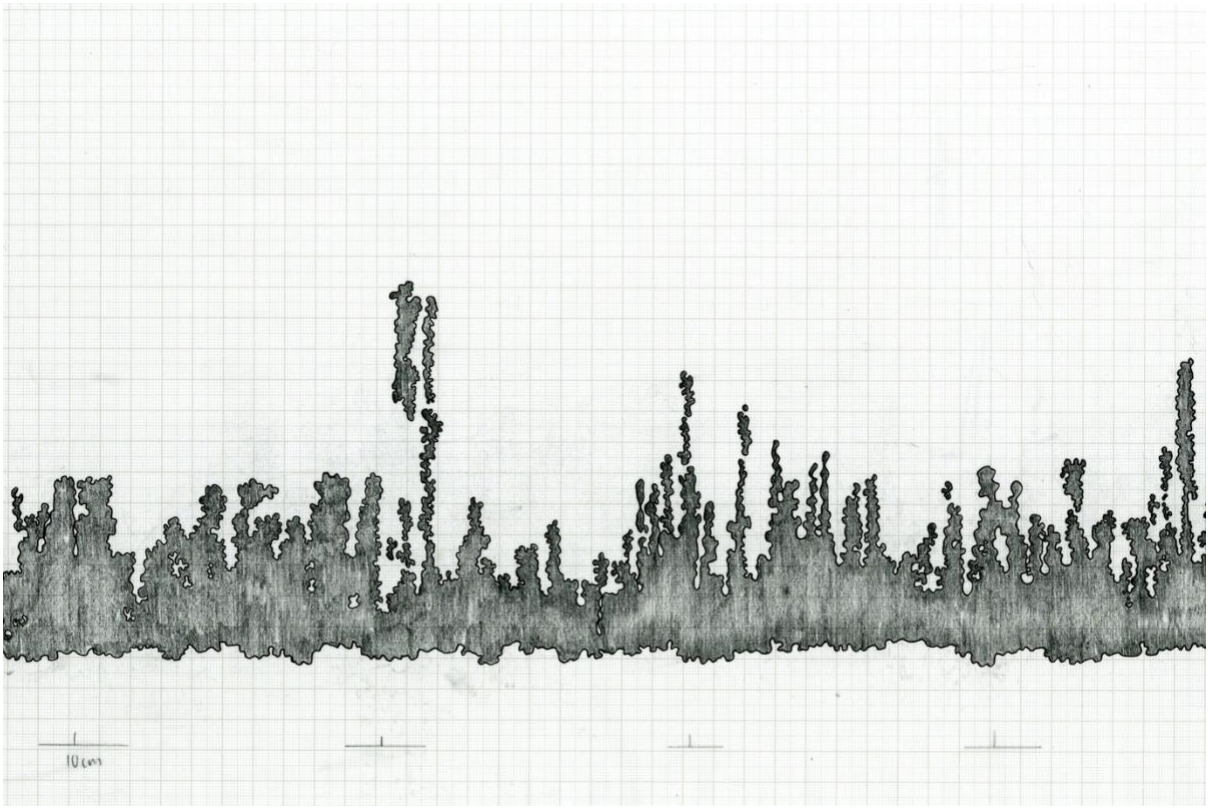

Figure 27: *Rainstorm Inside Forest Earth Diagram #2*, detail view, 2018. Pen on tracing and graph paper, 59.4 x 84.1 cm.

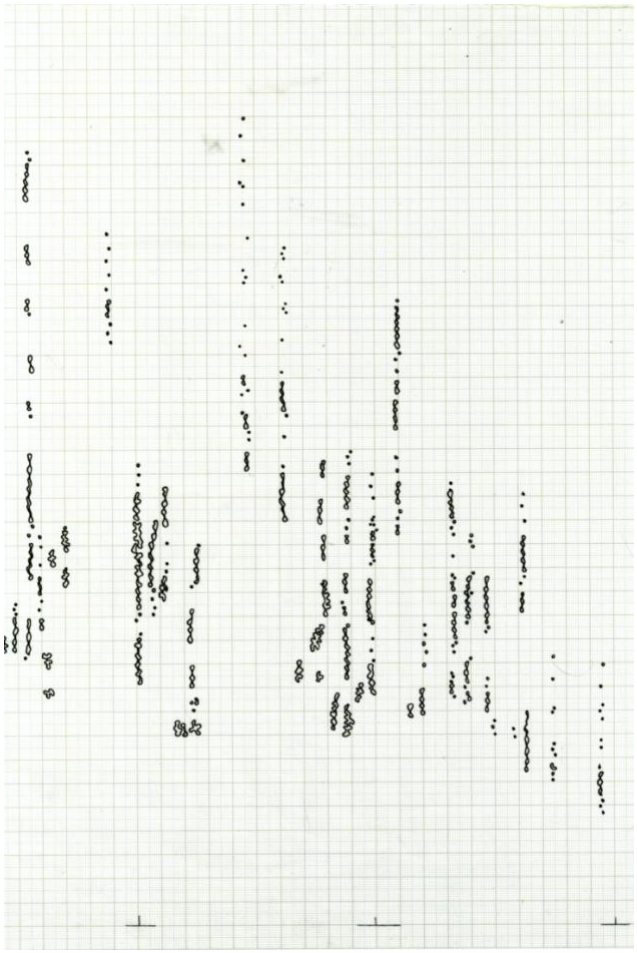

Figure 28: *Rainstorm Inside Forest Earth Diagram #3*, detail view, 2018. Pen on tracing and graph paper, 59.4 x 84.1 cm.

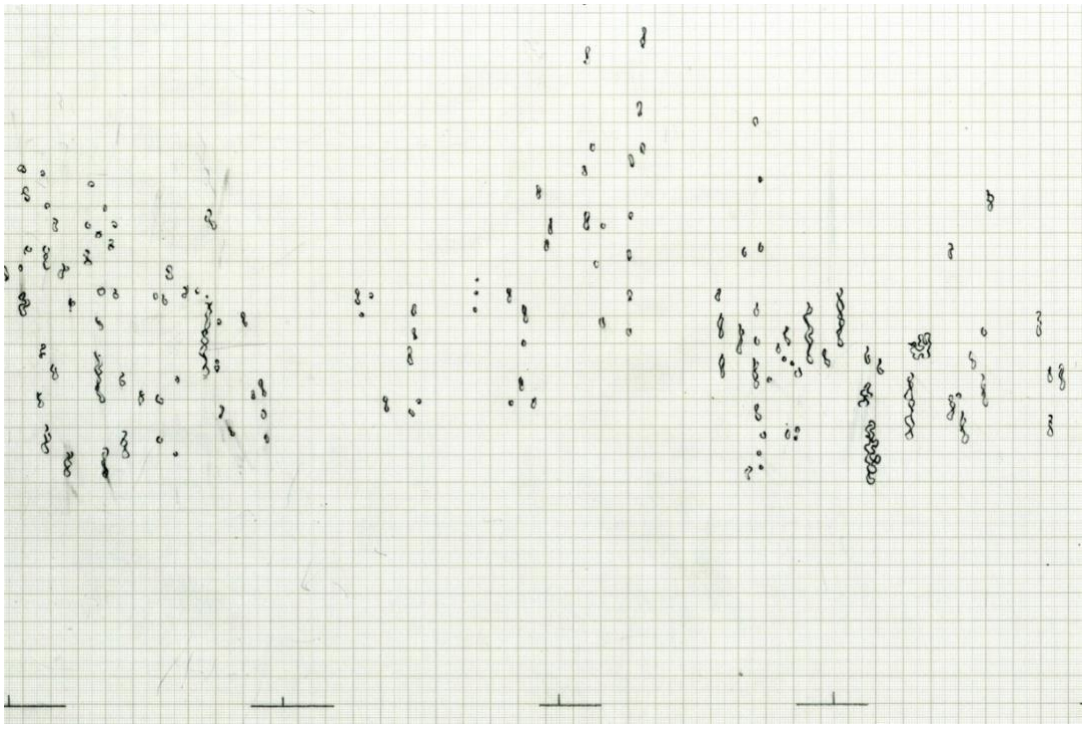

Figure 29: *Rainstorm Inside Forest Earth Diagram #4*, detail view, 2018. Pen on tracing and graph paper, 59.4 x 84.1 cm.

I used tone to differentiate between the four *Rainstorm Inside Forest Earth* volume dynamics diagrams. I did this by printing them using the photographic cyanotype technique (rather than the spectrograms standardised colour range). Cyanotype is an analogue photography technique in which a solution of iron compounds is painted onto paper (or other naturally absorbent material) and dried in the dark as the solution renders the paper light sensitive. When dried, objects or negatives are placed onto the paper and exposed to Ultraviolet light (such as the sun or UV lamp). The objects, or black ink on the negative, block the light, keeping those areas of the cyanotype soft. Where light hits the photo-sensitive emulsion, it hardens. After exposure, the paper is washed with water, and any soft areas of emulsion, unhardened by light, are washed away, revealing the white of the paper, whilst areas of emulsion hardened by light turn blue. Therefore, the image of the print is white and the background blue. The completed image is then dried. It is possible to control, to a certain degree, the density of both the blue background and the white image areas, resulting in an image with a blue tonal range and high levels of detail. With this technique I could retain the hand drawn aesthetic of my diagrams but modify the intensity of the classic cyanotype blue to show decibel level. The deepest blue depicted the loudest (for close and large raindrops) and the lightest depicted the faintest (for distant and small droplets) (Figs. 30 – 37).
The cyanotype process was also chosen for its historical links to my subject matter. Just one year after the technique was invented by Sir John Herschel, in 1842, the botanist and photographer Anna Atkins used the process to document the ferns and seaweed in her collection of botanical specimens. Over 10 years she created three volumes of organic photograms titled *British Algae: Cyanotype Impressions 1843-1853.*[319] Use of the cyanotype process became widespread from the 1880s to the 1950s by engineers and architects to reproduce detailed plans and drawings in the form of blueprints.[320] These two historical uses of cyanotypes, recording indicate details of botanical specimens and hand-drawn diagrams, link strongly with my investigation of forest flora and diagrammatical making processes. I had not intended the classic Prussian blue colour of cyanotypes to be a significant element of the images, however a frequent comment from viewers was that the vibrant blue brought rain and water to mind.

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[319] Brian Coe and Mark Haworth-Booth, *A Guide to Early Photographic Processes* (London: Victoria & Albert Museum, 1983), p. 19.
[320] Mike Ware, *Cyanomicon - History, Science and Art of Cyanotype: Photographic Printing in Prussian Blue*, 3rd edn (Buxton: Self Published, 2020), p. 18 <https://www.mikeware.co.uk/downloads/Cyanomicon.pdf> [accessed 6 February 2023].

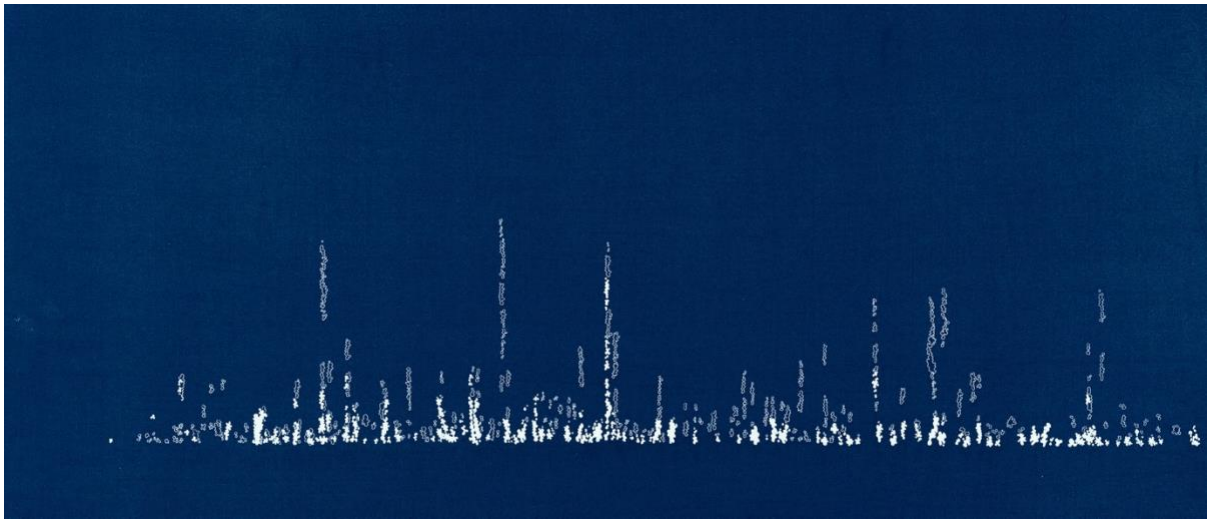

Figure 30: *Sound Sketch – Forest Rain #1*, 2019. Cyanotype, 77 x 34 cm.

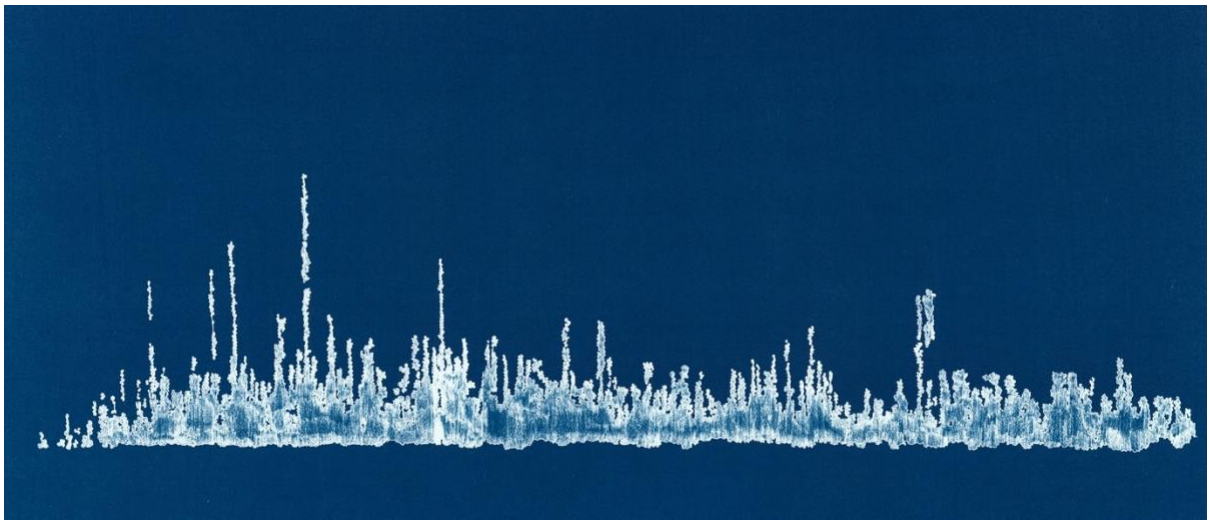

Figure 31: *Sound Sketch – Forest Rain #2*, 2019. Cyanotype, 77 x 34 cm.

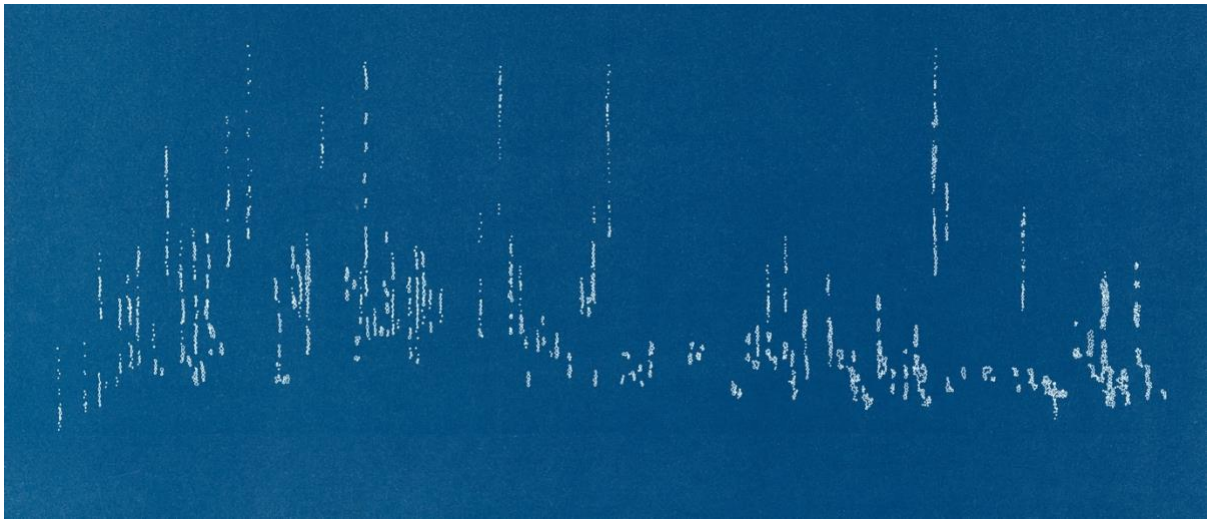

Figure 32: *Sound Sketch – Forest Rain #3*, 2019. Cyanotype, 77 x 34 cm

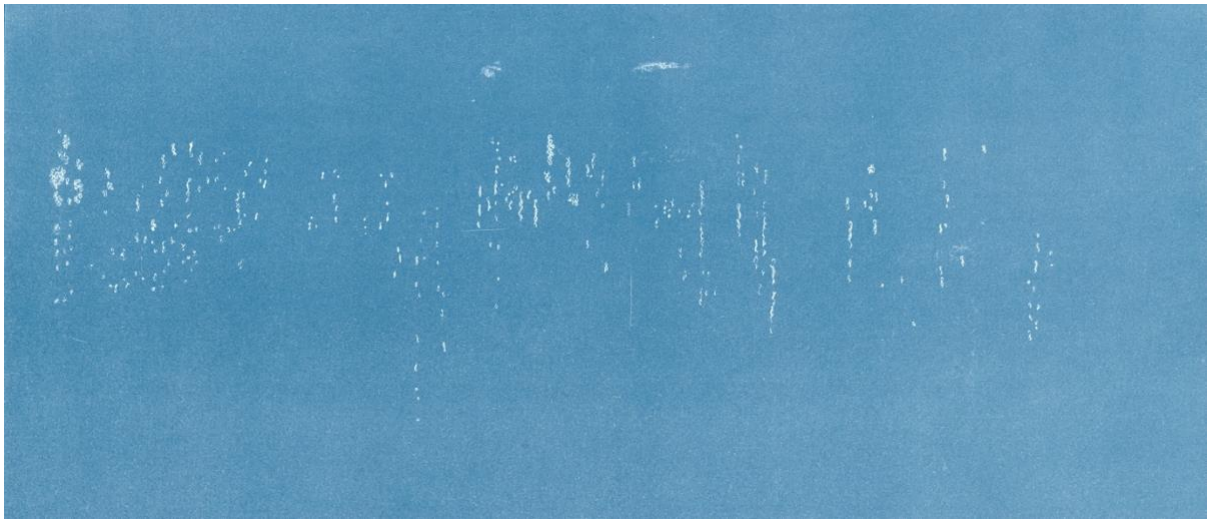

Figure 33: *Sound Sketch – Forest Rain #4*, 2019. Cyanotype, 77 x 34 cm.

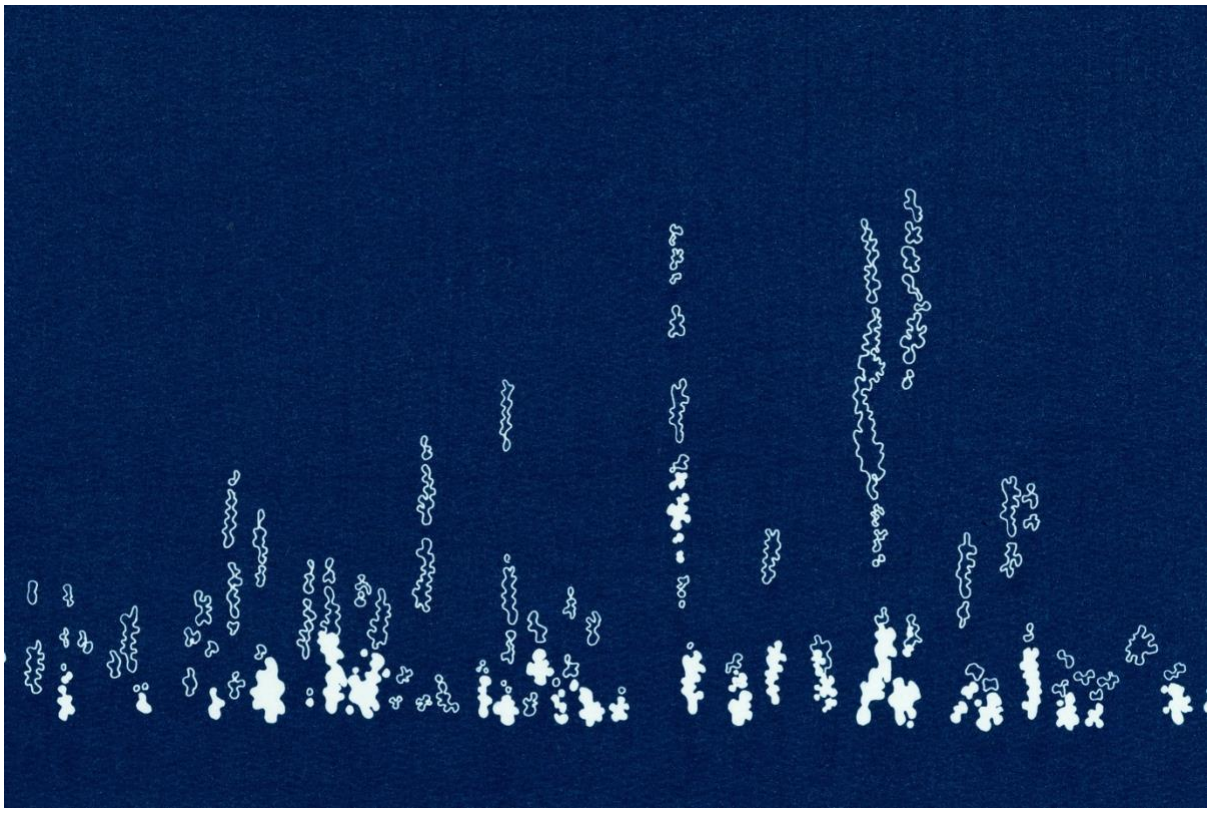

Figure 34: *Sound Sketch – Forest Rain #1*, detail view, 2019. Cyanotype, 77 x 34 cm.

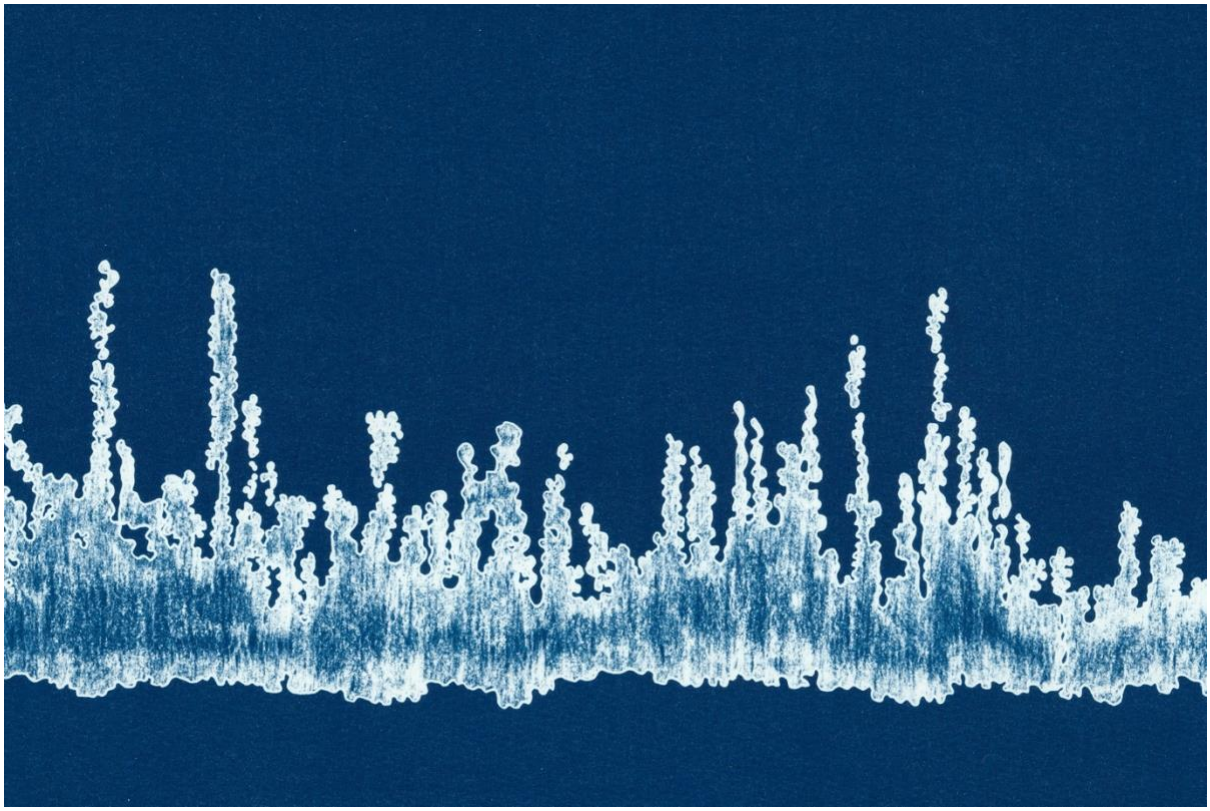

Figure 35: *Sound Sketch – Forest Rain #2*, detail view, 2019. Cyanotype, 77 x 34 cm.

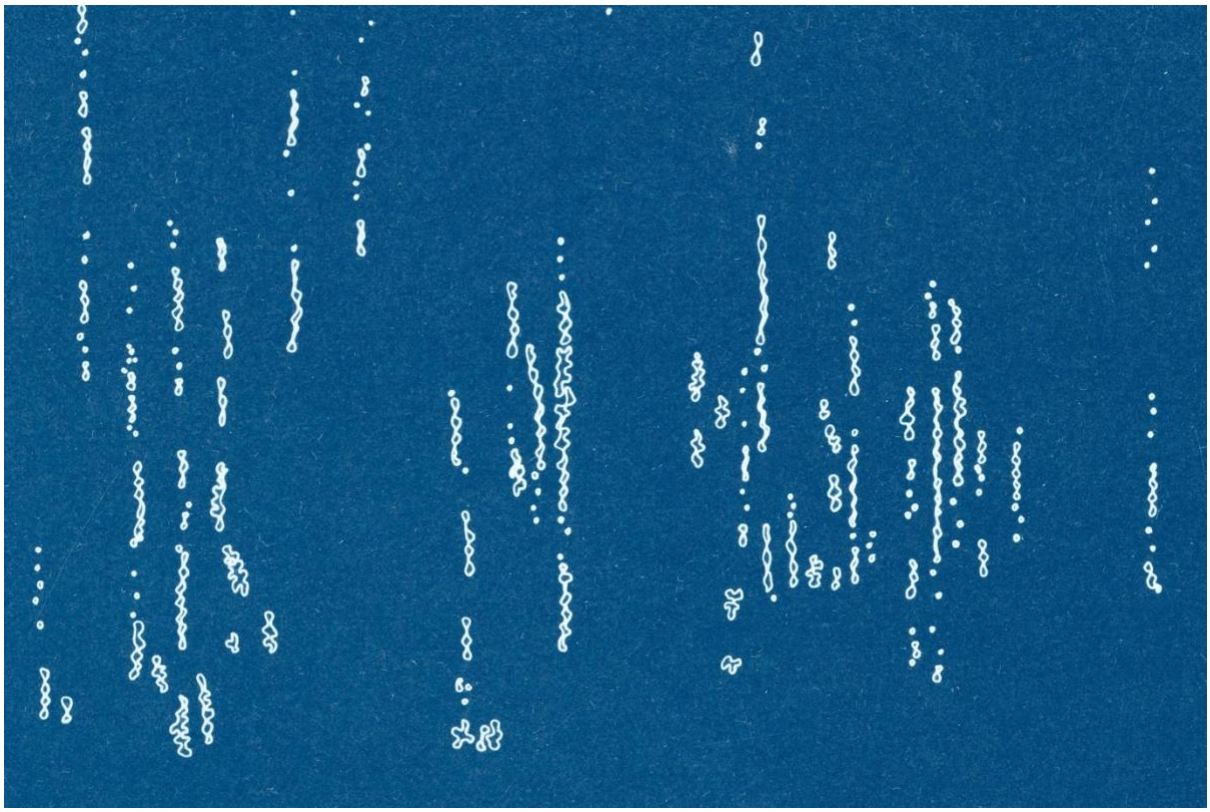

Figure 36: *Sound Sketch – Forest Rain #3*, detail view, 2019. Cyanotype, 77 x 34 cm.

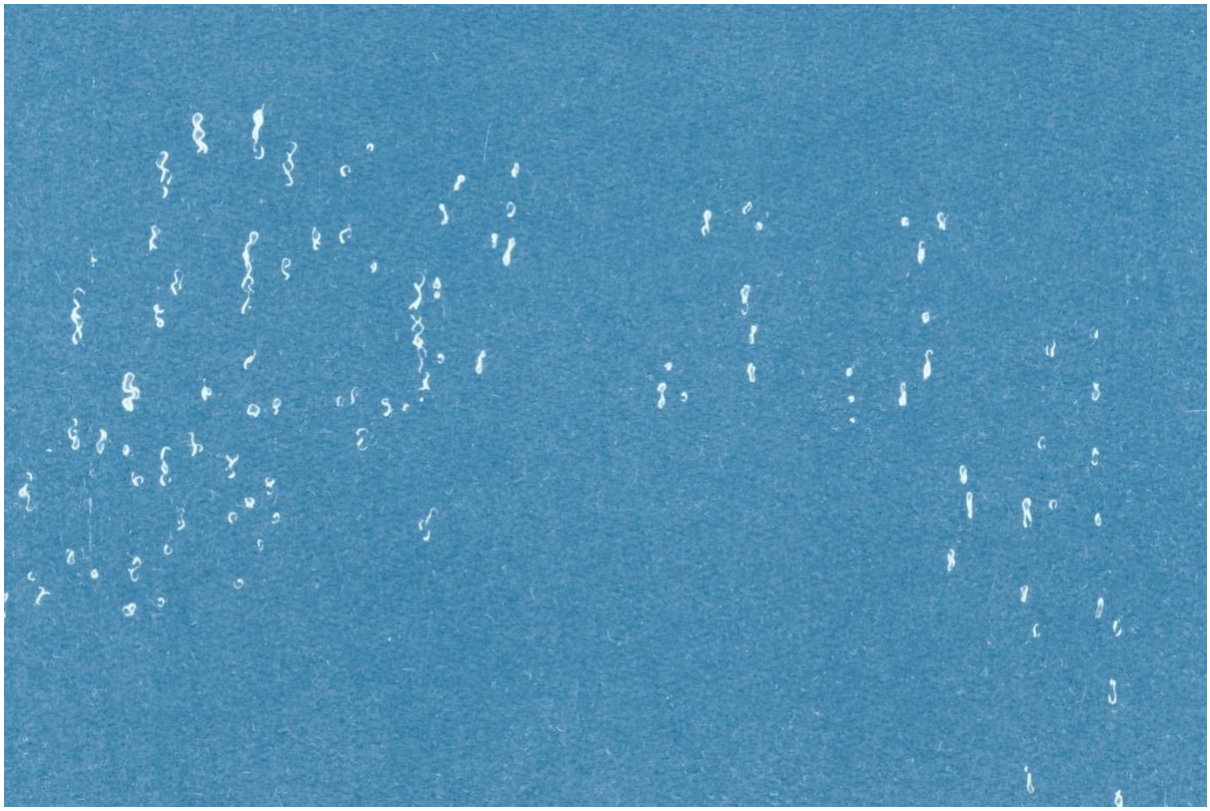

Figure 37: *Sound Sketch – Forest Rain #4*, detail view, 2019. Cyanotype, 77 x 34 cm.

Cyanotype is widely described as the saftest photo printing method. The classic cyanotype chemistry uses ferric ammonium citrate and potassium ferricyanide which are, according to the University of Brighton Photographic department, "no more dangerous than most common household cleaning supplies"[321] for which basic safety common sense is needed, such as wearing gloves, not consuming, and avoiding contact with eyes. However, during my research into the potential toxicity of cyanotype chemicals, I found an even more sustainable alternative. The anthotype is a similarly photographic process but uses plant materials to create the light sensitive emulsion instead of chemicals. I return to the topic of anthotype in the concluding chapter of this thesis when discussing future work and research.

5.5 Exhibiting audio-visual sylvan soundscapes

The four *Rainstorm Inside Forest Earth* sound diagrams were exhibited in *What on Earth* at The Koppel Project, TKP Exchange, Piccadilly Circus, London (2nd to 24th July 2021) as *Sound Sketch – Forest Rain* (Fig. 38). When evaluating the exhibition of these works on

[321] University of Brighton, 'Health and Safety - Ferric Ammonium Citrate and Potassium Ferricyanide', *Photographic Service Unit*, 2023 <https://blogs.brighton.ac.uk/photounit/cyanotype/health-safety/> [accessed 6 February 2023].

paper I felt the limitations of my sound visualisations were their inability to explore both a sense of space and the temporal experience of listening to a soundscape. I concluded that the visualisations could not replace the original soundscape as a still image cannot reflect sound's temporal and spatial qualities. Therefore, for the diagrams to function as an exploration of sound, I needed the visuals and the soundscape to be presented together in a single artwork. This led to the question:

How might exhibiting field recordings and sound diagrams as audio-visual installations change perspectives of sylvan sounds and how might this be affected by the exhibition setting?

Figure 38: *Sound Sketch – Forest Rain #1 – #4*, 2019. Cyanotype, 77 x 34 cm. What on Earth, The Koppel Project, TKP Exchange, Piccadilly Circus, London, 2 – 24 July 2021.

This notion of audio-visual sensory collaboration aligns with a growing number of artists who use multiple recording practices to provide richer engagement with environments for both recordist and audience. A notable example is Cusack who states:

> Our senses and the media that address them cover different areas of perception. We gain a much fuller picture when they are in proper balance. Sound on its own is as incomplete as visual images and language on their own.[322]

However, an argument contrary to both my own and Cusack's position is from critic of visual and sonic art Christoph Cox, who questions why within multi-sensory artworks from the twentieth and twenty-first century, sensory unity between sound and image is so fragmented and problematic. One reason Cox suggests for the separation of the 'noble senses' of vision and hearing is the siloed contexts in which visual art and music were experienced. Painting

[322] Cusack, p. 28.

and sculpture were traditionally experienced with the eyes and viewed in galleries and museums, and music was experienced with the ears within the concert hall. While Cox acknowledges sensory merging in the performing arts of theatre and cinema, he challenges "the anxious appropriation of sound into the visual arts", claiming that despite artistic attempts at sensory unity, he finds "a series of vexed encounters" within audio-visual artworks.[323] He suggests that a resistance to "seamless merging of sound and image" comes from the suspicion that an attempted convergence would "retain the hierarchy that subordinates all other modalities to the visual."[324] His conclusion is that a collaborative approach between sound and image must acknowledge the "differences between these media and their sensory modalities"[325] and that cinematic projects best achieve this goal. In response, I propose that a collaborative approach between sound and image can indeed be found within an audio-visual arts practice grounded in field recording and sound diagramming.

A multi-sensory practice that effectively combines sight and hearing can be found in the practice-based arts research of Matilde Meireles. Her work combines phonography, photography and text to "overcome the fragmentation of the senses inherent in field recording".[326] For Meireles, working with sound alone conveys only a single aspect of the recorded event, whereas a dialogue between sound, vision and text enables "listening across practices".[327] Her development of *extended phonography* goes beyond field recording to include visual and diaristic records in a non-hierarchical collaboration of methods. Miereles uses this combination of recording processes to engage herself and her audience with specific sites.[328] In contrast, my visualisations are an artefact generated from the soundscape through repeated listening and deep exploration of the field recording back in the studio. Instead of expanding the original context, they seek to expand the field recording, with the visual exploration acting as an elaborative, supportive structure to the listening experience. My aim is to promote the unique qualities of sight and sound affirming what Cox describes as "a

[323] Christoph Cox, *Sonic Flux: Sound, Art, and Metaphysics* (Chicago; London: The University of Chicago Press, 2018), pp. 174–75.
[324] Cox, p. 181.
[325] Ibid., p. 213.
[326] Matilde Meireles, 'Extended Phonography: Experiencing Place through Sound, a Multi-Sensorial Approach', *Organised Sound*, 23.1 (2018), 101–11 (p. 101).
[327] Meireles, p. 101.
[328] Ibid., p.110.

productive difference and tension between seeing and hearing."[329] The process acknowledges the differences in sensory perception of sight and sound but follows the notion that listening is not just an aural activity, and as such explores using multiple senses in non-hierarchical collaboration to expand the listening experience.

Following this line of research, I combined the field recording and the diagrams of *Rainstorm Inside Forest Earth* to make the audio-visual installation *Forest Listening*. In this format the cyanotype prints evolved from small-scale works on landscape-format paper measuring 77 x 34 cm, into twelve hanging canvas banners. Each banner was a vertical section of the cyanotype diagrams (measuring 4 x 21 cm) and enlarged to human height (24 x 126 cm) to surround the listener, echoing the perspective of the soundscape from below ground. The result was a magnified and fragmented version of the cyanotypes. The essence of the original diagram remained, with the frequency springing upwards, the range of four blue backgrounds indicating volume dynamics and the drawings' watery texture. The soundscape would change when heard in the different sites. Consequently, I intended the visual element of the installation to be site responsive. Recreating the cyanotype diagrams as long banners meant that the artwork could be de-composed and re-composed in response to each location. This avoided the static cyanotype images reflecting the permanence of maps, and enabled a constantly changing and evolving installation, just as sound is never static and a sketch is always under revision.

The following section of this chapter will analyse the successes and challenges of exhibiting *Forest Listening* in three locations: an outdoor courtyard for the *Unearthing Landscapes* Symposium (2019); an indoor gallery for the exhibition *(Eco)logical Sense* (2020); and an outdoor woodland within the Watts Artist Village (2021).

5.6 *Forest Listening* in a courtyard

Forest Listening was exhibited at Unearthing Landscapes, a symposium exploring "how the arts can enable a deeper understanding, knowledge and connection to landscape"[330] at the University for the Creative Arts (UCA), Farnham, Surrey, on 10th October 2019. Here, *Forest*

[329] Cox, p. 9.
[330] Surrey Hills Arts, 'Unearthing Landscapes Symposium', *Surrey Hills Arts*, 2019 <https://www.surreyhillsarts.org/unearthing-landscapes-symposium/> [accessed 6 April 2020].

Listening was installed outside in the university courtyard. The canvas banners were hung from the lowest canopy branches of a majestic maple tree – the only living greenery in the courtyard – and the sound element of the installation played from speakers lining the open-air space (Figs. 39 – 40). *Forest Listening* was the only physical exhibit at the symposium with all other artworks presented on screen in the lecture theatre. The courtyard wasn't often used as an exhibition space, it was more of a thoroughfare and a social hub with students eating, advertising student union activities, and delegates moving between symposium lecture theatres. The result was a location bustling with noise and activity which consequently, affected the reception of the *Forest Listening* installation. A disconnect arose between the sound and the visuals, where the visuals no longer supported the listening experience, and the two elements became separated. This broke down the multimodal listening experience therefore reducing the impact of the artwork.

Having to compete with other noise sources meant that the audio element of the installation was lost. However, the visuals created curiosity with people paying far more attention to the single tree in the courtyard because of the banners and the information provided about the project (Fig. 41). For example, a group of students practicing interview techniques focused their project on asking everyone in the courtyard what they thought of the *Forest Listening* banners. [331]

[331] I returned to UCA Farnham on 16 March 2020 to find that the maple tree had been cut down. I had grown close to this tree during my time installing the artwork and I felt its loss, as did many staff and students at UCA.

Figure 39: *Forest Listening*, 2019. Twelve canvas banners, each 24 x 126 cm. University for the Creative Arts, Farnham, Surrey, UK.

Figure 40: *Forest Listening*, detail view, 2019. Twelve canvas banners, each 24 x 126 cm. University for the Creative Arts, Farnham, Surrey, UK.

Figure 41: *Forest Listening*, 2019. Symposium delegate photographing the installation information. University for the Creative Arts, Farnham, Surrey, UK.

On reflection, the busy urban setting was a difficult context in which to attempt to showcase the detail and subtlety of a sylvan soundscape. The site presented challenges for an audio-visual installation. While the artwork increased awareness of the maple tree, the disconnect between the sound and the visuals supported the premise, laid out by Lisbeth Lipari and musician David Toop, that sensory perception of sound and vision differ greatly. Lipari describes the difference between audio and visual perception in terms of sensory boundaries. She compares the effects of visual perception, which create distance and separation, with the act of listening which, she argues, connects and bridges: "unlike light, sound blurs the boundaries between interior and exterior."[332] For Toop, sound provides a sense experience that surrounds, supplying feedback that is both immersive and specific, whilst seeing only shows what is in front of our eyes.[333] He also discusses the temporal commitment needed for the act of listening: "sound gives the impression of occupying time, even moving with time or determining time, so to hear we need to devote time to the activity."[334] At the UCA site, the field of noise was already saturated. It was a lo-fi audio environment in which individual sounds cannot be discerned as the volume and layers of sound become too much, as R Murray Schafer describes: "In a lo-fi soundscape individual acoustic signals are obscured in an overdense population of sounds."[335] In the courtyard, sound from the speakers was an extra layer on top of the audio already present in the space. Consequently, people filtered out the soundscape to continue their conversations and interactions. This could have been significantly different if it had been a hi-fi sound environment, which Schafer describes as "one in which discrete sounds can be heard clearly because of the low ambient noise level."[336] In a hi-fi sound environment it is much easier to attend to a focused listening experience and direct attention to novel sounds as there is less audio competition.

In contrast, the banners attracted attention as people were able to acknowledge their presence at a glance. The visual artwork engages immediately, needing no prolonged time commitment. The visuals could be explored whilst simultaneously eating lunch, walking by, or conversing. Visual dominance of the installation was something I neither intended nor desired. The film editor and sound designer Walter Murch discusses an interesting audio-visual paradox which offers a potential explanation for this. The typical human ear can

[332] Lipari, p. 194.
[333] Toop, pp. 27–28.
[334] Ibid., p. 40.
[335] Schafer, p. 43.
[336] Ibid., p.43.

perceive an audio spectrum equivalent to ten octaves, whilst our visual perception is equivalent to an electromagnetic spectrum of just one octave. Despite this huge difference in sensory perspective range, we use a much greater amount of brain power for visual processing than for audio. As much detail as possible is extracted from our limited visual range, yet we do significantly less with the "banquet of sound… presented to us."[337] This may explain why people in the courtyard were able to consider the novel visuals and filter out the audio.

Tim Ingold also discusses the Western separation between the experience of vision and hearing, examining the thesis that "sound penetrates whereas sight isolates" and "that the auditory world is dynamic and the visual world static, that to hear is to participate whereas to see is to observe from a distance."[338] However, Ingold questions this division of the senses, and following James Gibson, he maintains that perceptual systems overlap, and that far from being separate activities, looking, listening and touching are all "different facets of the same activity: that of the whole organism in its environment."[339] Ingold advocates for the depth of experience through sensory unity and suggests that investigations into the cross-over between the senses could provide a rich source of discovery about the human experience. I wanted to explore options for installing *Forest Listening* in alternative contexts, in which I could trial Ingold's argument that exploration of "the common ground between vision and hearing" leads to greater appreciation for the depth and richness of experience, as well as "a more generous, open-ended and participatory understanding of thought."[340] Might the audio-visual elements of *Forest Listening* command more of an equal platform in a traditional gallery setting? Might a hi-fi sound environment, in which sounds are not overly dense but clear and distinguishable, augment the audio element of the artwork into more of a partnership with the visuals? Might the gallery environment create an opportunity to consider forest rain from an alternative perspective?

5.7 *Forest Listening* in a gallery

[337] Walter Murch, 'Surrounded by Soundscapes: Charles Amirkhanian, Bernie Krause, Walter Murch' (Berkeley Art Museum and Pacific Film Archive, 2013) <https://www.youtube.com/watch?v=_kXunfOQ_A0> [accessed 10 March 2020].
[338] Ingold, *The Perception of the Environment*, p. 251.
[339] Ingold, p. 261.
[340] Ibid., p. 287.

Forest Listening was exhibited in *(Eco)logical Sense* at the Hockney Gallery, Royal College of Art, London (12th to 15th March 2020), an exhibition that critiqued and reflected on attitudes to materials, modes of production and human relationships with the multi-species world. The banners were installed against a white wall, enhancing the four shades of blue, highlighting their contrast and allowing the volume and frequency range to stand out. In the gallery the atmosphere was meditative and still, voices were hushed, providing time and mental space for reflection. *Rainstorm Inside Forest Earth* was audible through headphones. This created an intimate and personal listening space, augmenting the sense of being surrounded by the rainstorm inside the earth. The high ceiling within the gallery provided ample space to raise the banners above the eye line of visitors. I intended the perspective of the audience to be shifted to below the banners, inviting them to look up to see the artwork and echoing the below-ground position of the audio recording (Figs. 42 – 44).

Figure 42: *Forest Listening*, 2020. Twelve canvas banners, each 24 x 126 cm. (Eco)logical Sense, Hockney Gallery, Royal College of Art, London, UK.

Figure 43: *Forest Listening*, detail view, 2020. Three of twelve canvas banners, each 24 x 126 cm. (Eco)logical Sense, Hockney Gallery, Royal College of Art, London, UK.

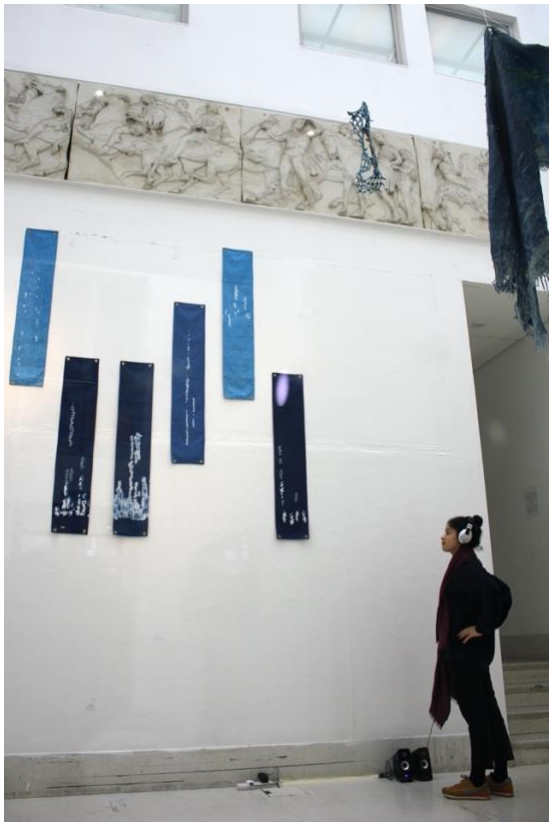

Figure 44: *Forest Listening*, 2020. Visitor looking up at visual artwork. (Eco)logical Sense, Hockney Gallery, Royal College of Art, London, UK.

The exhibition of *Forest Listening* in the gallery created a listening experience that aligns with literature scholar Steph Ceraso's call for *multimodal listening* experiences in which she conceives the act of "listening as an expansive multisensory practice".[341] She compares ear-centric hearing (that she calls *ear-ing)* in which the goal is to "hear and interpret audible sound" with multimodal listening which "amplifies the ecological relationship between sound, bodies, and environments."[342] Ceraso is interested in the holistic experience of listening, one that does not separate body and mind or isolate senses. From a pedagogical position, she is invested in "what people might learn, do, or make with their experiences of heightened vitality"[343] gained through a multimodal listening practice. In the publication *(Re)Educating the Senses* Ceraso encourages teachers to "design opportunities and assignments that give listeners a chance to experience sound in new and surprising ways."[344] In the same article she advocates that the audience experience at sonic events is affected by the environment, that listening is a "highly contextual experience"[345] and therefore she teaches her students that sonic composition needs to attend to multimodal elements such as images, video or text, in a much more holistic approach.[346]

A large-scale example of a multimodal listening experience in a gallery context with an explicit ecological agenda is *The Great Animal Orchestra*. This video installation is a collaboration between Bernie Krause and United Visual Artists (UVA)[347] that combines field recording and moving image techniques. Krause's and UVA's immersive gallery installation explores the soundscapes of seven habitats under threat of extinction. Krause selected these from his extensive collection of field recordings since 1968: an archive of sounds from almost 15,000 species. From this collection, half have now disappeared or have been significantly degraded due to human disruption.[348] In the exhibition we hear rich biophonies

[341] Steph Ceraso, '(Re)Educating the Senses: Multimodal Listening, Bodily Learning, and the Composition of Sonic Experiences', *College English*, 77.2 (2014), 102–23 (p. 104).
[342] Ceraso, p. 105.
[343] Ibid., p. 106.
[344] Ibid., p. 113.
[345] Ibid., p. 117.
[346] Ibid., p. 116.
[347] Since its creation in 2016, The Great Animal Orchestra has toured Paris, Seoul, Shanghai, Milan, and in 2019 came to 180 The Strand in London. The extensive reach of this exhibition is significant and its reception among the public as well as leading figures from music and anthropology to ecological philosophy is impressive and commendable. United Visual Artists is a London based arts practice founded by British artist Matthew Clarke (b.1974) in 2003.
[348] Krause and others, p. 32.

from several continents and from beneath the ocean.[349] The exhibition moves on to reveal chilling before-and-after audio comparisons in which environments once teeming with sonic life are reduced to near-silence due to deforestation and habitat loss. We hear the result of coral reef destruction, clear-cut logging, selective logging, streams drying up and season creep. The importance of this work in gauging habitat health is underlined by Krause's funding from bodies such as the US National Park Service. Krause marvels at the wonder of the living world, while his sound works also serve science. *The Great Animal Orchestra* fulfils Krause's aspiration to "create a bridge between the science of soundscape ecology and the arts".[350]

Within *The Great Animal Orchestra* field recordings are translated into visual imagery using spectrogram techniques to expand soundscapes into multimodal listening experiences. The resulting artwork is both a collaboration between sound and visuals, and an artistic collaboration. UVA's visual interpretations were generated from Krause's archive of soundscapes, as Matthew Clarke, founder of UVA states: "The installation wouldn't have any visual composition if it wasn't for the sound driving it."[351] UVA often work collaboratively, combining traditional artistic media with new technologies to create "events in time" rather than material objects, in which light, sound and movement "manipulate our perception and expose the relativity of our experiences."[352] In *The Great Animal Orchestra* a software algorithm represents the soundscapes through light with a spectrogram visualising the sound in real time. The imagery moves 180 degrees around the exhibition space surrounding the vision of the audience as well as immersing them in the biophony of the soundscape. A pool of water below the digital imagery reflects the unfolding spectrogram and ripples with the vibrations of the bass frequencies. For Clarke it "embodies a sense of the here and now, something happening immediately, and feels alive."[353] (Fig. 45).

[349] Algonquin Provincial Park, Ontario, Canada; Dzanga-Sangha National Park, Prefecture of Sangha-Mbaéré, Central African Republic; Yukon Delta National Wildlife Refuge, Alaska, United States; Mungwezi Ranch, Gonarezhou National Park, Province of Masvingo, Zimbabwe; Camp KM41 in Amazonas, Brazil; Crescent Meadow, Sequoia and Kings national Parks, California, United States; and five oceans locations in the Pacific Caribbean and Big Sur.
[350] Krause and others, p. 31.
[351] Ibid., p. 19.
[352] Ibid., p. 101.
[353] Ibid., p. 19.

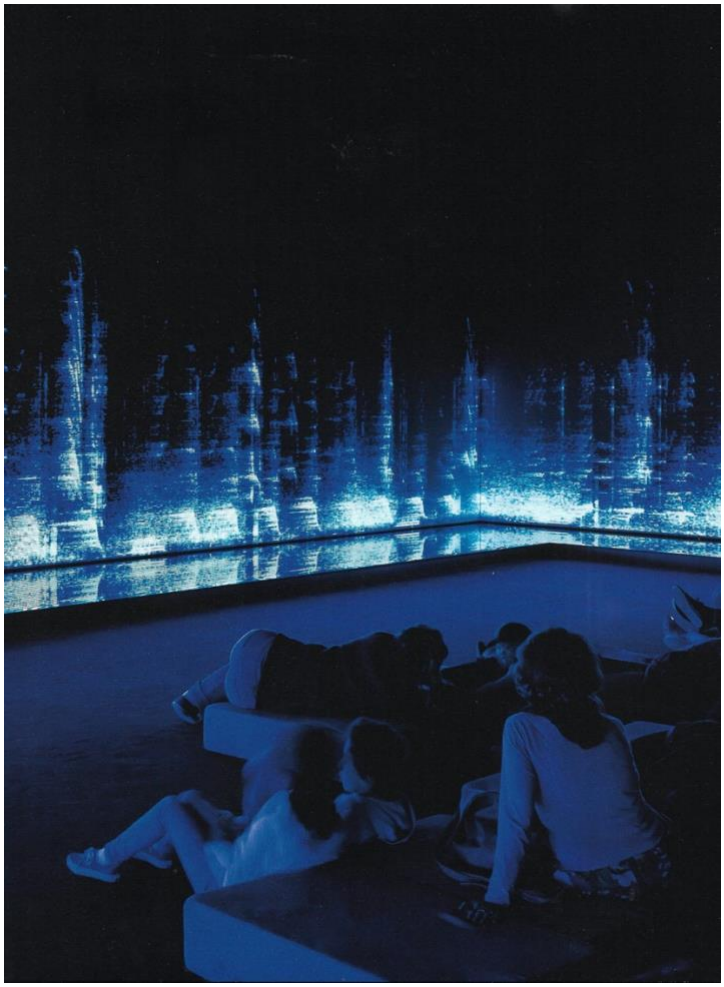

Figure 45: Bernie Krause and UVA, detail view, *The Great Animal Orchestra*, 2016, Collection Foundation Cartier Pour L'art Contemporain, Paris. Image by Luc Boegly. Used with permission of Bernie Krause and UVA.

Just as with *Forest Listening* at the Hockney gallery, a key consideration for the installation of *The Great Animal Orchestra* was commanding the exhibition space to affect the listening experience of the audience. Both exhibits approached immersion in different ways. Experiencing the sound within *Forest Listening* through personal headphones created a solo listening environment. In *The Great Animal Orchestra*, the listening experience was communal, with the field recordings played through speakers to the collective audience. The challenge for Krause and UVA was to create a listening environment in which an audience would sit quietly, long enough to contemplate its ecological importance. Clarke laments that "[p]eople can have very short attention spans".[354] Within the exhibition, beanbags provided a relaxing space, inviting you to sit down and spend time with the sounds and visuals. Almost complete darkness meant you could not be seen. You were allowed a private response. This enabled UVA to capture sustained attention from the audience. Most lingered for multiple

[354] Krause and others, p. 21.

soundscape sections, even remaining seated during Krause's ecological message at the end. The substantial commitment of those who stayed the course was more than an hour and a half. An interesting comparison arose here of the collective versus the individual listening experience. This is a topic outside the scope of this thesis and an avenue for future research.[355]

The hi-fi gallery setting proved to be a successful multimodal listening environment. Despite this, I was still curious to test *Forest Listening* in a woodland. Reminded of my performance of *Listening to Sylvan Sounds* on the cliff top in Bude, I was struck by the power of listening to sylvan sounds in the rural landscape, and how this augmented perception of, and attention on, the ecological setting. I wanted to return sylvan sounds to the forest and test how the immersive, multimodal listening experience inside a woodland might affect the exhibition of *Forest Listening*?

5.8 *Forest Listening* in a woodland

As a featured artist in the Surrey Hills Arts 2019-2020 program, I was invited to exhibit *Forest Listening* in Limnerslease woodland in the Watts Gallery & Artists' Village, Guildford, Surrey from 7th September to 4th October 2020. In the press release for the exhibition Ellen Love, the Community Programme Curator, commented on why *Forest Listening* had been selected:

> The Limnerslease Woodland, which surrounds the home and studios of the founders of Watts Gallery, George and Mary Watts, acted as a source of inspiration to both artists. The couple named their house and the woodland Limnerslease because 'Limner' is the Old English word for artist, and 'lease', to glean hope for the future, so it is all the more fitting that artists, like Liz, exhibit work in the woodland.[356]

The 'hope for the future' that Love referred to was hope for the ecological crisis but could also have been a reference to the global situation directly affecting us at the time of the exhibition. During the autumn of 2020 we were in between the spring-summer and autumn-winter lockdowns of the Covid-19 pandemic. At the time, gathering outdoors was the safest

[355] *Forest Listening* was exhibited at *Listening Pasts – Listening Futures*, a conference for the 30th anniversary of the World Forum for Acoustic Ecology, at the Atlantic Centre for the Arts, Florida, 23 – 26 March 2023. This provided the opportunity to make this comparison as the sound system was a communal listening experience. However, there was not enough time for evaluation between the conference and my thesis submission date.
[356] Ellen Love, 'Surrey Hills Arts Forest Listening Project', *Surrey Hills National Landscape*, 2020 <https://surreyhills.org/surrey-hills-arts-forest-listening-project/> [accessed 13 February 2023].

way to attempt normal socialising and Watts Gallery were particularly keen to attract visitors to their outside space (18 acres of grounds) to continue their exhibition program during the pandemic. As this installation was outdoors, visitors were able to explore the artwork whilst maintaining social distancing measures.

The significant change we made because of the lockdowns was to the meet-the-artist weekends. We had hoped these would take place in the Watts Gallery Clore Learning Studio throughout the exhibition for visitors to learn more about the project. As Covid-19 social distancing measures did not allow face-to-face activities, we decided that a suitable replacement would be a short introductory film for the Watts YouTube channel describing how the artwork was made and my intentions for the project, as well as a film responding to public responses and feedback about the project. Questions and comments were submitted to Watts Gallery, Surrey Hills Arts, and me, via social media and email. Considering the unprecedented circumstances, the films worked well as a public outreach method with ample engagement and feedback from visitors to analyse and evaluate the effect of *Forest Listening* in the Limnerslease woodland. I will refer to feedback from visitors and Watts Gallery throughout this analysis.[357]

At Limnerslease, visitors could listen to *Rainstorm Inside Forest Earth* on their personal mobile device via the Surrey Hills Arts website and the Smartify app (Fig. 46). This app is an established tool for the gallery with visitors using it regularly to access information about exhibits. The result of listening to the soundscape via the website or app was that visitors could choose either a personal listening experience through their own headphones or a group experience by playing the soundscape aloud (Fig. 47). One visitor commented on how listening to the soundscape enabled them to attune to both the forest and themselves: "The act of listening… [was] a very focused experience… once we had adjusted (sort of attuned) to our surrounding and the integration of forest noises, our breathing, and forest listening audio layer, then the experience made us slow down."[358] In contrast to the bustling, lo-fi environment in the UCA courtyard, in which people couldn't listen to the soundscape and connect it to the visuals, the hi-fi woodland audio environment provided opportunity to identify, locate and appreciate subtle and quiet sounds. It prompted this question from the

[357] This is not a qualitative data analysis of audience response to the artwork but an analysis of my presentation of the artwork using selected comments submitted from visitors to support my own understanding and evaluation of the installation.
[358] Melanie Lenz, email to Liz K Miller, 20 October 2020.

public: “The very low frequencies that I can hear in the sound recording, what produces that sound in the forest floor?”,[359] to which I responded in my Q&A film: “when you’re listening to [a] rainstorm from beneath the ground there’s so much more surface area for the sounds to vibrate within and perhaps that’s what produces those low tones.”[360] Here, the listener was considering the phenomena of rain from a novel non-human perspective leading to thoughts of materials and how sound is produced.

Figure 46: *Forest Listening*, 2020. Smartify App information and sound link. Limnerslease woodland, Watts Artists’ Village, Guildford, Surrey, UK.

[359] Liz K Miller, ‘Forest Listening: Questions from Visitors’ (Watts Gallery & Artist’s Village, 2020) <https://www.youtube.com/watch?v=Dahd7XDjmNM> [accessed 13 March 2023].
[360] Miller, ‘Forest Listening: Questions from Visitors’.

Figure 47: *Forest Listening*, 2020. Visitor listening with personal mobile device. Limnerslease woodland, Watts Artists' Village, Guildford, Surrey, UK.

For the Limnerslease woodland, I altered the format of the banners from twelve banners measuring 24 x 126 cm, to eight banners measuring 38 x 190 cm (Fig. 48). This increase in size was to give the banners a slightly larger presence within the expanse of the woodland. The banners were spread throughout the woodland, hanging from trees with their positions dependent upon the heights of the branches. The woodland has paths through densely growing trees and shrubs as well as more open clearings. The banners were spread out just far enough that it wasn't possible to see them all at once, so visitors needed to delve deeper into the woodland and venture off the main path to find them all (Figs. 49 – 50). One visitor commented on this experience: "It was cool to see a flash of blue from the road when we didn't know where exactly the installation was then the excitement of discovery going along the path."[361] In contrast to the installations at UCA and the Hockney Gallery, in the woodland visitors could walk around and amongst the banners viewing them from all sides. The format of the original sound diagrams, taken from the form of the spectrogram, represented time in a linear progression. In Limnerslease, this was replaced with the spatial dimension of the woodland. Breaking away of the linear progression of time was an intentional expansion out of the restrictions of this diagrammatical format. My aim was to create a multimodal listening experience in which the audience was in amongst the audio of the field recording, the visual of the banners, and the physical environment of the forest, with the frequency of the raindrops springing up all around the visitor both aurally and visually. This recreated on a human scale the physical space in which the hydrophones had been buried when making the recording: in the dry earth with rain pounding down all around them.

[361] Kumar Kolar, email to Liz K Miller, 6 October 2020.

Figure 48: *Forest Listening*, 2020. One of eight canvas banners, each 38 x 190 cm. Limnerslease woodland, Watts Artists' Village, Guildford, Surrey, UK.

Figure 49: *Forest Listening, 2020*. Five of eight canvas banners, each 38 x 190 cm. Limnerslease woodland, Watts Artists' Village, Guildford, Surrey, UK.

Figure 50: *Forest Listening*, 2020. Five of eight canvas banners, each 38 x 190 cm. Limnerslease woodland, Watts Artists' Village, Guildford, Surrey, UK.

Jez Riley French considers the visuals of a location or space to be a vital part of the listening experience: "sound is affected by place not only in terms of the acoustics but also the visual elements."[362] In the early 1990s, French installed speakers into a forest in Yorkshire. The public were scathing of his interruption to the 'natural' sounds of the forest, yet the speakers had been silent. French simply made his audience listen a little more closely and had augmented their acoustic experience without playing a sound.[363] French used a visual cue to make his audience listen more carefully. The visual was used to direct attention towards the sonic.

Back in Limnerslease, as sunlight shone through the canvas banners, they took on a translucent quality, the imagery becoming ghostly visible through the two layers, the back and the front of the canvas, creating a watery echo reminiscent of the sound from which they were drawn. A visitor commented on the meditative quality of the banners and how they sparked curiosity:

> Really liked the hanging banners, initially the beauty of the dark banners and then it almost became a little hypnotic and zoned out starting at them. Our kid Suki loved studying the details on the light ones and trying to figure out what was going on.[364]

Forest Listening drew visual attention while blending sympathetically with the landscape. It did not shout its presence. Unless a visitor came through the woodland looking for it, it could be easily overlooked and passed by – echoing the hidden and unnoticed subtlety of the original soundscape. The banners neither imposed on the woodland, nor disappeared within it. The landscape was neither a backdrop nor a plinth; my intention was to create an unimposing artwork that encouraged curiosity and fostered an attentive engagement with the forest.

Literature and media scholar Yves Citton states that attention is inextricably and reciprocally linked to value: "it is only possible to value something whose existence we have noticed by an effort of attention; reciprocally, we tend to pay attention to what we have learned to value."[365] He asserts that like herds, flocks and shoals "we tend to look in the same direction as our fellows"[366] and this is in fact an act of care as we are "attentive to what preoccupies

[362] Jez Riley French, email to Liz K Miller, 24 June 2019.
[363] Jez Riley French, 'The Act and Art of Located Sound' (SAE Institute, London, 2018).
[364] Kumar Kolar, email to Liz K Miller, 6 October 2020.
[365] Yves Citton, The Ecology of Attention, (Cambridge, UK: Polity, 2017), p. 67.
[366] Citton, p. 33.

others."[367] Due to this, aesthetic experiences such as music, literature and art, are important, as they help guide us through "the incessant communication that overloads us with crushing information"[368]. Art can be used to focus and guide attention towards the overlooked and unnoticed, in this case highlighting the underheard sounds of the forest.

Forest Listening created new avenues for attunement with the woodland. In Limnerslease, the three elements of the installation – the soundscape, the banners, and the site-specific spatial install – all worked collaboratively to create a sensory experience that provided a novel perspective of forest rain, leading to enhanced perception of, and curiosity about, elements of the forest previously unnoticed or filtered out. Here I return to Anna Tsing's writing about re-connecting with companion species: "Projects for re-building curiosity… are essential work for living with others."[369] Tsing's emphasis on the importance of curiosity in the ecological crisis is reinforced by the novelist Marina Warner who observes that curiosity, when used to artistic ends, has the potential to uncover "value in the most unexpected places."[370]

5.9 Conclusion

The spectrogram is a highly successful communication tool and visual aid to augment the listening experience as used by Krause and Monacchi. In my own work, I wanted to expand the use of the spectrogram from the explanatory to the exploratory. Taking *Rainstorm Inside Forest Earth* as my soundscape for this task, I expanded its spectrogram in three ways: I translated the format from digital to analogue; I created four diagrams depicting separate levels of volume dynamics; and I remade the four diagrams as cyanotype prints using tonal shades to represent volume dynamics.

I combined the field recording of *Rainstorm Inside Forest Earth,* with hanging canvas banners, made from my cyanotype prints, to create the multimodal installation *Forest Listening*. I analysed the exhibition of *Forest Listening* in a courtyard, a gallery and a woodland.

The woodland proved to be the exhibition setting that provided the richest multimodal listening experience. By exhibiting *Forest Listening* in a woodland, the subject matter and the

[367] Citton, p.113.
[368] Ibid., p. 19.
[369] Tsing, p. 364.
[370] Brian Dillon and Marina Warner, *Curiosity: Art and the Pleasures of Knowing* (London: Hayward Publishing, 2013, 2013), p. 36.

context for the installation aligned, working together to foster curiosity about both the artwork and the forest. This could have been because the installation was hung in a manner that encouraged more interaction. Visitors could move amongst the visual artwork at their own pace, physically unrestricted by gallery walls and sonically unrestricted by a lo-fi sound field, thereby bringing the sound and physicality of the work on par with the visual experience. Added to this, the hi-fi sound field meant visitors could listen to the sounds of Limnerslease woodland whilst simultaneously listening to *Rainstorm Inside Forest Earth*, with one ear bud in and one out, or switch between listening to one then the other, or listen out loud with the two soundscapes combined. This level of listener agency could be a reason for increased attention. The accompanying videos provided a further level for audience engagement, prompting further questions, responses and interaction through feedback which fed into the Q&A film. It was through this audience engagement that I could discern how visitors were using the artwork to consider forest sounds from an alternative perspective.

The audio-visual nature of *Forest Listening* expands the listening experience, using the visual element to take the act of listening beyond just the auditory. I consider this multi-modal listening as a method for generating alternative perspectives that move towards considering woodlands not as an ecosystem service (for the use and exploitation by humans) but as complex, interconnected life forms, whose vibrant processes are worthy of celebration and auditory focus.

Exhibiting *Forest Listening* in Limnerslease woodland was important both as a climax and a close to the practice element of my PhD research. The initial intention for this study was to investigate how I might reattune myself to the forest through listening. I began my journey listening within forests, and so by exhibiting *Forest Listening* in a woodland I felt I had come full circle. To draw my journey of forest reconnection to a momentary close, in the concluding chapter I will discuss my methods, findings, contribution to new knowledge, and suggest future practice-based research generated from the making and thinking completed during this thesis.

6. Concluding Chapter

6.1 Introduction and research questions

The catalyst for this PhD research was a desire to address my personal and professional disconnect from the multi-species world. By turning away, I felt that I was failing to engage with the most important issue facing humanity – climate and ecological breakdown. By not engaging, I was adding to the problem. As an artist with a background and specialism in the listening experience and sound visualisation, I chose to reorientate my practice from a musical focus to thinking about ecological sound. Through this reorientation I hoped to reattune myself to the sylvan world in my home country of the UK. I have sought to learn from trees and about trees, but crucially about myself and how I interact with the multi-species sylvan environment. In doing so, my intention has been, in the words of Donna Haraway, to learn ways of "staying with the trouble" in this critical time of the Anthropocene.[371] This was the context which led to the primary question of my thesis:
Within the current crisis of ecological breakdown, how can listening and sound visualisation enhance human connection with forests?
To answer it, I addressed four secondary questions, each acting as a guide for the differing disciplines of my practice-based research:

1. How can listening to the sounds made by trees reconnect humans to the forest?
2. What might sylvan soundscapes contribute to the field of ecological sound art?
3. How can I use sound visualisation to deepen my understanding of sylvan field recordings?
4. How might exhibiting field recordings and sound diagrams as audio-visual installations change perspectives of sylvan sounds and how might this be affected by the exhibition setting?

Art has the power to provide guidance and resilience in navigating difficult feelings and concepts. It offers glimmers of understanding and possible routes forward both for the artist and the audience. As an interdisciplinary artist, I approached this study using a research-through-making audio-visual methodology. For the audio element of the research, I combined listening and field recording to explore and present the sounds made by trees. For the visual

[371] Haraway, p. 1.

element I used drawing, diagramming, and sketching techniques to make sound visualisations which I then used to analyse and present my field recordings in greater depth. The resulting audio presentations, visual artworks and audio-visual installations offer practice-based contributions to knowledge. The field recordings *Searching for Sylvan Sounds* and audio presentations *Listening to Sylvan Sounds* create a sylvan-focused body of work within the field of ecological sound art. The sound visualisation artworks *Sylvan Sound Diagram*; *Dendrophony Diagram*; *Listening for the Creak*; *Sound Sketch – Forest Rain*; and the audio-visual installation *Forest Listening*, combine to offer an original contribution to sound visualisation and ecological art practices with their dedicated focus on the sounds of trees.

In this concluding chapter I give a brief outline of my methods, review a key limitation and challenge within the research, discuss my findings and original contribution to knowledge, and finish with a final thought and suggestions for future practice-based research.

6.2 Methods outline

The three practice-based methods used within this thesis were listening, field recording, and sound diagramming.

Listening (aided by specialised field recording equipment) proved to be a successful method for attuning to, and connecting with, the forest environment for the following reasons: listening provided the opportunity to focus on unnoticed sonic elements, specifically the subtle sounds of trees; and specialised field recording equipment enabled deeper access to forest sounds beyond human hearing range such as inside tree matter, water and the earth. Forensically analysing field recordings to create visualisations necessitates deep listening back in the studio. Subtle details are discovered during this process that are missed when listening in the field or during first playback. Studio listening creates an opportunity for sylvan connection to continue after leaving the forest and returning to the urban.

Diagramming as a research method enabled me to deconstruct my field recordings, analyse the fragmented parts, and re-form my perception of the sounds as the diagrams took shape. The resulting change in perception of sound, and novel insight about sound, occurred as the audio transformed to image on the page. The diagram is both my research process and an artistic outcome, with the aesthetics of carefully considered and constructed line work to be a driver of interest and intrigue. Unique characteristics of hand drawn marks, the scaffolding of

a diagram, is for me, both its form and function. I discovered during this process that hand-drawn methods are better suited to my making practice. I find that when drawing, the physical marks made by my hand are a more personal expression, and the slow development of thought when drawing, allows ideas to percolate and flourish.

6.3 Limitation of current research and challenge for future research

This thesis consolidated my ambition to use my art practice – both audio and visual – as a tool for ecological investigation. A limitation of this research was not addressing sustainable material use and consumption within my visual making-practice (for example using paper and cyanotype chemicals). Having considered the ecological complications of my listening practice, I suggest that future research could involve applying that same rigour to my visual making process and materials. Leading on from my research into how listening can attune humans to the forest, I propose that further investigation is needed to explore the question: How can an art-making practice become an act of sylvan connection and how might that practice navigate the entangled complications of sylvan material consumption and use?
I suggest an avenue to explore this question could be through making anthotypes (a chemical-free, plant-based version of cyanotypes) and hand-crafting pigment and dye from sylvan and botanical material. My nascent experiments into making sylvan dye reveal promising aspects of sylvan connection embedded in the making process. My first foray was to gather birch leaves from a local park to make yellow dye. I gathered only the small amount needed, following what Kimmerer describes as "sustainable harvesting"[372], the practice of respectfully receiving the gifts of plants. She describes how: "[t]raditional Onondaga understand a world in which all beings were given as a gift, a gift that simultaneously engenders a responsibility to the world."[373] The sylvan gifts of birch leaves were an opportunity for deeper learning about and from trees. Time and effort were taken to process the leaves, creating space for a human-sylvan connection to develop. I pulled apart the leaf fibres with my fingers, and noticed the changes in the material as it soaked and dye seeped into the boiling water. I sieved the leaf matter from the dye, submerged paper in the dye bath, and laid it out to dry. I distilled the remaining dye to make a concentrated liquid for print paste and pigment and composted the spent sylvan material. Nothing was wasted. I

[372] Kimmerer, p. 284.
[373] Kimmerer, pp. 527–28.

consciously followed Kimmerer's maxim: "By using materials as if they were a gift, and returning that gift through worthy use, we find balance."[374] These sylvan materials were not a resource, rather, the process of dye making was an opportunity for sylvan connection and learning.

6.4 Lessons learnt from audience feedback

Presenting *Listening to Sylvan Sounds* in several scenarios enabled me to analyse how different formats (live online, pre-recorded radio, and live outdoors) might alter how I introduce my field recordings and ideas to audiences. I found the most successful event was presenting live and outdoors (at the *Listening to Field, Body and Voice* summer school in Bude). Discussing my soundscapes and presentation style with this group influenced the direction of this practice-based research (and will go on to inform future sound-based presentations beyond my PhD). Audience feedback included: the mysteriousness of particular soundscapes which encouraged imaginative play with the surrounding visual environment, "it was this idea that that huge rumble could be coming from just… [group laughter] You're just like, what is it? It must be something. It must be that!";[375] the vibrancy of sylvan matter, "those [sound] works, for me, told a story of the interface between different materials";[376] the choice to locate the sound event outdoors, "for me, this was really special, hearing it outside and giving it the air to breathe.";[377] and the decision to speak alongside the soundscapes, "I loved the way you started talking, you let it play on. It was a lovely staging."[378] This feedback led me to develop the project into a multimodal listening experience, to return to woodlands to exhibit, and to present my soundscapes with my voice and thoughts as an integral element of presentations.

Installing *Forest Listening* in several settings was an important factor in determining the most effective location in which to exhibit my audio-visual sylvan sounds. In the courtyard and the gallery, I considered the reception of the artwork from my own observations of audience interaction with the installation. The courtyard was challenging for the audio element of the

[374] Kimmerer, p. 262.
[375] Participant B, Appendix C p. 179.
[376] Participant G, Appendix C p. 179.
[377] Participant G, Appendix C p. 181.
[378] Participant A, Appendix C p. 182.

work, whereas the gallery enabled parity between the audio and the visual as well as providing the space to raise the visuals, encouraging listeners to look up and consider the below ground perspective of *Rainstorm Inside Forest Earth*. The reception of the installation in Limnerslease woodland was more thorough due to the opportunity to gather visitor feedback. Surrey Hills Arts, and the host venue, Watts Gallery, both tracked user data during the display period (7th September to 4th October 2020). They recorded: 438 interactions with the artwork description and audio on the Smartify App, 253 visits to the *Forest Listening* event page on the Surrey Hills Arts website; 154 views for the *Forest Listening* artist's talk and 196 views of the artist's Q&A (both videos on the Watts Gallery YouTube channel); plus 40 posts and 1149 likes across the Surrey Hills Arts, Surrey Hills AONB, Watts Gallery and *Forest Listening* Instagram accounts combined. Watts Gallery commented that "[t]his is really impressive for the timeframe!"[379]

These statistics indicate considerable audience interest, although this engagement could be superficial. It is through the questions and comments received through these social media channels that I could determine how the artwork resonated with visitors and how this altered their response to the forest environment. One comment suggested that the aesthetics of the banners created curiosity about the sound visualisation process and the sound itself: "I thought they were beautiful. I was listening and trying to connect what I was listening to with the visuals on the banners. It made me curious about the process of translating the sounds into a visual form."[380] Another comment revealed how the installation enabled a deeper group listening experience and how they began to consider the rainstorm from an alternative perspective:

> The visual banners provided us with a shared space (as a family) to stop and listen. It helped us wayfind in a sense. We grabbed some logs to sit on and looked at the hangings whilst listening to the audio. They helped us imagine what a rainstorm might sound/ look /feel like.[381]

This visitor feedback was gathered as part of an online question and answer session that would ordinarily have been an in-person event. These responses helped guide my understanding of how the artwork was received. The comments suggest that visitors considered the sound of a rainstorm with an open-minded readiness to learn about this familiar soundscape from a new perspective. They show how visitors used the visuals to

[379] Ellen Love, email to Liz K Miller, 14 October 2020.
[380] Elizabeth Forte, email to Liz K Miller, 7 October 2020.
[381] Melanie Lenz, email to Liz K Miller, 10 October 2020.

listen more deeply and how the aesthetics of the visuals sparked curiosity about how the sound diagramming process functioned. Most importantly, these responses show how the installation encouraged slowing down and lingering in the woodland to listen, look and connect with the forest environment.

6.5 Findings

Listening to trees enabled connection with the forest by creating novel pathways for learning about trees and generating opportunities for relationship rebalance with the forest.
Through listening I learnt of the sonic relationship between tree material, wind, water, and ants, showing that leaves, pine needles, decaying birch logs and xylem vessels are valuable agents in the forest sound-making process. It became increasingly apparent that these sounds are inextricably woven together, reflecting the interconnectedness of the forest in which independent elements, species and materials are all reliant on one another for nourishment within a symbiotic ecosystem. This finding suggests that sylvan matter could be just as much an active sonic element of the forest as animals or precipitation.
Personal rebalance occurred in two ways when listening to trees: an embracing of not fully understanding; and an acknowledgment of my sylvan complication.
The former occurred when listening with audio-enhancing field recording equipment which allowed me to access the sounds of trees from a new perspective – from inside the tree. This decentred my prior knowledge of trees as I couldn't fully comprehend what I was hearing. Following Lipari, I modified my mindset to embrace partial understanding as this generated curiosity and a drive to continue listening for further hidden sylvan sonic gems.
The latter occurred with the realisation that my efforts to attune myself to the acoustic forest could be both ecologically positive (reconnecting to land), and negative (consuming earthly resources). This led me to question my methods, and following Kimmerer and Voegelin, I resolved that my active participation within forests was enabling me to form a sylvan relationship by creating opportunities for engagement and perception change.
These findings from my research show how attuned listening to trees fosters connection to the forest. This new knowledge contributes to the field of listening studies, situated within the broader fields of sound studies and ecological art.

The forest soundscape is much explored within ecological sound art. However, focus is often on the whole acoustic fabric with biophony and geophony as predominant sound sources or contrasting the biophony and geophony with the anthropophony and technophony of human destruction. One study highlights the plight of piñon pines yet still omits sounds of the dendrophony, focusing instead on the biophony of beetles. The closest sound work to my sylvan listening intentions focuses on the sounds of ash trees with a highly composed, performative and interactive style. In contrast to these sound works my sound presentations focus on the deep listening experience. Audience engagement with my presentations suggested that the deep listening presentation format enabled greater engagement with the sounds themselves, leading to augmented attention and awareness of the surrounding environment.

My initial hypothesis, developed during my experience visualising music, was that the visual can enhance the listening experience by highlighting previously unnoticed sonic details and providing alternative perspectives through which to consider familiar sound through a new lens. My findings suggest that when applied to ecological sound, this hypothesis also holds true. The iterative process of diagramming by hand facilitated the organisation and clarification of my ideas about sound. The sylvan sounds flow diagram led to clarification of the differences between sylvan sounds and the dendrophony. The dendrophony Venn diagram facilitated greater understanding of the interconnections between the dendrophony, biophony and geophony, and revealed avenues for future investigation into the sounds of plants and where this might fit within soundscape ecology. *Listening for the Creak* revealed the value of a sketch to interpret and unravel the listening experience ahead of analytical investigation. Making the set of diagrams *Sound Sketch – Forest Rain*, showed how the conversion of the digital image to the hand drawn, changed the function of the spectrogram from an explanatory communication tool into an exploratory diagramming method.

Exhibiting field recordings and sound diagrams together as an installation altered the listening experience. It offered audiences an alternative audio perspective of trees, leading to augmented attention and awareness of the forest. The visual element of the artwork expanded the act of listening beyond the auditory and into the multimodal. Limnerslease woodland proved to be an effective location for the *Forest Listening* installation. By returning to a woodland, the subject matter and the context for the installation worked together to foster

curiosity about both the artwork and the forest. The installation encouraged visitors to explore with their senses attuned and receptive to the sights and sounds of the woodland.

In summary, I found that the practice of listening to trees enhanced human connection with forests in two ways. First, listening enabled space and time for the interconnected relationship between dendrophony, biophony and geophony to emerge. Second, listening fostered a state of mind in which a personal recalibration with the forest began. This recalibration occurred through embracing the wonder of not fully understanding the intricacies of trees, and through acknowledging the complication of being a human in the world using and consuming sylvan resources by the very act of living. Visualisation of sylvan soundscapes developed these findings further still. This practice enhanced connection with forests for the maker of the diagrammatical artwork by generating deeper insights and understanding of sylvan soundscapes and their interrelations with other forest elements. It also facilitated connection for the viewer of the diagram by enabling a heuristic journey of interpretation and discovery.

6.6 Contribution to knowledge

Within the field of ecological art and sound visualisation, my contribution to new knowledge is the method of combining field recordings with their corresponding sound diagrams and presenting them as audio-visual installations. My sound visualisations are an invitation to excite curiosity and deeper connection with trees. An essential aspect of this method is a practice of ethical listening in which attention is given to non-human liveliness and multi-species interconnection. This listening practice is a purposeful act that intends to counter the widespread refusal to listen to the signs of the ecological crisis.

6.7 Final thought

Greta Thunberg talks of hope not as a noun, but a verb, a thing that you do, create and earn. She says: "[h]ope is taking action."[382] Similarly, Rebecca Solnit writes of resisting despair, defeat and feeling overwhelmed in the face of climate and ecological breakdown. For her this

[382] Greta Thunberg, *The Climate Book* (UK, USA, Canada, Ireland, Australia, India, New Zealand, South Africa: Allen Lane, 2022), p. 421.

is achieved through hope. Hope that is earned through study and participation.[383] This thesis is a fundamental realignment of my art practice to focus on ecological reconnection through dedicated participation within forests and study of trees. In the introduction, I proposed that through art I might confront my feelings of ecological disconnect and find ways to engage with the climate and ecological crisis. This research has showed me that through making and presenting art it is indeed possible to 'stay with the trouble' in a way that feels meaningful. Of course, the work in this thesis is just a drop in the ocean of what is needed to tackle the climate crisis. However, my research has shown that artworks present a viable route to engage, learn, and connect with ecology.

6.8 Future practice-based research

Further work could develop my sound diagramming methods. Further diagrammatical investigations could explore focal and global attention, or noise and signal sounds within my gathering of sylvan soundscapes. Sylvan sounds diagrams could be expanded to include complicated sylvan sounds and geographical location. Dendrophony diagrams could be expanded to include the anthropophony, technophony, sounds of plants or even viruses. The acceptance of the new term, dendrophony, by Bernie Krause, has opened the door a crack, and could be pushed further, even to a revision of biophony to differentiate between plant and animal (all animal) sounds. I suggest diagramming would be a fruitful method to explore this expansion in all its complexity.

This research began with the aim of finding pathways of reconnection to the more-than-human. During my time attuning to the sounds of trees through listening and diagramming, a topic that continuously arose was participation with land as a vital element of the reconnection process. It is the subject of participation that I propose for future practice-based research. I would like to investigate the connective process between people and trees through land regeneration projects such as rewilding. My time with Trees for Life gave me some insight into the value of forest restoration, both for the land and the people working to achieve it. Using the methods of listening, field recording, and sound diagramming developed throughout this thesis, I propose the following question: How might audio-visual artwork

[383] Solnit, p. 142.

about human-nonhuman relationships within land restoration, create pathways towards greater ecological care and connection?

Appendices

Appendix A. Broadcast Transcript: *Listening to Sylvan Sounds*

Radiophrenia, Glasgow

15 November 2020 5 – 5:30 pm

These are the sounds of a rainy summer's day in Blackheath Forest in the Surrey Hills, an hour's train south from central London. A rainstorm has just passed over, soaking the bark of the young Scots pine saplings. I'm Liz K Miller and this podcast introduces my listening practice – Sylvan Sounds.

In this recording, you'll be able to hear as the wind picks up and flutters the leaves of the birch trees.

Two pines have grown just close enough to touch, and as the wind pushes them back and forth you can hear them creak as their water-saturated barks rub together.

I hung the tiny omni microphones I used to make this field recording right next to where the trees touched, so the creaking is amplified. This is a sound that would normally be hidden amongst the other sounds you can hear in this recording – the birds, the wind, and the planes going over head to Gatwick airport.

Within the discipline of soundscape ecology, sounds are grouped into:

sounds made by animals, birds and fish – Biophony.

sounds made by earthly elements like the wind, rain, thunder and fire – which is Geophony

And Anthropophony – all sounds made by humans – from speech and music to technology to industry. My work asks - where do the sounds made by trees fit into all of this?

This is the sound of dry oak leaves clattering in the wind in Clocaenog forest in North Wales. It's early April and the buds of new growth are here, but last year's leaves refuse to let go. Listening to the susurration of the leaves makes me think about where the sounds of trees might fit into the biophony, or the geophony or the anthropophony.

Trees are alive, so they're not an earthy element. But they're not animals - so they are neither biophony nor geophony. And certainly not anthropophony!

Trees are essential to the forest ecosystem and yet their sounds have no place in our classification.

I'd like a new classification – the sounds of trees should be the Dendrophony: from the old Greek word for tree. But in my work, I also like to call them Sylvan Sounds from the Latin for wood or forest.

As I spend more time listening in the forest, I have started to hear the subtler sounds of the dendrophony. But I'm still experiencing the forest from a human perspective. If I could explore the sounds within trees – sounds that are just beyond the range of human hearing – what might that reveal?

This is the sound of wood ants, building a nest in the fallen pine needles at the foot of a very young Scots pine sapling, recorded on a hot July day in the forest of Mar in the Scottish Cairngorms.

Again, the sound is hard to categorize: are we listening to the biophony of the wood ants? Or the dendrophony of the pine needles? Or both? The sound cannot exist without either the wood ants or the pine needles.

This next recording is from Glen Affric in the Scottish Highlands, just after the spring snows. It's from another ant's nest but this time they are carpenter ants, burrowing into a pile of felled birch logs, that I'd found decomposing in a wet bog.

The carpenter ants and the wood ants use different sylvan species – pine and birch – and different sylvan materials – needles and trunk – resulting in completely different sylvan sounds.

But internal sylvan sounds aren't restricted to decay and decomposition, here are the sounds of growth and life inside a living tree.

These sounds come from an ash tree in Scott's wood on the banks of the Helford River in Cornwall. You can hear two sylvan sounds - the grumble of the tree moving in the wind and the pop of the water moving up the tree, in the woody xylem vessels just beneath the bark of the trunk. This is the sound of transpiration.

In the recordings of the ants, I used contact microphones, but these aren't sensitive enough to pick up transpiration, so this recording is made using designer Alex Metcalf's Tree Listening Device.

The device looks a bit like a Victorian ear trumpet – you put the trumpet end up against the tree and listen through the tapered end.

Here's Alex describing how it works:

> [Alex Metcalf] If you cup your ear against a tree trunk in the right way, you get the angle and you're listening intensely enough you can hear the trees vibrations… but whether or not people can hear the sound of water with the naked ear I would be sceptical because my listening device is amplifying the sound by over 400 times and even then, it's not the loudest sound that we can hear when we were recording. The overall sound, the loudest sound is the movement of the tree. As the tree is sitting in the ground it's picking up vibrations, not just from the wind moving the branches, and the vibrations sending movement back through the trunk, it's also picking up vibrations from the ground and then travelling up. So, you've got a lot of low frequency grumbling, kids describe it's as a motorbike engine or a thunder storm.

This is geophany in concert with dendrophony – the wind moving the tree to create the grumbling sound.

> [Alex Metcalf] And then in the background to that – the popping sound – which I describe as a kind of rice crispy crackly pop, that is the water as it travels up the xylem tubes. And the water enters into an airfield chamber in the xylem tubes. The xylem tubes aren't one continuous column, or straw, they are interlinked and have valves, and when water enters into an airfield-pocket it spins, which is a cavitation, that cavitation creates a pop.

This soundscape is a dendrophony duo. Two different sounds created by movement of water and wind inside this ash tree.

Now, instead of listening to water moving up through a tree, we're listening to water raining down on the forest floor. This is the first rain in months hitting the dry forest earth during a summer heatwave in the Forest of Mar. But the recording is from a perspective that humans don't normally experience - from beneath the forest floor.
You could imagine being down there with the earthworms and the tree roots, listening to the drumming of the rain. I find that shifting to a non-human perspective like this, helps me to understand the forest a little better.

Back in Blackheath Forest, these are the sounds from inside a forest puddle on a rainy June day. You can hear the planes flying overhead and the train hoot in the distance – the anthropophony – as well as the biophony of the birds, but they all fade into the background compared to the sounds of the rain drops. I like this example of how a non-human perspective can completely change a soundscape.

The final sylvan sound of this podcast wasn't recorded by me. It was gathered by the sound designer and composer Jo Langton. It's the sound of creaking again, but this time from below the ground, from tree roots.
Jo made this recording at the Dune du Pilat on the coast near Bordeaux in France, right where the dune meets the pine forest. Here's Jo describing this fascinating landscape:

> [Jo Langton] The Dune du Pilat is the largest sand dune in Europe. It's far higher than the tree line and there's a forest behind it and the Atlantic Ocean on the other side. So, you've got these pine trees struggling, putting their roots down, and what you can hear is this kind of squeaking, and I can't say that I'm certain, I didn't put a camera down there so I don't know for 100 percent whether that might have been insects, but I'm pretty sure it was the sound of tree roots kind of trying to cling on with the sand dune ever growing. This kind of monster sand dune moving forwards and taking over the forest.
> There was actually an air strip there, which the sand dune has completely engulfed, and there was a village on the edge of this forest, which the sand dune has completely engulfed.
> In my mind, the sound of these roots, kind of rubbing up against each other and trying to cling onto life, and to keep the sand dune at bay.

One of the reasons Jo made this recording was to document changing landscapes during this time of climate breakdown. For me, listening to sylvan sounds is a way of reconnecting with forest landscapes in the uncertain and rapidly changing time of the Anthropocene.

Appendix B. Presentation Script: *Listening to Sylvan Sounds*

Publication launch of: *I am Listening to You*

Gunnersbury Triangle, West London

17 August 2020

We are going to listen to six tree soundscapes recorded in woodlands and forests in the UK.
Each sound sample will last three minutes.
There will be: two external tree sounds – from a human audio perspective; two internal tree sounds – from inside tree matter; and two sounds from beneath the forest floor.
I like to call them Sylvan Sounds from the Latin – Silva – meaning wood or forest.
I'll speak briefly about each sound, but mostly I'll give them plenty of space to breathe.

These are the sounds of a rainy summer's day in Blackheath Forest in the Surrey Hills, about an hour's train south from central London. Recorded in June last year. A rainstorm has just passed over, soaking the bark of the young Scots pine saplings.
In this recording, you'll be able to hear as the wind picks up and flutters the leaves of the birch trees.
Two pines have grown just close enough to touch, and as the wind pushes them back and forth you can hear them creak as their water-saturated barks rub together.
I hung the tiny omni microphones I used to make this field recording right next to where the trees touched, so the creak is amplified. This is a sound that would normally be hidden amongst the other sounds you can hear in this recording – the birds, the wind, and the planes going over head to Gatwick airport.

This is the sound of wood ants, building a nest in the fallen pine needles at the foot of a very young Scots pine sapling, recorded on a hot July day in the forest of Mar in the Scottish Cairngorms in 2018.
Are we listening to the sounds made by the wood ants? Or, the pine needles? Or both? The sound can't exist without either the wood ants or the pine needles.

This next recording is from Glen Affric in the Scottish Highlands, just after the spring snows in 2019. It's from another ant's nest but this time they're carpenter ants, burrowing into a pile of felled birch logs, that I'd found decomposing in a wet bog.

The carpenter ants and the wood ants use different sylvan species – pine and birch – and different sylvan materials – needles and trunk – resulting in completely different sylvan sounds.
This is the first rain in months hitting the dry forest earth during the 2018 summer heatwave in the Forest of Mar. But the recording is from a perspective that humans don't normally experience - from beneath the forest floor.
You could imagine being down there with the earthworms and the tree roots, listening to the drumming of the rain. I'm finding that shifting to a non-human perspective like this, is helping me understand the forest in a different way.

Back in Blackheath Forest, these are the sounds from inside a forest puddle on a rainy June day last year. You can hear the train hoot in the distance, as well as the birds, but they all fade

into the background compared to the sounds of the rain drops. This recording is an example of my curiosity into how shifting to a non-human perspective can completely change a soundscape.

This was a spontaneous recording made during a day of confinement in the outhouse of a mountain hut in the Scottish Highlands. My original plan was to record at the site of the last elm in the glen. This famous elm was the lone survivor of Dutch Elm disease in Glen Affric. I don't remember any frustration at my plans to record the elm being thwarted by the storm, I do remember the new listening experience gifted to me by my confinement.

Previously we have been listening to the forest itself:
The sound of growth and life of the creaking pine trees.
The sounds of decomposition and reuse of tree matter by ants.
And the sounds of rain nurturing the foundations of the forest floor.
But this sound of the stove is about me, the person, and how I interact with trees. In this recording my interaction was through burning the wood. This is still a sylvan sound, but perhaps a negative one, in which I am interrupting the natural cycle of the forest and destroying trees for my own benefit.

So, to finish with – natural ecosystems, like forests, are being destroyed so quickly, that I believe we need to find ways to reconnect with them and help us value them. And for me, listening to all of these different sylvan sounds has helped me to do that. I feel like I'm beginning a journey to reattune myself to the forest landscape through sound. Thanks for listening.

Appendix C. Transcript of audience discussion at *Listening to Sylvan Sounds* live event
Listening to Field, Body and Voice Summer School
Bude, Cornwall, UK
12 July 2019
Audience members are anonymised as letters A to I. Liz K Miller is LKM.

A: Do you think it changes it, listening like this, outside in this environment? Do you think it changes the material at all? What happens when you play it out here in the field? The

sounds are interior, they have an interior feel to them. The insides of trees but also the inside of the house [sound muffled] I just wonder if anyone knows, if they can explain a bit? What kind of change we're doing here? The difference between playing it here and playing it here, or in London, or something?

B: It feels really cold. It's making me feel really cold.

C: Yeah

A: [Sound muffled] There were flying gulls at one stage. I was very conscious of that. Playing these sounds, these interior sounds, with, kind of, these things over there and these things up there, I'm not sure what I'm trying to say but it's some sort of um, conversation or rhythm going between [sound muffled].

D: [Sound muffled] I found myself going between. It's really interesting hearing outside sounds from somewhere else, outside. What we are looking at is very different to what we are hearing. [Sound muffled].

A: The way the cloud is kind of breaking, and there's those little, kind of, puffy balls there, there's so many things going on, and the sounds are so beautiful.

B: All the sounds are so mysterious, I found something fascinating happening out here. So, the scuttling one became the sounds that the clouds make as they go overhead, and that creaky one was exactly the rhythm, there's three wind turbines on the hill, so it sort of became the sounds from… it's weird how your brain is so desperate to find the source. Right? And…

E & D: Yeah

B: …like a rumble was really working with the way this little clover was trembling in the breeze, so it was this idea that that huge rumble could be coming from just… [group laughter] You're just like, what is it? It must be something, it must be that!

D: Yeah

F: And the birds, I thought "it's sunset, it must be the birds that we're hearing."

G: There were really good moments, that was particularly powerful.

D: Yeah that was nice, it kind of brought birds into what is at the moment, a bird-less sky. Didn't it? It was really interesting.

G: Those, what was it four, five and six, those three recordings I thought were particularly special as they suggested an interface between two worlds. So you heard birds and creaking, you heard beautiful bird song, you felt water, you felt wood, those ones I thought were really strong. All of them are very compelling, but those works, for me, told a story of the interface between different materials, energy and media… really good.

LKM: Yeah, four, five and six, that was the creaking pines, then the wood and the carpenter ants were behaving with the woody material.

G: It's really interesting.

F: Which one was the birds in?

LKM: That was where the trees were creaking.

F: Ah OK.

G: It's interesting, with those three, I picked the ones that had active nonhuman agents, part of the creation of this third world that was unfolding. And then this one, I think that this one is extraordinary, the last one is extraordinary. I love this kind of work. This is absolutely stunning. What for me was really powerful, going to what *** was saying about how we listen, how we listen outside, was that I imagined a stone hearth in the middle of that field. [Multiple agreements]. You could feel, you could hear, it bounded, somehow, invisible in space. It was great. And I don't know whether you spent time separating the speakers, or you know, working it out, but it was just, I could feel something emerging in front of me that was reflecting, it was the bodies and warmth, and it was fantastic, and it's great that it's cold out here, the wind is up…

A: It adds to it, with the sound of the fire.

G: But also, at the same time, you're sort of leaning in for a bit of that warmth of the fire, you can almost hear warmth, so I think the whole batch… My question is how are you thinking of presenting them? What are you thinking of doing with them? Because it's so rich.

LKM: I'm definitely still working out in what scenario; how do I want it to be heard? This is the first collective, group listening outing that these have had, all other attempts to present this within contexts at the RCA have failed miserably and I've ended up having to describe the sound.

G: Why failed miserably?

LKM: Terrible acoustics, really bad sound systems…

A: I think there is something so good about playing it outside. There's something so important to play it outside, and so going back to the Royal College I would insist that you have that next seminar in the Kensington gardens or something, you know just outside…

F: Is there a roof?

A: There's something really terrific about it being outside.

G: Have you thought about propagating it back through wood? You know you can use an induction…

LKM: No, I don't know about this.

G: You know like if you're hard of hearing, you can use an induction loop system to hear sound when you're buying a train ticket, or whatever. You also have bone induction, things where you can feel sound through a solid object.

LKM: Oh wow!

G: So, it might be worth you looking at transducers to put the sound back into the surface.

LKM: Wow that sounds fascinating.

G: Definitely keep the outside open. I just think you should be thinking about how do you take this outside, keep it outside.

LKM: And not take it back to a square white box?

A: It's so radical like this.

G: I think you can do the square white box, and you can do the café Oto performance, or you could do all kinds of things with this material because it's got a lot of compositional energy to it, you can work with it, and collaborate with different people, and engage with the material, there's lots of different things but for me, this was really special, hearing it outside and giving it the air to breathe.

E: I would like to hear it in a forest as well.

G: Definitely. I think that is the goal.

B: You could take the different forests to meet each other. [Laughter]

G: Bringing an instrument out of the forest, to hear the forest.

LKM: It's becoming a rhythm to going back to particular forests in different weather conditions, different seasons…

F: Yeah

E: Like on a bright sunny day, and just have the sound of the storm.

D: Amazing!

G: I think Glenn Affric would be really good to do because it's a space where cars aren't allowed. It's one of the only places where you don't hear over flights.

H: It's a tried and tested method in anthropology, through the crisis we went through over representation in ethics and all this stuff of play back you know, and a sense of dialogical play back, the voices of people with the recordist, like Steven Feld has done this a lot and it's really interesting when you get to a non-human level of dialogical playback so taking that and playing it back even to the tree that you recorded it from and what happens in that sort of conversation is a very interesting experiment.

LKM: I let that play on until the end. I've got a couple of those recordings from inside the bothy with the storm outside, and I really hoped that this was the one where everyone would come back from the walk, they were also soaked, and they opened up the door and said "hi" so there's a really lovely person interaction at the end of that one.

A: I loved the way you started talking, you let it play on, it was a lovely staging.

I: The credits

A: The way you started talking about it as it played on, it was terrific, whether you did it naturally or, well you did that naturally, it was just a clever, a brilliant way of drawing it out, rather than pressing stop, that would have been a horrible interruption, having your voice come in at the end, on that final piece, it was terrific.

LKM: It was luck. I was hoping there would be the finale where everyone returned home. But it didn't happen [Laughter]. Thank you so much for listening and for you feedback [Clapping].

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'With', *Oxford English Dictionary [Online]* <https://www.oed.com/view/Entry/34948#eid9209081> [accessed 25 October 2022]

Wohlleben, Peter, *The Hidden Life of Trees* (London: William Collins, 2017)

Wright, Mark Peter, *Listening after Nature: Field Recording, Ecology, Critical Practice* (New York: Bloomsbury Academic, 2022)

Wright, Susan, Peter Cairns, and Nick Underdown, *Scotland: A Rewilding Journey* (Kingussie: SCOTLAND: The Big Picture, 2021)

Zara, Janelle, 'She's Creating Her Own Language: Christine Sun Kim's Unique Sound Art', *Guardian*, 24 March 2022 <https://www.theguardian.com/artanddesign/2022/mar/24/christine-sun-kim-unique-sound-art-queens-museum> [accessed 19 January 2023]

Discography

Leah Barclay

Rainforest Listening (2015)
Format: Installation (geotagged rainforest field recordings accessed via mobile phone)
Duration: Various
Documentation available at: http://www.rainforestlistening.com [accessed: 18 December 2023]

River Listening (2014)
Format: Collaborative project with outcomes including community workshops, soundscape ecology research, soundscape compositions and installations.
Duration: Various
Documentation available at: https://leahbarclay.com/portfolio_page/river-listening/ [accessed: 18 December 2023]

Sonic Reef (2017)
Format: Collaborative project with outcomes including community workshops, soundscape ecology research, soundscape compositions and installations.
Duration: Various
Documentation available at: https://leahbarclay.com/portfolio_page/sonic-reef/ [accessed: 18 December 2023]

The Dam(n) Project (2011)
Format: Collaborative project with outcomes including community workshops, soundscape compositions, a dance work, and a short film.
Duration: Various
Documentation available at: https://leahbarclay.com/portfolio_page/the-damn-project/ [accessed: 18 December 2023]

Peter Cusack

Sounds from Dangerous Places (2006-12)
Format: Sonic journalism (field recording, photography, writing)
Duration: Various
Available on: Cusack, Peter, *Sounds from Dangerous Places* [CD / book] (Surrey: ReR Megacorp / Berlin: Berliner Künstlerprogramm des DAAD, 2012)
Documentation available at: http://sounds-from-dangerous-places.org [accessed: 18 December 2023]

David Dunn

The Sound of Light in Trees (2006)
Format: Field recording
Duration: 59min 13sec
Available on: Dunn, David, *The Sound of Light in Trees* [CD] (Albany, NM: EarthEar, 2006)

Bernie Krause and United Visual Artists

The Great Animal Orchestra (2016-17)
Format: Installation (field recording, spectrogram visualisation, water)
Duration: Unspecified
Documentation available at: https://www.uva.co.uk/features/great-animal-orchestra-cartier-foundation [accessed: 18 December 2023]

Jo Langton

Sand Creep (2018)
Format: field recording and soundscape composition
Duration: 9min 30sec
Documentation available at: https://head.hesge.ch/taag/wp-content/uploads/2018/12/Brochure_Terror-on-Tour-2018-FINAL.pdf [accessed: 18 December 2023]

Nikki Lindt

The Underground Sound Project (2022-23)
Format: Field recording, soundwalk, online video
Duration: Various
Documentation available at: https://theundergroundsoundproject.com [accessed: 18 December 2023]

Annea Lockwood

A Sound Map of the Danube (2005)
Format: Installation (surround sound soundscape comprising 59 field recordings and 13 interviews, wall map and stones)
Duration: 2hrs 47min
Available on: Lockwood, Annea, *A Sound Map of the Danube* [CD] (New York: Lovely Music, 2008)
Documentation available at: https://www.annealockwood.com/compositions/a-sound-map-of-the-danube/ [accessed: 18 December 2023]

Francesco López

La Selva (1998)
Format: Field recording
Duration: 1hr 10min 49sec
Available on: López, Francisco, *La Selva* [CD] (Rotterdam: V2_Archief, 1998)

David Monacchi

Fragments of Extinction (2002)
Format: Installation and performance (field recording, live electronics, spectrogram visualisation)
Duration: Unspecified
Field recordings available on: Monacchi, David, *Prima Amazonia: Portraits of Acoustic Biodiversity* [CD] (Glen Ellen, CA: Wild Sanctuary, 2007)
Compositions available on: Monacchi, David, *Eco-Acoustic Compositions* [CD] (New York:

EMF / Albany, NM: EarthEar, 2008)
Documentation available at: http://www.fragmentsofextinction.org [accessed: 18 December 2023]

Adrian Newton

Heartwood (2014)
Format: Installation and performance (tree listening via contact microphones, ultrasound detectors and sensors)
Duration: Unspecified
Documentation available at: https://nemeton.org.uk/other/heartwood-2017/ [accessed: 18 December 2023]
Remixes of sound recordings from installation available on: Newton, Adrien, *Woodland Works* (Internet Archive, 2018) Available at: https://archive.org/details/nocti33/02nocti33.aif [accessed: 18 December 2023]

Mikel R. Nieto

Dark Sound (2016)
Format: Field recording and book
Duration: 1hr 4min 53sec
Available on: Nieto, Mikel R., *Dark Sound* [CD / book] (Frankfurt: Gruenrekorder, 2016)

Douglas Quin

Forests: A Book of Hours (1999)
Format: Soundscape composition
Duration: 55min 35sec
Available on: Quin, Douglas, *Forests: A Book of Hours* [CD] (Santa Fe, NM: EarthEar, 1999)

Chris Watson

'Green Planet' (2022)

Format: Radio programme. *In the Studio*, dir. by Sarah Blunt (BBC World Service, 2022)
Duration: 27min
Available on: https://www.bbc.co.uk/programmes/w3ct1tfb [accessed 18 December 2023]

Hildegard Westerkamp

Beneath the Forest Floor (1992)
Format: Soundscape composition
Duration: 17min 23sec
Available on: Westerkamp, Hildegard, *Transformations* [CD] (Montreal, QC: Empreintes DIGITALes, 1996)

Kits Beach Soundwalk (1989)
Format: Soundscape composition
Duration: 9min 42sec
Available on: Westerkamp, Hildegard, *Transformations* [CD] (Montreal, QC: Empreintes DIGITALes, 1996)

Jana Winderen

Spring Bloom in the Marginal Ice Zone (2018)
Format: Field recording, soundscape composition, booklet
Duration: 77min 49sec
Available on: Winderen, Jana, *Spring Bloom in the Marginal Ice Zone* [CD] (London: Touch Records, 2020)