Portfolio of Original Compositions

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Ovington, H. (2022) *What Sound Does a Stone Make?* Land Lines Project. Exhibition Piece and E-Publication, Available at: https://landlinesproject.wordpress.com/harrys-compositions/ Accessed: 03/11/2022.

Sonic Rewild (2021) *Push/Pull: Bluespace.* Ilkley Literature Festival. Online Exhibition and E-Publication, Available at: https://www.ilkleyliteraturefestival.org.uk/new-writing/2021-spring-commissions/sonic-rewild Accessed: 02/01/2023.

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Ovington, H. (2020) *Streamed Environments.* The British Library, Sound and Moving Image Library (fixed media composition) Published 17/05/2022. Available at: SHELFMARK: DD00047159 Date Accessed: 04/12/2022

0.1 List of performances

MANTIS (UoM): *The Eutrophication of Cumbrian Water*. 03/03/2018 [Sound diffusion performance].

Manchester International Festival 2019: *Quality Check: Utopolis Manchester (alternative version)*. 10/07/2019 - 15/07/2019 [Performative soundwalk with multi-channel playback].

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Abstract

This PhD examines the combined practices of field recording and data sonification in a portfolio of original works that seek to explore new perspectives on the soundscapes we inhabit. Throughout the portfolio, numerical datasets depicting environmental change, and detriment, have been used to manipulate and transform field recordings. The research produced a compositional methodology that considers the composer's role in environmental activism and re-contextualises it as active stages in the compositional process.

Each of the five portfolio pieces are site-specific and site-responsive, meaning that they examine the ecological welfare of a given location and how this might be perceived by its inhabitants.

The five pieces explore a variety of landscapes and environmental narratives, all of which are re-contextualised utilising electroacoustic musical languages.

The Eutrophication of Cumbrian Water. An exploration of gesture, linking human musical gesture to human-environmental impacts on water systems.

Quality Check: Utopolis Manchester. A study of air pollution in Manchester. Juxtaposed with soundscape materials portraying contributing factors to air pollution, and also its consequences.

A Path to Shore. An exploration of footpaths, the composer's role in the soundscape, and physically collaborating with the landscape during field recording.

Perspective- U. An examination of the environmental consequences of harvesting wind energy (a severe increase in bat mortality rates).

A Year in Blue Space. A year-long composition project exploring how blue spaces can contribute to improved mental health, and how this can be portrayed within a composition process.

Declaration

No portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

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Acknowledgements

The submitted thesis and portfolio represent doctoral research undertaken at the University of Manchester between 2018 and 2023.

I have immense gratitude toward everyone who has contributed toward my research journey, whether that be in shared knowledge or access to particular facilities.

I also feel grateful for the opportunity to spend this time interacting and collaborating with the environment. Doing so has enlightened me to a passion for promoting environmental awareness, but this has also enabled me to put into context the reasons and methods for how I wish to create art.

I would like to thank my supervisor Prof. Ricardo Climent, and my co-supervisor Dr. Rupert Cox for their ongoing support throughout the project. I would additionally like to thank other members of the NOVARS Research Centre, especially Prof. David Berezan, and Guillaume Dujat.

Outside of NOVARS I would like to thank my friends and family for their encouragement and support, in particular my partner Emma-Louise Smith.

0.2 Link to portfolio and materials

The following download (no expiry) link grants access to the submitted portfolio of compositions and Max data sonification patches. All of the submitted compositions can be played using a normal (stereo) playback device. The patches will need the user to have Max (version 8) installed on their computer. There are also *READ ME.txt* files provided to give further instructional information.

Please copy and paste the url to your browser, right-click and download the folder titled HOvington PhD COMPLETE SUBMISSION using this link.

https://drive.google.com/drive/folders/1AhBB4yXCPr1pxagluRYJIkovHAVWZKcb?usp=sharing

0.3 About the author

Figure 1: Field recording in West Yorkshire 2020 (photo by Oliver Halstead).

Harry Ovington is a British composer and sound artist, now based in Bath (UK). His work is environmentally focused, with a particular specialised knowledge in combining field recording and data sonification to extend the perceived soundscape.

Harry's objective is to utilise composition as a means of developing an advanced ecological awareness in the public domain. This has been achieved through concert performances, large-scale installation pieces, gallery exhibitions, geolocative sound maps, and creative nature writing. During this PhD, he started his own professional practice (under the name Sonic Rewild). This work has been supported and presented by organisations such as Manchester Museum, The Whitworth Art Gallery, and Manchester International Festival (2019).

Up to date information can be found at: https://sonicrewild.co.uk/

Chapter 1

Introduction

1.1 Research inquiry

This research inquiry examines compositional space and the narratives of environmental deterioration, and welfare, in the context of the interactions between humans and the environment. It makes use of the language and grammar of electroacoustic music composition by exploring site-specific materials encountered during the environmental journey as the basis for the compositional process. This compositional process follows a three-act structure of field recording, data sonification, and compositional arrangement methods. As the portfolio develops, these main components are expanded with technological advances such as location-aware tools, and theoretical considerations which examine the role of the composer within the environmental composition process. The main objective in combining these components is to create extended soundscapes where inaudible or imperceptible elements of a natural environment can be sonically articulated and artistically represented within electroacoustic music. The following considerations have informed the artistic and research-based choices throughout the portfolio:

- How can the aesthetics of field recording be applied within a dialectical[1] relationship between artist and landscape to extract sonic materials with a resonance to environmental narratives?

- Can human-environmental interaction be applied as an integral part of the compositional process, emerging from the conceptual preparation methods to the final delivery?

- Through sonification, how can environmental data be applied to musical parameters in order to re-purpose recorded materials as an audible part of the imperceptible landscape?

- How can languages and technologies relating to soundscape studies, electroacoustic composition, and environmental sound-art be implemented to represent space and human-environmental interactions in site-specific work?

[1] In this case, a relationship where resistance between humans and nature is present, either to provoke tension or resolution.

1.2 Portfolio of musical works

1	*The Eutrophication of Cumbrian Water*	2018	Fixed media, stereo	10.22
2	*Quality Check: Utopolis Manchester*	2019	Fixed media, stereo	8.56
3	*A Path to Shore*	2020	Fixed media, stereo	14.00
4	*Perspective- U*	2020	Fixed media, stereo	17.34
5	*A Year in Blue Space*	2021	Fixed media, stereo	35.12

Figure 1.1: List of musical portfolio.

1.3 Field recording and landscape interaction

Field recording has long existed as a means of documenting and examining environments. In Schafer's (1994) soundscape terminologies[2], there are distinct observations that have facilitated the aural study of our natural world and have enabled us to understand the interplay between humans and their environments.

The composer initially utilised field recording as a means of documenting and sonically representing an environmental space (via playback). However, it quickly became apparent that it could be utilised in constructing narratives about the dialectical relationship between human action and environmental impacts. The distinction being between soundscape recording of a passive nature, and a more pointed approach where specific materials are captured due to their poignancy to the environmental narrative in each piece. Where soundscape field recording tends to examine our impact on an environment from a societal perspective, the materials in a landscape (which are inherent to environmental processes) may not produce sound without some form of human interaction. Therefore, the approach to field recording in this research inquiry focused on capturing landscape materials which could be utilised musically to represent these inaudible processes. This engaged approach to recording the environment has a synergy with the human-environmental interactions within each site-specific narrative.

For example, the first work within this portfolio (*The Eutrophication of Cumbrian Water*) features materials captured to emphasise these types of relationships. Field recordings, made by sampling a lithophone[3], are used to sonically represent human-environmental interactions through musical gesture (striking the instrument). Secondly, recognisable elements of the specific environmental space (running water, birdsong, etc.) contextualise the environment in which these processes (eutrophication[4]) take place. The distinction between the two sound sources provides materials that can be used to construct soundscapes where

[2]Schafer, R. M. (1994) *The Soundscape: Our Sonic Environment and the Tuning of the World.* 2nd edn. Rochester: Vt: Destiny Books.

[3]Tuned percussion instrument made from slate.

[4]The process of a body of water becoming overly enriched with nutrients (and pollutants), leading to the formation of toxic algae.

human action can be represented separately to the environment which it affects.

Within this approach, the composer found particular resonance in Leonard's (2016) writing[5] for their composition *Antarctica: Music From the Ice*[6]. In this, Leonard details their use of observational field recordings that imply an environmental narrative (melting ice being one of the cornerstone concerns of climate change), but also the use of site-specific landscape materials which allude to the apparent environmental detriment of the space (in this case, the bones of deceased penguins). Here, the link between the passive soundscape recordings (ice melting, or wind), and the sounds produced with human engagement (percussive use of penguin bones) sonically place the human engagement (player) as a musical participant of environmental change. Ultimately, we hear the deterioration of an ecosystem, and come to understand that inhabitant species are dead.

This connection has been pertinent to the composer's sonic examination of environments, and explores the inquisitive sound categories established by Bernie Krause (1998) in his definitions of three soundscape ecology terms: biophony[7], anthropophony[8], and geophony[9]. These distinctions enable assertions about an environment through listening. However, through developments in personal landscape interactions, ultrasonic recording, and bioacoustic analysis, this research inquiry enables further listening of our consequential roles within an environment.

The works in this portfolio explore how as a recordist, a listener, an improviser, and an environmental collaborator, the composer can become more actively engaged in the environment. If the striking of penguin bones can provoke sonic notions of climate change, then this kind of provocation could be elaborated on with a broader range of materials (audible and not). Taking inspiration from Leonard's combination of passive recordings and active sonic engagement within the environment, the composer strived to devise ways in which they could increase their environmental engagement to where the composed materials could not exist without dialectical composition processes between composer and environment. These engagements included constructing land-art sculptures, using ultrasonic recording equipment to investigate imperceptible environmental detriment, and utilising machine-learning to extract bioacoustic information from the environment.

It is Robert Smithson's view, discussed by Brady (2007)[10], that the human-environmental interactions inherent in land art are to be considered as showing aesthetic regard for nature. In the context of this portfolio, the composer's dialectical engagements with the environment provided them with site-specific sonic materials that represented their own aesthetic regard for the environment. Combining these materials with traditional soundscape recordings and detailed field recordings enabled the creation of unique compositions that represent environmental space, environmental narrative, and a positive awareness of environ-

[5]Bianchi, F. and Manzo, V. J. (2016) *Environmental sound artists: in their own words.* New York: Oxford University Press.

[6]Leonard, E. C. (2009) *Antarctica: Music from the Ice.* Cheryl E. Leonard. Antarctica: Music from the Ice. Great Hoary Marmot Music.

[7]Sounds emanating from non-human organisms.

[8]Sounds emanating from humans and human activity.

[9]Naturally occurring, non-biological sound. E.g., wind, running water etc.

[10]Brady, E. (2007) Aesthetic Regard for Nature in Environmental and Land Art, Ethics, Place and Environment, *A Journal of Philosophy and Geography*, 10 (3), pp.287-300.

mental information.

1.4 Sonification

Field recording, soundwalking, and listening methodologies[11] continue to help us understand different landscapes based on the audible materials within each environment. The majority of this examination is done on-site during the recording process. However, the detriment of a landscape can often go undetected to the untrained ear, or even eye. Take for instance the misleading abundance of vibrant green plant life in eutrophication. Not to mention that a lot of detrimental processes within an environment do not produce their own sounds, or even possess visual indicators of their occurrence. In the past it has been common practice to use the tropes of soundscape listening[12] to determine causes and consequences of certain sounds, whilst linking them to pre-existing knowledge about environmental welfare.

Aside from the sonic domain, data collection[13] reliably sources information about the state of a particular environment. It is the purpose of this research inquiry to combine this inaudible information (which often represents inaudible environmental processes) with site-specific, audible materials relating to the same processes. Ultimately, this was a creative process for applying the same listening practices found in soundscape ecology and field recording, to materials derived from data sonification[14]. Listening, and considering musical languages within these sounds, creates an opportunity to extend the soundscape and understand more about the environmental processes in a given location. Using data also contributes to constructing a compositional narrative where recorded information can be attributed to the transformations and manipulations of sound materials throughout. The composer believes that this thread of non-musical information contributes to a listener's perception and understanding of electroacoustic musical languages, as representational elements of a described landscape (soundscape).

There were two distinctions of how data were gathered and utilised for sonification purposes. Recorded data can be categorised through a direct and indirect lens (in terms of what it represents, and how). The first distinction can be made where certain data does and does not exist. This is exemplified with the available data from air quality monitoring stations in Manchester, as opposed to the lack of data that can quantify the amount of eutrophication in the Lake District at any time.

Even with a lack of specific data, audible and inaudible materials can be combined to create new sonic objects which artistically represent inaudible environmental processes. For instance, where specific datasets for the lakes' eutrophication appear to be non-existent,

[11] Adams et al., (2008). Soundwalking as a methodology for understanding soundscapes. *Proceedings of the Institute of Acoustics*, 30(2).

[12] Schafer, R. M. (1994) *The Soundscape: Our Sonic Environment and the Tuning of the World.* 2nd edn. Rochester: Vt: Destiny Books.

[13] Magpi (2022) Magpi Terms of Service. Available at https://www.magpi.com/blog/environmental-data-collection. Accessed on 01/02/2022

[14] Applying numerical data to musical parameters.

datasets which detail a number of its variable influences and consequences are readily available (rainfall, water temperature, air temperature, pH-level, phosphorus and nitrate levels). Thus, it is possible to see evidence of eutrophication within the data, which can then be applied to musical parameters when manipulating relevant field recordings.

This process poses an opportunity to create sonifications that contain narrative information about the inaudible, or lesser perceived, elements of an environment. For example, whilst we cannot 'hear' eutrophication, we do understand that a formative element in its process is rainfall washing pesticides off the land and into water systems. Therefore, a musical instrument made from the environment (lithophone), combined with rainfall data from a relevant time period (documented eutrophication), can musically voice inaudible events within the eutrophication process. As the research in this portfolio developed, less importance was placed on the environment producing 'musical' sound like the lithophone, but rather how field recording could capture crucial landscape materials to represent the environmental processes inherent to every piece.

The second distinction is the sonification methodologies. Firstly, digital signal processing techniques (granular synthesis, time stretching, harmonic enrichment) have enabled the use of data to manipulate pre-recorded sound. This aids in building recognisable elements of sonic space through source-bonded environmental sounds, where the listener is aware of sonic manipulations to semi-recognisable materials. This type of sonification poses questions as to why the recognisable sonic elements of an environment appear manipulated, and what the reasoning for this might be. These processes have been implemented across the programming environment Max, and also in DAW softwares such as Ableton Live and Reaper.

Alternatively, sonifications of a purely synthesised nature exist within the portfolio. In these cases, environmental datasets have been applied to parameters of digital synthesis methods in the programming environment Max. The output of these methods (FM synthesis, additive / subtractive synthesis) is entirely synthesised and does not rely on a sound that can be source-bonded to the soundscape. These sonifications have been placed amongst recognisable soundscapes and further represent the imperceptible elements of the environmental narratives. Their relevance to the soundscape is often achieved via their spectral arrangement, or their placement across the acousmatic-realism continuum, where their sonic characteristics may spatially or spectromorphologically refer to elements of recognisable environmental spaces.

Whereas Rosalia Soria-Luz's *State Space Models Sonification*[15] investigates how to create sonifications that map specific mathematical equations to corresponding synthesis parameters, the sonification process in this research inquiry serves as a means of extending the soundscape for the purposes of deep listening[16] practices which lead to a greater sonic understanding of a natural environment, for composition purposes. In the case of this re-

[15]Soria Luz, R. (2016). Portfolio of original compositions. University of Manchester.

[16]Bogueva, D. and Marinova, D. (2020) Autonomous Sensory Meridian Response (ASMR) for Responding to Climate Change, *Sustainability*, 12(17), e6947.

search, the data (appropriately scaled and mapped) acts as a source of modulation which has origins in a real-world environmental source. Creating a playback system where field recordings are manipulated with environmental data, in real-time, enabled the opportunity to perform listening techniques borrowed from soundscape music analysis, but applied to inaudible elements of a given landscape. Furthermore, modulations in rainfall data can transform the percussive gestures of the lithophone into a continuously streaming sonic texture; one could argue that this is a unique opportunity to listen to the land run-off[17] often found as the cause of water pollution. Using recorded data as a tool for autonomous modulation takes influences from the fields of computer-aided algorithmic music[18] (algorithms dictate musical choice), and the likening of Cagean[19] randomness to perceived irregularities found in nature[20]. It also refers to generative music techniques[21] employed by Brian Eno. These fields of research show a collaboration between composer and musical-output system. For this research, that system functioned to extend the soundscape, thus enabling the composer to explore interaction and collaboration with previously imperceptible elements of the soundscape. Consistently, the sonification system was set up in a fashion which continuously applies the data to live playback of field recordings with the manipulation of sonic parameters being observed and recorded in real time. During these sessions, the composer employed the same listening and monitoring techniques used in the field recording sessions. The listening practices employed at this stage also informed preliminary choices about compositional structuring and arrangement of the materials.

1.5 Compositional arrangement

Within the music in this portfolio a dichotomy exists, from a listening perspective, between recognisable elements of soundscape and acousmatic sonifications and transformations. However, by utilising electroacoustic composition languages, it becomes plausible to recognise abstract elements of sound as being a part of the soundscape - even in a psychological or holistic way. A key influential piece demonstrative of this is Hildegard Westerkamp's *Beneath the Forest Floor* (1992)[22].

The compositional arrangement methods employed in this research project reflect Robert Smithson's interpretation of artistic entropy[23], and the process of creating art in collaboration with the landscape. When interviewed[24], Smithson describes the exchange between synthetic and natural elements that form the core irreversible materials for each new work. In this research inquiry, this notion is reflected where numerical data and computerised sound processing can be categorised as synthetic materials, and field recordings as

[17]Rainfall washing pollutants from the land into the water systems.

[18]Garnett, G. E. (2001) The Aesthetics of Interactive Computer Music, *Computer music journal*, 25(1), pp.21–33.

[19]Theories and methods akin to the work of John Cage.

[20]Piekut, B. (2013) Chance and Certainty: John Cage's Politics of Nature, *Cultural Critique*. 84. pp.134-163.

[21]Eno, B. (1996) *Generative music*. In Motion Magazine. Available at: https://inmotionmagazine.com/eno1.html. Accessed on 02/06/2022

[22]Westerkamp, H. et al. (1996) Beneath the Forest Floor "Transformations." emprientes DIGITALes. Television.

[23]Moffitt, L. (2017). Sand, Silt, Salt, Water: Entropy as a Lens for Design in Post-Industrial Landscapes, *Landscape research*, 42(7), pp.769–781.

[24]Smithson, R. (1996) *ROBERT SMITHSON: THE COLLECTED WRITINGS*. 2nd edn. California: University of California Press, LTD.

natural materials. Therefore, the sonic output (transformed field recordings and synthesised sound) can be thought of as irreversible combinations of synthetic and natural, much like the formed structures in Smithson's land-art pieces.

However, similar to the set asphalt in Smithson's 'pour'[25] experiments, these sonifications exist in abstract form to the everyday listener. Where small traces of source material might be sonically recognisable, the newly developed sonic characteristics may contain changes with greater context than their material form alone. So, in order for these new materials to contribute to an aural representation of an environmental process, they need to be appropriately arranged and treated in ways which emphasise their new contextual information. Within this research, the languages of electroacoustic composition have been utilised to emphasise contextual information by likening the sonic characteristics of the materials to recognisable elements of the soundscape or documented elements in environmental processes. In particular, Dennis Smalley's (1997) terminologies in Spectromorphology and Spatiomorphology[26] categorise sound based on their gestural or textural nature, their motion and growth behaviours, their spectral density, and their proposed origins (even when transformed). Therefore, these distinctions seemed entirely appropriate to have in mind when reconstructing soundscapes with material that has been transformed to contain information about the physical textures, gestures, motion and growth inherent to environmental processes. Additionally, Smalley's Space Form[27] informed methods for achieving recognisable structures of spectral occupancies[28] in a soundscape consisting of abstracted materials.

1.6 Impacts of COVID-19

After a year of productive research and completing the first two compositions in the portfolio, the pandemic struck and immediately restricted the composer's research and composition capabilities in every way possible. Living in the Calder Valley in West Yorkshire at the time, the composer had to reconsider how they might approach gathering the relevant materials for their compositional process. All in all, this change in approach triggered several trajectories of expanded research and methodology, which ultimately enhanced the original research inquiry.

Firstly, the prospect of geolocative choice was reduced to sites within walking distance of the composer's residence. This meant that any location visited, for compositional purposes, had to be examined more thoroughly (during extended time periods) for materials which were appropriate for composition. As the rules wavered and the composer's radius increased, the prospect of becoming more engaged with a location lingered. Instead of incorporating travel as a means of reaching documented environmental narratives (eutrophication in the Lake District), the composer became aware that they could further examine

[25] Smithson, Robert. Asphalt Rundown. 1969. Holt/Smithson Foundation, Licensed by VAGA at ARS, New York.

[26] Smalley, D. (1997) Spectromorphology: Explaining Sound-Shapes, *Organised sound : an international journal of music technology*, 2(2), pp.107–126.

[27] Smalley, D.(2007) Space-Form and the Acousmatic Image, *Organised sound : an international journal of music technology*, 12(1), pp.35–58.

[28] The perceived orientation of a sound, based on its frequency content and behaviours.

an environment through their personal interactions with a site. This change in trajectory redefined their role within each environment from observer/recordist to engager/collaborator. This change, in fact, mirrored the dialectical relationships between humans and nature that had previously instigated this research inquiry. The composer began to realise that if they used different methods of engaging with an environment, their experiences doing so would gather momentum and inspire further artistic choices about field recording techniques, environmental processes, and sonifications methods. The turning point was the change from the documentary style approach to field recording in the first two pieces (where the composer's role in the soundscape is not present), to the third piece where their role as a land-artist is included in the soundscape.

The restrictions of lockdowns also inspired a change in how data was to be incorporated into the compositional narratives. Data depicting the environmental welfare of the composer's legal radius of work did not exist. Air quality monitoring stations existed, but this environmental concern had already been covered in previous pieces. Instead, the composer's focus turned to how data might represent the ways in which the environment had an effect on the composer. Whether this took from citizen science[29] practices, weather pattern data from a specific time period, or data retrieved from bioacoustic analysis of field recordings, these new approaches to sourcing data examined details about the composer's personal interactions with the environment, and less about our collective social impact on the environment.

The composer found these shifts toward an autobiographical approach with the environment resonant with both audiences and commissioning bodies. Each post-lockdown composition in the portfolio was funded and exhibited in a variety of formats including: geolocative sonic maps, fixed-media gallery installations, composition attached to published articles of creative writing, short documentary film, interactive listening workshops, and the presentation of the composer's artistic practice in public speaking events. Notable collaborators and commissioners have been: Manchester Museum, The University of Leeds, Land Lines Arts and Research Project, Natural England, and the AHRC. It has been through these styles of dissemination that the bridge between the composer's practice and environmental research has found an audience. These opportunities have also included the benefits of additional programme notes, which have further informed audiences on both the compositional and environmental information behind each piece.

[29](Muki) Haklay, M., Mazumdar, S., Wardlaw, J. (2018) Citizen Science for Observing and Understanding the Earth, *Earth Observation Open Science and Innovation. ISSI Scientific Report Series*, 15.

Chapter 2

2. *The Eutrophication of Cumbrian Water* (2018, 10.22) [Stereo, Fixed Media]

"In the summer of 2017, I found myself absorbing the green palette I had been deprived of in Manchester's languid greyness. I stood on the shore of a small beach looking across Coniston Water, using the emerald and the viridescent as positive indications of the landscape's health - even the water had encouraged a sheet green film of plant life." The composer's personal journal, 2018.

2.1 Sonification context

The first work in this portfolio is a fixed-media stereo composition which links place (Coniston Water, Lake District) with a detrimental environmental process (eutrophication), that regularly occurs there. The piece presents the established[1] correlation between human-environmental actions and the increase in eutrophication. This is achieved by combining audio recordings of a lithophone[2], and site-specific soundscape[3] recordings, with numerical datasets representing eutrophication. The sonic materials are transformed with numerical data through DSP[4] sonification processes to link humanistic musical gestures (playing the lithophone) to our instigative roles in eutrophication. This is implemented through a structural trajectory that uses electroacoustic languages to link transformations in sonic objects to the physical environmental changes inherent to eutrophication. This trajectory uses listening surrogacy theory[5] to establish a listener's recognition of sonic objects, before the transformation process utilises soundscape and space form[6] theories to place these new semi-acousmatic[7] materials as a part of the constructed soundscape. This structural trajectory of sonic materials connects human-environmental interactions with musical language in order to listen to eutrophication as part of the soundscape.

[1] Chislock, M.F. et al. (2013) Eutrophication: Causes, consequences, and controls in aquatic ecosystems, *Nature Education Knowledge*, 4.

[2] A tuned percussion instrument with stone keys. Structurally similar to a marimba.

[3] The acoustic environment as perceived by the human ear, in a composition-specific location.

[4] Digital signal processing.

[5] The different ways in which a listener may associate how a sound originated.

[6] The spatial organisation of sounds within the soundscape.

[7] Sounds which do not have an immediately recognisable source.

2.2 Landscape interaction

The lithophone used in this composition is a 21st century replica of one privately owned by John Ruskin[8]. It is situated within his Brantwood[9] estate, elevated in an outbuilding overlooking Coniston Water. The location of the instrument links rather romantically to the ecological awareness at the core of this composition due to Brantwood being a prominent location in the founding of The National Trust[10].

During September 2018, the composer travelled to Brantwood estate to record audio samples of the lithophone in their collection. The instrument spoke to the varying ways in which the composer had narrowed their focus on human-environment interactions contributing to environmental detriment. Its materiality (local slate) and its reliance on human gesture to procure sound made for an immediate sonic allusion to the human instigation inherent to the process of eutrophication. This metaphoric value became a major consideration whilst constructing sonic materials which emphasised human influences on eutrophication. Therefore, the lithophone exists as an appropriate sound source for creating sonic allusions to some of the inaudible contributing processes to eutrophication.

Allusions to the physical processes of eutrophication were emphasised by utilising relevant numerical data, in order to reflect the physical-geographic causes of eutrophication. For example, by processing recordings of the lithophone with numerical datasets depicting rainfall, it is possible to produce new sonic material that represents the run-off of pollutants from the landscape and into the water systems. The connection to motion in an environmental process is further suggested with additional developments in spectromorphological characteristics (growth, textural changes, and motion).

The process of recording the lithophone utilised a developed version of the Decca Tree[11] microphone array. This was implemented in order to capture detailed samples of each of the instrument's keys both at an intimate level and at an elevated height, where the ambient resonance of the space was also captured.

[8] A Victorian writer, philosopher and art critic.
[9] *Brantwood*, Cumbria, England.
[10] A charity and membership organisation for heritage conservation in the United Kingdom.
[11] A microphone array usually utilised in orchestral recording practices.

Figure 2.1: Lithophone recording set-up (photo by Harry Ovington).

2.3 Eutrophication as material for sonification

The process and consequences of eutrophication are examined further in Appendix 9.1.1.

Having visited the site in 2017, the composer witnessed the effects of eutrophication. Subsequently, further evidence[12] of current (to the time) eutrophication was established. Upon further research, it was also clear that there had been proof[13] of long-term, historic eutrophication in the Lake District; something which had been rapidly increased in correlation to revolution in human industry (mostly agricultural).

The composer wanted to utilise historic (1945-2013) datasets[14], that depicted conditions and causes of eutrophication in the specific area, as a means for creating musical modulation through sonification. In retrospect, the use of historic data meant that the connection between composer, location, and eutrophication was not as robust as it could have been with data which depicted eutrophication in the time of the composer's visit to the site. On this occasion, this particular artistic aim could not be met, due to the lack of published data. It did, however, affirm that future works should be constructed with data depicting environmental conditions actually experienced by the artist. Since the completion of this work, the Environmental Information Data Center[15] has published data[16] which covers the time of this composition, and still shows evidence of conditions that contribute to eutrophication.

[12]Environmental Agency. 2019. 'Blue Green Algae remains present in four Lake District locations'. https://www.gov.uk/government/news/blue-green-algae-remains-present-in-four-lake-district-locations. Accessed on 02/03/2022.

[13]Fielding, James and Croudace, Ian and Kemp, Alan and Pearce, Richard and Cotterill, Carol and Langdon, Peter and Avery, Rachael. (2020). Tracing lake pollution, eutrophication and partial recovery from the sediments of Windermere, UK, using geochemistry and sediment microfabrics. Science of The Total Environment. 722. 137745. 10.1016/j.scitotenv.2020.137745.

[14]Maberly, S.C.; Brierley, B.; Carter, H.T.; Clarke, M.A.; De Ville, M.M.; Fletcher, J.M.; James, J.B.; Keenan, P.; Kelly, J.L.; Mackay, E.B.; Parker, J.E.; Patel, M.; Pereira, M.G.; Rhodes, G.; Tanna, B.; Thackeray, S.J.; Vincent, C.J.; Feuchtmayr, H. (2017). Surface temperature, surface oxygen, water clarity, water chemistry and phytoplankton chlorophyll a data from Windermere North Basin, 1945 to 2013. NERC Environmental Information Data Centre. (Dataset). https://doi.org/10.5285/f385b60a-2a6b-432e-aadd-a9690415a0ca

[15]Environmental Information Data Center, Available at: https://eidc.ac.uk/ Accessed on 09/11/2021.

[16]Feuchtmayr, H.; Beith, S. ; Clarke, M.A.; De Ville, M.M.; Dodd, B.A.; Fletcher, J.; Hunt, A.G.; James, J.B.; Mackay, E.B.; Rhodes, G.; Thackeray, S.J.; Maberly, S.C. (2021). Surface temperature, surface oxygen, water clarity, water chemistry and phytoplankton chlorophyll a data from Windermere North Basin, 2014 to 2018. NERC Environmental Information Data Centre. (Dataset). https://doi.org/10.5285/bee7003f-90d8-412b-90b0-0c06dec9c1b6

In an effort to include data representative of eutrophication in the time-span of the field work for this project, climatic data relating to contributors of eutrophication (daily rainfall [mm] and air temperature [C]) were utilised to inform parameters in the same granular synthesis[17] patch[18]. The data[19] showed daily values for these parameters, and depicted these climatic observations during the three months leading up to the observations of eutrophication in the location (summer 2018).

2.3.1 Structure of sonification materials

The composition exists in four different sections, with the first three sections each introducing a new set of field recordings and a new method of mapping data to parameters in granular synthesis. The fourth passage features fusions of all previous transformations. The first three passages are concerned with connecting datasets with recorded materials in order to allude to some of the physical occurrences within the process of eutrophication.

Time (minutes)	Sound Material	Dataset	Granular synthesis Parameter
00.00 - 1.38	Lithophone	Nitrate (NO3N)→	Grain rate [ms] (max)
		Phosphorus → (TOTP)	Grain duration [ms] (max)
1.38 - 5.00	Lithophone	Daily Rainfall (mm) → Daily Air Temperature (c)	Grain rate [ms] (max)
5.00 - 8.10	Female Vocal Replicated Sonic Land Art	→ → Daily Water Temperature (c) → →	Playback Rate [ms] Loop size [frames] Grain rate [ms] (max) Grain Pitch (max)
8.10 - 9.22	Lithophone	Oxygen (%) →	Grain rate [ms] (max)
		pH →	Grain Pitch (max)
9.22 - 10.22	All Previous Materials	All Previous Data	All Previous Parameters

Figure 2.2: Eutrophication sonification table.

2.4 Analysis of composition

00.00 - 1.38 (minutes)

The piece begins with the sound of the lithophone being struck. The initial onset of the sound is immediately recognisable as a percussive instrument played by a human per-

[17] Sound synthesis technique which utilises small particles of sound.

[18] *Eutrophication Granular synth.maxpat*

[19] Met Office; Hollis, D.; McCarthy, M.; Kendon, M.; Legg, T. (2022): HadUK-Grid Climate Observations by Administrative Regions over the UK, v1.1.0.0 (1836-2021). NERC EDS Centre for Environmental Data Analysis, 26 May 2022. doi:10.5285/7edd216fcf794b1f9a5889d496d50e54. http://dx.doi.org/10.5285/7edd216fcf794b1f9a5889d496d50e54

former. This provides metaphorical context for human musical gestures linked to human-environmental impacts throughout the piece. Similarly, the emergence of birdsong (00.29) is key to establishing another element of the perceived listening space. This directs the listener's awareness to the fact that eutrophication may have implications on the wider environment and species who rely on the welfare of the water system. Similar to Barry Truax's categorisations[20] of sounds within the soundscape, gestural sonic material from the anthrophony[21] is set against sounds from the biophony[22]. This creates a perceived space where musical human gesture is juxtaposed and situated against passive ecological soundscapes to act as the metaphor for human impacts on the environment.

To reinforce the correlative relationship between humans and the environment, a process of sonification has been utilised to further extend the spectromorphologies and give the lithophone developments in its behavioural and textural qualities. These new manipulations of the audio source can still be source-bonded through timbre, whilst possessing new textural changes, variations of motion, and directional behaviours which do not belong to how this instrument is traditionally played. These manipulations intend to behave as being triggered by the initial human gesture. Considering this with listening surrogacies, this likens their relationship to the relationship between human-environmental impacts, and environmental processes which we cannot perceive.

The sense of environmental space is further developed (0.56) with the emergent sound of running water. Not only does this direct the listening focus to the relevant element of the landscape, but its manipulation also points toward the environmental narrative (eutrophication). The hydrophone recording first emerges in its full frequency range which is then reduced with a low-pass filter. The filtering of this sound source creates the illusion of descending pitch which in turn alludes to descending motion towards a rootedness. This motion, paired with the materiality of the sound, sonically represents the motion concerned in the land run-off which contributes to eutrophication.

1.38 - 5.00 (minutes)

"…intuitive knowledge of the human physical gesture involved is inextricably bound up with our knowledge of music as an activity." (Smalley, 1997).

The compositional objective within this passage was to maintain the timbral and tonal characteristics of the lithophone in order to continue the musically-insinuated human influence on the landscape. However, an emphasis on transforming its spectromorphological characteristics was implemented via sonification methods. Firstly, by implementing data with low numerical value (rainfall [mm] during the summer months) to granular synthesis parameters, new developments in motion and growth[23] are established. These are most prevalent in the reintroduction of these transformed lithophone recordings. The gestural na-

[20]Radford, L. (2001) Barry Truax, editor: Handbook of Acoustic Ecology, 2nd edition (CD-ROM version); Multimedia: Handbook of Acoustic Ecology, 2nd edition (CD-ROM version), Computer music journal, 25(1), pp.93–94.

[21]Human instigated sounds within the soundscape (cars, instrumentation etc.).

[22]Sounds emitted from wildlife (mating calls, communicative vocalisations etc.).

[23]Smalley, D. (1997), pp.9-10.

ture of the original recordings reappears as the instigator of composite gestures[24], where the lithophone being struck appears to cause elongated textural motions and growth behaviours. However, these new materials still maintain their identity through timbre, preserving their ability to be source-bonded to the lithophone and metaphorical human action. The growth and new abundance of smaller spectromorphologies is a direct likening to the growth and development of new algal life in the eutrophication process.

The source-bonding of sounds to human action on the environment is further developed via the use of a particular sample taken from the sonification process. A low frequency gesture (1.43) pulses in metre, and stays rhythmically structured this way until its eventual and gradual disappearance. The rigidity of its rhythmical structure creates reciprocal motion; the illusion of tight behavioural characteristics. It has been established[25] that rhythmic repetition, like this, is a prominent feature within human performative music. So the implementation of it here is to further establish the presence of human action within the soundscape.

In an effort to place these sounds within a newly constructed soundscape, daily air temperature (C) was applied to granular synthesis parameters to create one fluid tonal texture (1.52). This acts with specific spectromorphologies (texture motion, behaviours) in tandem with ideologies about spatial occupancy[26], to assume similar behavioural qualities to the previously heard recordings of water and the additional harmonic element alluding to the human action (lithophone).

The gestural and textural transformations of the lithophone continue into this section where they contribute to a structural arc which links materiality and timbre to human action, and vice versa. The flux between source-bonded timbre and new sonic material is delineated by manipulations of the pitch-based parameters in the granular synthesis patch. Where data is applied to pitch modulations, the lithophone samples become abstracted from any listener recognition. The reasoning for situating unrecognisable sound amongst the source-bonded soundscape is to emphasise causality between human action and environmental processes.

5.00 - 9.10 (minutes)

The emergence of human vocal sounds (5.00) can be recognised as another compositional development of human action within the landscape being represented. The vocal sample was taken from a newly recorded hymn[27], originating from Quaker culture which is prominent in the historic culture of the landscape in this composition. Whilst this hymn is of American origin, it belongs to the Quaker[28] culture, originating in Cumbria. The orig-

[24]Blackburn, M. (2011) The Visual Sound-Shapes of Spectromorphology: An Illustrative Guide to Composition, *Organised sound : an international journal of music technology* 16(1), pp.5–13.

[25]Emmerson, S. (2008) Pulse, Metre, Rhythm in Electro-Acoustic Music, *EMS-Network Conference* Paris.

[26]Smalley, D.(2007) Space-Form and the Acousmatic Image, *Organised sound : an international journal of music technology*, 12(1), pp.35–58.

[27]Scott, John et al. "How Can I Keep from Singing?." EMI Classics, 1996. Television.

[28]Quakers are people who belong to a historically Protestant Christian set of denominations known formally as the Religious Society of Friends.

inal intention of including this as a sound source was to include a cultural emblem[29] as an allusion to the historic culture of the location. However, through sonification processes this sound source proved more valuable as a way of extending the metaphor between human musical action and environmental processes. This recording was made in a studio during the summer 2018 at NOVARS Research Centre, performed by Alice McIlwraith, and recorded by the composer.

The way in which the vocal has been transformed, develops the metaphoric implications of having it as part of the newly developed soundscape. It acts as a keynote[30] in its longer continuous textural behaviours (5.40-8.03), likening its unidirectional motions and streaming texture motions to those in the previously heard recordings of water, and other manipulated representations of water. It also occupies a similar foreground domain (sound signal[31]) as the previously heard fragmented lithophone recordings which have metaphorically represented detrimental human action on the environment.

The coexistence of this new sonic material with the continuation of recognisable human musical gesture (lithophone) further cements human action as a part of the newly constructed soundscape. As the two sound sources accumulated through growth and abundance, digital distortion was applied (Ableton Live Saturation VST) to further obscure the listening space (akin to the surface of the water being obscured by eutrophication).

9.10 - 10.22 (minutes)

The final section in the piece uses sound materials and transformations from all previous sections in the composition. The lithophone strikes are used as the primary instigators in the composite gestures which develop with layered elements of the soundscape, transformations and other recordings. These fused elements further exaggerate the relationship of causality between human action and environmental narrative.

[29]Blackburn, M. (2011) Importing the Sonic Souvenir: issues of cross-cultural composition, *Electroacoustic Music Studies Conference, Sforzando!* New York.

[30]A frequent sound which may become background to certain listeners. E.g., running water in a soundscape near a lake.

[31]Foreground sound designed to attract attention.

Chapter 3

3. *Quality Check: Utopolis Manchester* (2019, 8.56) [Stereo, Fixed Media]

"Scanning the internet for accommodation in Manchester… another alarming article about poor air quality and extremely polluted bus routes…" The composer's personal journal, 2019.

3.1 Context

Quality Check: Utopolis Manchester is a fixed media, stereo composition that investigates the impact of our human-environmental interactions on air pollution in Manchester[1]. The piece is informed by musical aesthetics in soundscape, field recordings, and vocabulary emerging from electroacoustic spectromorphology and spatiomorphology. It combines source-bonded elements found in soundscapes and human gesture to produce an acousmatic narrative. The composition examines aspects of space (materiality, gesture, spectral occupancy/density) in terms of its relation with human gesture. Initially, this is found within the obvious tropes of soundscape music, i.e., traffic noise alluding to human-led pollutant emissions. However, as the piece develops and sonic materials become transformed (via sonification), it further explores how emerging sonic materials can form the basis to construct novel narrative-driven aural soundscapes. These constructed soundscapes are informed by Smalley's Space-Form[2]. Compositionally, they reveal our counter-environmental actions as recorded sound that is re-purposed within the auditory display. Their aim is to illustrate how we utilise these spaces, how we contribute to their environmental welfare, and how poor environmental welfare may affect us in return.

The field recordings were captured both in preparation and during the performances of a commissioned work, a city-wide multichannel interactive audio experience, during Manchester International Festival 2019 entitled *Utopolis Manchester*[3]. The composer was commissioned to create a piece for this in January 2019, with the performances commencing in July 2019. The commission ultimately resulted in work that encapsulated this re-

[1] Taylor, M. (2018) People in Manchester 'exposed to dangerous levels of air pollution', *The Guardian*, 14th June. Available at: https://www.theguardian.com/uk-news/2018/jun/14/people-in-manchester-exposed-to-dangerous-levels-of-air-pollution

[2] Smalley, D.(2007) Space-Form and the Acousmatic Image, *Organised sound : an international journal of music technology*, 12(1), pp.35–58.

[3] *Utopolis Manchester* (2019) Created by Rimini Protokoll. [Interactive performance art]. Manchester International Festival 2019.

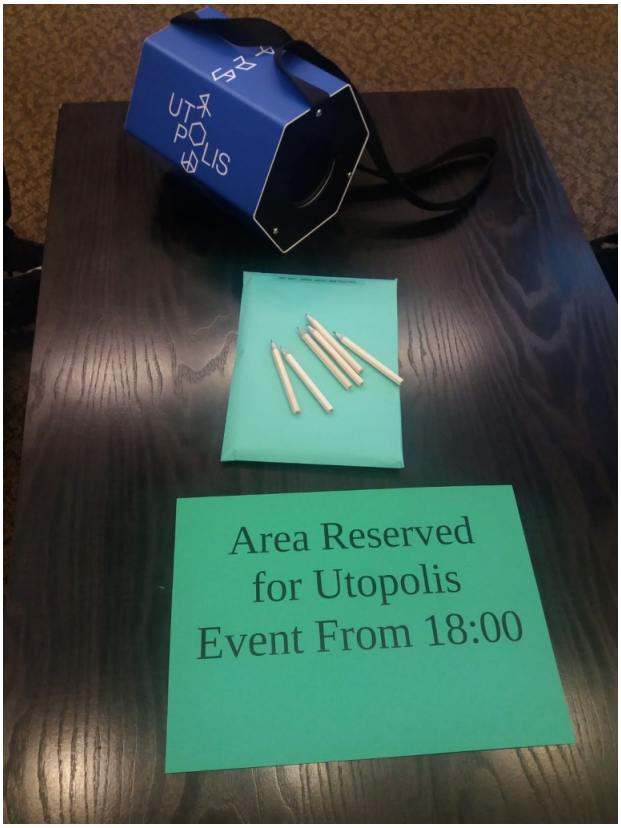

Figure 3.1: Portable speaker and reservation for the beginning of the commissioned performance (photo by Harry Ovington).

search, but also stretched outside of it. For that reason, the composer created a separate composition (the portfolio piece) from elements of the commission that were focused on their areas of research.

The sonified materials within the composition were created using air quality datasets from Manchester monitoring stations to modulate parameters of granular synthesis (with the field recordings). Data also informed frequency stipulations in frequency modulation synthesis and both approaches were executed in the programming environment Max. Additionally, a binaural simulation plug-in[4] was utilised to enhance the spectral placement of acousmatic sound materials. This enabled the listener to aurally perceive elements of their environment that are usually inaudible (air pollution).

3.2 Landscape interaction

The core creative objective of this piece was to use relatively simple recording strategies to examine sounds that demonstrate our influence and dependency on the atmospheric environment, with a site-specific approach in Manchester. All recorded materials were captured using a Zoom H6 portable field recorder, and its on-board X/Y[5] microphone capsule. This allowed the composer to use the rehearsals and performances of the commissioned work as a route to construct meaningful interactions between the landscape and the people

[4]D. Poirier-Quinot and B. F.G. Katz, "The Anaglyph binaural audio engine," Proc. Audio Eng. Soc., pp. 9591:1–8, May 2018. ref: 10.1121/1.4996457.

[5]A stereo recording technique using two microphones with overlapping polar patterns.

within it. These recorded soundwalks captured key sound signals[6] of sonic spaces, human utterance, and mechanised soundscapes which alluded to some of the causes and consequences of air pollution. By studying sounds from the anthropophony of Manchester's city centre, it became clear just how much humans contribute to air pollution, and then exist in constant consumption of those consequences. Whether that be in the way our transportation systems contribute to air pollution, or how in our everyday and recreational activities (like walking or singing in church) we may be inhaling the very pollutants that we have spread into the atmosphere.

Another part of the commissioned brief was to capture interactive feedback amongst the participants in each rehearsal. This was prompted throughout the experience by the theme of utopia, and often it alluded to the environment. The commissioners thought this demonstrated an interesting dichotomy between the intentions and desires of the public, and their reality.

The transformations of the recorded materials always belong to first and second order listening surrogacies - meaning that their source is maintained as recognisable but their spectromorphologies and spatiomorphologies change. The piece initially explores this by examining source-bonded sound-marks[7], which imply poor air quality and environmental welfare; e.g., traffic, vehicles and machinery. This idea is explored further via two different distinctions in human sonic gesture within the soundscape: agential[8] and utterance[9]. By creating transformation in the first and second order listening surrogacy, and using these to construct soundscapes in accordance with Smalley's space-form theories, sonic space is still recognisable but with allusions to an alteration (air pollution).

Figure 3.2: Festival attendees experiencing the cumulative multi-channel experience (photo by Harry Ovington).

[6]Foreground sounds intended to be listened to consciously.
[7]Source-bonded sonic object which relates to location, culture or activity.
[8]Human interactions with materials and objects (non-musical) which produce sound.
[9]Verbal and vocal utterances of sound.

3.3 Sonification

The datasets used to manipulate and produce sonic material were taken from Air Quality England[10], and specifically focus on the monitoring stations in locations close to the festival performance areas in Manchester (Oxford Road and Piccadilly [LA]). The datasets detailed a means of measuring air pollution levels via a reading of PM10[11]. Both of these locations depict hourly readings of these values during the pre-production phase of the project (01/01/2019-01/06/2019). The data can be obtained by inputting these geolocative and time stipulations to the data index service provided by Air Quality England. At times, there are occurrences where no data was recorded at one, or both locations. These errors were disregarded and only data entries where both locations recorded a monitoring level were used to create sonifications.

In order to create sonifications and transformed material from the field recordings, the datasets were applied to the following parameters of a granular synthesis patch in Max: Grain Pitch (min/max), Grain Duration (min/max), and Grain Rate (min/max).

Additionally, the datasets were applied to the two frequency parameters within a frequency modulation synthesis[12] patch in Max. Within the patch, two delineations of frequency can be made - one of the carrier signal and one of the modulating frequency (labeled *harmonicity* in the patch). The PM10 datasets from each location were applied to opposing parameters (in both alterations) and scaled in relative size to create sonic material that varied in spectral occupancy and tonality. The amplitude envelope was determined by the composer as an artistic choice, and mostly utilised short attack and long sustain in order to leave a sustained tone, which could be re-purposed at a later stage with additional spectromorphological choices.

A key compositional objective was to position acousmatic materials (FM synthesis and granular synthesis) within the soundscape, arranging their place according to the factors of causality[13] structuring, and attention to (in)harmonicity[14]. This observation in arrangement and structure is applied within the established aesthetics of soundscape music composition so that the acousmatic becomes inhabited within the soundscapes. The inclusion of the acousmatic within the soundscape implies the otherwise imperceptible environmental forces which are alluded to with soundscape's usual musical aesthetics.

All the sonified transformations within the piece are further established as having a metaphoric likeness to air and atmosphere by the use of the binaural audio simulation engine Anaglyph[15]. This tool was utilised for spatially arranging the acousmatic and sonified materials in a way that would allude to real spatial movement and distancing (from a lis-

[10] Air Quality England. Available at: https://www.airqualityengland.co.uk/ Accessed on 09/09/2021

[11] Particles less than 10 μm in diameter.

[12] Where the frequency of one waveform is modulated by another in order to change its sound.

[13] Smalley, D. (1997), p. 11.

[14] Levack, J. (2002) Soundscape Composition: The Convergence of Ethnography and Acousmatic Music, *Organised sound: an international journal of music technology*, 7(1), pp.21–27.

[15] D. Poirier-Quinot and B. F.G. Katz, "The Anaglyph binaural audio engine," Proc. Audio Eng. Soc., pp. 9591:1–8, May 2018. ref: 10.1121/1.4996457.

tener's perspective). Furthermore, the tool acted as a conduit to incorporate the constructed soundscapes as a part of the recorded soundscapes.

A rationale for submitting a condensed version of the commissioned piece is detailed in Appendix 9.2.1.

3.4 Analysis of composition

00.00 - 2.36 (minutes)

The first passage in this piece is largely concerned with presenting mechanised space[16] as a means of linking the perceptual listening space to an environmental narrative. The use of mechanised space emphasises the lack of sound from the biophony[17] within the soundscape. Sound markers[18] such as the noise emitted from Metro-Link Trams (0.26) and general city traffic (0.12) are first presented within a singular recording processed with a high-pass filter (cut-off: 100Hz), in order to remove the perception of proximity to the individual sonic events. The recordings detailed an enacted space[19] whereby no focus is drawn to one specific event. Instead, they occurred simultaneously and frequently, alluding to the relevance of human action within the environmental narrative of the piece (air pollution). As the passage progressed, the key components of the space (i.e. tram at 0.44 and car at 2.15) were reintroduced with broader spectral occupancy (via increased frequency domains). These more detailed recordings also possessed spatial qualities with directional movement across the stereo field being emphasised. Whilst they are not binaural recordings, these spatial movements can be associated with transmodal perceptions[20] that further denote the listener as both the perceptual receiver of the space, and the instigator(s) of gestural content within it.

The sonifications within this section also possessed factors that identify them as part of the soundscape, though in a semi-acousmatic manner. The granular sonifications (introduced 0.30) contributed to the perception of human activity within the space, emphasising human prominence within the compositional theme. These sonic materials belonged to agential space[21] and illustrated human interaction with materials in the landscape. This aimed to analogise the more abstract sonic gestures and textures to our actions on the environment, which may not be immediately perceivable. The perception of air pollution as particulate matter (and the commonly perceived motion of air) was also implicit within the fragmentation, spatial placement, and spectral occupancy[22] of these new sound objects. Smalley would refer to these sounds as belonging to first-order listening surrogacy[23], where the material and timbral qualities of the sound can be source-bonded to particular landscape

[16] Smalley, D.(2007), p. 4
[17] Sounds produced by non-human, living organisms.
[18] Sound material with recognisable connotations to location and/or culture.
[19] Space where events are source-bound to human culture and actions.
[20] Different forms of spatial movement which evoke senses of recognisable source-bound movement.
[21] Where sound is provoked by human interaction with objects, surfaces and materials.
[22] Smalley, D. (1997), p. 15.
[23] Ibid., pp 6-7.

materials. The landscape materials must be manipulated (struck, brushed past, walked on) by humans in order to produce sound, so their gestural source was defined by this. However, the sonification process moved them into remote surrogacy, where their gestural behaviour accumulates in growth to a sporadic texture that would not naturally occur within the original soundscape. They were, therefore, used to link recognisable materials and mundane human action to materials beyond our sensory perception of the environment.

Further textural sonifications (e.g. layered tram engine at 1.02, through granular synthesis) were also implemented as transitional materials holding spatial resemblance (in stereo movement and transient amplitudes) to agential gesture (traffic/tram movement) within the soundscape. These transformations also developed pitch manipulations in their textural nature, creating a bi-directional movement at odds with the uni-directional movement heard in a non-sonified tram recording (0.44). This sonically juxtaposes the sonifications with their source-bonded origins. A soundmark[24] (Metrolink tram horn, 1.15) was used to develop the link between the acousmatic and source-bonded materials in this section.

Sonifications made with FM synthesis were incorporated (1.46) intentionally to introduce acousmatic elements as part of an otherwise semi-source bonded soundscape. Texturally and spectromorphologically, these acted similarly to the recorded soundscapes at the start of the piece (slow emergence, occupancy of high-mid frequency range, and the development of a sense of proximity, through spectral widening). Through transmodal perception, these objects appeared as much a part of the sonic atmosphere as the physical atmosphere in the field recordings. Their assumed place as a part of the soundscape implied to a listener that there were imperceptible elements of their surrounding environments.

For both types of sonifications, the transmodal perception of their place in the soundscape was further aided by use of the binaural spatialisation engine, Anaglyph[25]. By placing these sounds at 90° (Figure 3.1) and in line with the listener's ear, they were perceived in a similar manner to sound materials within the recorded soundscape.

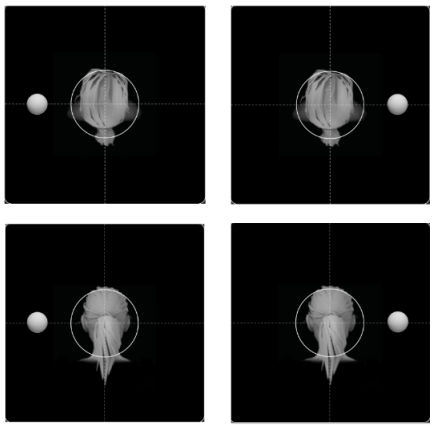

Figure 3.3: Binaural placement with Anaglyph.

[24]Sound recognisable to a certain culture or community by location.

[25]D. Poirier-Quinot and B. F.G. Katz, "The Anaglyph binaural audio engine," Proc. Audio Eng. Soc., pp. 9591:1–8, May 2018. ref: 10.1121/1.4996457.

2.36 - 5.00 (minutes)

In connection to the wider research establishing a correlation between air pollution and its deteriotive health effects (on the human voice and respiratory conditions[26]), this passage of the piece examines what Smalley would refer to as utterance space[27]. The materials within this passage were taken from a part of the commissioned performances in the Cross Street Unitarian Chapel, Manchester, UK. During this section of the performances, a choir sang a hymn (emerging at 2.36 and terminating at 3.35), and a short sermon was given with the accompaniment of a pianist (3.36 - 4.47). The choral performance was tonally recognisable as belonging to western musical notation, whilst the language of the spoken word sermon further establishes information about space. Becoming aware of the human action (singing) within the space was important in understanding the transaction between recreational human activity and the polluted air, most prevalent here with increased inhalation through singing. This was further supported by the introduction (3.10) of sonified manipulations of the vocal material. These new sound objects transcended from the first to the second-order listening surrogacy, where their behaviours in pitch, gesture, and texture were manipulated beyond the recognition of the original source material.

Another objective within this passage was to demonstrate the influence of polluted air across other regions of the spectral space. This was achieved with the placement of recorded birdsong (3.26), which took place simultaneously to the choral performance and sermon. Having established knowledge of a bird's primary spectral space (canopy), it was therefore assumed that the accompanying acousmatic sonifications, based on their similarities in behaviour, also occupy in the canopy domain of the spectral space. These similarities were created via an envelope follower[28] to map the amplitude of the bird song to the amplitude of the FM synthesis sonifications. The new transformations were placed to occur delayed from the original sound source, thus, establishing a causal relationship between the field recordings and their transformations. The nature of their relationship was further established by their artificial elevated position within the spectral space (via use of Anaglyph VST).

There were also more prominent resonant textures (emerging at 4.07) created via FM synthesis sonifications. These were arranged and placed within the soundscape to appear to have a destructive causality on the components of the utterance space (speech). To achieve this, their amplitude was mapped to the high-pass cut-off parameter of a filter on the recorded speech. Thus, when a resonant sonification rose in amplitude, the vocal material loses frequencies and becomes obscured, further reflecting the established health concerns between air quality and our vocal abilities.

5.00 - 8.56 (minutes)

This passage was largely concerned with the creation of a new composed space from the fragmented granular sonifications of each prior agential space within the piece. In their granular form, the previous soundscapes were reduced to their material sources and had

[26]Sataloff, R.T. (1992) The impact of pollution on the voice, *Otolaryngology–Head and Neck Surgery*, 106(6), pp.701-705.
[27]Spaces where gesture is created vocally by humans and wildlife.
[28]Max4 LIVE Envelope Follower tool.

formed gestures that were algorithmically instigated[29], rather than solely by human action. The creative intention behind this new space was to utilise source bonded materials (with previous connotations to human impacts) to compose a new space, saturated with sonified spectral spaces which behave as a constant atmosphere. Where Smalley might have explained an internal space as being made of sounds that seemingly resonate from within a material, here the piece fragmented the agential sounds of material-human interaction to create a new soundscape that utilised our gestural actions as a way of depicting the affected atmosphere.

The constructed atmospheric soundscape was then combined with the introduction of human speech samples (5.13). This material was taken from recordings made for the original commission in which members of the Manchester public hypothesised their own utopian ideals whilst experiencing the performance. Their suggestions often detailed calm and calculated feedback about an idealised lifestyle. Furthermore, their narratives explicitly offered potential hopes and desires, whilst the accompanying soundscape accumulated in chaos and density.

Moreover, Quakernack (2018) states: "In addition to the verbal narrative of the undocumented narrator, other possible participants or voices and noises from the immediate surroundings need to be recognized as important constituents of meaning in the narratives."[30] The narrative of our social actions and their affects on our surrounding environment were sonically represented within this passage by setting the transformed agential space directly alongside hopeful ideology in the spoken feedback. In essence, the sonic representation of our environmental impact obscured the speech that represents our utopian ideas.

[29] Via the sonification process.
[30] Quakernack, S. (2018) *Political Protest and Undocumented Immigrant Youth.* 1st edn. New York: Routledge, pp.139–169.

Chapter 4

4. *A Path to Shore* (2020, 14.00) [Stereo, Fixed Media]

"COVID-19 means retracing the same cautious footsteps each day for some respite from the indoors. My usual compositional resources are hard to reach. I can record, but it's hard to find inspiring local data. The only novelty is the time and opportunity to indulge in repetition and improvisation." The composer's personal journal, 2020.

4.1 Context

A Path to Shore was conceptualised and composed during the early stages of the Covid-19 pandemic to explore new methodologies for interacting with the landscape as a composer and field recordist. The core compositional concept was to carry out field recordings and landscape interactions along a lesser-used public footpath, in order to create compositional materials that promote a sense of ecological connection among audiences. The chosen footpath led to a disused Baptist church (Shore Chapel, Todmorden, West Yorkshire), and did not receive much public use at the time of the composition field work. This made it logistically safe for the composer to carry out an extended period of field work and also made it an appealing site of rural isolation and tranquillity (a scarcity for many in lockdown conditions). The compositional objective was to present an artistic representation of the composer's time spent interacting with the environment along the footpath, in ways which would lead to a listener achieving an element of a personal ecological connection for themselves. This was achieved by creating compositional materials that recognisably demonstrated the field work process, and creating a sense of compositional timelessness[1] through sonifications and manipulated sonic objects. The compositional exploration of time and timelessness was achieved through improvisational techniques and data sonification, both in the field and studio. The outputs from these methods explored compositional time along two continuums: between soundscape materials and acousmatic sound, and between pulsed and non-pulsed[2] sound.

[1] Mountain, R. (2020) Elaborating Analogies of Time Perception. *Organised sound: an international journal of music technology*, 25(2), pp.259–268.

[2] Sound with/without recognisable rhythmic qualities.

The application of these unique sonic materials in a geolocational audio map[3] also contributed to the practice of Ecosono (Burtner, 2005)[4]. With the composition's accompanying article[5] as context, the process of obtaining these materials became a forefront narrative for listeners. The contextual information about compositional process and location helped to align the listener's perspective with the composer's, a perspective of increased ecological connection.

4.2 Landscape interaction

For the purpose of this composition, a combined number of processes and practices were utilised, including: field recording, land art practices, data gathering and sonification, improvisational composition techniques, and deep listening[6]. The aim was to formulate a repeatable compositional practice, while creating a means of artistic and personal engagement with the environment, in order to form and shape the aural soundscape. These interactions also extended to the listener's perspective. This was achieved by using geolocational audio technologies[7] as a tool to help further promote this environmental engagement to audiences.

A formative idea in the field work of this composition was the concept of repetition. This was inspired by the interplay between environmental interaction and photography aesthetics in Richard Long's *A Line Made by Walking*[8].

4.2.1 Deep listening and soundwalks

"A soundwalk is any excursion whose main purpose is listening to the environment. It is exposing our ears to every sound around us no matter where we are." Westerkamp, 1974.[9]

The compositional concept of this piece originally stemmed from the Rambler Society's[10] public outreach initiative[11] to document all public footpaths before an ownership audit in 2026. Considering that footpaths generally enable travel on foot through rural areas, soundwalking and deep listening seemed an appropriate ideology for gaining a sonic and compositional understanding of the location in this piece. However the combination of land art construction, field recording, and data gathering served as activities which could elaborate on the composer's sonic output in the space. These new explorations were recorded in

[3] A means of plotting interactive audio along a map which can be experienced on-location via an interface. For example, a smart phone and headphones.

[4] Burtner, M. (2011) EcoSono: Adventures in interactive ecoacoustics in the world, *Organised sound: an international journal of music technology*, 16(3), pp.234–244.

[5] Ovington, H. (2020) Sonic Rewild. *Tracks, Traces and Trails: Nature Revealed* Land Lines Project. Available at: https://landlineproject.wordpress.com/sonic-rewild-by-harry-ovington/

[6] Oliveros, P., 2005. Deep Listening: A Composer's Sound Practice. iUniverse

[7] Sonic Maps, https://sonicmaps.xyz/ Accessed on 02/04/2022.

[8] Long, R. 1967. *A Line Made by Walking*. Land Art and Photograpghy. https://www.tate.org.uk/art/artworks/long-a-line-made-by-walking-p07149

[9] Westerkamp, H. Soundwalking. Sound Heritage 3 no. 4, 1974: 18-27. Republished in Autumn Leaves, Sound and the Environment in Artistic Practice, Edited by Angus Carlyle. Paris: Double Entendre, 2007.

[10] A British charity focused on walking.

[11] The Rambler Society (2020) *Don't Lose Your Way.* https://www.ramblers.org.uk/get-involved/campaign-with-us/dont-lose-your-way-2026.aspx. Accessed on 09/09/2021.

order to apply improvised listening techniques (through studio playback) which then determined how the compositional activities had interacted with the soundscape. In essence, the newly devised landscape interactions and decreased sonic output from the anthropophony, due to the lockdown, amplified the interplay between the anthropophony, the biophony, and geophony. This observation encouraged a development of how to listen back to recordings, as part of the creative process, when choosing material for compositional purposes. The choice of sonic materials now needed to consider which recorded actions contributed toward the compositional objectives, and how they might musically contribute to a listener gaining a greater environmental connection to the location.

4.2.2 Improvised listening and land art

"One of the most striking experiences in very quiet environments is the emergence of the desire to make sounds, language, and music." Hildergard Westerkamp, 1988[12].

Whilst improvised listening[13] prompted musical action from the participants in Hildegard Westerkamp's *The Zone of Silence*[14], the intention of the landscape interactions in this piece was to produce sounds that were non-verbal and non-musical, and that promoted a positive regard for the environment. Alternatively, Robert Smithson's work[15], although it has no direct focus on the sonic output of his processes, does utilise landscape materials in ways that would produce unique sonic material. For example, the sound of asphalt being poured down a hillside is not one that naturally occurs without instigation. Even when it does occur, it is rare. His belief[16] that the construction of land art promotes a positive regard for the landscape is what held a particular resonance to the implementation of his practice within this composition.

From noticing the reduction in sonic output from the anthropophony during lockdown, compositional strategies explore how to utilise land art as a tool for creating new sonic materials where the composer's positive regard for the landscape could be recorded as an improvisational practice. In essence, by applying improvised listening to the newly developed soundscape, compositional decisions led to improvisation techniques being applied to physical interactions all over the landscape, in order to produce varied sonic materials. Furthermore, by utilising land art as an improvisational tool within the field recording process, this achieved the provocation of new agential[17] sonic content which linked directly to these interactions with the environment. The land art pieces constructed in this project were a cairn and stone circle (see appendix 9.3.1).

[12]Westerkamp, H. *Music From the Zone of Silence*, 1988. Available at: https://www.hildegardwesterkamp.ca/sound/comp/3/zonemusic/

[13]Making compositional decisions based on determinations on a space made through listening.

[14]Westerkamp, H. 1988. *Music From the Zone of Silence*, Hildegard Westerkamp.

[15]A pioneer of the land art movement.

[16]Brady, E. (2007) Aesthetic Regard for Nature in Environmental and Land Art, *Ethics, Place and Environment*, 10(3), pp.287-300

[17]Sound produced by general human movement and engagement with materials.

Figure 4.1: Cairn constructed for sonic materials (photo by Harry Ovington).

Figure 4.2: Centre pin for constructing the stone circle (photo by Harry Ovington).

4.2.3 Studio-based Improvisation

"I only went out for a walk, and finally concluded to stay out till sundown, for going out, I found, was really going in." John Muir (1913)[18]

Muir's writing[19] alludes to psychological introspection being linked to the act of walking in an outdoors environment. Introspection was achieved in this composition through the combination of improvised listening (field recording, soundwalking) and improvised environmental interactions (land art construction). This created an improvisational compositional practice, which relied on the environment as a means of supplying physical materials

[18]Wade, J. S. (1938) John Muir's Journals John of the Mountains: The Unpublished Journals of John Muir, *The Auk*, 55(4), pp.682–684.

[19]The composer hereby recognises the recent re-evaluation of some of Muir's troubling views and wishes to make it known that they do not agree with these, only the statement about the psychological benefits of walking.

Figure 4.3: Recording the construction of the stone circle. X/Y Capsule and hydrophone (capsule out of shot) (photo by Harry Ovington).

to work within the compositional framework. However, more than just physical materials, the environment also contributed benefits to the composer's wellbeing. In a neurological study[20] (Limb and Braun, 2008) a link is established between musical improvisation (Jazz) and a dissociative pattern in the prefrontal cortex of the human brain. This pattern creates an increase in "internally motivated behaviours" and "autobiographical thought", whilst decreasing behaviours linked with judgmental thought and corrective thinking, essentially alluding to the idea of "free thought" (p.4). With this in mind, it became clear that combining improvised listening with improvised action, in an outdoors environment, may promote an introspective state of mind associated with ecological connection.

A process of re-appropriating the field recordings, from the improvisational field work, was then implemented as a means of gaining further introspection and meditations on the composer's environmental interactions. This materialised through a process of feeding the unedited field recordings into a modular synthesizer (via an envelope follower). The rationale was to examine creative decisions in terms of amplitude, which could then control musical improvisations that were not harmonically or tonally connected to the original recordings. The synthesis parameters were modulated via amplified actions in the recordings, which created a means of developing acousmatic sonic materials that are still attributed to the composer's role and modes of interaction within the soundscape. This process of re-synthesis and transformation shared the same psychological introspection present during the initial environmental improvisation. There was no objective set, other than the basic premise of using the recordings and materials for varying modulation sources in synthesis. Moreover, these improvised interpretations of the original fieldwork contributed toward the exploration of compositional time by introducing acousmatic elements to the soundscape.

[20]Limb, C. J. and Braun, A. R. (2008) Neural Substrates of Spontaneous Musical Performance: An fMRI Study of Jazz Improvisation, *PLoS ONE*, 3(2), e1679.

4.2.4 Self-gathered data

The decision to use self-gathered data was primarily implemented due to the pandemic restricting the composer's access to locations with recorded environmental data. However, this process contributed an allusion to citizen science theories, and how these types of survey practices often lead to a greater understanding of the environment through public engagement. This contributed a method for the expansion of the composer's environmental awareness of the location during the recording process, which did not rely on sonic elements of the landscape.

Figure 4.4: The composer gathering water purity data (photo by Harry Ovington).

4.2.5 Geolocative audio

The rationale and methodologies used in presenting this work as geolocative audio is explored further in the appendix (*Appendix 9.3.2*).

4.3 Sonification

The datasets used and gathered for this project also contributed to the idea of achieving a greater understanding of an environment through personal interaction. Firstly, weather pattern data was gathered from online forecasting services. This data represented specific values (air temperature) about the climatic conditions in which the field work was performed. This concept linked back to the methodologies in Burtner's *EcoSono*, whereby details of the composer's artistic environmental interactions form a part of the compositional narrative. At a time when audience members may have been isolated in their homes, this link to environmental exposure seemed like a pertinent inclusion. Air temperature was chosen due to this being the most prevalent climatic condition that the composer experienced during the field work. Sources, time frame, and scaling information about the data are stipulated (*see Appendix 9.3.3*).

Additionally, to parallel the type of environmental learning found in citizen scientific practices, water purity data was gathered during the process of building the stone circle. The data was gathered at ten-minute intervals during the time in which it took to complete

the structure. This was achieved via the use of a TDS (total dissolved solids) metering tool which tested for the following:

- PPM (parts per million, or otherwise, milligrams per litre)
- µS/cm (conductivity)
- Temperature (C)

Information regarding the scaling of this data is explored further *(see Appendix 9.3.4)*.

Whereas datasets were previously used in this research project to demonstrate environmental concern, here the process of gathering data served as an additional informant for small environmental changes that occurred during the period of field work.

Both sources of data were utilised in audio time-stretching, performed with the playback rate parameter, in the DAW (Reaper). The data values were scaled to match the same range of the playback rate parameter.

4.4 Analysis of composition

00.00 - 05.22 minutes

The first passage of the piece concerns sonic materials derived from, and created in relation to, the building of the cairn at the beginning of the footpath. The section includes source-bonded sounds, which relate to space and materiality, as well as improvised manipulations and sonifications derived from those same source materials. The purpose of this interplay was to create a listening perspective where a sense of timelessness exists within a semi-recognisable sonic space. This was achieved through creating contrasting temporal fluctuations in sonic materials which were already transcending the continuum between realism and acousmatic sound. The shift between perceptions of time was implemented to reflect the introspective perception of time during musical and environmental improvisation.

The piece begins (00.00-00.49) with synthesised re-appropriations of two elements from a soundscape recorded during the building of the cairn. These two sounds delineated the two kinds of agential sound within the space. Firstly, the synthesised tones with a quick attack and minimal continuations were obtained via inputting recordings (stone being placed on top of another) through the modular system. Similarly, the synthesised tones with lengthier onsets and contributions were sculpted using the same process, but with recordings of cars passing by during improvisational field work. The purpose of this was to create a way of linking musical improvisation to the aforementioned improvisational field work technique, whilst still responding to elements of agential acoustic space present throughout. This section ends (00.49-00.54) with a transitional composite gesture that introduces an unprocessed recording of the original stone material.

With the introduction of sonic material of stones being smoothed out against each other, a discontinuous texture motion was established (00.54-01.44). This sonic object had clear connotations to source-bonded materiality, aided by both its published program notes and its fragmented behaviour. However, a cyclic motion was also established through perceived amplitude. This was achieved by recording the physical motion in mono[21], in order to create amplitude modulations through proximity to the microphone.

A more direct representation of the fieldwork was introduced (01.54) with gestures that were source-bonded, for example, a stone being struck. The arrangement of these materials reflected how the exploration of perceived time was tackled. Whilst the program notes explain that the fieldwork was carried out by one performer, it can be assumed that the irregular and overlapping gestures were not performed, but compositionally arranged. Much like in Pierre Schaeffer's *Études aux chemins de fer*[22], the collage of recorded gestures encapsulates sonic events from a linear time frame into a shortened version of that time. The passing of time during the fieldwork was also suggested by the introduction of a continuous streaming texture (02.15). This sonification process (time-stretching) combined data (daily temperature) with recordings of the field work being carried out. The intention was to create sonic material that depicted the composer's actions, and also the environmental conditions of the space they were performing in. This was linked to peripheral temporal directionality[23], whereby sonic events contain contextual information, but their perceived order alludes to a reframed sense of time.

These sonic events then appeared in reverse (reversed audio file) (02.53-04.00). This further demonstrates their lack of tense, or time. The expansion of how these materials were perceived across time, alluded to the elongated period of field work without the need to elongate the composition to this time frame.

Synthesised drones (04.00-4.51) were improvised and placed to add a harmonic musical framework to the improvised field work. The improvisation strategies within the field work worked as spontaneous musical gestures within the existing harmonic framework.

A fusion of all previously heard materials formed a composite gesture (4.51) and concluded this passage of the piece. The gesture's attacking onset was derived from the gestural qualities of placing the final stone on the cairn, whilst the elongated termination of the gesture was a reflection of the improvisational state of mind coming to an end.

05.22 - 09.17 minutes

The second passage was concerned with emphasising sonic references from the environment, in terms of soundscape music practice. Furthermore, it portrayed the composer's role within the soundscape in ways which highlight how the landscape changes as the footpath meanders away from its urban beginnings. An exploration of time was prevalent in

[21]Recording with a singular microphone, which creates one channel of audio.

[22]Schaeffer, P. 1948. *Études aux chemins de fer*, October 5, 1948, "Absolute premiere": Concert de bruits, Radio Paris-Inter, Paris (France)

[23]Dahan, K. (2020) A Temporal Framework for Electroacoustic Music Exploration, *Organised sound: an international journal of music technology*, 25(2), pp.248–258.

perceived sonic realism, and also improvised acousmatic materials. These abstract materials referenced a key electroacoustic composition[24] which also made use of acousmatic materials to represent psychological experiences within the landscape. The same interplay between source-bonded temporal materials and acousmatic timelessness was now heard more definitely, separating the sonic output of the composer from their sonically represented holistic experiences.

This passage emphasises the composer's actions as a soundwalker within the acoustic characteristics of the footpath. This was achieved by using field recordings of footsteps on the path (05.22-06.28), in combination with recordings of bird song from the same period and location. This combination demonstrated the interplay between the composer's environmental interactions, and the non-human acoustic space in which they take place. It also influenced the listener to reconsider the whole landscape as their listening focus. It achieved this by including materials both at the root and canopy[25] of spectral occupancy.

With influence from *Beneath the Forest Floor*, a low frequency pulse appeared at 05.33-06.28. The intervallic unpredictability of the pulsing was juxtaposed against the regular periodic motion of the source-bonded footsteps. It could be argued that the footsteps contained intrinsic temporal directionality[26], whereas the low frequency pulsing had extrinsic temporal directionality[27]. The implication of this is that source-bonded, human sonic events contained recognisable temporal order, and that acousmatic sounds, which do not possess recognisable temporal structure, must not be human. They also do not immediately lend themselves to any recognisable bioacoustic sound, so they are attributed to the possibility of introspective experiences represented through sound.

Between 06.28-06.38, a sonification process was introduced. This was a result of the water purity dataset being applied onto time stretching parameters in the DAW. The output of this experiment was a continuous streaming texture with a fluid motion, much like that of running water within the landscape. This re-emerged (06.52) and combined with field recordings of running water (7.55). The inclusion of these field recordings helped link the streaming qualities of the time stretched texture to real elements of the soundscape. Field recordings of the stream were thought of as aural documentaries of the landscape, while the sonification of the composer's footsteps represented the synergy emerging from the landscape through interaction and improvisation.

Through different characteristics of agential space recognition, the listener became aware of a change in the materiality of the landscape. This was achieved (06.08- 06.52) where the footsteps alluded to the landscape changing from loose gravel, to foliage, and finally wet mud and water. This created a representation of the composer's directional choices during the field work.

[24]Westerkamp, H. 1992. *Beneath the Forest Floor.* Commissioned by CBC Radio for Two New Hours Radio premiere: May 17, 1992, Canadian Broadcasting Corporation, Toronto, Ontario, Canada

[25]The highest perceived sound, in terms of vertical elevation.

[26]Where a series of sonic events seem related in chronology, and their order seems recognisable as a real structure of events, e.g. one footstep after another.

[27]Where the order and timing of sonic events are not similar to the expectation of the listener.

At 08.12 the listening focus changed and the recognisable elements of soundscape materials no longer held the foreground. Instead, there was a series of modular improvisations derived from a number of interventions in the field (beginning of the stone circle build process). These were reached through the same process of inputting field recordings and using transient amplitude information to control and modulate improvised synthesizer patches. Where the field recording of running water was attenuated in amplitude (08.12), a series of harmonic synthesised improvisations appeared. These spectromorphologically coexisted with the element of soundscape (running water). There was no reactive behaviour between them, and neither one seemed to cause the other. Their coexistence reflected the holistic connection achieved between the physical improvisations and the elements of the landscape.

09.17 - 14.00 minutes

The final passage included sonic material gathered from the building of the stone circle structure. The sonic materials consisted of recorded vocalisations of passing walkers, improvised synthesis, and acousmatic sonifications of field recordings. It also featured fused sonic objects. The latter derived from combining field recordings of agential action and soundscape, before sonifying with the same dataset. This fusion reflected the ecological connection made between composer and the environment.

In a further exploration of compositional time, temporal distancing[28] was utilised to create the sense of being detached, or removed, from the previous soundscape whilst still maintaining a relevance to it. This partial removal was achieved through the use of sonic objects which individually contributed to both attached[29] and detached temporal distancing[30]. The interplay between these two temporal distinctions, and the coexistence of these sounds created surfaced temporal distancing[31]. This resulted in a musical passage where the sonic events were compositionally abstract, but still referred to source-bonded materials. The sudden lack of suggested interpretation (where soundscape materials have previously interpreted information about space) led the listener to consider this new space as representation of the holistic mindset during the process of fieldwork.

The periodic emergence of a low frequency tone (09.18) was categorised as attached temporal distancing. Its periodic stability lent itself to a recognisable musical pulse (albeit very slow), but its continual descendent pitch helped to ground it, in terms of spectral occupancy, at the root of the sonic space. This linked this sonic event to the previously heard (05.33-06.28) low frequency oscillations in the soundscape.

The cacophony of gestures (9.57) derived from placing and shaping stone during the fieldwork play a role in creating an interplay between attached and detached temporal distancing. Whilst their timbre could be source-bonded to previously heard gestures, made

[28]The ways in which sounds with different temporal directions interact with one another.

[29]For example, the steady rhythmic structure of footsteps.

[30]Sounds made with the intention of removing the perception of chronology or order, e.g. the cacophany of stone-made gestures at 9.57.

[31]The coexistence of attached and detached temporal distancing, which creates a musical state where some sounds contribute to a recognisable time frame, and others detract.

with stone, their temporal arrangement did not lend themselves to coming from a solely human performance. The harmonic, synthesised improvisations layered with these gestures also suggested their detachment from a linear time frame in the real world.

This same ideology was applied to the time-stretched vocal materials (11.07). These were created by applying the water purity dataset values to the time stretching parameter in the DAW. The purpose of these was to create further sonic materials which can be source-bonded to elements of the physical sonic space, whilst their transformed spectromorphologies suggest a drastic shift in their place within that space. These continue in a composed arrangement, which adheres to spectral occupancy to link them to the usual perception of soundscape, until the termination of the piece.

Chapter 5

5. *Perspective- U* (2020, 17.34) [Stereo, Fixed Media]

"After moving to the Calder Valley in July 2019, and switching to a green household energy plan, I found myself at the foothills of the Pennine Way. Staring up at the daunting rotations of the Scout Moor wind turbines, I was alarmed to find a number of deceased bats littered across the floor." The composer's personal journal, 2020.

5.1 Context

Perspective-U (fixed-media, 2020, 17.34) is a composition based on research[1] that demonstrates the ecological damage caused by wind farms to UK bat species. More specifically, the correlation between the increased mortality rate in UK bat species and their proximity to wind farms. In order to focus on this as a compositional narrative, the composer utilised ultrasonic field recording technologies in order to gain bioacoustic information about bat species in the location of the fieldwork (Scout Moor Wind Farm, West Yorkshire, UK). These recordings were transposed[2] so that imperceptible soundscape information about the area could be utilised as a part of the soundscape depicted in the piece. These usually imperceptible elements of the soundscape were juxtaposed with field recordings (in human hearing ranges) which demonstrated sonic information about the wind farm. The recordings were captured during April 2021. The composition also utilised datasets detailing wind-energy production values, from the same geographic area as the wind farm, in order to create sonifications with DSP techniques and synthesis methods.

The mimetic discourse[3] within the piece references Dani Iosafat's analysis[4] of his own installation, *Urban Portrait: Thessaloniki*[5] (2008). In the same way Iosafat represents space and place, this composition used DSP techniques to transform recorded soundscape materials so that they appeared as mimetic representations of elements from the landscape

[1] Cryan, P. M. et al. (2014) Behavior of bats at wind turbines, *Proceedings of the National Academy of Sciences - PNAS*, 111(42), pp.15126–15131.

[2] Reducing ultrasonic frequencies to the scale of the human hearing range.

[3] That which imitates nature (i.e. the physical world) portrays aspects of human culture not usually associated with musical material (Emmerson, 1986).

[4] Iosafat, D. (2009) On Sonification of Place: Psychosonography and Urban Portrait, *Organised sound: an international journal of music technology*, 14(1), pp.47–55.

[5] Iosafat, D. (2008) Urban Portrait: Thessaloniki. Lansdown Centre for Electronic Arts of Middlesex University, London. Sonic art installation.

(wind farm). However, these same techniques were also applied in order to create non-mimetic sounds that contributed towards expressing the imperceptible (to humans) distortion and confusion between bats and wind farms. These non-mimetic sounds were the result of applying wind-energy production datasets to parameters within the DSP techniques. By using the inherent irregularity from the data as a source of modulation, non source-bonded behaviours were created. This musical ambiguity alluded to the imperceptible sonic confusion within the environmental narrative. These acousmatic sounds were juxtaposed with recognisable elements of the soundscape to create an interplay between first-order[6] and remote[7] listening surrogacies[8]. This creates a soundscape where new acousmatic sound events still retain relevance to the soundscape, whilst also alluding to the existence of imperceptible forces within it.

The fieldwork for this piece also included site-specific recorded materials made from field recordings (non-ultrasonic) at the wind farm. This consisted of using X/Y[9] stereo recording techniques, shotgun microphones[10], and contact microphones[11] to gain a further listening perspective on the mechanised space of the wind farm. The sounds gathered here consist of mechanical utterances like engine sounds and the sound of turbine blades cutting through the air.

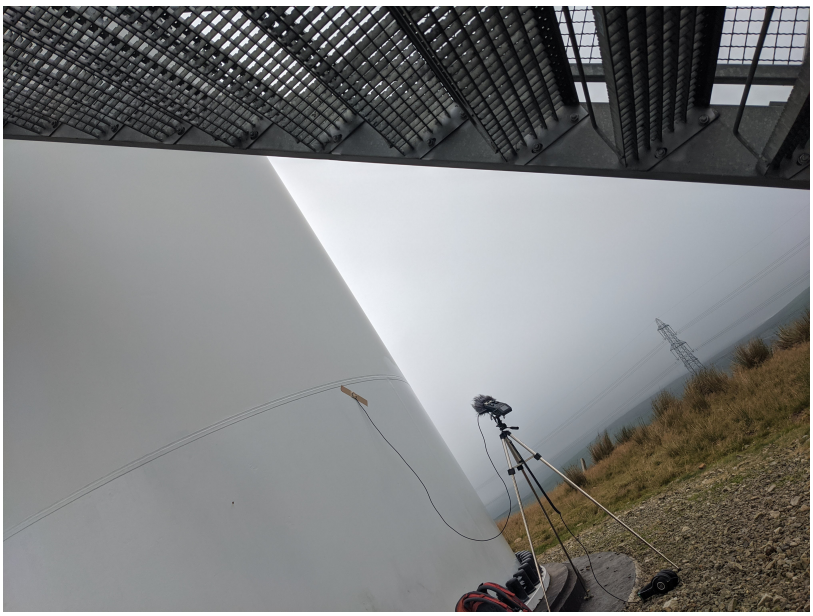

Figure 5.1: Recording set-up, Scout Moor Wind Farm, UK (photo by Harry Ovington).

The piece included further manipulations and improvisations created by inputting the field recordings and sonifications to DSP techniques in a modular synthesizer. These sounds included elaborations of pitch, harmony, texture motions, and behaviours which do not exist in the soundscape (or the recorded and sonified materials). These sonic materials were a result of the composer having spent time in the landscape, becoming aware of the ecological damage, and responding to it emotively with improvisation. The piece has

[6]Where sounds could be recognised by gesture and used 'instrumentally' to contribute to a narrative e.g., recorded wind turbine blades.

[7]Where gestural information was removed or transformed, but may still be vaguely attached.

[8]Smalley, D. (1997), pp.6.

[9]Zoom H6, Portable Recorder.

[10]Beyer Dynamic, MCE86N(C).

[11]Jez Riley French, Contact Microphone.

been commissioned and presented in two instances. Firstly, a collaborative film was produced with visual artist Sean Clarke[12]. The film is titled *The Cost of Wind* and features alongside an online publication[13] that gives further context about the ecological impacts of wind farms to bat species. Additionally, the piece featured as the score for *Resonance*[14], a film about bats and their visual behaviours. The film was featured as an artwork in Madelon Hooykaas's *Wheel of Life* exhibition at the Machinery of Me[15] gallery in Holland (03/10/2021-19/12/2021).

5.2 Structural information

The piece revolves around having re-appropriated the Youguo (2005) three-element structure[16] of soundscape music. Instead of considering the elements as human, environment and sound, they were instead a means of considering how utilising space can further deliver key points within the piece's environmental narrative. The new three-element structure is then mechanised space, bioacoustic space, and abstracted (intrinsic) space[17]. These elements of space coexist in varying degrees throughout the composition and aim to represent the environmental narrative within a constructed soundscape which utilises field recordings and acousmatic sound.

The piece also utilises listening surrogacy theory, applied to sonification and sound transformation, to create the illusion of confusion between the sonic materials and their original source. For instance, in the first passage of the piece (00.00 - 07.51) the listener is presented with bioacoustic recordings which have been sonified and manipulated to mimic both inaudible attributes of the bats (flight direction / motion), but also elements of mechanised space through spectromorphologies which mimic physical attributes of the landscape (wind turbines). Where this confusion between source and output exists, it mimics the fundamental sonic confusion that causes an increase in bat mortality rates within the landscape.

The piece then utilises site-specific soundscape materials (07.51 - 10.07) to further illustrate the presence of mechanised space. This section gives a novel insight to a listening perspective which is not perhaps very common (from the base of a wind turbine).

The final section of the piece concerns abstracted (intrinsic) space where the compositional aim was to construct a soundscape of mainly acousmatic sound which has some psychological allusions to elements of the described environmental narrative. This is mostly achieved through percussive gestures in flux between source-bonded timbre (10.07), and acousmatic layers of harmony (13.16 onwards). The source-bonded timbre intends to contribute to first-order listening surrogacy, where the listener might assume their origin to be

[12]Sean Clarke, https://www.test-card.com/. Accessed on 02/01/2023.

[13]Ovington, H. (2020) Sonic Rewild. *Tracks, Traces and Trails: Nature Revealed* Land Lines Project. Available at: https://landline-sproject.wordpress.com/sonic-rewild-by-harry-ovington/ Accessed on 06/07/2021.

[14]Hooykaas, M. Wheel of Life (2021). Machinery of Me, Gelderland, Holland.

[15]https://www.machineryofme.nl/ Accessed on 06/06/2021.

[16]Qin Youguo. (2005). The category of Soundscape study. Architectural Journal, 2005(01): 45-46.

[17]Space where sonic objects are abstracted but draw strong psychological associations through spectromorphological and cultural references.

of human creation (human-environmental impacts). For example, the acousmatic layers of harmony that allude to the confusion between the shared frequencies in the bioacoustic and mechanised spaces (bats and wind turbines, respectively).

The purpose of this structure was to first present the two existing soundscapes inherent to the environmental narrative (even if they need uncovering in the case of ultrasound), then, to construct an acousmatic soundscape which describes the imperceptible elements of the environmental narrative.

5.3 Compositional analysis

5.3.1 Landscape interaction

The landscape interactions within this piece focused on utilising ultrasonic recording technologies, along with bioacoustic analysis to investigate the mortality phenomenon between bat species and wind farms. The fieldwork for the piece primarily consisted of soundwalking and field recording amongst wind turbines and other infrastructures of the wind farm. The initial methodology framework exposed the composer to a listening environment where mechanised space[18] could be heard as a keynote[19] of positive environmental change. However, initial observations in the field noticed an alarming number of dead bats amongst the foliage at the base of the turbines.

After ascertaining the cause of this ecological issue to be damaged wind turbine blades creating ultrasonic emissions, the composer strived to conduct sonic investigations into the bats being affected and the sonic behaviours of the turbines. To do this, the composer used an ultrasonic microphone (Dodotronic Ultramic 384K BLE) connected to a real-time bat identification app[20], as a tool to visualise ultrasonic sound as it occurred around them. This investigative style of recording was performed during nocturnal soundwalks that spanned the distance between the composer's residence and the wind farm.

During these recording sessions, the most abundant bat registered by the app was the Common Pipistrelle. The echolocation of these bats, as detailed by Vaughan et al. (1997)[21], have a frequency response of approximately 45.1kHz (minimum) and 54.7kHz (maximum). This was also the species of bat found deceased in the wind farm area. In addition, research[22] suggests that the ultrasonic emissions from wind turbines have been registered between 20-50kHz, hence, an overlap in frequencies occurs. There appears to be some speculation between the cause of death being collision with the blades, or a change in air pressure[23] as a result of the turbine's movement; the increased mortality rate exists either way and research

[18] Smalley, D.(2007), pp.5.

[19] A key sonic element of the landscape (wind turbines).

[20] Kraus, B. (2016). Bat Recorder. Android application. Version 1.0R172

[21] Vaughan, N. et al. (1997) Habitat Use by Bats (Chiroptera) Assessed by Means of a Broad-Band Acoustic Method. *Journal of Applied Ecology*, 34(3), pp.716–30.

[22] Long, C.V. et al. (2011). Ultrasonic noise emissions from wind turbines: Potential effects on bat species. *Proceedings of the Institute of Acoustics*, 33, pp.907-913.

[23] Biello, D. (2008) On a Wing and Low Air: The Surprising Way Wind Turbines Kill Bats, *Scientific America*, August 26, Available at: https://www.scientificamerican.com/article/wind-turbines-kill-bats/

suggests that the sonic crossover is to blame for the bats flying too close to the turbines. In summary, the recording sessions resulted in the knowledge that the frequency response of the Common Pipistrelle shares established frequency emissions of wind turbine blades, and this is what has caused the bats to be in close proximity with the wind farm. Furthermore, recordings of the wind farm are most prominent at 08.17 - 10.57. The wind farm's contribution to mechanised space is further established through the placement of a recording of the wind turbine's engine (07.53).

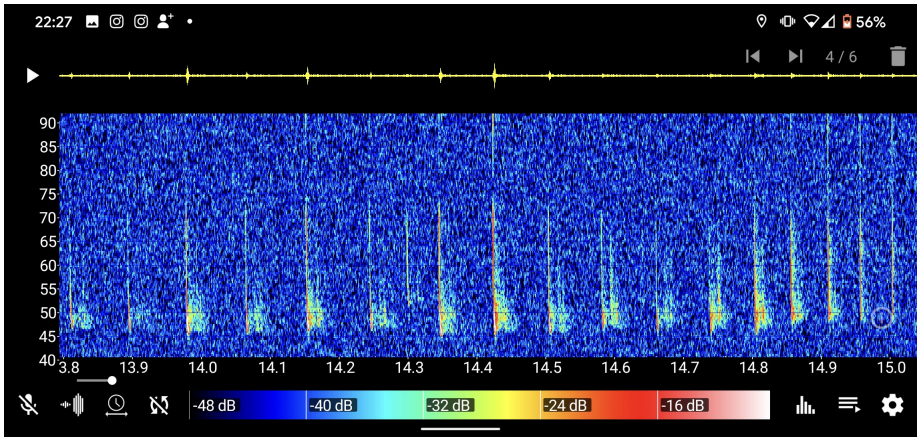

Figure 5.2: Common Pipistrelle ultrasonic spectrogram.

The ultrasonic field recordings were transposed in frequency to the human hearing range[24]. This was achieved using the bioacoustic analysis software Raven Lite[25]. The software allows for audio playback speed to be manipulated on a spectrum of 0.00-1.0, 1.0 being the original speed and values below 1.0 resulting in slower speeds (the bioacoustic gesture at 00.52). These reduced recordings are evident in the elongated continuation of the bat ultrasounds (00.49).

The addition of synthesised sound and harmonic elaborations of the recorded materials also formed a part of the landscape interactions within this piece. This links back to Iosafat's interpretations of impression[26] and expression[27], and uses these to construct a process whereby the composer's impression of the landscape, and the ecological issue, can be realised and expressed through the composition of harmonic passages which are more easily interpreted by listeners. These expressions were composed directly after conducting fieldwork in the landscape, and provide links to emotive musical languages like harmony. These harmonic editions are most prevalent in the section (03.38 - 05.30).

Further sonic content was gathered through use of an electromagnetic listening device[28]. The composer's home at the time was connected to a green energy plan, meaning that a percentage of the energy supplied to it had come from ecological energy solutions, such as wind and solar farms. This device allowed the composer to capture electromagnetic induced sonic materials that were potentially derived directly from wind farms. These were

[24]Approximately between 20Hz - 20kHz.

[25]K. Lisa Yang Center for Conservation Bioacoustics at the Cornell Lab of Ornithology. (2022). Raven Lite: Interactive Sound Analysis Software (Version 2.0.3) [Computer software]. Ithaca, NY: The Cornell Lab of Ornithology. Available from https://ravensoundsoftware.com/

[26]The reception of the stimulus and the subjective reconstruction of a poetic image.

[27]The image is formed into an experience that can be described and represented.

[28]Lom Elektrosluch 3+.

captured by using the device to listen to the electromagnetic field of household appliances. These are notably prominent (04.07 - 05.14) where their spectral occupancy (canopy) and multi-directional behaviours liken them to the possible ways that a bat's flight pattern might be perceived.

5.3.2 Sonification

Much like the acousmatic granular synthesis in Barry Truax's *Riverrun*[29], this composition used DSP techniques to create mimetic allusions to elements of the landscape. This was predominantly achieved through utilising a modified version[30] of a Max for Live Doppler[31] plugin to create the same spatial orientation and perception of rotation one might experience when being in close proximity to an active wind turbine. The doppler effect was applied to both the ultrasonic bat recordings and soundscape materials. The doppler effect simulates two virtual microphones rotating circularly around a sonic object, much like the rotation of wind turbines. The doppler contains two parameters. Firstly, parameters which dictate variables about the simulated rotation (rotation rate, L/R separation, and listener position). Secondly, parameters which dictate variables measuring sound modulation in relation to its position. These include pitch shifting, amplitude modulation, and low-pass filtering. The sonifications of positional parameters are most evident in the synthesised rotations (05.34), which mimic the rotations of the wind turbine with harmonic content. For example, the most prominent sonifications of pitch-based parameters are in the descending rotations of pitch (08.55 - 10.05).

The data was sourced from the National Grid[32] Archive. The data[33] detailed the amount of energy generated (megawatt) per month in the UK in the years 2019 and 2020. The data is separated into data from Scotland, and data from England and Wales. In the case of the sonification methods, this data had to be scaled to match the value ranges of the parameters within the doppler patch. This was achieved using a scaling tool in Max which took the maximum and minimum values in the data and mathematically adjusted them to relatively match the parameter range (minimum/maximum). Within the patch, the data values from Scotland control positional parameters, whilst the data from England and Wales control pitch and time based parameters.

The data was also subject to another kind of scaling where it was utilised to inform the Max patch *pulseburstgen.maxpat*. In this case, the data was scaled (universally divided by 100) and used to inform the following parameters in order to create short bursts of synthesised clicks. These were then subject to additional time-stretching (Reaper) at integer values replicating the divisional playback options in the bioacoustic software. This process created sonic material for which the amount of micro-gestures happening at one time repre-

[29]Truax, B. 1986. Riverrun. Cambridge Street Records.

[30]In submitted materials, *ml.circular.doppler for sonification.amxd*.

[31]Henke, R. (Monolake.) (2010) *Circular Doppler 1.0* 8.1 Available at: https://maxforlive.com/library/device/239/circular-doppler

[32]The main distributor of electricity and gas in the UK.

[33]National Grid ESO. (2020) Monthly Operational Metered Wind Output 2019-2020. Available at: https://data.nationalgrideso.com/generation/monthly-operational-metered-wind-output/r/monthly-operational-metered-wind-output-2019-2020. Accessed on 02/02/2021.

sented the fluctuations in wind-energy production values. These materials were arranged to allude to multi-directional motion and growth processes, in order to represent the agglomeration and dissipation of wind-energy production throughout different climatic conditions; most notably, the montage of micro-gestures (beginning 10.08). These sonic events were also subject to further improvisations via the use of the modular synthesizer. In their first iteration (10.08) they appear with an allusion to wooden materiality (achieved via use of a physical modelling module[34]). The allusion to materiality and agential space once again links the seemingly acousmatic sounds to human action through first-order listening surrogacy. Further into the piece (12.50) these reappear in different timbral form. These new manipulations were achieved by utilising different digital oscillator[35] types, with CV envelope shapes controlling pitch manipulations in each gesture. This improvisation came from the composer wanting to create a means of manipulating the sonifications in a way that alludes to the aural confusion within the environmental narrative of the piece.

Where Truax utilised behaviours of acousmatic material to allude to the sonic characteristics of a river, this composition includes acousmatic sounds with intentionally ambiguous and enigmatic sonic behaviours. This was achieved by applying the wind-energy datasets to the parameters of the doppler effect. Due to the irregularity of the data, the perception of regular sonic rotations was disturbed. This method produced sounds which alluded to the narrative of bats becoming sonically confused and flying toward their deaths. By including non-mimetic sonic movement, a juxtaposition was formed between sonic movements which could be source-bonded to the landscape, and those a listener could assume were the ultrasonic conflicts, which cannot normally be perceived outside of the composition. These come from instances where the data applied extremely fast and turbulent modulations of the doppler's parameters, which created turbulent motions and texture motions that sonically allude to the perception of disturbed flight. The disturbance comes within the seemingly pressured motion trajectories of these sounds (00.35).

The same methods (Reaper DAW) of audio time-stretching (in prior portfolio compositions) were also applied to the breadth of recorded material. The intention was to transform the materials from their original gestural form in order to repurpose them as elongated textures, to once again allude to the sonically represented 'miscommunications' within the environmental narrative of this piece.

The sonifications in this piece were also subject to the same improvisational transformations via the modular synthesizer. This further contributed to the aforementioned impression/expression process. This was perhaps most notable in the rotating cyclic gesture (01.56 - 02.13), where the application of digital distortion (via a bit-crushing module[36]) once again alludes to the prospect of mechanised space and human-environmental impacts.

[34]Mutable Instruments, Elements.
[35]Erica Synths, Pico.
[36]Qu-Bit, PRISM module.

Chapter 6

6. *A Year in Blue Space* (2021, 35.12) [Stereo, Fixed Media]

"I find myself compelled to visit the same hillside pond in Todmorden, West Yorkshire on a daily basis. Throughout the duration of my PhD, I've recognised the shifting seasonal changes as a key contributor to regular fluctuations in my mental health and wellbeing. Without conscious effort, I've accumulated a good breadth of skills for self-improvement in these areas. I've often gravitated towards walking, cycling, and running as a means of psychological remedy, however, never in the confines of a gym. I'm beginning to realise how much the landscape and green spaces have been contributing to these activities. I want to spend the coming year exploring how I can interact with blue spaces as a means of self improvement. I want to see how these landscapes may influence me differently to green spaces, and how these endeavours might be captured as part of a compositional process."
The composer's personal journal, 2021.

6.1 Context and presentation of work

A Year in Blue Space originates from a year-long composition project focused on exploring ways of interacting with blue spaces in order to produce sonic material which reflected the blue space's contribution to improving the composer's mental health. The compositonal processes were performed in multiple blue spaces (nationally) and included bioacoustic analysis methodologies, data sonifications, and performative elements which all contribute to the primary aim. The field work started with the composer exploring two swimming ponds near Todmorden, West Yorkshire, and expanded (due to relocation) to explore the diversity of blue spaces along the South Coast of England. The project was aimed at improving the composer's mental health and wellbeing by aurally examining the established[1] benefits of blue space.

The piece was presented in stereo playback, alongside an accompanying article[2]. The article detailed further information about the compositional process such as: compositional

[1] Völker, S. and Kistemann, T. (2011) The impact of blue space on human health and well-being – Salutogenetic health effects of inland surface waters: A review, *International Journal of Hygiene and Environmental Health*, 214(6), pp.449–460.

[2] Ovington, H. 2023. *A Year in Blue Space, by Harry Ovington* (online). Land Lines Project. Available at:https://landlinesproject.wordpress.com/blog/ Accessed on 02/01/2023.

objectives, influential works, mental health as compositional material, and how the piece is structured in relation to the locations of the field work.

6.2 Data sources

The climatic data for this project was sourced from the Met Office database[3], and details weather observations from the closest monitoring station to the initial field work (Rochdale, Greater Manchester). More specifically, these can be sourced via the referenced data catalogue under the following titles: *MIDAS Open: UK daily weather observation data, v202207 > Midas-open-uk-hourly-weather-obs-dv-202207-greater-manchester-01125-rochdale-qcv-1-2021* and *Midas-open-uk-hourly-rain-obs-dv-202207-greater-manchester-01125-rochdale-qcv-1-2021*.

Later in the piece, weather pattern data depicting warmer climatic information from the composer's new residential location was utilised. This is sourced from the same catalogue, under the title *midas-open-uk-hourly-weather-obs-dv-202207-dorset-00843-bournemouth-kings-park-qcv-1-2021.csv*.

The piece also utilises tidal datasets[4], which depict sea-level measurements at Bournemouth Pier, at fifteen-minute intervals for the year 2021. The data can be sourced utilising the National Oceanography Data Centre data indexing[5] tool.

Additionally, data created with bioacoustic recording and technology was recorded for this composition. The data[6] shows frequency and species information relating to the existence of Daubenton bats in the recording location.

6.3 Analysis of composition

6.3.1 Pt. 1 Gaddings Dam and a private swimming pond, West Yorkshire (00.00 - 08.40)

The sonic materials in this passage of the piece all contributed to creating an auditory display of the influencing factors and repercussions of the composer's struggles with seasonal affective disorder (SAD). There were also materials relating to the ways in which the composer began to combat this during the course of this project.

The piece begins with interpreted speech taken from the kind of online resources, about the benefits of wild swimming, that the composer was consuming during this period. The speech included a spoken testimonial about the holistic enhancements of wild swimming. The interpreted speech was subject to a process of sonification where climatic data

[3]Met Office (2019): Met Office MIDAS Open: UK Land Surface Stations Data (1853-current). Centre for Environmental Data Analysis, date of citation. http://catalogue.ceda.ac.uk/uuid/dbd451271eb04662beade68da43546e1. Date Accessed 01/12/2022.

[4]National Oceanography Centre, 2021. *Bournemouth Sea Level Data 2021*.National Oceanography Centre, British Oceanographic Date Centre BODC. Available at: https://www.bodc.ac.uk/data/hosted-data-systems/sea-level/uk-tide-gauge-network/processed/requestlist. Date Accessed 01/12/2022.

[5]https://www.bodc.ac.uk/data/hosted$_{d}ata_{s}ystems/sea_{l}evel/uk_{t}ide_{g}auge_{n}etwork/processed/requestlist.DateAccessed01/12/2022.$

[6]In submitted materials as *Kaleidoscope Bat ID Data.csv*.

(hourly air temperature [C] and rainfall [mm] from 01/01/2021 - 01/04/2021 of the project) were applied to parameters (pulse period and pulse width) in a Max vocoder patch[7]. The aim of connecting these materials was to create a sonic metaphor where vocalisations, relating to well-being improvement are being distorted by the climatic conditions of the season. This mirrors the causality between climatic conditions and SAD, where weather patterns shroud an individual's opportunity for good mental health. Furthermore, the manipulations of these parameters lead to a granular texture motion, not dissimilar to that of falling raindrops.

A recording of rainfall, captured at the private pond, is introduced (00.11) and utilised as means of using geophonic[8] sound to represent one of the main environmental contributors to SAD. In order to engage sonically with the negative impact of this climatic condition, the composer devised a means of utilising it as a collaborative force in sound synthesis. In order to achieve this, a contact microphone[9] was placed on a skyward facing window pane, during heavy rainfall. The microphone was input through an amplitude following Eurorack interface module[10], which converted the amplitude of each raindrop to CV[11] and utilised this as a means of creating resonant modulations of an oscillated[12] frequency (139 Hz). This was achieved by inputting the oscillator module through a low-pass filter module[13]. The aim of this was to create a way of re-purposing the negative effect of the environmental conditions as a collaborative tool for achieving improved well-being through listening and musical improvisation. This texture coexists with recorded rainfall and birdsong to provide contextual information about perceived space.

A transitional passage (01.44) consisting of recordings of water in streaming liquid textures leads the piece into demonstrating its next performative method. A sustained pad[14] with wide spectral occupancy is introduced (01.51). This texture was created by combining recordings of the composer performing a cold water exposure breathing exercise[15], with the same (as prior) weather pattern data that controlled parameters *(Inharmonicity and Relaxation)* of a resonator effect Max patch[16]. This process attached multiple resonant frequencies and layered harmonics to each recorded breath. The elongation of the breaths alluded to the fact that the wellbeing exercises may be having a positive influence on the composer's health. Additionally, the spectral structure of the layered resonant frequencies allude to the feeling of being submerged in water during wild swimming, with each layer of depth feeling like a different temperature against your body. The resonance also alludes to the resonance found in metallic bells and gongs used for well-being purposes in sound baths[17].

[7] *WeatherVocoderjan-marchDATA*.
[8] Sound from the Geophony (sounds produced by non-biological natural forces like wind and rain).
[9] Jez Riley-French, Contact Microphone.
[10] Befaco, i2 Instrument Interface. Eurorack Module.
[11] Controlled voltage.
[12] Make Noise, Telharmonic Oscillator. Eurorack Module.
[13] Intellijel, Polaris. Eurorack Filter Module.
[14] A sustained note or chord, usually synthesised.
[15] Wim Hoff, Cold Water Exposure Breathing Technique.
[16] *Breathing resonator Jan-marchDATA*.
[17] An immersive listening experience which utilises acoustic frequencies as holistic therapy.

Field recordings of rain at the private pond are reintroduced (02.09) and coexist with un-processed recordings of the breathing exercises, and more of the material produced by the vocoder method. The purpose of this section was to construct a new soundscape which combined all the recorded and sonified materials.

Figure 6.1: Hydrophones recording the ice thawing, Gaddings Dam West Yorkshire (photo by Harry Ovington).

The resonant sonifications, and original recordings of the performed breathing exercise continue to coexist (03.54 - 06.10) with each other and recordings of howling wind. The breathing exercise was performed in the basement of the composer's residence and took place with an outside door open. Simultaneously recording the climatic conditions during these breathing exercises helped to further construct a soundscape where the causes of SAD were audible alongside the sound produced from the attempted remedial methods.

The final passage (06.10 - 08.38) in the first section of the piece consists of sounds that occurred during the months in which the affectations of the composer's SAD symptoms had begun to ease. This is evident in the natural chronology of the seasonal changes (hydrophone recording of ice on Gaddings Dam thawing out, 06.21), but also in the ways in which the composer had focussed their recording activities around the seasonal change. Most prominent was the awareness of the mating seasons of both common frogs and toads (February and March, respectively). These sonic observations were recorded at the private pond and Gaddings Dam, using hydrophones and are included in the composition (06.13 - 08.10) as a means of documenting the composer's raised environmental awareness, and also promoting the idea of raising the environmental awareness of listeners.

6.3.2 Pt. 2 Chapmans Pool, St. Catherine's by the Sea, and Highcliffe Beach, Dorset (08.40 - 26.57)

This section of the piece begins with hydrophone recordings of waves crashing against a shingle beach. This material captured the tidal changes which occurred over an hour long

Figure 6.2: Frog mating season, West Yorkshire (photo by Harry Ovington).

recording session at Chapmans Pool, Dorset. The purpose of the session was to capture material that depicted how the composer had sought out to become regularly aware of tidal changes (for the established[18] well-being benefits). During the course of this sub-aquatic soundscape (08.40 - 10.57), the material is arranged to accumulate intensity through amplitude and stereo-widening. This sonically represents the process of becoming increasingly aware of changes in oceanic blue spaces throughout the course of the composition process.

It became a primary focus to create a method for linking musical improvisation with the new found awareness of tidal patterns. To achieve this, the composer created a system where improvised guitar could be manipulated in real-time with pre-recorded datasets that depicted tidal movements. The data used here detailed the tidal movements in the time period (20/06/2021), the same day the recordings of the ocean took place.

The system was set up (Figure 6.3) to enable the composer to improvise freely, responding to the changes that the data made in real-time. There were also artistic parameter choices which focused the sonic output of this experiment to mimic spectromorphologies in the recorded material from the environment. Firstly, the guitar was input through a volume expression[19] pedal, which allowed the composer/performer to remove the guitar's usually fast onset and replace it with varying speeds of sonic emergence - much like the unpredictability of how waves arrive at shore. Secondly, the signal from the guitar was then subject to further processing in a Max patch[20], where a delay[21] plug-in[22] (with pitch modulation capabilities), and a flanger[23] plug-in[24] were modulated with the tidal pattern data. The data was mapped to the shift parameter of the delay, and the rate parameter of the flanger. Both the plug-in's outputs were set up to be armed and disengaged via a MIDI controller[25]

[18] Wheaton, B. et al. (2020) Coastal Blue Space and Wellbeing Research: Looking Beyond Western Tides, *Leisure studies*, 39(1), pp.83–95.
[19] Boss ME80, Multi Effects Pedal.
[20] *Guitar Tidal processing.maxpat*
[21] A system for recording an input signal and repeating it over periods of time.
[22] Valhalla, Freq Echo.
[23] An audio effect caused by mixing two identical signals together with one of them being slightly out of synchronicity with the other.
[24] Valhalla, Space Modulator.
[25] Akai, LPD8.

on the floor that could be used by the composer in a similar fashion to other guitar effects pedals (by foot). The patch also included a reverb plug-in[26] which was not modulated, but could still be armed and disengaged by foot.

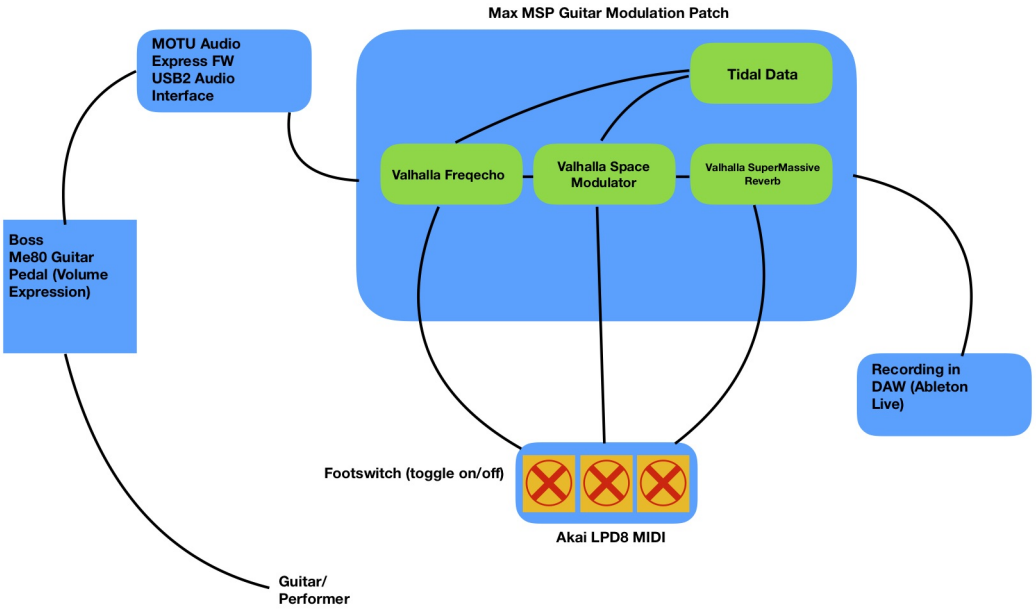

Figure 6.3: Tidal guitar processing Max diagram.

To create the same diversity and irregularity of oceanic behaviour, the rate at which the data changed from one value to the next could be dictated (in milliseconds) by the composer at their discretion, based on what oceanic conditions they had experienced that day. The implementation of this artistic choice can be heard in the the prolonged harmonic structures, which have a similar reciprocal[27] motion to the coexisting oceanic field recordings (10.57 - 11.56). Some loose causality exists between the recordings of the ocean and the sonified harmonic structures. This was achieved by applying the amplitude of the oceanic recordings to that of the sonifications, and furthered the implied bond between the environment and the sound creation method. Using shorter modulation periods (ramps between data values [ms]) enabled the creation of faster modulations of pitch and turbulent motion (11.56 - 12.25), which represent the movement of the ocean during rougher and more irregular tides and swell periods.

Finally, the sonification process also produced material which exists much lower than the usual frequency range of a guitar. This was utilised (14.19) to create a descent in sonic motion which alludes to the exploration of the ocean, past the surface. This symbolises the exploration taken during the composer's physical submersion in the ocean, but also the developments in their holistic exploration of blue spaces.

Between 15.25 and 16.25, the relationship between the recorded ocean and the sonified materials becomes completely fused. This fusion created a sonic metaphor for the psychological benefit of fusing the natural environment with musical improvisation.

[26] Valhalla, Super Massive.
[27] Smalley, D. (1997), pp.10.

Field recordings of wind were reintroduced (16.25) and were taken from a new location (St. Catherine's by the Sea Chapel, Ringstead Bay, Dorset). The visit to this location signified the halfway point in the project (June 2021), and for this reason was chosen as the location to perform the same breathing exercise. The reason for repeating this method was to refer back to a previous experiment, but gain the psychological and physical benefits in a new location. It also enabled the opportunity to perform the same sonification method (resonator with weather pattern data), but with data which depicted more positive climatic conditions from a mental health perspective (air temp [C]). This time applied only to the *relaxation* parameter in the Max patch[28], all other parameters were artistically informed.

The piece enters a new passage (19.01 - 26.57) concerned with utilising autonomous field recording technology and bioacoustic analysis software as a means for gathering information about a blue space whilst the composer was not physically on location. The recorder was set up over two nights (14/04/2021- 15/04/2021) in a small woodland outside a beach-side chapel (St. Catherine's by the Sea Chapel, Ringstead Bay, Dorset). The recorder was set to record fifty-five seconds of every minute, over the course of an approximate eleven-hour period (08.30pm - 05.04am), with a sample rate of 384kHz. Being subject to bioacoustic analysis, the recordings showed sixty-five instances of detecting Daubenton[29] (MYODAU[30]) bats. The data analysis of these bioacoustic vocalisations showed various parameters of information; most pertinent to the sonification process for this piece were pulses[31], mean frequency (fmean, kHz)[32], and match ratio[33].

These values were utilised to inform the parameters of a Max patch[34] that created short bursts of sawtooth wave synthesis pulses (beginning at 19.03). The parameter mapping was as follows (Figure 6.4).

Kaleidoscope Bioacoustic Data	Max MSP Synthesis Patch Parameter Name
Pulses→	'How Many'
Mean Freq (kHz)→	'Frequency Hz'
Match Ratio (%)→	'Duty Cycle'

Figure 6.4: Bioacoustic data mapping parameters.

[28] *BreathingResonatorJune21.maxpat.*
[29] A species of UK bat, commonly found near wetlands.
[30] Shorthand for Daubenton, in Kaleidoscope Pro Analysis Software.
[31] The amount of pulses recorded.
[32] The average frequency (kHz) detected.
[33] The percentage of certainty relating to the identification of species.
[34] *Bioacoustic-pulseburstgenerator.maxpat*.

In order to create bursts of pulses with multiple timbral layers, the patch consisted of seven pulse generator systems, each one informed by the same data which had been scaled to the same divisional integers as the playback system within the analysis software (this is mainly for aural examination of recordings). These are as follows: 0 (real time), /4, /8, /10, /16, /20, and /24.

These first occur (19.04) alongside field recordings of a bat vocalisation from the recording session. The bat vocalisation was edited into a phrase which repeats and re-emerges throughout the duration of this passage. The sawtooth pulses are also subject to further sonification methods where the same weather pattern data (Bournemouth air temp [C]) added harmonic resonance to each pulse through the same resonator patch[35] as previously used in this piece. The purpose of this sonification was to create synergistic sonic material between bioacoustic data and climatic conditions. This passage (19.03 - 20.08) allows the field recording and data gathered from the field recording to coexist as separate sonic objects. The sonified pulses also mimic the streaming, granular texture of the recorded rainfall previously heard in the piece. The applied resonance, with short decay time, also alluded to the sonic characteristics of rain dropping onto a resonant surface, such as a window or iron roof.

At 20.08, a long-form composite gesture arrives and fuses multiple layers of sonified pulses with field recordings of wind from the chapel. Throughout its duration (20.08 - 21.00), the sonifications occupy all levels of spectral space, from low frequency pulses to canopy-esque streaming textures. The coexistence of sound from the biophony (recorded wind), aids in contextualising the acousmatic sonification as environmentally source-bonded. The aim of this was to re-purpose environmental data as an artistic element of the soundscape, having used the bioacoustic process to become more aware of the environment at a time when the composer was not physically engaging with it.

The phrased bat vocalisation reappears (20.56) and coexists with the field recordings of wind and sonified weather mimesis. These continue as a transitional passage until the emergence (21.36) of resonant materials with fluid texture motions. These were the beginning of a set of sonic materials which were the result of inputting the sonic output of the sonification process (bioacoustic information as pulses) through a modular synthesizer for improvisation purposes. This process intended to serve as another way in which the composer could link improvisational performance to engaging with the environment. More specifically, the sonified materials were input through a DSP effects processor module[36] for Eurorack, in order to be manipulated via delay effects, bit-crushing[37], comb filtering[38], and audio-freeze[39] functions. These performances created both the water-like sonic content (21.36 - 22.30), and the chaotic granular passage (22.30 - 24.03) which mimics the composer's visual perception of bat flight paths as multi-directional motions of sonic energy. The original bat vocalisation is placed intermittently amongst this passage to provide

[35] *BreathingResonatorJune21.maxpat.*
[36] QU-Bit, PRISM Eurorack Module.
[37] A low resolution digital distortion effect.
[38] A type of filtering which emulates the effect of multiple versions of one sound source in a short space of time.
[39] A continuous hold of a fragment of audio.

repetitive context to the mostly acousmatic soundscape.

This section of the piece concludes (24.03 - 26.57) with a reintroduction of the resonant breath sonification from earlier in the piece. Here the breath only holds the transient amplitude of the original recorded exercise, and is implemented as a means of symbolising the composers expanded synergy with the sonic elements which it coexists with (remnants of bioacoustic sonification, and bat vocalisation).

6.3.3 Pt. 3 *Push/Pull: Bluespace*. Commissioned for Ilkley Literature Festival 2021 (26.57 - 35.12)

The final passage of the piece utilises field recordings and samples of sonification processes from throughout the entire project (aside from the bioacoustic sonification which came later in the chronology of the project). The aim of this section was to present various materials from the project, as a cohesive passage that demonstrates the achievement of the initial project aims (to enhance the composer's own wellbeing through interacting with blue spaces). As a result of its cumulative nature, it also serves as a consolidated version of the project, which makes it ideal for showcasing the project in smaller scale commissioning opportunities. It is important to note that this is a positive by-product of the composition, not an initial aim. This section of the piece was commissioned for an online exhibition as part of Ilkley Literature Festival 2021[40].

In order to emphasise the initial aims of the project to audiences, the composer used sonic materials which focussed on highlighting elements of acoustic space and source-bonding capabilities. For this reason, the passage begins (26.57) with a hydrophone recording of running water (during a wild swimming session at the private swimming pond, West Yorkshire). This established a link between listener and the compositional space.

The sonified guitar improvisations are arranged and utilised (27.24 - 28.45) to form an ostinato. The use of ostinato[41] implements some form of well recognised musicality, which lends itself to listeners from outside of the electroacoustic community. The harmonic and timbral qualities of this material also references the use of western instrumentation and musicality in pastoral music. This further develops the piece's appeal from commissioning opportunities by widening its receivability.

Between 28.51 and 30.51, the piece showcases elements of agential[42] space (movement of water caused by the composer's wild swimming activity) alongside sound from the biophony (birdsong), and continuations of the guitar based sonifications. The purpose of this was to compose a new space for the listener where the sound of the composer's physical interactions with the space coexist with their musical interactions (sonified guitar), and are arranged with bioacoustic sound from the spaces. These three elements all contributed

[40] Ovington, H. 2021 *Push/Pull: Bluespace.* Ilkely Literature Festival 2021. Available at: https://www.ilkleyliteraturefestival.org.uk/new-writing/2021-spring-commissions/sonic-rewild. Accessed on 03/05/2021.

[41] A short melodic phrase, repeated throughout a composition which may be subject to subtle variation.

[42] Acoustic space where human action produces sound from materials and objects (non-instrumental).

toward the aim of improved well-being and mental health, so arranging them alongside one another depicted the core aims of the project as a listenable experience.

Whereas previous examples of the composer's breathing exercises have appeared in various states of manipulation, recordings of the activity appear (31.25) in a montage[43] arrangement which demonstrates their original sonic characteristics (un-manipulated). The purpose of this was to present the well-being focused activity in an immediately source-bonded form.

The motion and behaviour of the breathing exercise then goes on to inform spectromorphological movement (32.05 - 34.12). The previous elements of the soundscape (hydrophone recordings and sonified guitar) now possessed a behavioural relationship to the breath sounds which create a shared motion between the separate sounds. More specifically, the centric motion caused by amplitude in the breathing exercise is now applied to the soundscape materials and sonifications. This provides a fusion through motion and behaviour, and further demonstrates the synergy created through the aims of this project.

Finally, a gestural passage (34.12 - 35.12) demonstrates the sounds of ice being broken. This not only symbolises the seasonal changes inherent in ice thawing, but also alludes to the seasonal changes alleviating the symptoms of SAD. Furthermore, the wide stereo placement (spanning the entire listening perspective) of these sound objects allude to the psychological bond between space and the composer's mental health during this project.

6.4 Future of the work

Looking forward, the composer is excited to use this composition and publication as a chance to showcase the culmination of the artistic developments made during their PhD journey. They hope to present this composition in a variety of different academic and creative means, in order to promote their artistic practice and also to continue to raise awareness concerning mental health and wellbeing.

[43] An arrangement of sonic materials which do overlap and do not adhere to the chronology of their performances.

Chapter 7

7. Conclusions

7.1 Summary

This portfolio explored how field recording practices and data sonification could be combined as a means of extending the study of certain soundscapes, using a range of electroacoustic musical languages. As the portfolio developed, a clear creative process emerged where considerations from the two practices could be used as an agenda for composing pieces that examined dialectic relationships between humans and the environment. The focus of this relationship shifted throughout the research project.

7.2 Field recording methodologies

The Eutrophication of Cumbrian Water and *Quality Check: Utopolis Manchester* used the creative process to examine the causes, and consequences, of environmental detriment through the lens of field recording and soundscape studies. This environmental information was further supported in the data used for sonfications which created abstracted sonic materials that alluded to imperceptible elements of these environmental narratives.

However, later works *(A Path to Shore* and *A Year in Blue Space)* explored how technological developments in bioacoustic field recording could produce data relating to biodiversity information in a given location. This created a framework for utilising the creative process to examine how learning about an environment could lead to positive benefits for the composer and listener. This shift was prompted by the preliminary bioacoustic analysis used in the ultrasonic field recording techniques used in *Perspective-U*.

In essence, there was a shift between focusing on the anthropophony, and utilising recording and listening techniques to examine the biophony and geophony. It was determined that the positive health and well-being benefits inherent to this kind of ecological consideration was superior in enhancing both the composer's and listener's ecological awareness.

7.3 Sonification

Throughout this research, sonification has enabled the composer to develop their understanding of environmental processes at a material level. Using field recordings as the base materials, and manipulating them with data-informed musical parameters, created a means for illustrating sonic metaphors about the environmental welfare of a location and its inhabitants. This is most notable in *Quality Check: Utopolis Manchester* where air pollution data manipulates vocal utterance. Sonification has also been utilised to synthesise acousmatic sounds, which further represented imperceptible elements of an environmental space within a composition. It has also been used to create mimesis between recorded sound and elements of the landscape which prove difficult to record properly (wind turbines in *Perspective-U*).

However, much like the shift in field recording purposes, the role of sonification also developed into a much more holistic experience. In later works (*A Path to Shore* and *A Year in Blue Space*), the sonification processes examined how numerical data from the environment could be used as a collaborative tool for the composer to musically partner with. Thus, the creation of sonification systems where the composer's musical output was influenced and changed by incoming environmental data. This is most clearly illustrated in the improvised guitar affected by tidal data in *A Year in Blue Space*. These sonification processes indicate that this research has established a means for utilising individual ecological experiences as situations for musical output. These collaborations with the environment possess the inherent benefits of musical improvisation, but also the positive personal developments gained through environmental connections.

A shift also occurred where the composer conducted field recording practices merely for the data that could be extracted from them. In the case of the ultrasonic bioacoustic recordings in *A Year in Blue Space*, very little of the recorded audio was used. Instead, the harvested frequency data created synthesised material that contained greater context than the recordings. Nonetheless, it was the initial recording process which informed the further artistic decisions in the sonification and arrangement processes that followed.

7.4 The impression/expression continuum

During this PhD, a great deal of personal enlightenment has been made about the various landscapes focused on. The composition process was based on an intake of environmental information that could be designed and arranged for public consumption, in order to raise ecological awareness in listeners. In every case, the process followed a linear structure with each progression being a direct result of the impression left on the composer from the previous action. More directly, an element of affectation in a landscape may lead the composer to conduct environmental research. The results of which inform decisions and methodologies in field recording, which carry forward their own findings. These then inform decisions about sourcing data and sonification methods, which create sound materials

from the landscape which did not previously exist.

These new sonic materials are the result of combining environmental research with electroacoustic music practices and enabled the composer to listen to the imperceptible elements of the landscape. This insight equipped them with the knowledge and inspiration to compose musical works that expressed these findings to audiences.

7.5 Multi-format presentation modes

The personal developments made during the impression/expression exchanges proved to be vital as information which could be used in further developing the environmental awareness raised in audiences. This was first realised when re-composing *Quality Check: Utopolis Manchester*, where it was decided that a condensed version of a commissioned performance could more directly address the aims of this research, and portray them within a concert piece format.

The autobiographical nature of the composition process also began to prove key in raising awareness in listeners. Imparting experience and knowledge from all stages of the composition process became a pertinent part of this research. But due to the individual nature of these experiences, it became apparent that this could be best achieved by presenting elements of the work across different platforms, technologies, and media formats. Most comprehensively in *A Path to Shore, Perspective-U,* and *A Year in Blue Space*, where geolocative audio installations, work-in-progress compositions, and audio-visual art were supported by published creative writing. These pieces all benefited from a final arrangement as complete concert pieces, but their multi-format existence was key in elaborating on the methods by which a listener could engage with the work, and more importantly, the environment.

7.6 Scope for future research

As a continuation of this research, the composer wishes to expand upon the multi-format presentation of future compositions by collaborating with other established artists and practitioners. There were ideas within the course of this project which were unfortunately deemed unachievable when considered against time-restraints and other dictating factors. This is prominant in the use of newly developed bioacoustic analysis technologies as tools for artistic expression. The composer believes this has contributed to creating an interdisciplinary development between bioacoustic analysis and environmental sound art, and composition; something which they are keen to further explore and promote. Finally, the composer's aim of increasing environmental awareness, through research and art, will continue as a life-long venture.

Chapter 8

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Chapter 9

Appendix

9.1 *The Eutrophication of Cumbrian Water*

9.1.1 Eutrophication information

The visible indication of eutrophication is large blooms of toxic algae covering the surface of the water. Eutrophication inflicts a series of health implications to humans using lakes and rivers recreationally, and to other inhabiting wildlife. For humans, eutrophication contributes to the spread of gastrointestinal and dermatological diseases. Whilst for aquatic life, obscuring of the water's surface leads to a decrease in dissolved oxygen (due to decreased photosynthetic activity under the surface), and the lowering of the water's pH level - also known as ocean acidification.

9.2 *Quality Check: Utopolis Manchester*

9.2.1 Submitted composition

The submitted composition of this wider-scale project was repurposed for the format of the PhD both in length and format, compared to the original performance which lasted over three hours. The original speaker placement and accumulation gave the impression of a multichannel composition. However, the ad-hoc nature of the multichannel speaker placement was not something that could be logistically replicated within the studio environment. As the commission developed and the need to communicate the work to wider audiences emerged, contemporary pop music styles were introduced (ambient, dance, vaporwave) and became increasingly prominent elements of the compositional palette. Due to these factors, it was agreed within supervision that a more focused composition addressing the research inquiry could emerge from the original one, utilising recorded and sonified materials from the production and performances of the project. This version consolidates the strands of this PhD research which were prominent within the final performances and highlights them without focus on any of the other artistic material that became a part of the commissioned piece.

9.3 *A Path to Shore*

9.3.1 Land-art sculptures

Cairn:

The first constructed piece was a cairn[1] made from the remnants of a collapsed dry stone wall. This particular structure was chosen primarily for its cultural context[2] as a marker for directional purposes, or as an indicator of a beginning of some kind. The cairn was built on the side of a hill, perpendicular to the cul-de-sac which leads to the beginning of the footpath. The cairn not only marked the entrance to the site of the field work, but also enabled the opportunity to physically work with recycled materials from a dry-stone wall. This resulted in recorded sonic artefacts that would not exist if not for this process and which are site-specific in nature.

Stone Circle:

The second piece constructed was a stone circle, located in a small section of the stream about halfway up the footpath. The significance and purpose of stone circles throughout history is questionable and at best, speculative. However, the documented historical reuse of these structures[3] was most pertinent to its purpose in this field work. The compositional intentions were to construct a piece of land art with reused materials from the landscape, that also contributed specific sonic usability in the creative process. The recordings from this process featured attributes which were specific to this artistic process (breaking stones underwater, human movement in water, and the stacking of stones in formation).

9.3.2 Geolocative audio

This composition was also presented as a geolocative audio work within an interactive map for smartphones. Elements of the field recordings and manipulated audio were plotted using an online locative-audio tool[4], meaning that listeners could explore the composed materials on a browsed map of the location, using a smartphone, whilst walking a predetermined real-world route both virtually (during the pandemic) and physically (post-pandemic). To do so, listeners use the web-based platform remotely by placing an avatar on the map and moving it around accordingly. The sound map was duplicated across two physical locations. Firstly, the original path, where the compositional field work had taken place and secondly, in a suburban area of Greater Manchester. This secondary map mirrored the cultural heritage of the original footpath, due to its termination at a Baptist Church. The maps were duplicated like this with the intention of enabling audience members to access the environmentally focused sonic art, regardless of where they lived. The map's intention

[1] A man-made mound of stones, signifying directional information to walkers.

[2] Kelleher, K. 2010. National Geographic *Why do people stack stones in the wild?* Available at: https://www.nationalgeographic.com/travel/article/why-people-stacks-stones-and-where-to-see-them-in-the-wild

[3] Nimura, Courtney. (2016) *The Use and Reuse of Stone Circles: Fieldwork at Five Scottish Monuments and its Implications,* Oxford: Oxbow Books.

[4] Sonic Maps. https://sonicmaps.xyz/

was based on the established[5] link between geolocative soundwalks and heightened ecological awareness. These soundwalk maps presented materials from the compositional process in a rudimentary form which does not mirror the composed arrangement of the final piece. The maps were published[6] alongside extended program notes in an online exhibition of sound art. An early iteration of the piece was also premiered[7] at the first online MANTIS event, hosted by NOVARS, University of Manchester. Direct website addresses for each map, along with user information can be accessed in the submitted document *READ ME A Path to Shore Sonic Map Links*. There are also two examples[8] of audio taken from the experiences, submitted as evidence that this technology allows for variation in the listener's perception of the work. The ability to listen on-location or remotely was particularly useful during the period of the global pandemic. The publication also included a work-in-progress version[9] of the piece via a Bandcamp link.

9.3.3 Weather pattern data information

The weather data detailed two measurements of air temperature (minimum/maximum [C]) each day, at twelve-hour intervals (09:00 and 21:00). The data used for this project used these readings from the time-span of the entire field work (04/04/2020-05/05/2020). The dataset[10] depicts these climatic conditions from the nearest monitoring station to the field work location (Rochdale, Greater Manchester), and can be sourced by using these location and time stipulations in the online indexing service provided by the Centre for Environmental Data Analysis[11]. For the purposes of sonification, the data was scaled (universally divided by one hundred) to achieve the correct decimal value for the sonification method (between 0.0 and 1.0). In this form, the data obviously no longer resembles actual temperature, but the intervalic changes between data entries still depict the relative changes between measurements in the original data.

9.3.4 Water purity data information

This self-gathered data is included[12] in the submitted materials which accompany this thesis. This data also was subject to a process of scaling for sonification purposes. Where the data was measured in two-digit values (PPM and Temperature [with a decimal]), the data was subject to the same scaling formula (divided universally by one hundred) to achieve the correct relative scale. Where the data was measured in three-digit readings (Conductivity), it was scaled accordingly (divided universally by one thousand) for sonification pur-

[5] Radi B. M. (2021) *Geolocational Soundwalk as Ecological Choreography: Walking and Listening Towards Ecological Awareness.* MA Thesis, Contemporary Theatre, Dance, and Dramaturgy. Utrecht University.

[6] Ovington, H. 2020. *A Path to Shore: Wrong without Turning* Available at:https://landlinesproject.wordpress.com/sonic-rewild-by-harry-ovington/

[7] MANTIS Festival (Online Version). 16/04/2021.

[8] *Todmorden Map Render.wav* and *Coverdale Baptist Church Map Render.wav*

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[11] https://archive.ceda.ac.uk/

[12] *A Path to Shore Water Data.*

poses. Due to the separate data variables being used independently of each other, the composer determined that the different scaling formulas did not detract from the aim of using the data to depict the intervallic environmental fluctuations.