

Future Pasts

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Navigating Soundscape Research

A Review of Literature at the Intersection of Sound and Environmental Studies

Reylon Yount

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Bath Spa University, School of Oriental & African Studies, University of Edinburgh
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Future Pasts draws on Arts and Humanities research methodologies to document and analyse culturally-inflected perceptions and practices of sustainability. The project has a particular geographical focus on west Namibia, where three of our core research team have long-term field research experience.

The project seeks to:

- enhance understanding of sociocultural, economic and environmental changes in historical and post-independence contexts;
- document and support cultural heritage and indigenous knowledge regarding present and historical cultural landscapes of west Namibia;
- extend analysis and understanding of the historical ecologies of the Namib;
- interrogate interpretations of 'sustainability', particularly those contributing to the promotion of a growth-oriented 'green economy';
- foster cross-cultural public discussion of concerns relating to environmental change and sustainability;
- critically engage with the power dimensions shaping whose pasts become transferred forwards to the future in contemporary approaches to environmental conservation and sustainability.

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CONTEXT FOR THE WORKING PAPER

***'Navigating Soundscape Research: A Review of Literature at the Intersection of Sound and Environmental Studies'* by Reylon Yount**

Angela Impey

Future Pasts explores different versions of sustainability in west Namibia, in part through considering varied livelihood solutions to environmental variability by focusing on culturally embedded or enacted ecological knowledge. We contend that while the concept of sustainable development may include a social mandate, the human dimension is often subsumed by an overriding concern with bio-physical sustainability and by a prevailing discourse that conflates 'development' with 'economic growth'. We propose that a better understanding of cultural landscapes may contribute toward more locally apposite policies on climate change adaptation and environmental justice in Namibia, which may, in turn, attend to escalating levels of poverty, food insecurity and social inequality. As an ethnomusicologist in a cross-disciplinary team of environmental humanities scholars I have sought to contribute insights regarding how songs, oral narratives and ritual practices might contribute to cultural senses of place.

My initial intention was to develop methodologies to examine human-environment interactions, particularly as made evident in the soundworld. More specifically, I was interested in exploring the intersection between acoustic/soundscape ecology, which focuses on sound as an indicator of behavioural interaction and change in the natural world, and cultural acoustics or 'acoustemology', which examines the cultural meanings given to natural sound by humans. Both seek to understand how sounds are used to capture and share strategic information as a basis for survival.

Building on the premise that sound is a powerful activating modality for narratives about natural features, relationships and experiences, I began my work in the Namib-Naukluft National Park, first recording indicator soundscapes (e.g. dawn chorus) and then attempting to ascertain responses to them by conducting 'sound-walks' with elderly members of †Aonin (Topnaar) communities resident in the ephemeral !Khuseb River.

My aim was to use these narratives as a basis for an exploration into how sounds and bodies are stylized in †Aonin culture in order to actuate natural powers: i.e. how specific sounds, vocalisations, vocal patterning, stylised movements, embodied interactions, and sensory elements such as sweat, heat, etc. are culturally shaped/articulated to communicate with, and activate the natural world.

By extension, I aimed to examine what individuals judge today as culturally valuable and what their perceptions are of the status of these 'sustainability values' within the context of contemporary environmental change.

In preparing for this research, in June 2014 I attended a workshop on 'Ecology and Acoustics' at the Muséum National d'Histoire Naturelle in Paris (see <https://ecoacoustics.sciencesconf.org/>). The symposium, which had the strapline 'Emergent properties from community to landscape', was aimed at ecologists, biologists, urban and landscape planners, and educationalists whose mutual interest was to develop more

systematic methods of sound analysis for environmental assessments and long-term environmental monitoring. As articulated in the conference proceedings, the meeting aimed 'to help humans to better tune the complexity of the natural systems toward the desired sustainability under a growing concern of irreversible climatic changes'.

What became most evident in the three-day meeting was the relative novelty of sound analysis in environmental studies, as broadly construed. Moreover none of the papers examined human-environmental interactions, nor did they draw on cultural perceptions/uses of natural sounds, which is a rapidly developing area of interest in disciplines such as sound studies and ethnomusicology. Clearly there remains a significant disciplinary schism between applied sound studies in the sciences and humanities. However, conceptual overlaps and opportunities for disciplinary cooperation were equally apparent.

In order to identify cross-disciplinary literatures relevant to this emerging area of study, I commissioned a literature review on which the working paper that follows is based. The author Reylon Yount has a first-class undergraduate degree in Environmental Science and Public Policy from Harvard University. He is an active (Grammy award-winning) musician, and, at the time of writing, was completing his Masters degree at SOAS in Music in Development (with Ethnomusicology). Additionally, Reylon has a specific interest in eco-acoustics and sound design, so is unusually well-positioned to undertake a critical assessment of both scientific/environmental and humanities/music-based literatures.

'Navigating Soundscape Research: A Review of Literature at the Intersection of Sound and Environmental Studies' is the result of this initial attempt to explore and summarise the literatures at this cross-disciplinary edge.



'Sound walking' with Oupa Edward Swartbooi and Caroline Swartbooi at Armstraat, !Khuseb River, 16 February 2016. Photographer: Kara Lankers.

Navigating Soundscape Research: A Review of Literature at the Intersection of Sound and Environmental Studies

Reylon Yount¹

Abstract.

There is a growing body of literature at the intersection of sound studies and environmental studies. Academics use various terms to characterise research at this intersection, including “soundscape ecology”, “soundscape studies”, and “acoustic ecology”. However, the lexical and methodological distinctions between these subfields remain unclear. This paper summarises some of the key definitions and theories that structure the fields at the intersection of sound studies and environmental studies. The aim of the paper is to assist those interested in this emerging field to navigate the various terms and concepts at its core.

Key words. Soundscape; soundscape ecology; soundscape studies; acoustic ecology; ecoacoustics

This paper provides a broad overview of research conducted in the fields of sound studies and environmental studies. A cursory search in academic databases yields a plethora of subfields and subjects at this intersection, such as “bioacoustics,” “soundscape studies” and “acoustic ecology.” The definitions of the terms used to describe these subfields are in flux, and the boundaries separating the disciplines are uncertain. The purpose of this review is to provide a general guide to the existing set of academic disciplines that combine acoustic and environmental research, tracking some of the lexical and methodological commonalities and differences that currently structure this academic space.

The discussion is divided into three main components. The first focuses on explicating terms associated with more quantitative inquiry, and the second focuses on more qualitative inquiry. This separation is somewhat artificial, as there are both quantitative and qualitative aspects to each subfield, but it offers a starting point for navigating the terminologies. The final component compiles organising frameworks that attempt to map the set of subfields in relation to each other.

It must be emphasised that this is not an authoritative glossary. The terms and categories listed below have porous definitional boundaries and, in some cases, are contested or used

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interchangeably depending on the context and author. The loose nature of the usage of these terms is largely a result of the multidisciplinary nature of the field. This paper is not a comprehensive literature review therefore; rather, it is a sampling of prominent literature aimed at discerning subfields and prompting further inquiry.²

1. Quantitative Inquiry

The areas of acoustic and environmental study that involve quantitative methods arise largely from the earth sciences and life sciences. Acoustics is the broader subfield of physics within which are nested all studies related to sound. Bioacoustics encapsulates all organismic communication, both within and among species. Soundscape ecology, soundscape studies, and eco-acoustics, all of which refer to approximately the same methods, designate more integrative studies that reach toward qualitative and ethnographic inquiry, but remain largely rooted in ecological and biological methodologies.

Acoustics

Acoustics is a branch of physics focused on the study of sound (mechanical waves passing through gases, liquids, and solids).³ The term “acoustics” is conventionally used in musical and architectural contexts to refer to the way sound is produced, transmitted, controlled, and received in a given space. However, acoustics as an academic field spans multiple disciplines across the life sciences, earth sciences, engineering sciences, and the arts. The Acoustical Society of America, which was founded in 1929 and became a foundational component of the American Society of Physics in 1931, designated 13 main areas of study within the field of acoustics:⁴

- Acoustical Oceanography (AO)
- Animal Bioacoustics (AB)
- Architectural Acoustics (AA)
- Biomedical Ultrasound/Bioresponse to Vibration (BB)
- Engineering Acoustics (EA)
- Musical Acoustics (MU)
- Noise (NS)
- Physical Acoustics (PA)
- Psychological and Physiological Acoustics (PP)
- Signal Processing in Acoustics (SP)
- Speech Communication (SC)
- Structural Acoustics and Vibration (SA)
- Underwater Acoustics (UW)

In 1964, physicist R. Bruce Lindsay published a visual framework displaying the various fields associated with acoustics.

² Prominence was determined primarily in terms of the relative number of citations appearing in Google Scholar search results.

³ “Acoustics”

⁴ “What is Acoustics?”

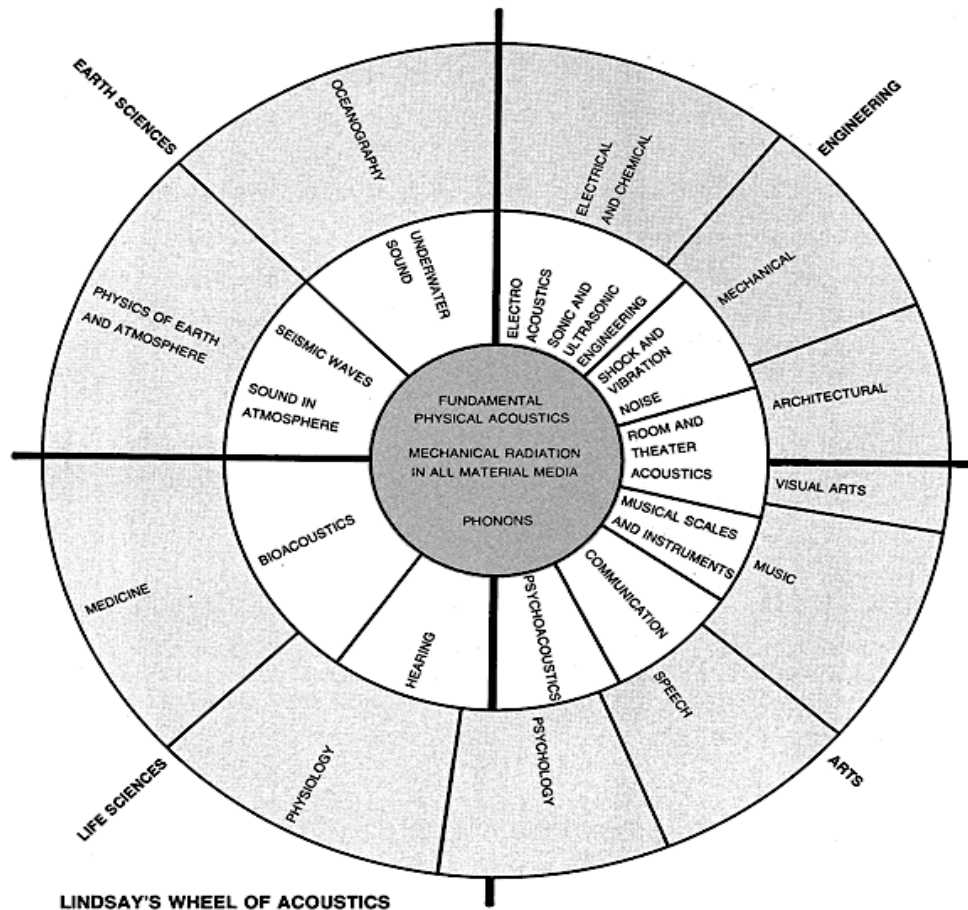


Figure 1. Lindsay's Wheel of Acoustics⁵

Resources: [Acoustic Glossary](#)

Bioacoustics

Bioacoustics is a cross-disciplinary science that combines biology and acoustics to study sonic communication in the animal kingdom. The field was pioneered by Slovenian entomologist Ivan Regen, who systematically studied the sounds created by insects. In a series of experiments in the 1920s, he mechanically reproduced the sounds of a male cricket and successfully prompting female crickets to move towards the loudspeaker. His was the first study that demonstrated insects' responses to sound waves based on a sense of hearing.⁶

The field of bioacoustics includes the study of sonic interactions among animals, as well as the study of the physiology of sound reception in their bodies. In his chapter, "Animal Bioacoustics," Neville Fletcher (2014) suggests that biological research on the physiology of hearing and communication in organisms is more abundant than research from an acoustic perspective, which he describes as concerned with whole-system behaviour.

Resources: [International Journal of Bioacoustics](#).

Soundscape Ecology / Soundscape Studies / Ecoacoustics

⁵ R. Bruce Lindsey 1964, in J. Acoust. Soc. Am. V. 36, p. 2242. Reproduced in "What is Acoustics?"

⁶ Wever 2017

“Soundscape ecology,” “soundscape studies,” and “ecoacoustics” are terms used to describe research that studies sound in a physical landscape and its effects on the organisms living in that landscape. The terms are used somewhat interchangeably. The only notable distinction is the focus on a particular landscape as a parameter for inquiry in research referring to “soundscapes.” Researchers in these fields frame their work as interdisciplinary and integrative, bringing together approaches from various scientific disciplines. There is an emphasis on objective inquiry and methods applied are largely quantitative.

The term “soundscape” refers to the relationship between a landscape and the composition of its sound.⁷ One of the first appearances of this term was in urban planning literature, specifically in the work of Southworth (1969) who studied how sound affected people’s perceptions of cities. Schafer helped popularize the term in his seminal work, *Tuning of the World* (1977). In the book, he asserted that sounds are ecological properties of landscapes and referred to soundscapes as “the acoustical characteristics of an area that reflect natural processes”.⁸ Since these initial usages, the term has come to describe urban and natural processes alike.

The research in soundscape ecology centres upon the study of interactions among three kinds of sound – biophony, geophony, anthrophony.⁹ **Biophony** refers to sound produced by animal and plant life. **Geophony** refers to sound produced by the Earth’s physical processes, such as thunder, wind, or waves. **Anthrophony** refers to sound produced by humans and technology. Soundscape ecologists examine a given landscape and analyse acoustical patterns in these three categories across a variety of spatial and temporal scales.¹⁰

Some prominent studies in this area investigate the ways in which organisms adjust the way they produce sounds in order to maximize their reproductive fitness in their local habitat. These adjustments occur both through the evolution of the species over generations and through adaptation in real-time to variables such as surrounding sonic stimuli, light levels, and temperature.

Pijanowski et al. have done substantial work to centralize knowledge in soundscape studies. They describe various “phonic interactions” that are possible, in which biophony, geophony, and anthrophony affect each other. These are some examples:

- Geophony affecting biophony: Wind, rain affecting timing of animal vocalizations.
- Anthrophony affecting biophony: Noise affecting timing and frequencies of animal vocalizations, creates “micro-evolutionary pressures” on species populations.
- Geophony and biophony → anthrophony: Humans listening to the sounds of nature and creating music inspired by it.

In their 2011b paper, Pijanowski *et al.* offer concise explanations of some of the influential theories that have emerged from soundscape ecology research.

Morphological Adaptation Hypothesis (MAH): “The MAH focuses on the sender, and posits that an organism’s physical attributes, such as its body size, the length of its trachea, and the

⁷ Pijanowski *et al.* 2011b

⁸ Ibid.

⁹ See <https://www.wildsanctuary.com> for some audio [examples](#)

¹⁰ Pijanowski *et al.* 2011b

structure of its beak, influence what sorts of sound signals an organism can produce (e.g., Bennet-Clark 1998).”¹¹

Acoustic Adaptation Hypothesis (AAH): “The AAH (e.g. Daniel and Blumstein 1998) focuses on interactions between the sender and the medium, and proposes that certain groups of organisms will adjust the attributes of their sounds to maximize their propagation (Morton 1975).”¹²

Acoustic Niche Hypothesis (ANH): “In his formulation of the ANH, Krause (1987) pointed out that both the morphological and the behavioural adaptations described by the MAH and the AAH can also be triggered by interspecific interference when organisms’ calls contain similar frequency and timing features.”¹³

They also outline variables that scientists in the field can measure and questions that can be asked about factors affecting these variables, in terms of both environmental dynamics and human impacts (see Table 1).¹⁴ There is less research designated under the terms “soundscape ecology” and “ecoacoustics” that refers to social effects. There have been studies conducted in the field of “urban environmental acoustics,” a field which applies methodologies found in the ecoacoustics to the built environment, examining locations with a higher prevalence of anthropony. There are also studies which deal with human perception of rural environments, such as the paper by Pheasant et al. (2008) that studied perceptions of tranquillity as they related to a rural soundscape and the visual presence of natural features.¹⁵ Pijanowski *et al.* suggest that an area of improvement for “soundscape ecology” could be the discipline’s expansion to include more qualitative, human-centred, and subjective methodologies.

¹¹ Pijanowski *et al.* 2011b

¹² Ibid.

¹³ Ibid.

¹⁴ Ibid.

¹⁵ Phoenix *et al.* 2008

Dimension	Natural dynamics	Human impacts
Frequency patterns (6.1)	How common is acoustic niche partitioning? Is acoustic niche separation more important in the tropics where species richness is greatest? How can we measure acoustic niches?	How does habitat alteration by humans impact acoustic partitioning? As climate will re-order species at the local scale, how will that affect acoustic niches? Are empty acoustic niches a sign of disturbance?
Temporal patterns (6.2)	What are characteristic of dawn and dusk choruses? How do these vary across different habitats? With latitude? Over a season? What are the natural seasonal patterns of biophony?	How do human activities affect dawn and dusk choruses via habitat alteration and/or introduction of anthrophony? How does climate change alter the timing and composition of the dawn and dusk chorus? How does climate change alter timing of biophony patterns?
Vegetation/land use gradient (6.3)	How does biophony and geophony vary with the complexity of vegetation structure? Is biophony greatest in areas with the tallest canopies? Does vegetation strata correlate with biophony?	How does biophony, geophony and anthrophony vary across a gradient of human disturbance like land use? In what ways does anthrophony alter biophony in urban, agricultural and other human dominated systems? What is the effect of topographic features on the distribution of anthrophony? How can land use planning be improved to increase biophony and decrease anthrophony?
Altitudinal gradients (6.3)	How does biophony and geophony vary across the altitudinal gradient? Is there any evidence for shifts in the composition of soundscapes with isoclines that occur along elevational gradients? Are soundscape patterns the same in tropical mountains versus mountains in mid- and high-latitudes?	Given that species altitudinal ranges are smaller in tropical mountain areas, how do human sounds (e.g., roads) along altitudinal gradients affect animal communication?
Core-edge habitat gradients (6.3)	How does biophony vary across edges? How does biophony vary across sharp versus soft edges? How far into the core does wind-generated geophony decrease? How does biophony vary over time at an edge compared to the core?	How does the composition of biophony, geophony and anthrophony differ in interior habitats versus those along edges? How does the composition of the soundscape vary from center to edge of a patch? How does habitat fragmentation affect soundscapes across the landscape?
Flow gradients (6.3)	How variable are river acoustic fluxes? How does river morphology (channel structure) impact geophonies? How do animals adjust their sound production along rivers during low flow, moderate flow and peak flow periods?	How might changes in land use in a river basin affect stream flow, geophony and then biophony? How might climate change impact river geophonies in ways that negatively impact animal communication?
Latitudinal gradients (6.3)	How does the dawn and dusk chorus vary with latitude? What are the consistent elements of the dawn and dusk chorus across all latitudes? Do certain taxonomic groups (e.g., insects) become more prominent as one moves northward? How does the dawn and dusk chorus intensity vary with latitude? In very high latitudes, how does the dawn and dusk chorus "play out" during the summer solstice?	Are there certain latitudes that are most sensitive to human generated noise? Are there times of the year where, at a given latitude, that anthrophony needs to be controlled?
Soundscapes as information resources (6.4)	How do animals use biophony and geophony to navigate through a landscape? What types of sounds are used to identify spatial distribution of resources? How do organisms use sound with visual cues to locate these resources?	How does noise impact the ability of animals to find food, shelter, etc.? Are landscapes where animals use sound exclusively to navigate through the landscape being damaged by anthrophony?

Table 1: Cited from Pijanowski *et. al* 2011a, showing research questions associated with different variables characterising soundscapes

2. Qualitative Inquiry

Research on sound and the environment that involves more qualitative inquiry arises from disciplines such as anthropology, ethnomusicology, music composition, and philosophy. These areas of research – including acoustic ecology, deep ecology, soundscape composition – deal with the ways humans interpret and create meaning from the sounds they hear in their environments.

Acoustic ecology

Acoustic ecology is the study of the relationship between humans and their environment as it is mediated through sound. Pijanowski et al. describe the discipline and distinguish it from soundscape ecology as follows:

“Acoustic ecology, as introduced by Schafer (1977) and Truax (1999), is seen as complementary to traditional ecological concepts rather than situated within them. Broadly interdisciplinary, acoustic ecology studies the relationships and interactions among humans and sounds in an environment, including musical orchestrations, aural awareness, and acoustic design (Schafer 1977, Truax 1999). Acoustic ecology largely emphasizes human-centered inquiry rather than the larger socioecological systems approach taken here.”¹⁶

Kendall Wrightson (2000) describes R. Murray Schafer’s influential work as encouraging people to listen to the sounds of the environment as a musical composition. Two objectives of the field of acoustic ecology, as Wrightson frames it, are to offer a theoretical alternative to vision-based academia, and to advocate for the preservation of natural soundscapes disrupted by noise pollution.¹⁷

In terms of methodology, acoustic ecology as a discipline differs from soundscape ecology in its emphasis on creative practice as research. A recent edition of *Soundscape: The Journal of Acoustic Ecology* (2017) pays tribute to the composer Pauline Oliveros and her “musical, spiritual, and communicative legacies.”¹⁸ Towards the end of the volume is a paper written by Leah Barclay tracing Barclay’s investigations of “locative sound.” The format follows the conventions of scientific papers, with content that is descriptive, recounting the author’s experience creating sound installations and performances. There exists in this particular community a transdisciplinary mentality that accepts creative practice as equally legitimate as social scientific inquiry. There is an openness to the intermixing of methods that are scientific, artistic, and spiritual in nature.

One potential trade-off inherent in this openness may be a loss of specificity in the inquiry. Barclay’s abstract explains that the paper describes projects “designed to explore the value of acoustic ecology as a socially engaged, accessible and interdisciplinary field that can inspire communities across the world to listen to their environment.” She also states that the paper introduces “new projects that are informed by this research, and reflections on the future possibilities of locative media in exploring layers of our social, cultural and ecological environments through sound.” This publishers’ level of comfort with such all-encompassing language in a featured article may be an indication of a desire to cast a wide net, to make the field relevant to a wide range of issues as a means of asserting its legitimacy in academia.

Resources: Acoustic Ecology Institute: <http://www.acousticecology.org/>; World Forum of Acoustic Ecology, Journal of Acoustic Ecology: <https://www.wfae.net/>

¹⁶ Pijanowski *et al.* 2011b

¹⁷ Wrightson 2000

¹⁸ *Soundscape: The Journal of Acoustic Ecology*

Acoustemology

Acoustemology is a term popularized by ethnomusicologist Steven Feld that refers to a kind of “knowing through sound.” Tom Rice summarizes the field as follows:

“‘Acoustemology’ conjoins the words ‘acoustic’ and ‘epistemology’ to refer to a sonic way of knowing and being in the world. The term was introduced by anthropologist and ethnomusicologist Steven Feld following his fieldwork among the Kaluli of Papua New Guinea. He sought to describe the highly developed practices of listening, hearing and sounding that characterised Kaluli engagement with their rainforest environment. Feld also used ‘acoustemology’ to expand upon existing vocabulary for the anthropological discussion of human engagement with sound.”¹⁹

Anthropology in Sound

Some nascent research within the field of anthropology uses first-person ethnographic inquiry to examine experiences of particular environments through sonic means. This is a niche area of research. One example is Stefan Helmreich’s account of an experience aboard a submarine. Here is an excerpt from the abstract of the paper:

“In this article, I deliver a first-person anthropological report on a dive to the seafloor in the Woods Hole Oceanographic Institution’s three-person submersible, Alvin. I examine multiple meanings of immersion: as a descent into liquid, an absorption in activity, and the all-encompassing entry of an anthropologist into a cultural medium. Tuning in to the rhythms of what I call the “submarine cyborg”—“doing anthropology in sound,” as advocated by Steven Feld and Donald Brenneis (2004)—I show how interior and exterior soundscapes create a sense of immersion, and I argue that a transductive ethnography can make explicit the technical structures and social practices of sounding, hearing, and listening that support this sense of sonic presence.”²⁰

Resources: [Sound Studies Lab](#);

Deep Ecology

Deep ecology is a philosophical movement that considers human life as one of many equal parts of a global ecosystem. As Stephen Harding describes, “For Arne Naess, ecological science, concerned with facts and logic alone, cannot answer ethical questions about how we should live. For this we need ecological wisdom. Deep ecology seeks to develop this by focusing on deep experience, deep questioning and deep commitment.”²¹ The movement entails a renouncement of the human-centred way of living that characterizes modern development.

Soundscape Composition

Soundscape composition is a form of electroacoustic music characterized by “recognizable environmental sounds and contexts, the purpose being to invoke the listener’s associations, memories, and imagination related to the soundscape.”²² This creative method stands in contrast to the more scientific methods used in other subfields. Drever also considers

¹⁹ Rice 2018

²⁰ Helmreich 2007

²¹ Harding 2018

²² Simon Fraser University, "Soundscape Composition" (n.d.)

subjective soundscape composition methods as a form of ethnography.²³ The Biosphere Soundscapes project is a prominent institution promoting soundscape composition. A noteworthy feature of their work is the residencies and masterclasses they host for both scientists and artists, blurring the lines between scientific research and creative practice.

Resources: [Organised Sound](#): International Journal of Music and Technology; [Biosphere Soundscapes](#); [World Soundscape Project](#);

Psychoacoustics

Psychoacoustics is the study of human perception of sound. A wide range of studies have been conducted on the effects of noise on urban populations. Both industrial studies and community studies of occupational and environmental noise show evidence that noise pollution can result in non-auditory related health issues, such as hypertension, long-term memory loss, raised blood pressure, and psychological symptoms.²⁴

Ecophenomenology

Ecophenomenology is described by Brown and Toadvine (2003) as “the pursuit of the relationalities of worldly engagement, both human and those of other creatures”. It operates in a realm of abstraction in which it is possible to discuss the physical relations created in sonic engagement and the discursive, cultural relations created in political engagement.

“Phenomenology concerns itself with the ways in which human beings find and construct meaning in the world. But from its first beginnings in the work of Edmund Husserl [1859-1938], it saw itself as saving humanity from the threat of a purely naturalistic view of things, which ultimately treats everything – included humans – as reducible to the operation of causal laws. We might think that phenomenology deserves to survive only if it is willing to restrict itself to the ‘intentional’ realm, the human space of meaning. How then could there be a phenomenology of nature? If phenomenology is to be able to think about Nature, it must either rescue Nature itself from naturalism, or work out a new relationship to what it had perceived as the danger of naturalism. Or both.” (Brown & Toadvine 2003)

Sensory ethnography

While not focused explicitly on sound or the environment, the field of sensory ethnography provides methodological tools for examining aspects of sound and human experience of their social environments not captured by other disciplines. Howes provides an overview of the field, stating the viewpoint that “sensual relations are social relations” and presenting Serres’ supposition that the senses are “continuously exceeding or surpassing the body, ‘mingling’ with the world, and each other.”²⁵ In describing the human senses as aspects of ourselves that exceed the body and interact with the external world, Howes and Serres offer a potential new framework for understanding perception of sound in an environment as something active rather than passive, social rather than just physical.

Political ecology

Political ecology is “the study of the relationships between political, economic and social factors with environmental issues and changes.”²⁶ Brannstrom describes that the field

²³ Drever 2002

²⁴ Stansfeld and Matheson 2003

²⁵ Howes 2014, p.11

²⁶ “Political Ecology”, *Environment and Ecology*.

emerged in the 1980s and frames environmental change as “a result of power relations, which cause highly variable access to resources.”²⁷

In *Third World Political Ecology* (1997), Raymond L. Bryant and Sinéad Bailey establish three fundamental assumptions in practising political ecology:

- First, “costs and benefits associated with environmental change are for the most part distributed among actors unequally.”²⁸
- Second, “an unequal distribution of environmental costs and benefits reinforces or reduces existing social and economic inequalities.”²⁹
- Third, “the differentiated social and economic impact of environmental change also has political implications in terms of the altered power of actors in relation to other actors. Thus, environmental change not only signifies wealth creation for some and impoverishment for others, it also thereby alters the ability of actors to control or resist other actors.”³⁰

3. Organising Frameworks

Unifying Principles

Howes (2014) presents three principles that unify all sound studies practitioners:

- (1) They agree that sound has been neglected as an object of study;
- (2) they believe that sound offers a fundamentally different knowledge of the world than vision; and
- (3) they recognize that most academic disciplines remain vision-based, not only in the materials they study, but in the theoretical models they deploy to interpret them.³¹

Mapping Relations within the Field

Several researchers have made attempts to create frameworks for organising the various subfields in relation to each other. The frameworks presented by Pijanowski *et al* (2011a) are relatively comprehensive and clearly designed. These are reproduced below.

²⁷ “Political Ecology,” Oxford Bibliographies

²⁸ Bryant and Bailey 1997 p. 27

²⁹ Ibid.

³⁰ Ibid., p. 28

³¹ Howes 2014, p. 11

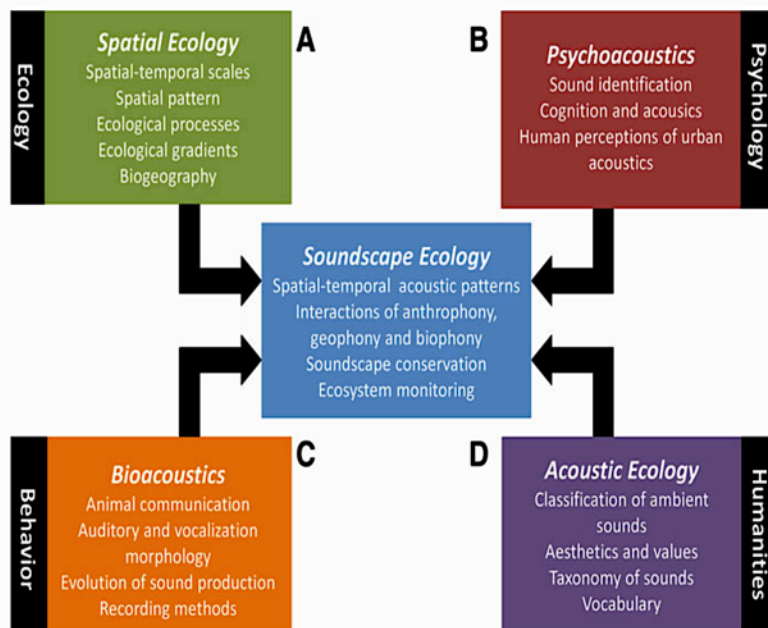


Fig. 1 Intellectual foundations of soundscape ecology. Colors of the boxes are used for the online version to indicate which discipline contributes to the integrative framework contained in Fig. 2

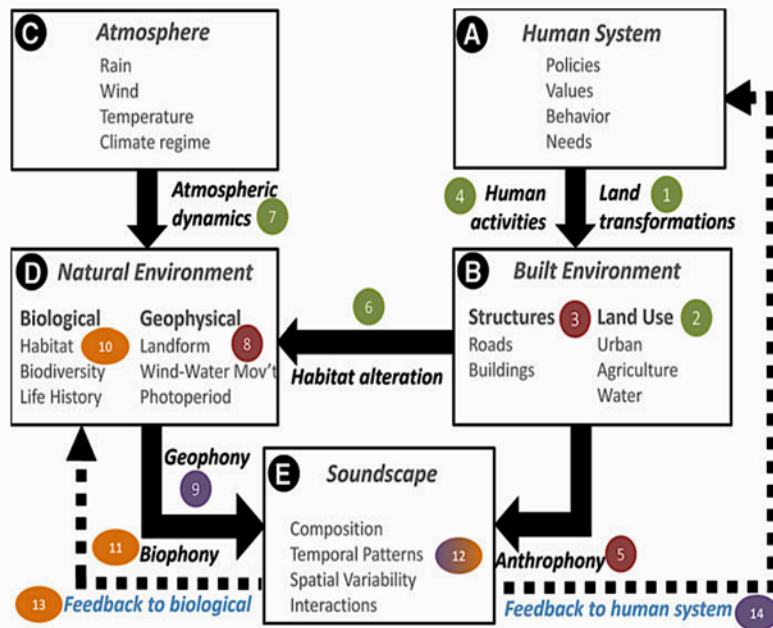


Fig. 2 Conceptual framework describing the underlying processes of the soundscape. Labels and color coding are used for the online version to tie the information presented in Fig. 1

Figure 1: figures from Pijanowski *et al.* 2011a, organising subfields in relation to each other

Mapping Terminology

Paola Moscoso *et al.* (2018) at the University of Sussex have examined literature examining soundscape ecology and well-being. They point out that “well-being” is increasingly a metric of concern in the United Nations Sustainable Development Goals. In light of this, they conducted a meta-analysis, which has yet to be peer-reviewed, of 2379 articles

(SCOPUS=1144; Web of Science=1235...) discussing soundscape ecology and well-being of some kind.³²

Their analysis “was conducted by analysing the ‘keyword co-occurrence’ among the database publications. ‘Co-occurrence’ refers to the number of times one keyword appears in close relation with another...distance between two terms can be interpreted as an indication of the relatedness of the terms: the smaller the distance between them, the more strongly they are likely to be related to each other.”³³ This analysis found 331 terms that meet the threshold (number of co-occurrences of a keyword ≥ 10).

Moscoso *et al* observed that: “The evolution of the field [of soundscape ecology and well-being] was associated with the diversification of terminology and the evolution of new branches of research. Moreover, research appears to have evolved from the study of particular associations between sound and health, to an integrative multidimensional field addressing soundscape and wellbeing, across human and non-human species, including ecologically based studies.” Figure 2 below shows their resulting network of terms, grouped into six clusters:

1. (Green) Medical/Physiological research: groups words which are lexically related to sense of hearing, and human/animal physiology research
2. (Yellow) Technological/Medical applications: comprises terms associated with the development of acoustic technologies and research into the properties of sound.
3. (Red) Acoustic perception research I: gathers terms related to acoustic assessment and sound measurement based on psychological research, especially focusing on ‘noise’ and ‘urban’ areas.
4. (Blue) Acoustic perception research II: includes terms that reflect broader research on soundscape perception and integrates a range of cultural/social aspects (e.g. tranquillity, identity, memory). This category differentiates from ‘Acoustic perception research I’ because it is more focused on community, rather than individual levels, and include perspectives not only related to psychological research.
5. (Purple) Ecological research: gathers terms based on ecological research, especially in ecologically relevant descriptive patterns and noise.
6. (Light Blue) Health care: contains terms associated with the application of research in health care practices.

Moscoso *et al.* also categorized the reports into categories of well-being: Human Health, Cultural and Social Wellness, and Ecological Integrity, and examined publication trends in each of these categories over time (see figure 2 below).

³² Moscoso *et al.* 2018

³³ Moscoso *et al.* 2018

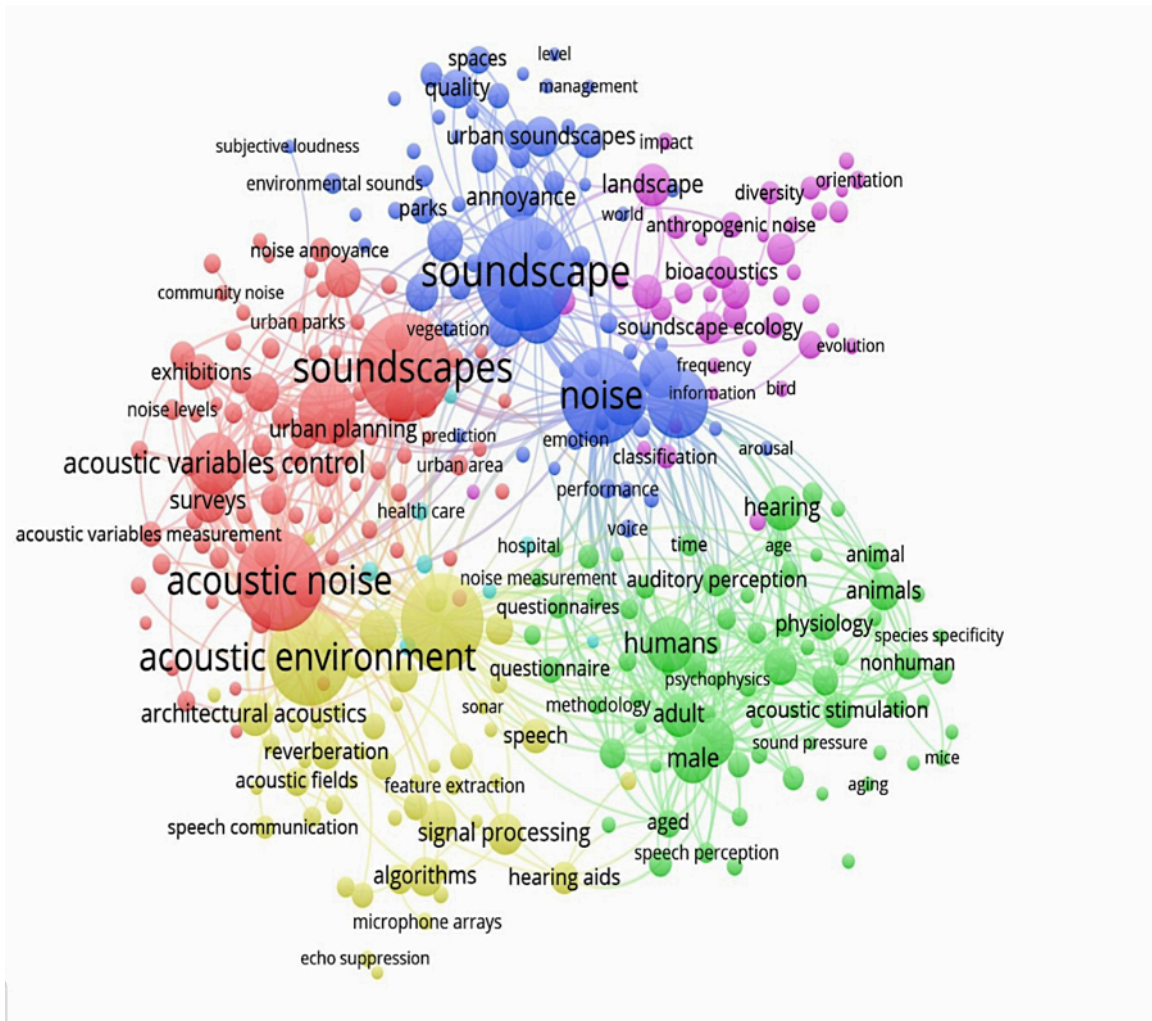


Figure 2.

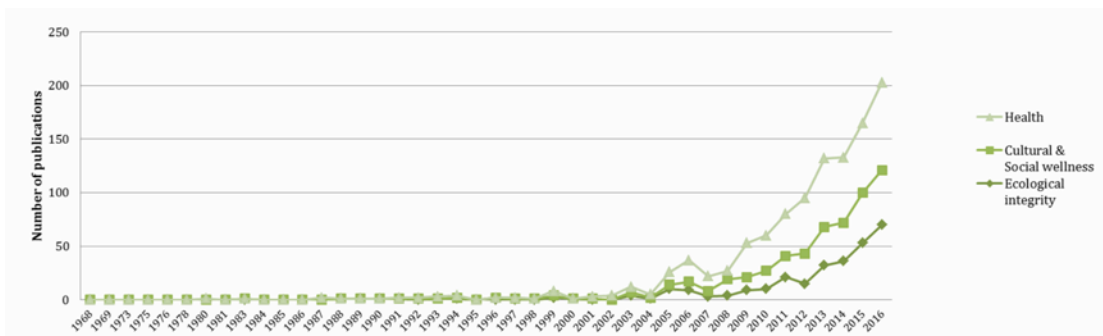


Figure 3: Number of publications reporting the association between soundscape and distinct domains of wellbeing: 1. Health, 2. Social and Cultural wellness, and 3. Ecological integrity, based on the analysis of ‘author-keywords’ or ‘index-keywords’.³⁴

³⁴ Moscoso *et al.* 2018

Conclusion

This review is far from comprehensive. More extensive research would be required to achieve a granular view of the changes that have occurred at this academic intersection over the past few decades. Hopefully, this sampling of literature can provide a window into some of these changes and patterns. The review does make apparent that the intersection between studies of sound and studies of the environment has given rise to a flourishing of fields of inquiry. The diversity of this set of disciplines creates an added challenge for new researchers, who must find ways to navigate existing literature spread across uncoordinated lexicons. Some forms of harmonization and centralization, in efforts such as those of Pijanowski *et al.*, will be important to the progression of the field. The diversity and nascent status of the field also creates new opportunities for interdisciplinary collaboration, across lines currently separating physical and social sciences, quantitative and qualitative methodologies, empirical research and creative practice.

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