LEARNING TO HEAR THE CALL OF THE WILD

A study of Soundscape Ecology & A Fellowship in Wild Sound
Learning to Hear the Call of The Wild
A Study of Soundscape Ecology & a Fellowship In Wild Sound
By Missing Wolf

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Trying to control the world
I see you won’t succeed.

The world is a spiritual vessel
And cannot be controlled.

Those who control fail.
Those who grasp loose.

The Sage sees things as they are,
without trying to control them.

She lets them go their own way,
and resides at the centre of the circle.

Lao Tzu, Tao Te Ching, 29
Abstract

The Wild: A state of nature neither tamed nor domesticated. (dictionary.com 2017) ‘[The]Wild [meaning] self-willed’ Jack turner 1996. The wild: mysterious, beautiful, frightening, vibrant, a place of death, and a place of life, unbroken. It is fierce and it speaks. To explore its voice, to understand its messages, what it expresses about the natural world, about us, our ancestry and our connection with it: for this we have soundscape ecology and an organisation dedicated to researching and archiving wild soundscapes, to creating art and music in order to express the voice of the wild. This organisation, named Wild Sanctuary, is where I travelled to as a Winston Churchill Fellow to work alongside Dr Bernie Krause in Northern California, USA, to better understand how soundscape ecology may be used for the benefit of the people and ecology of the United Kingdom. I met with specialists affiliated with Wild Sanctuary involved with soundscape ecology, field recording, state park management, ecological research, and community science projects. To develop the skills first-hand that are necessary to conduct soundscape surveys, I also undertook expeditions into the wild, through forests, deserts, over mountains, and into deep caves. In conjunction, Dr Krause instructed me in the protocols and methods deployed in the field as well as techniques that are used in the studio to record and perceive the voice of the natural wild. What I found was compelling and startling and, in the very least, through the lens of soundscape ecology the way we hear the world around us may change forever. This Fellowship looks to establish soundscape studies, art, and music as part of the implementation of soundscape ecology in the United Kingdom, extending the reach of the Fellowship and the benefits that it may yield.

Introduction

Dr Bernard L Krause is a musician and soundscape ecologist, who in 1968 founded Wild Sanctuary, an organisation dedicated to documenting and archiving wild soundscapes. Throughout the last half decade, Dr Krause has pioneered the field of soundscape ecology, the study of acoustic energy emanating from the landscape, which considers the soundscape as an environmental proxy for habitat health. Furthermore, Dr Krause has introduced many new terms and hypotheses in the endeavour of deciphering wild soundscapes.
Having recorded over a staggering 1,300 terrestrial and aquatic sites from the Arctic to the deep Amazon and beyond, Dr Krause has been able to reveal part of the subtle messages relayed to us by wild soundscapes. His discoveries have lead to many new lines of enquiry into how humans developed musical expression and how ecological trends that have been hidden to the eye can be exposed via careful listening. In turn, this has lead to a revelation in the way we perceive the acoustic expression of the natural wild.

Dr Krause has found that up to 50% of the recorded habitats in his archive of wild soundscapes have either become extinct or have changed beyond recognition. This is a startling sign of a world under siege as the remarkable voice of the wild falls silent. Due to the magnitude of this issue, I travelled to California to better understand the innovative methods, practices and protocols of soundscape ecology. By taking part in soundscape-based ecological surveys and by working closely with Dr Krause, I aimed to answer the following questions:

- How are soundscapes relevant to our ecological and cultural understanding of the world and our society?
- What can we learn about the ecology through the analysis of a soundscape?
- What is the significance of the fading wild soundscapes on earth and what does this mean for ecological viability?
- How may soundscape ecology aid in the protection of wild habitats in the United Kingdom and its overseas territories?
- What role has our historical relationship to the soundscape around us played in the development of our musical expression?
- How may the intersection of soundscape ecology and music be utilised in both the dissemination of information and in furthering our understanding of wild soundscapes?

To answer these questions, the report has been divided into three main areas of discussion: (1) The methods and principles of soundscape ecology, (2) soundscapes and the protection of the wild, and (3) musical expression, its wild heritage and future role in soundscape studies.

The written report forms half of the output from the WCMT Fellowship that I carried out from 04th April – 30th May 2017, and is paired with the ‘Sonic Report’, a 23-minute audio piece containing an interview that I conducted with Dr Krause and recordings of wild soundscapes. The ‘Sonic Report’ is referenced throughout and quotes found in the text marked with ‘Sonic Report 2017’ are from the audio piece.
Key Findings

Summarised below are my key findings that form the basis for the recommendations that follow.

- The soundscape is a valuable feature of the natural world and one that is full of information pertaining to its given habitat, including biodiversity, habitat health, present/historical stress levels, as well as long-term and short-term impacts on the environment.

- The practices developed and deployed through soundscape ecology form fundamental lenses through which to explore and interpret soundscapes. Many of these are recent developments that include recording whole habitats, the Acoustic Niche Hypothesis, and the perception and definition of a soundscape’s anatomy.

- Soundscape ecology offers many new tools to detect ecological events and trends that have either gone unnoticed, or could not be measured by visual methods of ecological evaluation. In turn, the practice of soundscape ecology can revolutionise the ways in which we perceive animal vocalisations and habitats across the globe, in stand alone soundscape studies or whilst working in addition with other methods of ecological evaluation.

- The acoustic interactions that take place in and form a soundscape are much more complex than previously thought, with the Acoustic Niche Hypothesis revealing how all soundscapes are constructed in interrelated frequential and temporal bandwidths.

- Many practices involved in soundscape ecology are still not fully utilised in ecological evaluation or conservation, although this is developing due to the growing perception of the soundscape’s value as an ecological proxy.

- Human-generated noise termed ‘Anthropophony’ must be considered an ephemeral pollution that is highly pervasive and spreading at an alarming rate. ‘Uncontrolled anthropophony’ especially is much more hazardous to the environment than previously assumed and is having a dramatic effect on the ecological stability of wild habitats.

- Wild soundscapes are under threat and heading towards extinction with 50% of Wild Sanctuary’s archive either silent or changed beyond recognition. This huge loss has taken place in a very short space of time from 1968 to 2017, making it a very time-sensitive issue.

- We must consider that wild soundscapes are an integer for the state of the world around us. Bearing that in mind, the declining wild soundscapes are symptomatic of a world that is ecologically under threat. In tackling this falling quietude, many other ecological factors would also have to be addressed, for example habitat restoration and noise abatement.
- Through the lens of soundscape ecology we have been able to identify clear trends between the health of a habitat, the wildness of a place, and qualities including the diversity and density of its soundscape. This may enable us to better combat this falling quietude as we engage the factors that are causing the decrease in wild soundscapes.

- Audio archives of whole recorded soundscapes are a crucial intangible heritage that forms the basis for future scientific research into the changing ecology on earth through soundscape study. Archives are equally important as historical and artistic references for future generations.

- There are strong parallels between the formation of wild soundscapes and the development of our own musical expression. As exposed by the Acoustic Niche Hypothesis, the structure of frequentual and temporal bandwidths can be directly equated to the development of pitch and rhythm. With greater harmonic and textural elements that form our music also being present in wild soundscapes, there is a strong case for human musical heritage coming from the wild.

- Wild soundscapes throughout history have played a pivotal role in the lives of those who lived connected to nature, in how we understand and intersect with the world as well as in the development of our artistic expression.

- Humans have the capacity to be acoustically sensitive and connected to their surroundings through audible means, as demonstrated by the B'aka. This makes the soundscape an incredibly relevant factor in human mental and physical wellbeing, as well as to our experience and connection to our time and place.

- Soundscape ecology is a collaborative field of investigation where the intersection between the arts and science play a crucial role in both scientific study and dissemination of findings.

- Arts and music have the ability to go beyond science in communicating the information derived through soundscape ecology. This is a crucial role that sheds light on the relevance of scientific and ecological ideas to people’s lives, which in turn nurtures further engagement with the subject.

- The ability to effectively disseminate information gathered through soundscape study far and wide is important due to the time sensitive-nature of issues that wild soundscapes face.
Report Recommendations

The following recommendations fall into five categories:

1. Protecting the ecology and biodiversity, rewilding, and the value of soundscapes in understanding the ecology.

2. Education, academic research, and scientific study.

3. The significance of archives of soundscape data.

4. Collaboration on global, national, and local levels.

5. The soundscape’s relevance to culture, music, art, and the role of the arts in the preservation and understanding of wild soundscapes and creation of new wild traditions.

1. In regards to ecological protection, safeguarding biodiversity, rewilding, and the value of wild soundscapes in relation to the ecology, I make the following recommendations:

   1. We must consider the soundscape as a vital part of any habitat, one that must remain intact to maintain a stable environment. Further to this, respecting the soundscape as an invaluable environmental proxy that relates vital information about the environment is also an important step in our ability to protect the ecology in the UK.

   2. To establish a fuller image of the state of the ecology in the UK, the incorporation of soundscape study into the existing practice of organisations already involved in conservation, ecological survey, and rewilding will make a real difference in the ways in which we observe and document trends as well their success outcomes. It is imperative that organisations who work with the environment in research, conservation, and rewilding, consider the use of soundscape ecology and its practices as a tool to enhance their already established work.

   3. Due to the alarming rate at which wild soundscapes are declining and falling silent, it is important that we take action immediately on a national level to protect the wild soundscapes of the United Kingdom and their respective habitats. Due to its overseas territories, the UK will play an even larger role in safeguarding the wild and its soundscapes on a global scale.

   4. As the risk that human-generated noise (anthropophony) poses to the wild can be so great, taking steps to abate and in some areas eradicate anthropophony will help to maintain healthy wild soundscapes and ecology in the UK.

   5. The data soundscape ecology yields gives us a fuller image of the ecology in the UK, and so be utilised to influence wider decisions in land management, environmental protection, town planning, and infrastructure development on local, national and international levels.
6. I recommend that by implementing environmental preservation based on the protection of wild soundscapes and their respective habitats on a national level the United Kingdom would be well situated to lead the way internationally. Coupled with a process of rewilding, this could establish the wild and its voice in the United Kingdom and all of its territories as a valued asset and symbol of our nation, its ‘Natural Anthem’ if you like. This kind of leadership could open up new discussions on the world stage in regards to the value of the wild and its soundscape to people, communities, and nations today and for the future.

7. Internationally, the protection of wild soundscapes must be given the highest priority. Currently, endangered or valued languages, traditions, and cultures can be given the status of ‘Intangible Cultural Heritage’ by the United Nations Educational, Scientific, and Cultural Organisation (UNESCO). Working alongside UNESCO programs such as ‘One Planet, One Ocean’, creating the category of ‘Intangible Natural Wild Heritage’ could help establish protected areas of wilderness where the soundscape of that environment is also regarded as precious and important. Setting such a precedent may also change the ways in which we appreciate our acoustic surroundings, leading to further measures to preserve and restore wild soundscapes from local forests and parks to large national reserves.

2. To further our understanding and exploration of the world’s soundscapes, establishing educational pathways for the study of soundscape ecology and the soundscape on a more holistic level will necessarily make a real difference. So I make the following recommendations:

8. Due to the importance of soundscapes to the health of habitats and the status placed on the soundscape through the practice of soundscape ecology, establishing respective courses in the United Kingdom at higher educational institutions will help to facilitate research and aid in our ability to preserve and protect the natural world. Through the creation of programs that run from undergraduate through to post-graduate level, it will then be possible to establish a basis for soundscape study in the UK. I strongly recommend working with existing experts in the field of soundscape ecology in establishing and implementing these programs to ensure the quality of the education and training that can be achieved. Such programs would equip UK – based researchers with vital new tools and methods for ecological evaluation.

9. It would also be advantageous to start such education early. So a further recommendation is to add soundscape studies to both the science and music curricula from key stage one through to A-levels, giving educators a chance to nurture our sonic sensibilities and awareness of the importance of the voice of the wild from a young age.
3. In relation to archives of soundscape data:

10. Archives of soundscape data play a significant role in our capacity for research going forward. I recommend that any organisation or individual involved in ecological research, surveys, and evaluation must regard high-quality archives as an important historical reference, one that provides reliable baseline data that can aid in and advance future investigations.

11. Beyond research material alone, soundscape archives form the cornerstone of soundscape-based educational programs, providing much of the material needed to create reliable and valuable content for higher educational courses. In consideration of this, I recommend that institutes of higher education must acquire or gain access to archives, with the primary objective of establishing such programs.

12. I would also recommend establishing open archives in community spaces such as libraries, and encouraging the creation of art and music that draws on these archives. Being a collection of precious moments abstracted from time that document some of the weirdest of animal behaviours and most wondrous of places, the value of soundscape archives reaches beyond the academic and scientific worlds. By giving people access to these archives and exposing them to the recordings, it is possible to bring the wild into their lives, allowing them to connect to this visceral world on an intuitive and inquisitive level, in turn nurturing their engagement and relationship to the natural world.

4. With regards to global collaboration and local communities:

13. In both areas of education and research, global collaboration is essential as the loss of wild soundscapes is a worldwide issue. Sharing expertise and resources will greatly increase our ability to apply soundscape ecology on an international scale.

14. Interdisciplinary collaboration from a diverse spectrum of subjects ranging across the scientific to the creative inspires a greater variety of work to take place. Conducting the research with as many minds and ears as possible opens more pathways in research and ways to disseminate ideas. This leads to a positive impact on the wider public as collaboration at this level has the potential to make soundscape ecology and the protection of wild soundscapes a household idea.

15. Collaboration between professionals working in the field of soundscape ecology and skilled amateurs as well as communities will make a real difference in our ability to document wild soundscapes and detect trends. In the field of astronomy, amateurs have made many genuine discoveries, as having many eyes looking out meant that more sky could be observed. Community contributions hold the same potential with respect to soundscape ecology. With many ears working to established protocols, we will have a much more detailed image of soundscapes across wider sections of the UK and its territories.
5. In consideration of the intersection between wild soundscapes and the past as well as future development of our musical expression, art, and culture, the following recommendations apply:

16. Harnessing our music’s historical relationship to the voice of the wild offers great creative opportunities as we look to rewild our musical expression. So I recommend that as musicians we learn to appreciate wild soundscapes as a complex symphony, recognising its value by incorporating biophonies into our work. In turn, learning to listen to the anatomy of a soundscape could become an intrinsic part of musicianship. This process offers not just creative benefit but it may also help to facilitate our re-connection to the wild, aiding us to intuitively react to issues facing the ecology on earth.

17. The arts and music have the ability to go beyond science in communicating the information derived through soundscape ecology. I recommend that artists and musicians use this potential in the expression and dissemination of the messages detected from the wild to increase the reach and relevance of the subject in people’s lives. Through the creation of new wild traditions and myth to connect people and wilderness once more.

18. I would also argue that the role of field recordists, musicians, and others who deal with sound on a professional level have a role to play in the science of soundscape ecology. Therefore, I recommend that future soundscape studies incorporate the expertise of these ‘sound professionals’ in gathering and analysing data.

Next steps

One of the most significant results of the Fellowship was the relationships that were forged during my stay in California. By maintaining a close working relationship with Dr Krause and Wild Sanctuary, the development of soundscape ecology in the UK and future work as framed by this Fellowship are enhanced greatly. In combination with the knowledge gained over the Fellowship, these connections may prove to be one of the strongest aspects moving forward.

The next major aim is to spearhead future scientific and creative work in the UK based on the study of soundscapes and the development of soundscape study. To help achieve these aims, in 2018 I will be working towards establishing soundscape ecology as a recognised field of study in the UK. This will be achieved in part through the combined efforts of Wild Sanctuary, faculty leaders at Universities in the UK, and myself. Further to this, there are plans with environmental NGO’s for future soundscape surveys in Europe, including sites in Eastern Europe and the UK. In conjunction with the above, I have also been developing creative projects to help further communicate the findings from this Fellowship as well as putting many of the principles outlined in the report into my own artistic practice.

It is my sincere aim to work in collaboration with others in the protection of the wild and its voice. An important factor in the ability to realise many of the recommendations outlined in this report is our capacity to share and disseminate the story of the wild and its value, both on a social and political level. It will be in our attitude and the value we place on the wild and its soundscape that will determine the fate of the ever-surrounding voice of the natural world.
Main Report: Learning to Hear The Call of The Wild

It is dark and a crescent moon hangs in the sky. You might have mistaken the scene to be that of a deep and calm night, but it is morning. It is silent. Silent except for the calm breeze that passes over the desert, between the rocks and the cacti, a spectre of a stream passing through the land. Silent, the sound of a desolate place, of mute shrubs, and hushed stone structures, or am I deceived? Waiting, observing, tuning into the land that surrounds me, pre-empting the appearance of the light, voices stir. Increasing with the coming of dawn, that which was silent awakens with sound, as each shrub, crevice, and hard holding tree comes to life with the voices of the wild. The desert, the great desolate desert, now living, full of sound, and song. How I had been surrounded in the dark, mistakenly alone, by life, waiting, sleeping, until the dawn had come.

Missing Wolf, Mojave Desert, May 2017, WCMT Fellowship

Photographs taken in the Mojave desert, at first light (left) and the twilight of dawn (right)

What Is Soundscape Ecology?
Methods, Principles, and Protocols

Soundscape ecology is a new branch of ecological science resulting from the integration of different disciplines including landscape ecology, bioacoustics, acoustic ecology, and music. Pioneered by Dr Bernie Krause, soundscape ecology considers the soundscape a relevant environmental proxy for animal and human life, biodiversity, and habitat health. Put very simply by Dr Krause (Sonic Report 2017), soundscape ecology is “the study of sound in the landscape, whether that landscape is urban, rural, or wild.” Professor Almo Farina, in his 2014 book Soundscape Ecology, defines the soundscape as “the entire sonic energy produced by a landscape.”1 Each soundscape is a unique formation of sounds pertaining to one location, acoustically defining a given habitat, be it terrestrial or aquatic.

I would like to start by introducing a number of methods, principles and protocols that are fundamental aspects of soundscape ecology that are relevant in our understanding of the subject moving forward.

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1 R. Murray Shafer, Canadian composer and naturalist, was the first to define the soundscape as “all of the sound that reaches our ears from whatever source,” in his 1977 book, Tuning of the World.
The Anatomy of a Soundscape
Firstly, to better understand the acoustic anatomy of a habitat, as written about in ‘Wild Soundscapes: Discovering The Voice of The Natural World, B.Krause 2002’. Dr Krause defined three basic sound sources that in combination form the soundscape:

Geophony  Non-biological sounds that occur in any given habitat, for example wind in the trees, waves at the ocean shore, the movement of the earth.

Biophony The sum of collective sounds generated by organisms in a given habitat at one time and one place.

Anthropophony Is human-generated sound. This can be split into two subcategories:
- Controlled anthropophony: This includes music, language, and theatre.
- Uncontrolled anthropophony: Is chaotic and incoherent, often produced by electromechanical devices, machines, and technology. Also referred to as noise.

Wild Soundscape Is the term I will use for the combined sonic expression of all biophony and geophony of a given habitat, often referred to by Dr Krause as “the voice of the natural world.” Each and every wild soundscape has its own unique sound signature that contains incredible amounts of information pertaining to that habitat. Encapsulated in the term is the ideal and value of the wildness, the untamed and uncompromised nature.

Analysing the interaction between the three categories of geophony, biophony, and anthropophony has allowed Dr Krause to expose the intricate acoustic relationships that take place in a given environment. By noting how these different sources interact and relate to each other we may better interpret the quality of a soundscape, allowing us to use the soundscape as a proxy for many ecological attributes including habitat health and as an indicator of biodiversity.

Capturing Whole Habitats
One of the most defining principles of soundscape ecology that I encountered on my Fellowship lies in its focus on the entire soundscape. Previously in the study of animal and environmental sound, there had been an emphasis on the fragmented capture of individual species. A typical example of this would be the extraction of a single birdcall out of the dawn chorus in an attempt to analyse the behaviour attributing to the bird and its vocalisation. However, in the words of Dr Bernie Krause (TED 2013), “this is like trying to understand the magnificence of Beethoven’s 5th Symphony by abstracting the sound of a single violin player out of the context of the orchestra.” The paradigm shift towards
the capture of whole soundscapes allows for new observations to be made, providing us with innovative methods with which to understand the complexity inherent to the biophony of a habitat.

“It took many years, almost thirty years, before recording ‘whole habitat’ was thought of as being possibly acceptable. It’s only now in the last few years, since soundscape ecology became a field for exploration, that that has come about.” Dr Krause, Sonic Report 2017

Attended Recording Practice
To analyse a habitat in this way, soundscape ecology utilises recording equipment and software often used by field recordists and studios involved in music and broadcast media. Further to this, by implementing a strict protocol in field practice, including the documentation of meta data pertaining to the site and calibration of equipment, the audio recordings collected become reliable data sets. Recording habitats with calibrated surround and stereo arrays have also made it possible to represent the soundscape in its spatial dimensions, allowing for almost instantaneous 360° capture of a given habitat. This was simply not feasible with more traditional visual methods of ecological evaluation and it is a key advantage of the methods deployed by soundscape ecologists in the field.

In the collection of audio data, different types of field practice will yield different results. I encountered a number of methods during my time in California but one that stood out to me was the practise of ‘attended recording’, which requires that the equipment is accompanied by a field recordist for the complete duration of recording. One advantage of this method is that observations of the environment can be made in real time, delivering more holistic data sets. With other, methods I encountered such as remote recording this is simply not possible since the technologies to capture long term acoustic data sets are commonly left unattended. Consequently, while attended recording produces lesser volumes of data in comparison, it tends to yield data of a much higher quality. There are number of reasons for this: firstly, the equipment that can be deployed when attended can record a much more precise acoustic image than that of remote units. This is due to the fact that equipment deployed is not limited by the necessity to be left in the field unattended for extended periods of time. This makes the choice of microphones, recorders, and peripheral equipment more expansive including more versatile and higher calibre gear. The result is that audio quality tends to be clearer, and more defined, as well as allowing for more options in what and how to record. Secondly, just as soundscape ecology focuses on the whole soundscape, attended recording allows for the capture of entire event sequences, resisting the temptation to isolate moments by recording every five minutes of each hour – fragmenting temporal structure – as is typical with

2 With double MS or ambisonic microphone configurations, in particular.
remote practices. This parallel ethos combined with the quality of the equipment deployed, allows the recordist to capture more cohesive and relevant data sets.

As the recordings of the best quality can have a greater impact on listeners, it is key in the engagement of a wider spectrum of people. As we strive to rekindle our connection to the wild, presenting recordings that can stir emotions and recreate a sense of space are crucial. Finally my own experience of ‘attended recording practice’ was an enlightening one in relation to my effort to research and connect to the voice of the wild. Being out at dawn I was present and focused in a way that I had not come across before. It is my belief that if we are to understand the world around us, we must be present in it. Dr Krause recalled and similar feeling stating that: ‘[Wild soundscapes] have helped re-orient me to a part of this life experience that we all have… in ways I otherwise thought not possible and it’s been very gratifying to know that.’ (Sonic Report 2017) Being present in the wild is then a valuable practice for researchers and the wider human population.

Analysing Audio Data through Spectrograms

Once the data are collected, the recordings can be analysed with the use of specialist software. These pieces of software are able to transform audio into a spectrogram, a visual representation of sound, which can expose the exact frequency and temporal structures of a soundscape.

Below (Figure 1) is an example of a typical spectrogram with frequencies running from top to bottom on the Y axis, and time running from left to right on X axis. The acoustic energy (how loud or quite a sound is) is represented by the colour gradient with the quieter sounds being purple to the loudest sounds represented in yellow.

![Figure 1 Spectrogram Graphic from a recording taken at Sugar Loaf California, USA, Missing Wolf](image)

Working directly with the spectrogram allows for in-depth analyses of the soundscape. Unlike more conventional digital audio work stations where you deal with the waveform and so all the acoustic energy at once, the spectrogram is much more precise. For example, it is possible to work directly with individual frequency bandwidths by filtering selected aspects of the spectrogram. With the entire spectrum of the soundscape laid out, it is then possible to single out a particular bird song for identification, or to cut out unwanted acoustic signatures such as airplanes. As the software works like a kind of Photoshop for audio, it makes it easier to study single events, elements, and relationships that form the soundscape. This manner of processing recorded data allows us to slow down and focus on any part of the soundscape we wish, forming a vital tool to aid in our perception of the voice of the natural wild.
Spectrograms can also help soundscape ecologists demonstrate complex acoustic patterns in a very clear, understandable fashion. This tool for studying spectrograms is a keystone apparatus for any soundscape ecologist who wishes to further expose intricate acoustic interactions. Over the last thirty years, Dr Krause has been able to demonstrate how the practice of soundscape ecology in the field can revolutionise the ways in which we conduct environmental evaluation. Using the soundscape as a proxy may allow us to detect shifts and trends not visible to the eye as well as to determine attributes of a habitat such as its biodiversity and health.

Two Case Studies of Soundscape Ecology in Action
Lifting the Veil of the Eye and Ecological Analysis through Careful Listening

soundscape ecology has the potential to shift how we perceive and understand our environment through careful listening and analysis of the biophony. Dr Krause stated in an interview with me that “the models [used for ecological study and evaluation] were typically from a visual perspective... we really did not think that the soundscape would hold any information of value” (Sonic Report 2017). More than just a scientific change of focus, soundscape ecology creates a cultural challenge, asserting that the soundscape is in fact a vital aspect of a habitat. Over the course of my Fellowship, I witnessed how this shift of focus to the voice of the wild, the biophony, can reveal new clues that visual methods would not have been able to derive.

“What I have learnt from these encounters is that careful listening gives us incredibly valuable tools with which to evaluate the health of a habitat across the entire spectrum of life.” Dr Bernie Krause TED 2013

Hiking down the trail, we came to a point where Sonoma Creek cuts across the path. Working by the light of head torches, within minutes we were set up ready to record. The calibration tone was set at the start of the recording, and Dr Krause slated the meta data, reading out GPS location, weather, wind, temperature, equipment, and the recorder settings. We then took up our position around one hundred and fifty meters down the trail and waited. The silence remained unbroken except for the river as it passed by our backs. Light slowly faded in through the dark; the mist that was clinging to the nearby peaks broke up as the sun burnt its way across the pale blue sky. It was dawn, it was spring but it was quiet. The birds were there but they are not singing. Why? Missing Wolf Field Notes, Sugarloaf Ridge 10th April 2017

Case Study 1 – Sugarloaf State Park
In April of 2017, many birds had nested in the coyote brush and oak trees that camouflaged the creek, which cuts through the heart of this riparian habitat at Sugarloaf Ridge, in Northern California, USA. At a glance, our eyes tell us there is no issue: Everything looks in place, the flora is rich and the creek is running at its full flow.
Our ears, in the same moment, tell a different story: Dr Krause and myself made numerous visits to Sugarloaf Ridge throughout my Fellowship. The spring had been silent at Sugarloaf since the draught had started four years prior. Being a riparian habitat reliant on Sonoma creek, a drought hits the area quite dramatically. This year, there had been rain, so the creek flowed once more, reinvigorating the habitat. With the draught abating, the birds did return to the area. However, the ever so reticent April persisted. It seemed that the whole area was experiencing a sort of quietude.

**Figure 2.1** shows a single recording taken on 10\(^{th}\) April 2017 that starts just before first light and runs all the way through to the sun being fully risen in the sky. What we see is a sparse and relatively quiet dawn chorus with low density and diversity which is not very characteristic of this time in spring.

**Figure 2.2** was taken at the same site but on 21\(^{st}\) April 2017. The density and diversity have increased very slightly but are still nowhere near to displaying the vibrancy that we would expect. It was not until the beginning of May, nearly a whole month later than expected, that we finally heard the dawn chorus at Sugarloaf re-emerging - in what was for me quite a spectacular fashion- after the devastating drought of the past four years. **Figure 2.3** (below) is of a recording made in the same area to the same calibration protocol on 5\(^{th}\) of May 2017.
The difference between spectrogram (Figure 2.3) and the previous, (Figure 2.2 and 2.1) one is astounding. Sugarloaf had come to life with the diversity and density of animal vocalisations increasing dramatically. The two spectrograms below (Fig 2.4 and 2.5) compare a 30 second sample from the height of the dawn chorus from the first of the recordings on 10th April 2017 with that of the one taken on 5th May 2017.

When viewed in such detail, figure 2.4 is almost incomparable with the later Figure 2.5 showing a richer and fuller dawn chorus with greater acoustic energy and an increase in both density and diversity of vocalising species. This kind of dawn chorus has been absent from Sugarloaf over the last few years of drought. It has returned, although later and in comparison with early recordings from 2004 in a muted form. It is quite startling to observe that even in a protected area like a state park we may witness such dramatic trends as both density and diversity decline.3

As we listened over my time in California, many questions were raised. Why were birds present but silent? Why was the dawn chorus late? Is the habitat at Sugarloaf at the start of a slow recovery? Have global climatic trends changed the behaviour in both the migrating and domestic avian population? What factors may be causing this difference in behaviour at Sugarloaf? What are the long-term effects of extreme weather conditions produced by global warming on riparian habitats and wildlife?

3Forest fires in October, 2017 ravaged the state park and surrounding Sonoma and Napa valleys destroying over 250 sq. miles. 70% of Sugarloaf State Park was destroyed. The recordings that these spectrograms represent may be for a time the only way to hear the soundscape of Sugarloaf.
Before moving towards finding the answers, it is important to appreciate that these questions, and the solutions they can lead to, would not have come up by visual observations alone. These are questions asked by our ears, with soundscape ecology paving the way for new practices in ecological investigation. Using the soundscape as a proxy to evaluate the condition of an environment, this research is able to address historic and current ecological impacts in environments that are urban, rural, or wild.

Case Study 2 – Lincoln Meadow
An example that Dr Krause showed me that I would like to add is a powerful episode revealing how effective the methods and protocols of soundscape ecology can be when put into action. This case comes from Lincoln Meadow in 1988, where a timber company convinced local residents that there would be minimal environmental impact through the technique of logging smaller sections of the forest. Dr Krause recorded a number of dawn choruses at the site to a strict protocol with calibrated equipment before and after the logging took place (Figure 4).

The spectrogram below is take from the recording made by Dr Karuse at the same time and date as the image above:

FIGURE 3: LINCOLN MEADOW IN 1988 BEFORE LOGGING BEGAN. (COURTESY OF WILD SANCTUARY)

FIGURE 4: SPECTROGRAM OF LINCOLN MEADOW 1988 (COURTESY OF WILD SANCTUARY)
The spectrogram (figure 5 above) displays a rich dawn chorus, containing a variety of bird species all vocalising as the sun rises. Each animal vocalises above the drone of the stream that can be seen in the bottom third of the image.

One year later in 1989, after the logging had been completed, Dr Krause returned at dawn to record once more to the same calibration and protocol. The biophony had altogether disappeared. All that can be heard is the stream running at the bottom of the image, accompanied by the lone hammering of a Williamson’s Sapsucker (a species of Woodpecker) in the lower right hand side of the image (Figure 6).

However, here is the photograph (Figure 7) of the same spot taken three years later in 1991:

To the eye there appears to be no change, supporting the claims of the timber company that there was very little environmental impact. However, we hear a completely different story. Dr Krause has returned to the site fifteen times in the years that followed and in 2013 stated that, ‘the biophony, its density and diversity, have not returned since’ (TED 2013)
The soundscape as an expression reveals much about a habitat that would go unnoted through other models of evaluation, meaning that we are deaf to a huge part of that habitat and are drawing conclusions about the ecology that may not be complete. Soundscape ecology sets out new lines of enquiry, researching the acoustic signature of our wild world and in doing so has identified that the soundscape, far from being without value, is an integral part of any ecosystem, and one that we must pay attention to if we are to better understand our world.

‘[It is essential] to protect these environments and their biophonies, because the voice of that environment, the soundscape, is an expression of how that environment is doing! If you [grasp] that idea and can see how important it is, it’s going to have an impact on your decisions: who you vote for and how you view the world you live in.’ Dr Bernie Krause, Sonic Report 2017

The Acoustic Niche Hypothesis
Interpreting The Wild Sophisticated Symphony

To further understand wild soundscapes, it is crucial to comprehend how the biophony, geophony, and anthropophony interact with one another. To do this, we must be able to decipher the intricate relationships inherent in any given soundscape. The Acoustic Niche Hypothesis, pioneered by Dr Krause in the 1980s, lays out the framework for this interpretation. As Dr Krause noticed: ‘The soundscape seemed to be formed in a way that animals were finding different bandwidths to vocalise in ... [meaning] that all of the animals found a certain acoustic niche. ... Otherwise their voices would be masked’ (Sonic Report 2017). The spectrogram below (Figure 8) is of a recording taken by Dr Krause in Zimbabwe that visibly demonstrates the separate vocal niches present in the soundscape. Note the different niches that the birds, insects, and bats fill across the spectrogram over a twenty-seven second excerpt:
From the rainforests to the deserts to the oceans and the lakes: It is possible to witness this elaborate display of vocal niches at work, the extent of which dawned on me during my Fellowship whilst using a hydrophone to record in a small puddle that had formed at the side of the trail. I observed the same separation of temporal and frequency niches. It was a marvel to witness the same grand intricacy that forms in the soundscapes of our jungles, forest, and plains in the shallow depths of a trailside puddle. Further more this was overwhelming evidence of the presence and formation of animal vocal niches across a wide spectrum of habitats.

Over my Fellowship in the United States, I was able to record many different biomes including forests, deserts, as well as beneath the water in lakes and reservoirs, at sites both urban and wild. I witnessed first-hand in the field that each and every organism in a habitat vocalises in its own frequency bandwidth, in channels that are ideally clear so that its voice may be heard. Other examples that Dr Krause showed to me in his studio also demonstrated how in healthy and established habitats, these niches are precise and distinct with each creature finding its place within the fabric of the soundscape.

The Acoustic Niche Hypothesis potentially shifts our understanding of a soundscape’s formation, anatomy, and its expression. This transforms the ways in which we perceive the soundscapes of our world: not as a random cacophony but an elaborate mosaic of interwoven and interrelating expressions. This highlights the necessity for us to comprehend the world with a sensitivity and an awareness that in turn helps to aid us in combating many of the global issues that we face today, and those that lie ahead.

‘All kinds of critters that [surrounded our home where] I grew up, in the early forties, were extremely expressive... to this day, I still have that resonance in my mind.’ (Dr Krause Sonic report 2017)

Anthropophony
The Dangers of Human Noise Masking Wild Voices

Soundscape ecology and in particular the Acoustic Niche Hypothesis has revealed that human endeavour may be having a greater impact than we have previously been aware of. If the biophony is an expression of the health of a habitat, its biodiversity, and levels of stress, and if a healthy habitat will have clear and defined niches, then how does human-generated sound – anthropophony – impact the biophony’s vocal niches?

Influential composer and author R. Murray Schafer coined the term ‘soundscape’ and much of his work is relevant to our appreciation of soundscapes today. Schafer in 1977, in his book ‘Tuning Of The World’, predicts that the changing acoustic landscape in an industrialised world would have many negative consequences on both people and the environment:
The soundscape of the world is changing. Modern man is beginning to inhabit a world with an acoustic environment radically different from that he has hitherto known. These knew sounds, which differ in quality and intensity of the past ... [are] dangers of an indiscriminate and imperialistic spread of more and larger sounds into every corner of mans life.

Since Schafer made this statement, we have become increasingly aware of noise pollution on the human psyche. What we have yet to properly consider is the effect of our ‘indiscriminate and imperialistic’ noise on other inhabitants of the earth. A less noted consequence of this is sonic masking that takes place as our anthropophony blocks frequency bandwidths used by organisms to vocalise and communicate in. The vocalisations of one animal in a soundscape form with an awareness of other biophonic as well as geophonic sounds that are present. In contrast, our noise is unaware and directly pollutes the wild soundscapes by interfering with and blocking frequency channels that have evolved over millennia. This causes stress levels to rise in the habitat and pressures animals into changing their vocal behaviour as they adapt to the forced exposure to our noise. This in turn threatens the ability of certain species to survive if they are unable to make these adaptations. Anthropophony then plays a major role in the loss of wild soundscapes, dramatically effecting biodiversity and habitat viability.

To illustrate this point, I have two separate examples. One is from Dr Bernie Krause’s observations made at Mono Lake, a site that I also visited to record whilst on my Fellowship. The second is from Professor Nadia Pieretti of Urbino University, Italy, whose work has uncovered some of the ways in which songbirds are adapting their vocal behaviour in an urban environment.

**Case Study 3 - Mono Lake**

*It is dusty; the arid wind akin to that of a whip lashes the landscape. Stretching out before me, filling the full range and the scope of the eye, an alien, otherworldly place that seems that it is not quite of this earth, but it is. In contrast with the dry and dust-filled residence, the bright alkaline waters of a vast lake shinning blue as the sun heats the still sheets of water spanning out dominating this world. As if to enforce its sense of otherness, huge white tufa spires thrust through the parched land, forming brilliant towers that, in collaboration with the lake, define the landscape that lies before me. A land that could be misunderstood, a place of stark, fragile beauty, and one filled with life.*

*Missing Wolf Field notes whilst visiting Mono Lake 17th May 2017*
Mono Lake is an alkaline lake that sits just east of the Sierra Nevada mountain range and Yosemite National Park, in California. Exploring this very special environment had a real impact on me, and the story that had unfolded at Mono Lake is also a great example of how careful listening can help us to understand the natural wild world. Being situated in the high desert, Mono Lake is a place of extreme temperatures with baking days and freezing nights, making the area vulnerable to global warming as temperatures rise. Mono Lake also faces other stresses introduced by humans: Firstly, the lake is used to supply water to populations living in towns and cities in California. Only after hard-fought campaigns, restrictions were placed on the amount of water that could be drawn from Mono Lake, helping to maintain the water level. A second factor has been posed by the military as they fly aerial maneuvers over the Mono basin. The incredibly loud jet aircrafts pass over a couple of hundred feet above the lake, as a consequence effecting ecological stability.

When conditions are wet enough in the Mono basin, the Pacific Spadefoot Toad digs its way up from the mud to mate. When on the surface, the frogs chorus together. This cooperative behaviour means that predators like coyotes cannot pinpoint a single frog for predation. It was noted by Dr Krause through recording and analysing the soundscape of this habitat, that the noise produced by the fighter jets masked the frequency channels used by the Spadefoot Toads as they chorused. This meant that the chorusing Spadefoots fell out of sync with one another as the jets passed overhead, in turn allowing predators to swoop in and pick off a few of their numbers. Over time, their population decreased rapidly. However, after careful habitat restoration and fewer flights by the military, the Spadefoot Toads have returned to almost normal numbers. (Dr Krause) This example demonstrates how we can use the information gathered via studying the soundscape to effectively lessen a strain on that habitat that we otherwise would not have been aware of.

Dr Krause’s Acoustic Niche Hypothesis has been supported by further studies in animal vocal behaviour. As written about in Almo Farina’s book ‘Soundscape Ecology’ (2014), Prof Nadia Pieretti of Urbino University, Italy, discovered that urban songbirds had transposed their songs to a generally higher frequency bandwidth than those in a wild setting. This adaption was linked to acoustic competition posed by the anthropophony that surrounded the urban birds. To be able to carry on communicating, they had to find a new vocal niche. For me, this modification in behaviour is remarkable as it indicates the existence of a
precise acoustic awareness. As stated by Dr Krause in the Sonic Report: ‘An animal’s vocal behaviour is very much a part of their survival strategy. If they are going to survive successfully… they have to be able to transmit and receive information in channels that are noise-free.’

Anthropophony, whether it is by masking specific niches and thus making certain animals more vulnerable, or by motivating certain species to adapt via shifting to a clearer bandwidth, is having a huge impact on the natural world. This is practically problematic in the case of uncontrolled anthropophony’s pervasive nature and intrusive spread of this ephemeral pollution around the earth.

Intangible Heritage of a Half-Century of Sound
The Importance of Audio Archives

If we are to start to understand how the soundscape of our world is changing in relation to challenges caused by human endeavor including anthropophonic spread, expanding infrastructure, climate change, and habitat loss, then archives of recordings will play a crucial role in our ability to grasp these global trends. Made up of around 1300 different sites, Dr Krause’s archive is one of a very limited numbers around the world, stored on rows of Digital Audio Tape and as digital recordings saved to hard disk. ‘The archive itself goes back fifty years, so if you wanted to know what a place sounded like … fifty years ago, the archive is a good historical reference’ (Sonic Report 2017). Through observation and comparison of soundscape recordings, Dr Krause has already noted how radically the environment and its subsequent soundscape has changed over the last fifty years, revealing that ‘50% of the archive or more are from habitats that no longer exist’ (Sonic Report 2017). So the archive, being valuable as a historic reference, is also important as intangible heritage. The reality is that when Dr Krause says these habitats no longer exist, their biophonies and geophonies are either altogether silent or they can no longer be heard in their original form (Dr Krause). Without such archives this silent extinction would come to pass undocumented and unnoticed.

There is something both stunning and stirring when it comes to the archive that Dr Krause has built over the last half decade, containing countless examples of some of the most wondrous habitats and animal behaviour I have ever encountered. For instance, from Alaska comes a recording that conjures an apparition of a low breathy wind passing over the frozen tundra. However, I was astonished to learn that this sonic phantom was in actuality two packs of wolves creating a sound I had never expected to hear from a canine. What does this sound mean? Is there a relationship between this voice and that of the wind? This sound, so surreal and unexpected, something you could only have heard if you had been present in Alaska at that moment, was there for me to experience sitting in a studio in Northern California. The spectrogram below depicts that event recorded by Dr Krause, with the Wolves vocalisations at the bottom of the image. (See Figure 10)
A different example involves a very special primate, the Baboon. In this recording, a group of Baboons in Zimbabwe are shouting/barking towards a flat rock face in the jungle. Exactly what they are doing does not become apparent until one of them hits the reverberation sweet spot, creating a seven second echo as the voice decays. They then take it in turns to play with the reverberation. I was awe-struck at how the Baboons played and at their knowledge of how their voices would interact with the rock face.

Look to the bottom section of the spectrogram (Figure 11) you can see the moment the Baboons find the right spot. This recording is a reminder that the other life around us expresses itself in many of the same ways we do, this time through play. These instances in time captured and recorded are both historical and scientific, as well as precious examples, adding to the mystique and wonder of the wild world. The archive forms an invaluable report, which is testimony to the wild voices of the world, the significance of which will come to bear its true meaning in the years to come as a historical, scientific, and artistic resource.

When speaking to Dr Krause concerning his archives and others like it, he remarked: ‘I’m just hoping that archives like mine, Martin Stewart’s, and Chris Watson’s, that these archives are not the only way we are able to hear what was once here in this world… [and] that people are going to get wise enough fast enough to really grasp the urgency of protecting these places and these sounds. It’s simply that.’ (Sonic Report 2017)
Soundscape ecology is an effective tool to evaluate the health of a habitat across the entire spectrum of life, contributing new ecological information and posing new questions that could change the way we perceive the workings of the wild world forever. However, due to the nature of the wild it can take time to record the data required to truly understand how our world is changing. In the protection of our wild world time is a luxury we do not always have. Archives of calibrated recorded soundscapes are thus integral to ongoing research, giving us a basis from which to comprehend the state of affairs around the globe. Quite simply, archives such as Dr Krause’s are valuable for posterity and in the present as they provide the basis for current and future investigation of the world’s ecology via its soundscape.

‘This is the voice of the natural world, and it speaks to us, [poetically and with a lyricism that cries for our attention.] … and these voices are screaming out [literally pleading for us to stop the incessant plunder], saying, hey don’t do this, its not cool. [If we don’t, soon they won’t be there any more.]’

Dr Krause (Sonic Report 2017)

The Urgency in Protecting Wildness
The Fading Call of the Wild

‘If all the beasts were gone
Man would die from loneliness of spirit;
For whatever happens to the beasts, happens to the man.
All things are connected.
Whatever befalls the earth, befalls the sons of earth.’

Chief Seattle, Dzisnsh

It became clear over the course of my Fellowship that as we are learning to listen to the voice of the wild, we are confronted with an urgent message. Wild soundscapes are gradually falling silent around the world. Due to anthropophony, habitat destruction for agriculture and industry, climate change and global warming, as well as pollution of the air and oceans, wild habitats and their soundscapes are being dramatically altered. Dr Krause has experienced this decline first-hand and, in reflection upon some of the changes witnessed, stated: ‘Alaska is changing rapidly and radically, and that’s a stark reminder of the consequences of our actions. Same thing goes for many of the rain forests and places I have recorded on coral reefs’ (Dr Krause Sonic Report 2017). Taking Dr Krause’s observations into account, it would seem we are running a very real risk that wild soundscapes will become extinct and a thing of the past.
A declining wild soundscape signifies the decline of the natural world. This dramatic trend has taken place over a very short amount of time. When asked about the future of wild soundscapes, Dr Krause reflected that ‘as long as our goal is not to destroy [the wild] and pick it apart. Otherwise I don’t think we have another fifty years.’ (Dr Krause Sonic Report 2017)

‘I’m just sitting here as an observer and when I go out to talk to people I say: Is this what you want to happen?’ (Dr Krause Sonic Report 2017)

A major factor in the waning natural soundscapes on earth is the rapid decrease in wild places, the loss of which in the UK is obscured. Lacking the opportunity to ever be in true wild places most people have no direct experience of wildness. This leads to a disconnect and lack of awareness that anything is being lost. Speaking at a national parks conference in 2015, British author George Monbiot stated that ‘in the United Kingdom, we have a lack in wilderness, with our forest cover being reduced to just 13% of our terrestrial space, which compared to the European average of 37% is incredibly low.’ This impression is supported by my own experience on a recording expedition to the Great Langdale in the Lake District National Park, northwest England, in early 2017. I was surprised how sparse and fractured the wild soundscape was in this awesome valley, with its crashing waterfalls and high peaks. The lack of wildness seemed to be related to the most prominent use of the landscape in Langdale, which are sheep farms. There seemed little room left for the wild in between the sheep as the flora had been grazed all but to the periphery of the valley. In comparison, on my Fellowship in the United States, I encountered a different scale of nature, not just in geographic size but also in its richness and diversity. This contrast was reflected in the quality of the soundscapes that I recorded, which increased the wilder the places became.

‘Since wilderness is a place, and wildness a quality, we can ask, “how wild is our wilderness, and how wild is our experience there?”’ Jack Turner 1996

By no means am I stating that everything is fine in the United States. On my travels, I witnessed incredible strain on natural habitats across the west and southwest, mainly due to overdevelopment and climate change induced drought and forest fires. However, although the wild is compromised in the United States, and in some cases not truly wild at all, there is much about it that we lack in the UK. One example that struck me was the spaces shared with the alpha predators, snakes, and other species that the equivalent of in the UK are either extinct or endangered. It is in these places that the wild soundscape can be heard at its healthiest and most vibrant. This may be due to the fact that these predators are a keystone species that play a pivotal role in eco-engineering habitats helping to maintain and manage the land ‘wildly’. If we consider that the soundscape is a proxy for habitat health and considering how the intensity, density and diversity increased the wilder the soundscape became it is then a fair hypothesis that the ‘wild’ is a beneficial state of nature displaying richer, healthier, and more bio-diverse habitats, a more intact state of nature. Sam
Turner, the author of The Absrtract wild, states ‘One does not kill, destroy or exploit what one truly loves’ (1996) Can people love what they do not know, that which they have never touched, breathed in, or felt? How do we express the loss of wild soundscapes when we have never listened to the critters in our own neighborhood, or gardens? This will take a new approach in how we situate ourselves in the world, it will mean relinquishing control, and crucially as Jack Turner states creating ‘new wild traditions’ (1996). Understanding wildness, its value to both the ecology and our lives is crucial if we are to hear the soundscape of the United Kingdom flourish.

What counts as wildness and wilderness is determined not by the absence of people, but the relationship between people and place. Jack Turner 1996

Many Ears Make Light Work
The Contribution of Wider Communities in Documenting Wild Soundscapes

In the United Kingdom we have thriving communities of field recordists, musicians, artists, environmentalists, and naturalists. To the extent that they can be encouraged to work together, these communities could play a vital role in documenting, researching, and understanding the messages expressed by the voice of the wild. Just as we have seen in the field of astronomy, skilled communities and amateurs can make genuine scientific discoveries. The situation is similar in the case of soundscape ecology as it is not many eyes that we need but many ears.

The United Kingdom has a particularly active community of field recordists that could contribute in data collection and environmental observation. Being able to operate specialist audio equipment and having experience in the field can make all the difference in the quality of data gathered. If the field recording community were to adopt the same protocols and calibration methods used by Dr Krause and other soundscape ecologists, a potentially large community of people would be able to contribute reliable data. This in turn would aid in research and understanding of the wild soundscapes of the United Kingdom.

In Seattle, Washington State, I attended the Nature Sound Workshop to better understand equipment, field protocol, and new software that is utilised in the application and execution of soundscape ecology. The workshop was lead by Martyn Stewart, who is one of the top field recordists in the world. Originally from Scotland, Martyn has worked on many BBC documentaries with David.
Attenborough. At the workshop, when the participants were asked what their motivation was for attending, many cited the protection of and an interest in the natural world. With discussion turning to environmental issues relevant to the subject of field recording, it became clear that many in the field recording community in the USA are driven by their passion for the wild world. During the workshop, Martyn explained basic field protocols and microphone calibration. This format could be replicated in the United Kingdom, equipping skilled and novice field recordists with the knowledge to contribute to our ecological understanding of the UK through its soundscape.

However, it is not only field recordists that can contribute. At the Nature Sound Workshop I learnt how you can even use your smartphone out in the field to record. With some relatively good recordings having been made with smartphones, documenting the voice of the wild is no longer the domain of the professionals alone. Due to the nature of soundscape ecology as a field, it is possible for anyone to play a role in the cause to protect the voice of the wild.

The purpose of recording the wild, however is not just for the collection of endless data sets. Field recordings are incredibly rich sonic resources for us to use in the arts and in music, not only allowing for scientific contributions but also cultural and artistic ones. This is especially significant given the role wild soundscapes have played in the development of our musical expression.

‘I am really hoping that others will take up the gauntlet, go for it, and develop other ideas.’ Dr Krause Sonic Report 2017

Musical Lessons Learnt From The Wild
Primitive, Visceral, and Savage, or Fundamental, Innate, and Ancient

Throughout my Fellowship working with Dr Krause, the discussion often turned to music as we listened to and worked with wild soundscapes in the field and in his studio. Music is one of the many fields that soundscape ecology intersects with, enabling it to inform our musical understanding and for music to inform our understanding of the soundscapes of our world. The practice of careful listening that can lead us to an understanding of our environment is not necessarily a modern mechanism but an ancient one developed by our most distant ancestors. As Dr Krause (Sonic Report 2017) stated in interview with me:

When we lived much more closely [connected] to the natural world ... the sounds of the forest and the sounds of the plains were what informed us, because we needed to figure out a way to be in sync with the other life around us. ... [In response] we begun to express ourselves and our sense of the world in relation to those [soundscapes]. To me that is key to our understanding of how we developed music. It is an issue we have got to pay some attention to because the great animal orchestra is every bit as important as Beethoven’s 5th.
According to Dr Krause, the call of the wild that has sounded for millennia has been an influential source for our musical expression. Today that same voice is still a creative source that musicians and composers in the United Kingdom need to connect with to develop and redefine their musical and artistic paradigms.

The Wild: Musical Heritage and Formation
Our first point of exploration in tracing our musical roots to wild soundscapes comes from a question posed by Dr Krause in 2012 whilst speaking at Harvard University, USA: ‘How did we get this kind of organisation, what is it about our organisation of music and our connection to it we found from the natural world?’ By applying Dr Krause’s Acoustic Niche Hypothesis to recordings of our own music, a fundamental aspect of our musical expression is revealed in the formation of wild soundscapes:

Below, the spectrogram (Figure 8) from Zimbabwe that we have previously seen:

The biophony pictured has clearly defined vocal niches as with any healthy habitat this close to the equator, with bats in the highest part of the frequency spectrum, followed by insects and birds in the lower portion. Now if we compare this with the spectrogram (Figure 13) of American jazz-rock band Snarky Puppy’s ‘Gretel’ from 2015, we can observe the same vocal partitioning that can be found within the soundscape of Zimbabwe:

Figure 13 Depiction of Snarky Puppy’s ‘Gretel’ 2015, Spectrogram produced by Missing Wolf 2017
Just as each animal establishes its own acoustic niche so does each instrument in the fabric of the music. The acoustic awareness observed in wild soundscapes that encompasses rhythmic, harmonic, dynamic, and melodic interaction in humans, is often referred to as musicianship. These shared patterns are an indication of how we may have inherited our musical organisation from the acoustic formation of wild soundscapes. This connection seems to be a historic one, the collective articulation that is the biophony and geophony having influenced the fundamental building blocks of our musical expression since our ancestors first listened to the world around them.

The Wild and Musical Innovation Today
However, over the course of my Fellowship it became evident that the ever-articulate voice of the wild has more to teach us. Through conscientious listening, composers and musicians in the United Kingdom may be able to learn to distinguish the complex harmonic, melodic, rhythmic, and timbral attributes of a wild soundscape once more. Through the application of soundscape ecology’s practices and tools, the potential appears for us to innovate aspects of our music further. This may allow musicians and composers to go beyond our more standard musical practices, broadening their attention to the sonic qualities and structures present in the sounds emanating from the wild.

Whilst working with Dr Krause one afternoon in his studio, we listened to a set of recordings from an album that he had written at the end of the 1980s, titled ‘Gorillas In The Mix’. Listening to the album of pop and rap music of its time, what I thought I heard, and what I was actually hearing, were two different things. The track ‘Ape No Mountain High Enough’ opens with a distorted electric guitar playing the main riff, followed by percussion, and steel pans. Well, it turns out that the electric guitar was the vocalisation of a Humpback Whale, the percussion various utterances of fish, and the steel pans, were of course elephants. With the vocalisations taken out of context by Dr Krause via the musical practice of sampling, the sources of the vocalisations become obscured. This leaves us to perceive the sonic quality of the sounds and reinterpret them in this musical setting.

I was completely taken aback by the uncanny resemblance between the animal vocalisations and the very modern instrumental sounds I was hearing. This was especially true in regards to the distorted electric guitar (or should I say Humpback Whale): As an instrument, the electric guitar only appeared in the 1930s and is relatively modern. However, it would seem that the sonic quality of the electric guitar was pre-empted by the vocalisation of the Humpback some 40 million years before...long before our human ancestors first appeared. It occurs to me that we have attuned ourselves to certain acoustic qualities, qualities that have been present in the voice of the wild all along. The acoustic character of the biophony and geophony around us could quite possibly have influenced our choices of which sounds would form our musical expression.
By listening to the sonic traits of animal vocalisations, we may add to our image of the historical inheritance of our music from the wild. Further to this, it is my observation that due to the complex and intricate nature inherent to the acoustic signatures of the wild, soundscape ecology and its tools present composers and musicians with a way to re-access these sounds. Focusing on the sonic qualities of the biophony and geophony can become more than musical inspiration – a resource of sonic material that directly blends into our music. In my experience as a composer and field recordist, the sounds I have heard emanating from the wild are sonically detailed in ways that would take hours to manufacture. By turning to the wild for musical and sonic inspiration, composers may find a source for sonic innovation, one that defines new melodic structures and behaviour as well as establishing the sounds of the biophony and geophony as a mainstay of our musical expression.

Case Study 4 – The Great Animal Orchestra Symphony

‘I thought it was a gift to a composer, this whole idea of how the natural world organises itself in hierarchies of scale, from the very highest to the very lowest, and how this corresponds with the highest and lowest instruments of the orchestra.’ Richard Blackford 2014

Dr Krause, who has been at the forefront of this creative movement ever since his work with his late music partner Paul Beaver on ‘In a Wild Sanctuary’, teamed up with composer Richard Blackford after the latter had read Dr Krause’s book ‘The Great Animal Orchestra’. They began work in 2013 on a symphony for orchestra and wild soundscapes, which would be premiered a year later with the BBC National Orchestra of Wales, at the Cheltenham music festival.

The ‘Great Animal Orchestra Symphony’ combines a 70 piece traditional orchestra performing “live” with recorded wild soundscapes from Dr Krause’s archive. Blackford reflects on the process of creating ‘The Great Animal Orchestra Symphony’ in an interview with Nimbus Records in 2014:

I felt I wanted the thing to appear seamless and effortless, but in fact it took hours and hours of listening. We listened to well over two hundred recordings. … From that started to emerge structures of which I felt could form the basis for a symphonic composition. … I wanted to see exactly how fast the screaming Piha screamed, and it was a crotchet at 144 [bpm], so that particular movement can only go at that tempo for it to work. … A whale came in on a particular B note, so I started to construct musical ideas around what the animals were already doing, especially the musician wren, which has an incredible melody, so I thought I could make a whole theme and variations on that.

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4 Recorded in 1968, released in 1970 ‘In a Wild Sanctuary’ is generally cited as one of the first recorded musical works to use wild soundscapes as an element of orchestration.
Blackford was able to determine certain qualities from the animal vocalisations that were musically related to symphonic composition. By constructing musical ideas around wild soundscapes, Blackford established common expressions that already exist in both symphonic music and the biophony of the wild.

To help illustrate the process Blackford has described, I have chosen two examples from his symphony to demonstrate the methods that they used to meld the symphonic and the wild:

**FIGURE 14: ‘INTRO AND TUNING’ FROM THE GREAT ANIMAL ORCHESTRA SYMPHONY, BY BLACKFORD AND KRAUSE 2012. SPECTROGRAM PRODUCED BY MISSING WOLF 2017**

Depicted is the opening of the symphony with solo Gibbon songs whose final note is taken on by the strings. The insects above play over the transition, laying the background rhythm for both Gibbons and strings. In this example the wild vocalisations precede that of the orchestra. This is a significant structural choice that appears through the symphony and defines the role of the wild soundscapes as the lead for the acoustic vocabulary throughout.

**FIGURE 15: ‘VARIATIONS’ FROM THE GREAT ANIMAL ORCHESTRA SYMPHONY BY BLACKFORD AND KRAUSE, 2012.**
In the example ‘Variations’ (Figure 15 above), the flute first listens to the melody of a Musician Wren as it sings its solo song. The flute then plays the melody together with the bird. Finally, the wren drops out and the flute takes over the role of playing the melody, slowly varying what was originally observed: In the space of thirty seconds, Blackford was able to play out the historic process that took place as our ancestors first listened and then mimicked the voices around them. This process may have lead to the creation of our musical expression as we derived new meaning out of the sounds that we had originally heard. I believe that it was no accident that Blackford made the choice to structure the symphony this way. The process of listening to wild soundscapes that Blackford went through with Dr Krause, seems to not just have highlighted musical ideas that could work, but rather defined the musical parameters in both how the symphony would unfold and in its musical content.

‘The Great Animal Orchestra Symphony’ is an initial expedition that not just explores the use of wild soundscapes in music but also the direct relationship between soundscapes and symphonic music. For me, the symphony is not defined by the animal vocalisations but is a manifestation of the wild soundscapes that Blackford listened to in the studio with Dr Krause.

‘There was no template for this … I could think of that had combined soundscape textures … in the way that we have done. In many ways it was liberating but quite terrifying as well.’ Richard Blackford 2014

Our Acoustic awareness and Learning To Listen
Establishing a practice of listening to the wild and taking the time to focus and engage with it on a creative level comes back to our relationship to it. The more time we spend with it, the more we learn. Imagine then that by focusing and nurturing our connection to the wild, it would be possible to perceive the dawn chorus in the forest not as a discordant cacophony but as a multi-layered mosaic of sound. Well, Dr Krause played me a recording displaying just that from the South Western part of the Central African Republic of a ‘yelli’, a vocal style of the Babenzélé Pygmies (B’Aka), who traditionally live within the forests of the Central African Republic. The following spectrogram is of a recording made on site by Louis Sarno in the Dzanga-Sanga Rainforest, Central African Republic, December, 1994, as the B’Aka sang their ‘yelli’ for gathering mushrooms.

What we see in the spectrogram (Figure 16 below) is a visible display of the B’aka’s ability to place their singing between the established vocal niches of the forest, finding their own niche just as each and every organism that forms the biophony does. By honing their hearing and nurturing their connection to the natural world, the B’Aka have been able to distinguish and perceive intricate and subtle acoustic increments that are born of the wild.
Via the analysis of vocal niches we may also develop an acute awareness of this complex structure. By re-opening our ears to the wild we may yet again connect to this rich sonic tapestry. In turn radically altering our sense of pitch, rhythm, and harmony as we re-focus our ears and expand our musical vocabulary, an example of which is ‘The Great Animal Orchestra’ seen previously.

The practice of singing with the biophony is symbiotic, for the B’aka’s sensibilities have evolved in connection with the forest that is their home. This awareness has allowed them to perceive in detail what is taking place in their world, something that is vital when co-existing and living from the land. The B’Aka are not alone in this as many different peoples historically all around the world have tuned into the biophony around them to hunt and navigate the encompassing world. ‘In these cultures it is astounding how closely their music reflects the complex rhythms, polyphonies, and sonic textures of the habitats where they live.’ (Krause 1998) It is then the very relationship we hold to the natural wild around us that may help us discover new artistic and musical originality based on this historic connection, in turn nurturing our understanding of the natural world through these new wild traditions.

Although forgotten this bond is still present. You may be surprised at how in tune with the voices of the wild you may already be. Whilst working with recordings of crickets with Dr Krause, I could tell by the way the crickets stridulated if it was morning, afternoon, or night. The sense of time and place engrained in the sounds I was hearing was incredibly clear. This is our natural tuning to the world that is already present within all of us – very likely a component of our DNA. It has become a sonic awareness that is hardwired within, connecting us organically to the world. However, this is but a remnant of our past connection as Dr Krause summarised in his book ‘Into a Wild Sanctuary: A Life in Music and Natural Sound 1998):

‘Industrial societies are primarily visual cultures, no longer connected spiritually or aesthetically to the sounds of the natural wild. As a consequence, we’ve lost a certain aural acuity once central to the dynamic of our lives. This of course, had a profound impact on our understanding of the natural world which we now experience as abstract and distorted.’
A process of re-wilding our music is then part of a much more holistic and fundamental movement towards deepening our relationship to the wild world. ‘What we need now is a new tradition of the wild that teaches us how human bings live best by living in… the wild without taming or destroying it’ Jack Turner 1996.

The Role of Art and Music in Soundscape Ecology

Interdisciplinary collaboration

“Since the origins of music [were inspired by] the sounds of the natural world… from impressions that we have of [its] expression… since our music comes from that, at one point or another, all of our music has a very important role [to play in conveying those links].” Dr Bernie Krause  Sonic Report 2017

An assertion of Dr Krause’s is that the kinship between music and wild soundscapes is crucial to the evolution of soundscape ecology as a field of study, especially in how we communicate and disseminate its findings. We often think of science and art as two separate endeavours. However, soundscape ecology has been directly informed by our understanding of music just as much as it has informed it. The fact that Dr Krause as a musician was able to propose and develop the Acoustic Niche Hypothesis is significant, as the ability to focus our listening and note acoustic structures relates to skills originally reserved for musicians.

Soundscape ecology is an interdisciplinary field of study, one where artists and scientists can both work towards the comprehension and recognition of wild soundscapes. However, whilst collaboration between the arts and sciences may generate new lines of inquiry, it is music and art that can ‘go beyond science’, lighting up the imagination and stirring emotions. Although this may seem radical as Dr Krause (Sonic Report 2017) puts it:

If you are just writing scientific articles about it and three people read it, it’s not going to have much of an impact. On the other hand, if these studies are somehow transformed into language that most people will understand — see it’s through the arts people respond intuitively — if the message is right and framed in the right way … most people in the world are going to get this stuff. [It’s a common language]

An example of art in action comes from 2016 when the Fondation Cartier pour l’art contemporain in Paris commissioned an art piece to be installed by Dr Krause as the focal point of an exhibition they titled ‘Le Grand Orchestre Des Animaux’, after Dr Krause Book. The commissioned piece (figure 18) enveloped audiences in different soundscapes recorded by Dr Krause, that were played back via a surround system. The spectrogram was simultaneously streamed across the walls of the room as
the soundscape played. I was in attendance at the opening event of this piece in July 2016 and can testify to the impact created as the audience sat in silence transfixed by what they were hearing. Within the period running between July 2016 and January 2017, whilst the piece was installed at Fondation Cartier pour l’art contemporain, over 180,000 people came to experience wild soundscapes. Now having been to South Korea, ‘Le Grand Orchestre Des Animaux’ has been extending its reach to many 100,000 more. This is an excellent example of how art can open up new audiences to the world of wild soundscapes, and through framing science as art, Dr Krause was able to communicate much of soundscape ecology’s current data. Through the arts that we can strike at the heart of people, as it is often how we ‘feel’ about something, not what we ‘think’ about it, that will

‘Getting the information out there, that these habitats are under stress, that we are responsible for that, [and] if we want to save them for ourselves and our children, we better get out there and make sure people know about that … anyway we know how’ (Dr Krause Sonic Report 2017).

If we are not able to express the messages that can be detected through the practice of soundscape ecology and leave this information to gather dust, we may fail to meet a prime objective of soundscape study – to protect and preserve the wild soundscapes on earth. Dr Krause warns that, ‘we haven’t got a lot of time left, stuff is going so fast. … If we have any hope of changing minds and attitudes, we better do it as quickly as possible and the only ways we know how’ (Sonic Report 2017). The interdisciplinary nature of soundscape ecology is in my opinion a major asset in facing this incredibly time-sensitive challenge to protect the flora and fauna of this planet. Through collaborative efforts we do not just deepen the scope of research possible but also our ability to communicate these findings. By telling the powerful story of the complexity and intricacy of the world’s soundscapes, its historical and cultural relevance to us, and the plight of the wild and its voice, we may keep the wondrous and mysterious beauty of the world intact, for it is the most valuable thing on earth.

“If you value it, you will want to protect it, and you won’t want to let it go, because it’s not going to come back if you do”. Dr Krause Sonic Report 2017
Conclusion

Over the past half-century, Dr Krause has worked at the forefront of wild sound. Throughout this time, Dr Krause has been able to set out the framework for soundscape ecology and establish many lenses from which we may investigate wild soundscapes, on both a scientific and creative level. Due to its fledgling state, soundscape ecology is open to innovation and new ideas. When put into practice soundscape ecology could, reveal information that could radically alter our perception of soundscapes and their value in relation to ecological stability, scientific understanding, and human culture. The world of soundscape ecology is moving fast, reaching out, and intersecting with people from many diverse disciplines. As a result both art and science may enhance research through collaborative efforts in the joint pursuit of the expression, protection, and understanding of wild soundscapes.

My experience of the wild has become a defining feature of my Fellowship. The sense of presence and awareness generated by being in the wilderness has stayed with me ever since and acts as a reminder to me of our place as part of this world. Witnessing the practices of soundscape ecology in the field first-hand and the questions it can raise through careful attention to the soundscape was a powerful experience. I observed Dr Krause’s Acoustic Niche Hypothesis unfold in the humble trailside puddle in no lesser way than in the deep oak forests, with the same careful acoustic formation being present in both. This experience was awe-inspiring and an affirmation of the work of Dr Krause and the future potential of soundscape ecology. It was my further fortune to receive a guided audio tour of Dr Krause’s archive, as he played back the weird, wonderful, and most wild, unexpected aspects of the natural world, revealing evermore of its mystery and wealth, and a further reason as to why we must protect the wild and its emanating voice.

The future of wild soundscapes is not clear but through the practices and principles of soundscape ecology we have a chance of responding to the fading call of the wild. Combining soundscape ecology’s methods with visual observations and practices may also represent an opportunity to move towards a more holistic approach in regards to ecological research, conservation, and appreciation of the natural world.

In the UK and its overseas territories, acknowledging the role of wildness in the protection and restoration of wild soundscapes could define our efforts. Changing our cultural appreciation through wild traditions and the relationship we choose to the land is then crucial to the future prosperity of wild soundscapes. This is due to the fact that habitat restoration and care for biodiversity are key factors in sustaining soundscape health.

Through the combination of creative and cultural aspects of soundscape study with the ecological sciences it is possible to generate a mutually co-operative platform to further the development and reach of soundscape ecology, the
protection of the wild, and to enhance our own creative expression. As a result we may also start to notice cultural ramifications in regards to our relationship to the wild as well as the development in our ecological understanding.

This report has attempted to bring together topics related to ecology, science, and art that are all influenced by the study of soundscapes. This includes: an introduction to soundscape ecology, the advantage of methods and practices of soundscape ecology in ecological evaluation, the Acoustic Niche Hypothesis, human noise, the relevance of audio archives, the urgency in protecting wild soundscapes, community involvement, soundscapes and musical heritage, soundscapes and musical innovation, and art and music’s role in the development of soundscape ecology. The overarching principle that runs throughout this report is that the soundscape is a precious surrounding voice – one that must be protected – and if we can learn to listen for its messages we may uncover information pertaining to our world and how we are doing in relation to it. This may lead us to learn not just about the ecology on earth, and how to better live alongside it, but to new aspects of our very nature as human beings born of the natural wild world.

Missing Wolf 2018

**Figure 19:** Map of West and Southwest USA highlighting counties where expeditions took place, including photographs of a selection of 10 sites from those recorded during the Fellowship, 2017.
About The Author - www.missingwolf.com

It has only been since conducting the Fellowship that I have come to understand a feeling that I have had with me all my life. The ‘Call of The Wild’ may in some part summarise this sense and my experiences of meeting wildness and recording there in the United States.

I chose the name Missing Wolf as a reminder and a way of connecting the things that I create to that which I care about. In short, I am a composer with a passion for the wild, or something wild that has a passion for music, a naturalist of sorts, although tags are not always very useful in defining what we are.

Having studied music from Japan, and having spent an extended period of time in Ghana with the Ewe drumming cultures, I would say that I have always been listening out to the world around me. Whilst studying a BA in Contemporary Composition at Dartington College of Arts and Falmouth University (2009 – 2012), I was inspired to turn my ear to the sounds around me. I learnt to listen for finer sonic details, to record these sounds, and to manipulate them for art. I started to train my ear. Since then I have created original works for film, dance, installation, and performance. Further to this, I lecture and teach music through my company ‘Drum Culture’, as well as perform in a variety of musical ensembles.

It was not until WOMAD festival in 2015, where I was scheduled to perform, that (dropping all my camping gear) I sprinted off to catch a talk about ‘The Origins of Music in The World’s Wild Places’ by a guy called Bernie Krause – little did I know the impact that this talk would have. The wonder of wild soundscapes as described by Dr Krause through the lenses of soundscape ecology absolutely gripped me. The intersection of sound, music, and wilderness seemed almost mystical. Soundscape ecology was a revelation to me, the role it plays in ecological protection, ecological research, our understanding of life on earth, and of our own culture. As a composer, as a human, I knew that soundscape ecology offered a fresh perspective and one that I wanted to be involved in. To that end I have been incredibly fortunate to be awarded a 2017 Travelling Fellowship in Science and Innovation by the Winston Churchill Memorial Trust and to work alongside Dr Bernie Krause. The Fellowship has helped to establish a strong framework from which to explore the subject of soundscape ecology, and going forward has enabled me to practise and share what I have learnt on the Fellowship for the benefit of the United Kingdom and all that is wild.

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