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The Voice of the Other.

The Case for Deep Listening and Nonhuman Music

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ABSTRACT

The climate crisis is arguably the most significant issue the human race is facing right now, possibly ever; and yet, the global solutions to this emergency feel underwhelming and lacking the sense of momentousness that should be required. Part of the reason is that human inaction toward climate change has a cultural basis, the very basis that is responsible, or at best, complicit, in the environmental crisis in the first place. Quoting Amitav Ghosh, the climate crisis is a crisis of culture, and as of now, the culture is rooted in anthropocentrism and binary thinking, resulting in a dismissal of the nonhuman, stripping it of its agency and voice. There is a need to rebuild the human relationship with his surroundings, there is a need to listen. Ecomusicology and zoomusicology are two relatively new interdisciplinary fields of research focusing on nonhuman sound, both challenging anthropocentric views and encouraging a more informed, perhaps kinder, understanding of the Other. Music has a role to play in this process: it has always been considered something that could only be made by, and for, humans, yet another instance of the kind of thinking that leads to further detachment from the nonhuman. To broaden one's scope toward what is more than human in a sonic context, to listen, is the very first step leading to a reconciliation with the Other, due to the inevitable recognition that it has a voice, and it can have music.

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INTRODUCTION

The climate crisis is arguably the most significant issue the human race is facing right now, possibly ever. Its ramifications are to be found everywhere, from extreme heat waves and droughts to the loss of biodiversity, and yet, the global solutions to this emergency feel underwhelming and lacking the sense of momentousness that should be required. Part of the reason is that human inaction toward climate change has a cultural basis, the very basis that is responsible, or at best, complicit, in the environmental crisis in the first place. Amitav Ghosh famously stated that "The climate crisis is a crisis of culture, and thus of the imagination", arguing for a deeper involvement of the arts and humanities in tackling environmental challenges, hand in hand with the so-called "hard" sciences. This interconnectedness between disciplines at an academic level becomes even more salient once one considers one of the many detrimental cultural biases that need deconstructing to try and solve the crisis of culture that led to the climate crisis: binary thinking. Traditional Western thought has preoccupied itself for far too long in creating meanings out of opposing terms, such as "nature" versus "culture", "human" versus "animal", or "arts" and "sciences". This type of narrative needs to be abandoned as the human race moves forward into a more harmonious worldview, because it produced the conceptual alienation of the human in its relationship with nature, treating nature's problems as "other than". This is the necessary philosophical ground on which my thesis will stand, dealing with music, ecomusicology, soundscapes, and zoomusicology. It is important to understand this need for deconstruction and wholistic thinking to fully appreciate the input of the humanities in exploring environmental issues, otherwise, one might be stuck with questions such as "What does music have to do with it?"

Still, the question remains valid: what insights can the study of music give us in terms of being more conscious of and perhaps even helping find a solution to the climate crisis? Well, humans have always resorted to music as a fundamental means of engaging with their natural ecosystem, as the act of expressing their relationship with the world, being inspired by the dialogue between the beauty of their surroundings and the emotional responses provoked by it, has played and continues to play a major role in many sonic cultures around the world. There is no point in denying the fact that, at least when it comes to popular Western music, there has been a disconnection with the nonhuman element, and perhaps that too stems from the rise of binary thinking and the associated disenchantment of nature, together with the rise of the so-called "objective" sciences. Nevertheless, the act of listening carries a fundamental

quality of interconnectedness within itself, as it has the potential to blur the lines between the self and the Other: in fact, the person who listens enters into a relationship with their surroundings, one that is continuously being shaped by every being participating in this dialogue, so that it is impossible to hear one's self without hearing the external world, and vice versa. Many scholars, notably David Ingram and Timothy Morton, argue that the act of listening, cultivating the sensory perception of one's surroundings is the only way to internalize the principle of ecological interconnectedness, which is paramount in the necessary shift from an "egocentric" to an "ecocentric" worldview. This is why music matters in an ecocritical context: while it obviously cannot be regarded as a solution to the issues, its importance in nurturing human imaginative and emotional responses to the natural world should not be underestimated.

Now that the relevance of the subject matter in the general discourse about environmental issues has been established, I will turn to my thesis's structure and aim.

This thesis aims to provide an introduction to the subject of ecomusicology, a relatively new field of study concerning the intersection of music and the environment. It is a theme that perfectly encapsulates the kind of direction that is needed in the conversations relating to the climate crisis, due to its intrinsic interdisciplinarity and attention towards nonhuman agency; in fact, by exploring ecomusicology's arguments and questions, one can find helpful ways to overcome the aforementioned outdated binary thinking, leading toward a more harmonious reconciliation between the human and the nonhuman. One of the characteristics of the Anthropocene is, of course, that of being an epoch shaped by the needs and desires of humans, disregarding the Other as inferior. There is a need to learn to listen to the nonhuman element to give it back its agency. Furthermore, when one thinks of music, it is considered an exclusively human activity: this thesis intends to broaden this view by showing the musicality of the environment and its creatures, and its potential for fruitful collaborations with composers.

The first chapter of my thesis will start by exploring the relationship between humans and music throughout time and cultures, as well as looking into the intrinsic qualities of music and listening that could be insightful in a shift toward a new paradigm, one that could allow the human race to imagine alternative futures.

Then, I will turn to a task as fundamental as it is arduous: defining the word "music". The problem with finding a suitable definition of music lies in the fact that it is a notion that is

subjective to a multitude of different attitudes and ideas that are cultural-specific, and impossible to define as a universal concept. Furthermore, many proposed definitions of music fail to consider the possibility of music being created by something other than human agency, which is precisely the type of anthropocentric approach that should be dismantled. Ultimately, the process of trying to define music blends seamlessly with the process of dwelling on the relationship between the human and the nonhuman, and the role and agency of the latter in this matter.

The interrelation between sound and the environment was popularized in 1962 by Rachel Carson's "Silent Spring", one of the pillars of the modern environmental movement. However, several publications in the second half of the twentieth century have dealt with the importance of sound in an environmental context which ultimately led to the emerging subfield of ecomusicology. Before diving into it, I will briefly summarize the main areas of inquiry that could not remain uncredited in the formation of ecomusicology, most notably sound art, zoomusicology (which will be dealt with in a more detailed fashion in the third chapter), and ethnomusicology.

As my thesis falls into the field of ecomusicology, the first chapter will define ecomusicology as "the study of music, culture, and nature in all the complexities of those terms ... consider[ing] musical and sonic issues, both textual and performative, related to ecology and the natural environment", quoting musicologist Aaron S. Allen, one of the founding fathers of the discipline, whose relatively recent formation can be traced back to 2013. The definition will be examined more broadly, and some of the most relevant publications in the field will be explored to elaborate on its intricacies. Some of these include the interpretation of its prefix, "eco", as "ecocritical" or "ecological", and the importance of an interdisciplinary attitude, which is a defining quality of ecomusicology, as it is informed by a multitude of research areas. In fact, there cannot be any kind of academic endeavor that can be thought of as perfectly exemplifying everything that ecomusicology stands for; rather, each work touches on some of the key disciplinary areas connected to it.

The final part of the first chapter will focus on this aspect of ecomusicology, dividing the field into six subcategories. I have found this approach to be the most useful in giving the reader a fair representation of most, if not all, of the possible directions that ecomusicology can take. The first subcategory deals with publications informed by the field of acoustic ecology, made out of a melting pot of composers, ecologists, and ethnographers who make and study soundscapes. The notion of soundscape is deserving of a more apt analysis, which will take

place in the second chapter of this thesis. For now, let us define the soundscape as our sonic environment. Works falling into this section have the aim of making explicit the patterns and changes of the sounding world, thus raising awareness about its state.
The second subcategory deals with music in relation to animal biology and the concept of biomusic, which is a long-standing research collaboration between scholars of neurology, biology, evolution, and anthropology and music researchers in cognition, education, and performance, among other areas. Works in this section investigate the nature of music and the "music of nature" with natural science methodologies.
The third subcategory is comprised of works coming from the field of ethnomusicology that take a more active and explicitly environmentalist approach, exploring the cultural relation between musicians and their environment, and the way they are influenced by the sounds that populate their surroundings.
The fourth subcategory also considers the way that a place can influence a musician, but from a different perspective: studies in this category take into account how the landscape inhabited by a musician will affect their ideology, which will in turn affect their compositions. Furthermore, they also focus on how can music be employed to provoke emotional reactions that aid environmental activism.
The fifth subcategory is made up of musical scholars who prefer to employ a historical approach to study past conceptions of nature, which can be beneficial in uncovering complexities associated with modes of thought from the past.
The last subcategory deals with the concept of sustainability, a word that in itself can be taken to mean a variety of things. As a result, studies in this section use this concept in various ways, but they all share a focus on cultural and ecological sustainability, and how decisions pertaining to the practice of music can have detrimental environmental ramifications.
Ultimately, the first chapter serves as an introduction to the relationship between music and the environment, and most importantly as a presentation of the field of ecomusicology, which deals with this very topic; as such, it is essential to have a general understanding of this area of research, especially since it has not been established for long.

As I previously mentioned, the second chapter of this thesis will focus on the topic of the soundscape. It will start by thoroughly defining the soundscape, as the term itself has been frequently used ambiguously, at times indicating an objective reality of all sounds that can be

perceived and at times pinpointed as a subjective interpretation of them. By briefly recollecting the history of the concept, more clarity will be offered on the matter.
Then, the link between soundscape and landscape ecology will be discussed, as the developing scientific approach of soundscape ecology focuses on the study of sound to evaluate the state of local biodiversity. It is an important part of the research in ecomusicology dealing with acoustic ecology, as the main goal of soundscape ecology is to develop appropriate solutions to reduce noise pollution, emphasizing the role played by humans as an integral part of
ecosystems. The field of bioacoustics will also be mentioned, being an interdisciplinary science combining biology and acoustics to investigate how sound is produced and received in animals.
The chapter will proceed by deconstructing the main components of the soundscape, taking it as the vast array of sounds that can be listened to by the human ear. In fact, the soundscape is more than a mere sum of individual sounds, as it underlies a complex interdependence between multiple actors: to sum up, sound sources go through processes of alteration caused by acoustic filters, which, in turn, are affected by a wide variety of environmental factors. Sound sources are the primary sonic entities and are further grouped into three categories: biophony, for biotic inputs, geophony, for abiotic inputs, and anthrophony, for human-made sound sources. Acoustic filters are divided into sound propagation filters, relying on the conditions of the environment being taken into account, and receiver filters, which depend instead on the characteristics of the receiver, such as their location or acoustic sensitivity. Finally, environmental factors are partitioned into five categories: temporal factors, spatial factors, abiotic factors, biotic factors, and acoustic factors. Since my goals in writing this thesis include both revealing the underlying interconnectedness associated with the sonic world and making tangible what often remains unseen, or rather, unheard, it is essential to take a closer look at the structure of the soundscape to recognize the agency of each one of its elements. Even so, there is not a single kind of soundscape, and that depends both on the scale that is taken into consideration as well as the quantity of potential receiver positions. As such, it is possible to divide the soundscape into three distinguished yet complementary categories: the distal soundscape, amounting to the spatial and temporal distribution of sounds in a given area, the proximal soundscape, referring to the collection of sound signals that occur at a specific position in space, and the perceptual soundscape, which is defined as an individual's interpretation of a proximal soundscape. These concepts are compatible because, for any

sonic environment one wishes to examine, there is but one distal soundscape, as it is the collection of all sounds in the said area; however, that same place also has a multiplicity of proximal soundscapes, one for every receiver position. Finally, as the perceptual soundscape is extremely subjective by definition, there will be a potentially infinite number of perceptual soundscapes for each proximal soundscape.

The idea of the soundscape as potentially being subjective and different to any individual provides the perfect segue into the topic of soundscape composition, dealing with the role of human agency in shaping meaning attributed to soundscapes. The rationale shared by many composers is that there should be an emphasis on the relationship between an individual and their sonic environment in the creation of the soundscape, and this idea lies at the foundation of composers' soundscape productions. The artistic reinterpretation or remix of soundscape source materials has the potential to start dialogues and considerations on humanity's impact on the sounding Anthropocene, due to the specific personal perspective of each composer, which is what allows them to blur the lines between "real" soundscapes, acoustic experiences, and aural imagination: soundscape

composition is as much a comment on the state of the environment in question as it is a reflection of

the composer's experiences and attitudes toward the soundscape.

The inquiry into the field of soundscape composition will proceed with an analysis of the four main categories of the works associated with it, divided into field recordings, defined as musical pieces incorporating recorded sounds from natural or urban environments, soundwalks, which can be referred to as either the recording of a composer moving through a chosen environment or the act of walking and listening to one's surroundings in itself, sonifications, or the results of the process of mapping data into sound, and interactive events, artistic pieces where the audience is encouraged to participate and interact with the composer or the environment.

Each of these types of soundscape composition has a predominantly digital aspect at play, as the most used techniques for treating environmental sounds rely on samplers and signal processing. The composer utilizes technology as a tool to amplify the significance of the web of interrelations carried out by the sounds employed in the piece so that environmental aural information can not only be rich in acoustic complexity but also in a wide array of meanings, sometimes personal, sometimes cultural, and even cross-cultural. In short, actively manipulating a sonic object leads to its functional and conceptual understanding. A few of the

most implemented techniques in soundscape composition will be identified to appreciate this concept better. For the sake of clarity, I will group them into three structural models that may not contain every soundscape composition, but make up for most of the approaches typically used by artists in this field. These structural models are determined by the type of aural perspective on which they are based: the fixed spatial perspective emphasizes the flow of time or a discrete series of fixed perspectives, in the sense that it is this flow of sound events over time that determines the structure of the piece. In this structural model, the emphasis is put on the passage of time from a set point of view. The moving perspective, on the other hand, focuses on the concept of movement, emphasizing the narrative of the journey by using a smoothly connected space/time flow in composing a soundscape. The aim is to create the illusion of movement so that the listener feels like they are traveling from one place to another. Finally, the variable perspective contains the approaches implemented by artists who choose to incorporate both of the aforementioned structures into their work, creating a kind of soundscape composition where the listener can feel disoriented either because the perspective changes too abruptly or because multiple scenes are presented at the same time. My goal in this part of the chapter is not to fully explore the technical tools available at the hands of the composers, but instead to dissect their modus operandi so that, even without listening to a soundscape composition, one could be prepared in terms of what to expect and/or look for, especially since it is still a somewhat obscure part of the vast universe of musical composition. In fact, the final part of the second chapter deals with the development of soundscape composition across the years, which has been going closely together with the extensive research on the matter carried out by Simon Fraser University (SFU). It is essential to credit the scholars and composers involved in this, motivated by a concern for the decaying state of the soundscape, whose work was originally archival but later turned more interdisciplinary, bringing musical pieces into the research. The contributions of Raymond Murray Schafer, Hildegard Westerkamp, and Barry Truax will be singled out, as well as one of the most significant projects that all three were involved in, the World Soundscape Project (WSP), aiming to both document and archive soundscapes from all over the world, describing and analyzing them, to promote public awareness of environmental sound through listening and critical thinking. It also provides an opportunity to ponder on whether the soundscape is an experience shared globally. Certainly, the now virtually omnipresent character of technology promotes standardization and uniformity at least in urban soundscapes, and some scholars

argue that being exposed to this kind of soundscape may result in forming a common habit of non-listening.

The third chapter starts off by acknowledging a type of soundscape that remains mostly inaccessible to human physiology: that of the underwater world. For decades, it has been portrayed as silent, due to the fact that many of its sound sources are undetectable to the human ear; however, recent developments in technology have resulted in a better awareness of the underwater soundscape as a crucial part of aquatic life. As creatures inhabit a largely dark habitat, sounds are used in a great multifariousness of ways about which still very little is known. A perfect opportunity to gain not only an improved understanding of the underwater soundscape but also an insight into nonhuman musicality is offered by the analysis of humpback whales' vocalizations. Popularized in the 1970s by the massively influential album and article by Roger Payne and Scott McVay "Songs of the Humpback Whales", which has been instrumental in the environmental campaign that led to the abolition of the practice of whale hunting, the sounds produced by these large mammals are extremely fascinating from a musicological context. The reason for this lies in the fact that even though there is still no certainty about their meanings, they make up complex, and structured songs, whose elements can be hierarchically organized. Furthermore, whale songs are of particular significance because they are the result of an interplay between natural instincts and learned behavior: in fact, humpback whales do have culture, for they are able to form population-specific idiosyncratic styles. Not only that, the songs of the whales constantly mutate through the innovations of a few individual males within the population, and also through a process called "song revolution", where an encounter between two distinct populations leads to the song of one population to completely replace that of the other.

The assertion that music is not an exclusively human phenomenon is at the very core of the research field of zoomusicology, which has been mentioned in the first chapter but will now be dealt with in a more encompassing fashion. This area of research originated in 1983 with the writings of musician and musicologist François Bernard Mâche and could be defined as the discipline that studies the aesthetic use of sound communication among animals. Its goal is to challenge the very definition of music, the relationship between human beings and animals, and the idea of the animal itself. Like ecomusicology, zoomusicology is a necessarily interdisciplinary field, as it is bound to stand on the verge of multiple dichotomies. For this reason, it is best to divide zoomusicological methodologies depending on the way that the

discipline relates to its approaches, and how it relates to its targets, leading to the formation of four distinct kinds of zoomusicology: empirical, theoretical, ethological, or anthropological. Of course, these categories are not binding, as so-called "clean" research is not only virtually impossible but also not advisable, as every subset within zoomusicology is complementary and supportive of each other, so contamination among approaches and targets is preferable. Nonetheless, it is useful to take a closer look at the disciplines informing zoomusicology to appreciate how their contributions might be of value. Ethnomusicology is to be considered a very close relative of zoomusicology, for the simple reason that much like ethnomusicologists' goal was to demonstrate that music was not exclusively Western, zoomusicology has to prove that music is not exclusively human. Hence, research strategies are very similar in both branches of knowledge.

Ethology provides another example of a fruitful collaboration with a foreign discipline, as ethology is defined as the evolutionary and comparative study of non-human animal thought processes, consciousness, beliefs, or rationality, and one of its discoveries has been that of a possible commonality between animal and human mental experiences. It should also be noted that a key inquiry shared by ethology and zoomusicology can be found in the focus on the problem of aesthetics in nonhuman animals.

Though not all zoomusicologists employ its approaches, semiotics makes for another important contribution to the field. Since it focuses on the study of sign processes and the communication of meaning, its insights are valuable in answering diverse zoomusicological questions, due to the fact that perhaps even more so in the animal kingdom, the relationship between music and communication is a very close one.

All of these areas of inquiry have points in common concerning their methods, especially in the past. The gradualistic outlook refers to a generically Darwinian procedure founded on the assertion that there is an evolutionary continuum in which the human being occupies the highest position, while species less and less complex and refined are on the other end of the spectrum, while discontinuity refers to the generally skeptical, perhaps even hostile, attitude toward the idea that animals could possess an idea of music. I will mention these outdated approaches to show that only a pluralistic line of action could work for zoomusicology, and possibly the most suitable framework for this is that postulated by the theoretical biologist Jakob von Uexküll, known as the theory of Umwelt. This theory states that all animals must be recognized as subjects capable of making meanings of their world through their specific ways of perceiving and acting on it. The implications of this concept lead the way toward a

better understanding of the relationship between the human and the nonhuman, and it lays the background for another pivotal matter in zoomusicology, which is the quest for music universals. The question of whether music could be considered a universal phenomenon arose in the 1970s within the field of ethnomusicologists, but it is an issue that is yet to be resolved. The reason for this is that it is incredibly easy to show that music is not a universal language, meaning that it is impossible to find characteristics of musical traits displayed by every single musical culture (including animal cultures). Nonetheless, it could be enough to prove that certain characteristics appear in independent contexts and that their inner workings present too precise analogies to be attributed to chance, as most nonhuman musical activities display a common articulation concerning human music-making. This should not be taken to support either anthropocentric ideologies exemplified as "animals make music just like humans", or reductionist ones whose rationale is "human music is nothing else than what animals do". Both remarks are inaccurate, as zoomusicology's main objective is to affirm music's existence outside of the human species.

After this needed "introduction" on the theme of zoomusicology's aim and methodologies, I will focus on three artistic compositions employing whale songs. Judy Collins' "Farewell to Tarwathie" is a haunting duet between a human and a whale. It is a song from the 19th century written about a sailor who is embarking on a whale-hunting mission. However, due to the presence of its vocalizations throughout the whole track, contrasting both the soft voice of the singer and the lyrics sympathizing with the hunter, the whale is treated as a subject, encouraging an interspecies empathetic identification and affiliation.

John Cage's "Litany for the Whale", on the other hand, does not employ any field recording of whale vocalizations, as it is a piece written for two human voices singing in antiphony. However, it follows the structure of whale songs as well as recalling Christian liturgy and medieval chants. The interplay between these two factors situates the singing of whales within man's devotional and musical past and gives a voice not to the whale itself but to its capability of musicality.

The last piece that will be discussed is David Rothenberg's "To Wail with a Whale". The idea behind this piece and related article was that of playing the clarinet to a whale, listening to its response, and keeping on playing off the whale's variations of his sounds. Rothenberg, through a detailed use of spectrograms, analyzed a nearly five-minute-long portion of the duet, in which the whale appears to change his song in response to the clarinet, generating the impression of two free jazz musicians improvising with each other. This remarkable result not

only helps to confirm the reigning theories around the cultural dimension within whale song, but it also reveals a new notion of nonhuman sound and the possible courses of action in human interaction with it.

Finally, the chapter concludes with a few considerations on the subject of human exceptionalism. Of course, much like ecomusicology and other post-modernist areas of research, zoomusicology is a disruptive force to anthropocentrism; nonetheless, the rationale of human exceptionalism is still something that needs to be accounted for. Namely, the fact that 22 out of the 90 species of whales and dolphins are currently regarded as threatened by the IUCN reflects the reality of anthropogenic threats to cetaceans, meaning that their interests are far from being acknowledged. Furthermore, even within zoomusicological research run the risk of being framed as mostly relating to the human. This is due to the fact that it can be arduous to expand access to the nonhuman sonic world in a way that does not end up being just another level of exploitation and commodifying the environment. Also, there are two compositional processes employing animal sounds that reinforce, perhaps unwillingly, human exceptionalism: one is that of "anthropodenial", which is a blindness to the human-like characteristics of animals, and the other is that of eliminating all differences between the human and the nonhuman, hindering accurate descriptions and explanations of animal behavior. Ultimately, the challenge for zoomusicology is that of creating a shared vulnerability and a promotion of kindness beyond the human.

CHAPTER 1. ECOMUSICOLOGY: SOUNDING OUT THE CRISIS

1.1 The need for deconstruction

Pollution, biodiversity loss, climate change, sustainability: in recent years environmental issues have become some of the most significant socio-political, and arguably, moral, concerns of our time. However, there seems to be a lack of consistency between the gravity of the situation and the overwhelmingly refrained global response, as humankind is still somewhat failing to respond to this crisis with the necessary degree of urgency.[1]

When looking for answers, nothing resonates more than Amitav Ghosh's words, stating, "The climate crisis is a crisis of culture, and thus of the imagination."[2] Ghosh is certainly not the only scholar who feels that human inaction toward climate change has a cultural basis; many argue further that the arts may have a role to play in facilitating our ability to tackle contemporary environmental challenges, as they carry the power of making humans fully recognize, at a cognitive level but also at an emotional one, what is happening. In fact, the humanities at large need to be involved in the environmental discourse because a change of culture is simply impossible without their participation. Since the 1970s, interest in the relationship between humanity and the natural environment has emerged throughout the academy, although not all academic fields have been "greened" in the same way. Still, as linguist Ken Hyland observed, the languages of academia have begun to insert themselves into every cranny of our lives, and this statement holds true even when applied to the vocabulary of the environmental humanities. Of course, much work still needs to be done to bridge the gap between the debates happening in the universities and conferences and those happening outside of these spaces. One of the challenges that need to be overcome for this to happen could be identified with the deconstructive approach used by scholars, which may enter into contradiction with the very real weight of the issues expressed by the ecological movement. This can definitely prove to be frustrating to a certain degree, because as feminist

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[1]Jonathan Gilmurray, "Ecological Sound Art: Steps towards a New Field," *Organised Sound* 22, no. 1 (March 7, 2017): 32–41, https://doi.org/10.1017/s1355771816000315.

[2]Amitav Ghosh, *The Great Derangement: Climate Change and the Unthinkable*, 2016, http://dx.doi.org/10.7208/chicago/9780226323176.001.0001.

philosopher Kate Soper stated, "It is not language that has a hole in its ozone layer."[3] However, this challenging aspect surely does not mean that theoretical discussions about language and concepts should not be addressed; it is but one weakness of the environmental humanist's *modus operandi.* If there is one thing that sparked the current interest in ecological topics is a pronounced sense of acute crisis, and conveying it to the general public is no easy task, especially when so many notions that should lay the groundwork for any discussion about ecology desperately need deconstructing. It is sufficient to take into consideration the word "nature" to realize this: what does one mean when speaking of nature? The Marxist literary critic Raymond Williams famously called it "perhaps the most complex word in the language."[4] Indeed, different people in diverse cultures interpret the word in multifarious ways and at times even within the same cultural framework. Surely the kind of binary thinking typically associated with traditional Western thought does not help in defining "nature" because it merely puts the term in opposition to "culture", or "human". Ultimately, depicting nature as something other than human cannot tell us what it actually is, but only what it is not, which is nonhuman. However, this modality of conceptualizing the human relationship to nature has the adverse effect of alienating the human from the equation, which can prove to be detrimental, perhaps even disruptive, to a harmonious worldview. This is why deconstructing is worth the risk of over-complicating concepts for the general public.

1.2 The relationship between music and the environment

The concept of a harmonious universe is far from being a novel one, and the fact that the word "harmonious" is defined as both "marked by accord in sentiment or action" and "having agreement between musical components" is no coincidence: one must look no further than the ancient Greek theory of the music of the spheres, attributed to Pythagoras, to realize how related these two concepts are.[5] This theory is one of the oldest music-ecological ideas, and it states that the motions of astronomical bodies and consonant musical intervals are governed by the same mathematical ratios and that it could only follow that heavenly bodies must make

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[3]Alexander Rehding, "Ecomusicology between Apocalypse and Nostalgia," *Journal of the American Musicological Society* 64, no. 2 (January 1, 2011): 409–14, https://doi.org/10.1525/jams.2011.64.2.409.

[4] ibid.

[5] Curt Sachs, The Rise of Music in the Ancient World, East and West (Courier Corporation, 2008).

pleasing music, although not one that could be possibly heard by human beings.[6] In ancient China arose a similar theory, formulated around the importance given to the idea of a harmonious universe; they developed a pitch system based on the mathematics of the overtone series, accompanied by a legendary tale of the discovery of the musical notes and their correspondence to nature, or, more precisely, birdsong. Confucius thought that music was necessary to maintain order in both human society and the cosmos, and Plato wrote that music helps to "bring order to any orbit in our souls that has become unharmonized".[7] Even in the 16th century, Johannes Kepler, much like Pythagoras, theorized that spatial relationships between the Sun and its planets were numerically paralleled by musical harmonic intervals.

Humans have always resorted to music as a fundamental means of engaging with the natural ecosystem they exist within. The act of expressing our relationship with the world remains the primary focus and function of many sonic cultures around the world, from the yodeling of the Bayaka pygmies to the throat singing of the Tuva.[8] Even in Western musical history, there is no shortage of evocations of the natural world and our emotional responses to it: Vivaldi's Four Seasons, Beethoven's Pastoral Symphony, Debussy's La Mer… However, though it is apparent that prominent thinkers of the past used to believe in the leading role played by music both as a fundamental element of nature and in the functioning of the cosmos, such a worldview emphasizing the connection between humans and the natural world has yet been certainly hindered, if not lost entirely. The reason for this cultural shift is credited by numerous historians of science to the increasing "disenchantment" of nature associated with the rise of so-called "objective" scientific studies during the 18th-century Enlightenment. This also coincided with a general change in attitude about the relationship between humans and the natural world, which in turn resulted in the ontological chasm between the two, and the increasingly exploitative character of human interactions with the nonhuman element. One could perhaps summarize the multitude of binaries arising from this disenchantment as a separation between intellect and feeling: everything that could not serve an immediate, obvious purpose or capital value was discarded as unimportant and inferior, as there was no

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[6]Jeff Todd Titon, "AFTERWORD: Ecomusicology and the Problems in Ecology," *MUSICultures* 45 (January 1, 2018), https://journals.lib.unb.ca/index.php/MC/article/download/28944/1882521787.

[7]Donald J. Zeyl, "Plato and Talk of a World in Flux: Timaeus 49a6-50b5," *Harvard Studies in Classical Philology* 79 (January 1, 1975): 125, https://doi.org/10.2307/311132.

[8]Jonathan Gilmurray, "Sounding the Alarm: An Introduction to Ecological Sound Art," *Musicological Annual* 52, no. 2 (December 9, 2016): 71–84, https://doi.org/10.4312/mz.52.2.71-84.

space for emotions in discussions about hard facts. Interestingly, one could think about the binary between sight and hearing in those terms: in "The Jukebox in the Garden: Ecocriticism and Popular Music Since 1960", David Ingram emphasizes the inherently spiritual features associated with the act of listening, stating that "the dominance of the visual sense in human beings encourages a sense of separation between subject and object, or human perceiver and things in the world, which has had disastrous consequences for the health of the environment… [while] the sense of hearing overcomes the limitations of sight by enacting the fundamental ecological principle of holistic interconnectedness".[9] Listening has the potential to blur the lines between the self and the Other because the person who listens enters into a renewed relationship between them and the environment, where the person lives in equivalence and reciprocity with their surroundings; all sounds exist within a sonic framework that is constantly being created by every being participating in it, so that it is impossible to hear external sounds without hearing one's self, and vice versa.

There's a fundamental quality of interconnectedness embedded within the act of listening, one that is particularly relevant in our time, where humans are constantly being faced with the prospect of planetary warming that affects all life on earth indiscriminately: in the Anthropocene, it is human action (and inaction) the smoking gun threatening to haunt the possibility of all kinds of life, so it only makes sense to start from a position where everything is connected and, even more importantly, where the human is no longer the measure of all things.[10] This is one of the fundamental pillars of contemporary ecological theory, the recognition of the network of interconnections between different elements within the earth's ecosystems. Timothy Morton coined the term "the mesh" to describe this very principle: the mesh does not merely include organic forms, but all matter. He states that nothing exists all by itself, and therefore nothing is fully "itself" - each being in the mesh interacts with others.[11]

In his book "The Spell of the Sensuous", David Abram argues that cultivating the human sensorial perception of the world is the only way to truly internalize this principle of ecological interconnectedness. He states that it is necessary to enter into a sympathetic

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[9]David Ingram, *The Jukebox in the Garden: Ecocriticism and American Popular Music since 1960*., 2010, http://ci.nii.ac.jp/ncid/BB08873694.

[10]Alexander Rehding, "Music Theory's Other Nature: Reflections on Gaia, Humans, and Music in the Anthropocene," *19th-Century Music* 45, no. 1 (January 1, 2021): 7–22, https://doi.org/10.1525/ncm.2021.45.1.7.

[11]Timothy Morton, "The Ecological Thought," in *Harvard University Press eBooks*, 2010, https://doi.org/10.4159/9780674056732.

relationship with the perceived, where perception is defined as "an attunement or synchronization between one's own rhythms and the rhythms of the things themselves, their tones and textures"[12] It is interesting to notice how the vocabulary employed by Abram owes much to an auditory context: attunement, rhythms, tones are all words linked with our aural faculty. Even if hearing is not the only way to perceive something, sound has the cultural effect of semiconsciously putting humans in a direct relationship with other living beings, and non-living entities.[13] Granting all this, it is true that sound does not work well as a text, in a narrow sense: the reason for this is that while a sign may be attributable, an author may be identifiable, and a message interpreted, sonic events move in a transitional space, opening up interpretive possibilities.[14] However, inhabiting this vague and hard-to-define dimension, sound does not impose any strict distinctions between musical material and meaning, as each is experienced as "immediately" as the next: this is one of the basic points of the field of the ecology of perception, whose focus is the interpretation of aural elements in terms of the relationship between a perceiver and its environment. It is against this background that music can be viewed, in the words of the musicologist Daniel Grimley, as "a more broadly environmental discourse" because it is a medium that can create the sense of being within a particular time and space.[15][16] On that note, the importance of sentiment must not be understated: music is a phenomenon that can trigger powerful emotional responses, making it a valuable channel for communicating environmental messages. Of course, it would be disingenuous to imply that music has the capacity to be the best agent of change in an environmental context: quoting David Ingram, "Music is obviously not a solution to environmental problems in and of itself (…) but music can nurture our imaginative, emotional responses to the natural world, and thus extend human rationality".[17] Furthermore, much

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[12]David Abram, "The Spell of the Sensuous: Perception and Language in a More than Human World," *Colonial Waterbirds* 20, no. 1 (January 1, 1997): 152, https://doi.org/10.2307/1521797.

[13]Ulaş Özdemir, "Ekoeleştirel ve Doğakültürel Bir Müzikoloji Yaklaşımı Olarak Ekomüzikoloji," *Konservatoryum* 6, no. 2 (December 31, 2019): 117–37, https://doi.org/10.26650/cons2019-0012.

[14]Aaron S. Allen, "33. Ecomusicology from Poetic to Practical," in *De Gruyter eBooks*, 2016, 644–63, https://doi.org/10.1515/9783110314595-035.

[15]Holly Watkins, "Musical Ecologies of Place and Placelessness," *Journal of the American Musicological Society* 64, no. 2 (August 1, 2011): 404–8, https://doi.org/10.1525/jams.2011.64.2.404.

[16]Daniel M. Grimley, *Grieg: Music, Landscape and Norwegian Identity,* 2006, https://ci.nii.ac.jp/ncid/BA80535363.

[17]Ingram, *The Jukebox in the Garden: Ecocriticism and American Popular Music since 1960.*

depends on what one means when speaking of music, and to what extent the study of the cultural, historical, physical, and intellectual connections that music can facilitate are considered.

1.3 What is music?

Let us begin by addressing the question of defining the object of discussion, music. Music is a universal cultural expression and it also exists in sounds of the natural world. It is traditionally defined as "an agreeable sound", "vocal, instrumental, or mechanical sounds having rhythm, melody, or harmony", "the science or art of ordering tones or sounds in succession, in combination, and in temporal relationships to produce a composition having unity and continuity".[18][19] In the Western context, music is usually understood as an auditory art form that incorporates elements of melody, harmony, rhythm, tempo, and dynamics (or volume). The problem with finding a suitable definition of music lies in the fact that it is a notion that is subjective to a multitude of different attitudes and ideas that are cultural-specific: it would be inaccurate to speak of music as if it were a universal concept and not a mental and social construct. Composer Edgar Vare produced a broader, more essential definition of music: "organized sound". However, even this basic statement fails to consider the possibility of music being created by something other than human agency, or the existence of music among nonhuman animals altogether. In fact, this issue is directly related to the Western concept of "art": against the Western cultural background, once something is categorized as "art" it becomes non-natural, artificial; in other words, human-made. The nonhuman world is cut out entirely from the process of music-making, as can be summarized in a syllogism: music is artificial, nonhuman beings are natural, nonhuman beings make no music.[20] This is counterintuitive as sonic productions can be classified as "natural" long before they can ever be "cultural", it is sufficient to note the physical effort necessary to produce all kinds of perceivable sound: the breathing out activating the vocal cords of a singer, the striking of something to make percussive rhythms… meaningful sound, as one way to describe music, has

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[18]Kate Turner and Bill Freedman, "Music and Environmental Studies," *The Journal of Environmental Education* 36, no. 1 (October 1, 2004): 45–52, https://doi.org/10.3200/joee.36.1.45-52.

[19]"Music," in *Merriam-Webster Dictionary*, November 25, 2023, https://www.merriam-webster.com/dictionary/music.

[20]Marcello Sorce Keller, "Linnaeus, Zoomusicology, Ecomusicology, and The Quest for Meaningful Categories," *Musicological Annual* 52, no. 2 (December 9, 2016): 163–76, https://doi.org/10.4312/mz.52.2.163-176.

just as much to do with nature as it has with culture. It can only follow that any definition of music that tries to classify it as the "art" of sound is narrow and misleading. All sounds consist of vibrations arising from either natural or unnatural ways which are transformed into sound waves by a vibrating object, and only then are they connected to the social consensus, accepted as "music" outside of their physicality. The complexity arises due to how different societies accept these sounds as agreeable or perceive them as unwanted and disturbing. Furthermore, if the term "music" is considered to express only the notion of sounds produced by humans that are pleasing to the ear, then music would only be defined as sonic elements, which would necessarily exclude the messages they carry.[21] Nicholas Cook proposes a more encompassing framework for the concept of music, one that includes speeches of a "musical" nature, such as the susurration of the wind, birds chirping, and poetry.[22] Many artists in the past have used sounds of nature in their compositions. In particular, Claude Debussy firmly believed in the importance of environmental sound in music, declaring in 1909: "Too much importance is attached to the writing of music, too much to the formula, the craft: we seek ideas inside ourselves, when in fact they should be sought from outside. We combine, we construct...we do not hear around us the countless sounds of nature, we do not sufficiently appreciate this immensely varied music which nature offers us in such abundance...And there, according to me, is the new way forward. But...I have scarcely glimpsed it, since what remains to be done is immense!"[23]

Ultimately, the incorporation of natural elements in music is one of the ways in which the binary between the human and the nonhuman could be reconciled, because it nudges the listener to acknowledge how people are intrinsically linked to their surroundings and are inspired and moved by the places they inhabit. Of course, this is merely one mundane example of the cultural intersections between music, or sound in general, and the environment; this is where ecomusicology comes into play. However, there's no shortage of publications dwelling on the relationship between sound and the environment before ecomusicology came into being.

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[21]Özdemir, "Ekoeleştirel ve Doğakültürel Bir Müzikoloji Yaklaşımı Olarak Ekomüzikoloji."

[22] Nicholas Cook, and Mark Everist, eds, *Rethinking music*, Oxford University Press, USA, 1999.

[23]François Bernard Mâche, *Music, Myth, and Nature, or, The Dolphins of Arion*, 1992, http://ci.nii.ac.jp/ncid/BA2310096X.

1.4 Before Ecomusicology

In 1962 Rachel Carson wrote one of the pillars of the modern environmental movement, "Silent Spring", where she exposed the ecological damage being done by the spraying of crops with pesticides.[24] The title employs a powerful metaphor based on sound, referring to the notion of the absence of birdsong as the key indicator of the damage done by the toxic chemicals, demonstrating the importance of listening in interpreting and understanding the ecological dynamics of the environment on a tangible level. Another publication that could be seen as foreseeing the rise of ecomusicology is the educational pamphlet written by the composer Raymond Murray Schafer called "The New Soundscape". In his writing, Schafer encourages an aesthetic appreciation of environmental sound, describing the soundscape as a "continuously unfolding symphony for whose content we were all responsible", denouncing the increasing levels of noise pollution stemming from the process of industrialization.[25] The purpose of the booklet was to direct the reader's ear toward the new soundscape of contemporary life, as well as to provide an opportunity for the listener to acquaint a sort of vocabulary of sounds that they could recognize in a multitude of settings. Another area of inquiry that was formed before ecomusicology is to be found in what is called sound art, which began to gain widespread recognition towards the end of the twentieth century. Sound art can be described as a field with fluid boundaries, one that encompasses works in a variety of media. The quality at the core that is shared by all these works is the concern with issues revolving around sound and listening, with sound constituting the medium, material, and/or subject matter for the work. It is not always easy to draw a line between sound art and music, particularly experimental music, and the distinction between the two depends largely upon one's individual understanding of the terminology.[26] Another area that carries a certain degree of importance in breaking the ground for ecomusicology is zoomusicology. Even though it must be said that not many mainstream music scholars have expressed in-depth interest in it so far, zoomusicology is still relevant in challenging the idea that music must be outside or above nature, something that only humans can make. In fact, in the 1970s, marine biologists studying humpback whales revealed that these animals can produce highly organized sound patterns that are unique to each population within the same species. Since

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[24] Rachel Carson, *Silent Spring* (Houghton Mifflin Harcourt, 2002).

[25] R. Murray Schafer, The New Soundscape : A Handbook for the Modern Music Teacher, 1969, http://ci.nii.ac.jp/ncid/BA04846320.

[26] Leigh Landy, *Understanding the Art of Sound Organization* (MIT Press, 2007).

then, comparable forms of sonic behavior have been reported concerning other animal species, stressing the point that, if culture is defined as "learned behavior", then groups of animals can have it as well as humans, as they learn and transmit what they know to the younger generations.

Ethnomusicology also needs to be addressed, as ecomusicology can be seen as following its footsteps. As a field, ethnomusicology gives the necessary attention to diverse cultural understandings of music. At its core is the notion of cultural relativism, based on the work of Franz Boas, Ruth Benedict, Margaret Mead, and Gregory Bateson, widely considered to be the pillars of the anthropological theory that marked the first half of the twentieth century.[27] Ethnomusicologists examine music as a social process to understand what music is and what it means to its practitioners and audiences. However, ethnomusicological approaches and research interests run the risk of being anthropocentric: the reason for this is that, while ethnomusicologists understand that music is not a universal concept, they still utilize the word "music" as if it were something that existed in the world, failing to address the fact that it isn't but a mental and social construct, only significant to a few, leaving, notably, the nonhuman out of the equation. Ecocriticism has been a major force in activating the interest of music scholars in a more open direction. In 2007 a Study Group for Ecocriticism was founded within the American Musicological Society, which is an organization whose devotion lies in the study of Western music, with a predominantly historical approach. In 2011 the Society for Ethnomusicology followed and officially recognized its Special Interest Group for Ecomusicology, a showcase of a productive encounter of scholars converging from diverse backgrounds. The reasons why the scope of ethnomusicology needed to be broadened are threefold: first, because knowledge of the nonhuman can elucidate relationships between music and contemporary crises; second, because music and musicking affect the nonhuman as well as humans; and third, because music's effect on the non-human, in turn, affects musical meaning and relationships between music and society. A multispecies ethnomusicology provides a more-than-human comprehension of music's place in the contemporary world, and that is precisely the aim of ecomusicology.

1.5 Ecomusicology

Defining ecomusicology is no easy task. Even Aaron S. Allen, one of the most prominent intellectuals in this field of study, was "reluctant to define an emerging subfield yet lacking in

[27] Keller, "Linnaeus, Zoomusicology, Ecomusicology, and the Quest for Meaningful Categories."

consensus" in 2011.[28] However, in the years since then, there has been a blossoming of scholarly and public interest in the intersections between music, place, and the environment, and in 2013 Allen defined ecomusicology in the Grove Dictionary of American Music as "the study of music, culture, and nature in all the complexities of those terms ... consider[ing] musical and sonic issues, both textual and performative, related to ecology and the natural environment".[29] Indeed, ecomusicology can be considered as a "crisis field" apt to address issues of music and the environment in a time of environmental crisis. It is a relatively new field of study, as it coalesced in the 2010s under the guiding hand of musicologist Aaron S. Allen, who was involved in several landmark eco-musicological publications, namely, a colloquy of articles under the heading ecomusicology published in 2011 in the Journal of the American Musicological Society, the mentioned above entry defining ecomusicology in the Grove Dictionary of American Music, available to scholars since 2011 but published in 2014. Both of these publications drew on the seminal review article by the music theorist and musicologist Alexander Rehding discussing various German composers' works on music and nature under the heading "Ecomusicology". In the article, Rehding acknowledged the unstable, complex, and at times contested character embedded within the meanings of nature, culture, and music; Allen built on these assumptions to explain that the "eco" in ecomusicology was not a reference to ecology, but rather to ecocriticism, a branch of literary criticism whose focus is the relations between authors, literature, and the environment. Hence, ecomusicology is to be understood as ecocritical musicology, emphasizing the links between composers, music literature, and the environment.[30] This clarification is relevant because the analogy between music and ecology has been used by many authors in the past, and the prefix "eco" in ecomusicology has been employed to mean "ecology" in their works and definitions. The critique that is usually moved on this lies in the invocation of ecology to mean something other than what ecological scientists mean by it, it is what Allen refers to as the "problem of ecology".[31] However, since its 19th-century development as a biological science, ecology has

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[28]Aaron S. Allen, "Ecomusicology: Ecocriticism and Musicology," *Journal of the American Musicological Society* 64, no. 2 (August 1, 2011): 391–94, https://doi.org/10.1525/jams.2011.64.2.391.

[29]Aaron S. Allen, "Ecomusicology," *Oxford Music Online*, July 25, 2013, https://doi.org/10.1093/gmo/9781561592630.article.a2240765.

[30]Jeff Todd Titon, "Within Ethnomusicology, Where Is Ecomusicology? Music, Sound, and Environment," *Ethnomusicology Journal* 3, no. 2 (2020): 194-204

[31]Aaron S. Allen, "One ecology and many ecologies: The problem and opportunity of ecology for music and sound studies," *MUSICultures* 45, no.1-2, 2018.

informed other realms of inquiry that resonate with music and sound studies, particularly in the humanities and in the disciplines of philosophy and literature. In the words of scientist John Kricher, "Ecology is no longer the arcane study of natural history. Ecology, in the twenty-first century, may be the key to human destiny in the twenty-second century and beyond", and there are many principles that can be borrowed from this field of study that are relevant to both facing the environmental crisis and expanding our understanding of ecomusicology.[32] In particular, four main principles can be discerned: the first one is the adaptive value of diversity, the second is that continuously expanding growth is unsustainable, the third is connectedness, and the fourth is stewardship or the idea that humans are caretakers and not owners of resources. All of these concepts are discussed and explored by ecomusicologists, so it may be useful to take a "both/and" rather than an "either/or" approach towards the meaning of "eco" in ecomusicology. Nonetheless, by taking it as "ecocritical" one emphasizes the importance of the relatedness with ecocriticism, a subject of study that is separate from ecomusicology but to which ecomusicology owes much. After all, ecomusicology can be described as the coming together of music and sound studies with environmental studies and science, so it only makes sense that it should be approached with an open mind and an interdisciplinary attitude. This aspect of multiplicity is a crucial part of ecomusicology, and is even more evident in its formulation as "ecomusicologies", as it has been used in the introduction of the volume by Allen and Kevin Dawe "Current Directions in Ecomusicology": they maintain that "there is no one ecomusicology but many ecomusicologies constituting a dynamic field", and such an outlook can connect the related but often disparate areas of soundscape ecology and acoustic ecology, biomusicology and zoomusicology, environmental studies and environmental humanities, and others.[33] This dynamism is the consequence of the input of a wide range of disciplines, so much so that ecomusicology could even be thought of as not a new discipline but rather an umbrella of related fields with complex intellectual and ecological interactions. Ecomusicologists are, perhaps above all, interdisciplinary. The ideas that comprise ecomusicology, namely, human-nature relations as mediated by music or sound, are of broad interest, so the wide diversity of influences from many fields is balanced by the potential usefulness and interest to them. The

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[32] John C. Kricher, *The Balance of Nature: Ecology's Enduring Myth*, 2009, http://ci.nii.ac.jp/ncid/BB00923223.

[33] Jacob A. Cohen, "Current Directions in Ecomusicology: Music, Culture, Nature Eds. By Aaron S. Allen and Kevin Dawe," *Notes* 74, no. 1 (January 1, 2017): 83–86, https://doi.org/10.1353/not.2017.0088.

potential relevance of ecomusicology could be due to the emotional pleasures and the multitude of intellectual engagements that many experience with music, but also due to the inherently multidisciplinary aspect of all music studies and the ubiquity of sound on Earth.[34] The value of interdisciplinarity cannot be understated. Quoting musicologist Philip Tagg: "It's impossible to understand much about music without considering it from the viewpoints of areas such as music making, musicology, ethnomusicology, anthropology, psychology, sociology, acoustics and bioacoustics, neurology, technology, electronics, economics, and politics".[35] By drawing from so many influences, ecomusicology can avoid falling into overly prescriptive rhetoric or being divided into rigidly opposed factions. Of course, this does not mean that there are no alternative schools of thought within the field, but they can often be thought of as two sides of the same coin. For example, two perspectives seem to be the most recurrent in discussions of music and environment: one treats music as an ecosystem, emphasizes the utility of music to create spaces and movements, and its capacity to turn them into a range of experiential environments; the other perspective treats music as a nexus through which human cultures are bound up with a single world understood in naturalistic terms. To choose between these alternatives is not to refute the premises of the other, as it comes down to choosing whether one wants to risk oversimplification for the sake of clarity or if one values more abstraction and the appreciation of complexity. Ecomusicologists are making admirable attempts to get beyond dual thinking in all its forms, overcoming the binaries between science and the humanities, real and constructed, objective and subjective, and so on.[36] On that note, scholar William Echard calls for an "energetic and spatial icons and indices" model, which would serve as a tool to develop critical synthesis, a position that he describes as "open to science but also non-reductive", one that "expands the meaning of 'environment'," "suggests a conceptual and literal continuum between human and non-human," and "is ontologically flexible". As far as goals go, ecomusicology certainly seems like a good fit for championing these ideals.[37] Indeed, it is not unique in this regard, as, for instance, environmental history and environmental literature also share this potential for

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[34]Allen, "33. Ecomusicology from Poetic to Practical."

[35]Philip Tagg, "Caught on the Back Foot: Epistemic Inertia and Visible Music," *IASPM@Journal 2*, no. 1–2 (February 29, 2012): 3–18, https://doi.org/10.5429/2079-3871(2011)v2i1-2.2en.

[36]Mark Pedelty, "Ecomusicology, Music Studies, and the IASPM: Beyond 'Epistemic Inertia,'" *IASPM@Journal* 3, no. 2 (June 24, 2013): 33–47, https://doi.org/10.5429/2079-3871(2013)v3i2.3en.

[37]William Echard, "Psychedelia, Musical Semiotics, and Environmental Unconscious," *Green Letters*, January 1, 2011, https://doi.org/10.1080/14688417.2011.10589091.

bridging the sciences, arts, and the humanities, ecomusicology offers instructive perspectives on the critical and connective thinking skills provided by the arts and the humanities which should play an important role in environmental education for the future.[38] The result of this multidimensional approach drawing from many areas of scholarly interest is a diverse output put forth by many authors with different spheres of influence, and as such, it is best to group works in ecomusicology into subcategories. There cannot be a text or any kind of academic endeavor that can be thought of as a singular exemplar of ecomusicology; rather, each study touches on some of the key disciplinary areas connected to it.[39]

1.6 Subcategories of ecomusicology

1.6.1 Ecology

The works in ecomusicology under this category are the ones informed by the well-developed, international field of acoustic ecology, which is a melting pot of composers, ecologists, and ethnographers who make and study soundscapes. The soundscape is a term coined by Schafer, meaning "our sonic environment, the ever-present array of noises with which we all live."[40] Soundscape art and soundscape studies are intended to make explicit the patterns and changes in this sounding world and to raise awareness about the state of the world, as revealed through sound. Soundscape studies are heterogeneous and could be exemplified as a continuum, where on one end of the spectrum are the studies on the artistic works of various composers, and on the other are studies that relate to the ecological fieldwork done by scientists. A lot of inquiries could be positioned toward the middle of this continuum, in an arena broadly construed as cultural studies. This subcategory of ecomusicology takes into consideration the skillsets of both artists and scientists, and due to this interdisciplinary methodology and blending of communication abilities, works that fall into this section have resulted in creative solutions for environmental problems. Acoustic ecologist David Dunn maintains that the power of this collaboration relies upon the input provided by artists, mainly in the form of innovative speculations which scientists can lack. For Dunn, artists have unique

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[38]Aaron S. Allen, "Ecomusicology: Bridging the Sciences, Arts, and Humanities," in *SAGE Publications, Inc. eBooks*, 2012, 373–81, https://doi.org/10.4135/9781452218601.n40.

[39]Allen, "Ecomusicology: Bridging the Sciences, Arts, and Humanities."

[40]R. Murray Schafer, "The Tuning of the World," *Leonardo* 16, no. 1 (January 1, 1983): 69, https://doi.org/10.2307/1575066.

and valuable epistemic positions because their outsider status enables them to pose hypotheses external to the scientific canon.[41]

1.6.2 Biology

The body of work in this subcategory can be described as a productive collaboration of biomusic researchers who study the music of nature and the nature of music, primarily with life- and natural-science methodologies. Biomusic is a long-standing research collaboration between scholars of neurology, biology, evolution, and anthropology and music researchers in cognition, education, and performance, among other areas.[42] To better understand the nature of this kind of approach it is probably best to provide an example, such as "The Wild Music project", a collective effort put forward by cetologist Roger Payne. The Wild Music project consisted of an exhibit where Payne worked with scientists and musicians to transcribe and analyze the vocalizations of whales. This has resulted in a greater understanding of whale mating, whale migration, and the acoustic environment of the ocean; the latter is especially relevant in the context of sustainability as the impact of human noise pollution in the sea is only just starting to be comprehended.[43] Generally, biomusic studies, by looking at how animals communicate, can lead evolutionary biologists down many paths to correlate human and animal music-making.[44]

1.6.3 Anthropology

Anthropologic studies in ecomusicology come from the field of ethnomusicology, which is the study of music in its social and cultural contexts. Ethnomusicologists examine music as a social process to understand what music is and what it means to its practitioners and audiences, using anthropological and ethnographic methods (i.e., fieldwork and interviews) as well as

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[41]David B. Dunn and James P. Crutchfield, "Entomogenic Climate Change: Insect Bioacoustics and Future Forest Ecology," *Leonardo* 42, no. 3 (June 1, 2009): 239–44, https://doi.org/10.1162/leon.2009.42.3.239.

[42]Patricia Gray et al., "The Music of Nature and the Nature of Music," *Science* 291, no. 5501 (January 5, 2001): 52–54, https://doi.org/10.1126/science.10.1126/science.1056960.

[43]ibid.

[44]W. Tecumseh Fitch, "The Biology and Evolution of Music: A Comparative Perspective," *Cognition* 100, no. 1 (May 1, 2006): 173–215, https://doi.org/10.1016/j.cognition.2005.11.009.

musical, sociological, religious, and other analytical approaches.[45] The idea that is often central to these ethnographic projects is that of "acoustemology", meaning the truths of sonic understanding, which is an apt way to comprehend human-nature connections.[46] Many ethnomusicologists consider the relationships between sound, culture, and place, exploring how local musicians are influenced by and, in turn, influence elemental sounds as well as animal ones. The rationale behind this is that as biodiversity goes extinct, so does cultural and musical diversity. Many anthropologists who operate within the field of ecomusicology have expressed concerns about the environment, thus beginning to take a more active and explicitly environmental activist approach, promoting dialogue through the recovery and public dissemination of cultural and environmental heritages.

1.6.4 Geography

Geography's considerations of space, place, and landscape have also resonated with music studies. The landscapes inhabited by a composer are fundamental in their music and their reception. Both natural and human-constructed environments are more than just a picturesque backdrop for a person's music-making: landscape affects ideology, which affects the compositions and the public's understanding of them.[47] Works in ecomusicology that fall into this category focus on the two-way relationship between place and music, exploring how the nonhuman element can move the human, but also how can music be used to elicit evocative, emotional reactions that aid environmental activism. The United States in particular has been fertile ground both for composers connecting with place and for the scholarly inquiry into their inspirations and relations. For example, composer John Luther Adams has written eloquently about the importance of Alaska for his music, and Denise Von Glahn has explored how a place can help create national and regional identities, analyzing symphonies inspired by Niagara Falls in relation to the composers' and audiences'

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[45]"About Ethnomusicology - Society for Ethnomusicology," n.d., https://www.ethnomusicology.org/page/AboutEthnomusicol#:~:text=Ethnomusicology%20is%20the%20study%20of,to%20its%20practitioners%20and%20audiences.

[46]Steven Feld, "*Waterfalls of Song: An Acoustemology of Place Resounding in Bosavi Papua New Guinea'in Feld, S. and Basso, K.(eds) Senses of Place,*" 1996

[47]Grimley, *Grieg: Music, Landscape and Norwegian Identity.*

identification with the waterfalls.[4849] It was not only nature that sparked the interest of composers and scholars, but also human ingenuity regarding controlling or tapping into it. However, issues of environmentalism, though present, are not prominent in these studies: usually, the emphasis is put on the description of the places represented in music.

1.6.5 History

There are music scholars who prefer to employ a historical approach to engage with past conceptions, however distant or recent, of nature. A common *modus operandi* among historical studies in ecomusicology is that of taking into account the biographies of composers, as well as the cultural context in which they lived. At a more general level, one of the assets of taking a historical approach towards music is that changes in the way that certain sonic elements were perceived become more apparent, making the construction of a logical narrative much easier. However, by analyzing carefully various musical conceptions of the past one is also able to notice the contradictions and intricacies of the cultures under the microscope, for culture can never be monolithic. For instance, in one of her studies, musicologist Elizabeth Leach focused on the topic of the meaning of birdsong in medieval European thought about music, finding that although music was culturally understood as a rational art to be made exclusively by humans, and birdsong was considered irrational and therefore beneath the dignity of human engagement as music, birdsong was nevertheless used in musical compositions to praise musicians and in music theory.[50] Such contradictions are an important factor that can help us to better understand the complexities of history and perceptions that are not in line with modern ones. Ultimately, historical studies can discover the intricacies associated with past modes of thought, allowing for a richer understanding of the world as well as the human conceptions of it.

1.6.6 Sustainability

"Sustainabiliity" is a word that lends itself to multiple interpretations. Some studies in this subcategory have utilized the word in the context of the long-term preservation of ecologies

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[48]John Luther Adams, *The Place Where You Go to Listen: In Search of an Ecology of Music*, 2009, http://muse.jhu.edu/chapter/248715.

[49]Denise Von Glahn, "The Sounds of Place: Music and the American Cultural Landscape," *Choice Reviews Online* 41, no. 08 (April 1, 2004): 41–4552, https://doi.org/10.5860/choice.41-4552.

[50]Elizabeth Eva Leach, "Sung Birds: Music, Nature, and Poetry in the Later Middle Ages," *Choice Reviews Online* 45, no. 01 (September 1, 2007): 45–0200, https://doi.org/10.5860/choice.45-0200.

and natural resources that humans use. Several authors have taken an interest in analyzing the environmental impact associated with the music industry, which is certainly not exempt from criticism in this area. It suffices to be reminded of the environmental costs of large concerts and music festivals, or the ecological pressures that can come with the production of musical instruments. For example, to construct violins, builders require Brazilian Pernambuco and Italian spruce. Considering the life history of these instruments as cultural commodities shows the connections between cultural sustainability and ecological sustainability, as today only 8% of the original forest is still in existence, due to the majority of professional players continuing to insist on ecologically destructive Pernambuco bows.[51] The message that studies like this one drive home is that cultural decisions have ecological ramifications. Other authors have used the concept of sustainability in a different context, namely, by using the word as a model or theoretical framework for understanding the preservation of entire cultural traditions, like dance-related or musical practices, without considering the possible impacts on an ecological or environmental level. In these kinds of studies, it is music itself that is treated as an endangered species: Jeff Todd Titon employs this line of reasoning, stating that music is "a biocultural resource, a product of human life; further, it is a renewable resource. (…) In short, sustaining music means sustaining people making music."[52] This way, the idea of sustainability becomes particularly efficient as an analogy, allowing the authors to borrow core principles of conservation biology, such as diversity, limits to growth, interconnectedness, and stewardship, and apply them to cultural policies regarding heritage management.

1.7 To imagine a sound

As one can see, ecomusicological approaches are not unified. They reflect a messy reality in the field that reflects the messy reality of art and humanity in the world. Nevertheless, this diverse array of reflective and applied approaches to ecomusicology helps achieve the goal of making studies and music inclusive of the Earth, with all its plants, animals, places, as well as humans.[53] Ecomusicology contributes to understanding the cultural roots of the environmental crisis by "sounding out" contemporary ecological crises. What is the sound of climate change? Is it the deafening noise of industrial engines? Is it the crash of a glacier

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[51]Aaron S. Allen, '*Fatto di Fiemme': Stradivari's violins and the musical trees of the Paneveggio*, na, 2012

[52]Jeff Todd Titon, "Music and sustainability: An ecological viewpoint," *The world of music* 5, no. 1: 119-137.

[53]Allen, "33. Ecomusicology from Poetic to Practical."

melting into the sea? Is it an absence of sound altogether? Ecomusicologists take into account creative attitudes that can not only help people listen to the many voices of the nonhuman but also assist them in understanding environmental issues from new perspectives, and most importantly, imagining how things could be different. If, as stated by Amitav Ghosh, the climate crisis is a crisis of imagination, ecomusicology might just help.[54]

[54]Gilmurray, "Sounding the Alarm: An Introduction to Ecological Sound Art."

CHAPTER 2. SEEING THROUGH SOUND: THE SOUNDSCAPE

2.1 Defining the Soundscape

Silence and noise are two of the most important core principles at the basis of current ecological discussions about sound and listening. Noise is understood as a subjectively perceived high presence or overpresence of one or more specific sounds, whereas silence is to be defined as a subjectively perceived low amount and density or an under-presence of sounds.[55] These opposing concepts can be viewed as occupying the ends of the spectrum of the sonosphere, a neologism that stands to signify the sonic envelope of the earth, encompassing all sounds that can be perceived by humans, animals, birds, plants, trees, and machines. All of these aural identities form the soundscape, conceived as the acoustic equivalent of the landscape.[56] The soundscape could be loosely defined as the human's perception of the sonosphere, although, as several definitions of soundscapes have been proposed, the term is frequently used ambiguously, at times associated with objective reality and at times pinpointed as a subjective interpretation.[57]

The term "soundscape" was originally coined by Micheal Southworth in 1969, while writing about the perception of urban acoustic environment. In this first usage of the word, the soundscape was taken to signify "the quality and type of sounds and their arrangement in space and time".[58] However, it was Canadian composer Raymond Murray Schafer who popularised the term in 1977, to bring to light the rising emergence of noise pollution as a potential threat to human health and culture, although he did not have any scientific evidence at the time. His concern revolved around the ever-growing "low-fidelity soundscapes", as he called them, consisting of soundscapes where quiet and distant sounds could not be heard

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[55]Patricia Jäggi, "Listening to Reveries: Sounds of a Post-Anthropocene Ecology," *Zenodo (CERN European Organization for Nuclear Research)*, March 15, 2021, https://doi.org/10.5281/zenodo.4709853.

[56]Mercede Erfanian et al., "The Psychophysiological Implications of Soundscape: A Systematic Review of Empirical Literature and a Research Agenda," *International Journal of Environmental Research and Public Health/International Journal of Environmental Research and Public Health* 16, no. 19 (September 21, 2019): 3533, https://doi.org/10.3390/ijerph16193533.

[57]Elie Grinfeder et al., "What Do We Mean by 'Soundscape'? A Functional Description," *Frontiers in Ecology and Evolution* 10 (June 15, 2022), https://doi.org/10.3389/fevo.2022.894232.

[58]Micheal Southworth, "The Sonic Environment of Cities," *Environment and Behavior* 1, no. 1 (June 1, 1969): 49–70, https://doi.org/10.1177/001391656900100104.

clearly because of the dominating noise; at the expense of "high-fidelity soundscapes", soundscapes where all sounds could be heard distinctly, each occupying its own separate acoustic space, much like instruments in a classical orchestra.[59] This kind of framing on the matter of the acoustic environment led to the emergence of soundscape ecology and ecoacoustics, where the concept of soundscape was used to label an acoustic space that could be studied in an ecological context.

Still, this definition still comes off as somewhat vague. In 2011, attempting to be more specific, Pijanowski et al. described the soundscape as "the collection of biological, geophysical and anthropogenic sounds that emanate from a landscape and which vary over space and time reflecting important ecosystem processes and human activities."[60] However, even this phrasing presents some issues: namely, as Almo Farina and Nadia Pieretti observed in 2012, the landscape can be defined in more than one way, based on the discipline and the epistemological basis that is adopted.[61] Farina later proposed an additional definition to that of Pijanowsky and his co-authors, stating that the soundscape is "the acoustic context produced and, in turn, perceived in different ways by both animals and humans."[62]

More recent interpretations of the concept seem to withdraw back away from Pijanowski's holistic idea of the soundscape, deciding rather to focus on the description of the sounds that arrive at an observer. Furthermore, there is a well-established idea within the framework of soundscape composition, the idea being that the soundscape and its recording are the same. According to composer Hildegard Westerkamp, a soundscape may be understood as the outcome of a process of juxtaposition of environmental sound recordings ultimately providing an "artistic, sonic transmission of meanings about place, time, environment and listening perception."[63]

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[59]Aki Pasoulas, "The Art and Science of Acoustic Ecology," *Ent and Audiology News* 28, no. 6 (February 1, 2020)

[60]Bryan C. Pijanowski et al., "What Is Soundscape Ecology? An Introduction and Overview of an Emerging New Science," *Landscape Ecology* 26, no. 9 (May 1, 2011): 1213–32, https://doi.org/10.1007/s10980-011-9600-8.

[61]Almo Farina and Nadia Pieretti, "The Soundscape Ecology: A New Frontier of Landscape Research and Its Application to Islands and Coastal Systems," *Journal of Marine and Island Cultures* 1, no. 1 (June 1, 2012): 21–26, https://doi.org/10.1016/j.imic.2012.04.002.

[62]Almo Farina, "Soundscape and Landscape Ecology," in *Springer eBooks*, 2013, 1–28, https://doi.org/10.1007/978-94-007-7374-5_1.

[63]Hildegard Westerkamp, "Linking Soundscape Composition and Acoustic Ecology," *Organised Sound* 7, no. 1 (April 1, 2002): 51–56, https://doi.org/10.1017/s1355771802001085.

2.2 Soundscape ecology and bioacoustics

Soundscape ecology is a developing scientific approach closely related to the discipline of landscape ecology focusing on the study of sound to evaluate local biodiversity. Its foundations are to be found in the fields of animal communication and behavior, biogeography, signal processing, data mining, and psychoacoustics.[64] The methodologies involved in soundscape ecology studies mainly revolve around using remote sensing technologies, such as passive acoustic recorders, in diverse ecosystems, seeking links between biophysical and social scientific methods to address issues of biological conservation. Soundscape ecology asks questions about how noise affects organisms in terms of their communication ability, survival, and long-term health. Its main goal is to develop appropriate solutions to reduce noise pollution, emphasizing the role played by humans as an integral part of ecosystems.[65]

The birth of this scientific area of research was heavily inspired by the "Acoustic Niche Hypothesis", which was first posed by Bernie Krause and Ruth Happel in 1983. This theory proposes that different species have evolved to occupy different frequency ranges, or acoustic niches, in a given habitat. Studies have revealed that species will indeed adjust their signals, either through a change in timing or frequency range, due to competitive exclusion, to minimize possible interferences with other sound-producing animals. This is why any disturbance to the soundscape could harm the delicate balance of acoustic niches in a soundscape, which can in turn result in a loss of biodiversity, namely if a species' mating calls go unheard.

One key concept borrowed from landscape ecology is perspectival awareness: for instance, as the physical landscape of a bird varies greatly from that of a slug in terms of the niches they occupy, so does the soundscape, meaning that not all organisms occupy the same acoustic niche. This may be attributed to animals not having the same hearing range or using sound in different ways. Nonetheless, the awareness of the diversity of perspectives is key to appreciating the interdisciplinary and receptive attitude of soundscape ecology.

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[64]Guillermo De Llera Blanes, "Trek to Everest Base Camp: (Re)Composing a Sound-Trek and (Re)Experiencing as Soundscape Remix," *Cadernos De Arte E Antropologia*, no. Vol. 10, No 2 (September 19, 2021): 71–94, https://doi.org/10.4000/cadernosaa.3864.

[65]Megan A Reich, "Soundscape Composition: Music as Environmental Activism," *University of Puget Sound*, January 1, 2018, https://soundideas.pugetsound.edu/cgi/viewcontent.cgi?article=1028&context=honors_program_theses.

As I mentioned before, this area of inquiry is still developing, mainly because no coherent theory on the ecological significance of the sounds emanating from a landscape has been formed yet. However, improvements in technologies, like automated recording devices, developments in acoustic data processing, the existence of inexpensive storage capabilities, as well as new findings in landscape ecology, have allowed research in soundscape ecology to progress.[66]

Another field of study closely related to soundscape ecology is that of bioacoustics, which is an interdisciplinary science combining biology and acoustics, referring to the investigation of sound production, dispersion, and reception in animals.[67] The findings provide clues on the evolution of acoustic mechanisms of animals, which, in turn, provide information about their evolution. The majority of bioacoustics studies focus on a single species or a comparison of species, unlike soundscape ecology, which concentrates mostly on macro or community acoustics.

2.3 Components of a Soundscape

Taking the soundscape as the vast array of sounds that can be listened to by the human ear, one can classify its components into three main categories: in fact, the soundscape is more than the sum of several individual sounds, as it underlies a complex interdependence between sound sources and acoustic filters, that are in turn affected by a wide variety of environmental factors. Sound sources are the primary sonic entities before going through any alteration and are further grouped into three categories: biophony, for biotic inputs, geophony, for abiotic inputs, and anthrophony, for human-made sound sources. Acoustic filters are divided into sound propagation filters, relying on the conditions of the environment being taken into account, and receiver filters, which depend instead on the characteristics of the receiver, such as their location or acoustic sensitivity. Finally, environmental factors are partitioned into five categories: temporal factors, spatial factors, abiotic factors, biotic factors, and acoustic factors.

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[66]Bryan C. Pijanowski et al., "Soundscape Ecology: The Science of Sound in the Landscape," *BioScience/Bioscience* 61, no. 3 (March 1, 2011): 203–16, https://doi.org/10.1525/bio.2011.61.3.6.

[67] Neville Fletcher, "Animal Bioacoustics," in *Springer eBooks*, 2007, 785–804, https://doi.org/10.1007/978-0-387-30425-0_19.

2.3.1 Sound sources

2.3.1.1 Geophony

Geophony refers to the sounds produced by abiotic sources. It is useful to divide these kinds of sounds into two main categories: weather sounds and hydrological sounds. It must be noted that these two categories do not encompass the totality of the geophony, for example, seismic activity or forest fires cannot fit into these two subdivisions. However, geophonic sound sources that are neither hydrological nor are produced by weather have a low rate of occurrence and have been less studied, hence, for the sake of clarity, they will not be included.

The occurrence and power of weather sounds depend of course on abiotic climatic and meteorological factors, like the force of the wind or the intensity of the rain. On the other hand, the quality of the sound textures depends on the interaction between these factors and the physical elements of the landscape, which can be biotic. Namely, one can think of the wind passing through tree foliage redesigning its sound, not to mention that episodes of heavy rain can also alter animal behavior.[68]

Hydrological sound sources are produced by moving bodies of water, such as rivers, oceans, or waterfalls. Although their presence is pervasive, it can go through changes both in terms of quantity and quality, depending yet again on climatic and meteorological factors. During dry seasons, it is not uncommon for a small stream to disappear, whereas the sounds of a river can be heard quite prominently during a rainy day. Also, the noise produced by rivers can be impactful to species' distribution of territory.[69]

2.3.1.2 Biophony

Biophony refers to sounds that are produced, either intentionally or incidentally, by biotic sources. Though this definition is not limited to the animal kingdom, animals make up most of biophony.

Each biophonic sound is the result of the species-specific behavior of any given individual in the landscape, encompassing a wide variety of sounds produced by a wide variety of sound

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[68]Thierry Lengagne and Peter J. B. Slater, "The Effects of Rain on Acoustic Communication: Tawny Owls Have Good Reason for Calling Less in Wet Weather," *Proceedings - Royal Society. Biological Sciences/ Proceedings - Royal Society. Biological Sciences* 269, no. 1505 (October 22, 2002): 2121–25, https://doi.org/10.1098/rspb.2002.2115.

[69]Dylan G. E. Gomes, Thomas Hesselberg, and Jesse R. Barber, "Phantom River Noise Alters Orb-weaving Spider Abundance, Web Size and Prey Capture," *Functional Ecology* 35, no. 3 (December 21, 2020): 717–26, https://doi.org/10.1111/1365-2435.13739.

production systems, like vocalization, stridulation, and percussion. These sounds vary by season, hour, and depending on species interaction.[70]

2.3.1.3 Ambient sounds

Ambient sounds are commonly understood as background sounds, meaning mostly inherently undesirable sounds. However, not only are ambient sounds a significant component of the soundscape, but they also amount to the main source of sound during periods of reduced biotic and abiotic activity.[71] Ambient sounds are a combination of external and internal ambient sounds. External ambient sounds, also referred to as "environmental noise", are defined as a concoction of both biophonic and geophonic signals that cannot be properly separated and identified due to too much attenuation or distortion. Internal ambient sounds are produced by the body of the receiver that can only be perceived by it. For animals, the origin of these sounds could be of a neural, vascular, or pulmonary kind; whereas for artificial recorders, internal ambient sounds are mechanical sounds resulting from the physical configuration and operation of the recording gear.

2.3.1.4 Anthrophony

Anthrophony refers to sound sources that are either physically generated by humans, such as human voices, or human activity-related sounds, like vehicles, heavy machinery, or the general noise of a city. Anthrophony is generally more consistent than biophony in terms of overall sound production fluctuations, but it is possible to recognize emerging patterns: for example, an increase in traffic noise during a city's rush hour. Due to its overbearing presence in everyday life, anthrophony has been somewhat underrepresented in soundscape studies, which often focus on "pristine" environments. Nonetheless, it is, possibly to the chagrin of environmental scientists, an important component of the soundscape.[72]

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[70]Grinfeder et al., "What Do We Mean by 'Soundscape'? A Functional Description."

[71]Elie Grinfeder et al., "Soundscape Dynamics of a Cold Protected Forest: Dominance of Aircraft Noise," *Landscape Ecology* 37, no. 2 (January 8, 2022): 567–82, https://doi.org/10.1007/s10980-021-01360-1.

[72]John E. Quinn et al., "Intersections of Soundscapes and Conservation: Ecologies of Sound in Naturecultures," *MUSICultures* 45 (January 1, 2018), https://journals.lib.unb.ca/index.php/MC/article/view/28934.

2.3.2 Environmental factors

2.3.2.1 Temporal factors

Temporal environmental factors consider time changes at different scales. For example, animal behavior is both directly and indirectly influenced by the lunar cycle, in particular when it comes to acoustic communication.[73] The changing of the seasons and the weather variations that come with it also regulate yearly animal activity and therefore affect the composition of sound sources coming from local species.

2.3.2.2 Spatial factors

Spatial factors include abiotic entities that are relevant to the geographical location of the soundscape and its geospatial coordinates. Sound propagation can be impacted by the topography and the ground surface, with obstacles and elevation possibly inducing, for instance, sound scattering events and ground effects.

2.3.2.3 Abiotic factors

Climate and weather are capable of altering animal and vegetal biotic factors. The weather also produces geophonic sound sources, such as wind and rain, which can, in turn, alter hydrologic landscape sounds such as rivers. In open areas, namely meadows, wind can also create acoustic meteorological effects generating amplitude fluctuations. Climate and weather have an impact on the local microclimate, in terms of temperature, humidity, and sun irradiance of the area taken into account. These factors influence both animal behavior and acoustic meteorological effects.[74]

2.3.2.4 Biotic factors

The category of biotic environmental factors is quite rich, as these are factors covering a wide range of phenomena, spacing from physiological characteristics to ecological relationships. The most cited factors within the available literature concerning biophony production are

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[73]Rohini Balakrishnan, "Behavioral Ecology of Insect Acoustic Communication," in *Springer Handbook of Auditory Research*, 2016, 49–80, https://doi.org/10.1007/978-3-319-28890-1_3.

[74]L. C. Birch, "The Role of Weather in Determining the Distribution and Abundance of Animals," Cold Spring Harbor Symposia on Quantitative Biology/Cold Spring Harbor Symposia on Quantitative Biology 22, no. 0 (January 1, 1957): 203–18, https://doi.org/10.1101/sqb.1957.022.01.021.

vegetation, acoustic community, acoustic behavior, population density, territory distribution, and trophic interactions.

All kinds of vegetation affect sound propagation. The characteristics of plant components such as trunks and leaves can produce acoustic scattering and ground effects, and, especially in closed habitats, the presence of vegetation is a core determinant of the local microclimate. Furthermore, vegetation can influence wind currents, which can create specific sound profiles.[75]

In the fields of soundscape ecology and ecoacoustics, an acoustic community is defined as an assemblage of species sharing the same acoustic space.[76] Acoustic communities are different depending on their geospatial coordinates, and can also evolve through time according to the season, migration, and environmental change. As the main elements creating the biophony, it is crucial to understand the local species dynamics of acoustic communities.

Population density is the number of acoustically active individuals in a given area and therefore represents the abundance of sounds produced in it.[77] It depends, ecologically, on population dynamics, which are affected by the species' intrinsic rate of increase and trophic interactions.

Trophic interactions, such as prey-predator and plant-animal relations, have a significant impact on animal behavior, affecting biotic sound sources as well, through acoustic behavior. When considering an ecosystem, trophic interactions are the core of inter-specific relationships.

Territory distribution refers to the position of any animal participating in the biophony of an area. Unlike abiotic factors, whose location could be identified from topographical sources, animals' position in space can vary greatly depending on individual movements to defend their territory as well as the processes of exploration and exploitation of their home range.[78]

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[75]T. G. Forrest, "From Sender to Receiver: Propagation and Environmental Effects on Acoustic Signals," *American Zoologist* 34, no. 6 (December 1, 1994): 644–54, https://doi.org/10.1093/icb/34.6.644.

[76]A. Gasc et al., "Acoustic Indices for Biodiversity Assessments: Analyses of Bias Based on Simulated Bird Assemblages and Recommendations for Field Surveys," *Biological Conservation* 191 (November 1, 2015): 306–12, https://doi.org/10.1016/j.biocon.2015.06.018.

[77]Deanna K. Dawson and Murray G. Efford, "Bird Population Density Estimated From Acoustic Signals," *Journal of Applied Ecology* 46, no. 6 (November 26, 2009): 1201–9, https://doi.org/10.1111/j.1365-2664.2009.01731.x.

[78]Birch, "The Role of Weather in Determining the Distribution and Abundance of Animals," January 1, 1957.

2.3.2.5 Acoustic factors

I have mentioned before ground effects, which describe the reflection of sound waves on the ground, which changes the distance that the sound wave can travel. This kind of phenomenon interferes with sound propagation, at times in a destructive fashion, producing attenuation, and at times in a constructive way, generating amplification. The impact of ground effects is heard especially at low frequencies, and the overall magnitude of the aftermath depends on the composition of the different layers and the distance between the sound source and the ground.[79]

I have also mentioned sound scattering, which is the occurrence of absorption, refraction, and reverberation of sound sources. This phenomenon happens when the wavelength of a sound is smaller than the dimension of surrounding objects, namely trunks and foliage. It is mostly noticeable at high frequencies rather than low, and since it is more significant in closed habitats, the kind of sound scattering produced depends mostly on forest characteristics like tree and foliage density, leaf shape, and rock configuration.[80]

Meteorological effects consist of all abiotic and biotic phenomena concerning climate and weather impacting sound propagation. For instance, humidity can help facilitate atmospheric absorption, and ambient temperature changes the speed of sound. The combination of wind currents and temperature fluctuations is able to cause atmospheric turbulence resulting in irregular amplitude fluctuations.[81] Meteorological effects are perceived most prominently in open areas.

2.4 Types of Soundscape

To better understand different types of soundscapes it is best to divide them into three distinguished yet complementary categories: distal soundscape, proximal soundscape, and perceptual soundscape. The distal soundscape amounts to the spatial and temporal distribution of sounds in a given area, the proximal soundscape refers to the collection of

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[79]Tony F. W. Embleton, "Tutorial on Sound Propagation Outdoors," the Journal of the Acoustical Society of America/the Journal of the Acoustical Society of America 100, no. 1 (July 1, 1996): 31–48, https://doi.org/10.1121/1.415879.

[80]Michelle E. Swearingen and Michael J. White, "Influence of Scattering, Atmospheric Refraction, and Ground Effect on Sound Propagation Through a Pine Forest," *the Journal of the Acoustical Society of America/the Journal of the Acoustical Society of America* 122, no. 1 (July 1, 2007): 113–19, https://doi.org/10.1121/1.2735108.

[81]Embleton, "Tutorial on Sound Propagation Outdoors," July 1, 1996.

sound signals occurring at a specific position in space, and the perceptual soundscape to the interpretation of a proximal soundscape. The reason for this further subcategorization by Grinfeder, Lorenzi, Haupert, and Sueur is to explicitly clarify the definitions of soundscape, which is often reduced to a simple collection of individual sounds, hoping to make soundscape ecology more functional, with the purpose of helping ecoacousticians, bioacousticians, psychoacousticians and environmental managers to protect natural areas in a more significant and suitable way.[82]

2.4.1 The Distal Soundscape

The distal soundscape can be thought of as the acoustic equivalent of the landscape. The reason for this analogy lies in the fact that landscape ecology studies ecological invariant patterns of interest that emerge from a collection of singular events.[83] A landscape event cannot be ascribed to a singular signal and, similarly, it would be more accurate to consider a soundscape event in the same fashion, as a collection of sound signals in a given area. Since no observer is able to receive the totality of the acoustic information in an area, this spatial and temporal distribution of sound signals remains mostly theoretical. Still, the distal soundscape is to be considered as the collection and subsequent identification of spatial and temporal patterns. The main problem with this definition of the distal soundscape is its lack of addressing the acoustic scale of the sound signals, which can limit the quantity of sound signals taken into consideration. To see this issue, one can wonder whether the sound of insects in the soil should be considered when studying the distal soundscape at the volume scale of larger animals. Many findings of soundscape ecologists relate to a specific time, frequency, and amplitude range, which are often more implied rather than explicitly stated.[84] Hence, the distal soundscape can be summarized as the spatial and temporal distribution of sounds in a given area; when described, a distal soundscape should be associated with both a specific time period and a specific acoustic range.

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[82]Grinfeder et al., "What Do We Mean by 'Soundscape'? A Functional Description."

[83] Kevin McGarical, and D. Urban, "Introduction to landscape ecology," *Landscape Ecology course notes, Duke University* (2001).

[84] Grinfeder et al., "What Do We Mean by 'Soundscape'? A Functional Description."

2.4.2 The Proximal Soundscape

The proximal soundscape is defined as the array of propagated sound signals occurring at a specific point in space. It is perhaps helpful to bring back the concept of the distal soundscape to clarify this notion: as the distal soundscape surveys all the potential effects of sound propagation taking place in a defined space, the proximal landscape refers to the filtering of these sound signals at a single point in space.[85] Hence, although there is but one distal soundscape for a given area, there is a multiplicity of proximal soundscapes occurring at the same time, one for every potential receiver position. Ideally, this category of soundscape should be depicted by a recording with s limitless acoustic scale and no internal ambient sounds.

2.4.3 The Perceptual Soundscape

A perceptual event directly relates to a dynamic internal representation of an acquired proximal event through time and space. It could be defined as a subjective representation built by the observer to rationalize the acquired information. The observer's analysis of a proximal soundscape is a process involving multiple sensory and cognitive processes, which can at times be very fast and automatic but can at other times be slower. Neuroscience research has shown that the auditory processing of complex acoustic signals requires the segregation of the sound objects into categories based on pitch, timbre, loudness, and dynamic patterns, as well as attentional processes that emphasize the salience of certain acoustic events, and cognitive activities involving decision and memory. [86]

On a neural level, there are two processing pathways associated with soundscape: in simple terms, the first one relates to the analysis of the acquired sound signals, and the second refers to the processing of these sounds, once analyzed and identified, into an emotional response. Eventually, the observer is able to construct an elaborate cognitive representation of the

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[85]Daniele Barchiesi et al., "Acoustic Scene Classification: Classifying Environments From the Sounds They Produce," *IEEE Signal Processing Magazine* 32, no. 3 (May 1, 2015): 16–34, https://doi.org/10.1109/msp.2014.2326181.

[86]Christoph Kayser et al., "Mechanisms for Allocating Auditory Attention: An Auditory Saliency Map," *CB/Current Biology* 15, no. 21 (November 1, 2005): 1943–47, https://doi.org/10.1016/j.cub.2005.09.040.

acoustic event, which could finally be stored in episodic and semantic autobiographical memory.[87]

Ultimately, the perceptual soundscape is defined as the individual subjective interpretation of a proximal soundscape. While there are several proximal soundscapes for any given area, the number of perceptual soundscapes is infinite, varying greatly based on the receiver's nature and processing stages.

2.5 Soundscape composition

Humans' perception of the environment is largely affected by sound, but the matter of what sounds the individual listener puts at the forefront or into the sonic backdrop of their minds involves a personalized mix of inputs, chosen by their degree of relevance to their personal history, preferences, and feelings. This means that the shaping of meaning attributed to soundscapes is influenced by human agency as an interactive factor.[88] Scholars Payne, Davies, and Adams incorporated this concept in their definition of soundscapes, stating that there should be an emphasis on the relationship between an individual's or society's perception of, understanding of, and interactions with the sonic environment.[89] This idea of co-creation of the soundscape lies at the foundation of composers' soundscape productions. The artistic reinterpretation or remix of soundscape source materials has the potential to start dialogues and considerations on humanity's impact on the sounding Anthropocene.

In the words of Hildegard Westerkamp**,** the essence of soundscape composition is the artistic, sonic transmission of meanings about place, time, environment, and listening perception. To define it more precisely would be challenging, as each soundscape composition is a product of its cultural, political, and environmental context, and each one is presented in a new way. The reason for this is that a soundscape recording refers to a specific moment in time and in a place with its own sound characteristics. Of course, in this type of artistic endeavor the skills and crafts of the composer, as well as their unique perspective, play a role. Ultimately,

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[87]Ali Í Tekcan et al., "Retrieval and Phenomenology of Autobiographical Memories in Blind Individuals," *Memory* 23, no. 3 (February 17, 2014): 329–39, https://doi.org/10.1080/09658211.2014.886702.

[88]De Llera Blanes, "Trek to Everest Base Camp: (Re)Composing a Sound-Trek and (Re)Experiencing as Soundscape Remix."

[89]Sarah R. Payne, William J. Davies, and Mags Adams, "Research into the practical and policy applications of soundscape concepts and techniques in urban areas (NANR 200)," *Nanr*, October 1, 2009, https://pure.hw.ac.uk/ws/files/10337069/Payne.Defra_soundscape_report.pdf.

soundscape composition is the result of the interaction of all these factors: The human listening experience is equally important as the source material.[90]

To fully appreciate this point, one has to look no further than the starting point of any soundscape composer, the microphone. The microphone alters listening, often intensifying the recordist's aural experience and providing them with increased availability of sounds that would otherwise be lost to the human ear, due to them being overwhelmed by other sources. However, the microphone is also non-selective, because it cannot tune in and out the way the ear can. The ear can focus, switching the attention from one sound to the other. The composer's mission is to make their recordings more human, a job accomplished by sound production in the studio, via equalizing, filtering, pitch shifting, adding reverb, and so on. The specific perspective of the composer is what allows them to blur the lines between "real" soundscapes, acoustic experiences, and aural imagination. Soundscape composition is as much a comment on the state of the environment in question as it is a reflection of the composer's experiences and attitudes toward the soundscape. This implies a knowledge of the soundscape and of the ways humans hear and process sounds.

This kind of thinking is essential in soundscape composition, as any composition is always rooted in themes involving the sound environment, and it is never abstract. However, any artist dealing with this kind of creative endeavor may run the risk of only adding a series of environmental components from found materials in their work, failing to become an integrated whole.[91] This is the challenge of soundscape composition, that of creating a piece with its own integrity, a new moment in a new place with its own life and characteristics, yet one that is still connected to the place and time of the original recordings and the composer's state of mind and intention.

Composer Micheal Rüsenberg stated that soundscape composition is the intent of an artist to musicalize a recording of a certain location at a certain time, and the artist works on the assumption that aesthetic values can be ascribed to that soundscape or elements of it. While this definition may seem valid, it fails to mention the importance of sound materials. Composing with environmental sound implies a relationship between the composer and the recorded materials, and both should have an equal amount of agency. Whatever intent the composer may have is not enough to create something meaningful because the materials speak

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[90]Hildegard Westerkamp, "Linking Soundscape Composition and Acoustic Ecology," Organised Sound 7, no.1: 51–56 (2002). https://doi.org/10.1017/S1355771802001085.

[91] ibid.

in a different language, and their deeper meanings may only emerge with the aid of repeated listening and sound processing. That in itself can shift the composer's intent, which is why the role played by a dialogic attitude towards soundscape composition should not be understated. In light of these considerations, Westerkamp proposes a revised interpretation of Rüsenberg's definition of soundscape composition, which states that in soundscape composition the artist seeks to discover the sonic/musical essence contained within the recordings and thus within the place and time where it was recorded. The artist works with the understanding that aesthetic values will emerge from the recorded soundscape or some of its elements.[92] After all, soundscape composition cannot really be pre-planned, at least not entirely: it emerges as much as it is discovered. Not only do the artists not know what kind of sounds they will gather once they enter a place, but they also do not know beforehand the kind of emotional responses they will experience to each of these inputs. Furthermore, the very nature of environmental recordings does not provide composers with clean, isolated sound objects, but rather a whole context of other signals. It is in this multiplicity of sources that the human interpretation of the soundscape is shaped, guiding the composer's decisions on how to work with the available materials.

Of course, this is merely the starting point of the process, as it only reflects on the personal experience of the person composing the soundscape. The big question is whether the audience can relate to the sonic language that is being used, as well as the message of the artist. The fact that the composer may have developed a close relationship with the sound sources and the environments in question does not automatically mean that listeners will do the same. There is no real answer to this question, as it is impossible to predict how someone else might react to art. Nevertheless, it would be useful for any artist to keep this inquiry in mind because it brings forth the existence of another actor in the process, the audience, possibly developing further the dialogue started in the compositional phase between the artist and the soundscape. In fact, the listener has to actively contribute for a soundscape production to be experienced most effectively, as the creation of resonance between audience and composition does not fall entirely under the composer's responsibilities. For their part, the best thing that a listener can do is to be more involved in consciously experiencing the soundscape in daily life, so that they would have a more emotional and informed attitude when it comes to listening to a soundscape composition.

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[92] Westerkamp, "Linking Soundscape Composition and Acoustic Ecology."

2.6 Types of Soundscape Compositions

The field of soundscape composition is informed by a variety of emerging artists and scientists bringing their diverse backgrounds and skill sets to the table. These individuals range from field recording artists with a biology education to musicians with Western classical training, and as a result, soundscape composers take a multiplicity of approaches to recording, mixing, and presenting their works. However, it is possible to split up most of the works in soundscape composition into four main categories: field recordings, soundwalks, sonifications, and interactive events.[93]

2.6.1 Field recordings

A soundscape composition based on field recordings can be defined as a musical piece that incorporates recorded sounds from natural or urban environments. The composer is usually the one who finds and records these sounds, as well as being the one to choose if and how to process them, combining recordings from different locations, isolating certain elements, manipulating the sound objects, and so on. At the most basic level, the only tools needed to create a field recording-based soundscape composition are a recorder and a microphone.

2.6.2 Soundwalks

A soundwalk is a recording made by a composer as they move through a chosen environment. In fairness, it can also refer to the act of walking and listening to one's surroundings as well as the recorded product itself. Sometimes the composer might invite external participants to join them in the soundwalk experience, and their vocal observations and reflections might be incorporated into the recording. If one considers soundwalks as experiences it is quite easy to understand why they often take shape as public events emphasizing awareness and engagement with the environment, as they are much more interactive than other types of soundscape composition: as a person walks, stops, turns around, or changes their pace, the perspective of the soundscape shifts, and the microphone becomes an extension of the body of the listener, reflecting their every movement. The artist creating a soundwalk-based composition usually has no pre-set agenda, letting the sounds of their surroundings dictate the direction of the experience by sparking the composer's curiosity to explore further.[94]

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[93]Reich, "Soundscape Composition: Music as Environmental Activism."

[94] ibid.

2.6.3 Sonifications

A sonification is the result of the process of mapping data into sound. There is virtually no limit to the kind of data that could be sonified, such as weather patterns, molecular structures, or the electrical activity of the brain. While the term usually refers to its use as a scientific method of data display, in the context of soundscape composition this process is mostly appreciated for its being a gateway to an emotional reaction or connection to a place. The rationale behind sonification-based musical pieces lies not in the intention of separating the sound from its source, but rather of revealing the nature of the source by decoding the information it contains via sound. This practice was most common in the conceptual art movement of the 1960s: for example, John Cage incorporated it in his work "Atlas Eclipticalis", where he superimposed music paper on top of star charts and organized musical passages as if they were constellations. This reveals one of the most attractive qualities of sonification from the point of view of an artist, its indeterminacy, which acts as a way of letting nature speak for itself.[95]

A subset of sonification is audification, which consists of converting a sound signal outside of the range of human hearing into one that could be heard. For instance, humans cannot hear the seismographic waves of an earthquake as they are below our frequency range, but if the playback speed of these waves is increased they become hearable.[96]

2.6.4 Interactive events

Public participation in soundscape composition can be encouraged in many ways. While the methods of these interactive events are always based on field recordings, soundwalks, or sonifications, the settings of such events can vary, from taking place in a museum to a public street or a forest. The ways in which the audience can interact with the composer or the environment are also diverse, but perhaps the most common practice employed in these events is that of incorporating a phone application that lets the listener interact with a pre-installed soundscape, either by moving through space to explore the soundscape or by manipulating the

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[95]Jonathan Sterne and Mitchell Akiyama, The Recording That Never Wanted to Be Heard and Other Stories of Sonification, Oxford University Press eBooks, 2011, https://doi.org/10.1093/oxfordhb/9780195388947.013.0115.

[96]Alexandra Supper, The Search for the "Killer Application": Drawing the Boundaries Around the Sonification of Scientific Data, Oxford University Press eBooks, 2011, https://doi.org/10.1093/oxfordhb/9780195388947.013.0064.

sonic output themselves. Alternatively, soundscape compositions can also be presented as installations, functioning more similarly to a gallery of visual art rather than a concert.[97]

2.7 Sound processing techniques

There is a predominantly digital nature within the act of soundscape composition, as the most used techniques for treating environmental sounds rely on samplers and signal processing. Usually, in traditional music-making, when one captures an aural signal on tape and subjects it to studio processing later on, the rationale behind this decision is that of using the sound for its desired effect, essentially turning it into a consumable product. However, within soundscape composition, the process is actually reversed, as it is the sound that could be said to be using the composer and, ultimately, the listener. To fully appreciate this concept, one should understand that when listening to a soundscape composition the sounds guide the audience and the composer through a multiplicity of images and associations that could be at times difficult to verbalize. The distinction between this and a typical acoustic composition may be subtle, but key: while in a linear model of music-making the composer typically sends out messages to provoke an emotional reaction, in soundscape composition it is the sound itself that mediates the relationship between the composer and the listener, providing the social and environmental context, commenting on it, and exploring its possible meanings. To summarize, one is both composing and being composed through the sound.[98] Environmental sounds then are not only rich in acoustic complexity but also in a variety of levels of meaning, that can be personal, cultural, and possibly even cross-cultural. These sounds form a web of relationships connecting the listener to many different spaces, both physically and socially. The composer of a soundscape treats the sounds abstractly through the artificiality of electro-acoustic techniques to amplify these relationships, bringing them into the compositional context.[99] Still, it must be noted that the result of this process should not be reduced to a kind of collage, as many environmental sound sources carry a lot of symbolic information interacting with images and metaphors to create an aesthetic discourse within the musical composition.

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[97]Reich, "Soundscape Composition: Music as Environmental Activism."

[98]Barry Truax, "Soundscape, Acoustic Communication and Environmental Sound Composition," *Contemporary Music Review* 15, no. 1–2 (July 1, 1996): 49–65, https://doi.org/10.1080/07494469608629688.

[99]Barry Truax, "The Inner and Outer Complexity of Music," *Perspectives of New Music* 32, no. 1 (January 1, 1994): 176, https://doi.org/10.2307/833161.

Technology plays a central role in this process, from the earliest stages of recording to the later stages of studio transformation and final mixing. Studio transformation in particular is such a key element in the compositional process that it is often central to the final product presented to the listener.[100] In a way, it is similar to the role that playing has in children's cognitive development: active manipulation of an object, in this case a sonic object, leads to its functional and conceptual understanding. Playing with a sound involves both imagination and memory, nudging the listener to ask themselves a multitude of "what if" questions, as well as stimulating their sense of discovery. Technological means are able to achieve this by manipulating the sounds, but the expanded awareness brought about by studio processing can linger even under circumstances untouched by technological intervention: for example, a composer could decide to slow down a particular sound to emphasize a certain detail of it, and once the listener realizes that particular quality of the sound, they might be able to recognize it when the playback speed of the sound is returned to normal. This example provides an opportunity to introduce what is perhaps the most important technique in soundscape composition, real-time granulation of sampled sounds. This technique consists of dividing the sound into singular "grains" of a duration of 50 ms or less and then reproducing them in high density ranging from several hundred to several thousand grains per second.[101] The result is a dramatic alteration of the sound called "time stretching", meaning that the original sound could be prolonged by any factor with no change in pitch, creating what could be described as a "slow-motion sound". This effect can be used to create drones out of field recordings, but also to allow the timbral character of any particular sound to emerge. Furthermore, increasing the duration of a sound tends to have a bigger impact on the listener's memory, as it provides more time for relevant emotional associations to occur. Other techniques involve putting a sound object out of context, or at a volume much higher than normal, pitching it down or up, producing a stereo image of it to create a sense of movement through speakers or headphones… There are countless ways to manipulate sound, but the important quality shared by all of these processes is the fact that in soundscape composition all kinds of digital processing are in service of revealing the true nature of the sounds, rather than using found sounds as tools to achieve a certain desired musicality. Still,

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[100]Denis Smalley, "Defining Transformations," *Interface* 22, no. 4 (November 1, 1993): 279–300, https://doi.org/10.1080/09298219308570638.

[101]Barry Truax, "Time-shifting of Sampled Sound with a Real-time Granulation Technique," *ICMC* 1990 (January 1, 1990), http://quod.lib.umich.edu/i/icmc/bbp2372.1990.026?rgn=main;view=fulltext.

the same sonic information could inspire different artists in many ways, completely changing the narratives at the heart of the compositions, even when using soundscapes from the same environment. In fact, three core structural models could be distinguished based on the type of aural perspective on which they are based: fixed spatial perspective, moving spatial perspective, and variable spatial perspective.[102] To be clear, there is a multitude of available sound modulation techniques, and some of them do not fit any of these structural categories. However, for the sake of clarity I will focus on the techniques that do, especially since, in the context of soundscape composition, they make up for most of the approaches employed by soundscape artists.

2.7.1 Fixed spatial perspective

The fixed spatial perspective emphasizes the flow of time or a discrete series of fixed perspectives, in the sense that it is this flow of sound events over time that determines the structure of the piece. While this may be true of all music, in this kind of soundscape composition the listener experiences the flow of time as created by the relationships between the sounds, rather than being created by the apparent movement of the listener. This effect can be obtained by a completely unedited field recording as well as by a compressed segment of a longer duration. It can also be densified by layering multiple parts of a field recording from the same environment together. The fixed spatial approach can also work well with the introduction of a narrative, poetic, or oral history component: for example, David Copeland used the voices of a few blind people to convey the sense of disorientation they experience in society in his work called "Recharting the Senses".[103]

The fixed approach can also include a series of different perspectives in succession occurring at too fast a pace to create the illusion of travel or movement. Usually, soundscape composers tend to prefer less abrupt transitions from one scene to the other, possibly because they are more similar to what one might encounter in real life. Also, the technique known as "cross-fade", where one track or sound diminishes in volume while another one rises and takes its place, has become quite common in everyday media, so that transitions don't pose any issue for the average listener, even though there may be no rational explanation for them. However,

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[102]Barry Truax, "Genres and Techniques of Soundscape Composition as Developed at Simon Fraser University," *Organised Sound* 7, no. 1 (April 1, 2002): 5–14, https://doi.org/10.1017/s1355771802001024.

[103] ibid.

it is precisely because of the listener's acquired familiarity with slow transitions that certain composers may prefer, at times, to shift from one environment to the next in a less subtle way, to convey a feeling of uneasiness and mystery, because the listener does not feel like he is moving gradually from one place to another.

2.7.2 The Moving Perspective

People have always been drawn to the experience of a journey, whether it is in the sense of an adventure, a spiritual development of the self, or symbolic, involving a conflict and a resolution. Music as a medium is no stranger to this kind of narrative, and soundscape compositions that propose an illusion of a moving perspective function in some, or all, of these levels. Motion is at the very basis of sound, as it is involved in its formation as well as in its structure. Furthermore, the auditory system is equipped to deal with the detection of both motion in the environment as well as the dynamic movement of the listener in relation to their surroundings. The moving spatial perspective focuses on this concept, emphasizing the narrative of the journey by using a smoothly connected space/time flow in composing a soundscape.[104]

To achieve this, there are two main techniques: the cross-fade, which is not used in a fixed spatial perspective, becomes very useful in the moving spatial perspective as it creates the illusion of travel, which now becomes the desired result. Stereo panning, where sounds quite literally move from one speaker to the other, is also useful to shift the listener's standing within the soundscape. The illusion of movement could be created so that the audience feels like they are traveling from one place to another, but the motion could also be from a realistic sound source towards an abstract version of it, or the other way around. For example, in his work "La Sera di Benevento", Barry Truax employs a cross-fade to transition from a loop of a recording of a moving train to an altered version of it, where the noise of the train has been stretched out and pitched down, before mutating to a soundscape of a square with a fountain. This transition is not only a physical movement in space but also from the "real" soundscape to a processed one, symbolizing a mental movement on the part of the listener from the outer world to the inner world of the daydream, as explained by the composer.

In short, soundscape compositions using the moving perspective deal with more than just the listener's abilities to recognize and give meaning to a set of acoustic environments and how they change, as they also play with the listener's patterns and habits of listening and memory.

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[104]Truax, "Soundscape, Acoustic Communication and Environmental Sound Composition."

The effect is that of immersing oneself in a multiplicity of acoustic worlds ranging from the mundane to the highly abstracted.[105]

2.7.3 The variable perspective

Many artists choose to incorporate both of the aforementioned approaches into their work, coming up with new ways of organizing and presenting their material. This subcategory of soundscapes can be described as using a variable perspective. In this kind of soundscape composition, the listener can at times feel no plausible movement from one scene to another, either because the perspective changes too abruptly or because multiple scenes are presented at the same time. The latter technique directly relates to what Schafer calls the "schizophonic" experience, which consists of taking sounds out of their original context and reproducing them arbitrarily in another.[106] Today's standard multi-track editing process makes the creation of simultaneous layers of arbitrary sound events and ambiances fairly easy, and the use of loudspeakers creates a soundscape that is not a coherent single image, but rather a more complex and imaginary one, a collage of different sound sources that can perhaps escape an immediate interpretation. For example, in one section of composer Claude Schryer's "Vancouver Soundscapes Revisited" called "Fire", he uses sounds of Chinese firecrackers, folk-dancing, Krishna musicians, a baseball game, churchbells, a mechanical piano, gulls in the harbor, and a large number of natural and processed boat horns and sirens. Such a diverse collection of aural objects pushes the listener's expectations, nudging them into forming personal streams of association to make sense of what they have just heard.

2.8 SFU and WSP

The development of the field of soundscape composition has been going very much hand in hand with the extensive research on the subject carried out by Simon Fraser University. The scholars involved in the matter began with a study of environmental sound and all aspects of its behavior and communication roles as distinct from its potential value; the original aim of their work was motivated by a concern for the decaying state of the soundscape, and the nature of it was largely educational and archival. However, as the original participants involved in soundscape research were mainly composers, their aural sensibilities eventually

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[105]Truax, "Genres and Techniques of Soundscape Composition as Developed at Simon Fraser University."

[106] Schafer, The New Soundscape : A Handbook for the Modern Music Teacher.

played their part in bringing musical compositions into their work. Still, the rationale behind it remained the same, as there was no desire to further exploit the environment as a source of musical material, but rather to exploit the knowledge base of musical design to redesign the soundscape, and to reawaken people's perceptual appreciation of its importance.[107]

There are three main composers within the SFU whose contributions to the field deserve to be singled out: Raymond Murray Schafer, Hildegard Westerkamp, and Barry Truax. One of the most significant projects that all three were involved in was the World Soundscape Project (WSP), aiming to both document and archive soundscapes, describing and analyzing them, to promote public awareness of environmental sound through listening and critical thinking. Schafer is the one who founded the WSP in the late 1960s and supervised its activities, and with his numerous publications, he established a descriptive basis for soundscape studies.[108] Westerkamp was a member of the original WSP group, and probably the one who has worked both educationally and compositionally with environmental sound most consistently. Barry Truax joined the WSP in 1973, with a focus on extending the theoretical and applied basis of soundscape studies within acoustic but also electroacoustic contexts, as his compositional work since 1987 has been created using digitally sampled environmental sound exclusively, for which Truax has developed techniques for its processing.

The WSP was the result of Schafer's concerns with the increasing industrial noise in Vancouver: for him, the sounds of traffic and factories were not only harmful in the context of pollution but also as obstacles to building human connections. For example, they can overpower sounds that play a role as community signifiers, like church bells. Hence, the WSP was founded with the purpose of studying the acoustic environment as well as the impact of technology on it, and that is why within the project the concept of soundscape includes not only the "natural" soundscapes of various habitats and ecosystems researched by soundscape ecologists, but also acknowledges the variety of sound sources encountered in people's everyday life when living inside a human community.[109]

The WSP also rose out of Schafer's uneasiness with the emergence of what is known as "musique concrète", a subgenre of experimental electronic music developed in the late 1940s and 1950s by Pierre Schaeffer. The idea behind this was to take tape-recorded sounds of

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[107]Truax, "Soundscape, Acoustic Communication and Environmental Sound Composition."

[108]W. Garner and R. Murray Schafer, "The Tuning of the World," *Leonardo* 16, no. 1 (January 1, 1983): 69, https://doi.org/10.2307/1575066.

[109]Reich, "Soundscape Composition: Music as Environmental Activism."

everyday objects and process them to the point of unrecognizability. Schaeffer argued that such an experience would incite what he called "acousmatic listening", meaning a kind of listening that did not require the recipient to understand the context or sources of sound, but simply to appreciate the sound itself.[110]

However, Schafer feared that acousmatic listening would only result in separating people further from their soundscape. For Schafer, a soundscape "cannot and should not be separated from its geographical location", as it is conceptualized as an acoustic manifestation of a place, and a medium through which one can attribute social meaning to said place.[111]

One of the WSP's first major publications was "The Vancouver Soundscape", consisting of a booklet and and two records, in 1973. Twenty years later, there was a reissue of it on a double CD, where the second CD consisted of various documentary recordings alongside soundscape compositions derived from digital recordings made in Vancouver in the 1990s. The Vancouver Soundscape was already very influential, being virtually the first systematic study of the soundscape of a city, but the twenty years between that and the follow-up project resulted in not only an aural representation of a place but also of its rapid evolution. Since both personal and cultural memory are known to fall short in keeping track of the aural changes in the environment, this type of approach, dealing with a longer time period, should be encouraged in soundscape documentation, as it is still somewhat rare in acoustics and noise studies.

The success of the Vancouver Soundscape resulted in the creation of numerous "city portraits" all over the world, though varying in the degree to which they push the boundaries between documentation and composition. It must be stated that they were mostly carried out by individuals outside of the WSP group, as its only later publication dealing with a non-Canadian environment was the "Five Village Soundscapes", focusing on European rural areas. Still, the global drive and international breadth of the WSP allowed its influence to spread worldwide, but as a concept practiced by locals, rather than by outside experts.[112] In fact, in 1993 the World Forum for Acoustic Ecology (WFAE) was formed, an international association of affiliated organizations and individuals sharing an interest in the soundscapes of

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[110]Brian Kane, "L'Objet Sonore Maintenant: Pierre Schaeffer, Sound Objects and the Phenomenological Reduction," *Organised Sound* 12, no. 1 (April 1, 2007): 15–24, https://doi.org/10.1017/s135577180700163x.

[111]Andrea Polli, "Soundscape, Sonification, and Sound Activism," *AI & Society* 27, no. 2 (September 1, 2011): 257–68, https://doi.org/10.1007/s00146-011-0345-3.

[112]Barry Truax, "Soundscape Composition as Global Music: Electroacoustic Music as Soundscape," *Organised Sound* 13, no. 2 (June 25, 2008): 103–9, https://doi.org/10.1017/s1355771808000149.

the world, maintaining an extensive website, a newsletter, as well as an online discussion group.[113] As a type of system, the WFAE can be described as an international network with local nodes, proving to be a testament to the WSP's goal of creating a sort of map of the world's many soundscapes.

The implication of the expanding evolution of the cultural frame related to soundscape certainly provides food for thought: is the soundscape an experience shared globally? Of course, the nature of any place's soundscape is inherently local and particularised, but there is one major force pushing toward homologation, and that is the pervasive influence of technological sounds and noise. Technology promotes standardization and uniformity, from the noises of household appliances to the noise of cars, to the noises of factories… These are sound sources that influence the soundscapes of multiple urban centers around the world, creating the aforementioned "lo-fi" soundscapes. The difference between this kind of soundscape and its "hi-fi" counterpart lies in the fact that hi-fi soundscapes are varied and local in a unique way; many individual species populate them, they are information-rich, and are most aptly interpreted by local people who have the tools to make sense of their contextual meanings.[114] Lo-fi soundscapes, on the other hand, are created as a result of an overpowering dominance of the most powerful sounds, masking all local varieties. According to Truax, however, the dangers associated with the proliferation of lo-fi soundscapes do not stop at an increasingly homologated aural world, as he believes that being exposed to this kind of soundscape creates a common habit of non-listening, which would be not only detrimental to the individual but also to the soundscape itself, as this habit allows the soundscape to deteriorate unchecked.[115]

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[113]"ABOUT," World Forum for Acoustic Ecology, n.d., https://www.wfae.net/about.html.

[114]R. Murray Schafer, *Voices of Tyranny Temples of Silence*, 1993, https://openlibrary.org/books/OL15071283M/Voices_of_tyranny.

[115]Mary Simoni and Kristin Fosdick, "Barry Truax: Acoustic Communication and Compositional Techniques," *Computer Music Journal* 34, no. 2 (June 1, 2010): 96–98, https://doi.org/10.1162/comj.2010.34.2.96.

CHAPTER 3. WHALE SONGS AND ZOOMUSICOLOGY

3.1 The underwater soundscape

Listening to soundscapes requires a recognition of the potential influence of one's actions and presence on the environment with which one engages. The systemic relationship occurring between complex networks of ever-interacting ecological parts demands an active approach where the listener is no mere observer, but rather an immersed participant. However, this could prove to be a challenging task when taking into consideration the aural quality of an environment that remains mostly inaccessible to human physiology, such as the underwater world.

For years, marine environments have been portrayed as silent. For instance, Schafer dedicated only two pages to "the sounds of water creatures" in his book "The Soundscape", dismissing the matter due to the fact that "many fish have no sound-producing mechanisms and no developed organs to hear sounds", only citing a few exceptions.[116] It is striking how limited knowledge of underwater sound was in 1977, the year of publication of "The Soundscape", even for Schafer, a specialist in environmental sound. Nonetheless, although research on the topic has developed greatly, the sounds below the water's surface belong to an extensive area about which relatively little is known. Many sound sources are undetectable to human ears, and there is still uncertainty on how they are produced, used, and their meaning. However, the last decades witnessed a blooming awareness of the importance of underwater soundscapes by scientists, as they began to realize how crucial sound is to aquatic life: as creatures inhabit a largely dark habitat, sounds are used to detect motions, prey, and currents.[117] In 2002, bio-acoustician Micheal Stocker gave an extremely informative overview of the issues and findings of the research on the subject, such as the characteristics of sound propagation in water, where sounds travel five times faster than in air, how different species of sea creatures use, produce, and perceive sound, and the quality and effect of anthropogenic sounds in the ocean.

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[116] Schafer, The New Soundscape : A Handbook for the Modern Music Teacher.

[117] Yolande Harris, "Understanding Underwater: The Art and Science of Interpreting Whale Sounds," *Interference: A Journal of Audio Culture* 2 (2012).

Even so, he stated that "human understanding [of underwater sound] is minuscule compared to the vast diversity of sea animals and their adaptations to sound".[118]

Every encounter with a marine sound object leads to questions about its origin, function, and meaning, for both nonhuman entities embedded in the aquatic environment and researchers alike. To find answers, one must listen - but the human relationship with this particular context is one that is fundamentally defined by how overwhelmingly alien it is, and more often than not, knowledge of underwater sound must be produced through mediation by technological extensions. The implications of this concept make the marine soundscape more challenging than land-based soundscapes for both researchers and composers, due to the simple fact that sounds cannot be experienced directly: underwater sound is not bound to human sense perception, as it extends vastly into larger and smaller scales, frequencies, time-frames, spatial dispersion, and volumes.

Luckily, technology is able to make audible the otherwise inaudible through sonifications, audifications, and visualization techniques, but be that as it may, it calls for imagination in thinking of the presence of the sounds one cannot hear, as well as interpretative skills in making sense of the sonic environment revealed by these processes, by correlating the sound qualities with patterns of behavior and contextual comprehension of the environment.[119] This last insight into the role of perspectivity builds on American artist and sound theorist Brandon LaBelle's notion of the relational quality of sound, proposing that sounds can only be understood in relation to the broad environment in which they occur.[120] As I mentioned in the previous chapter, ambient sound is a critical component of natural habitats: it would be unwise to try and understand the voice of a single creature by removing it from the space it inhabits, as the biophony of any environment can, and should, be thought of as a kind of "nonhuman orchestra", where each being occupies a unique niche among the other musicians.[121] Bearing this in mind, it is also true that the more one broadens their gaze, the

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[118] Micheal Stocker, "Fish, Mollusks and other Sea Animals' use of Sound, and the Impact of Anthropogenic Noise in the Marine Acoustic Environment," *Soundscape Journal of Acoustic Ecology 3,* no. 2 (2002): 16-29.

[119] Yolande Harris, "Making the Inaudible Audible: Strategies and Disagreements," *Proceedings of the 16th International Symposium for Electronic Arts, ISEA2010 Ruhr*, Berlin: Revolver Publishing, 133- 35.

[120] Brandon LaBelle, *Background Noise: Perspectives on Sound Art*, 2006, http://ci.nii.ac.jp/ncid/BA87166083.

[121] Krause, Bernie. "The niche hypothesis: How animals taught us to dance and sing." *Whole Earth Review* 57, no. 57 (1987): 14-16.

less focused it grows, and this could prove to be detrimental to a field of inquiry that is already as demanding as it is. Besides, especially when dealing with musicality in nonhuman spaces, the most accessible and interesting aspect of ocean soundscapes is to be found in animal calls, particularly whales, and thus, the analysis of whale songs will be the focal point in discussing the underwater sonic landscape. Of course, whales are not the only beings capable of making musical sounds forming a natural conduit between the human species and others, or between the arts and the sciences, but they provide us with a unique opportunity to look at musical commonalities on the edge between the human and the nonhuman: to listen to whales is to enlarge one's understanding of music.[122]

3.2 The story of the whale: between myth and reality

The story of the whale is intimately intertwined with research on underwater sound, as these mammals are known to use sound in a very sophisticated fashion, even though humans have only recently started to hear them, let alone understand them. Undoubtedly, the whale's popular appeal as a "charismatic" animal contributed to increased funding for research: the very thought of the whale holds an incredible power in human imagination. In fact, interest in the whale goes far further than scientific research endeavors to find out about the specifics of the animal, its context, and social behaviors. The mythic resonance of the whale often overshadows its qualities as an animal species in its own right, and should not be underestimated.[123] For centuries, Western civilizations depicted cetaceans as scary figures with deformed imaginary bodies, while in other parts of the world, they were revered as gods.[124] During the 19th and 20th centuries, the phenomenon of whale hunting for food and goods started, which has been extremely consequential to the formation of the contemporary popular image of whales. Human interactions with cetaceans remained negative even after the 1982 International Whaling Commission moratorium, putting a halt on the practice of commercial whaling, due to the rise of other anthropogenic activities such as marine traffic, chemical and sound pollution, and, overall, climate change. However, since the 1960s there has also been a renewed interest in these large marine mammals, perhaps due to the fact that,

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[122] Patricia M. Gray et al., "The Music of Nature and the Nature of Music," *Science* 291, no. 5501 (January 5, 2001): 52–54, https://doi.org/10.1126/science.10.1126/science.1056960.

[123] Harris, "Understanding Underwater: The Art and Science of Interpreting Whale Sounds."

[124] Rochelle Constantine, "Folklore and legends," *Encyclopedia of Marine Mammals,* Academic Press, 2009. 447-449.

as access to pleasure sail and motor crafts had been rendered much more democratized, interactions between humans and whales were not as rare anymore.[125] Furthermore, many countries started a new management of the oceans, committing to the protection of cetaceans through an array of international, regional, and national policies, which also contributed to a widespread regeneration of higher respect for the animal.[126] This contextual change in the human relationship with whales led to an increase in the number of research projects on cetacean species, to gain a more informed understanding of their behaviors, their interactions, their habitats, and their migration routes, as well as to better describe the potential effects of anthropogenic activities on them and the marine environment. Nonetheless, the outcome of many of these research projects was that of feeding into the semi-mythical notion of the whale, at times unintentionally doing a disservice to this important area of study. This should not be taken as an entirely negative fact: quoting composer and researcher David Dunn, "The richest knowledge of the tree includes both myth and botany".[127] The meaning of this is that the interplay between the view of the whale as a mythical and romantic figure and scientific hypotheses brought along a richer set of interpretations of the image of the whale. As it turns out, turning to the musicality of whales falls quite precisely in this miscellaneous approach.

3.3 Songs of the Humpback Whales

3.3.1 Roger Payne and Scott McVay

The song of the humpback whale is the most extended patterned vocalization produced by any animal.[128] Their first description within the literature comes from the work of Roger Payne and Scott McVay in 1971, with the seminal paper and accompanying recordings titled "Songs of the Humpback Whales". The paper deals with reporting a series of recordings of humpback whales over several years from the coast of Bermuda, praising the surprising

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[125] E. C. M. Parsons and Danielle Monaghan-Brown, "From Hunting to Watching: Human Interactions With Cetaceans," in *Animal Welfare*, 2017, 67–89, https://doi.org/10.1007/978-3-319-46994-2_5.

[126] Baur, Donald C., Micheal J. Bean, and Micheal L. Gosliner. "The laws governing marine mammal conservation in the United States." *Conservation and management of marine mammals. Smithsonian Institution Press, Washington, DC* (1999): 48-86.

[127] "Navigating the Space of the Future | NIMk," n.d., http://nimk.nl/eng/search/navigating-the-space-of-the-future.

[128] David Rothenberg, "To Wail With a Whale: Anatomy of an Interspecies Duet," *Trans : Transcultural Music Review = Revista Transcultural De Música*, no. 12 (January 1, 2008): 12, https://dialnet.unirioja.es/servlet/articulo?codigo=2789590.

beauty of these sounds.[129] The album containing the songs of the Whales remains to this day the best-selling nature recording of all time, rapidly becoming the soundtrack to the "Save the Whales" campaign in the 1970s. Arguably, this album can be conceived as responsible for the aforementioned cultural shift towards the safeguarding of cetaceans, as it is widely credited with being a key resource for activism in the period leading to the 1982 moratorium.[130] The importance of this publication is hard to overstate for a variety of reasons: firstly, it brought forth the very first publicly available recordings of whale sound; secondly, it used a primitive visualization technique to analyze the sound patterns, which greatly influenced subsequent research on the matter; and finally, it employed simple musical analysis to reframe the sounds emitted from whales as songs, themes, phrases, and units.[131] All of this contributed to a more informed public awareness of whale voices, and within a relatively short time, whales went through a "dramatic social transformation, from an instrumentally hunted natural resource to a near-sacrosanct agent of empathy and protection".[132]

3.3.2 Analysis of whale vocalizations

The topic of whale vocalization begs many questions that carry on being unanswered. Several hypotheses have been offered to explain it: it could be a communication signal related to territory; a form of echolocation used to navigate through the darkness of the ocean; it is used for mating, as this sonic activity happens predominantly during mating season. If it actually is related to mating, it still remains unclear whether it is used to attract a female or to bond with other males, since females never seem to respond to these sounds.[133] In short, no certainty could be offered on elucidations on why whales sing, or who listens to their wailing.
However, starting with the works of Payne and McVay, whale vocalizations have since been analyzed to characterize their internal structure. To do this, vocalizations are detected,

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[129] Roger S. Payne and Scott McVay, "Songs of Humpback Whales," *Science* 173, no. 3997 (August 13, 1971): 585–97, https://doi.org/10.1126/science.173.3997.585.

[130] D. Graham Burnett, The Sounding of the Whale: Science and Cetaceans in the Twentieth Century, 2012, https://ci.nii.ac.jp/ncid/BB15001041.

[131] Harris, "Understanding Underwater: The Art and Science of Interpreting Whale Sounds."

[132] Anders Blok, "Actor-networking Ceta-sociality, or, What Is Sociological About Contemporary Whales?," *Distinktion* 8, no. 2 (January 1, 2007): 65–89, https://doi.org/10.1080/1600910x.2007.9672947.

[133] Charles P. Nicklin, James D. Darling, and Meagan E. Jones, "Humpback Whale Songs: Do They Organize Males During the Breeding Season?," *Behaviour* 143, no. 9 (January 1, 2006): 1051–1101, https://doi.org/10.1163/156853906778607381.

extracted, and "translated" into sonograms, which is crucial for scientists in turning fleeting sounds that can become hard to recognize into something more tangible, especially since whales emit frequencies that go beyond the human hearing range and temporal perceptual ability. After being able to visualize the data, Payne and McVay were able to piece together the structure of whale songs.

Most humpback whales follow an annual migratory pattern where they breed in subtropical latitudes during winter and migrate to high-latitude waters to feed in the summer. The vocalizations produced in these periods vary greatly, as feeding calls involve a few simple motifs arranged in simple sequences, whereas the songs during the breeding season are more complex.[134] For the purpose of this thesis, only the latter will be taken into consideration.

The term song is used in animal studies to describe an acoustic signal involving a wide variety of sounds repeated in a specific sequence. In the case of humpback whales, Payne and McVay proposed a hierarchical structure for it. Each whale song consists of a succession of discrete sound elements called units, meaning harmonic or pulsed vocalizations emitted between two silences. These units cover a frequency range between 30 and 3000 Hz and can be classified by looking at acoustic time, duration, relative acoustic intensity, and presence of harmonics.[135] Sequences of units are grouped into phrases, and when a single phrase, or more phrases that are very similar, are repeated several times, they make up a theme. The song consists of a patterned sequence of themes, which will be repeated many times with considerable accuracy to make a song session, whose reported range duration is from 6 to 35 minutes.[136]

3.3.3 Structure of whale song

All humpback whales produce units with a set of predictable acoustic characteristics that are similar among whale populations, allowing for the chance to compare their songs. The current state of research on the topic has brought forth the hypothesis that there may be a general repertoire of unit types, suggesting that humpbacks may possess an inherited basic template of

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[134] D'Vincent et al., "Vocalization and coordinated feeding behavior of the humpback whale in southeastern Alaska," *Sci. Rep. Whales Res. Inst* 36 (1985): 41-47.

[135] Rebecca A. Dunlop et al., "The Social Vocalization Repertoire of East Australian Migrating Humpback Whales (Megaptera Novaeangliae)," *the Journal of the Acoustical Society of America/the Journal of the Acoustical Society of America* 122, no. 5 (November 1, 2007): 2893–2905, https://doi.org/10.1121/1.2783115.

[136] H. E. Winn and L. K. Winn, "The Song of the Humpback Whale Megaptera Novaeangliae in the West Indies," *Marine Biology* 47, no. 2 (January 1, 1978): 97–114, https://doi.org/10.1007/bf00395631.

species sound units. However, it is the arrangement and rearrangement of these units into distinct patterns that has drawn the most attention within the field of humpback song research. Humpback whales are considered to be "eventual variety" singers, a term that was first introduced by publications on birdsong, meaning that they repeat phrases within each theme before moving on to the next one.[137] There is strong cultural conformity to the current "version" of the song so that at any point in time most males within a population will sing the same song type.

In 2002, a study by Whitlow W. L. Au and others shed light on the details of the humpback whale song structure, using a vertical array of five hydrophones to measure the acoustic field in the vertical plane of singing humpback whales in the waters of the Auau channel. Having access to more advanced technology, their results are clearer than Payne's. Through the analysis of the spectrograms obtained, Au and others were able to classify nine types of units, some possessing tonal quality and higher frequency harmonics, and others that were relatively broadband with rumble, grunts, or gurgle-like qualities and weak harmonics (table 1).

Unit	Description
A	Vibrating upsweep
B	Double upsweep
C	Frequency sweeping cry
D	Flat tonal groan
E	Low gulp jumping to very sharp upsweep
E2	High-frequency tonal wail
F	Short low-frequency downsweep
G	Short low-frequency upsweep
H	Mid-frequency tonal wail

TABLE 1. Aural description of the nine units for the humpback whale songs during the 2002 wintering season in Hawaii.[138]

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[137] Danielle M. Cholewiak, Renata S. Sousa-Lima, and Salvatore Cerchio, "Humpback Whale Song Hierarchical Structure: Historical Context and Discussion of Current Classification Issues," *Marine Mammal Science* 29, no. 3 (November 21, 2012), https://doi.org/10.1111/mms.12005.

[138] Whitlow W. L. Au et al., "Acoustic Properties of Humpback Whale Songs," *the Journal of the Acoustical Society of America/the Journal of the Acoustical Society of America* 120, no. 2 (August 1, 2006): 1103–10, https://doi.org/10.1121/1.2211547.

Once the song units had been recognized, four distinct themes were able to be distinguished, observing the recordings of nine humpback whales. One can observe that there is a considerable variety within a theme, both in terms of the number of units and their sequence (table 2).

Theme	Units
1	B C (B-C) D D A
2	D A D E F D (E-F-D) E A
3	A F F F A F F E F D (E-F-D) E2 E A F F F A F F F F E E E
4	G G G G H

TABLE 2. The general sequence of units producing the four themes observed in the recordings of nine humpback whales. The units in parentheses are those that are repeated seemingly randomly from one to seven times, depending on the specific whale.[139]

This kind of structure provides an example of what to expect from humpback whales' songs, but of course, depending on the population and time of recording, it can vary to a great extent. Furthermore, even within a given population scientists have discovered that songs can evolve, either through addition, deletion, and/or substitution at all levels. Individual sound units can be stretched or split, new themes can be added and older themes can be deleted. As the song changes, all males within the population will incorporate the adjustments into their own songs, since one of the main features of humpback whales is their strong cultural conformity. It remains unclear which males are responsible for innovating the songs or creating new arrangements *ex novo* entirely, but it is known that this process goes only in one way, as once a song has been dropped by the population, it does not reappear.[140] Other studies on whale vocalizations reported year-to-year regional differences, suggesting variable interactions but ultimately to be regarded as "fluid divergences from a more general North Pacific song".[141]

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[139] Au et al., "Acoustic Properties of Humpback Whale Songs."

[140] Douglas H. Cato, "Songs of humpback whales: the Australian perspective," *Memoirs of the Queensland Museum* 30, no. 2 (1991): 277-290.

[141] James D. Darling et al., "Convergence and Divergence of Songs Suggests Ongoing, but Annually Variable, Mixing of Humpback Whale Populations Throughout the North Pacific," *Scientific Reports* 9, no. 1 (May 7, 2019), https://doi.org/10.1038/s41598-019-42233-7.

However, the song of the humpback whale does not only mutate through the innovations of some individual males within a single population: in 2000, Noad and others documented the implementation of the song from the West Australian population of humpback whales in the East Australian population, rapidly replacing the existing song. This process was termed "song revolution", to differentiate it from the aforementioned more common and slower process of song evolution.[142] At first, this striking cultural phenomenon was believed to be a unique event, but Garland and others have since conclusively demonstrated multiple song revolutions happening, with novel song types usually spreading from larger to smaller populations.[143] To date, the only mechanism that could be attributed to the initiation of this process lies in the appearance in an ocean basin of a new song type that can be traced to come from another. In fact, while it is true that examples of dialects occur among the vast majority of mammals, the instances of song evolution and song revolution in humpback whales make them a paradigmatic case of cultural transmission that allows for general observations about the whole issue. The singing of members of a given community tends to be quite homogeneous, but progressively different from communities located further away, so much so that the geographical characterization of musical dialects is more useful than traditional methods for population surveys, as many scholars base their information on each specimen according to the type of song it performs.[144]

3.3.4. Whale song as a cultural phenomenon

This offers an opportunity to properly frame whale songs as both "natural" and "cultural": they are "natural" as they characterize the species, but also "cultural", as imitation, individual creativity, and acceptance by the group lead to the formation of population-specific idiosyncratic styles.[145] If one were to define culture as "learned behavior" and not solely the expression of the genetic composition of individuals, then humpback whales (as well as other

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[142] Michael J. Noad et al., "Cultural Revolution in Whale Songs," *Nature* 408, no. 6812 (November 1, 2000): 537, https://doi.org/10.1038/35046199.

[143] Ellen C. Garland et al., "Song Hybridization Events During Revolutionary Song Change Provide Insights Into Cultural Transmission in Humpback Whales," *Proceedings of the National Academy of Sciences of the United States of America* 114, no. 30 (July 24, 2017): 7822–29, https://doi.org/10.1073/pnas.1621072114.

[144] Roger Payne, "New light on the singing whales," *National Geographic* 161, no. 4 (January 1, 1982): 463–76, https://dialnet.unirioja.es/servlet/articulo?codigo=6710831.

[145] Donald Redfield Griffin, The question of animal awareness: Evolutionary continuity of mental experience, Rockefeller University Press, 1976.

animal groups) do have it, as they learn and transmit what they know to the younger generations. Sound imitation implies practices of re-elaboration, abstraction, arrangement, and, well, having fun with sounds; all fundamental aspects in music-making. In a way, music in itself is a form of imitation, when one accounts for the presence and use of musical models, archetypes, and conventions.[146] In fact, it could be argued that the process of variation and geographical exchange of whale songs follows the same "rules" of oral traditions' folk songs, where each community possesses its own repertoire, but one that is flexible and mixable with others; including new songs as well as providing modifications on old ones.

However, this is not the only similarity between whales' vocalizations and human music-making:

- Humpback whales use rhythms similar to those employed in human music, but they also have the capacity to formulate free-form sounds.
- They produce musical phrases of comparable length to those produced by humans, and they create themes out of several phrases before singing the next theme. The preference to reiterate one's material is one that is shared between these marine mammals and human composers.
- The length of whale songs falls between the duration of a modern ballad and that of a movement of a symphony.
- Humpback whales can sing over a range of seven octaves, but the musical intervals they apply are similar to the intervals in human scales.
- Whale songs mix percussive elements with relatively pure tones, in a ratio akin to that of Western symphonic music.
- The overall structure of the song is similar to human compositions: a statement of theme, a section in which it is elaborated, and then a return to a slightly modified version of the original theme.[147]
- Many whale notes' tone and timbre are comparable to human musical sounds.

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[146] Dario Martinelli, "Zoomusicology and Musical Universals: The Question of Processes," *Trans : Transcultural Music Review = Revista Transcultural De Música*, no. 12 (January 1, 2008): 10, https://dialnet.unirioja.es/servlet/articulo?codigo=2789583.

[147] Gray et al., "The Music of Nature and the Nature of Music."

- Humpback whales' songs contain repeating refrains in the semblance of rhymes, suggesting that, much like humans, they use rhymes as a mnemonic device to help them remember complex material.[148]

Of course, it is important to understand that humpback whale song did not evolve for human ears, so the goal of analyzing it is not that of testing its musicality on human listeners, but rather that of showing the presence of music within the nonhuman world, and whales are the perfect candidate for this task. For example, much has been written about birdsong, since birds produce the most intuitively musical sounds to a common person. However, the songs of birds have a beginning, middle, and end, with the structure and form of these utterances being uniquely defined for each species. They must be performed correctly to either attract mates or defend territories, so there is no meaning apart from an accurate performance: if the piece is sung incorrectly, the job is not done. The song of the whale might be more unpleasant to a human listener, with its screeches and gurgles, but its extended and clear structure makes it more musical than the song of most birds.[149] This concept challenges the whole idea of music as inherently human: whale and human music have a lot in common despite the fact that their evolutionary paths have not intersected for 60 million years, suggesting that, rather than being the inventors of music, humans are latecomers to the musical scene.[150]

This idea is at the very core of the research field of zoomusicology, the assertion that music is not an exclusively human phenomenon, but rather an emotion and instinct-based one. That is why it is necessary to address it when focusing on broadening our definition of music.

3.4 Introduction to Zoomusicology

The study of meaningful sound across the animal world has been intensive for more than thirty years now, even though not many mainstream musicologists have expressed in-depth interest in the matter, potentially due to the widely held notion of music as artificial, or more simply, human.[151] In the years spanning between 1880 and 1950, the research area of comparative musicology was thriving, and many scholars, like Erich Moritz von Hornbostel

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[148] Roger Payne, "Whale Songs: Musicality or Mantra? BioMusic Symposium," *AAAS Annual Meeting*, 2000.

[149] David Rothenberg, Thousand Mile Song: Whale Music in a Sea of Sound, 2008, https://ci.nii.ac.jp/ncid/BA8590791X.

[150] Gray et al., "The Music of Nature and the Nature of Music."

[151] Nils Lennart Wallin, Björn Merker, and Steven Mar. Brown, *The Origins of Music.*, 2000, https://ci.nii.ac.jp/ncid/BA44962134.

and George Herzog, started asking questions about the birth of music, and whether it could have happened among nonhuman animals. Nonetheless, the interest in answering these questions waned off, partly because it can get quite arduous to search for the origins of something that is not easily defined in the first place, and as a result, the study of animal sound lost much of its allure.

That was until the 1970s, when ethologists came up with groundbreaking information about the inner workings of animal sound communication: of course, one of the most thought-provoking publications was Payne's research on humpback whales, which "forced" scholars to reckon with the question of culture and musicality in animals. This cultural context served as the foundation for the emergence of zoomusicology, which originated in 1983 by the writings of musician and musicologist François Bernard Mâche, in his book "Music, Myth, Nature". In the book, he stated that zoomusicology had not yet been born, as up until that point, very little had been written about the subject. Still, as it was the first time the word "zoomusicology" had been mentioned, this statement is now regarded as establishing in actual fact the birth of the discipline. The aim of Mâche's work was that of "beginning to speak of animal music other than with the quotation marks", which remains one of the goals of zoomusicology.[152]

Still, there is a need to address the definition of zoomusicology. I will employ the one provided by Italian musicologist Dario Martinelli, who wrote extensively on the topic: zoomusicology is the discipline that studies the aesthetic use of sound communication among animals.[153] This definition has several consequences. First of all, it avoids the word "music", preferring "aesthetics": this is due to the fact that studies in ethology now tend to acknowledge the existence of an aesthetic sense in animals, which represents a methodological presupposition about music, which is a concept that constitutes the real theoretical goal of zoomusicology. Furthermore, in Martinelli's opinion, words like "music" and "musicality" still have too strong an anthropological connotation to be applied to the rest of the animal kingdom.[154] Secondly, by using the word "animals" as opposed to "nonhuman ones", this definition allows for the possibility of including humans in zoomusicological research. This last idea can be thought of

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[152] François Bernard Mâche, *Music, Myth, and Nature, or, the Dolphins of Arion*, 1992, http://ci.nii.ac.jp/ncid/BA2310096X.

[153] Dario Martinelli, "The Musical Circle: The Umwelt Theory, as Applied to Zoomusicology," *Sign Systems Studies* 32, no. 1/2 (December 31, 2004): 229–52, https://doi.org/10.12697/sss.2004.32.1-2.10.

[154] ibid.

as somewhat controversial, but Martinelli's aim is that of stressing the point that zoomusicology is not opposed to anthropomusicology, but actually includes it.
Another fundamental question about zoomusicology deals with its raison d'être: what is zoomusicology's goal, and what is it challenging? The answer to both has to do with the very idea of music. As Mâche stated in 1992, "If it turns out that music is a widespread phenomenon in several living species apart from man, this will very much call into question the definition of music, and more widely that of man and his culture, as well as the idea we have of the animal itself".[155] This explanation also offers some insights already on the methodology of zoomusicology. It approaches nonhuman animals from a human sciences point of view while addressing music from the perspective of biological studies. This interplay of theoretical outlooks is essential in backing zoomusicology's innovative assertion that music is not an exclusively human phenomenon, because calling into question the strongly anthropocentric connotations of present definitions of music is the first step in adopting the zoomusicological paradigm. The whole premise of the field stands on the idea that the conception of the nature-culture is to be revised.
Zoomusicology is bound to stand on the verge of multiple dichotomies, starting with the presence of a more or less extensive interdisciplinary quality, as can be deduced by looking at the name itself. Zoomusicology studies phenomena that were considered to be exclusively part of the biological domain for the longest time, and human sciences must consider insights coming from biology that were previously deemed not worthy of any input from the humanities.[156] Furthermore, zoomusicology testifies to the encouraging progress of human knowledge in the study of other animals, stepping further away from backward theories of behaviorism and evolutionism to provide the opportunity for humans to perceive and understand other living beings in a more realistic and fair manner.

3.5 Zoomusicological methodologies

Due to the intrinsic interdisciplinarity of the field, one can draw a few distinctive methodologies within zoomusicology depending on how the discipline relates to its approaches, and how it relates to its targets. Concerning the former aspect, zoomusicological

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[155] Mâche, *Music, Myth, and Nature, or, the Dolphins of Arion.*

[156] Dario Martinelli, "Introduction (to the Issue and to Zoomusicology)," *Trans : Transcultural Music Review = Revista Transcultural De Música*, no. 12 (January 1, 2008): 8, http://www.redalyc.org/pdf/822/82201208.pdf.

studies can employ two different forms of data collection, and interpretation: an empirical one and a theoretical one. Publications that employ the first modus operandi fall under the subset of empirical zoomusicology, where scholars analyze data collected by them, which can consist of recordings, transcriptions, or other forms of interaction with a given animal. On the other hand, studies employing the theoretical mode of data collection do not depend on personal information or materials, as their main target is the development of models of interpretation and analysis, constituting a more speculative form of research called theoretical zoomusicology.

Zoomusicology can assume two further configurations considering the way it relates to its targets, which can be either ethological or anthropological. Ethological zoomusicology could be exemplified as the quintessential "version" of the field, as it deals with the study of non-human animal sounds based on the hypothesis that they can be considered musical, targeting the animal as the main and only focus.[157] Conversely, anthropological zoomusicology is interested in humans as well, focusing on the different forms of relation potentially establishable with nonhuman creatures. For example, studies wishing to explore this topic may include investigations into the many ways in which musicians may incorporate animal sounds in their compositions, or into musical interactions between composers and animals.

All of these four types of zoomusicology are by definition interdisciplinary, but for each of them, it is possible to see a privileged relation to one of the main branches of knowledge informing the general area of study as a whole. In fact, ethological zoomusicology and empirical zoomusicology are more likely to dwell on topics relating to natural sciences, whereas anthropological zoomusicology and theoretical zoomusicology may be a more suitable fit for topics dealing with human sciences and human artistic expressions. Of course, this division into branches should only be interpreted as a possible source of clarity in a discipline that inevitably lacks uniformity, serving merely as a means to frame better the works in zoomusicology; they should not be considered as something binding for the zoomusicologist. Dealing with an anthropological topic does not exclude the possibility of doing research in the ethological area, and so on. In fact, so-called "clean" research is not only virtually impossible but also not advisable, as every subset within zoomusicology is complementary and supportive of each other, so contamination among approaches and targets is preferable. It is more reasonable to identify the main research approach underlying a given work rather than trying to associate it as a whole with one single approach.

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[157] Martinelli, "Introduction (to the Issue and to Zoomusicology)."

3.6 Interactions between zoomusicology and other disciplines

Once the interdisciplinary nature of zoomusicology has been established, it is useful to take a closer look at the disciplines directly contributing to zoomusicological research and the way zoomusicology pertains to them.

3.6.1. Musicology and ethnomusicology

First, musicology: zoomusicology is part of the area of musicology carrying ethical implications, as it attempts to emancipate the study of music from frames of reference that are mostly Western and anthropocentric. In the words of Finnish musicologist and semiologist Eero Tarasti, "We want to make a new which is no longer ideological, essentialist, racist or secretly nationalistic. In other words, a new beginning that, neither consciously nor unconsciously, does not create differences and make evaluations".[158] Still, since zoomusicology deals with a musical Other by definition, it is better to consider it as a very close relative of ethnomusicology, as its relation to musicology is not quite an interdisciplinary one, but rather one that could be described as being more similar to a mother and child connection.

There is a multitude of reasons why ethnomusicology and zoomusicology make a good fit. For starters, they both share a common historical destiny, in the sense that much like ethnomusicologists were supposed to demonstrate that music was not exclusively Western, zoomusicology has to prove that music is not only human; hence, research strategies are very similar in both disciplines. Furthermore, one of these strategies is exactly the same, since both disciplines challenge traditional definitions of music, or rather stress the point that it is not possible to provide a unique definition, as traditional ones exclude sound manifestations that should be considered as music.

Another similarity lies in ethnomusicology's emphasis on distinguishing the cultural components from the anthropological ones in the theoretical reconfiguration of musical traits and behaviors; zoomusicology follows the same process, focusing on the zoological components. This also leads to the question of universals (which will be dealt with later in the chapter) is crucial in both disciplines. Finally, ethnomusicologists cannot fully do research without having to deal with musical civilizations with whom communication is barely possible; zoomusicologists face the same issue, evidently more so.[159]

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[158] Eero Tarasti, "The emancipation of the sign: On the corporeal and gestural meanings in music," *AS/SA* 4 (1997): 180-190.

[159] Martinelli, "Introduction (to the Issue and to Zoomusicology)."

3.6.2. Ethology

Arguably, zoomusicology's connection to ethology is the strongest bond established with a foreign discipline. Cognitive ethology is defined as "the evolutionary and comparative study of non-human animal thought processes, consciousness, beliefs or rationality, and [as] an area in which research is informed by different types of investigations and explanation".[160] Even though Darwin and his followers had already anticipated a portion of the contents of this area of study, it was not until 1976 that the term was introduced in Donald Griffin's seminal book, "The Question of Animal Awareness". He introduced the topic by stating that during the past few decades much had been discovered about the increasing complexities in animal behavior; and that the flexibility and appropriateness of such behavior suggested not only that complex processes occurred within animal brains, but that these events may have much in common with human mental experiences.[161]

It should also be noted that a key inquiry shared by ethology and zoomusicology can be found in the focus on the problem of aesthetics in nonhuman animals. Additionally, most of the materials employed in zoomusicological analysis are the result of the precious and numerous contributions provided by natural scientists.

3.6.3. Semiotics

Though not all zoomusicologists employ its approaches, semiotics makes for another important contribution to the field. Defined as the systematic study of sign processes and the communication of meaning, its insights are particularly thought-provoking in diverse zoomusicological questions. To appreciate the reason for this, first, it must be laid out that people deal with music in a rather spontaneous fashion, both socially and individually: this implies a competence that cannot only be attributed to a simple know-how process but also to a knowledge and understanding of musical phenomena. It could even be said that humans relate to music in the same way as it were a language in all respects. However, music is never traditionally described as a language, but rather as a syntactic system composed of rules and elements but ultimately unable to offer semantic value.[162]

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[160] Marc Bekoff, "Cognitive ethology and the explanation of nonhuman animal behavior," *Comparative approaches to cognitive science* 1 (1995): 19-150.

[161] Griffin, *The question of animal awareness: Evolutionary continuity of mental experience.*

[162] Gino Stefani, *Musica: Dall'esperienza alla teoria*, 1998

By the same token, in the last century, it has often been claimed that animals delegate to music a number of functions that cannot be dismissed as meaningless formal tasks.[163] The value of the aesthetic dimension within communication does not strip it of its functionality, but rather, it accompanies and enhances it. Several examples can be drawn from the literature on the issue, testifying that, for example, courting processes are much more efficient when formally elaborated and embellished. This is also true for human beings, as there is no shortage of reasons why we make music: to have fun, to reinforce camaraderie, to express one's emotions… All of this shows the need for semiotic research in music, as it is not only a grammatical issue but a semiotic one as well. It should be clear that this does not mean that singing should be approached in the same way as the process of speaking, as they are two entirely different communication strategies. However, this is precisely the point: they are both strategies of communication, with their own set of characteristics and degrees of efficiency, but they are both meaningful.[164]

3.7 Viable and outdated approaches within zoomusicology

All of the areas of inquiry informing zoomusicology, despite their diversity in typology and methodologies, have points in common regarding their approaches. There are three main approaches that could be identified as either potentially viable for zoomusicologists, simply outdated, or in need of changing: gradualism, discontinuity, and pluralism.

Gradualism refers to a generically Darwinian approach whose idea is founded on the assertion that there is an evolutionary continuum in which the human being occupies the highest position, while species less and less complex and refined are on the other end of the spectrum. In a zoomusicological context, what this implies is that, while utterances produced by nonhuman animals may well be considered musical, their lack of complexity is thought of as a manifestation of a comparatively inferior development. A gradualistic outlook can be found in studies arguing that the rudiments of art can be traced to several animal species, considering their vocalizations as proto-musical.

Discontinuity refers to the generally skeptical, perhaps even hostile, attitude toward the idea that animals could possess an idea of music. This approach accentuates the discontinuity in the evolution of human beings with respect to other living creatures, maintaining that the

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[163] Thomas A. Sebeok, "'Talking' With Animals: Zoosemiotics Explained," in *De Gruyter eBooks*, 2011, 87–94, https://doi.org/10.1515/9783110253436.87.

[164] Martinelli, "Introduction (to the Issue and to Zoomusicology)."

human race has gone through an autonomous and unique process of development that, as a result, provided us with exclusively human characteristics. The discontinuist attitude is by definition opposed to the intent of the zoomusicological research, which actively defends the thesis that music is not specific to humans only.[165]

It becomes clear that one should proceed toward zoomusicology in a pluralistic fashion, and possibly the most suitable framework for this is that postulated by the theoretical biologist Jakob von Uexküll, known as the theory of Umwelt. The Umwelt theory is an idea put forth in 1934 by the Estonian biologist Jakob von Uexküll, stating that all animals had to be understood as subjects, and the worlds they lived in as constituted and made meaningful through their specific ways of perceiving and acting upon their worlds, their *Umwelt* (translated: 'surrounding world').[166] Uexküll's usage of the word refers to these worlds of subjective experience. In fact, the basis of this theory relies on the assumption that humans and animals do not share the same Umwelt, as they form very different relations to their surroundings. Briefly put, different species see the same things as different objects.[167] The implications of this concept lead the way toward a better understanding of the relationship between the human and the nonhuman: firstly, it entails that to fully appreciate nonhuman communication, investigations must be made into how they organize their own experience, distinguishing what is perceived as pertinent or not to them. Secondly, something of significance for an animal may not even be perceived at all by humans.[168]

This paradigm is of particular use to zoomusicology because conceiving the animal kingdom through the lenses of the Umwelt theory leads to acknowledging trans-specific and species-specific traits in the various species. Species-specific elements present characteristics typical and exclusive to the species observed, showing how musicality has taken many courses according to not only the evolution of their species but also the articulation of their respective Umwelts. Trans-specific traits, on the other hand, can be identified in multiple species; this is

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[165] Martinelli, "The Musical Circle: The Umwelt Theory, as Applied to Zoomusicology."

[166] Sara Asu Schroer, "Jakob Von Uexküll: The Concept ofUmweltand Its Potentials for an Anthropology Beyond the Human," *Ethnos* 86, no. 1 (June 14, 2019): 132–52, https://doi.org/10.1080/00141844.2019.1606841.

[167] John Deely, "Semiotics and Jakob von Uexküll's concept of umwelt," *Σημειωτκή-Sign Systems Studies* 32, no. 1-2 (2004): 11-34.

[168] Felice Cimatti, "Beyond the human/non-human dichotomy: the philosophical problem of human animality," *Humanimalia* 7, no. 2 (2016): 35-55.

fundamental in showing the common biological bases of musicality.[169] This last point is another reason why the Umwelt theory could be singled out as the best way to deal with zoomusicological issues, as it lays the background against which another important theme can be presented, that of the search for music universals.

3.8 The quest for music universals

The question about the universal characteristics of music arose in the 1970s, mainly within the field of ethnomusicology, as the interest in non-western music went hand in hand with the urge to investigate the universality of music. Ethnomusicology possesses an essential comparative dimension, hence the fact that scholars have yet to encounter a civilization without music begs the question: what if music was a universal phenomenon?[170]
Zoomusicology also possesses the same comparative quality, but its scope goes necessarily beyond the human; while ethnomusicologists look for archetypal musical structures in human societies, zoomusicologists look for these structures by listening to nonhuman animals. For both disciplines, wondering about the universality of music implies wondering about music itself and its definitions.
However, the matter of universals is a theoretical issue for which it is quite hard to find a single solution, as it is rooted in a crucial philosophical question: what are the requirements that a musical element must fulfill for it to be defined as universal? There are two prime possibilities to address this topic. The first one is to look for an uncontradictable coherence of given musical traits across all communities,[171] while the second is to single out a continuity at the pragmatic level, i.e., in the way those musical traits work, or in the principles that motivate their appearance within certain (not necessarily all) communities.[172] In 1984, scholar Ellen Koskoff drew out a list of universal musical features, dividing it into two categories, "absolute hard-edged" universals, and "near-universals" (table 3). Her research was constructed with an ethnomusicologist perspective, hence the list is inevitably rooted in anthropocentrism.

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[169] Garner and Schafer, "The Tuning of the World," January 1, 1983.

[170] Jean Jaques Nattiez, "Under what conditions can one speak of the universals of music?," *The World of Music* 19, no. 1/2 (1977): 92-105.

[171] ibid.

[172] Leonard B. Meyer, "Universalism and Relativism in the Study of Ethnic Music," *Ethno Musicology* 4, no. 2 (May 1, 1960): 49, https://doi.org/10.2307/924262.

Nonetheless, it still provides a reference that could be useful even for zoomusicology, when stripped of its specifically anthropological connotations.

Universals A (absolute hard-edged)	**Universals B (near-universals, easier to find)**
Communicated and heard by human ears.	Communication of human feelings.
Aspect of form (a. dynamic contour, or b. pitch contour, or c. repetition)	Projection through physical human effort.
Purposeful (i.e., organised-modulated) presentation.	Story-telling.
Stress and release.	Rhythmic elements.
Beginning and end.	Beginning-middle-end.

TABLE 3. Koskoff's classification of musical universals.[173]

Ethnomusicologist and composer Kwabena Nketia incorporated both hypotheses in his denomination of absolute universals and universal consequents, following an empirical approach proceeding from the general to the particular, from the conceptual premise that an artistic worldview is of a qualitative type, rather than a quantitative one. Nketia's idea is that diversity is inevitable in music, but it is "accommodated in creative and conceptual terms through 1) the postulate of an archetypical source; 2) the concept of music as a world-wide art of which individual cultures are particular expressions; 3) the notion of complementarity and alternative modes of expression; and 4) the universality of aesthetic experience".[174] The force of this argument lies in its freeing attitude towards universal characteristics, as it states that one should not call universal only those musical traits displayed by every single musical culture, otherwise, the search for universality can become a hopeless task. As Mâche believed, it is all too easy to show that music is not a universal language, and it should not be considered essential that data matched up in every detail for them to be qualified as universal; it is enough to prove that certain characteristics appear in independent contexts and that their inner workings present too precise analogies to be attributed to chance.[175] This could be the right direction for zoomusicology. For instance, human beings and humpback whales constitute

[173] Ellen Koskoff, "Thoughts on universals in music," *The World of Music* 26, no. 2 (1984): 66-87.

[174] J.H. Kwabena Nketia, "Universal perspectives in ethnomusicology," *The World of Music* 26, no. 2 (1984): 3-24.

[175] Mâche, *Music, Myth, and Nature, or, the Dolphins of Arion.*

"independent musical contexts", it is not however problematic that a musical trait shared by both species is not also shared by another kind of animal.[176]

Having established the proper framing for the search for music universals in zoomusicology, one should address the ways through which the process of classification of possibly universal characteristics can be done. Researchers in the field adopt a methodology borrowed from ethnomusicology, that of formulating a tripartition of the three main occurrences within music-making: structures, processes, and experience.

Structures refer to the musical objects in themselves. In this level of tripartition, research involves a large use of sound material, namely recordings, and spectrograms, aiming to define the organization of sounds of a given species through observations on the range of sounds covered, recurrent intervals, and timbres.

Processes stand to signify the acts and behavioral patterns related to the emission and reception of sound. The analysis of processes includes the cultural dimension of music-making, which is the para-musical realm of rituals and social rules.

If the analysis of structures can be deemed objective, and that of processes can be deemed cultural, the analysis of experience is surely the level of subjectivity. The general idea behind it is that musical experiences may be considered a general experience taking place between a subject and an object, the object being a musical event. It follows that a universal feature in each experience is the restatement of particular conducts and competencies, which calls for an investigation of music as an experience lived by an individual.[177]

Unfortunately, fully illustrating the variety of practices, interactions, and roles underlying the activity of music-making in animals goes beyond the scope of this thesis. Nonetheless, it is crucial to have a general understanding of most nonhuman musical activities displaying a common articulation with human musical processes, structures, and experiences. This should not be taken to support either anthropocentric ideologies exemplified as "animals make music just like humans", or reductionist ones whose rationale is "human music is nothing else than what animals do". Both remarks are inaccurate, as zoomusicology's main objective is to affirm music's existence as a phenomenon with strong biological bases and developments that are not privy to human beings. As of now, the greatest insight produced by zoomusicology lies not in

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[176] Roger Payne, *Among whales*, 1995

[177] Dario Martinelli, "A whale of a sonata–Zoomusicology and the question of musical structures," *SEED Journal* 5, no.1 (2005): 2-29.

its ability to answer all questions on the topic of music, but in realizing that to find the answers one must broaden their gaze, including nonhuman animals in the equation.

3.9 Artistic Compositions Employing Whale Songs

Zoomusicology, much like ecomusicology, reveals the presence of music in nature. Now, after having laid out the theoretical foundation of research dealing with the topic, I will go back to the case of humpback whales, as they have been the subject of numerous zoomusicological studies involving human composers and their interaction with these animals. In fact, music carries within itself the potential of functioning as a medium allowing the meeting of whale voices and human ones. There are multiple zoomusicological studies in which the whale's vocalizations affect both human singing and listening, serving as examples of how music can be more than a merely symbolic projection of one's interpretation of the animal.[178]

3.9.1 Farewell to Tarwathie

In 1970, American singer-songwriter Judy Collins featured her version of "Farewell to Tarwathie" in her gold album "Whales and Nightingales". The lyrics had already been written in the 19th century, and are about the hunting of whales, specifically about a sailor who embarks on a dangerous hunting expedition to Greenland, leaving his lover behind. By looking at the words that are sung, one can clearly see that the songwriter sympathizes with the hunter rather than the hunted, reflecting an awareness of the risks involved in whale hunts. However, the novelty in Collins' version comes from the fact that the song presents the sound of humpback whales over her voice, which is unencumbered by any musical instrument. When interviewed about the matter, Collins stated: "It is like a call and response in a way, because I am having a dialogue with them [the humpback whales] – and vice versa, because they are answering me as well, and in a sense reaching out into the human species."[179] Indeed, the dialogue between her voice and the utterances of the whale completely override the possibly controversial meaning of the song itself, as the rhythmic, timbral, and harmonic differences between the humpback whale and the human singer are juxtaposed in time and allowed to coexist without comment. The listener is presented with two voices that are both dissimilar and strangely alike: the sounds of the whale are drawn out, unexpected, and low,

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[178] Rothenberg, *Thousand Mile Song: Whale Music in a Sea of Sound*, 2008.

[179] Micheal May, "Recordings that made waves: The songs that saved the whales," *National Public Radio All Things Considered* 26 (2014).

whereas Collins' voice is high, melodious, and structured; yet, each timbre carries with it a haunting emotional significance. This allows the listener to enter the worlds of both predator and prey, understanding them in their own unique way. Vocal timbre becomes the virtual place where the embodied capacities to hear and understand the Other are most audible, encouraging an empathetic identification and affiliation between the nonhuman and the human.[180] Zoomusicologist Alex South proposed a method of analysis of the field recordings using two distinct aesthetic dimensions: distance and difference. This approach is of particular use and will be borrowed when looking at the compositional treatment of each piece. Distance stands to mean the temporal separation created and perceived between human and cetacean voices; difference signifies the grouping of characteristics that make both voices distinguishable from each other, from objective acoustic properties such as frequency and sound pressure to relational ones, like perceived pitch and loudness.[181] In this case, as both voices are heard together throughout the whole track, one can hear the difference as they both maintain their acoustic individuality, but there is no distance between them, creating a "proximity without indifference".[182]

3.9.2 Litany for the Whale

In 1980, John Cage, one of the most influential artists of the 20th century, composed his "Litany for the Whale". Unlike the interspecies dialogue in Judy Collins' "Farewell to Tarwathie", Cage's piece was written for two human voices singing in antiphony, meaning responsive alternation between two groups. The structure of the work involves a repeated pattern where the first singer chants a call, the second responds with a variation of the call, the first repeats the call, which is then changed again by the second, and so on. The word "litany" in the title is a reference to the form of this kind of prayer, characterized by the announcement of invocations by a religious leader, to which a congregational response follows. Here, Cage plays with the traditional structure of the litany by not having a congregation but merely two similar voices, and by fixing the call rather than the response. The text that is being sung consists of the letters making up the word "whale", though the

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[180] Eric Clarke et al., "Music, empathy and cultural understanding," *Physics of life reviews* 15 (2015): 61-88.

[181] Alex South, "Composing With Cetaceans: Countering Human Exceptionalism Through a Practical Zoömusicology," *Journal of Interdisciplinary Voice Studies* 7, no. 1 (August 1, 2022): 51–67, https://doi.org/10.1386/jivs_00054_1.

[182] Donna J. Haraway, *Staying with the trouble: Making kin in the Chthulucene*, Duke University Press, 2020.

word itself is never pronounced: each letter is assigned a specific vowel pronunciation and a pitch that both stay the same throughout the totality of the piece. As a result, the articulation of each letter as individual vowels prevents the word "whale" from being voiced.

The voice of the humpback whale is not present in the piece, but the structure of it is very much in place. To see this, one should understand that the "unit" in this piece is formed by the calls from the singers, made up of a letter, a vowel, and a pitch. However, each response introduces a new pattern of units, which are created by the repetition, addition, and dropping of units, as well as the incorporation of silences within the phrase. All letters are sung slowly, softly, without vibrato, and equal both in length and dynamics, apart from the last one, which is always identical. The application of the call-and-response repeating structure, coupled with identical phrase endings and a narrow octave range points to two complementary ways of framing Cage's work. The first one can be found in a premeditated similarity with Christian liturgy and medieval chant, the earliest known notated music in the West, which employs all of these compositional devices.[183] The evocation of religious music situates the singing of whales within man's devotional and musical past. On the other hand, whale vocalizations provide the second frame of reference, as features like cyclicity and gravitational pitch are found mostly in whale songs, as it is quite unusual to find these procedures in human compositions. Moreover, Cage also uses moments of silence within the piece, a reminder of whales' pauses in anticipation of the reverberation effect; the identical calls can be likened to whales' singing units, in the same way that the varied responses are similar to whales' varied units. In essence, Cage wrote this piece by employing the procedures of a whale song. However, it should not be viewed as an imitation of whale vocalization as much as a study of its logic. In fact, though it admittedly does not give humpback whales a voice, "Litany for the Whale" gives a voice to the principles followed by singing whales, recognizing them as not only capable of musicality, but also of influencing human composers in a variety of concepts: what counts as vocal identity, how and when do voices come together, how to embed silence, how to form patterns, repetitions, variations, structures, and so on.[184]

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[183] Leo Treitler, "The Beginnings of Music-writing in the West: Historical and Semiotic Aspects," *Language & Communication* 9, no. 2–3 (January 1, 1989): 193–211, https://doi.org/10.1016/0271-5309(89)90018-9.

[184] Michal Grover Friedlander, "Whale Wonder," *Journal of Interdisciplinary Voice Studies* 5, no. 1 (April 1, 2020): 29–42, https://doi.org/10.1386/jivs_00014_1.

3.9.3 To Wail with a Whale

David Rothenberg is a clarinetist, composer, and associate professor in philosophy at the New Jersey Institute of Technology, deeply interested in interspecific music. In 2007, he took off on a boat off the coasts of Maui to record a duet between him, playing the clarinet, and humpback whales. He employed specific types of underwater microphones and amplifiers that allowed him both to blare the clarinet sounds into the ocean as well as to hear and record whale vocalizations as they happened. The idea behind this piece and related article, called "To Wail with a Whale", was that of playing the clarinet to the whale, listening to its response, and keeping on playing off the whale's variations of his sounds. Rothenberg, through a detailed use of spectrograms, analyzed a nearly five-minute-long portion of the duet, in which the whale appears to change his song in response to the clarinet. For the record, this section has not been edited to make it more interesting: simply, out of the many hours of recorded materials at his disposal, he chose the most engaging portion of his interactions with the whales.[185] Here is his recollection of some of the most telling moments of the piece:
"Throughout this duet are several clear examples where the whale seems to match the clarinet. Several of my favorites are enlarged here: at 2'50", where the whale is striving to match the steady clarinet pitch; 3'31", where my whale-like wail garners a never-previously heard squeaky response; 3'51", where the whale dares to match my sound as I am playing it. He can't quite hold the pitch but he is wavering up and down around it. At 3'58" I am now playing wavering tones as he has taught them to me, and he responds with a gritty growl; finally, at 4'06" he joins in with my steady note by uttering a deep, complex boom, then after my riff of discrete pitches he comes in with a whistle that finally matches me truly in tune, then I end with that new whale wail I have learned during this performance."[186]
This remarkable result not only helps to confirm the reigning theories around the cultural dimension within whale song, but it also reveals a new notion of nonhuman sound and the possible courses of action in human interaction with it. Rothenberg's clarinet sound possesses a distinct timbre from the cries of the humpback whale, and the notes played range widely across imitative and non-imitative gestures, which generate the impression of two free jazz improvisers co-creating on the spot. Crucially, there is no attempt to humanize the whale,

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[185] Rothenberg, "To Wail With a Whale: Anatomy of an Interspecies Duet."

[186] ibid.

whose song is valued and understood as it is.[187] For the listener, the human and the nonhuman part of the duet almost seem to morph into one, as the clarinet player imitates whales' vocalizations, and vice versa.[188] In a way, "To Wail with a Whale" could be considered a follow-up to Cage's "Litany", due to the fact that they share a similar structure based on a call-and-response process, but the former leaves up to the whale the responsibility to provide new responses, thus giving more agency to the animal.

3.10 Disrupting human exceptionalism

Just as ethnomusicologists asserted that music, as an anthropological phenomenon, could not be analyzed from a strictly Eurocentric point of view, it can now be said that as a zoological phenomenon, music can no longer be analyzed through an anthropocentric attitude. Any justification of human exceptionalism on the basis that nonhuman animals do not possess musicality is simply logically unsound. The field of zoomusicology calls into question long-established dogmas about music, providing the opportunity to use these doubts as resources for updating concepts about such issues. Zoomusicology, similarly to other post-modernist areas of research in feminist and non-Western music, aims to redefine age-old boundaries about music. Quoting music theorist Raymond Monelle, "It is a rejection of unification, of manifestos, of centralizing and totalizing forces. It is both a return to pluralism after the modernist experiment and – its true novelty – an embracing of pluralism as a fundamental tenet".[189] The sharp distinction between humans and nonhuman animals based on the former's rationality and self-identity is no longer convincing, leading the way to the formation of "multiple emotions, affects, and other extra-rational modes through which our thinking and interactions with animals might be called into question and transformed."[190] In the case of the humpback whale specifically, it is possible that works implementing the idea of recognizing whale songs as music may steer humanity's outlook on cetaceans to a more compassionate attitude. However, it is a fact that 22 out of the 90 species of whales and dolphins are

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[187] South, "Composing With Cetaceans: Countering Human Exceptionalism Through a Practical Zoömusicology."

[188] Aline Pénitot et al., "Bidirectional Interactions With Humpback Whale Singer Using Concrete Sound Elements," *Frontiers in Psychology* 12 (June 11, 2021), https://doi.org/10.3389/fpsyg.2021.654314.

[189] Raymond Monelle, *The sense of music: Semiotic essays*, Princeton University Press, 2010.

[190] Matthew Calarco, *Thinking Through Animals: Identity, Difference, Indistinction*, 2015, https://philpapers.org/rec/CALTTA-11.

currently regarded as threatened by the IUCN: their interests are far from being fully accounted for.[191] Hence, one must ask how music can truly challenge the position of human exceptionalism underlying current anthropogenic threats to cetaceans. Even works within Zoomusicology carry the potential of unwillingly contributing to anthropocentrism: for example, expanding access to the nonhuman world in a non-destructive way could still end up as being just another level of exploitation and commodifying the environment.[192] Even Payne and Mcvay's massively influential "Songs of the Humpback Whale", while being able to almost single-handedly shift the cultural paradigm surrounding whales, also produced a kind of introspection leading up to utopian reverie, de facto birthing the "therapeutic narcissism" of New Age culture emerging in 1970s America.[193] I find myself agreeing with composer David Dunn, who, through his supplying of intellectually challenging written commentaries on the environmental contexts of the sounds he presents, wants his listeners to be intellectually active and informed, and therefore to be more than merely passive consumers of his work.[194] It is also true that zoomusicologists do not have full control over how one's work will be received. Nonetheless, there are things to look out for within research methodologies when aiming to challenge human exceptionalism. For example, there are two compositional uses of field recordings that may unwittingly be defined as anthropocentric: one is that of othering the nonhuman through "anthropodenial", and one is that of eliminating differences between the human and the nonhuman through a naïve anthropomorphism projecting human qualities onto the animal. Anthropodenial is a blindness to the human-like characteristics of animals, or the animal-like characteristics of ourselves, while the misattribution of human-centered narratives on the nonhuman obstructs the project of accurate descriptions and explanations of animal behavior.

Ultimately, it is crucial to value the divergences between human and animal music just as much as the similarities they share. Ethologist De Waal calls for a third model to be used in zoomusicological research, called "animal-centric anthropomorphism", advocating for a

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[191] "The IUCN Red List of Threatened Species," *IUCN Red List of Threatened Species*, n.d., https://www.iucnredlist.org./.

[192] Ingram, "A Balance That You Can Hear: Deep Ecology, Serious Listening and the Soundscape Recordings of David Dunn."

[193] Bruce S. Thornton, *Plagues of the mind: The new epidemic of false knowledge*, Open Road Media, 2014.

[194] David Dunn, *Why Do Whales and Children Sing?: A Guide to Listening in Nature*, 1999, https://openlibrary.org/books/OL8448858M/Why_do_Whales_and_Children_Sing.

process of embracing the full complexities of sameness and difference.[195] Musicians have a better chance of fostering environmental responsibility by taking such a way of thinking, valuing and incorporating nonhuman sounds both differing and converging to those found in human musical practice. A key concept here is that of empathy: through the identification with the animal concerning its modes of perception and understanding of its environment, not only can one learn more about the motivations for animal behavior; but it also reduces the imagined distance between animals and humans. Music is an example of this distance, as it has been totalized by the human race, leaving the animal outside of the predicament. Whale vocalizations, just as myriads of other examples in the animal kingdom, force us to rethink this. Now, the challenge for zoomusicology is that of going even further: studies on nonhuman music must also point towards a shared vulnerability and a promotion of kindness, as the act of listening has the verifiable potential to inspire significant forms of collective action. The road ahead is long, but zoomusicology is going in the right direction.

[195] Frans B. M. de Waal, "Anthropomorphism and anthropodenial: consistency in our thinking about humans and other animals," *Philosophical topics* 27, no. 1 (1999): 255-280.

CONCLUSIONS

Ecomusicology and zoomusicology are a testament to the incredibly valuable contribution of interdisciplinarity, especially involving the humanities, to the environmental discourse. It should not at all be surprising that these fields of research, which necessarily deal with topics of interconnectedness and ecological thinking, are structured in a way that reflects this worldview. In their common rejection of anthropocentric processes and binary thinking, the aim of both disciplines can be found in a wish to tend to the conceptual alienation of the human in its relationship with nature, which ultimately resulted in the dismissal of nonhuman voices. The fact that the word "voice" has an obvious aural meaning, as something that could, and should, be heard, should also be understood quite literally. The Anthropocene can be defined in many ways, as there are many cultural phenomena underlying its formation; one of these coincides with the (fallacious) concept of human superiority, which inevitably leads to the failure of recognition of the nonhuman as a subject. Indeed, the nonhuman is merely understood as less than human, and as such it has not been taken into consideration in many practical and theoretical frameworks. The aspect of sound is yet another example of this and of the pernicious consequences of the Anthropocene: the human race is losing its ability to listen. Nonetheless, the practice of listening carries a fundamental quality of interconnectedness within itself, blurring the lines between the listener and their sonic environment, which is continuously being shaped by every entity participating in it. To cultivate the sensory perception of one's surroundings is paramount in the necessary cultural shift from an "egocentric" to an "ecocentric" worldview. However, casual, distracted listening is simply not enough: to fully appreciate the agency of the Other, there is a need to be prepared to engage in a dialogue between equals, and that requires deep listening. The soundscapes of the world are not only a reflection of the state of the environment, as revealed by the work of Rachel Carson, but only a chance to witness a complex interdependence between multiple actors. That is, however, if the listener is made conscious of each sound source, acoustic factor, and propagation filter. The act of listening should be intentional and informed, since passive listening may lead to a performative kind of activism that ultimately merely benefits the reproduction of narcissistic solipsism. That is not to say that feeling should not play a part in this practice; quite the opposite, the receiver of a sound signal should be open to embrace an empathetic worldview. Many composers have been inspired by the sounds of their surroundings, producing a vast array of musical pieces and performances motivated by a concern for the decaying state of the environment, and consequentially, its soundscape.

Such works have the potential to start dialogues and considerations on humanity's impact on the sounding Anthropocene, through artistic reinterpretation of nonhuman sound materials. The result is that of decoupling art and music from a solely human perspective, allowing the Other to have an impact on humans, thus feeding into the narrative of turning societal unidirectional and exploitative relationship with Nature into true dialogue. Surely, the now virtually omnipresent character of technology promotes standardization and uniformity at least in urban soundscapes, which may result in forming the habit of non-listening. That makes the work of ecomusicologists and zoomusicologists alike all the more important, for they must provide access, both practically and conceptually, to an appreciation for more than human voices. This could prove to be crucial in the context of environmental activism: one should look no further than Roger Payne and Scott McVay's "Songs of the Humpback Whales", whose impact on the campaign for the abolition of whaling is hard to overstate. The reason for this is greatly attributable to the emotional weight associated with a great number of people being introduced to sounds that were not accessible, or perhaps even known, to them. Not only that, the true power of whale songs lies in their structural and cultural similarities to human music-making. This realization allows both the human and the nonhuman to return each other gazes as individual subjects. It is important to stress that this should not lead to either a naïve anthropomorphism that misattributes human narratives and characteristics onto the animal or an "anthropodenial" attitude that eliminates the possibility of them ever being present and displayed in animal behavior. Many artists have shown ways of possible interaction with the Other, respecting its identity and agency while finding a contextual common ground that could be shared, encouraging an interspecies empathetic identification and affiliation. The challenges that lie ahead for both ecomusicology and zoomusicology are the same ones faced by humanity at large, consisting of the resistance towards the habit of falling into anthropocentric ways of thinking. There is the risk of reproduction of exploitative tendencies, as nonhuman sonic data can easily become commodified and repackaged in a more digestible way for casual listeners who will only consume them to fuel a kind of New Age therapeutic narcissism. Another challenge is that of finding new ways to emotionally move the general audience toward environmental action, because, when push comes to shove, this is what it is all about: otherwise, any engagement with the nonhuman becomes a meaningless performance of pseudo-intellectualism. There is also the question, or rather, the impossible task, of finding universal characteristics of music to prove its ubiquitous nature. However, as stated by François Bernard Mâche, it is enough to

prove that certain characteristics appear in independent contexts and that their inner workings present too precise analogies to be attributed to chance.

Ultimately, the goal of ecomusicology and zoomusicology is to create a global awareness of the limitations surrounding the traditional concept of music as something that is made exclusively by, and for, humans. The main forces of these crisis fields lie not only in the answers they are able to provide but also within the questions themselves, because they force us to broaden the scope through which humans relate to their environment. To call into question the conventional notion of music rooted in human exceptionalism means breaking down the divide between what is and what is not human, it means placing the first stone in the foundation of an ecocentric reframing of worldviews. It necessarily calls for a reinterpretation of human ideas around nonhuman beings and environmental matters, which results in further contemplations on our own place and responsibility towards them. Ecomsuicologists and zoomusicologists can guide the audience through the act of deep listening, allowing the nonhuman to reclaim its agency. It also allows us to gain access to the voice of the Other, which must not be taken or given: it must be heard.

BIBLIOGRAPHY

- "Music." In *Merriam-Webster Dictionary*, November 25, 2023. https://www.merriam-webster.com/dictionary/music.
- "Navigating the Space of the Future | NIMk," n.d. http://nimk.nl/eng/search/navigating-the-space-of-the-future.
- Abram, David. "The Spell of the Sensuous: Perception and Language in a More than Human World." *Colonial Waterbirds* 20, no. 1 (January 1, 1997): 152. https://doi.org/10.2307/1521797.
- Adams, John Luther. *The Place Where You Go to Listen: In Search of an Ecology of Music*, 2009. http://muse.jhu.edu/chapter/248715.
- Allen, Aaron S. '*Fatto di Fiemme': Stradivari's violins and the musical trees of the Paneveggio*. na, 2012.
- Allen, Aaron S. "33. Ecomusicology from Poetic to Practical." In *De Gruyter eBooks*, 644–63, 2016. https://doi.org/10.1515/9783110314595-035.
- Allen, Aaron S. "Ecomusicology: Bridging the Sciences, Arts, and Humanities." In *SAGE Publications, Inc. eBooks*, 373–81, 2012. https://doi.org/10.4135/9781452218601.n40.
- Allen, Aaron S. "Ecomusicology: Ecocriticism and Musicology." *Journal of the American Musicological Society* 64, no. 2 (August 1, 2011): 391–94. https://doi.org/10.1525/jams.2011.64.2.391.
- Allen, Aaron S. "Ecomusicology." *Oxford Music Online*, July 25, 2013. https://doi.org/10.1093/gmo/9781561592630.article.a2240765.
- Allen, Aaron S. "One ecology and many ecologies: The problem and opportunity of ecology for music and sound studies." *MUSICultures* 45, no.1-2, 2018.
- Au, Whitlow W. L., Adam A. Pack, Marc O. Lammers, Louis M. Herman, Mark H. Deakos, and Kim Andrews. "Acoustic Properties of Humpback Whale Songs." *the Journal of the Acoustical Society of America/the Journal of the Acoustical Society of America* 120, no. 2 (August 1, 2006): 1103–10. https://doi.org/10.1121/1.2211547.
- Balakrishnan, Rohini. "Behavioral Ecology of Insect Acoustic Communication." In *Springer Handbook of Auditory Research*, 49–80, 2016. https://doi.org/10.1007/978-3-319-28890-1_3.
- Barchiesi, Daniele, Dimitrios Giannoulis, Dan Stowell, and Mark D. Plumbley. "Acoustic Scene Classification: Classifying Environments From the Sounds They Produce." *IEEE Signal Processing Magazine* 32, no. 3 (May 1, 2015): 16–34. https://doi.org/10.1109/msp.2014.2326181.

- Baur, Donald C., Micheal J. Bean, and Micheal L. Gosliner. "The laws governing marine mammal conservation in the United States." *Conservation and management of marine mammals. Smithsonian Institution Press, Washington, DC* (1999): 48-86.
- Bekoff, Marc. "Cognitive ethology and the explanation of nonhuman animal behavior." *Comparative approaches to cognitive science* 1 (1995): 19-150.
- Birch, L. C. "The Role of Weather in Determining the Distribution and Abundance of Animals." Cold Spring Harbor Symposia on Quantitative Biology/Cold Spring Harbor Symposia on Quantitative Biology 22, no. 0 (January 1, 1957): 203–18. https://doi.org/10.1101/sqb.1957.022.01.021.
- Blok, Anders. "Actor-networking Ceta-sociality, or, What Is Sociological About Contemporary Whales?" *Distinktion* 8, no. 2 (January 1, 2007): 65–89. https://doi.org/10.1080/1600910x.2007.9672947.
- Burnett, D. Graham. *The Sounding of the Whale: Science and Cetaceans in the Twentieth Century*, 2012. https://ci.nii.ac.jp/ncid/BB15001041.
- Calarco, Matthew. *Thinking Through Animals: Identity, Difference, Indistinction*, 2015. https://philpapers.org/rec/CALTTA-11.
- Carson, Rachel. *Silent Spring*. Houghton Mifflin Harcourt, 2002.
- Cato, Douglas H. "Songs of humpback whales: the Australian perspective." *Memoirs of the Queensland Museum* 30, no. 2 (1991): 277-290.
- Cholewiak, Danielle M., Renata S. Sousa-Lima, and Salvatore Cerchio. "Humpback Whale Song Hierarchical Structure: Historical Context and Discussion of Current Classification Issues." *Marine Mammal Science* 29, no. 3 (November 21, 2012). https://doi.org/10.1111/mms.12005.
- Cimatti, Felice. "Beyond the human/non-human dichotomy: the philosophical problem of human animality." Humanimalia 7, no. 2 (2016): 35-55.
- Clarke, Eric, Tia DeNora, and Jonna Vuoskoski. "Music, empathy and cultural understanding." *Physics of life reviews* 15 (2015): 61-88.
- Cohen, Jacob A. "Current Directions in Ecomusicology: Music, Culture, Nature Eds. by Aaron S. Allen and Kevin Dawe." *Notes*74, no. 1 (January 1, 2017): 83–86. https://doi.org/10.1353/not.2017.0088.
- Constantine, Rochelle. "Folklore and legends." *Encyclopedia of Marine Mammals*. Academic Press, 2009. 447-449.

- Cook, Nicholas, and Mark Everist, eds. *Rethinking music*. Oxford University Press, USA, 1999.
- D'Vincent, Cynthia G., Russell M. Nilson, and Richard E. Hanna. "Vocalization and coordinated feeding behavior of the humpback whale in southeastern Alaska." *Sci. Rep. Whales Res. Inst* 36 (1985): 41-47.
- Darling, James D., Jo Marie V. Acebes, Oscar Frey, R. Jorge Urbán, and Manami Yamaguchi. "Convergence and Divergence of Songs Suggests Ongoing, but Annually Variable, Mixing of Humpback Whale Populations Throughout the North Pacific." *Scientific Reports* 9, no. 1 (May 7, 2019). https://doi.org/10.1038/s41598-019-42233-7.
- Dawson, Deanna K., and Murray G. Efford. "Bird Population Density Estimated From Acoustic Signals." *Journal of Applied Ecology* 46, no. 6 (November 26, 2009): 1201–9. https://doi.org/10.1111/j.1365-2664.2009.01731.x.
- De Llera Blanes, Guillermo. "Trek to Everest Base Camp: (Re)Composing a Sound-Trek and (Re)Experiencing as Soundscape Remix." *Cadernos De Arte E Antropologia*, no. Vol. 10, No 2 (September 19, 2021): 71–94. https://doi.org/10.4000/cadernosaa.3864.
- De Waal, Frans B.M. "Anthropomorphism and anthropodenial: consistency in our thinking about humans and other animals." *Philosophical topics* 27, no. 1 (1999): 255-280.
- Deely, John. "Semiotics and Jakob von Uexküll's concept of umwelt." *Σημειωτκή-Sign Systems Studies* 32, no. 1-2 (2004): 11-34.
- Doolittle, Emily, and Bruno Gingras. "Zoomusicology." *CB/Current Biology* 25, no. 19 (October 1, 2015): R819–20. https://doi.org/10.1016/j.cub.2015.06.039.
- Dunlop, Rebecca A., Michael J. Noad, Douglas H. Cato, and Dale Stokes. "The Social Vocalization Repertoire of East Australian Migrating Humpback Whales (Megaptera Novaeangliae)." *the Journal of the Acoustical Society of America/the Journal of the Acoustical Society of America* 122, no. 5 (November 1, 2007): 2893–2905. https://doi.org/10.1121/1.2783115.
- Dunn, David B., and James P. Crutchfield. "Entomogenic Climate Change: Insect Bioacoustics and Future Forest Ecology." *Leonardo* 42, no. 3 (June 1, 2009): 239–44. https://doi.org/10.1162/leon.2009.42.3.239.
- Dunn, David. *Why Do Whales and Children Sing?: A Guide to Listening in Nature*, 1999. https://openlibrary.org/books/OL8448858M/Why_do_Whales_and_Children_Sing.
- Echard, William. "Psychedelia, Musical Semiotics, and Environmental Unconscious." *Green Letters*, January 1, 2011. https://doi.org/10.1080/14688417.2011.10589091.

- Embleton, Tony F. W. "Tutorial on Sound Propagation Outdoors." the Journal of the Acoustical Society of America/the Journal of the Acoustical Society of America 100, no. 1 (July 1, 1996): 31–48. https://doi.org/10.1121/1.415879.
- Erfanian, Mercede, Andrew Mitchell, Jian Kang, and Francesco Aletta. "The Psychophysiological Implications of Soundscape: A Systematic Review of Empirical Literature and a Research Agenda." *International Journal of Environmental Research and Public Health/International Journal of Environmental Research and Public Health* 16, no. 19 (September 21, 2019): 3533. https://doi.org/10.3390/ijerph16193533.
- Farina, Almo, and Nadia Pieretti. "The Soundscape Ecology: A New Frontier of Landscape Research and Its Application to Islands and Coastal Systems." *Journal of Marine and Island Cultures* 1, no. 1 (June 1, 2012): 21–26. https://doi.org/10.1016/j.imic.2012.04.002.
- Farina, Almo. "Soundscape and Landscape Ecology." In *Springer eBooks*, 1–28, 2013. https://doi.org/10.1007/978-94-007-7374-5_1.
- Feld, Steven. "*Waterfalls of Song: An Acoustemology of Place Resounding in Bosavi Papua New Guinea'in Feld, S. and Basso, K.(eds) Senses of Place,*" 1996.
- Fitch, W. Tecumseh. "The Biology and Evolution of Music: A Comparative Perspective." *Cognition* 100, no. 1 (May 1, 2006): 173–215. https://doi.org/10.1016/j.cognition.2005.11.009.
- Fletcher, Neville. "Animal Bioacoustics." In *Springer eBooks*, 785–804, 2007. https://doi.org/10.1007/978-0-387-30425-0_19.
- Forrest, T. G. "From Sender to Receiver: Propagation and Environmental Effects on Acoustic Signals." *American Zoologist* 34, no. 6 (December 1, 1994): 644–54. https://doi.org/10.1093/icb/34.6.644.
- Friedlander, Michal Grover. "Whale Wonder." *Journal of Interdisciplinary Voice Studies* 5, no. 1 (April 1, 2020): 29–42. https://doi.org/10.1386/jivs_00014_1.
- Garland, Ellen C., and Peter K. McGregor. "Cultural Transmission, Evolution, and Revolution in Vocal Displays: Insights From Bird and Whale Song." *Frontiers in Psychology* 11 (September 29, 2020). https://doi.org/10.3389/fpsyg.2020.544929.
- Garland, Ellen C., Luke Rendell, Luca Lamoni, M. Michael Poole, and Michael J. Noad. "Song Hybridization Events During Revolutionary Song Change Provide Insights Into Cultural Transmission in Humpback Whales." *Proceedings of the National Academy of Sciences of the United States of America* 114, no. 30 (July 24, 2017): 7822–29. https://doi.org/10.1073/pnas.1621072114.

- Garner, W., and R. Murray Schafer. "The Tuning of the World." *Leonardo* 16, no. 1 (January 1, 1983): 69. https://doi.org/10.2307/1575066.
- Gasc, A., S. Pavoine, L. Lellouch, P. Grandcolas, and J. Sueur. "Acoustic Indices for Biodiversity Assessments: Analyses of Bias Based on Simulated Bird Assemblages and Recommendations for Field Surveys." *Biological Conservation* 191 (November 1, 2015): 306–12. https://doi.org/10.1016/j.biocon.2015.06.018.
- Ghosh, Amitav. *The Great Derangement: Climate Change and the Unthinkable*, 2016. http://dx.doi.org/10.7208/chicago/9780226323176.001.0001.
- Gilmurray, Jonathan. "Ecological Sound Art: Steps towards a New Field." *Organised Sound* 22, no. 1 (March 7, 2017): 32–41. https://doi.org/10.1017/s1355771816000315.
- Gilmurray, Jonathan. "Sounding the Alarm: An Introduction to Ecological Sound Art." *Musicological Annual* 52, no. 2 (December 9, 2016): 71–84. https://doi.org/10.4312/mz.52.2.71-84.
- Gomes, Dylan G. E., Thomas Hesselberg, and Jesse R. Barber. "Phantom River Noise Alters Orb-weaving Spider Abundance, Web Size and Prey Capture." *Functional Ecology* 35, no. 3 (December 21, 2020): 717–26. https://doi.org/10.1111/1365-2435.13739.
- Gray, Patricia M., Bernie Krause, Jelle Atema, Roger Payne, Carol Krumhansl, and Luis Baptista. "The Music of Nature and the Nature of Music." *Science* 291, no. 5501 (January 5, 2001): 52–54. https://doi.org/10.1126/science.10.1126/science.1056960.
- Griffin, Donald Redfield. *The question of animal awareness: Evolutionary continuity of mental experience*. Rockefeller University Press, 1976.
- Grimley, Daniel M. *Grieg: Music, Landscape and Norwegian Identity*, 2006. https://ci.nii.ac.jp/ncid/BA80535363.
- Grinfeder, Elie, Christian Lorenzi, Sylvain Haupert, and Jérôme Sueur. "What Do We Mean by 'Soundscape'? A Functional Description." *Frontiers in Ecology and Evolution* 10 (June 15, 2022). https://doi.org/10.3389/fevo.2022.894232.
- Grinfeder, Elie, Sylvain Haupert, Manon Ducrettet, Julien Barlet, Marie-Pierre Reynet, Frédéric Sèbe, and Jérôme Sueur. "Soundscape Dynamics of a Cold Protected Forest: Dominance of Aircraft Noise." *Landscape Ecology* 37, no. 2 (January 8, 2022): 567–82. https://doi.org/10.1007/s10980-021-01360-1.
- Haraway, Donna J. *Staying with the trouble: Making kin in the Chthulucene*. Duke University Press, 2020.

- Harris, Yolande. "Making the Inaudible Audible: Strategies and Disagreements." *Proceedings of the 16th International Symposium for Electronic Arts, ISEA2010 Ruhr*, Berlin: Revolver Publishing, 133- 35.
- Harris, Yolande. "Understanding Underwater: The Art and Science of Interpreting Whale Sounds." *Interference: A Journal of Audio Culture* 2 (2012).
- Ingram, David. "A Balance That You Can Hear: Deep Ecology, Serious Listening and the Soundscape Recordings of David Dunn." *European Journal of American Culture* 25, no. 2 (August 1, 2006): 123–38. https://doi.org/10.1386/ejac.25.2.123/1.
- Ingram, David. *The Jukebox in the Garden: Ecocriticism and American Popular Music since 1960*., 2010. http://ci.nii.ac.jp/ncid/BB08873694.
- IUCN Red List of Threatened Species. "The IUCN Red List of Threatened Species," n.d. https://www.iucnredlist.org./.
- Jäggi, Patricia. "Listening to Reveries: Sounds of a Post-Anthropocene Ecology." *Zenodo (CERN European Organization for Nuclear Research)*, March 15, 2021. https://doi.org/10.5281/zenodo.4709853.
- Kane, Brian. "L'Objet Sonore Maintenant: Pierre Schaeffer, Sound Objects and the Phenomenological Reduction." *Organised Sound* 12, no. 1 (April 1, 2007): 15–24. https://doi.org/10.1017/s135577180700163x.
- Kayser, Christoph, Christopher I. Petkov, Michael Lippert, and Nikos K. Logothetis. "Mechanisms for Allocating Auditory Attention: An Auditory Saliency Map." *CB/Current Biology* 15, no. 21 (November 1, 2005): 1943–47. https://doi.org/10.1016/j.cub.2005.09.040.
- Keller, Marcello Sorce. "Linnaeus, Zoomusicology, Ecomusicology, and The Quest for Meaningful Categories." *Musicological Annual* 52, no. 2 (December 9, 2016): 163–76. https://doi.org/10.4312/mz.52.2.163-176.
- Koskoff, Ellen. "Thoughts on universals in music." *The World of Music* 26, no. 2 (1984): 66-87.
- Krause, Bernie. "The niche hypothesis: How animals taught us to dance and sing." *Whole Earth Review* 57, no. 57 (1987): 14-16.
- Kricher, John C. *The Balance of Nature: Ecology's Enduring Myth*, 2009. http://ci.nii.ac.jp/ncid/BB00923223. • LaBelle, Brandon. *Background Noise: Perspectives on Sound Art*, 2006. http://ci.nii.ac.jp/ncid/BA87166083.
- Landy, Leigh. *Understanding the Art of Sound Organization*. MIT Press, 2007.

- Leach, Elizabeth Eva. “Sung Birds: Music, Nature, and Poetry in the Later Middle Ages.” *Choice Reviews Online* 45, no. 01 (September 1, 2007): 45–0200. https://doi.org/10.5860/choice.45-0200.
- Lengagne, Thierry, and Peter J. B. Slater. “The Effects of Rain on Acoustic Communication: Tawny Owls Have Good Reason for Calling Less in Wet Weather.” *Proceedings - Royal Society. Biological Sciences/Proceedings - Royal Society. Biological Sciences* 269, no. 1505 (October 22, 2002): 2121–25. https://doi.org/10.1098/rspb.2002.2115.
- Mâche, François Bernard. *Music, Myth, and Nature, or, The Dolphins of Arion*, 1992. http://ci.nii.ac.jp/ncid/BA2310096X.
- Martinelli, Dario. "A whale of a sonata–Zoomusicology and the question of musical structures." *SEED Journal* 5, no.1 (2005): 2-29.
- Martinelli, Dario. “Introduction (to the Issue and to Zoomusicology).” *Trans : Transcultural Music Review = Revista Transcultural De Música*, no. 12 (January 1, 2008): 8. http://www.redalyc.org/pdf/822/82201208.pdf.
- Martinelli, Dario. “Methodologies and Problems in Zoomusicology.” *Sign Systems Studies* 29, no. 1 (December 31, 2001): 341–52. https://doi.org/10.12697/sss.2001.29.1.21.
- Martinelli, Dario. “The Musical Circle: The Umwelt Theory, as Applied to Zoomusicology.” *Sign Systems Studies* 32, no. 1/2 (December 31, 2004): 229–52. https://doi.org/10.12697/sss.2004.32.1-2.10.
- Martinelli, Dario. “Zoomusicology and Musical Universals: The Question of Processes.” *Trans : Transcultural Music Review = Revista Transcultural De Música*, no. 12 (January 1, 2008): 10. https://dialnet.unirioja.es/servlet/articulo?codigo=2789583.
- May, Michael. "Recordings that made waves: The songs that saved the whales." *National Public Radio All Things Considered* 26 (2014).
- McGarigal, Kevin, and D. Urban. "Introduction to landscape ecology." *Landscape Ecology course notes, Duke University* (2001).
- Meyer, Leonard B. “Universalism and Relativism in the Study of Ethnic Music.” *Ethno Musicology* 4, no. 2 (May 1, 1960): 49. https://doi.org/10.2307/924262.
- Monelle, Raymond. *The sense of music: Semiotic essays*. Princeton University Press, 2010.
- Morton, Timothy. “The Ecological Thought.” In *Harvard University Press eBooks*, 2010. https://doi.org/10.4159/9780674056732.
- Nattiez, Jean-Jacques. "Under what conditions can one speak of the universals of music?." *The World of Music* 19, no. 1/2 (1977): 92-105.

- Nicklin, Charles P., James D. Darling, and Meagan E. Jones. “Humpback Whale Songs: Do They Organize Males During the Breeding Season?” *Behaviour* 143, no. 9 (January 1, 2006): 1051–1101. https://doi.org/10.1163/156853906778607381.
- Nketia, J.H. Kwabena. "Universal perspectives in ethnomusicology." *The World of Music* 26, no. 2 (1984): 3-24.
- Noad, Michael J., Douglas H. Cato, M. M. Bryden, Micheline -n. Jenner, and K. Curt S. Jenner. “Cultural Revolution in Whale Songs.” *Nature* 408, no. 6812 (November 1, 2000): 537. https://doi.org/10.1038/35046199.
- Özdemir, Ulaş. “Ekoeleştirel ve Doğakültürel Bir Müzikoloji Yaklaşımı Olarak Ekomüzikoloji.” *Konservatoryum* 6, no. 2 (December 31, 2019): 117–37. https://doi.org/10.26650/cons2019-0012.
- Parsons, E. C. M., and Danielle Monaghan-Brown. “From Hunting to Watching: Human Interactions With Cetaceans.” In *Animal Welfare*, 67–89, 2017. https://doi.org/10.1007/978-3-319-46994-2_5.
- Pasoulas, Aki. “The Art and Science of Acoustic Ecology.” *Ent and Audiology News* 28, no. 6 (February 1, 2020)
- Payne, Roger S., and Scott McVay. “Songs of Humpback Whales.” *Science* 173, no. 3997 (August 13, 1971): 585–97. https://doi.org/10.1126/science.173.3997.585.
- Payne, Roger. “New light on the singing whales.” *National Geographic* 161, no. 4 (January 1, 1982): 463–76. https://dialnet.unirioja.es/servlet/articulo?codigo=6710831.
- Payne, Roger. "Whale Songs: Musicality or Mantra? BioMusic Symposium." *AAAS Annual Meeting*. 2000.
- Payne, Roger. *Among whales.* 1995
- Payne, Sarah R., William J. Davies, and Mags Adam. “Research into the practical and policy applications of soundscape concepts and techniques in urban areas (NANR 200).” *Nanr*, October 1, 2009. https://pure.hw.ac.uk/ws/files/10337069/Payne.Defra_soundscape_report.pdf.
- Pedelty, Mark. “Ecomusicology, Music Studies, and the IASPM: Beyond ‘Epistemic Inertia.’” *IASPM@Journal* 3, no. 2 (June 24, 2013): 33–47. https://doi.org/10.5429/2079-3871(2013)v3i2.3en.
- Pénitot, Aline, Diemo Schwarz, Paul Nguyen Hong Duc, Dorian Cazau, and Olivier Adam. “Bidirectional Interactions With Humpback Whale Singer Using Concrete Sound

Elements." *Frontiers in Psychology* 12 (June 11, 2021). https://doi.org/10.3389/fpsyg.2021.654314.

- Pijanowski, Bryan C., Almo Farina, Stuart H. Gage, Sarah L. Dumyahn, and Bernie L. Krause. "What Is Soundscape Ecology? An Introduction and Overview of an Emerging New Science." *Landscape Ecology* 26, no. 9 (May 1, 2011): 1213–32. https://doi.org/10.1007/s10980-011-9600-8.
- Pijanowski, Bryan C., Luis J. Villanueva-Rivera, Sarah L. Dumyahn, Almo Farina, Bernie Krause, Brian M. Napoletano, Stuart H. Gage, and Nadia Pieretti. "Soundscape Ecology: The Science of Sound in the Landscape." *BioScience/Bioscience* 61, no. 3 (March 1, 2011): 203–16. https://doi.org/10.1525/bio.2011.61.3.6.
- Polli, Andrea. "Soundscape, Sonification, and Sound Activism." *AI & Society* 27, no. 2 (September 1, 2011): 257–68. https://doi.org/10.1007/s00146-011-0345-3.
- Quinn, John E., Anna J. Markey, Dakota Howard, Sam Crummett, and Alexander R. Schindler. "Intersections of Soundscapes and Conservation: Ecologies of Sound in Naturecultures." *MUSICultures* 45 (January 1, 2018). https://journals.lib.unb.ca/index.php/MC/article/view/28934.
- Rehding, Alexander. "Ecomusicology between Apocalypse and Nostalgia." *Journal of the American Musicological Society* 64, no. 2 (January 1, 2011): 409–14. https://doi.org/10.1525/jams.2011.64.2.409.
- Rehding, Alexander. "Music Theory's Other Nature: Reflections on Gaia, Humans, and Music in the Anthropocene." *19th-Century Music* 45, no. 1 (January 1, 2021): 7–22. https://doi.org/10.1525/ncm.2021.45.1.7.
- Reich, Megan A. "Soundscape Composition: Music as Environmental Activism." *University of Puget Sound*, January 1, 2018. https://soundideas.pugetsound.edu/cgi/viewcontent.cgi?article=1028&context=honors_program_theses.
- Rothenberg, David. "To Wail With a Whale: Anatomy of an Interspecies Duet." *Trans : Transcultural Music Review = Revista Transcultural De Música*, no. 12 (January 1, 2008): 12. https://dialnet.unirioja.es/servlet/articulo?codigo=2789590.
- Rothenberg, David. *Thousand Mile Song: Whale Music in a Sea of Sound*, 2008. https://ci.nii.ac.jp/ncid/BA8590791X.
- Sachs, Curt. *The Rise of Music in the Ancient World, East and West*. Courier Corporation, 2008.
- Schafer, R. Murray. "The Tuning of the World." *Leonardo* 16, no. 1 (January 1, 1983): 69. https://doi.org/10.2307/1575066.

- Schafer, R. Murray. The New Soundscape : A Handbook for the Modern Music Teacher, 1969. http://ci.nii.ac.jp/ncid/BA04846320.
- Schafer, R. Murray. *Voices of Tyranny Temples of Silence*, 1993. https://openlibrary.org/books/OL15071283M/Voices_of_tyranny.
- Schroer, Sara Asu. "Jakob Von Uexküll: The Concept ofUmweltand Its Potentials for an Anthropology Beyond the Human." *Ethnos* 86, no. 1 (June 14, 2019): 132–52. https://doi.org/10.1080/00141844.2019.1606841.
- Sebeok, Thomas A. "'Talking' With Animals: Zoosemiotics Explained." In *De Gruyter eBooks*, 87–94, 2011. https://doi.org/10.1515/9783110253436.87.
- Simoni, Mary, and Kristin Fosdick. "Barry Truax: Acoustic Communication and Compositional Techniques." *Computer Music Journal* 34, no. 2 (June 1, 2010): 96–98. https://doi.org/10.1162/comj.2010.34.2.96.
- Smalley, Denis. "Defining Transformations." *Interface* 22, no. 4 (November 1, 1993): 279–300. https://doi.org/10.1080/09298219308570638.
- South, Alex. "Composing With Cetaceans: Countering Human Exceptionalism Through a Practical Zoömusicology." *Journal of Interdisciplinary Voice Studies* 7, no. 1 (August 1, 2022): 51–67. https://doi.org/10.1386/jivs_00054_1.
- Southworth, Micheal. "The Sonic Environment of Cities." *Environment and Behavior* 1, no. 1 (June 1, 1969): 49–70. https://doi.org/10.1177/001391656900100104.
- Stefani, Gino. *Musica: Dall'esperienza alla teoria.* 1998
- Sterne, Jonathan, and Mitchell Akiyama. The Recording That Never Wanted to Be Heard and Other Stories of Sonification. Oxford University Press eBooks, 2011. https://doi.org/10.1093/oxfordhb/9780195388947.013.0115.
- Stocker, Michael. "Fish, Mollusks and other Sea Animals' use of Sound, and the Impact of Anthropogenic Noise in the Marine Acoustic Environment." *Soundscape Journal of Acoustic Ecology* 3, no. 2 (2002): 16-29.
- Supper, Alexandra. The Search for the "Killer Application": Drawing the Boundaries Around the Sonification of Scientific Data. Oxford University Press eBooks, 2011. https://doi.org/10.1093/oxfordhb/9780195388947.013.0064.
- Suzuki, Ryuji, John R. Buck, and Peter L. Tyack. "Information Entropy of Humpback Whale Songs." *the Journal of the Acoustical Society of America/the Journal of the Acoustical Society of America* 119, no. 3 (March 1, 2006): 1849–66. https://doi.org/10.1121/1.2161827.

- Swearingen, Michelle E., and Michael J. White. "Influence of Scattering, Atmospheric Refraction, and Ground Effect on Sound Propagation Through a Pine Forest." *the Journal of the Acoustical Society of America/the Journal of the Acoustical Society of America* 122, no. 1 (July 1, 2007): 113–19. https://doi.org/10.1121/1.2735108.
- Tagg, Philip. "Caught on the Back Foot: Epistemic Inertia and Visible Music." *IASPM@Journal* 2, no. 1–2 (February 29, 2012): 3–18. https://doi.org/10.5429/2079-3871(2011)v2i1-2.2en.
- Tarasti, Eero. "The emancipation of the sign: On the corporeal and gestural meanings in music." *AS/SA* 4 (1997): 180-190.
- Tekcan, Ali Í, Engin Yılmaz, Burcu Kaya Kızılöz, Dilay Z Karadöller, Merve Mutafoğlu, and Aslı Aktan Erciyes. "Retrieval and Phenomenology of Autobiographical Memories in Blind Individuals." *Memory* 23, no. 3 (February 17, 2014): 329–39. https://doi.org/10.1080/09658211.2014.886702.
- Thornton, Bruce S. *Plagues of the mind: The new epidemic of false knowledge*. Open Road Media, 2014.
- Titon, Jeff Todd. "AFTERWORD: Ecomusicology and the Problems in Ecology." *MUSICultures* 45 (January 1, 2018). https://journals.lib.unb.ca/index.php/MC/article/download/28944/1882521787.
- Titon, Jeff Todd. "Music and sustainability: An ecological viewpoint." *The world of music* 5, no. 1 (2009): 119-137.
- Titon, Jeff Todd. "Within Ethnomusicology, Where Is Ecomusicology? Music, Sound, and Environment." *Ethnomusicology Journal* 3, no. 2 (2020): 194-204.
- Treitler, Leo. "The Beginnings of Music-writing in the West: Historical and Semiotic Aspects." *Language & Communication* 9, no. 2–3 (January 1, 1989): 193–211. https://doi.org/10.1016/0271-5309(89)90018-9.
- Truax, Barry. "Genres and Techniques of Soundscape Composition as Developed at Simon Fraser University." *Organised Sound*7, no. 1 (April 1, 2002): 5–14. https://doi.org/10.1017/s1355771802001024.
- Truax, Barry. "Soundscape Composition as Global Music: Electroacoustic Music as Soundscape." *Organised Sound* 13, no. 2 (June 25, 2008): 103–9. https://doi.org/10.1017/s1355771808000149.

- Truax, Barry. “Soundscape, Acoustic Communication and Environmental Sound Composition.” *Contemporary Music Review* 15, no. 1–2 (July 1, 1996): 49–65. https://doi.org/10.1080/07494469608629688.
- Truax, Barry. “The Inner and Outer Complexity of Music.” *Perspectives of New Music* 32, no. 1 (January 1, 1994): 176. https://doi.org/10.2307/833161.
- Truax, Barry. “Time-shifting of Sampled Sound with a Real-time Granulation Technique.” *ICMC* 1990 (January 1, 1990). http://quod.lib.umich.edu/i/icmc/bbp2372.1990.026?rgn=main;view=fulltext.
- Turner, Kate, and Bill Freedman. “Music and Environmental Studies.” *The Journal of Environmental Education* 36, no. 1 (October 1, 2004): 45–52. https://doi.org/10.3200/joee.36.1.45-52.
- Von Glahn, Denise. “The Sounds of Place: Music and the American Cultural Landscape.” *Choice Reviews Online* 41, no. 08 (April 1, 2004): 41–4552. https://doi.org/10.5860/choice.41-4552.
- Walker, Lisa. "Whale Song or Whale Music? From a Composer’s Perspective." *Canadian Acoustics* 38, no. 3 (2010): 200-201.
- Wallin, Nils Lennart, Björn Merker, and Steven Mar. Brown. *The Origins of Music.*, 2000. https://ci.nii.ac.jp/ncid/BA44962134.
- Watkins, Holly. “Musical Ecologies of Place and Placelessness.” *Journal of the American Musicological Society* 64, no. 2 (August 1, 2011): 404–8. https://doi.org/10.1525/jams.2011.64.2.404.
- Westerkamp, Hildegard. “Linking Soundscape Composition and Acoustic Ecology.” *Organised Sound* 7, no.1: 51–56 (2002). https://doi.org/10.1017/S1355771802001085
- Winn, H. E., and L. K. Winn. “The Song of the Humpback Whale Megaptera Novaeangliae in the West Indies.” *Marine Biology* 47, no. 2 (January 1, 1978): 97–114. https://doi.org/10.1007/bf00395631.
- World Forum for Acoustic Ecology. “ABOUT,” n.d. https://www.wfae.net/about.html.
- Zeyl, Donald J. “Plato and Talk of a World in Flux: Timaeus 49a6-50b5.” *Harvard Studies in Classical Philology* 79 (January 1, 1975): 125. https://doi.org/10.2307/311132.